HUMPHREY HEATING & ROOFING, INC.
2423 N. Marine Blvd.
JACKSONVILLE, NORTH CAROLINA 28540-6999

OPERATION & MAINTENANCE

REPLACE A/C UNITS, VARIOUS BUILDINGS

MARINE CORPS AIR STATION, NEW RIVER

JACKSONVILLE, NORTH CAROLINA

N62470-86-C-5548

OPERATION & MAINTENANCE MANUAL

REPLACE A/C UNITS, VARIOUS BUILDINGS
MARINE CORPS AIR STATION, NEW RIVER
JACKSONVILLE, NORTH CAROLINA
N62470-86-C-5548

REPLACE A/C UNITS, VARIOUS BUILDINGS
MARINE CORPS AIR STATION, NEW RIVER
JACKSONVILLE, NORTH CAROLINA
N62470-86-C-5548

PRIME CONTRACTOR:	Humphrey Heating & Roofing, Inc. 2423 North Marine Boulevard Jacksonville, NC 28540 - 6999 Phone: (919) 455-3555
SUB-CONTRACTOR: Asbestos Removal	Waco, Incorporated Post Office Box 7160 Jacksonville, NC 28540 Phone: (919) 353-7574
SUB-CONTRACTOR: Electrical	Big John's Electric Company Route 2, Box 260 - A Jacksonville, NC 28540 Phone: (919) 455-2480
SUB-CONTRACTOR: Acoustical Systems	Acoustics East, Inc. Post Office Box 3217 New Bern, NC 28560 Phone: (919) 638-8158
SUB-CONTRACTOR: Insulation	Eastern Insulation Service of New Bern, Incorporated Post Office Box 3217 New Bern, NC 28560 Phone: (919) 638-8158
SUB-CONTRACTOR: Controls	Triangle Controls 2716 Discovery Drive Raleigh, NC 27604 - 1850 Phone: (919) 878-8015

EQUIPMENT SUPPLIERS FOR: REPLACE A/C UNITS, VARIOUS BUILDINGS
MARINE CORPS AIR STATION, NEW RIVER
JACKSONVILLE, NORTH CAROLINA
N62470-86-C-5548

The Trane Company
5214 Western Blvd.
Raleigh, NC 27606

Phone: (919) 851-4131

Central Station draw thru Air Handling Units; Condensing Units; Air Conditioners; Split System Condensing Units; Central Cooling Package System; Air Conditioner; Roof Top Accessories; Fresh Air Dampers; Time Delay Relay; Quick Attach Coupling Kit; Split System Condensing Units

Weeks - Williams - Devore
7000 Six Forks Road
Raleigh, NC 27609

Phone: (919) 848-8367

Burnham Steel Boiler

Chet Adams Company
Post Office Box 5218
Cary, NC 27511

Phone: (919) 851-6331

Exhaust Fans

Heat Transfer Sales
1305 Millbrook Road
Building C, Suite # 24
Raleigh, NC 27609

Phone: (919) 876-3846

Air Control System; Pumps; Heat Exchanger; Expansion Tanks; Tank Drainer

Trion, Incorporated
Post Office Box 760
Sanford, NC 27330

Phone: (919) 775-2201

Electronic Air Cleaner

Governair Corporation
4840 North Sewell Street
Oklahoma City, OK 73118

Phone: (405) 525-6546

Air Handling Equipment

Mec-Tric Controls Company
4110 Monroe Road
Charlotte, NC 28222

Phone: (919) 376-8555

Farris Safety Valves

Frischkorn-Carolina, Inc.
Post Office Box 10430
Wilmington, NC 28405

Phone: (919) 821-6150

Valves, Gauges, Thermometers, Traps, Circuit Setters, Strainers

Ihrie Supply Company, Inc.
Post Office Box 1587
Morehead City, NC 28557

Phone: (919) 682-0033

Valves; Backflow Preventors

CC Dickson & Company
115 Moosehart Avenue
Jacksonville, NC 28540

Phone: (919) 455-4996

Sight Glass; Filter Dryer

Industrial Maintenance Corp.
3520 Tryclan Drive
Charlotte, NC 28210

Phone: (704) 525-6967

Chemical Feeder

Triangle Controls
2716 Discovery Drive
Raleigh, NC 27604 - 1850

Phone: (919) 878-8015

Temperature Control System

REPLACE A/C UNITS, VARIOUS BUILDINGS

MARINE CORPS AIR STATION, NEW RIVER

JACKSONVILLE, NORTH CAROLINA

N62470-86-C-5548

TABLE OF CONTENTS

1. Central Station draw thru Air Handling Units - Maintenance and Installation Instructions.
2. Condensing Units - Installers Guide.
3. Air Conditioning Units - Reddie Facts.
4. Split System Condensing Units - Installation, Operation & Maintenance Instructions and Service Facts.
5. Central Cooling Package System - Installation, Operation and Maintenance Instructions.
6. Air Conditioners - Service Facts.
7. Roof Top Accessories - Installers Guide.
8. Fresh Air Dampers - Installers Guide.
9. Time Delay Relay - Installers Guide.
10. Quick Attach Coupling Kit - Installers Guide.
11. Split System Condensing Units - Installation, Operation and Maintenance Supplementary.
12. Burnham Steel Boiler - Start-up, Operation, Maintenance Shut down and Repair Instructions.
13. Exhaust Fans - Maintenance and Operating Instructions General Instructions, Terms & Conditions.
14. Air Control System - General Information.
15. Pumps - General Information.
16. Heat Exchangers - General Information.
17. Expansion Tanks - General Information.
18. Tank Drainer - Features and Operation Instructions.
19. Electronic Air Cleaner - Design, Installation, Operation Illustration & Drawings, Sequence of Operation and Control Schematic.

REPLACE A/C UNITS VARIOUS BUILDINGS

N62470-86-C-5548

TABLE OF CONTENTS (continued)

20. Air Handling Equipment - Installation, Operation and Maintenance Instructions, Replacement Parts Guide, Troubleshooters Guide.

21. Farris Safety Valve - User and Installation Manual, General Information.

22. Valves - General Information.

23. Gauges - General Information.

24. Thermometers - General Information.

25. Traps - General Information.

26. Circuit Setters - General Information.

27. Strainers - General Information.

28. Valves - General Information.

29. Backflow Preventors - Performance, Application, Construction, Warranty, Installation & Maintenance Instructions.

30. Sight Glass - General Information.

31. Filter Dryer - General Information.

32. Chemical Feeders - Installation Figures.

33. Temperature Control System - Sequence of Operation, Equipment Schedule, General Instructions.

EQUIPMENT LIST

REPLACE AIR CONDITIONING UNITS, VARIOUS BUILDINGS
MARINE CORPS AIR STATION, NEW RIVER
JACKSONVILLE, NORTH CAROLINA
N62470-85-C-5548

BUILDING AS-236

Air Handler # 1	Trane	Serial # K88B06604	5 Ton
		Model # CCDB0ANBH	
Condensing Unit # 1	Trane	Serial # C09298968	
		Model # TTA060A300A0	
Air Handler # 2	Trane	Serial # K88B06605	4 Ton
		Model # CCDB06ANBH	
Condensing Unit # 2	Trane	Serial # CC9298926	
		Model # TTA060A300A0	
Air Handler # 3	Trane	Serial # K88C08421	1 ½ Ton
		Model # CCDB03BNBH	
Condensing Unit # 3	Trane	Serial # C09276394	
		Model # TTB718A100A1	
Air Handler # 4	Trane	Serial # K88B06606	15 Ton
		Model # CCDB14A3AG	
Condensing Unit # 4	Trane	Serial # B15143825D	
		Model # BTA180F300AB	
Air Handler # 5	Trane	Serial # K88C08422	5 Ton
		Model # CCDB03BNBH	
Condensing Unit # 5	Trane	Serial # C09276210	
		Model # TTB718A100A1	
Air Handler # 6	Trane	Serial # K88B06607	1 ½ Ton
		Model # CCDB03ANBH	
Condensing Unit # 6	Trane	Serial # C11204558	
		Model # TTA048A300A0	
Hot Water Circulating Pump	TACO	Serial # 7A88	
		Model # P56N4T10C2	
Electronic Filter	Trion	Serial # MOD71V-88-00006	
		Model # 71-206-D2	

EQUIPMENT LIST

REPLACE AIR CONDITIONING UNITS, VARIOUS BUILDINGS
MARINE CORPS AIR STATION, NEW RIVER
JACKSONVILLE, NORTH CAROLINA
N62470-86-C-5548

BUILDING AS-3502

Air Handler	Trane	Serial # K88B06608	50 Ton
		Model # CCDB31BNAG	
Condensing Unit	Trane	Serial # J88B80443	
		Model # RAUBC506AE03	

BUILDING AS-202

Air Handler	Trane	Serial # K88B06609	5 Ton
		Model # CCDB03ABOH	
Condensing Unit	Trane	Serial # B46295287	
		Model # TTA06DA300AD	

BUILDING AS-502

Roof Mount A/C Unit	Trane	Serial # C10188896	10 Ton
		Model # BTC120F300HB	

BUILDING AS-205

Air Handler	Governair	Serial # 25998	40 Ton
		Model # RSA-02	
Condensing Unit	Governair	Serial # 25997	
		Model # ACU-302	
Exhaust Fan #1		Model # PV 83	
Exhaust Fan #2		Model # PV 83	
Exhaust Fan #3		Model # PV 83	
Hot Water Circulating Pump	TACO	Serial # YBM	
		Model # 5K47PG1822AT	

EQUIPMENT LIST

REPLACE AIR CONDITIONING UNITS, VARIOUS BUILDINGS
MARINE CORPS AIR STATION, NEW RIVER
JACKSONVILLE, NORTH CAROLINA
N62470-86-C-5548

BUILDING AS - 3504

Boiler	Serial # 18175 Model # 4FW-63-SPL-LB
Hot Water Circulating Pump	Serial # FJ 87 Model # M316P350

REPLACE AIR CONDITIONING UNITS

MARINE CORPS AIR STATION, NEW RIVER

JACKSONVILLE, NORTH CAROLINA

N62470-86-C-5548

VALVE TAG LIST

BUILDING AS-3504

VALVE TAG	SIZE	TYPE	DESCRIPTION
301	2"	Gate	HWS Behind Pump
302	2"	Gate	HWR Before Pump
303	1"	Cut off Valve	Secondary Low Water Cut off
304	1"	Gate	Air Blender Valve
305	2"	Gate	HWR To Boiler
306	3/4"	Gate	Before Chemical Feeder Tank
307	3/4"	Gate	After Chemical Feeder Tank
308	3/4"	Gate	Drain
309	1"	Water Cut off	Primary Low Water Cut off
310	1"	Ball Valve	Drain
311	1/2"	Sight Glass	Boiler Sight Glass
312	1½"	Gate	Boiler Drain
313	3/8"	Gate	F O S
314	3/8"	Check	F O S
315	3/8"	Gate	F O S
316	1/2"	Gate	Drain
317	1/2"	FillaTank	Make up Water
318	3/4"	Check	Make up Water
319	3/4"	Gate	Make up Water
320	3/4"	P R V	Make up By pass
321	3/4"	Globe	Make up By pass
322	3/4"	Strainer with Blowdown Gate	Make up By pass
323	3/4"	Gate	Make up By pass
324	3/4"	Backflow Preventer	Make up By pass
325	3/4"	Relief Valve	Boiler
326	1/4"	Pet Cock	Chemical Feeder Tank

TAB PLACEMENT HERE

DESCRIPTION:

Central Station

Air Handling Unit

☐ Tab page did not contain hand written information

☑ Tab page contained hand written information
*Scanned as next image

Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

TRANE™

Bldgs. 202 | 236 | 3502

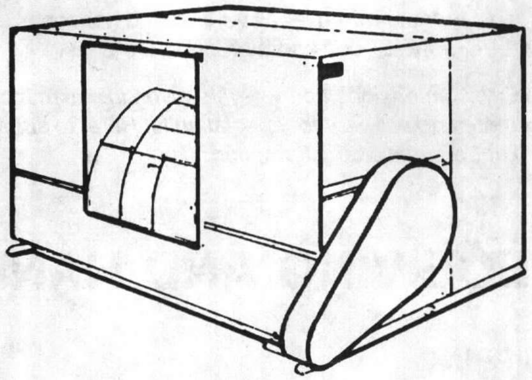
Installation CLCH-IN-3A

Library	Service Literature
Product Section	Air Handling
Product	Central Station Air Handlers
Model	Climate Changers
Literature Type	Installation
Sequence	3A
Date	August 1986
File No.	SV-AH-CLCH-CLCH-IN-3A-886
Supersedes	CLCH-IN-3 (186)

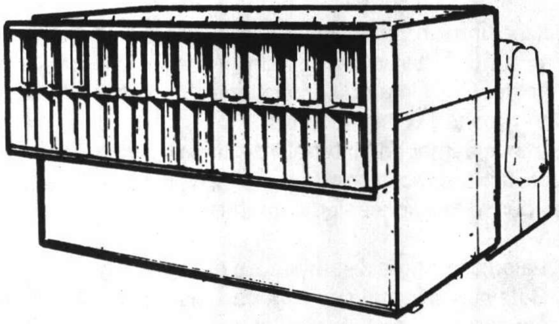
CLIMATE CHANGER® CENTRAL STATION AIR HANDLERS

DRAW-THRU, BLOW-THRU SPRAYED COIL AND HIGH PRESSURE UNITS

B DEVELOPMENT SEQUENCE



DRAW-THRU



BLOW-THRU

X39640290-02

The Trane Company
La Crosse, Wisconsin 54601-7599
Printed in U.S.A.

Since The Trane Company has a policy of continuous product improvement, it reserves the right to change specifications and design without notice. The installation and servicing of the equipment referred to in this booklet should be done by qualified, experienced technicians.

TABLE OF CONTENTS

ITEM	PAGE
GENERAL INFORMATION	2
RECEIVING AND HANDLING	2
INSTALLATION	
Unit Location Recommendations	5
Mounting	6
Accessories	17
Fan Motor Assembly	20
Dampers	21
Inlet Vanes	24
Ductwork	25
Piping	33
Wiring	35
INSTALLATION CHECKLIST	35
START-UP	37
Final Check/Procedures	38
Sheave Alignment	38
Setscrews	38
Wheel Clamps	39
Belt Tension	39

Literature Change History:

CLCH-IM-10 (June 81)

Introduce infinity variable fin series. Change design sequence to "C".

CLCH-IN-2 (August 84)

Change bearing type (opposite drive side) on unit sizes 17 thru 31 w/stub shaft. Include weights for units with wide coils. Specific instructions for units shipping with optional coilless. Convert CLCH-IM-10C into separate Installation and Maintenance Manuals (CLCH-IN-2 & CLCH-M-1). Change design sequence to "D".

CLCH-IN-3 (January 1986)

Added level coils and Delta-Flo coils to units. Added cradle dimensions for wide coil unit sizes 3 thru 31. Added and updated Tables (4, 8A and 12). Change design sequence to "E".

CLCH-IN-3A (August 1986)

Corrected Figure 49.

GENERAL INFORMATION

Central Station Climate Changers® are air handlers designed to provide complete heating, cooling and dehumidifying by means of a wide variety of unit sizes, coils, fans and efficiency capabilities. This manual will cover all vertical and horizontal, draw-thru, blow-thru, sprayed coil and high pressure units.

NOTE: *All dimensions and weights given in this manual are approximate and will vary for special units. Refer to submittal data for exact dimensional information.*

An Installation Checklist is given at the end of the Installation section of this manual to be used by the installing contractor to verify proper installation procedures. These checklists should not be substituted for the detailed information and procedures contained in appropriate sections of the manual.

RECEIVING AND HANDLING

SHIPPING

Central Station Climate Changers® are shipped either assembled or in sections, depending on unit size and accessories. All units or sections of units are attached securely to skids. Nuts, bolts and washers necessary for unit assembly are attached to one of the skids. Motors ship separately when their size or location on the unit prevents safe transit. Access section is shipped unassembled.

To protect against loss from in-transit damage, complete the following upon receipt of the unit:

1. Inspect individual pieces of the shipment before accepting it. Check for rattles, bent corners on cartons or other visible indications of shipping damage.
2. If a carton or unit has apparent damage, open it immediately and inspect the contents before accepting the unit. Do not refuse the shipment. Make specific notations concerning the damage on the freight bill.
3. Inspect the unit for concealed damage before it is stored and as soon as possible after delivery. Refer to the checklist given in step 8 for internal inspections. Concealed damage must be reported within 15 days.
4. Do not move damaged material from the receiving location if possible. It is the receiver's responsibility to provide reasonable evidence that concealed damage was not incurred after delivery.
5. If concealed damage is discovered, stop unpacking the shipment. Retain all internal packing, cartons and crates. Take photos of the damaged material if possible.
6. Notify the carrier's terminal of the damage immediately by phone and mail. Request an immediate joint inspection of the damage by the carrier and consignee.
7. Notify the Trane sales representative of the damage and ar-

range for repair. Do not repair the unit, however, until damage is inspected by the carrier's representative. Trane is not responsible for shipping damage.

8. Complete the following inspections before installing the unit:
   a. Verify that the correct unit has been received by comparing nameplate and model number information with submittal data.
   b. Rotate the fan manually to be sure that it is free to operate. Inspect the fan housing for obstructions which may have entered the unit during shipment.
   c. Check all dampers in the unit and accessories to be sure they are free to move and have not been damaged in transit.
   d. Make sure the inlet vanes operate freely. Check that all sets of vanes operate together when opening and closing.

Refer to the Unit Location Recommendations in this manual before setting the unit in place. It is recommended that units are left on their skids for protection and ease of handling until set in place. For proper rigging and hoisting procedures, refer to the Rigging section of this manual and the instruction label on the unit.

RIGGING

Before preparing the unit or component for lifting, estimate the approximate center of gravity for lifting safety. Because of placement of internal components, the unit weight may be unevenly distributed, with more weight in the coil area. Approximate unit weights are given in Tables 1, 2 and 3.

Before hoisting the unit, be sure that the proper method of rigging is used, with straps or slings and spreader bars for protection during lifting. See Figure 1. Refer to the unit label for recommended rigging procedures. Always test-lift the unit to determine exact unit balance and stability before hoisting it to the installation location.

WARNING: DO NOT LIFT THE UNIT WITHOUT TEST-LIFTING FOR BALANCE AND RIGGING. DO NOT LIFT THE UNIT IN WINDY CONDITIONS OR ABOVE PERSONNEL. DO NOT LIFT THE UNIT BY ATTACHING A CLEVIS, HOOKS, PINS OR BOLTS TO THE CASING, CASING HARDWARE, CORNER LUGS, ANGLES, TABS OR FLANGES. FAILURE TO OBSERVE THESE WARNINGS MAY RESULT IN PERSONAL INJURY OR DEATH OR EQUIPMENT DAMAGE.

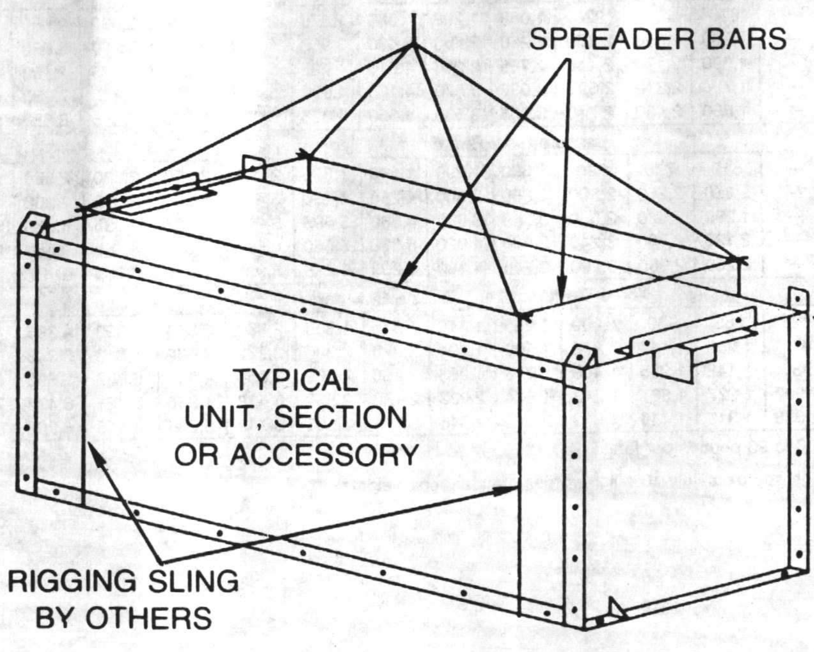


FIGURE 1 - Recommended Rigging Procedure

TABLE 1 - Climate Changer Unit Operating Weights In Pounds (Less Motors)

	UNIT SIZE															
	3	6	8	10	12	14	17	21	25	31	35	41	50	63	73	86
Draw-Thru Climate Changers																
Casing Only	205	275	400	460	700	750	1,015	1,225	1,380	1,455	2,100	2,540	2,750	4,270	4,710	5,030
2 Row	291	424	570	677	978	1,060	1,429	1,639	1,850	2,117	2,832	3,558	,3708	5,529	5,850	6,390
4 Row	328	487	657	785	1,108	1,213	1,618	1,876	2,219	2,453	3,198	3,797	4,260	6,218	6,710	7,420
6 Row	368	552	742	891	1,243	1,369	1,807	2,018	2,381	2,813	3,616	4,261	4,794	6,929	7,560	8,440
8 Row	406	618	828	988	1,373	1,520	1,981	2,321	2,643	3,143	3,984	4,699	5,330	7,611	8,320	9,330
Draw-Thru Climate Changer w/Wide Coil																
Casing Only	225	295	425	490	730	780	1045	1260	1415	1505	2190	2715	2950	4845	4850	5170
With 2 Row	365	495	665	779	1089	1166	1535	1738	1951	2262	3041	3959	4121	5781	6157	6697
With 4 Row	426	579	788	922	1257	1357	1759	2005	2372	2647	3467	4251	4796	6578	7142	7854
With 6 Row	491	666	908	1063	1431	1552	1982	2246	2557	3058	3953	4818	5448	7401	8117	9448
With 8 Row	553	754	1030	1192	1599	1740	2188	2526	2856	3436	4381	5354	6103	8190	8988	9998
Blow-Thru Climate Changers																
Casing Only	—	605	765	810	880	1,095	1,260	1,425	1,600	1,810	3,250	3,650	4,025	4,580	5,030	5,530
2 Row	—	754	935	1,027	1,158	1,405	1,614	1,839	2,070	2,472	3,982	4,463	4,983	5,839	6,436	7,142
4 Row	—	817	1,022	1,135	1,288	1,558	1,803	2,070	2,339	2,808	4,348	4,907	5,535	6,528	7,240	8,114
6 Row	—	882	1,107	1,241	1,423	1,714	1,992	2,298	2,609	3,168	4,766	5,367	6,069	7,239	8,018	9,046
8 Row	—	948	1,193	1,338	1,553	1,865	2,166	2,521	2,863	3,498	5,134	5,809	6,605	7.921	8,824	9.998
Single-Zone Blow-Thru Climate Changers																
Casing Only	—	386	544	631	760	900	1,080	1,235	1,370	1,560	2,780	3,115	3,435	4,425	4,870	5,280
2 Row	—	535	714	848	1,038	1,210	1,434	1,629	1,840	2,222	3,512	3,928	4,393	5,684	6,276	6,892
4 Row	—	598	801	956	1,168	1,363	1,623	1,860	2,109	2,558	3,878	4,372	4,945	6,373	7,080	7,864
6 Row	—	663	886	1,062	1,303	1,519	1,812	2,088	2,379	2,918	4,296	4,832	5,479	7,084	7,858	8,796
8 Row	—	729	972	1,159	1,473	1,670	1,986	2,311	2,673	3,248	4,664	5,274	6,015	7,766	8,664	9,748
Sprayed Coil Climate Changers																
Casing Only	690	915	1,105	1,270	1,880	2,130	3,100	3,285	3,305	3,485	4,950	5,700	6,230	9,050	10,485	12,355
4 Row	815	1,125	1,360	1,595	2,290	2,595	3,745	4,125	4,145	4,485	6,050	6,950	7,740	10,100	11,700	13,787
6 Row	855	1,190	1,445	1,700	2,425	2,750	3,925	4,285	4,305	4,855	6,465	7,420	8,275	11,710	13,560	15,985
8 Row	890	1,260	1,535	1,800	2,555	2,900	4,195	4,550	4,570	5,175	6,835	7,860	8,810	12,390	14,355	16,910
High Pressure Sprayed Coil Climate Changers																
Casing Only	—	—	1,590	2,130	2,500	2,670	3,210	3,840	4,350	5,100	5,350	6,000	7,200	9,400	12,250	14,910
4 Row	—	—	1,845	2,455	2,910	3,135	3,755	4,485	5,190	6,100	6,450	7,250	8,710	11,350	14,250	17,300
6 Row	—	—	1,930	2,560	3,045	3,290	3,940	4,665	5,350	6,460	6,865	7,720	9,245	12,060	15,100	18,320
8 Row	—	—	2,020	2,660	3,175	3,440	4,115	4,935	5,615	8,790	7,235	8,160	9,780	12,740	15,950	19,210
High Pressure Draw-Thru Climate Changers																
Fan Section Only	—	—	610	770	920	1,060	1,290	1,580	1,870	2,060	2,200	2,330	2,580	2,950	4,090	5,400
Fan and Coil Section	—	—	1,250	1,800	2,150	2,250	2,650	3,400	3,950	4,250	4,600	5,250	5,650	6,850	8,260	10,400
4 Row	—	—	1,590	2,170	2,440	2,765	3,210	4,010	4,795	5,055	5,535	6,335	7,180	8,600	10,260	12,790
6 Row	—	—	1,720	2,310	2,690	3,030	3,370	4,180	4,930	5,445	5,935	6,785	7,930	9,350	11,110	13,810
8 Row	—	—	1,850	2,450	2,740	3,095	3,530	4,350	5,325	5,835	6,335	7,235	8,680	10,000	11,960	14,700
High Pressure Blow-Thru Climate Changers																
Fan Section Only	—	—	610	770	920	1,060	1,290	1,580	1,870	2,060	2,200	2,330	2,580	2,950	4,090	5,400
Fan and Coil Section	—	—	1,650	2,250	2,600	2,850	3,300	4,250	4,850	5,400	6,000	6,850	7,300	9,300	12,140	14,900
4 Row	—	—	1,990	2,620	2,900	3,365	3,860	4,860	5,595	6,205	6,935	7,935	8,830	11,050	14,140	17,290
6 Row	—	—	2,120	2,760	3,240	3,630	4,020	5,030	5,860	6,595	7,335	8,385	9,580	11,800	14,990	18,310
8 Row	—	—	2,250	2,900	3,290	3,745	4,180	5,200	6,225	6,985	7,735	8,835	10,180	12,450	15,840	19,200
Three Deck Multizone Climate Changers																
Casing Only	—	725	885	930	1,000	1,255	1,440	1,615	1,830	2,060	3,350	4,000	4,385	4,950	—	—
2 Row	—	874	1,055	1,147	1,278	1,560	1,794	2,029	2,300	2,722	4,082	4,813	5,343	6,219	—	—
4 Row	—	937	1,142	1,255	1,408	1,718	1,983	2,260	2,669	3,058	4,448	5,257	5,895	6,908	—	—
6 Row	—	1,002	1,227	1,361	1,543	1,874	2,232	2,488	2,839	3,418	4,866	5,721	6,429	7,609	—	—
8 Row	—	1,068	1,313	1,458	1,673	2,025	2,346	2,711	3,093	3,748	5,234	6,159	6,965	8,291	—	—

NOTE: Inlet vane weights will vary from 38 to 93 pounds per fan.

NOTE: Units with Delta-Flo coils will weigh approximately 10% lighter than standard coil weights.

TABLE 2 - Approximate Motor Weights*

Motor Horsepower	¼	⅓	½	1	1½	2	3	5	7½	10	15	20	25	30	40	50	60	75
Motor Weight (Lbs.)	20	20	25	33	44	44	71	82	127	144	187	214	263	300	409	460	560	660

*Standard Open Ball Bearing T-Frame Motor.

TABLE 3 - Accessory Weights (LBS.)

UNIT SIZES	3	6	7	8	9	10	12	14	17	21	25	31	35	41	50	63	73	86
Flat Filter Box																		
Throwaway	28	38	42	45	54	68	73	76	92	113	120	135	170	180	210	335	388	457
Low Velocity Permanent	33	47	52	56	67	84	91	97	117	145	155	183	222	234	284	426	494	582
High Velocity Permanent	51	63	69	75	91	108	120	131	156	193	207	257	306	338	365	582	674	794
Medium Filter Box																		
Throwaway	76	101	131	144	167	171	178	228	247	303	324	355	370	456	520	565	655	775
Low Velocity Permanent	84	117	149	162	191	195	204	260	284	348	373	413	429	546	631	695	805	950
High Velocity Permanent	96	141	181	190	227	231	248	312	347	428	456	513	557	706	799	935	1,085	1,275
High Capacity Box																		
Throwaway	111	148	155	170	180	192	229	260	278	330	398	425	470	535	590	680	788	928
Low Velocity Permanent	120	166	184	194	208	223	261	305	324	393	468	512	574	660	735	865	1,002	1,180
High Velocity Permanent	136	198	217	230	257	271	317	360	396	489	576	648	742	852	950	1,160	1,344	1,583
Roll Filter	80	114	—	142	—	158	187	204	219	250	290	363	430	475	500	750	870	1,025
Comb. Filt./Mix Box																		
Throwaway	115	168	200	248	255	286	300	215	358	400	490	620	710	790	885	1,133	1,310	,550
Low Velocity Permanent	122	184	217	266	279	310	324	345	393	441	540	686	780	874	997	1,165	1,465	1,730
High Velocity Permanent	134	208	249	298	315	346	368	397	456	521	635	786	906	1,035	1,265	1,505	1,740	2,060
Deluxe Comb. Filter/Mix Box																		
Throwaway	193	240	263	352	369	376	407	474	501	586	604	732	986	—	—	—	—	—
Low Velocity Permanent	200	256	280	370	393	400	431	504	536	627	654	798	1,056	—	—	—	—	—
High Velocity Permanent	212	280	312	402	429	436	475	556	600	707	739	898	1,182	—	—	—	—	—
Mixing Box	82	118	122	169	175	182	256	270	319	340	380	437	519	623	750	869	1,010	1,185
High Efficiency Bag Filter																		
Filter Sections	—	—	—	191	—	227	249	319	329	403	454	592	606	682	718	751	—	—
Bag Filters	—	—	—	11	—	14	18	23	25	30	41	50	64	64	75	100	—	—
Prefilters	—	—	—	2	—	3	4	5	5	6	9	11	13	13	17	22	—	—
*Diffuser Section	—	—	—	55	—	79	84	88	107	130	138	153	191	202	232	357	—	—
External Face and Bypass	40	58	79	96	100	112	154	161	170	216	292	417	457	470	618	925	1,070	1,265
Internal Face and Bypass	30	53	74	77	92	100	109	113	124	184	223	327	334	363	441	535	620	730
Face Dampers	39	55	65	91	102	106	111	115	142	225	232	297	312	370	446	543	630	742
Straight Thru Discharge Plenum	50	65	90	100	130	110	130	150	170	180	200	300	400	400	—	—	—	—

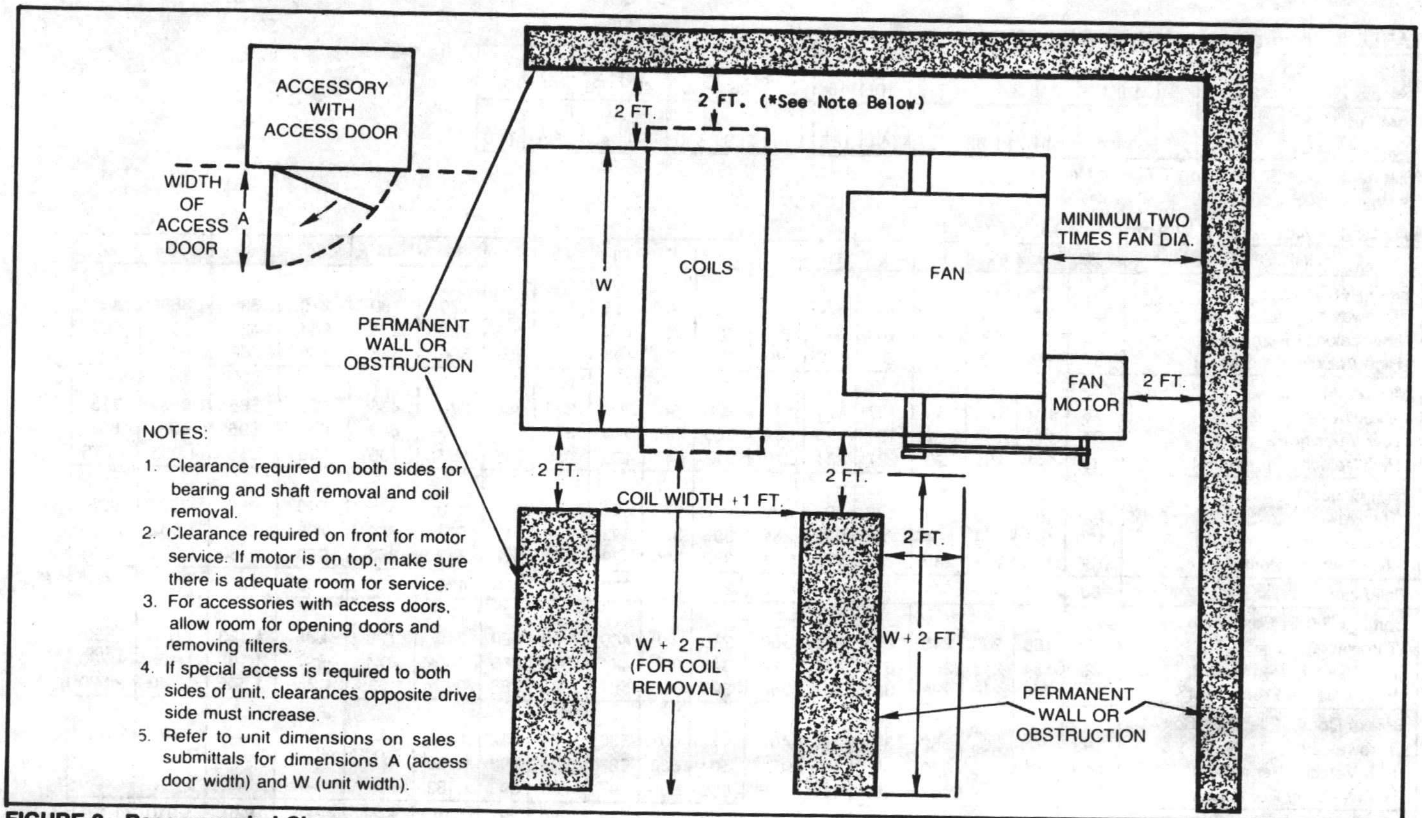
*Weight given is sum of diffuser section, duct extension and canvas duct.

INSTALLATION

UNIT LOCATION RECOMMENDATIONS

When selecting and preparing the unit operating site, consider the following:

1. Consider the weight of the unit. Tables 1, 2 and 3 list operating weights.
2. Allow sufficient space for the recommended clearances, access panel removal, and maintenance access. Refer to Figure 2. Zero clearance to combustible materials is approved for units with or without steam or hot water heating coils.
   NOTE: *For units with optional wide coil, always maintain a 2-foot clearance from coil section end panel to permanent wall or obstruction.*
3. The foundation or mounting platform must be large enough to include unit and accessory dimensions, given in specific sales submittals.
4. Rubber-in-shear or spring isolators are recommended. For floor-mounted units, anchor the unit to the floor or foundation to prevent strains on the piping and ductwork.
5. Installer must provide suspension or support frame for ceiling-mounted units size 35 and larger. Use the weights given in Tables 1, 2 and 3.
6. Prepare the floor or foundation so that it is level. The unit must be mounted level to ensure proper hydronic coil drainage and condensate flow.
7. Coil piping and condensate drain requirements must be considered. For units with Type F cooling coils, the installer must provide and install a condensing unit and piping. Allow room for proper ductwork and electrical connections. Support all piping and ductwork independently of unit to prevent excess noise and vibration.
8. Optional coilless horizontal draw-thru unit sizes 3, 6, 8, 10, 14 and 21 require the contractor to field install coil in unit per COIL INSTALLATION INSTRUCTIONS given in the installation manual (included with coil shipment). On ceiling-mounted unit applications it is recommended to install coil in unit **before** hoisting unit to operating position.



NOTES:

1. Clearance required on both sides for bearing and shaft removal and coil removal.
2. Clearance required on front for motor service. If motor is on top, make sure there is adequate room for service.
3. For accessories with access doors, allow room for opening doors and removing filters.
4. If special access is required to both sides of unit, clearances opposite drive side must increase.
5. Refer to unit dimensions on sales submittals for dimensions A (access door width) and W (unit width).

FIGURE 2 - Recommended Clearances

*NOTE FOR WIDE COIL UNITS: Always maintain a 2-foot clearance from coil section end panel to permanent wall or obstruction.

MOUNTING

VIBRATION ISOLATORS

Vibration isolators and isolator mounting legs, when supplied, are shipped with the unit and attached to the shipping skid. Locate the mounting legs at all corners of the unit or component section or at appropriate support sites. Fasten the isolators to the floor securely before mounting the unit. See Figure 3.

NOTE: *If mounting the unit on a raised platform or foundation, be sure to allow room for the mounting legs and isolators, which extend beyond the unit dimensions.*

Level the unit after installation by adjusting the isolator levelling bolts. For ceiling-mounted units, use threaded rods or adjustable isolators to level the unit.

Be sure to consider the additional unit height if isolators are used when making duct, piping and electrical connections. For large Draw-Thru and Sprayed Coil units, the coil section must be mounted on a higher base than the fan section in order to compensate for the height of the fan section isolators.

NOTE: *Non-Trane isolators must be properly sized to ensure adequate support of the unit. Allow at least 20 percent weight addition when sizing isolators.*

If using spring-type isolators, the isolator levelling bolt must be adjusted to provide adequate isolation, as unit weight may cause the upper isolator housing to rest on the lower housing. See Figure 4. Clearance B must be between 1/4-inch and 1/2-inch under full unit weight. To increase the clearance, lift the unit off the mountings and turn the levelling bolt clockwise. Recheck the unit level and shim as necessary under the isolators.

After the isolator height is adjusted correctly, adjust the horizontal snubber bolt to minimize any horizontal movements.

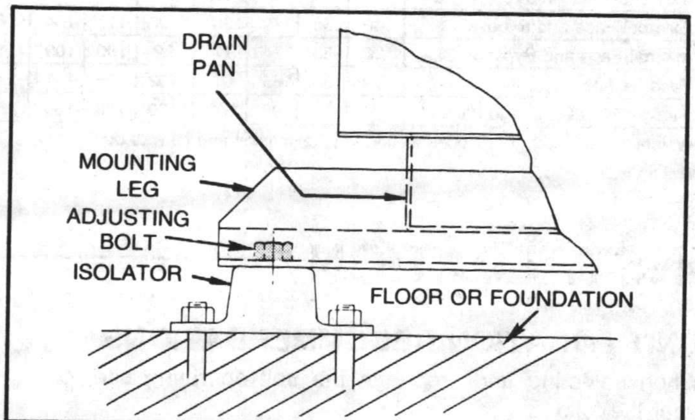


FIGURE 3 - Anchoring the Unit

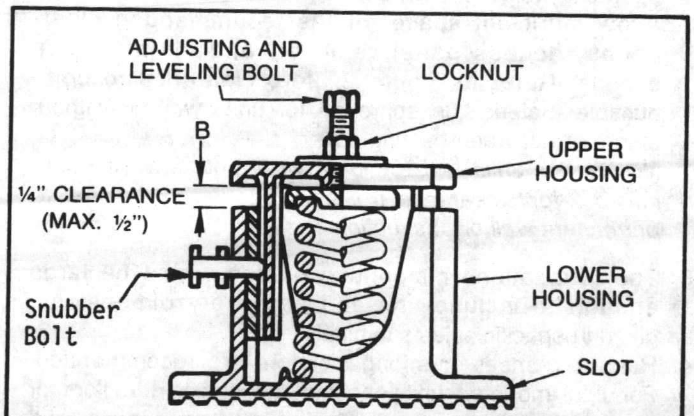


FIGURE 4 - Spring-Type Isolator Adjustment

MOUNTING — CLIMATE CHANGER AIR HANDLERS

DRAW-THRU UNITS

NOTE: *No draw-thru units and or accessories have factory gasketed panels or drain pan gasketing unless specified on the order.*

WARNING: DO NOT LIFT THE UNIT WITHOUT TEST LIFTING FOR BALANCE AND RIGGING. DO NOT LIFT THE UNIT IN WINDY CONDITIONS OR ABOVE PERSONNEL, DO NOT LIFT THE UNIT BY ATTACHING A CLEVIS, HOOKS, PINS OR BOLTS TO THE CASING, CASING HARDWARE, CORNER LUGS, ANGLES, TABS OR FLANGES. FAILURE TO OBSERVE THESE WARNINGS MAY RESULT IN PERSONAL INJURY OR DEATH OR EQUIPMENT DAMAGE.

NOTE: *On certain horizontal draw-thru units that ship from the factory in sections, a splash angle must be field installed connecting the coil section to the fan section. See Figure 9. The following units apply,*
- Horizontal D. T. Unit size 50 (with back vertical discharge).
- Horizontal D. T. Unit Size 63 (with front or back vertical discharge).
- Horizontal D. T. Unit size 63 (with extra length casing).

NOTE: *Check the bearing and sheave setscrews for proper torque settings. Refer to applicable section in this manual.*

Floor-Mounted — Horizontal Unit Sizes 3-50 and Vertical Unit Sizes 3-31. Ship from factory as one assembly (Fan Section, Coil Section and Drain Pan).

NOTE: *For optional coilless horizontal draw-thru units (size 3, 6, 8, 10, 14 and 21) refer to COIL INSTALLATION INSTRUCTIONS given in the installation manual to properly install coil in unit.*

1. Remove the diagonal shipping angles which secure coil(s) if they interfere with the use of access doors.
2. Attach accessories, if used. Gasketing not provided unless specified on sales order.
3. Anchor the isolators to the floor and mount the unit on the isolators. See Figure 3. For some applications it may be necessary to shorten the isolator adjusting bolt to properly secure unit to isolator.
4. Level the unit for proper coil drainage and condensate removal from the drain pan.
5. Connect the ductwork and necessary piping to the unit. Refer to applicable section in this manual.
6. Attach the motor, drives and motor splash pan if provided. If the motor was factory installed, check the bolts to make sure they are tight. Refer to the "Start-Up" section of the maintenance manual.

Note: All constant speed units are balanced at the factory at design rpm. If unit is to operate at more than 5% of design rpm a balance check and/or field rebalance will be necessary. Refer to "Start-Up" section in this manual.

Floor-Mounted — Horizontal Unit Sizes 63-86 and Vertical Unit Sizes 35-50. Ship from factory in 2 sections, (fan section and coil section).

NOTE: *On certain horizontal draw-thru units that ship from the factory in sections, a splash angle must be field installed connecting the coil section to the fan section. See Figure 9. The following units apply,*
- Horizontal D. T. Unit size 50 (with back vertical discharge).
- Horizontal D. T. Unit Size 63 (with front or back vertical discharge).
- Horizontal D. T. Unit size 63 (with extra length casing).

NOTE: *Check the bearing and sheave setscrews for proper torque settings. Refer to applicable section in this manual.*

1. Remove the diagonal shipping angles which secure coil(s) if they interfere with the use of access doors.
2. Fasten isolators to floor.
3. Horizontal Units Size 63 — To assemble multi-section horizontal units, remove the drain pan from the coil section discharge flange and set in place. Then set the fan and coil sections on the drain pan, as shown in Figure 5. Bolt the sections together, attach gasketing if supplied. Make sure that the coil section support channels are also attached to the fan section. Mount assembled unit on isolators and fasten unit to isolators.
4. Horizontal Units Size 73 and 86 — To assemble unit, mount the fan section on the isolators and fasten. Attach flexible connector to the fan section. Then fasten the splash guard to the fan section. See Figure 8. Mount the coil section on the base with the required distance between fan and coil sections. See Figure 7. Each fan section and coil section have separate factory assembled drain pans. Each drain pan must be trapped separately.

NOTE: *Coil section base is provided by the installer. Height of coil section base should be equal to working height of fan section isolators. Be sure the base is high enough to allow room for a piping trap. See Figure 7. Refer to drain trap sketches in piping section.*

Attach flexible connection to the coil section.

Fasten splash guard to coil section. Panel removal may be necessary to attach splash guard to coil section on size 86 units.

5. Vertical Units Size 35-50 — To assemble multi-section vertical discharge units, attach the fan section to the top of coil section. Removal of front panel on coil section is necessary to assemble fan section. Install gasketing if supplied. Drain pan is factory assembled to coil section. Mount assembled unit on isolators and fasten unit to isolators. See Figure 6.
6. Attach accessories, if used. Gasketing not provided unless specified on sales order.
7. Level the unit, fan and or coil sections to assure proper coil drainage and removal of condensate from the drain pan.

8. Connect the ductwork and necessary piping to the unit. Refer to applicable section in this manual.

9. Attach the motor, drives and motor splash pan if provided. If the motor was factory installed, check the bolts to make sure they are tight.

Floor-Mounted — Horizontal and Vertical Spray Coil Unit Sizes 3-31. Ship from factory as one assembly (Fan Section, Coil Section and Drain Pan).

WARNING: DO NOT LIFT THE UNIT WITHOUT TEST-LIFTING FOR BALANCE AND RIGGING. DO NOT LIFT THE UNIT IN WINDY CONDITIONS OR ABOVE PERSONNEL. DO NOT LIFT THE UNIT BY ATTACHING A CLEVIS, HOOKS, PINS OR BOLTS TO THE CASING, CASING HARDWARE, CORNER LUGS, ANGLES, TABS OR FLANGES. FAILURE TO OBSERVE THESE WARNINGS MAY RESULT IN PERSONAL INJURY OR DEATH OR EQUIPMENT DAMAGE.

NOTE: *The complete spray section is gasketed on all vertical and horizontal sizes. Also, the factory installs a gasket at the joint between the spray section and coil section.*

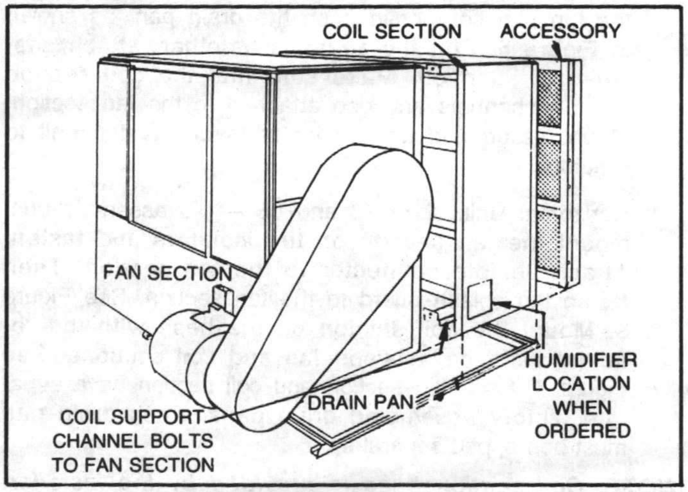


FIGURE 5 - Exploded View of the Horizontal Draw-Thru Unit Size 63

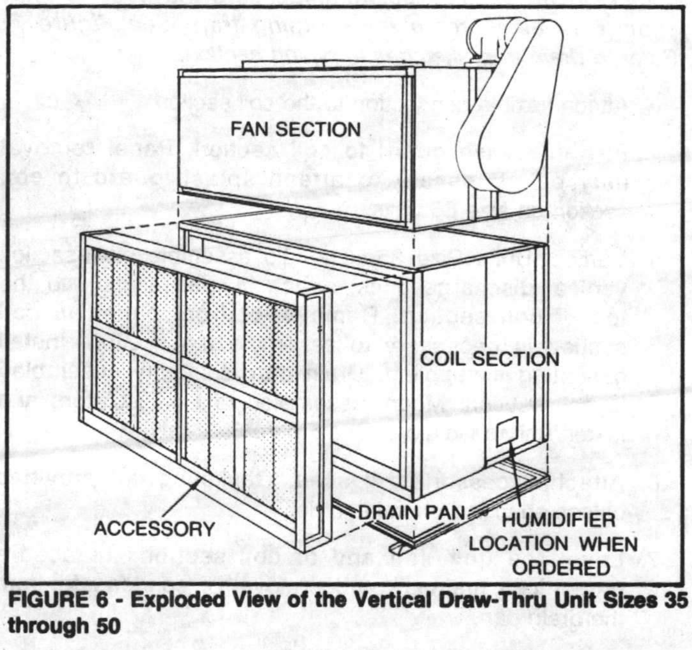


FIGURE 6 - Exploded View of the Vertical Draw-Thru Unit Sizes 35 through 50

NOTE: *Check the bearing, and sheave setscrews for proper torque settings. Refer to Applicable section in this manual.*

1. Remove the diagonal shipping angles which secure coil(s) if they interfere with the use of access doors.

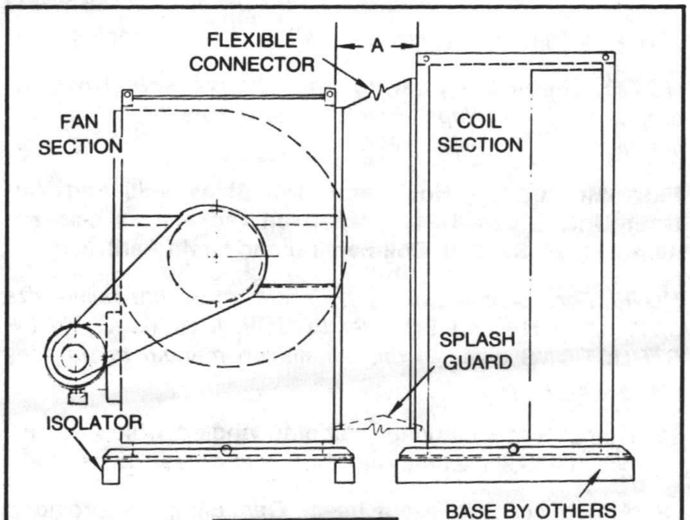
2. Attach accessories, if used. Gasketing not provided unless specified on sales order.

3. Anchor the isolators to the floor and mount the unit on the isolators. See Figure 3. For some applications it may be necessary to shorten the adjusting bolt to properly secure unit to isolator.

4. Level the unit for proper coil drainage and condensate removal from the drain pan. On horizontal units the drain pan empties back into the sump.

5. Connect the ductwork and necessary piping to the unit. Refer to applicable section in this manual.

6. Attach the motor, drives and motor splash pan if provided. If the motor was factory installed, check the bolts to make sure they are tight. Refer to the "Start-Up" section of this manual.



UNIT SIZE	A
73	9"
86	24"

FIGURE 7 - Mounting Clearance Dimensions for Draw-Thru Units Sizes 73-86

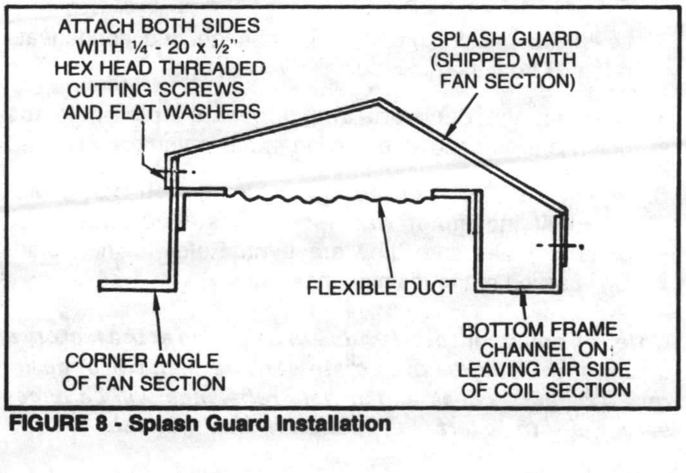


FIGURE 8 - Splash Guard Installation

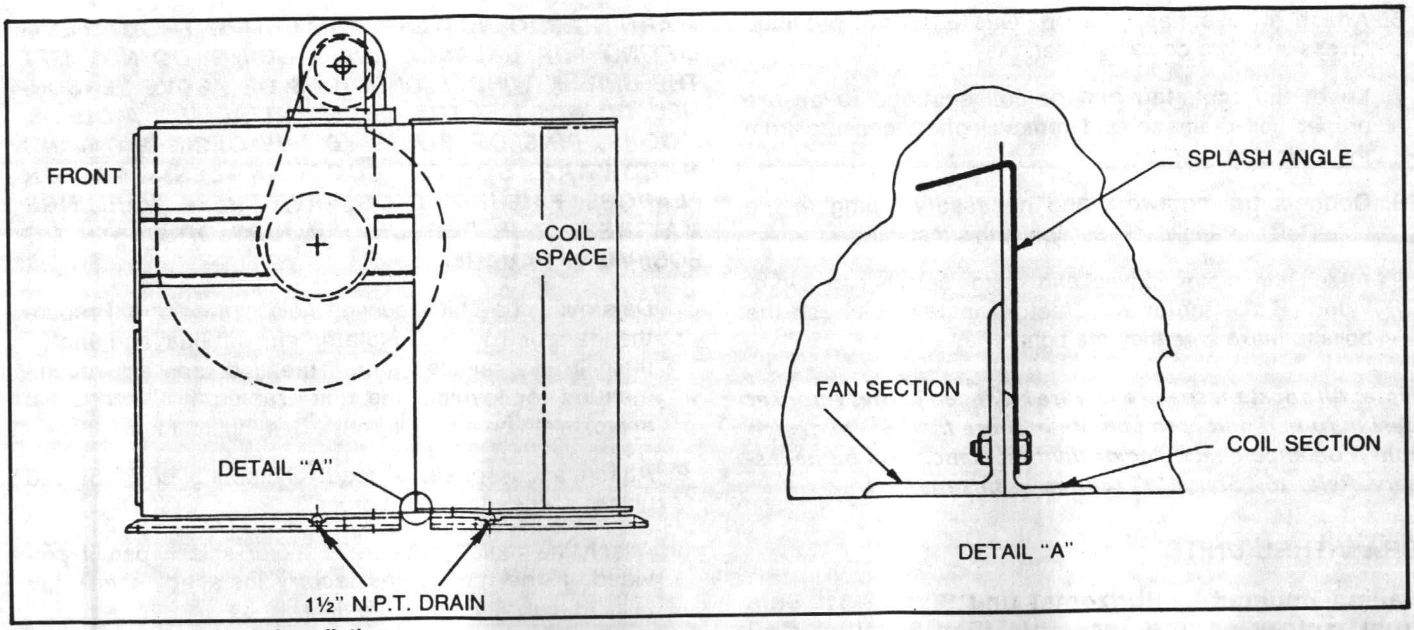


FIGURE 9 - Splash Angle Installation

Note: All constant speed units are balanced at the factory at design rpm. If unit is to operate at more than 5% of design rpm a balance check and/or field rebalance will be necessary. Refer to "Start-Up" section in this manual.

Floor-Mounted — Vertical Spray Coil Unit Sizes 35-50 ship from factory in 2 sections (fan section, coil section). Horizontal Spray Coil Unit Sizes 35-63 ship from factory in 3 sections (coil section, fan section, fan drain pan section). Horizontal Spray Coil Unit Sizes 73-86 ship from factory in 2 sections (fan section, coil section).

Note: The complete spray section is gasketed on all vertical and horizontal sizes. Also, the factory installs a gasket at the joint between the spray section and coil section.

NOTE: *Check the bearing and sheave setscrews for proper torque settings. Refer to applicable section in this manual.*

WARNING: DO NOT LIFT THE UNIT WITHOUT TEST-LIFTING FOR BALANCE AND RIGGING. DO NOT LIFT THE UNIT IN WINDY CONDITIONS OR ABOVE PERSONNEL. DO NOT LIFT THE UNIT BY ATTACHING A CLEVIS, HOOKS, PINS OR BOLTS TO THE CASING, CASING HARDWARE, CORNER LUGS, ANGLES, TABS OR FLANGES. FAILURE TO OBSERVE THESE WARNINGS MAY RESULT IN PERSONAL INJURY OR DEATH OR EQUIPMENT DAMAGE.

1. Remove the diagonal shipping angles which secure coil(s) if they interfere with the use of access doors.
2. Fasten isolators to floor.
3. Horizontal Units Size 35-63 — Attach the spray section to isolators. Fasten the two mounting legs to the fan section drain pan. Set the fan section on the drain pan and bolt in place. Attach the drain pan and fan section to the spray section. See Figure 10.
4. Horizontal Units Size 73 and 86 — To assemble unit, mount the fan section on the isolators and fasten. Attach flexible connector to the fan section. Mount the coil section on the base with the required distance between fan and coil sections. See Figure 7. Drain pan is factory assembled to each section.

NOTE: *Coil section base is provided by the installer. Height of coil section base should be equal to working height of fan section isolators. Be sure the base is high enough to allow room for a piping trap. See Figure 7. Refer to drain trap sketches in piping section.*

Attach flexible connection to the coil section.

5. Vertical Units Size 35-50 — Set the spray section over the isolators and bolt together. Place the fan section on top of the coil section and bolt together. Gasketing not provided between fan section and coil section unless specified on the sales order. Drain pan (sump assembly) is factory assembled to spray coil section.

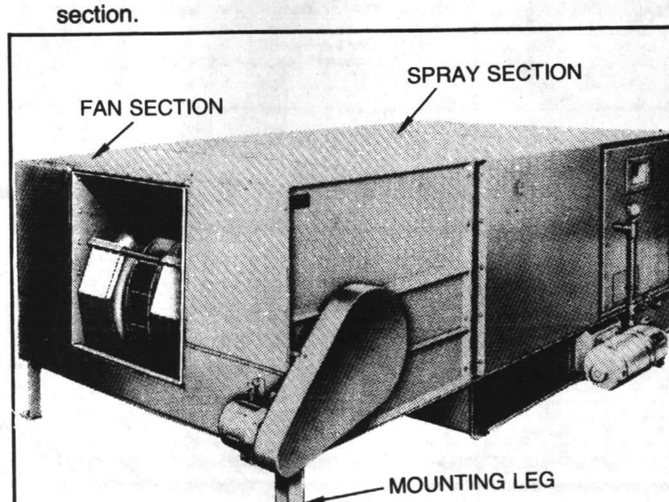


FIGURE 10 - Typical Horizontal Sprayed Coil Climate Changer

6. Attach accessories, if used. Gasketing not provided unless specified on sales order.
7. Level the unit, fan and or coil sections to assure proper coil drainage and removal of condensate from the drain pan.
8. Connect the ductwork and necessary piping to the unit. Refer to applicable section in this manual.
9. Attach the motor, drives and motor splash pan if provided. If the motor was factory installed, check the bolts to make sure they are tight.

Note: All constant speed units are balanced at the factory at design rpm. If unit is to operate at more than 5% of design rpm a balance check and/or field rebalance will be necessary. Refer to "Start-Up" section in this manual.

DRAW-THRU UNITS

Ceiling-Mounted — Horizontal Unit Sizes 3-31. Ship from factory as one assembly (Fan Section, Coil Section and Drain Pan).

NOTE: *For optional coilless horizontal draw-thru units (size 3, 6, 8, 10, 14 and 21) refer to COIL INSTALLATION INSTRUCTIONS given in CLCH-IN-1 to properly install coil in unit. On ceiling-mounted unit applications it is recommended to install coil in unit* ***before*** *hoisting unit to operating position.*

NOTE: *Check the bearing and sheave setscrews for proper torque settings. Refer to applicable section in this manual.*

Note: *All ceiling suspended units with wide coil application* ***must*** *use a cradle (angle iron). See Figure 11A for details.*

Note: *Because of their weight, unit sizes 3-31 (wide coil only) and 35-86 (wide coil and standard units) require suspension support frames, to be provided by the installer. Figures 11A, 12 and 13 give the configuration and dimension of these frames. Note that two frames are required for sizes 73 and 86. See Figure 13.*

WARNING: DO NOT LIFT THE UNIT WITHOUT TEST-LIFTING FOR BALANCE AND RIGGING. DO NOT LIFT THE UNIT IN WINDY CONDITIONS OR ABOVE PERSONNEL. DO NOT LIFT THE UNIT BY ATTACHING A CLEVIS, HOOKS, PINS OR BOLTS TO THE CASING, CASING HARDWARE, CORNER LUGS, ANGLES, TABS OR FLANGES. FAILURE TO OBSERVE THESE WARNINGS MAY RESULT IN PERSONAL INJURY OR DEATH OR EQUIPMENT DAMAGE.

1. Determine the unit mounting hole dimensions. Prepare the hanger rod and isolator assemblies and install them in the selected area. Threaded rods are recommended for leveling the unit. Tables 1, 2 and 3 list approximate operating weights. See Figure 11.
2. Attach accessories, if used. Gasketing not provided unless specified on sales order.
3. Attach the motor, drives and motor splash pan if provided. If the motor was factory installed, check the bolts to make sure they are tight.

Note: All constant speed units are balanced at the factory at design rpm. If unit is to operate at more than 5% of design rpm a balance check and/or field rebalance will be necessary. Refer to "Start-Up" section in this manual.

NOTE: *Check to determine that the motor is clean and dry prior to start-up.*

4. Hoist the unit to the hanger or suspension rods and attach. See Figure 11.
5. Level the unit for proper coil drainage and condensate removal from the drain pan. Refer to drain trap sketches in piping section.
6. Connect the ductwork and necessary piping to the unit. Refer to applicable section in this manual. Isolate piping separately.

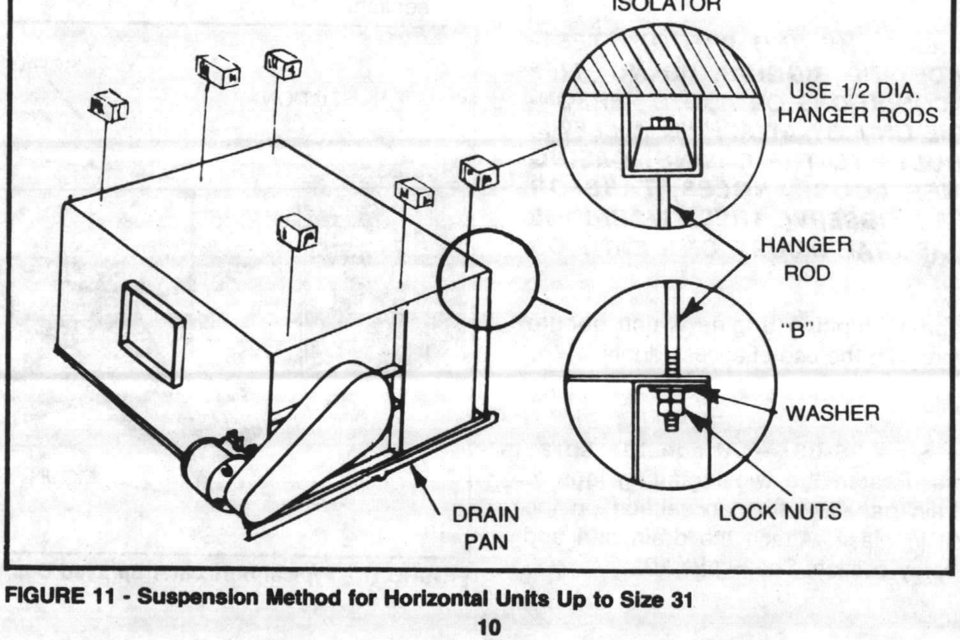
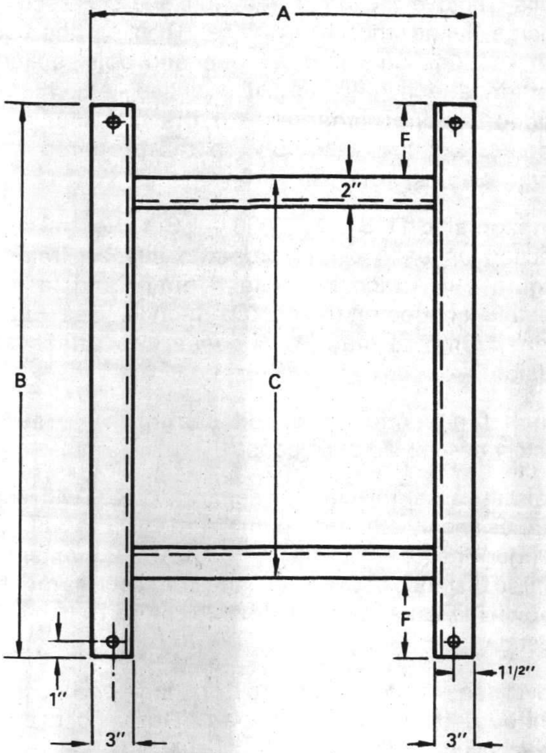


FIGURE 11 - Suspension Method for Horizontal Units Up to Size 31



Vertical Dimensions (Inches) With Wide Coil

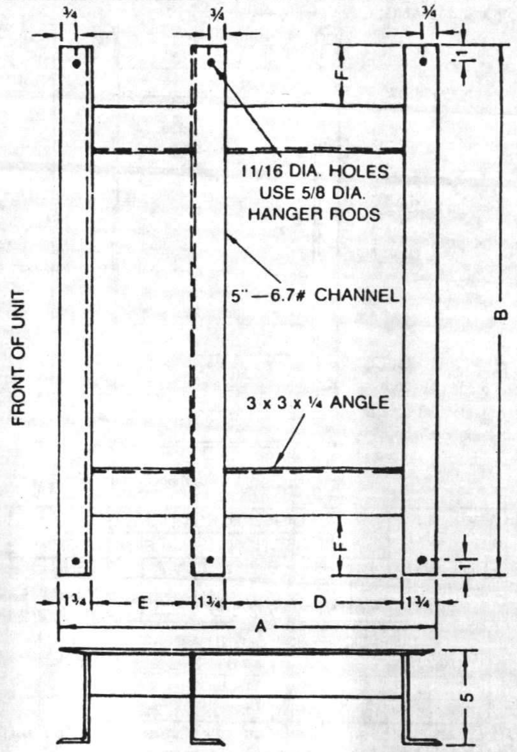
UNIT SIZE	A	B	C	F
3	23 7/8	54	34	10
6	23 7/8	75	55	10
8	28 7/8	66	46	10
10	28 7/8	75	55	10
12	32 7/8	81	61	10
14	32 7/8	90	70	10
17	32 7/8	111	91	10
21	36 7/8	129	109	10
25	42 7/8	135	115	10
31	42 7/8	135	115	10

Horizontal Dimensions (Inches) With Wide Coil

UNIT SIZE	A	B	C	F
3	32 3/4	54	34	10
6	34 3/4	75	55	10
8	44 3/4	66	46	10
10	44 3/4	75	55	10
12	48 3/4	81	61	10
14	48 3/4	90	70	10
17	48 3/4	111	91	10
21	52 3/4	129	109	10
25 Arr. 1 & 2	52 3/4	135	115	10
25 Arr. 3 & 4	58 3/4	135	115	10
31 Arr. 1 & 2	52 3/4	135	115	10
31 Arr. 3 & 4	58 3/4	135	115	10

Figure 11A — Ceiling Suspension Mounting Frame and Dimensions for Wide Coil Unit Sizes 3 thru 31.

CEILING-MOUNTED — Horizontal Unit Sizes 35-50 ship from factory as one assembly (fan section, coil section, and drain pan). Horizontal Unit Sizes 63-86 ship from factory in 2 sections (fan section and coil section).



UNIT SIZE	DIMENSIONS (INCHES) A	B	D	E	F
#35	79½	132⅝	40 1/16	34 3/16	10½
#41	84½	135⅝	43 1/16	36 3/16	10½
#50	90½	135⅝	46 1/16	39 3/16	10½
#63	97½	143⅝	50 1/16	42 3/16	14½

DIMENSIONS (INCHES) WITH WIDE COIL					
UNIT SIZE	A	B	D	E	F
35	79½	149⅝	40 1/16	34 3/16	19½
41	84½	159⅝	43 1/16	36 3/16	22½
50	90½	159⅝	46 1/16	39 3/16	22½
63	97½	152⅝	50 1/16	42 3/16	19½

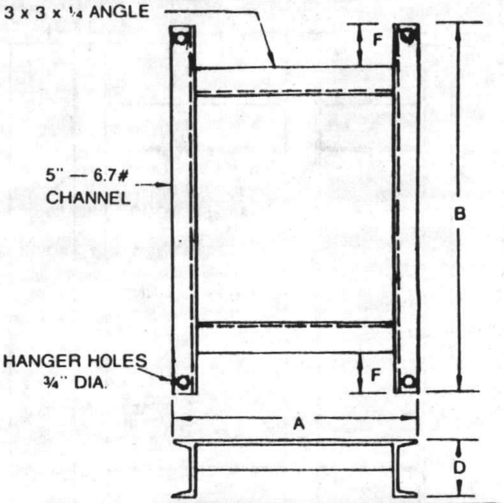
NOTE: Above sketch does not apply to Sprayed Coil Units.

FIGURE 12 - Ceiling Suspension Mounting Frame and Dimensions for Unit Sizes 35 to 63

NOTE: *On certain horizontal draw-thru units that ship from the factory in sections, a splash angle must be field installed connecting the coil section to the fan section. See Figure 9. The following units apply,*

- *Horizontal D. T. Unit size 50 (with back vertical discharge).*
- *Horizontal D. T. Unit Size 63 (with front or back vertical discharge).*
- *Horizontal D. T. Unit size 63 (with extra length casing).*

WARNING: DO NOT LIFT THE UNIT WITHOUT TEST LIFTING FOR BALANCE AND RIGGING. DO NOT LIFT THE UNIT IN WINDY CONDITIONS OR ABOVE PERSONNEL, DO NOT LIFT THE UNIT BY ATTACHING A CLEVIS, HOOKS, PINS OR BOLTS TO THE CASING, CASING HARDWARE, CORNER LUGS, ANGLES, TABS OR FLANGES. FAILURE TO OBSERVE THESE WARNINGS MAY RESULT IN PERSONAL INJURY OR DEATH OR EQUIPMENT DAMAGE.



UNIT SIZE	DIMENSIONS (INCHES)							
	COIL SECTION				FAN SECTION			
	A	B	D	F	A	B	D	F
73	51	129-3/8	5	3-½	61	150-5/8	5	18
86	51	151-5/8	5	3-½	61	150-5/8	5	18

DIMENSIONS (INCHES) WITH WIDE COIL				
UNIT SIZE	A	B	D	F
73	51	146 3/8	5	12
86	51	168 5/8	5	12

NOTE: Fan section dimensions are same for std. units and/or units with wide coil.

FIGURE 13 - Ceiling Suspension Mounting Frame and Dimensions for Unit Sizes 73 and 86 (Two Frames are Required for Each Unit)

1. Determine the unit mounting hole dimensions. Prepare the hanger rod and isolator assemblies and install them in the selected area. Threaded rods are recommended for leveling the unit. Tables 1, 2 and 3 list approximate operating weights.
2. Remove the diagonal shipping angles which secure coil(s) if they interfere with the use of access doors.
3. Attach accessories, if used. Gasketing not provided unless specified on the sales order.
4. Attach the motor, drives and motor splash pan if provided. If the motor was factory installed, check the bolts to make sure they are tight. Refer to the "Start-Up" section of the maintenance manual.

Note: All constant speed units are balanced at the factory at design rpm. If unit is to operate at more than 5% of design rpm a balance check and/or field rebalance will be necessary. Refer to "Start-Up" section in this manual.

***NOTE:** Check to determine that the motor is clean and dry prior to start-up.*

5. Horizontal Unit Sizes 3-50 — Attach the coil section support channels to the fan section base angles. Set the assembly on the prepared support frame. Reference Figures 11A and 12.
6. Horizontal Unit Size 63 — To assemble multi-section units, remove the drain pan from the coil section discharge flange and set in place. Then set the coil and fan sections on the drain pan and bolt sections together, attach gasketing if supplied. Attach the coil section support channels to the fan section base angles. Set the assembly on the prepared support frame. See Figure 12.
7. Horizontal Unit Sizes 73-86 — Set the coil and fan section on each of the prepared support frame. See Figure 13. Attach the splash guard and fasten the flexible connector to the fan section. See Figure 8. Panel removal may be necessary to attach splash guard.

   Each fan section and coil section have separate factory assembled drain pans.
8. Hoist the assembled unit or separate pieces with support frames and attach the support frames (sizes 3-86) to the hanger or suspension rods. For size 73-86 units, the required distance between fan and coil sections must be as shown in Figure 7. Attach flexible connection to the coil section.
9. Level the unit for proper coil drainage and condensate removal from the drain pan. Refer to drain trap sketches in piping section.
10. Connect the ductwork and necessary piping to the unit. Refer to applicable section in this manual. Isolate piping separately.

BLOW-THRU UNITS

Floor-Mounted — Three-Deck Unit Sizes 6-25 and Multizone Unit Sizes 6-31 ship from factory as one assembly (fan section, coil section w/drain pan and zone damper section).

WARNING: DO NOT LIFT THE UNIT WITHOUT TEST-LIFTING FOR BALANCE AND RIGGING. DO NOT LIFT THE UNIT IN WINDY CONDITIONS OR ABOVE PERSONNEL. DO NOT LIFT THE UNIT BY ATTACHING A CLEVIS, HOOKS, PINS OR BOLTS TO THE CASING, CASING HARDWARE, CORNER LUGS, ANGLES, TABS OR FLANGES. FAILURE TO OBSERVE THESE WARNINGS MAY RESULT IN PERSONAL INJURY OR DEATH OR EQUIPMENT DAMAGE.

***NOTE:** Check the bearing and sheave setscrews for proper torque settings. Refer to applicable section in this manual.*

1. Fasten isolators to the floor.
2. Mount the unit on the isolators and fasten.
3. Install accessories.
4. Level the unit for proper coil drainage and condensate removal from the drain pan.
5. Connect the ductwork and necessary piping to the unit. Refer to applicable section in this manual.

   ***NOTE:** See Figure 30 for duct installation.*

6. *Attach the motor, drives and motor splash pan if provided. If the motor was factory installed, check the bolts to make sure they are tight.*

Floor-Mounted — Multizone Blow-Thru Unit Sizes 35-41 and Three Deck Unit Sizes 31-35 ship from factory in 3 sections (coil section, fan section and zone damper section).

NOTE: *Check the bearing and sheave setscrews for proper torque settings. Refer to applicable section in this manual.*

WARNING: DO NOT LIFT THE UNIT WITHOUT TEST-LIFTING FOR BALANCE AND RIGGING. DO NOT LIFT THE UNIT IN WINDY CONDITIONS OR ABOVE PERSONNEL. DO NOT LIFT THE UNIT BY ATTACHING A CLEVIS, HOOKS, PINS OR BOLTS TO THE CASING, CASING HARDWARE, CORNER LUGS, ANGLES, TABS OR FLANGES. FAILURE TO OBSERVE THESE WARNINGS MAY RESULT IN PERSONAL INJURY OR DEATH OR EQUIPMENT DAMAGE.

1. Fasten isolators to floor.
2. If ordered, mount zone damper assembly to discharge opening of coil section. First remove shipping angle in discharge opening. Attach zone damper with gasketing factory provided. Attach splitter panel (dividing plate) to zone damper. Gasketing not provided for dividing plate.

CAUTION: When installing the damper assembly to the hot deck and bypass section, make sure it is mounted squarely, otherwise the damper blades may twist and fail to operate.

3. Remove the 90° cover panel.
4. Apply gasketing to the fan section mounting flange.
5. Set the assembled coil and damper sections on the isolators and fasten in place.
6. Gain access thru the 90° cover panel (removed previously) and bolt the fan section to the coil section through the gasketing. Be sure to bolt the fan section to the tie angle assembly, mounted on the coil section.

NOTE: *Horizontal bolting across top and bottom of fan section to coil section require internal access through the 90° cover panel. Vertical bolting along side of fan section to coil section does not require internal access.*

7. Apply gasketing to the 90° cover panel.
8. Attach the coil section 90° cover panel.
9. Install accessories.
10. Level the unit for proper coil drainage and condensate removal from the drain pan.
11. Connect the ductwork and necessary piping to the unit. Refer to applicable section in this manual.

NOTE: *See Figure 30 for duct installation.*

12. Attach the motor, drives and motor splash pan if provided. If the motor was factory installed, check the bolts to make sure they are tight.

Note: All constant speed units are balanced at the factory at design rpm. If unit is to operate at more than 5% of design rpm a balance check and/or field rebalance will be necessary. Refer to "Start-Up" section in this manual.

Floor-Mounted — Multizone Blow-Thru Unit Sizes 50-63 ship from factory in 4 sections (fan section, cooling coil section, heating coil section and zone damper section). Refer to Figure 15.

NOTE: *Check the bearing and sheave setscrews for proper torque settings. Refer to applicable section in this manual.*

WARNING: DO NOT LIFT THE UNIT WITHOUT TEST-LIFTING FOR BALANCE AND RIGGING. DO NOT LIFT THE UNIT IN WINDY CONDITIONS OR ABOVE PERSONNEL. DO NOT LIFT THE UNIT BY ATTACHING A CLEVIS, HOOKS, PINS OR BOLTS TO THE CASING, CASING HARDWARE, CORNER LUGS, ANGLES, TABS OR FLANGES. FAILURE TO OBSERVE THESE WARNINGS MAY RESULT IN PERSONAL INJURY OR DEATH OR EQUIPMENT DAMAGE.

1. Fasten isolators to floor.
2. Remove the shipping angles attached to the front or top of the coil section.
3. Vertical Discharge Units: Place hot deck on top of cold deck and bolt in place with gasketing factory provided. The front panel of coil section ships attached across the discharge opening. It must be removed and installed with gasketing to the front of the coil section. (This does not apply to horizontal discharge units.) Next, bolt the splitter panel (dividing plate) to the panel over the cooling coil.
4. Horizontal Discharge Units: Place the hot deck on top of cold deck and bolt in place with gasketing factory provided. Next, bolt the splitter panel (dividing plate) to the panel over the cooling coil.
5. Apply gasketing to the damper section or double-duct frame. Refer to Figure 14. Gasketing is not required at the center of the damper section where the dividing plate will be fastened.
6. Assemble the damper or double duct frame to the coil section bolting through the gasketing.

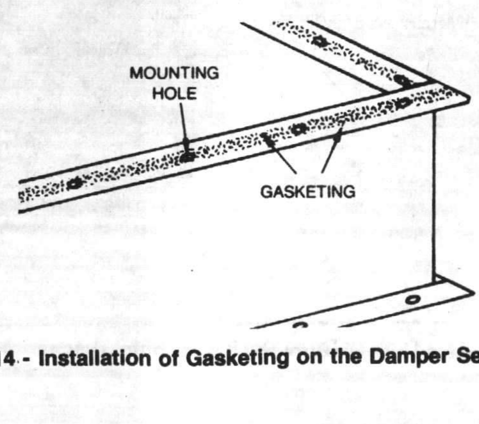


FIGURE 14 - Installation of Gasketing on the Damper Section

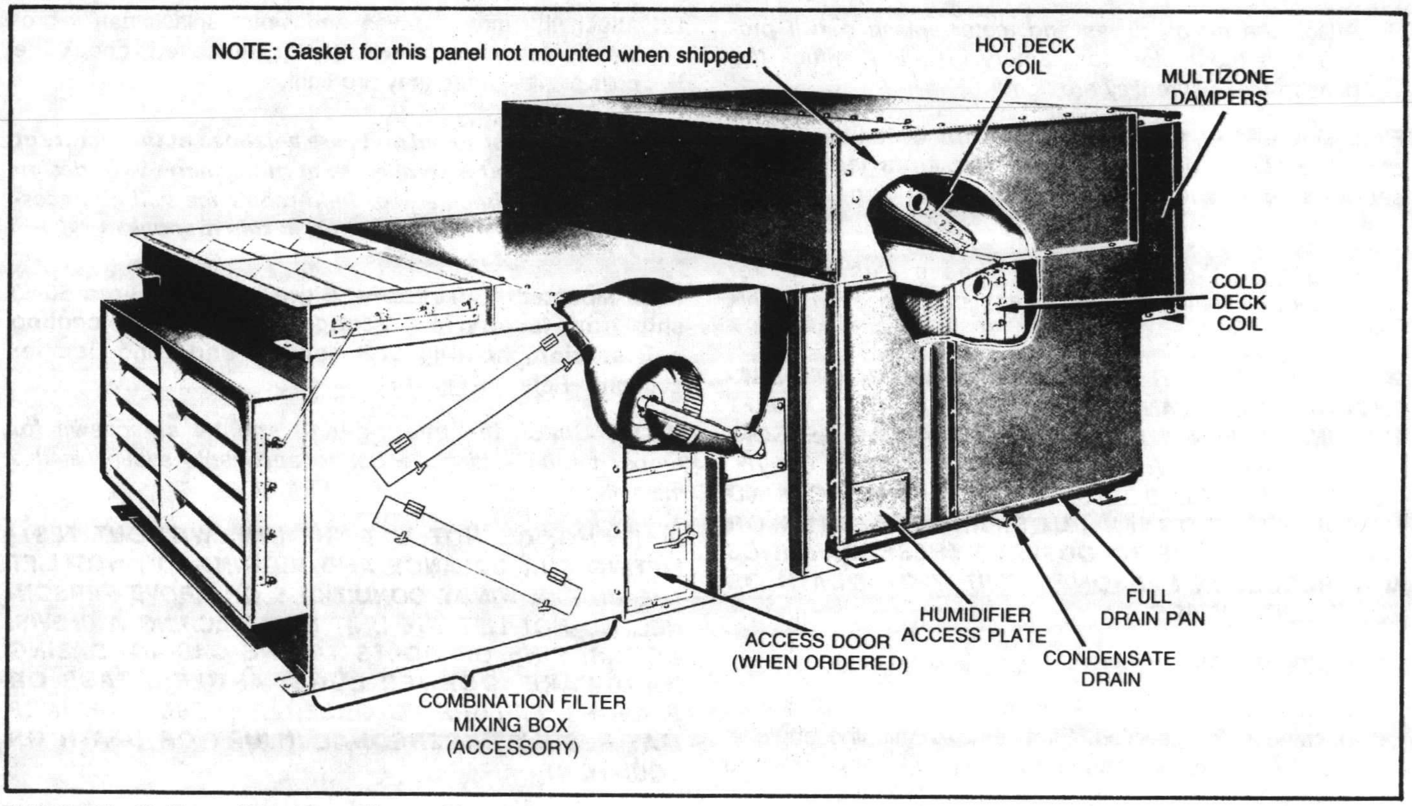


FIGURE 15 - Multizone Blow-Thru Climate Changers

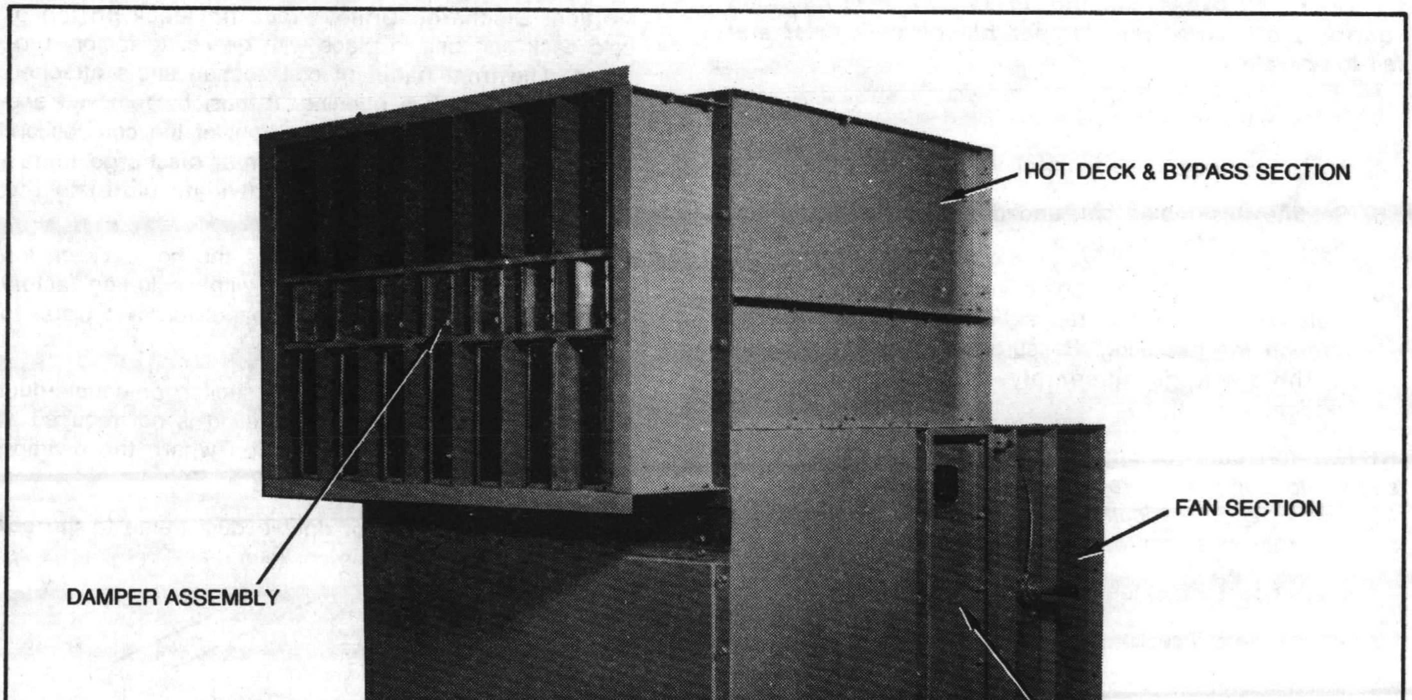


FIGURE 16 - Typical Three Deck Horizontal Discharge Climate Changer

CAUTION: When installing the damper assembly to the hot deck and bypass section, make sure it is mounted squarely, otherwise the dampers may twist and fail to operate.

7. Bolt the hot and cold deck dividing plate to the center of the damper section.
8. Remove the 90° cover panel of the coil section.
9. Apply gasketing to the fan section mounting flange. Set the assembled coil and damper sections on the isolators and fasten in place.
10. Gain access thru the 90° cover panel (removed previously) and bolt the fan section to the coil section through the gasketing. Be sure to bolt the fan section to the tie angle assembly mounted on the coil section.

Note: Horizontal bolting across top and bottom of fan section to coil section requires internal access through the 90° cover panel. Vertical bolting along side of fan section to coil section does not require internal access.

11. Apply the gasketing to the 90° cover panel.
12. Attach the coil section 90° cover panel.
13. Install accessories.
14. Level the unit for proper coil drainage and condensate removal from the drain pan.
15. Connect the ductwork and necessary piping to the unit. Refer to applicable section in this manual.
16. Attach the motor, drives and motor splash pan if provided. If the motor was factory installed, check the bolts to make sure they are tight. Refer to the "Start-Up" section of this manual.

Note: All constant speed units are balanced at the factory at design rpm. If unit is to operate at more than 5% of design rpm a balance check and/or field rebalance will be necessary. Refer to "Start-Up" section in this manual.

Floor-Mounted — Three Deck Blow-Thru Unit Sizes 41-63 ship from factory in 4 sections (cooling coil section, fan section, vent and heating coil section, and zone damper section). See Figure 16 for assembly.

NOTE: *Check the bearing and sheave setscrews for proper torque settings. Refer to applicable section in this manual.*

WARNING: DO NOT LIFT THE UNIT WITHOUT TEST-LIFTING FOR BALANCE AND RIGGING. DO NOT LIFT THE UNIT IN WINDY CONDITIONS OR ABOVE PERSONNEL. DO NOT LIFT THE UNIT BY ATTACHING A CLEVIS, HOOKS, PINS OR BOLTS TO THE CASING, CASING HARDWARE, CORNER LUGS, ANGLES, TABS OR FLANGES. FAILURE TO OBSERVE THESE WARNINGS MAY RESULT IN PERSONAL INJURY OR DEATH OR EQUIPMENT DAMAGE.

1. Fasten the isolators to the floor.
2. With gasketing applied to the top of the cooling coil section, mount the hot deck and bypass section to the cooling coil section. Bolt the bypass deck divider plate to the panel over the cooling coil.
3. Remove the shipping angles used to support the hot deck and bypass zone divider plates.
4. Vertical Discharge Units — Apply gasketing to the mounting flange of the fill-in section and mount the fill-in section to the cooling, bypass and hot deck section.
5. Apply gasketing to the damper assembly. See Figure 14. Gasketing is not required at the center of the damper section where the divider plate will be fastened.
6. Attach the damper section to the coil section, bolting through the gasketing.

CAUTION: When installing the damper assembly to the hot deck and bypass section, make sure it is mounted squarely, otherwise the damper blades may twist and fail to operate.

NOTE: *Be sure control rods are in correct position.*

7. Bolt the hot deck and bypass zone divider plates to the center dividers of the damper assembly. These must be bolted from the hot deck and cold deck side only. Gasketing not required.
8. Remove the 90° cover panel of the coil section.
9. Apply gasketing around the fan section mounting flange.
10. Set the assembled coil and damper sections over the isolators. Fasten in place.
11. Gain access thru the 90° cover panel (removed previously) and bolt the fan section to the coil section through the gasketing. Be sure to bolt the fan section to the tie angle assembly mounted on the coil section.

NOTE: *Horizontal bolting across top and bottom of fan section to coil section require internal access through the 90° cover panel. Vertical bolting along side of fan section to coil section does not require internal access.*

12. Apply the gasketing to the 90° cover panel.
13. Attach the coil section 90° cover panel.
14. Attach any accessories.
15. Level the unit for proper coil drainage and condensate removal from the drain pan.
16. Connect the ductwork and necessary piping to the unit. Refer to applicable section in this manual.
17. Attach the motor, drives and motor splash pan if provided. If the motor was factory installed, check the bolts to make sure they are tight. Refer to the "Start-Up" section of this manual.

Floor-Mounted — Multizone Blow-Thru Unit Sizes 73-86 ship from factory in 6 sections (fan section, cooling coil section, heating coil section, canvas duct section, inlet panel (size 73), extended plenum (size 86), and either double duct frame section or zone damper section).

NOTE: *Check the bearing and sheave setscrews for proper torque settings. Refer to applicable section in this manual.*

WARNING: DO NOT LIFT THE UNIT WITHOUT TEST-LIFTING FOR BALANCE AND RIGGING. DO NOT LIFT THE UNIT IN WINDY CONDITIONS OR ABOVE PERSONNEL. DO NOT LIFT THE UNIT BY ATTACHING A CLEVIS, HOOKS, PINS OR BOLTS TO THE CASING, CASING HARDWARE, CORNER LUGS, ANGLES, TABS OR FLANGES. FAILURE TO OBSERVE THESE WARNINGS MAY RESULT IN PERSONAL INJURY OR DEATH OR EQUIPMENT DAMAGE.

1. Fasten isolators to the floor.
2. Remove the shipping angles attached to the front or top of the coil section.
3. Vertical Discharge Units: Place hot deck on top of cold deck and bolt in place with gasketing, factory provided. The front panel of coil section ships attached across the discharge opening. It must be removed and installed with gasketing to the front of the coil section. (This does not apply to horizontal discharge units.) Next, bolt the splitter panel (dividing plate) to the panel over the cooling coil.
4. Horizontal Discharge Units: Place the hot deck on top of cold deck and bolt in place with gasketing factory provided. Next, bolt the splitter panel (dividing plate) to the panel over the cooling coil.
5. Apply gasketing to the damper section or double-duct frame. Refer to Figure 14. Gasketing is not required at the center of the damper section where the dividing plate will be fastened.
6. Assemble the damper or double duct frame to the coil section bolting through the gasketing.

CAUTION: When installing the damper assembly to the hot deck and bypass section, make sure it is mounted squarely, otherwise the damper blades may twist and fail to operate.

7. Bolt the hot and cold deck dividing plate to the center of the damper section.
8. Attach inlet panel (size 73) or extended plenum (size 86) to coil section inlet with gasketing, factory provided. Bolting for these sections is accomplished from exterior of the unit. See Figure 17.
9. Attach flex connector between fan section and coil section (size 73). Attach flex connector between fan section and extended plenum coil section (size 86). Refer to Figure 17 for dimensions.
10. Level the unit, fan and/or coil sections to assure proper coil drainage and removal of condensate from the drain pan.
11. Connect the ductwork and necessary piping to the unit. Refer to applicable section in this manual.
12. Attach the motor, drives and motor splash pan if provided. If the motor was factory installed, check the bolts to make sure they are tight.

NOTE: *All constant speed units are balanced at the factory at design rpm. If unit is to operate at more than 5% design rpm a balance check and/or field rebalance will be necessary. Refer to the "Start-Up" section.*

HIGH PRESSURE CLIMATE CHANGER — ALL SIZES

NOTE: *Check the bearing and sheave setscrews for proper torque settings. Refer to applicable section in this manual.*

WARNING: DO NOT LIFT THE UNIT WITHOUT TEST-LIFTING FOR BALANCE AND RIGGING. DO NOT LIFT THE UNIT IN WINDY CONDITIONS OR ABOVE PERSONNEL. DO NOT LIFT THE UNIT BY ATTACHING A CLEVIS, HOOKS, PINS OR BOLTS TO THE CASING, CASING HARDWARE, CORNER LUGS, ANGLES, TABS OR FLANGES. FAILURE TO OBSERVE THESE WARNINGS MAY RESULT IN PERSONAL INJURY OR DEATH OR EQUIPMENT DAMAGE.

1. Attach the mounting legs (Spray Coil Units only) and spring isolators to the fan section, as illustrated in Figure 18.
2. Set the fan section in place and fasten isolators to the floor.
3. Blow-Thru Units — Apply factory provided gasketing to the sections where canvas duct is to be attached.
4. Set the coil section in place. Attach the flexible connection. Place the bottom flange of the flexible connection in the V channel of the coil section.
5. Attach the splash guard to the bottom of the fan inlet opening, as in Figure 8.
6. Attach flexible connection to the fan section. Place the bottom flange of the flexible connection in the V channel of the fan section. Tighten bolts from exterior of the unit.
7. Blow-Thru Units — Attach horizontal tension restraints (installer-supplied) to the coil section. Span the flexible connection and anchor the restraints to the fan section. See Figure 17. These restraints will counteract reaction forces due to airflow and will relieve pressure from the flexible connection.
8. Install accessories.
9. Level the unit, fan and/or coil sections to assure proper coil drainage and removal of condensate from the drain pan.
10. Connect the ductwork and necessary piping to the unit. Refer to applicable section in this manual.
11. Attach the motor, drives and motor splash pan if provided. If the motor was factory installed, check the bolts to make sure they are tight.

Note: All constant speed units are balanced at the factory at design rpm. If unit is to operate at more than 5% of design rpm a balance check and/or field rebalance will be necessary. Refer to "Start-Up" section in this manual.

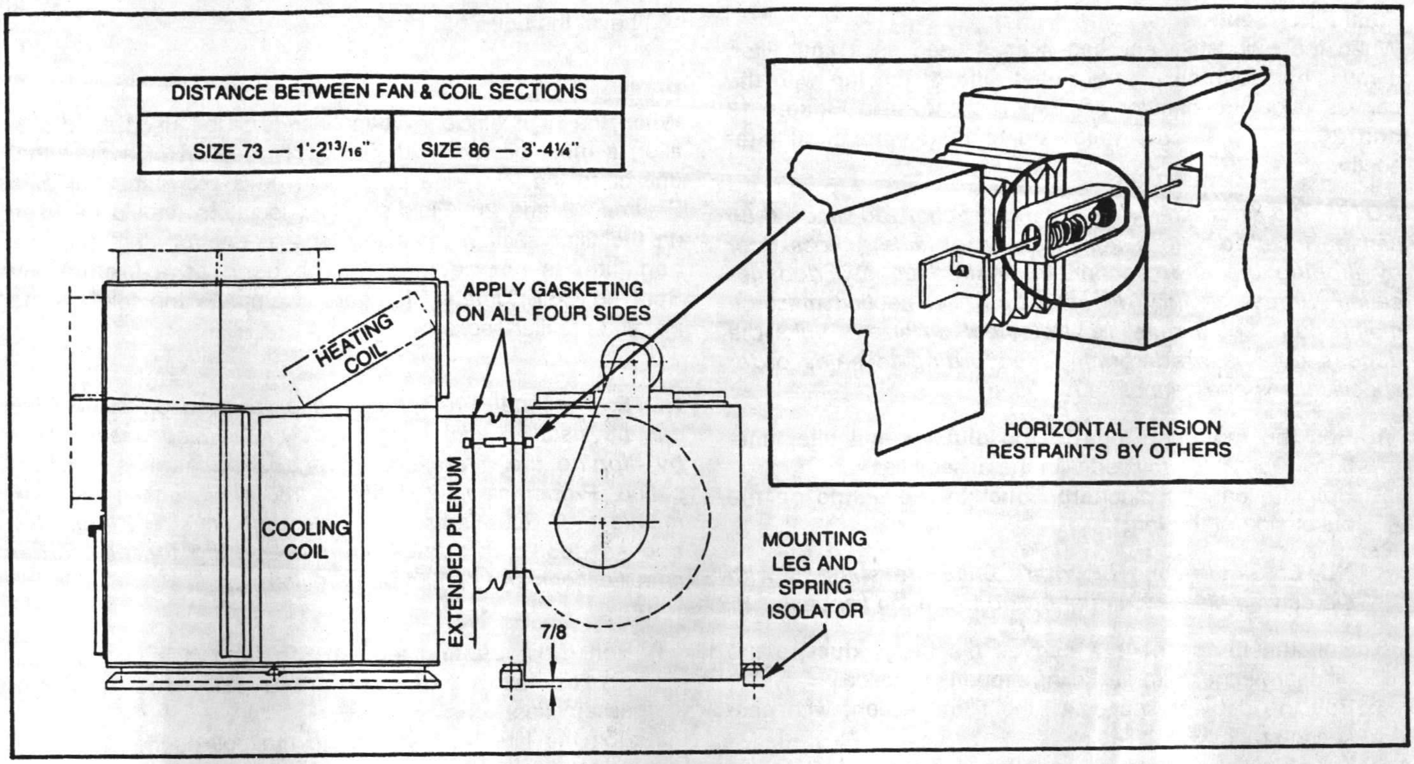


FIGURE 17 - Fan and Coil Section Ductwork Connections for Blow-Thru High Pressure Units

ACCESSORIES

Matching bolt holes are provided on all accessories for attachment to the unit or to other accessories. Mounting hardware is shipped with each accessory. Mounting legs on filter boxes and mixing boxes are to be attached to isolators and fastened to the floor or suspension device.

HIGH EFFICIENCY BAG FILTER

Before installing the bag filter accessory, be sure adequate clearance is provided to open the filter box and remove filters. Four feet of clearance on the access side of the filter section is recommended. Table 3 lists filter, filter section and diffuser section weights.

The high efficiency bag filter can be used as a prefilter when placed on the inlet side of the fan, a final filter when placed on the outlet of the fan, or as both when placed in both locations. When used as a prefilter, the canvas duct and diffuser sections are not used, but isolators should be installed by the contractor to ease vibration. When used as a final filter, the canvas duct and diffuser sections are used, but isolators are not required. Installation instructions for both applications follow.

NOTE: *The high efficiency bag filters can be operated at up to 100 percent relative humidity, but must not make direct contact with water droplets. Care must be taken to ensure that these filters are not used as prefilters with Sprayed Coil Climate Changers and to avoid water carry-over in standard units.*

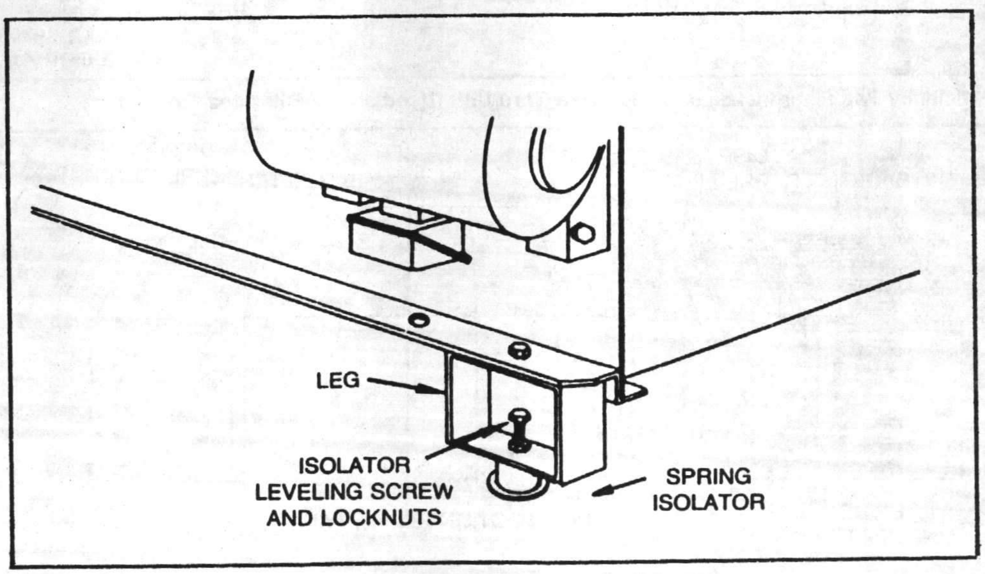


FIGURE 18 - Attaching the Mounting Leg and Spring Isolator to the High Pressure Sprayed Coil Unit

Final Filter Section

When the high efficiency bag filter is used as a final filter, it must be mounted on the outlet side of the fan with the canvas duct and diffuser sections, as shown in Figures 19 and 20. Complete the following to install the final filter section:

NOTE: *The final filter and prefilter section on sizes 6-86 can be installed with a right side or left side access door by flipping the filter section to desired access door location. Proper air flow direction thru filter section must be maintained. See Figure 19. Note that on size 3 units the access door is predetermined according to sales order specifications and cannot be modified.*

1. Bolt the mounting legs to the diffuser and filter sections. Bolts are provided with the assemblies.
2. Bolt the canvas discharge duct to the flange on the outlet side of the fan.

   NOTE: *Single-zone blow-thru units are shipped with the canvas discharge duct bolted to the fan flange.*

3. Bolt the flange on the canvas discharge duct to the diffuser flange, with gasketing properly installed.
4. Bolt the diffuser section to the filter section, with gasketing properly installed.
5. For U.L. listed units, the canvas discharge duct is not provided. Install a field-provided connector which meets the requirements of NFPA 90A Sect. 2.1.1 to 2.1.2.3.
6. Level the unit.

Prefilter Section

When the high efficiency bag filter is to be used as a prefilter, it must be mounted to the coil section of a draw-thru unit or to the inlet side of the fan on a blow-thru unit. See Figures 19 and 20. Field-supplied isolators should be used on the filter section mounting legs to control vibration. The bag filter is not designed to be used as a prefilter on Sprayed Coil Climate Changers. Complete the following to install a prefilter section:

NOTE: *The final filter and prefilter section on sizes 6-86 can be installed with a right side or left side access door by flipping the filter section to desired access door location. Proper air flow direction thru filter section must be maintained. See Figure 19. Note that on size 3 units the access door is predetermined according to sales order specifications and cannot be modified.*

1. Bolt the mounting legs to the filter box section and attach isolators. Bolts are provided with the assemblies.
2. Bolt the filter box section to the coil section on draw-thru units, or to the fan inlet with gasketing installed on blow-thru units.
3. Level the unit.

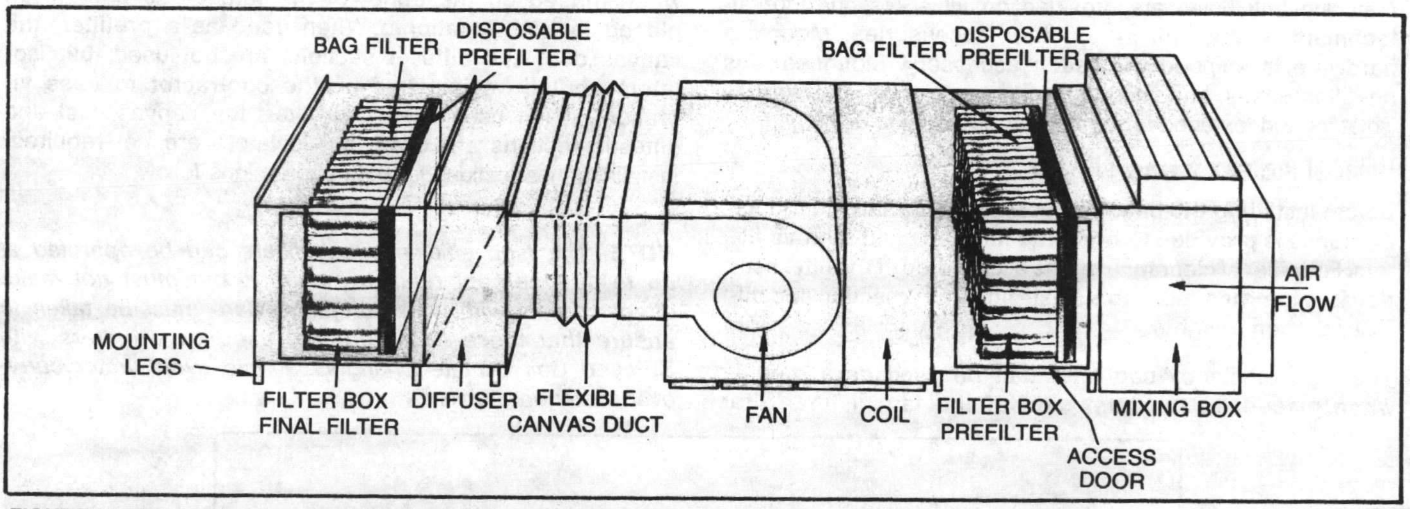


FIGURE 19 - High Efficiency Bag Filter Installation with Draw-Thru Unit (Used as Pre-Filter and Final Filter)

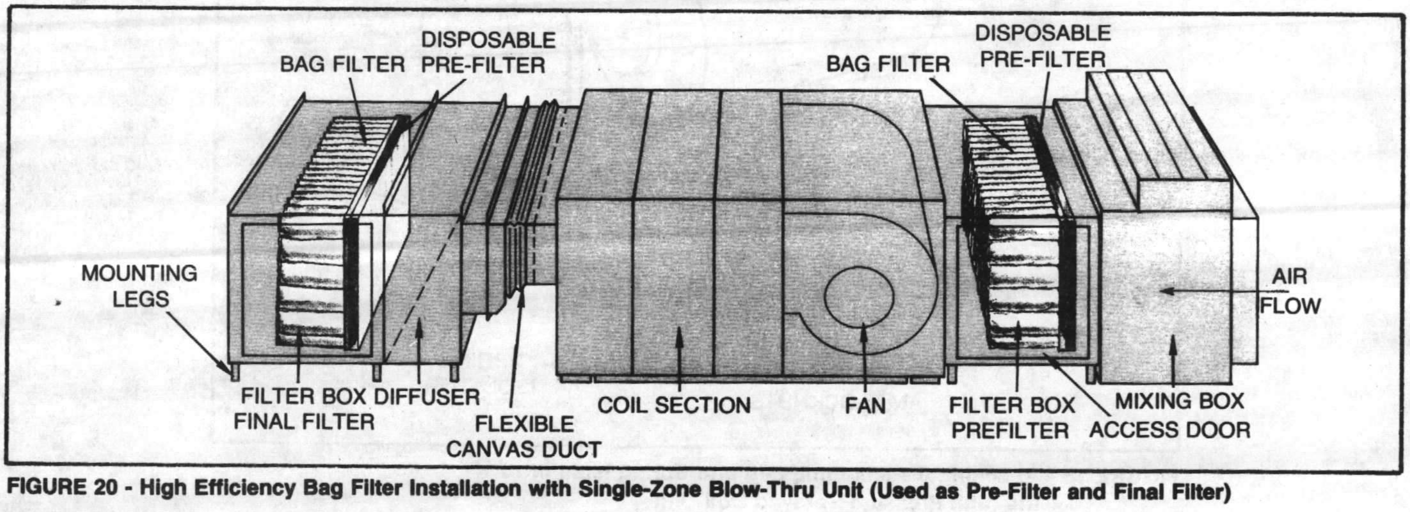


FIGURE 20 - High Efficiency Bag Filter Installation with Single-Zone Blow-Thru Unit (Used as Pre-Filter and Final Filter)

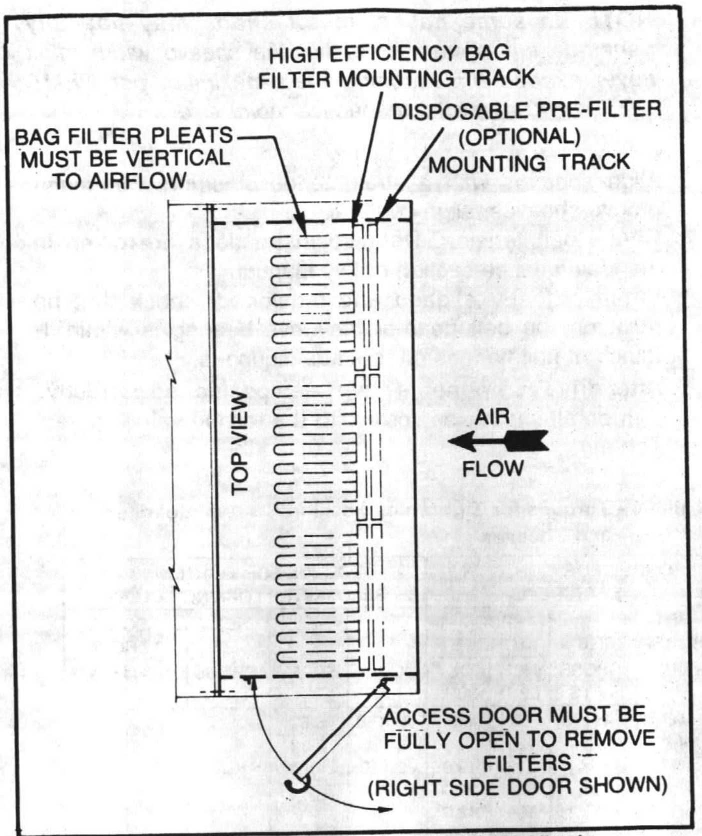


FIGURE 21 - Filter Mounting Track Location (Top View)

Filter Installation

Trane recommends the use of disposable prefilters with high efficiency bag filters. Prefilters slide into mounting tracks just ahead of the bag filter. Bag filter and prefilter size and quantity requirements are the same. See Figure 21 for filter arrangement and complete the following:

1. Ensure power is disconnected. Open filter section access door.

   WARNING: DISCONNECT POWER SOURCE BEFORE OPENING FILTER SECTION ACCESS DOOR. FAILURE TO DO SO MAY RESULT IN INJURY OR DEATH FROM ELECTRICAL SHOCK, HIGH PRESSURE OR MOVING PARTS.

2. Remove adjustable blockoff from filter track.
3. Slide bag filters and flat prefilters into the appropriate filter tracks. Bag filters must be installed with pleats vertical to airflow.
4. Slide adjustable blockoff into filter track.
5. Close the access door. If door can be closed without compressing the filters, adjust the blockoff by loosening its adjusting screws, moving the blockoff and tightening the screws. The door should squeeze the blockoff against the filters, compressing them.

NOTE: *Filters must have an airtight seal to prevent air bypass. If using other filters, apply foam gasketing to the vertical edges of the filter-holding frame to ensure a tight fit.*

For roll filter installation and operation checks, refer to RF-IM-1.

MANOMETER INSTALLATION

A manometer should be used with each bag filter accessory to monitor filter loading and is available from Trane. It should be located to read the pressure drop between the inlet and outlet of the filters. A 1-inch wg pressure difference indicates clogged filters.

WARNING: BAG FILTER FINAL RESISTANCE IS 1 INCH WATER GAUGE. FAILURE TO CHANGE BAG FILTERS AT THIS POINT MAY CAUSE PERSONAL INJURY, DEATH OR EQUIPMENT DAMAGE AS FILTERS WITH DUST MAY BE COMBUSTIBLE.

Five feet of double-column plastic tubing is provided with the gauge along with adapters for connection to 1/8" NPT fittings. To install the manometer, complete the following:

1. Mount the manometer in the two 27/64-inch diameter holes drilled in top or side wall of the filter box, using the self-tapping screws provided. Turn the screws down snug, but not tight.
2. Adjust the gauge until the bubble is centered in the spirit level. Tighten the mounting screws and check to be sure that the gauge remained level.
3. Turn the zero adjust knob counterclockwise until it stops. Then turn it clockwise approximately three full turns so that there is room for adjustment in either direction.
4. Remove the fill plug and pour in the provided gauge fluid until the fluid level is visible in the vicinity of zero on the scale. Adjust for exact zero setting with the zero knob and replace the fill plug.
5. Install a tubing adapter on each side of the filter.
6. Connect the coded red striped tube to the high pressure connection at the top of the gauge (left side) and insert the other end into the field-drilled port and adapter upstream of the bag filters.
7. Connect the uncoded tube to the low side connection at the top of the gauge (right side) and insert the other end into the field-drilled port and adapter downstream of the filter bags.

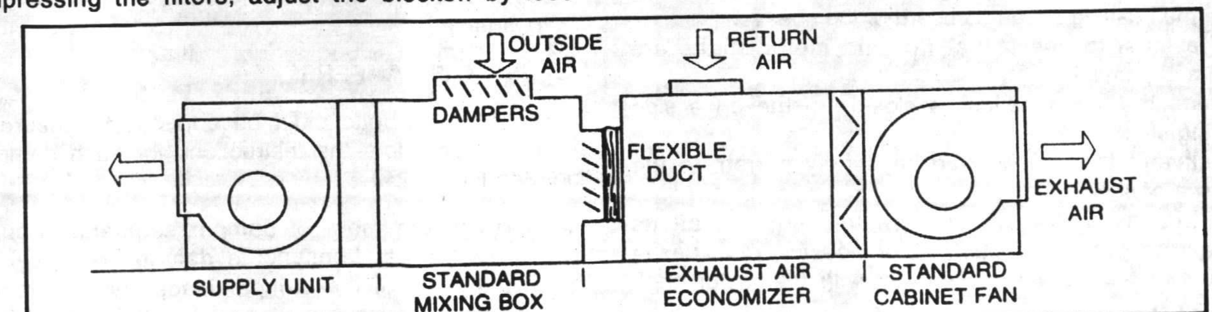


FIGURE 22 - Exhaust Air Economizer Installation

EXHAUST AIR ECONOMIZER

The Exhaust Air Economizer system consists of the economizer section and a Cabinet Fan. The accessory is attached to a Climate Changer with a standard or combination mixing box accessory, as shown in Figure 22. Cabinet Fan size should be identical to Climate Changer size, except as noted below.

NOTE: *Unit sizes 35 to 63 can use either the same size Cabinet Fan or a size 31 Cabinet Fan.*

The economizer section contains a single damper set, similar to a face damper, which is used to prevent backwheeling of the exhaust fan when it is shut off. Low leak and Ultra-low leak dampers can be used on the damper assembly. Refer to the Dampers section of this manual for operating torques.

CAUTION: To avoid equipment damage, the pressure differential across the damper must not exceed 3 inches during operation.

To install the Exhaust Air Economizer, complete the following:

1. Bolt the Exhaust Air Economizer to the Cabinet Fan with the bolts and gasketing provided.
2. If the unit is floor-mounted, fasten the isolators to the floor and mount the accessory on the isolators. If the unit is ceiling-mounted, follow proper safety precautions and hoist the accessory into position, attaching it to the hanger rods.
3. Attach the contractor supplied canvas duct to the mixing box flange with sheet metal screws (not provided).
4. Screw the canvas duct flange onto the economizer section flange from inside the economizer with sheet metal screws (not provided).
5. Attach the return air intake to the economizer section.
6. Level the unit. Secure all fasteners.

FAN MOTOR ASSEMBLY

On units that ship motors separately, the fan shafts, sheaves and drive assembly must be checked and aligned before unit operation. Complete the following:

WARNING: DISCONNECT ELECTRICAL POWER BEFORE INSPECTING FAN MOTOR ASSEMBLY. FAILURE TO DO SO MAY RESULT IN INJURY OR DEATH FROM ELECTRICAL SHOCK OR MOVING PARTS.

1. Check that the fan shafts fully penetrate the bore of sheaves or sheave bushings. Bushed sheaves should have the bushing flange outboard of the sheave.
2. Use a level to check that fan and motor shafts are level and parallel.
3. Position the fan sheaves as closely to the drive side bearing as possible.
4. Check that the fan sheave keys fully penetrate the bushing or sheave bore.
5. Position the motor sheaves on the motor shaft as closely as possible to the motor housing. All sheave setscrews must make full contact with the motor shaft or shaft key.

NOTE: *In some cases, motor shafts may not fully penetrate the sheave bore, but the sheave width must never exceed the recommended maximum per NEMA (MG1-14.43 a) for the respective motor size.*

6. Align sheaves with a straightedge or string. For multi-groove sheaves, align center lines.
7. Check belt tension. Detailed instructions are given in the Maintenance section of this manual.
8. When properly aligned and tensioned, check that no point on the belt nearest the drive bearing is within 1/2-inch of unit flanges or structural supports.
9. After drive components have been positioned correctly, tighten all sheave setscrews to the torque values given Table 4.

Table 4 - Torques for Tightening Locking Screws, Bearings and Sheaves

TORQUE FOR TIGHTENING SETSCREWS				TORQUE FOR TIGHTENING SEALMASTER LOCKING COLLAR				
SET SCREW DIA.	HEX SIZE ACROSS FLATS	RECOM. TORQUE INCH LBS.	RECOM. TORQUE FOOT LBS.	COLLAR	SCREW DIA.	HEX SIZE ACROSS FLATS	RECOM. TORQUE INCH LBS.	RECOM. TORQUE FOOT LBS.
1/4"	1/8"	66	5.5	2-015B	8-32	1/8"	70	5.8
5/16"	5/32"	126	10.5	2-13B	8-32	1/8"	70	5.8
3/8"	3/16"	228	19.0	2-17B	10-24	9/64"	90	7.5
7/16"	7/32"	348	29.0					
1/2"	1/4"	504	42.0					
5/8"	5/16"	1,104	92.0					

NOTE: Tighten bearing setscrews to the torque shown before running unit. Setscrews can loosen in shipment.

DAMPERS

DRIVE ROD ASSEMBLY — BLOW-THRU MULTIZONE UNITS

On all Blow-Thru Multizone units, the zone damper drive rods are recessed to prevent damage during shipment. Before attaching ductwork, complete the following steps and then set the damper zones as instructed after this list. Refer to Figures 23 to 24B.

1. Loosen the damper rod clip screws and extend each drive rod 2-1/2 inches beyond the edge of the damper assembly flange. See Figure 23.
2. Check each set of damper blades to make sure that they are at 90-degree angles to each other. Move the dampers to be sure they are not binding.
3. Tighten all damper rod clip screws.
4. Under certain operating conditions, condensate may form on the cold deck portion of the damper section. To prevent this, insulate around the damper rods. Be sure that the insulation does not affect damper operation.

SETTING THE DAMPERS

Dampers on all units must be adjusted to ensure proper operation. Complete the instructions for each damper section. See Figure 24A.

1. Select the number of damper segments required for the first zone. Loosen the damper lever set screws and turn all of the damper blades within the zone to the same position.

2. Tighten the damper lever set screws for this zone.
3. Cut the damper linkage bar at the last lever. Figure 24A illustrates an example that uses two damper segments.
4. Set all other zones with the same procedure given above.

NOTE: *Damper operators must be connected to damper drive rods on the linkage side of the zone damper section.*

DAMPER OPERATORS

Damper operators, levers and linkages, if not factory provided, are to be provided and installed by the contractor. Tables 5 through 8 list approximate values of damper torques to size the damper operators. When two motors are required, use synchronous motors. See Table 8A for actuator torques used with Multizone and 3-Deck Multizone damper units.

To install the operators, connect the motor to the damper drive rods on the linkage side of the zone damper section. Mount damper levers as close to the side of the unit as possible.

High-efficiency mixing box damper torques, given in Table 8, will vary with blade position (percent open), damper arrangement (top/back or top/bottom), pressure differential, cfm conditions and installation. The values given in Table 8 represent the maximums for all of the above conditions up to 0.4 inches of pressure difference and at a blade setting of 25 to 75 percent open. Greater pressure differences or incorrect adjustment will not be compensated for.

When low leak and ultra-low leak dampers are installed, operators should be sized according to operating torques given in Tables 5 through 7. Since low leak and ultra-low leak damper operating torques are much higher than those for standard dampers, care must be taken to choose a properly sized operator. Stroke distance from full-closed to full-open is 90 degrees.

Low leak dampers with blade seal material, should not be installed in positions where temperatures might exceed 150 F.

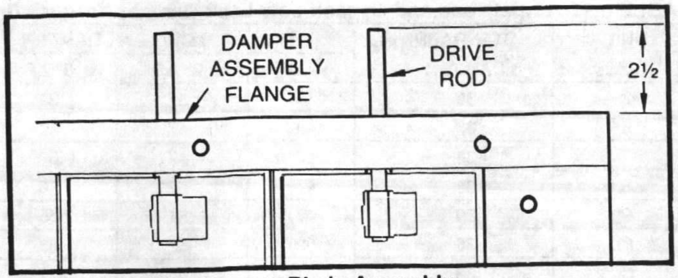


FIGURE 23 - Zone Damper Blade Assembly

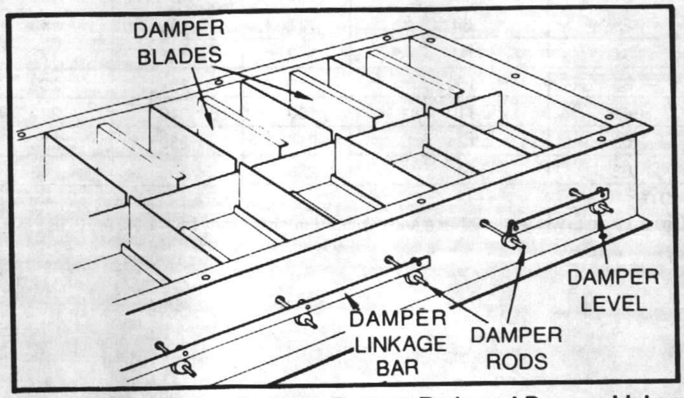


FIGURE 24A - Setting the Zone Damper Rods and Damper Linkage

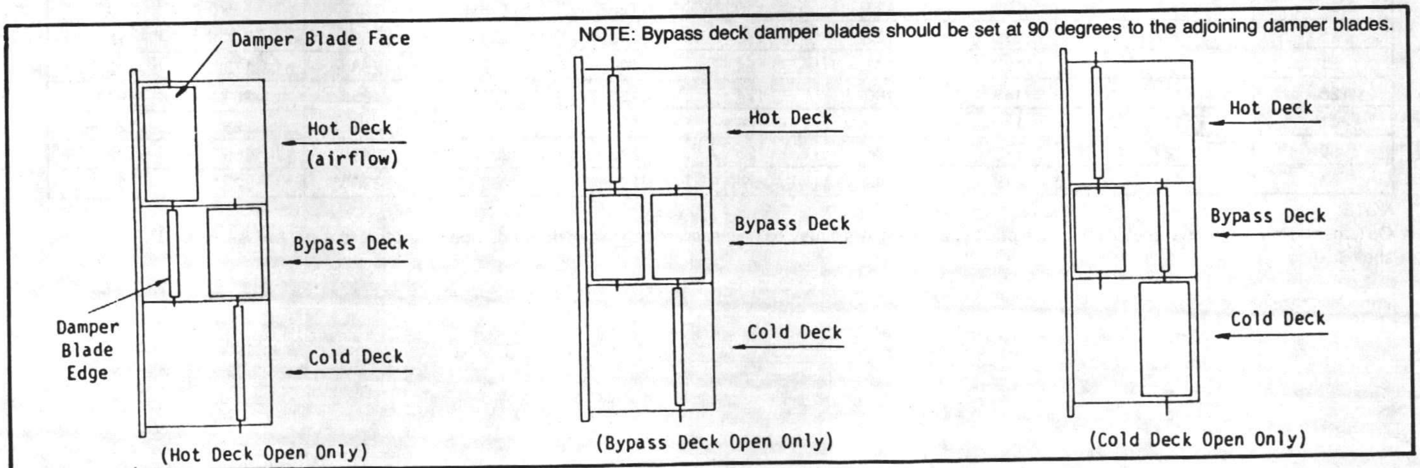


FIGURE 24B - Proper Three-Deck Multizone Damper Blade Configuration

TABLE 5 - External Face and Bypass Low Leak Damper Torques (In./Lbs.)

UNIT	STANDARD	LOW LEAK DAMPER				ULTRA-LOW LEAK DAMPER			
SIZE	DAMPER	1" ΔP	2" ΔP	3" ΔP	4" ΔP	1" ΔP	2" ΔP	3" ΔP	4" ΔP
3	30	36	37	39	41	39	41	43	44
6	33	43	47	50	53	50	54	57	60
7	33	43	47	50	52	49	53	56	59
8	35	47	52	56	59	55	60	64	67
9	36	47	51	55	58	54	58	62	65
10	36	52	58	63	67	62	68	73	77
12	38	67	65	71	76	70	77	83	88
14	40	63	71	79	85	77	86	94	100
17	42	68	78	87	93	85	95	103	110
21	77	108	120	131	139	128	141	151	159
25	84	121	136	149	159	146	161	173	183
31	93	142	161	177	190	174	193	210	222
35	100	159	182	202	217	198	221	241	256
41	110	190	216	239	256	234	261	283	300
50	124	214	250	280	304	273	310	339	363
63	145	259	305	343	373	335	381	419	449

NOTE:
On larger units with external face and bypass dampers it may be necessary to use two opposed damper operators to avoid excessive bending of damper shaft linkage.

TABLE 6 - Internal Face and Bypass Low Leak Damper Torques (In./Lbs.)

UNIT	STANDARD	LOW LEAK DAMPER				ULTRA-LOW LEAK DAMPER			
SIZE	DAMPER	1" ΔP	2" ΔP	3" ΔP	4" ΔP	1" ΔP	2" ΔP	3" ΔP	4" ΔP
3	30	33	35	36	37	35	37	38	39
6	33	40	43	45	47	44	47	49	51
7	33	39	42	44	46	44	46	48	50
8	35	45	48	52	54	51	55	58	60
9	36	44	46	49	51	48	51	54	56
10	36	48	53	57	60	56	61	65	68
12	38	52	57	62	65	61	66	71	74
14	40	56	63	68	72	67	73	78	83
17	42	62	70	77	82	76	84	90	96
21	77	101	111	119	125	118	127	135	142
25	84	111	122	130	138	129	139	148	155
31	93	129	143	154	164	152	166	178	187
35	100	143	160	174	186	171	188	203	214
41	110	159	179	195	208	192	212	228	241
50	124	183	206	226	242	222	245	265	281
63	145	219	249	274	293	269	298	323	343

NOTE:
On larger units with internal and external face and bypass dampers it may be necessary to use two opposed damper operators to avoid excessive bending of damper shaft linkage.

TABLE 7 - Mixing Box, Combination Filter Mixing Box Low Leak Damper Torques (In./Lbs.)

UNIT SIZE	STANDARD DAMPER	LOW LEAK DAMPER				ULTRA-LOW LEAK DAMPER			
		1" ΔP	2" ΔP	3" ΔP	4" ΔP	1" ΔP	2" ΔP	3" ΔP	4" ΔP
3	7	11	13	14	15	14	15	17	18
6	9	16	18	20	22	20	23	25	27
7	10	17	20	23	25	22	25	27	29
8	11	20	23	26	28	25	29	32	34
9	12	20	23	25	27	25	28	30	32
10	13	24	28	32	35	31	35	39	42
12	14	27	32	37	40	35	41	45	48
14	16	31	38	43	47	42	48	53	57
17	18	36	44	50	54	48	56	62	67
21	40	62	71	78	84	77	85	93	98
25	47	73	83	91	98	90	100	108	115
31	57	87	99	109	117	107	119	129	137
35	64	99	112	124	133	122	135	147	156
41	74	114	130	144	154	141	157	170	181
50	89	139	158	174	188	171	191	207	221
63	110	169	192	212	227	208	231	251	266

NOTE:
On larger units with internal and external face and bypass dampers it may be necessary to use two opposed damper operators to avoid excessive bending of damper shaft linkage.

TABLE 8 - High Efficiency Mixing Box Damper Torque

UNIT SIZE	TORQUE (FT.-LBS.) AT 0.4" ΔP 25 TO 75% OPEN
3	0.65
6	1.10
8	1.50
10	1.85
12	2.25
14	2.70
17	3.15
21	3.75
25	4.50
31	5.30
35	6.20
41	7.20
50	9.10
63	10.75

TABLE 8A — Multizone and Three-Deck — Multizone Zone Damper — Actuator Torques (In./Lbs)

UNIT SIZE	3	6	8	10	12	14	17	21	25	31	35	41	50	63
Torque (In./Lbs)	27	29	31	32	33	34	36	38	41	45	48	51	57	66

VARIABLE INLET GUIDE VANES

Inlet vanes are used to regulate fan capacity and to reduce horsepower at lower system requirements.

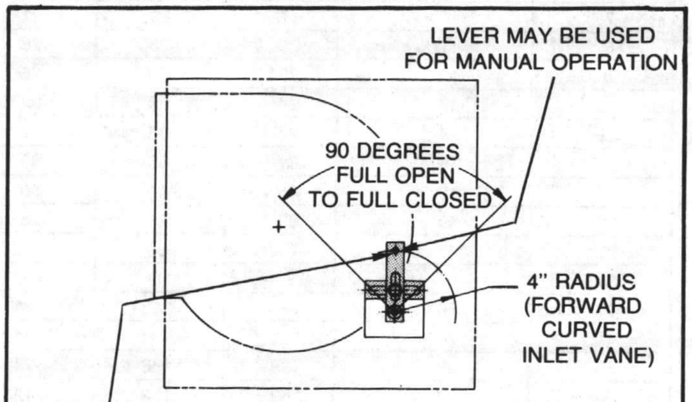
Inlet guide vane operator motors, if not factory provided, are to be provided and installed by the contractor, according to the operating torques given in Tables 9, 10, and 11. Control lever stroke and radius is given in Figure 25.

Before operation, check the vanes and assembly for freedom of movement. If resistance above the torques given in Tables 9, 10 and 11 is encountered, check for vane damage or linkage misalignment. **Do not force the vanes.** See Figure 25 for typical inlet vane operation. Figures 26 and 27 illustrate FC and AF inlet vanes.

TABLE 9 - Torque and Force Required to Operate Inlet Vanes - AF Fans - Unit Sizes 35-86

UNIT SIZE	TO OPEN OR CLOSE INLET VANES	FAN OUTLET VELOCITY 2,000 FPM TORQUE (IN.-LBS.)	2,000 FPM FORCE (LBS.)	3,000 FPM TORQUE (IN.-LBS.)	3,000 FPM FORCE (LBS.)
35	Open	70.0	7.7	158.0	16.7
	Close	17.0	1.9	39.0	4.3
41	Open	94.0	10.3	214.0	23.5
	Close	23.0	2.6	53.0	5.9
50	Open	128.0	14.1	287.0	31.5
	Close	31.0	3.4	71.0	7.8
63	Open	172.0	18.9	388.0	42.6
	Close	42.0	4.6	96.0	10.6
73	Open	172.0	18.9	388.0	42.6
	Close	42.0	4.6	96.0	10.6
86	Open	172.0	18.9	388.0	42.6
	Close	42.0	4.6	96.0	10.6

When automatic vane control is used, adjustment must be made to avoid forcing the vanes past either the full-open or full-closed positions. A locking lever is furnished if the inlet vanes are to be used with manual control.



USE THE ⅜" DIA. HOLE FOR DAMPER OPERATOR (PNEUMATIC OR ELECTRIC, IF BY OTHERS)

(OPPOSITE DRIVE SIDE ONLY)

NOTES:
1. Lever is furnished with the inlet vanes.
2. To open the inlet vanes, rotate the control lever clockwise for left-hand mount and counterclockwise for right-hand mount.

FIGURE 25 - Inlet Vane Operation

TABLE 10 - Torque and Force to Operate Inlet Vanes - FC Fans - Unit Sizes 6-31

NO. OF FANS AND FAN SIZE	TO OPEN OR CLOSE INLET VANES	FAN OUTLET VELOCITY 2,000 FPM TORQUE (IN.-LBS.)	2,000 FPM FORCE (LBS.) 4" ARM	3,000 FPM TORQUE (IN.-LBS.)	3,000 FPM FORCE (LBS.) 4" ARM
1-10½	Open	5.7	2.2	19.6	5.1
	Close	2.9	0.8	6.5	1.9
1-12¼	Open	10.0	2.5	22.5	5.7
	Close	3.5	0.9	7.8	2.1
1-13½	Open	10.9	2.8	24.5	6.2
	Close	3.9	1.0	8.7	2.3
1-15	Open	14.1	3.6	31.9	8.0
	Close	5.0	1.3	11.4	3.0
1-16½	Open	18.0	4.5	40.5	10.3
	Close	6.4	1.6	14.4	3.7
1-18¼	Open	23.1	5.8	52.2	13.3
	Close	8.3	2.1	18.6	4.8
1-20	Open	24.0	6.0	54.0	13.7
	Close	9.0	2.3	19.5	5.1
1-22	Open	25.0	6.3	56.0	14.2
	Close	9.5	2.4	21.0	5.3
1-25	Open	26.5	6.7	59.7	15.1
	Close	10.0	2.5	22.5	5.6
2-13½	Open	21.8	5.5	49.1	12.4
	Close	7.8	2.0	17.5	4.6
2-15	Open	28.3	7.1	63.9	16.0
	Close	10.1	2.6	22.8	5.7
2-16½	Open	36.0	9.0	81.1	20.3
	Close	12.8	3.2	28.9	7.3
2-18¼	Open	46.3	11.6	104.4	26.3
	Close	16.5	4.2	37.3	9.4
2-20	Open	48.0	12.0	108	27.2
	Close	18.0	4.5	39.0	9.9

TABLE 11 - Torque and Force Required to Operate Inlet Vanes — FC Fans — Unit Sizes 35-63

UNIT SIZE	FAN SIZE	TO OPEN OR CLOSE INLET VANES	FAN OUTLET VELOCITY 2000 FPM TORQUE (IN.-LBS.)	2000 FPM FORCE* (LBS.)	3000 FPM TORQUE (IN.-LBS.)	3000 FPM FORCE* (LBS.)	4000 FPM TORQUE (IN.-LBS.)	4000 FPM FORCE* (LBS.)
35	25	Open	26.5	6.7	59.7	15.1	—	—
		Close	10.0	2.5	22.5	5.6	—	—
	27	Open	115	29	190	48	240	60
		Close	40	10	90	23	140	35
41	27	Open	115	29	190	48	240	60
		Close	40	10	90	23	140	35
	30	Open	120	30	200	50	260	65
		Close	50	13	100	25	150	38
50	30	Open	120	30	200	50	260	65
		Close	50	13	100	25	150	38
63	30	Open	120	30	200	50	260	65
		Close	50	13	100	25	150	38

*NOTE: Force is calculated using a 4" lever arm.

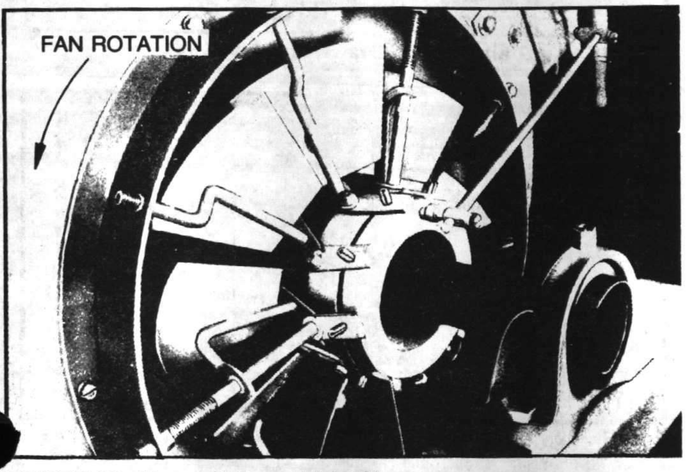


FIGURE 26 - Forward Curved Inlet Vanes

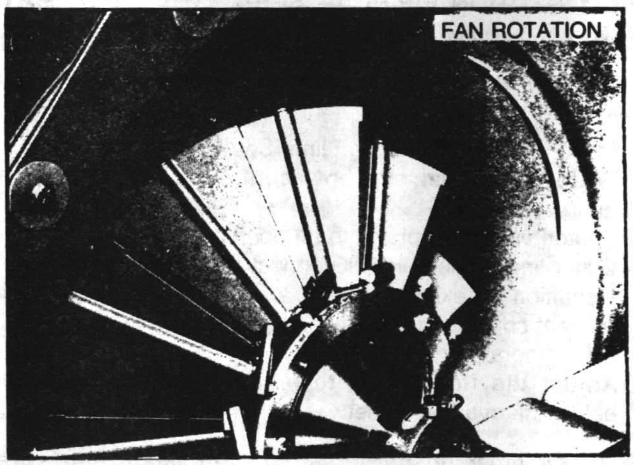


FIGURE 27 - Airfoil Inlet Vanes

DUCT CONNECTIONS

All air ducts should be installed in accordance with the standards of the National Fire Protection Association for the Installation of Air Conditioning and Ventilating Systems Other than Residence Type (NFPA 90A), and Residence Type Warm Air Heating and Air Conditioning Systems (90B).

***NOTE:** Installations that have supply ductwork without return ductwork may be restricted by local codes to serve a space exceeding 25,000 cubic feet in volume.*

All inlet and discharge air duct connections to the unit should be made with a flexible material. Typically, about three inches is needed for this connection to rigid ductwork. Do not draw the flexible material tight; leave it sufficiently loose to prevent the transmission of any noise or vibration to the ductwork.

Duct turns and transitions must be made carefully to minimize air friction losses. Avoid sharp turns and use splitters or turning vanes when elbows are necessary, as shown in Figure 28. Make turns in the same direction of rotation as the fan. Discharge ductwork should run in a straight line, unchanged in size or direction, for at least a distance of 1-1/2 fan diameters. See Figure 28.

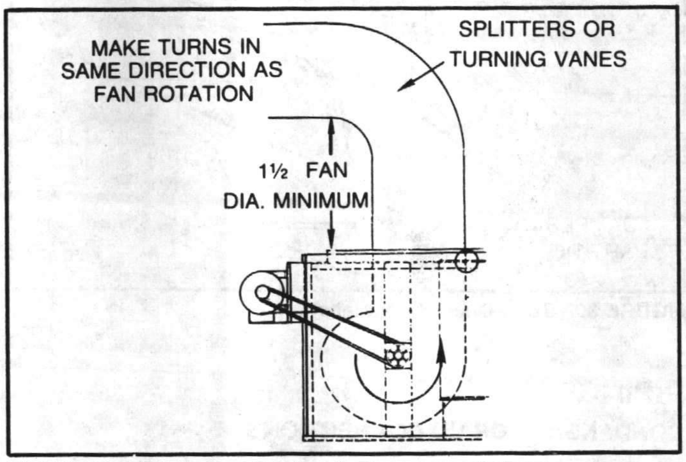


FIGURE 28 - Discharge Ductwork Recommendations

On two-fan units, both fan discharge openings should be jointed to a common duct after the recommended length of straight run. Figure 29 illustrates a proper duct run that will prevent unequal handling of air by the fans. Maximum duct transition should be 30 degrees. The included angle between joining ducts should not exceed 60 degrees. If necessary, split the duct at any point beyond the common connection.

For multizone units, zone duct clips are provided for attaching the ductwork to each zone. Refer to Figure 30. Inset the clips on the damper partitions as required for the number of zones. Approximately 7/16-inches of space will be left between each zone when the duct collar is placed in the duct clip.

***NOTE:** When attaching the ductwork to multizone units,* *ensure that the duct connection does not interfere with damper blade travel. If necessary, attach the ductwork to the outside of the fan discharge in order to leave the damper clear of obstructions. A clearance of one inch (minimum) is required between ductwork and low leak dampers for proper damper operation.*

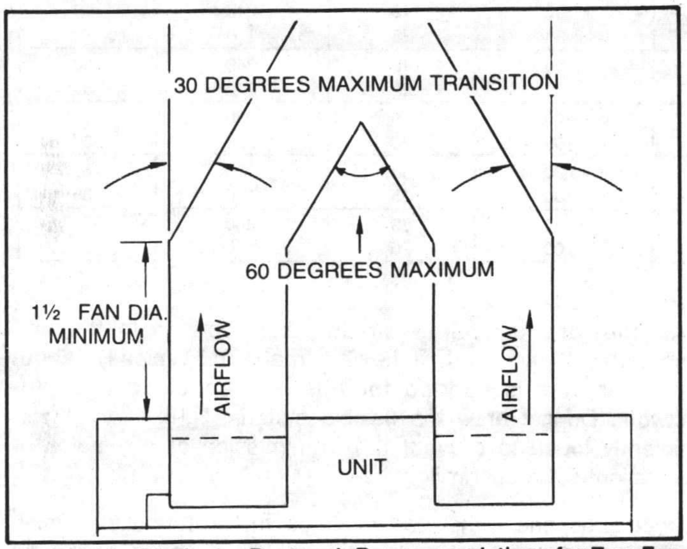


FIGURE 29 - Discharge Ductwork Recommendations for Two-Fan Units

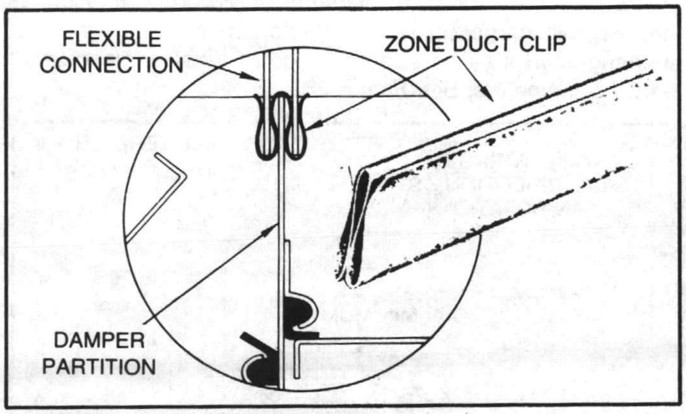


FIGURE 30 - Zone Duct Clip Installation

PIPING

CONDENSATE DRAIN CONNECTIONS

CAUTION: Failure to provide adequate condensate piping may result in water damage to the equipment or building.

Threaded condensate drain connections are provided on both sides of the coil section drain pan. Pitch the line downward toward an open drain and install a plugged tee to facilitate cleaning. Make sure the drain pan connection openings are unobstructed. Trap the drain line as shown in Figure 31 for draw-thru units and Figure 32 for blow-thru units. Draw-thru units size 73 and 86 have additional drain connections on both sides of the fan section. Run these drain connections into the coil section drain line or to a separate open drain.

Drain connection size on unit sizes 3 through 31 is 1-1/4-inch NPT (external). Drain connections on units size 35 to 86 is 1-1/2-inch NPT (internal). Install pipe caps or plugs on all unused unit drain connections.

Note: For units with optional wide coil, the contractor will need to extend the drain pan nipples under the extended drain pan before connecting the drain trap. Nipple length extension is determined by unit size. For size 3-31 units, add an additional 7½-inches in length. Size 41-50 units, add an additional 12-inches in length. Size 35, 63, 73 and 86 units, add an additional 8½-inches in length.

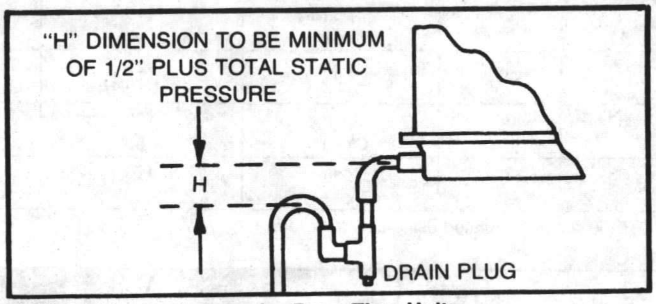


FIGURE 31 - Drain Trap for Draw-Thru Units

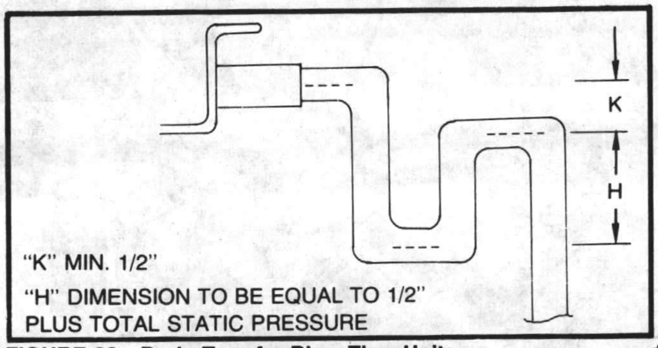


FIGURE 32 - Drain Trap for Blow-Thru Units

SPRAY SECTION PIPING — SPRAYED COIL CLIMATE CHANGER

Sprayed coil units require the following piping to the spray section:

1. Make-up water to the float line. See Figure 33A.
2. Water line from overflow connection to a trapped drain.
3. Shutoff valve and piping to an open or trapped drain.
4. Water line to the quick-fill connection.
5. Insulation of external piping around the spray pump to prevent condensate runoff.
6. Fill the spray tank.
7. Adjust the float valve to maintain a level 1/2-inch below the overflow outlet.

NOTE: *Air must be purged from the system and spray pump vavle must be adjusted for proper water flow. Instructions are given in the Start-Up section of the CLCH maintenance manual.*

CAUTION: Water treatment is required for Sprayed Coil Climate Changers if the supply water is scale forming or corrosive. If neccessary, engage the services of a qualified water treatment specialist. The object of water treatment is to prevent the fouling of the coil surfaces or undue metal damage. THE TRANE COMPANY CAN ASSUME NO RESPONSIBILITY FOR EQUIPMENT FAILURES WHICH ARE THE RESULT OF UNTREATED OR IMPROPERLY TREATED WATER.

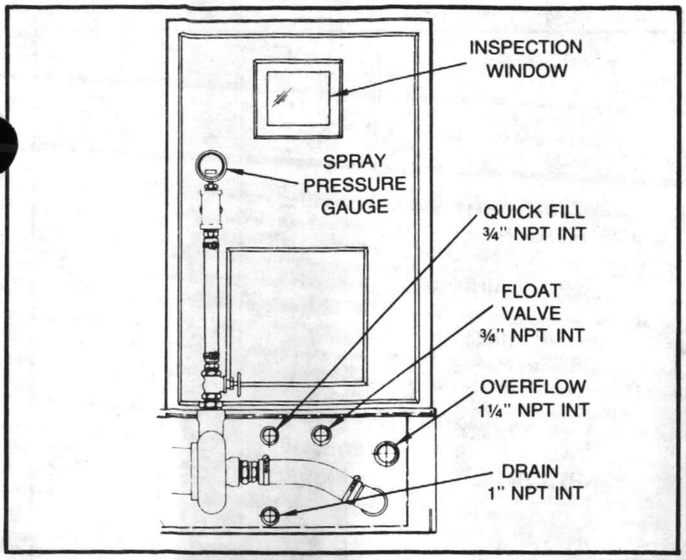


FIGURE 33A - Sprayed Coil Unit Tank Connections

GENERAL COIL PIPING RECOMMENDATIONS

1. Proper installation, piping and trapping is necessary to insure satisfactory coil operation and to prevent operational damage.
2. When selecting coil location, allow sufficient space for access to the coil for routine maintenance and service.
3. Support all piping independently of the coils.
4. Provide swing joints or flexible fittings in all connections that are adjacent to heating coils in order to absorb thermal expansion and contraction strains.
5. The Trane Company recommends that a short pipe nipple be used on coil headers prior to making up any welded flange or welded elbow type connections. This allows the use of a back-up pipe wrench when it is necessary to further rotate the welded flange or elbow when lining up bolt holes on the prefabricated piping.

   NOTE: *Use a "Back-Up Wrench" when attaching piping to coils with copper headers. Do not use brass fittings or brass pipe connectors. Brass distorts easily and causes connection leaks.*

   Delta-Flo coils have copper headers which extend outside the unit casing so that back-up pipe wrenches can be used.

6. When attaching the piping to the coil header, make the connection only tight enough to prevent leaks. Maximum recommended torque is 200 foot-pounds. Use pipe sealer on all threaded connections. **The use of Teflon tape or paste is not recommended by Trane.**
7. After completing the piping connections, seal the gap between the pipe and casing with tape or mastic before insulating the pipes.
8. To connect supply and return coil piping, outer coil panels must be removed. If not ordered, drain and vent access holes must be drilled. See Item 9.
9. Provisions must be made to drain those coils that are not in use when subjected to freezing temperatures.

   CAUTION: Failure to properly drain and vent coils when not in use during freezing temperatures may result in coil freeze-up damage.

   Coil types N, NS and A may be adequately drained in their pitched position in the unit. In coilless units, the coil, after field installation, is not pitched (unless special pitching coil support channel is ordered for steam coils) and may be adequately drained in their position in the unit. (Type N is drainable through the return connection.) The installer must provide appropriate piping for adequate drainage.

   Type WL coils are not drainable in either pitched or level position. To drain these coils remove the vent and drain plugs and blow the coils out as completely as possible with compressed air. The coils should then be filled and drained several times with full strength ethylene gylcol so that it will mix thoroughly with the water retained in the coil. Drain the coil out as completely as possible.

   Coil types D, DD, and K, plus W, P2, P4, P8, DL and LL are drainable in their factory-installed level position. Coil types D, DD, DL and LL also have Trane factory-installed drain and vent connections. Figures 34 through 39 illustrate coil drain and vent connections.

   Drainable coils installed in units containing coil types DL or LL will also have factory-installed drain and vent connections.

NOTE: *On units with stacked coils, there is a condensate follower located at each end of the coil connection. Figure 33B illustrates the condensate follower provided at the end of the stacked coils.*

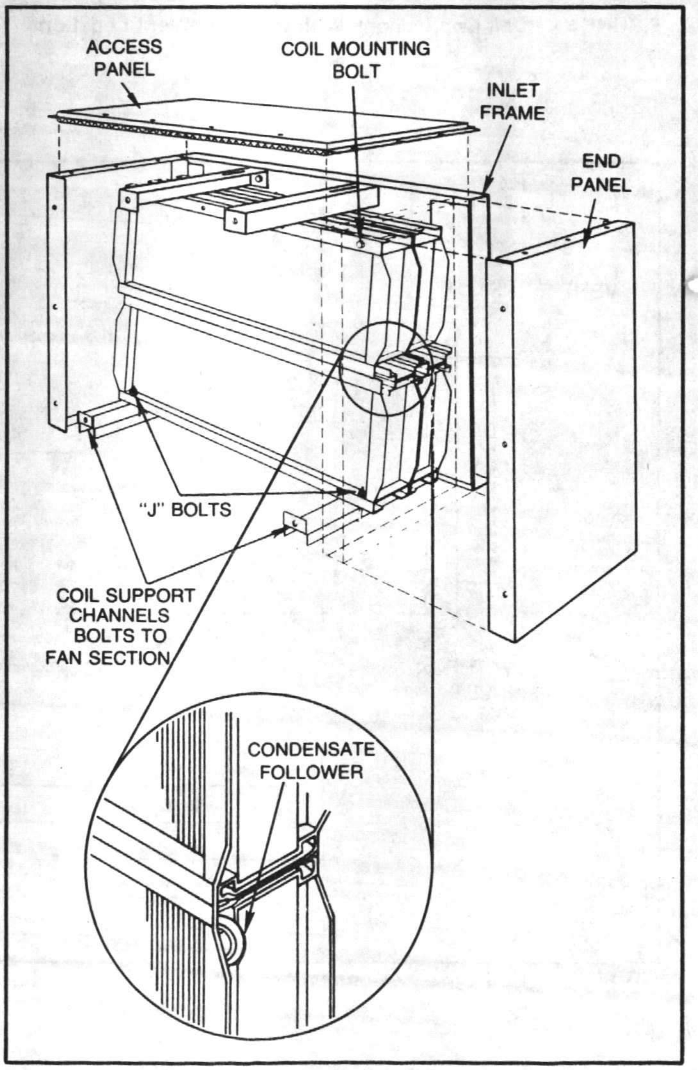
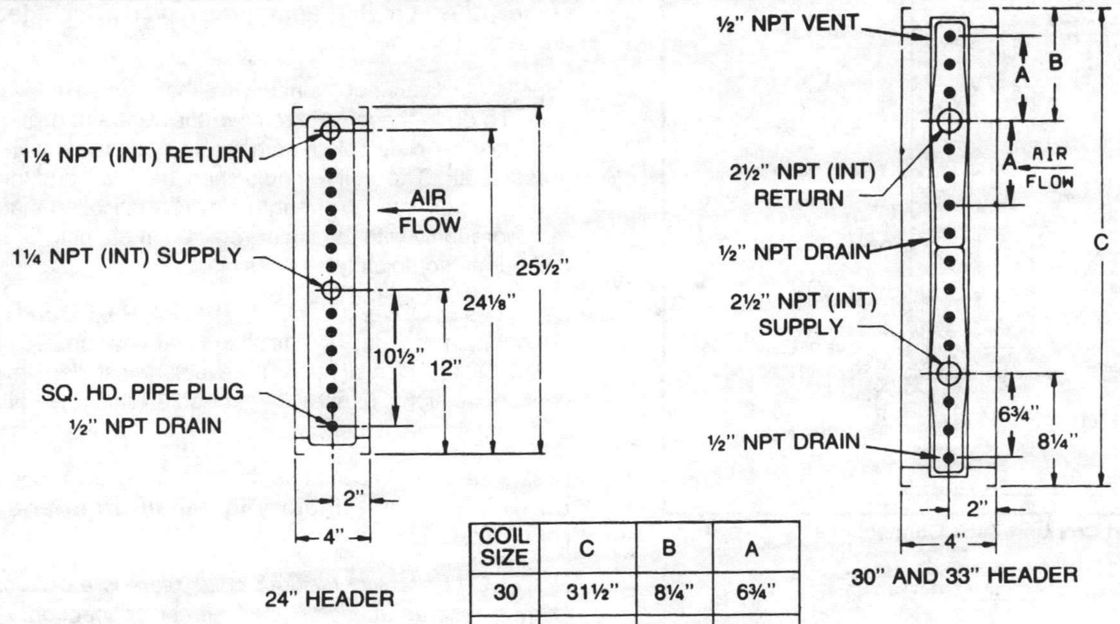


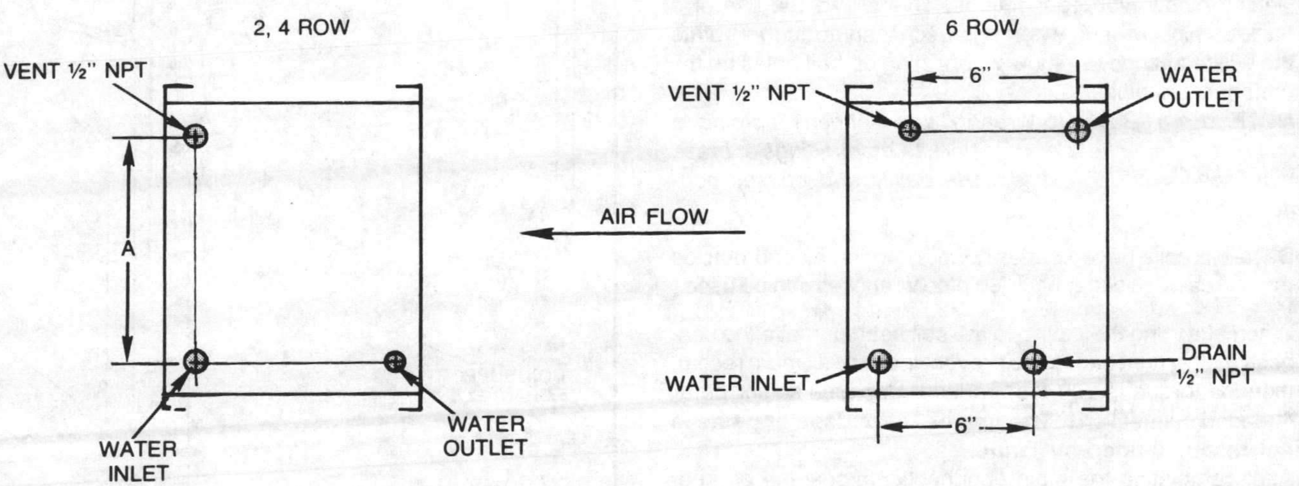
FIGURE 33B - Draw-Thru Unit Coil Section Details with View of Condensate Follower



COIL SIZE	C	B	A
30	31½"	8¼"	6¾"
33	34½"	9¾"	8¼"

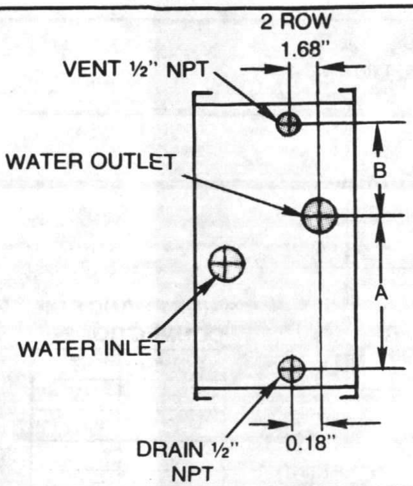
NOTE: COIL CONNECTIONS AVAILABLE RIGHT OR LEFT HAND (DETERMINED BY FACING INTO AIRFLOW)

FIGURE 34 - Coil Connections With Drain and Vent Locations (Type WC 24" and Type WS 30" and 33" Headers)

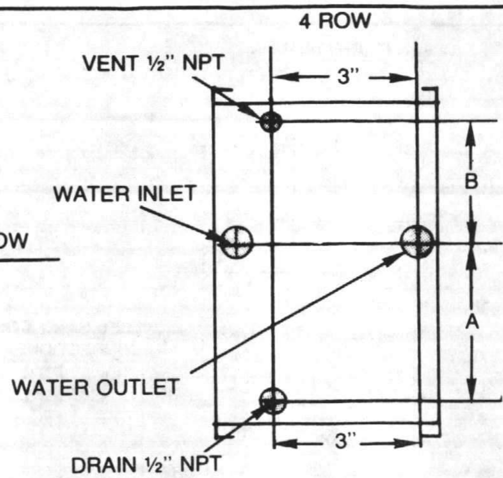


HEADER	A
18"	16½"
24"	22½"
30"	28½"

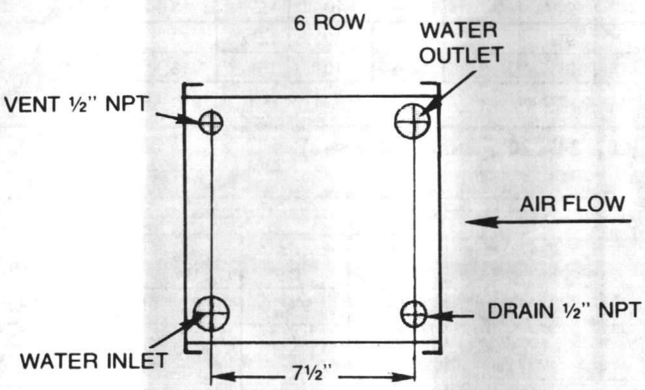
FIGURE 35 - Coil Type P2 Connections with Drain and Vent Locations (18", 24" and 30" Headers)

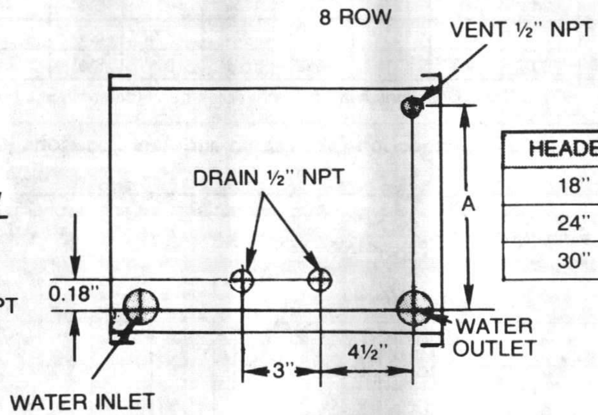


HEADER	A	B
18"	10½"	6"
24"	13½"	9"
30"	16½"	12"



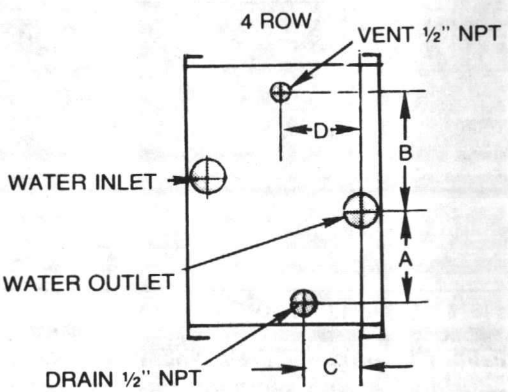
HEADER	A	B
18"	7½"	9"
24"	10½"	12"
30"	13½"	15"



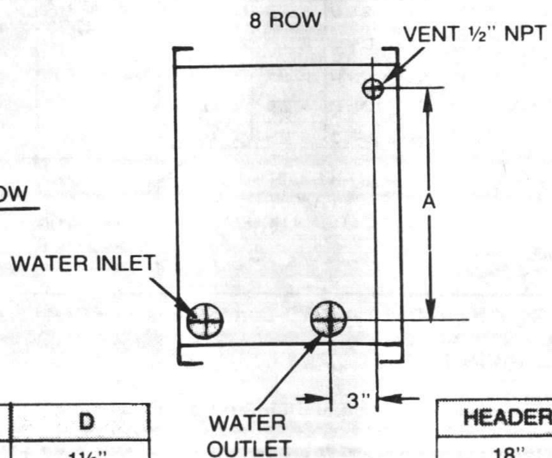


HEADER	A
18"	16 11/16"
24"	22 11/16"
30"	28 11/16"

FIGURE 36 - Coil Type P4 Connections with Drain and Vent Locations (18", 24", and 30" Headers)

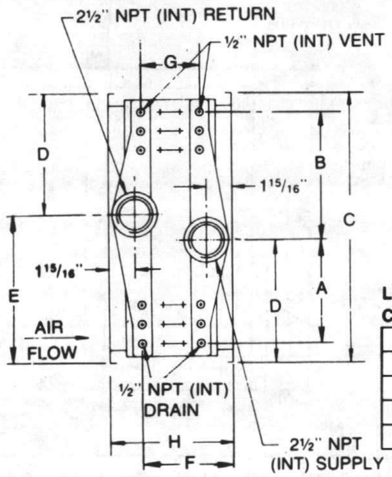


HEADER	A	B	C	D
18"	7½"	9"	1½"	1½"
24"	10½"	12"	0"	4½"
30"	13½"	15"	1½"	1½"



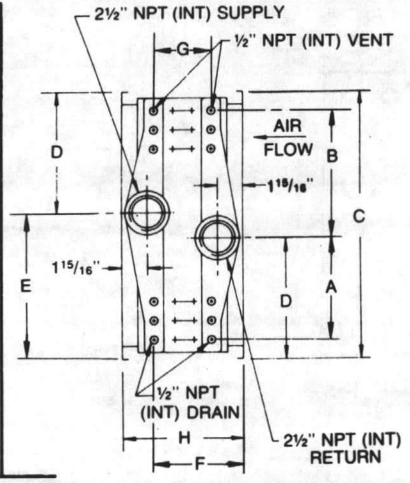
HEADER	A
18"	16½"
24"	22½"
30"	28½"

FIGURE 37 - Coil Type P8 Connections with Drain and Vent Locations (18", 24", and 30" Headers)



LEFT HAND COIL CONNECTIONS

ROWS	G
3	3
4	4½
6	7½
8	10½



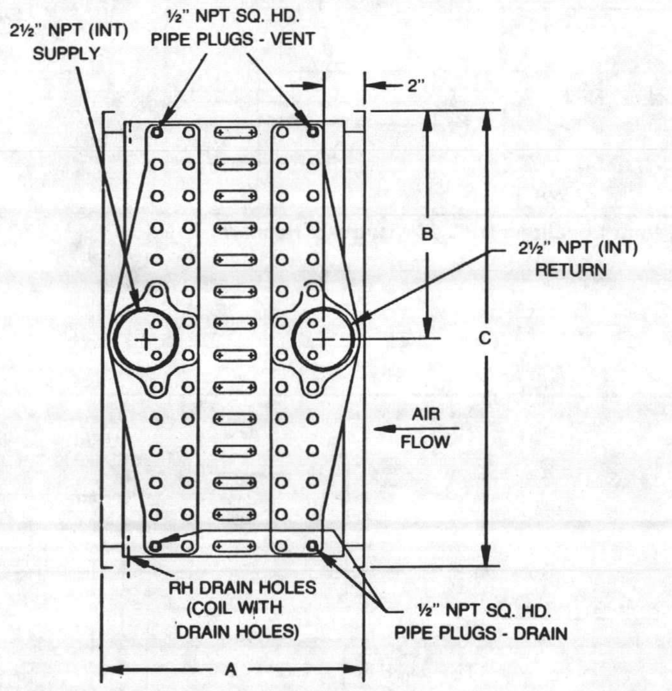
RIGHT HAND COIL CONNECTIONS

ROWS	G
3	3
4	4½
6	7½
8	10½

						2-ROW		4-ROW		6-ROW		8-ROW	
COIL SIZE	A	B	C	D	E	H	F	H	F	H	F	H	F
18	6¾"	9¾"	19½"	8¼"	11¼"	6½"	4"	9½"	7"	12½"	10"	15½"	13"
24	9¾"	12¾"	25½"	11¼"	14¼"	6½"	4"	9½"	7"	12½"	10"	15½"	13"
30	12¾"	15¾"	31½"	14¼"	17¼"	6½"	4"	9½"	7"	12½"	10"	15½"	13"
33	14¼"	17¼"	34½"	15¾"	18¾"	6½"	4"	9½"	7"	12½"	10"	15½"	13"

NOTE: Coil connections available right or left hand (determined by facing into air flow).

FIGURE 38 - Coil Type W Connections With Drain and Vent Locations (18", 24", 30", and 33" Headers)



COIL SIZE	B	C
18	9¾"	19½"
24	12¾"	25½"
30	15¾"	31½"
33	17¼"	34½"

ROWS	A
6	12½"
8	15½"
10	18½"
12	21½"

FIGURE 39 - Right Hand Coil Type WD Connections with Drain and Vent Locations (6, 8, 10, and 12 Rows)

STEAM COIL PIPING

Refer to Figures 40 to 45 for typical steam coil piping.

CAUTION: Condensate must flow freely from the coil at all times in order to prevent coil damage from water hammer, unequal thermal stresses, freeze-up and corrosion. Complete the following recommendations to prevent coil damage.

CAUTION: Failure to properly drain and vent coils when not in use during freezing temperatures may result in coil freeze-up damage.

1. Check that the coil is installed correctly, with airflow in the same direction as indicated on the nameplate or coil casing.
2. Install a 1/2-inch, 15-degree swing-check vacuum breaker in the unused condensate return tapping as close as possible to the coil.

TABLE 12 — Cooling and Heating Coil — Connection Sizes (Inches NPT)

COIL TYPE	HEADER HEIGHT	SUPPLY	RETURN	VENT	DRAIN
W	18, 24, 30, 33	2.5	2.5	0.5	0.5
D	18, 24, 30, 33	2.5	2.5	0.5	0.5
DD	18, 24, 30, 33	2.5	2.5	0.5	0.5
WD	18, 24, 30, 33	2.5	2.5	0.5	0.5
K	18, 24, 30, 33	2.5	2.5	0.5	0.5
P2	18, 24, 30	0.75	0.75	0.5	0.5
P4	18, 24, 30	1.0	1.0	0.5	0.5
P8	18, 24, 30	1.25	1.25	0.5	0.5
WC	18	1.0	1.0	0.5	0.5
	24	1.25	1.25	0.5	0.5
	30, 33	2.5	1.5	0.5	0.5
WA	18, 24, 30, 33	2.5	2.5	0.5	0.5
N, NS	18	2.0	1.0	NA	NA
	24	2.5	1.25	NA	NA
	30, 33	3.0	1.25	NA	NA
A, AA	18	2.5	1.0	NA	NA
	24, 30, 33	2.5	1.25	NA	NA
TT	18, 24, 30, 33	0.75	0.75	NA	NA
DL	18, 24, 30, 33	1.5	2.0	0.375	0.375
WL	18, 24, 30, 33	1.5	2.0	0.375	0.375
LL	18, 24, 30, 33	2.5	2.5	0.375	0.375

Notes:
1. Connections are NPT internal.
2. Coil Type NS drains through supply connections.

3. Vent the vacuum breaker line to the atmosphere or connect it to the return main at the discharge side of the steam trap.

   ***NOTE:** Vacuum breaker relief is mandatory when the coil is controlled by a modulating steam supply or a two-position (ON-OFF) automatic steam supply valve.*

4. Run the return pipe at the full size of the steam trap connection except for the short nipple screwed directly into the coil condensate connection. **Do not bush or reduce the coil return tapping size.**
5. With automatic controls, or where the possibility of low pressure supply steam exists, use float and thermostatic traps with atmospheric pressure gravity drain and continuous discharge operation. Locate the steam trap discharge at least 12 inches below the condensate return tapping. Use bucket traps **only** when supply steam is unmodulated and pressure is 25 psig or higher.
6. When coils are installed in a series, size the steam traps for each coil using the capacity of the first coil in airflow direction.
7. Always trap each coil separately to prevent holdup in one or more coils.
8. Always install strainers as close as possible to the inlet side of the trap.
9. Use a V-port modulating valve to obtain gradual modulating action.
10. Control each coil bank separately when installing coils for series airflow with automatic steam control valves.

    CAUTION: Always open the steam supply control valve slowly to prevent possible coil damage.

11. Do not modulate systems with overhead or pressurized returns unless the condensate is drained by gravity to a receiver (vented to the atmosphere) and returned to the main by a condensate pump.
12. At start-up on units with fresh air dampers, slowly turn the steam on full for at least 10 minutes before opening the fresh air intake.
13. Pitch all supply and return steam piping down a minimum of 1 inch per 10 feet in the direction of flow.
14. Do not drain the steam mains or take-offs through the coils. Drain the mains ahead of the coils through a steam trap to the return line.
15. Overhead returns require 1 psig of pressure at the steam trap discharge for each 2-foot elevation to assure continuous condensate removal.

TABLE 13 - Refrigerant Coil (Type F) Piping Sizes (Inches)

HEADER HEIGHT	NO. OF CIRCUITS	CONNECTION SIZE (INCHES)	
		LIQUID	SUCTION
18	2	7/8	1 3/8
	3	7/8	1 5/8
	6	1 1/8	2 1/8
	12	1 3/8	2 1/8
24	2	7/8	1 5/8
	4	7/8	1 5/8
	8	1 1/8	2 1/8
	16	(2)1 1/8	(2)2 1/8
30	2	7/8	1 3/8
	4	7/8	1 5/8
	5	7/8	2 1/8
	10	1 3/8	2 1/8
	20	(2)1 3/8	(2)2 1/8
33	3	7/8	1 5/8
	7	1 1/8	2 1/8
	11	1 3/8	2 1/8
	22	(2)1 3/8	(2)2 1/8

NOTE: Connections are piping OD.

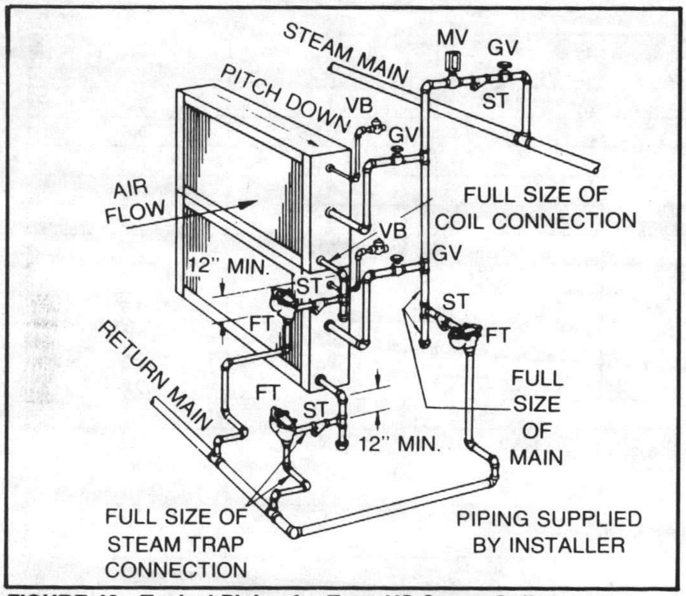


FIGURE 40 - Typical Piping for Type NS Steam Coils and Horizontal Tubes for Horizontal Airflow

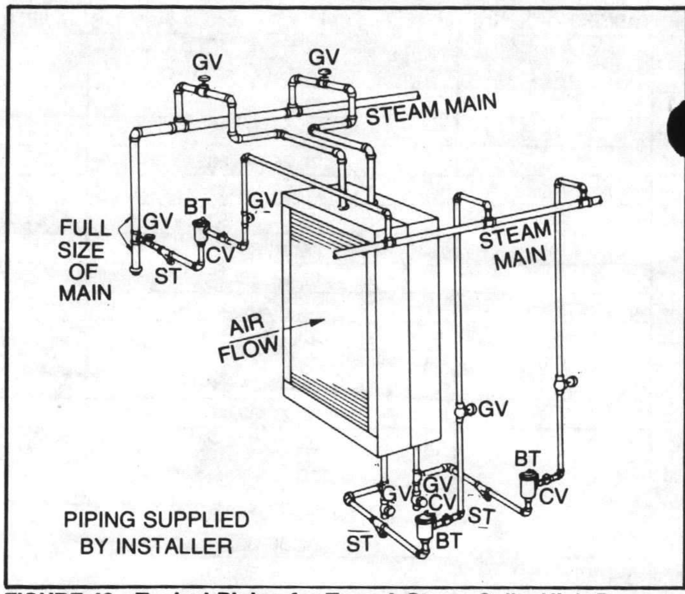


FIGURE 43 - Typical Piping for Type A Steam Coils, High Pressure, Vertical Tubes for Horizontal Airflow

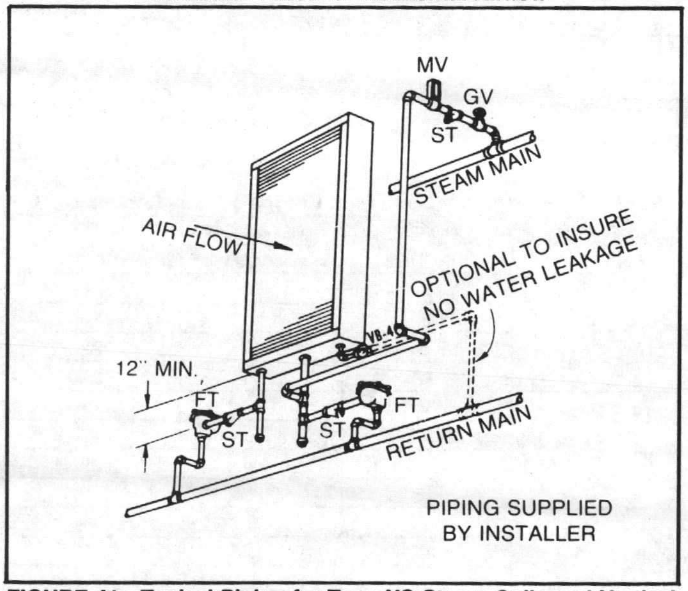


FIGURE 41 - Typical Piping for Type NS Steam Coils and Vertical Tubes for Vertical Airflow

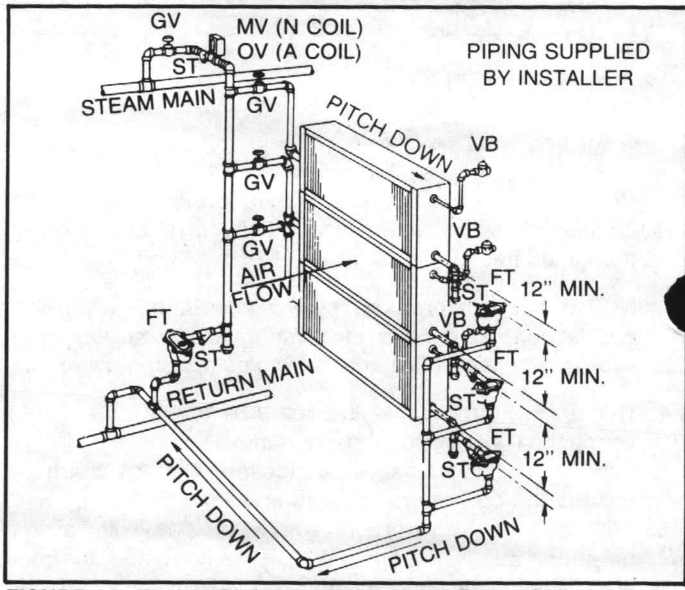


FIGURE 44 - Typical Piping for Type A or N Steam Coils, Horizontal Tubes for Horizontal Airflow

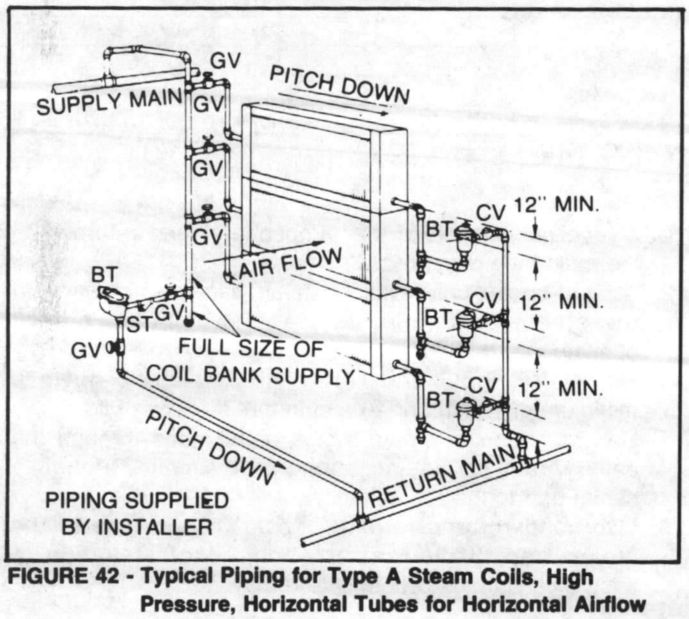


FIGURE 42 - Typical Piping for Type A Steam Coils, High Pressure, Horizontal Tubes for Horizontal Airflow

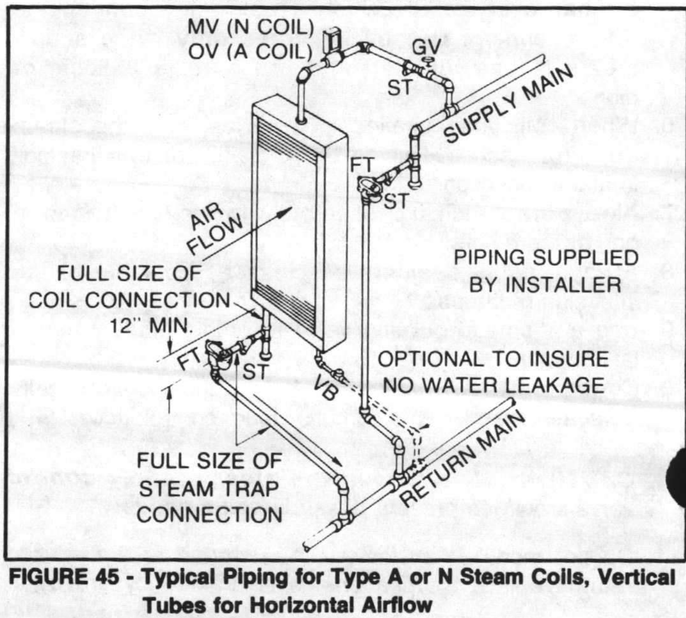


FIGURE 45 - Typical Piping for Type A or N Steam Coils, Vertical Tubes for Horizontal Airflow

HOT WATER COIL PIPING

Refer to Figures 46 to 48 for typical hot water coil piping.

1. Check that the coil is installed correctly, with airflow in the same direction as indicated on the nameplate or coil casing.
2. Type W, WL, DL, and WC hot water coils are self-venting only if the water velocity exceeds 1.5 feet per second. If it is below this rate, vent the coils by either of the following methods:
   a. Install an air vent in the top pipe plug tapping of the return header.
   b. Vent from the top of the return header horizontally to the return piping if the return line rises and is above the top of the coil.

CAUTION: Do not throttle or modulate the water flow for coils that are exposed to freezing air. Coil damage may result from freeze-up.

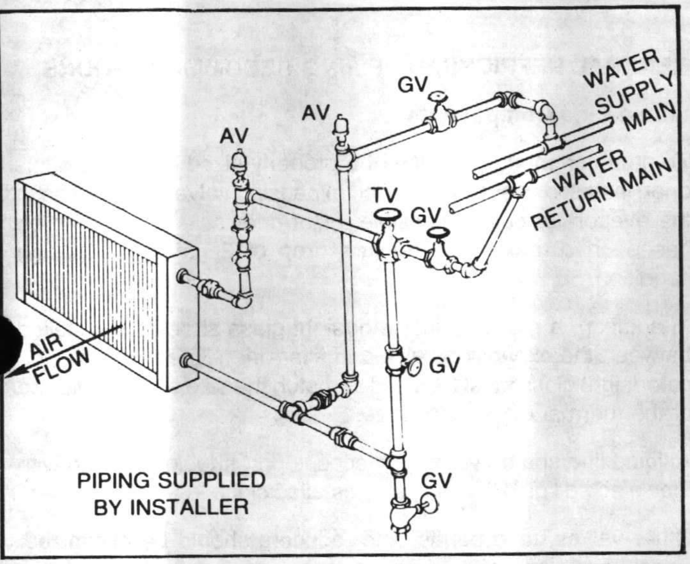


FIGURE 46 - Typical Piping for Type WC Water Coil

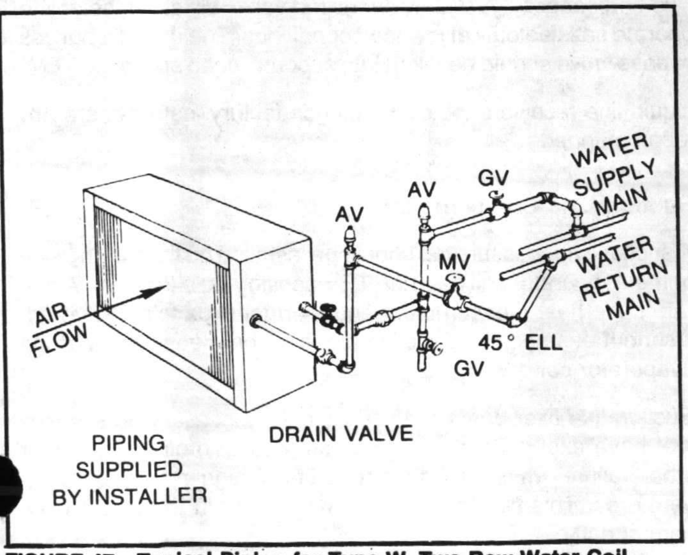


FIGURE 47 - Typical Piping for Type W, Two-Row Water Coil

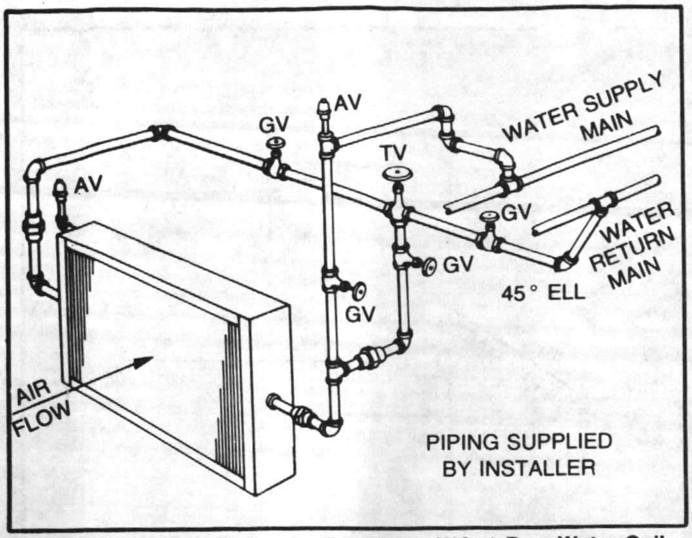


FIGURE 48 - Typical Piping for Type W or WA, 1-Row Water Coil

WATER COOLING COIL PIPING

Refer to Figures 49, 50 and 50A for typical water cooling coil piping.

1. Check that the coil is installed correctly, with airflow in the same direction as indicated on the nameplate or coil casing.
2. Vent both supply and return lines.
3. Install a strainer ahead of the control valve, if used.
4. Install a drain line and shutoff valve in the supply line near the coil.
5. Check for coil fin damage and straighten if necessary.
6. Type W, D, K, DL, WL and LL water coils are self-venting only if the water velocity exceeds 1.5 fps. Type DD and WD coils are self-venting only if the water velocity exceeds 2.5 fps. If water velocity is below these minimum values, vent by one of the following methods.
   a. Install an air vent in the top pipe plug tapping of the return header, or;
   b. When the return line rises above the top of the coil, vent from the top of the return header horizontally to the return piping.

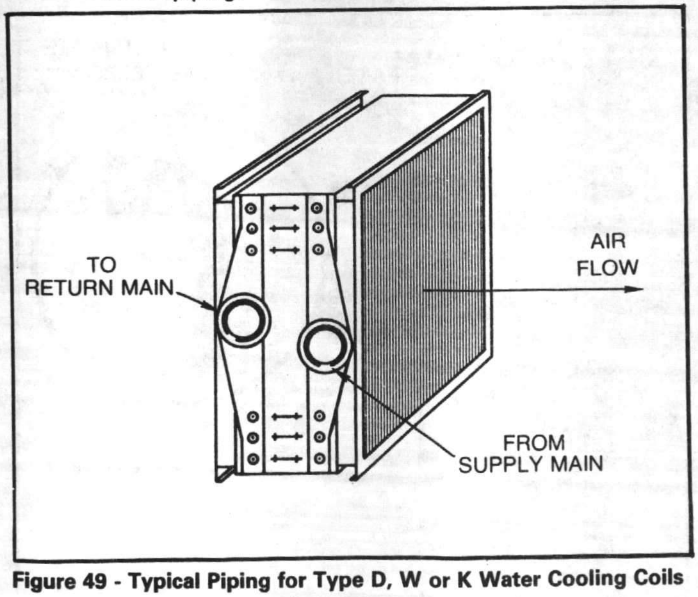


Figure 49 - Typical Piping for Type D, W or K Water Cooling Coils with End Connections.

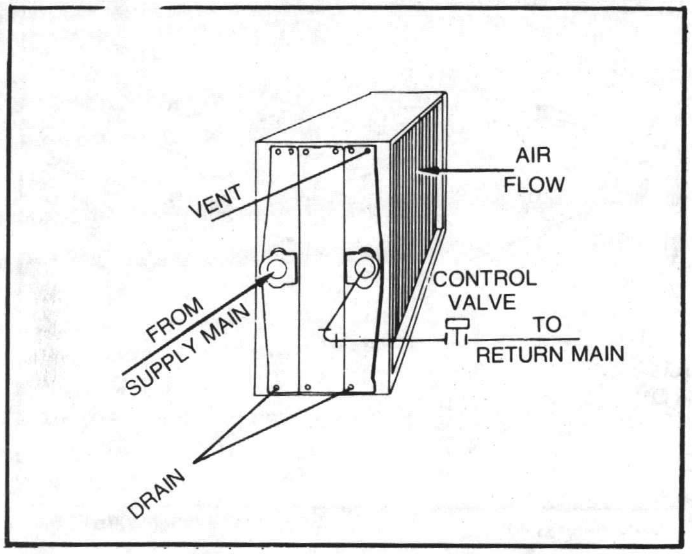


Figure 50 - Typical Piping for Type DD Water Cooling Coil with Center Connections.

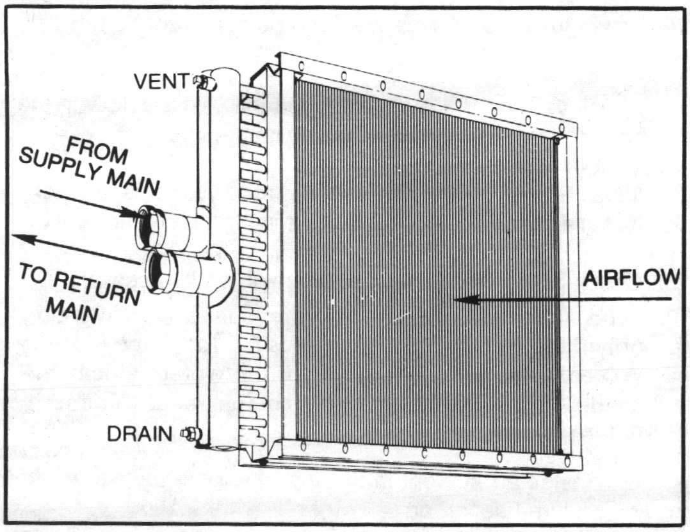


Figure 50A - Typical Piping for 2-Row, Type WL and DL Water Coil with Drain and Vent Locations.

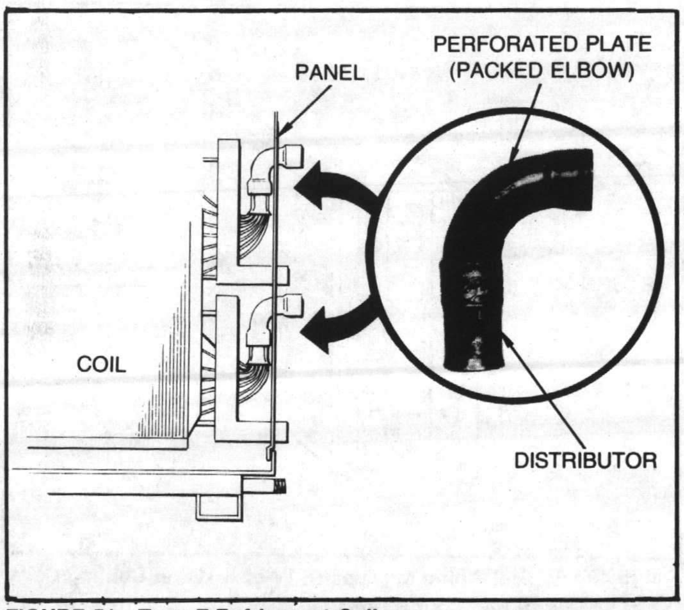


FIGURE 51 - Type F Refrigerant Coil

REFRIGERANT COIL PIPING

NOTE: *This coil has been dehydrated and charged with a holding charge. To prevent leaks and system contamination, do not break the seals until the coil is installed.*

Check that the coil is installed correctly, with airflow in the same direction as indicated on the coil nameplate or casing. The suction connection must be at the bottom of the suction header.

Follow accepted refrigeration piping practices and safety precautions. See Figure 51 for typical refrigerant coil piping. General refrigerant piping recommendations for component selection and line sizing follow. Specific recommendations should be provided with the high-side components, including instructions for pressure testing, evacuation, and system charging.

Leak-test the entire refrigeration system after piping is complete. Charge the unit according to approximate weight requirements and operating pressures. Measure superheat and adjust the thermal expansion valve setting if necessary.

GENERAL REFRIGERANT PIPING RECOMMENDATIONS

Liquid Line Components

Trane recommends the use of a properly sized liquid line filter-drier, installed upstream from the expansion valve and as close to the evaporator coil as possible. Filter-drier selection should be based on a maximum pressure drop of 2 psi at the design condition.

In addition, a moisture indicator/sight glass should be installed between the expansion valve and filter-drier. The moisture indicator/sight glass must be sized to match the size of the liquid line at the thermal expansion valve.

A liquid line shutoff valve with access port should be sized with the selected liquid line OD, and installed close to the condenser.

Other valves, tube bends, and reducers should be minimized, since these items tend to increase pressure drop and reduce subcooling at the expansion valve.

The Thermal Expansion Valve (TEV) must be selected for proper size and capacity. A slightly oversized valve will allow the unit to operate satisfactorily at low-load conditions. The use of a hot gas bypass valve should be taken into account when sizing the TEV.

Liquid line receivers, other than those factory-installed, are **not** recommended.

Suction Line Components

A suction line pressure tap should be installed on the leaving side of the evaporator coil near the TEV sensing bulb location. Accurate superheat measurement and thermal expansion valve adjustment demands that suction pressure be measured near the evaporator coil.

Suction line filter-driers are usually only necessary on systems that have experienced a severe compressor motor burn-out or other failure which results in extremely high refrigerant temperatures. This filter-drier should not be left in the suction line permanently.

Liquid Line Sizing

All compressors have a Refrigerant Charge Limit (RCL) that must not be exceeded. Since the RCL and pressure drop are in direct conflict with each other, Trane recommends that the liquid line be sized as small as possible, while maintaining a low enough pressure drop to ensure 5 degrees F of subcooling at the expansion valve.

Suction Line Sizing

Suction line tubes must be sized to maintain refrigerant vapor velocities that are high enough to ensure oil entrainment under all operating conditions.

Although not harmful, it is not necessary to pitch horizontal suction lines toward the compressor when the refrigerant coil is used with Trane condensing units, which are designed with a gas trap in the suction line just prior to the compressor. This gas trap helps the crankcase heater to stop temperature-induced migration during the off cycle. However, it also eliminates gravity flow to the compressor sump.

WIRING

WARNING: DISCONNECT ELECTRICAL POWER SOURCE BEFORE SERVICING THE UNIT OR CONNECTING ELECTRICAL WIRES. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY OR DEATH FROM ELECTRICAL SHOCK OR ENTANGLEMENT IN MOVING PARTS.

Wiring to the unit fan motor and the spray pump motor (sprayed coil units only) must be provided by the installer and must comply with all national and local electrical codes. The installer must also furnish a fused disconnect switch in compliance with national and local electrical codes.

CAUTION: Use copper conductors only for terminal connections. Use of aluminum or other type of wiring may result in galvanized corrosion or overheating and resultant equipment damage.

Fan motors require motor overload protective devices that are rated or selected in compliance with the National Electric Code. Specific unit and motor connection diagrams are provided on the unit. If wiring directly to the motor, provide a flexible connection at the motor to permit fan belt adjustment. Fractional-horse-power motors may be factory-connected to a terminal box on the unit. If this construction is provided, complete field wiring to this connection box.

INSTALLATION CHECKLIST

Complete this checklist as the unit is being installed to verify that all recommended installation procedures are accomplished before the unit is started. This checklist does not replace the detailed instructions given in appropriate places in the Installation section of this manual. Read the entire section carefully to become familiar with the installation before installing the unit.

WARNING: DISCONNECT ELECTRICAL POWER BEFORE SERVICING OR INSPECTING THE UNIT. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY OR DEATH FROM ELECTRICAL SHOCK OR ENTANGLEMENT IN MOVING PARTS.

RECEIVING AND HANDLING

☐ 1. Unit and accessories are inspected for shipping damage or material shortage. Report any claims immediately.

☐ 2. Unit nameplate data agrees with submittal and ordering information.

LIFTING

☐ 1. Center of gravity is approximated.

☐ 2. Proper rigging devices are installed, including slings and spreader bars.

☐ 3. Unit is hoisted to its approximate location.

UNIT LOCATION

☐ 1. Floor or foundation is prepared to support unit weight and to be level.

☐ 2. Sufficient access is provided for unit size, clearances and maintenance access.

☐ 3. Foundation or mounting platform is sized for unit, accessories and mounting legs.

☐ 4. For ceiling-mounted units, suspension frame is selected and prepared.

MOUNTING

- ☐ 1. Vibration isolators are installed and fastened to the floor.
- ☐ 2. Shipping angles are removed.
- ☐ 3. Multi-section units are assembled.

NOTE: *Some units require further assembly after part of the unit is mounted.*

- ☐ 4. Support frame are constructed and attached for ceiling-mounted units.
- ☐ 5. Assembled units are mounted on isolators or ceiling supports.
- ☐ 6. Unit assembly is complete.
- ☐ 7. Mutli-section units are joined with flexible connection material.
- ☐ 8. Tension restraints are installed on high-pressure units.
- ☐ 9. Splash guards are installed where necessary.
- ☐ 10. Unit is fastened to isolators.
- ☐ 11. Unit is level.

ACCESSORIES

- ☐ 1. Bag filter section is installed.
- ☐ 2. Filters are installed.
- ☐ 3. Manometers, if necessary, are installed.
- ☐ 4. Exhaust Air Economizer is installed.
- ☐ 5. All accessories are installed.

FAN MOTOR ASSEMBLY

- ☐ 1. Shafts are properly installed in bearings.
- ☐ 2. Sheaves are properly located on shafts.
- ☐ 3. Shafts are level and parallel.
- ☐ 4. Sheaves are aligned.
- ☐ 5. Belt tension is correct.
- ☐ 6. Belt is at least 1/2-inch from unit flanges or structural supports.
- ☐ 7. **All sheave and bearing set screws are tightened to the correct torques.**
- ☐ 8. Belt guard is installed.

DAMPERS

- ☐ 1. Blow-Thru Mutlizone units — Drive rod assembly is adjusted.
- ☐ 2. Cold deck damper rods are insulated (if necessary).
- ☐ 3. Dampers are set for each zone.
- ☐ 4. Damper operators (furnished by the installer) are installed and adjusted.

INLET VANES

- ☐ 1. Vanes and rod assemblies move freely. Lubricate if necessary.
- ☐ 2. Operators and linkage (furnished by the installer) are installed and adjusted.

DUCTWORK

- ☐ 1. Intake and discharge connections are made with flexible connection.
- ☐ 2. Discharge ductwork is unchanged in size or direction for at least 1-1/2 fan diameters in length.
- ☐ 3. Adequate clearance is allowed between duct connections and dampers.

PIPING

- ☐ 1. Condensate drain lines are trapped, installed and connected to the coil drain pan.
- ☐ 2. Unused drain connections are plugged.
- ☐ 3. Spray section piping is complete for sprayed-coil units.
- ☐ 4. Provisions are made for properly draining and venting all coils.
- ☐ 5. Supply and return coil connections are made.
- ☐ 6. Supply and return piping is complete.

WIRING

- ☐ 1. Supply power is connected to fan motor.
- ☐ 2. Wiring direct to fan motor is flexible connection.
- ☐ 3. If terminal box is provided, field-wiring to terminal box is complete.
- ☐ 4. Supply power is connected to spray pump motor (sprayed-coil units only).
- ☐ 5. Fused disconnect switch is installed within sight of unit.
- ☐ 6. Motor overload protective devices are installed.

START-UP

WARNING: DISCONNECT ELECTRICAL POWER AND ALLOW ALL ROTATING PARTS TO STOP COMPLETELY BEFORE SERVICING OR INSPECTING THE UNIT. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY OR DEATH FROM ELECTRICAL SHOCK, ENTANGLEMENT IN MOVING PARTS OR PRESSURE DIFFERENTIAL WITHIN THE UNIT.

PREPARATION

Perform the following checks and inspections before operating the unit:

1. **With the system de-energized,** check that the electrical connections are complete and tight at the terminals.
2. Make sure the belt guard is in place.
3. Inspect the fan wheels. They should turn freely in the proper direction of rotation.
4. As mentioned previously in the Installation section, check the bearing and sheave setscrews for proper torque settings. Refer to applicable section in this manual.
5. Inspect fan belt tension and sheave setscrews. Belt tension, sheave alignment and setscrew torques for the motor assembly are given in this manual.
6. Check the piping and valves for leaks. Open or close the valves, depending on their function in the system. Drain lines should be open. If a refrigerant coil is used, the system must be evacuated, leak-tested with dry nitrogen, and charged with refrigerant.
7. Check that the air filters are in place and that all dampers are set properly.
8. Remove all foreign material from the drain pan. Check the drain pan and condensate line to make sure they are not obstructed.
9. All unit access panels must be in place. All screws, nuts and bolts must be tightened to their proper torques.
10. On high-pressure units, the coil piping hole gaskets must be installed properly.
11. If the unit includes fan paralleling control, open it fully.
12. Inspect fan motor and bearing lubrication.

CAUTION: To prevent fan motor or bearing failures, it is necessary that they are lubricated properly. This must be checked before the unit is started for the first time. See the label on the side of the unit, the tag attached to the motor and the Climate Changer Maintenance Manual.

START-UP PROCEDURES

After completing all the items uner "Pre-Start-Up," the unit may be started and the following checks and adjustments performed:

NOTE: *High Pressure units with self-locking collar fan bearings. During start-up check rotation of fan shaft to determine if fan motor is wired correctly. Incorrect rotation of fan may cause premature bearing and shaft failure.*

1. Measure the motor voltage and amps on all phases to insure proper operation. Compare these readings with the motor nameplate.
2. If the unit includes a spray pump, open the spray pump air valve and purge air from the system. Adjust the spray pump valve until the spray pattern diameter equals the finned height of the top cooling coil. The resulting gauge pressure should be between 7 and 10 psig.
3. If the unit includes fan paralleling control (two-fan, blow-thru units only), adjustment may be required. An indication of an incorrect setting is paralleling of the fan (pulsating operation) and erratic fan motor amperage readings. Adjust the fan paralleling control until fan operation is smooth and the amperage reading is steady.

   The fan paralleling control should be closed only far enough to eliminate erratic operation. Rarely should adjustment exceed two inches on either fan. If the devices are closed too far, unit capacity will be reduced.

   Each fan paralleling control device has two rods per fan extending upward through the top of the blow-thru fan section. To adjust fan operation for a smooth airflow condition, the following should be done:

   a. Loosen the locking nut on one rod, lower the rod ½-inch and retighten. Repeat for the other rod on the fan.
   b. If the unstable condition still exists, repeat Step A.
   c. If the unstable condition still exists, relocate the fan paralleling control to the original position and perform Steps A and B on the other fan.
   d. If the unstable condition still exists, lower both fan paralleling devices to 1-inch from the original position. Repeat Steps A, B, and C, using 1-inch as a base reference.
4. Measure voltage at all three wires. Maximum allowable voltage imbalance is two percent. Voltage imbalance is defined as 100 times the sum of the deviation of the three voltages from the average, divided by twice the average voltage. For example, if the three measured voltages are 221, 230 and 227, the average voltage would be 226 volts. The percent of voltage imbalance is then calculated:

   $$\frac{100 \times \{ [226\text{-}221] + [230\text{-}226] + [227\text{-}226] \}}{2 \times 226} =$$
   2.2% (Unacceptable)

   In this example, 2.2 percent imbalance is not acceptable and the power company should be notified to correct it.
5. If the fan speed is changed more than 5% from the original designed rpm, or if parts such as shafts, fan wheels, bearings, or other drive components are replaced, the unit vibration should be checked.

   The unit vibration, measured horizontally and vertically directly on the fan shaft bearing (perpendicular to the shaft centerline), should not exceed 0.2 in/sec. or 3.0 mils, whichever is the lower displacement at the unit operating speed.

SHEAVE ALIGNMENT

To prevent interference of the fan frame with the belt, make sure that the belt edge closest to the motor has the proper clearance from the fan frame, as shown in Figure 52.

Align the fan and motor sheaves by using a straightedge as shown in Figure 53. The straightedge must be long enough to span the distance between the outside edges of the sheaves. When the sheaves are aligned, the straightedge will touch both sheaves at points A through D. A string, drawn tight, may be used in the same manner. For uneven width sheaves, place a string in the center groove of both sheaves and pull tight. Adjust sheaves and tighten the sheave setscrews to the proper torques, given in Table 4.

Parallel operation of the fan and motor shafts is necessary to prolong belt life. Place a level on the shafts to check horizontal alignment. Shim if necessary.

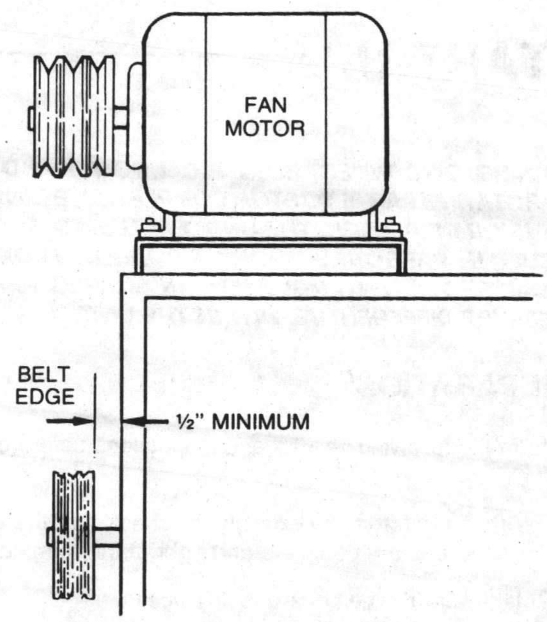


Figure 52 - Minimum Allowable Distance Between Frame Work and Fan Sheave.

FAN ASSEMBLY SETSCREWS

Check and adjust fan wheel, bearing and sheave setscrews whenever a component is removed or an adjustment is made. Refer to Table 4 for recommended Torques.

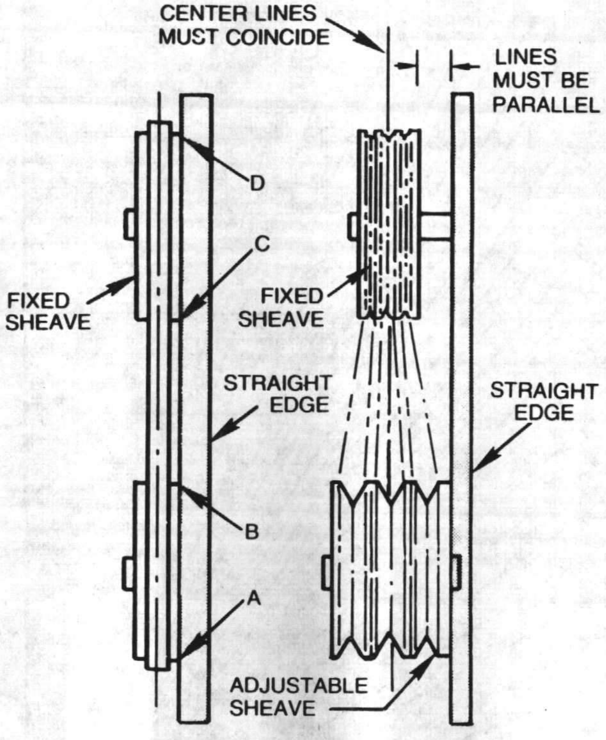


Figure 53 - Sheave Alignment

FAN WHEEL CLAMPS

The clamps that hold the fan hub on the shaft must be properly positioned and tightened to ensure safe fan operation.

NOTE: On fans that are 20 inches or smaller, the clamps should be replaced whenever the wheel or shaft is replaced.

On fans that are 20 inches or smaller, locate the two-piece clamp over the hub so that the hub tabs go through the clamp slots. Finger-tighten the two bolts evenly, then torque down both bolts **evenly** in small increments to 25 foot-pounds. The clamp flanges should meet at both bolt locations before 25 foot-pounds is reached.

On fans that are larger than 20 inches, finger-tighten the three bolts evenly, then torque down all three bolts **evenly,** in small increments, to 35 to 40 foot-pounds. Visually check the spacing between the three clamp flanges to make sure they are consistently tightened.

FAN BELT TENSION

NOTE: *Fan belt tension should be checked at least twice during the first days of operation, since there is a rapid decrease in tension until belts are run in.*

WARNING: DISCONNECT ELECTRICAL POWER SOURCE AND ALLOW ALL ROTATING EQUIPMENT TO STOP COMPLETELY BEFORE INSPECTING OR SERVICING THE UNIT. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY OR DEATH FROM ELECTRICAL SHOCK OR MOVING PARTS.

Proper belt tension is required to ensure maximum bearing and drive component life and is based on fan brake horsepower requirement. Use Chart 1 to find the proper tension and refer to the inset for an example. To use the chart, you must know:

1. Fan design bhp per belt (**not** motor hp)
2. Fan rpm
3. Fan sheave pitch diameter (Figure 54 - found by measuring where the middle of the belt rides in the sheave).
4. Type of belt cross-section (stamped on the belt)

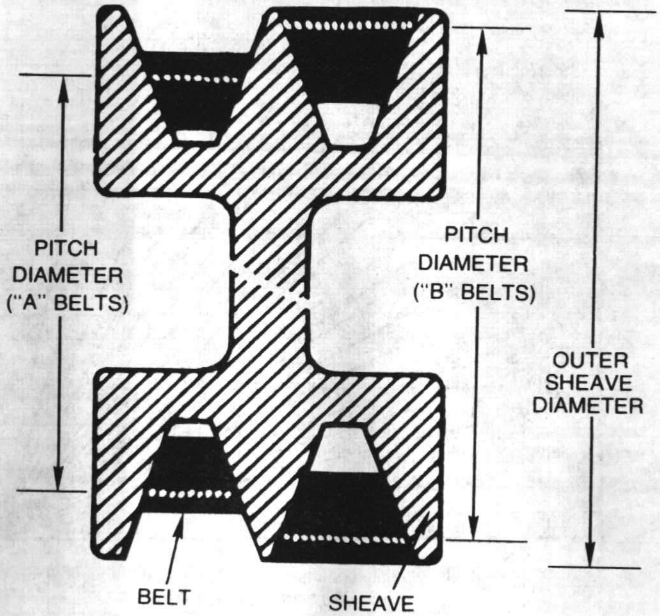


Figure 54 - Fan Sheave Pitch Diameter

As shown in the example of Chart 1, the correction tension (pounds force) is 9.6 pounds, at ½-inch deflection. Deflection is determined by dividing the belt span distance by 64, as shown in Figure 55.

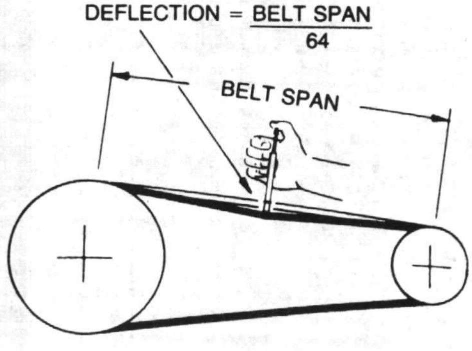
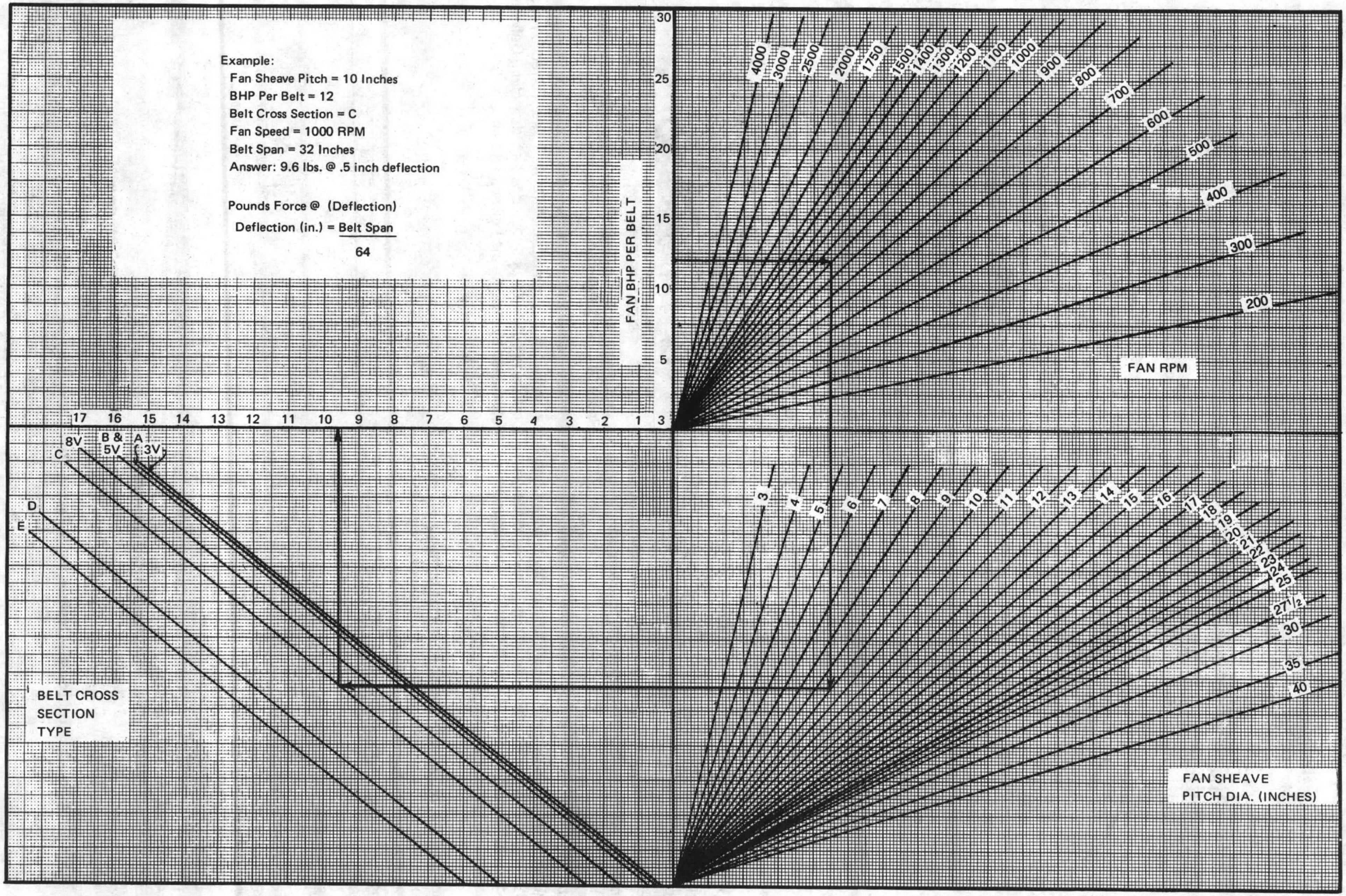


Figure 55 - Belt Tension Measurement

Table 14 — Values for K Factor (Belt Cross-Section Types)

BELT TYPE	A	B	C	D	E	3L	4L	5L	3V	5V	8V	AX	BX	CX	DX
"K" FACTOR	8	13	40	80	95	6	6	6	6	12	25	11	18	54	101

CHART 1 - Belt Tension



To measure belt tension, use a belt tensioner as shown in Figure 56. Determine actual deflection by depressing one belt with the belt tensioner and measuring the deflection relative to the other belts or to belt line. Adjust the belt tension to the correct pounds force and tighten all setscrews to the proper torques.

Figure 56 - Belt Tensioner

For belt cross-section types not given in Chart 1, refer to Table 14 and use the following equations to calculate correct belt tension:

$$F = \frac{T + K}{16}$$

where F = force measured in pounds at specific deflection

K = constant determined by belt cross-section type (See Table 14).

$$T = 24{,}750 \times \frac{\text{(fan hp per belt)}}{\text{(belt speed)}}$$

$$\text{Belt speed} = \frac{\text{(fan pitch diameter)}}{12} \times (\pi) \times \text{fan rpm (ft/min)}$$

For example, given the following:

Motor sheave pitch diameter: 16.8 inches, eight groove
Fan sheave pitch diameter: 19.8 inches, eight groove
Fan horsepower: 262.4 bhp
Fan rpm: 983 rpm
Belt type: 8V
Sheave span: 60.9 inches

$$\text{Belt speed} = \frac{19.8}{12} \times 3.14 \times 983 = 5092$$

$$T = 24{,}750 \times \frac{\text{(262.4 bhp/8 belts)}}{5092} = \frac{24{,}750 \times 32.8}{5092} = 159.4 \text{ lbs}$$

$$F = \frac{159.4 + 25}{16} = 11.5 \text{ lbs}$$

$$\text{Also, } D = \frac{\text{Belt span (inches)}}{64} = \frac{60.9}{64} = .95 =$$

approximately 15/16 inches

Therefore, the belt tensioner should read 11.5 pounds force at 15/16-inch deflection. This will yield 159.4 pounds force belt tension.

Belt tensions determined by using Chart 1 and Table 14 are minimum values. The correct operating tension for a V-belt drive is the lowest tension at which the belts will not slip under start-up or peak load conditions. It may be necessary, however, to increase the tension of some drives to reduce excessive belt flopping.

CAUTION: Do not over-tension the belts. Excessive tension will reduce fan and motor bearing life, accelerate belt wear and possibly cause shaft failure.

Remove the belt guard and clean the sheaves and belts with a dry cloth. Oil and gease should be kept away from the belts because they can cause deterioration and slippage. The use of belt dressing is **not** recommended.

For further information on this product or other Trane products, refer to the "Trane Service Literature Catalog", ordering number IDX-IOM-1. This catalog contains listings and prices for all service literature sold by Trane. The catalog may be ordered by sending a $20.00 check to: The Trane Company, Service Literature Sales, 3600 Pammel Creek Road, La Crosse, WI 54601.

PRINTED BY PRODUCTION SERVICES — LA CROSSE

JH/DL

TRANE™

Bldgs AS-202/AS-236/AS-3502

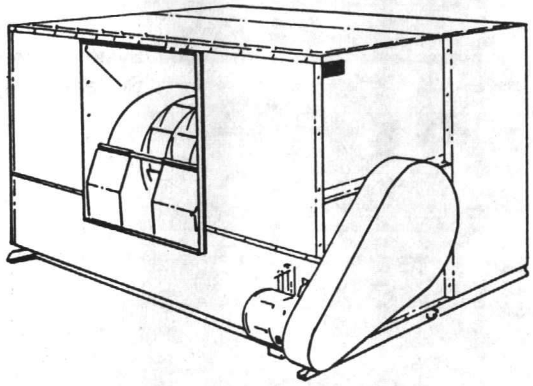
Maintenance CLCH-M-2

Library	Service Literature
Product Section	Air Handling
Product	Central Station Air Handlers
Model	Climate Changers
Literature Type	Maintenance
Sequence	2
Date	January 1986
File No.	SV-AH-CLCH-CLCH-M-2-186
Supersedes	

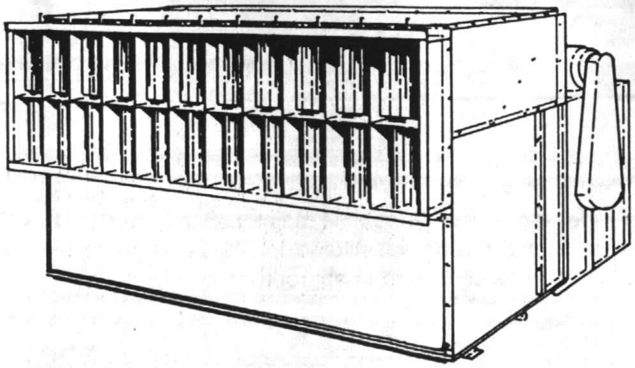
CLIMATE CHANGER® CENTRAL STATION AIR HANDLERS

DRAW-THRU, BLOW-THRU SPRAYED COIL AND HIGH PRESSURE UNITS

B DEVELOPMENT SEQUENCE



DRAW-THRU



BLOW-THRU

X39640291-01

LITERATURE HISTORY CHANGE:
Delta—Flow Coils added to units, changing design sequence to 'E'.

TABLE OF CONTENTS

SUBJECT	PAGE
GENERAL INFORMATION	2
START-UP	3
MAINTENANCE	4
Periodic Maintenance Checklist	4
Maintenance Procedures	4
Filters	4
Bearings	5
Fan Motors	7
Sheave Alignment	8
Setscrews	8
Wheel Clamps	8
Belt Tension	9
Coil Cleaning	11
Coil Winterization	11
Spray Humidifier Nozzle	12
Manometer Calibration	12
Sprayed Coil Water System	12
Thermal Expansion Valve Adjustment	13
TROUBLE ANALYSIS	14
System Check	14
System Analysis Charts	14

GENERAL INFORMATION

Central Station Climate Changers® are air handlers designed to provide complete heating, cooling and dehumidifying by means of wide variety of unit sizes, coils, fans and efficiency capabilities. This manual will cover all vertical and horizontal, draw-thru, blow-thru, sprayed coil and high pressure units. A Periodic Maintenance Checklist at the beginning of the Maintenance section provides the suggested routine maintenance schedule. This checklist should not be substituted for the detailed information and procedures contained in appropriate sections of the manual.

The Trane Company
La Crosse, Wisconsin 54601-7599
Printed in U.S.A.

START-UP

WARNING: DISCONNECT ELECTRICAL POWER AND ALLOW ALL ROTATING PARTS TO STOP COMPLETELY BEFORE SERVICING OR INSPECTING THE UNIT. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY OR DEATH FROM ELECTRICAL SHOCK, ENTANGLEMENT IN MOVING PARTS OR PRESSURE DIFFERENTIAL WITHIN THE UNIT.

PREPARATION

Perform the following checks and inspections before operating the unit:

1. **With the system de-energized,** check that the electrical connections are complete and tight at the terminals.
2. Make sure the belt guard is in place.
3. Inspect the fan wheels. They should turn freely.
4. As mentioned previously in the Installation Manual, check the bearing and sheave setscrews for proper torque settings. Refer to applicable section in this manual.
5. Inspect fan belt tension. Belt tension, sheave alignment and setscrew torque information is given in the applicable section of this manual.
6. Check the piping and valves for leaks. Open or close the valves, depending on their function in the system. If a refrigerant coil is used, the system must be evacuated, leak-tested with dry nitrogen and charged with refrigerant.

8. Remove any foreign material from the drain pan. Check the drain pan and condensate line to make sure they are not obstructed.
9. All unit access panels must be in place. All screws, nuts and bolts must be tight.

11. If the unit includes fan paralleling controls, open them fully.
12. Inspect fan motor and bearing lubrication.

CAUTION: To prevent fan motor or bearing failures, it is necessary that they are lubricated properly. This must be checked before the unit is started for the first time. See the label on the side of the unit, the tag attached to the motor, and the Maintenance section of this manual.

START-UP PROCEDURES

After completing all the items uner "Pre-Start-Up," the unit may be started and the following checks and adjustments performed:

***NOTE:** High Pressure units with self-locking collar fan bearings. During start-up check rotation of fan shaft to determine if fan motor is wired correctly. Incorrect rotation of fan may cause premature bearing and shaft failure. Refer to bearing section in this manual.*

1. Measure the motor voltage and amps on all phases to insure proper operation. Compare these readings with the motor nameplate.
2. If the unit includes a spray pump, open the spray pump air valve and purge air from the system. Adjust the spray pump valve until the spray pattern diameter equals the finned height of the top cooling coil. The resulting gauge pressure should be between 7 and 10 psig.
3. If the unit includes fan paralleling control (two-fan, blow-thru units only), adjustment may be required. An indication of an incorrect setting is paralleling of the fan (pulsating operation) and erratic fan motor amperage readings. Adjust the fan paralleling control until fan operation is smooth and the amperage reading is steady.

   The fan paralleling control should be closed only far enough to eliminate erratic operation. Rarely should adjustment exceed two inches on either fan. If the devices are closed too far, unit capacity will be reduced.

   Each fan paralleling control device has two rods per fan extending upward through the top of the blow-thru fan section. To adjust fan operation for a smooth airflow condition, the following should be done:

   a. Loosen the locking nut on one rod, lower the rod ½-inch and retighten. Repeat for the other rod on the fan.
   b. If the unstable condition still exists, repeat Step A.
   c. If the unstable condition still exists, relocate the fan paralleling control to the original position and perform Steps A and B on the other fan.
   d. If the unstable condition still exists, lower both fan paralleling devices to 1-inch from the original position. Repeat Steps A, B, and C, using 1-inch as a base reference.

4. Measure voltage at all three wires. Maximum allowable voltage imbalance is two percent. Voltage imbalance is defined as 100 times the sum of the deviation of the three voltages from the average, divided by twice the average voltage. For example, if the three measured voltages are 221, 230 and 227, the average voltage would be 226 volts. The percent of voltage imbalance is then calculated:

$$\frac{100 \times \{ [226\text{-}221] + [230\text{-}226] + [227\text{-}226] \}}{2 \times 226} = 2.2\% \text{ (Unacceptable)}$$

   In this example, 2.2 percent imbalance is not acceptable and the power company should be notified to correct it.

5. If the fan speed is changed more than 5% from the original designed rpm, or if parts such as shafts, fan wheels, bearings, or other drive components are replaced, the unit vibration should be checked.

   The unit vibration, measured horizontally and vertically directly on the fan shaft bearing (perpendicular to the shaft centerline), should not exceed 0.2 in/sec. or 3.0 mils, whichever is the lower displacement at the unit operating speed.

MAINTENANCE

PERIODIC MAINTENANCE CHECKLIST

WARNING: DISCONNECT ELECTRICAL POWER AND ALLOW ROTATING PARTS TO STOP BEFORE SERVICING THE UNIT OR REMOVING THE FAN BELT GUARD. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY OR DEATH FROM ELECTRICAL SHOCK OR ENTANGLEMENT IN MOVING PARTS.

The following checklist describes the suggested maintenance schedule to maintain proper operation of the unit. Detailed procedures for owner-operator maintenance checks are given after this checklist. For more information on the unit, refer to the Service Guide or contact a local Trane Service Company.

EVERY MONTH

☐ 1. Inspect air filters. Clean or replace if clogged.

☐ 2. Inspect air filter manometer for bag filters or roll filters with manual controls. Change bag filters when manometer reading is 1 inch wg. Change roll filters when manometer reading is ½ inch wg.

☐ 3. Check sump water concentration in Sprayed Coil units to make sure that no corrosive or scaling conditions have been created by poorly treated water.

EVERY THREE TO SIX MONTHS

NOTE: *The procedures listed in this section should be completed every three to six months. The frequency of their completion will depend on load and ambient conditions. Detailed procedures following this Maintenance Checklist will give more information on suggested conditions and schedules.*

☐ 1. Check that fan bearing grease lines are tight to the bearings so no grease leaks at the connection.

☐ 2. Lubricate fan bearings.

☐ 3. Check bearing locking setscrews and other setscrews for proper tightness. All bearing races must be secure.

☐ 4. Lubricate fan motors.

☐ 5. Check sheave alignment and level of shafts.

☐ 6. Check fan belt tension. Adjust if belts slip. Replace worn or frayed belts with a new matched set.

☐ 7. Inspect coils for frost or dirt built-up. Clean fins if airflow is clogged.

☐ 8. Inspect spray humidifier for lime deposits in the spray nozzle. Clean if flow is clogged.

☐ 9. Inspect steam grid humidifier wrapping. Replace if flow is clogged.

EVERY YEAR

☐ 1. Inspect electrical wiring for condition. Tighten all connections.

☐ 2. Inspect the unit casing and accessories for chipping or corrosion. If damage is found, clean and repaint with a good grade of rust resistant zinc chromate paint.

☐ 3. Inspect the drain pan for sludge or other foreign material. Clear the drain openings and drain line to ensure adequate flow.

☐ 4. Check damper linkages, setscrews and blade adjustment for proper tightness and operation. Do not lubricate nylon damper rod bushings.

☐ 5. Check inlet vane linkages, setscrews and vane adjustment for proper tightness, operation, and alignment.

☐ 6. Recalibrate the filter manometer.

☐ 7. Clean and check the water system on Sprayed Coil Climate Changers.

MAINTENANCE PROCEDURES

FILTERS

Table 1 lists air filter sizes and quantities required for all filter boxes. Replace with UL Class 2 approved filters only. Always install filters with directional arrows pointing in direction of airflow.

To clean permanent filters, wash under a stream of hot water to remove dirt and lint. Follow with a wash of mild alkali solution to remove old filter oil. Rinse thoroughly and let dry. Recoat both sides of the filter with Air Maze filter oil or an equivalent and let dry. Replace filter element in the unit.

Bag filters should be replaced when pressure differential across the filter is 1 inch wg. A manometer should have been installed for surveillance of pressure drop across the filter.

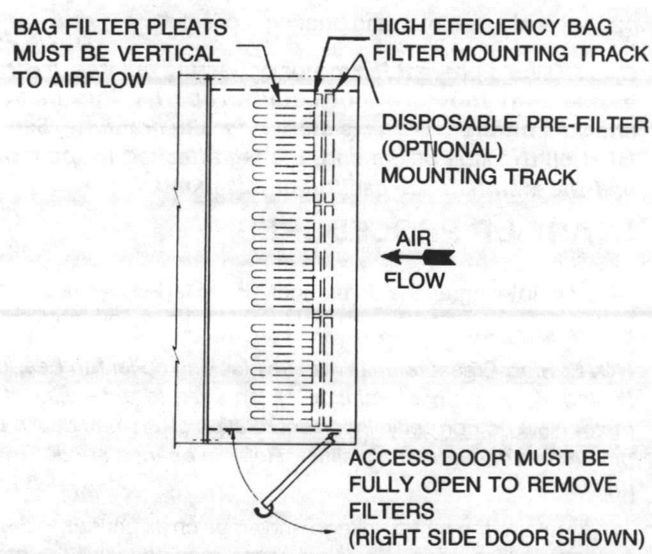


FIGURE 1 - Filter Mounting Track Location (Top View)

TABLE 1 - Filter Sizes and Quantities Per Set

UNIT SIZE	2-INCH FLAT FILTER BOX	COMBINATION & MEDIUM FILTER BOX	HIGH CAPACITY BOX	BAG FILTER AND PREFILTER (HXW)	4-INCH PLEATED FILTER BOX
3	1-20x25	2-16x25	2-20x25	—	—
6	2-20x25	4-16x25	4-20x25	—	—
8	4-16x20	4-20x25	6-20x20	1-24x12 1-24x24	4-16x20
10	4-16x25	6-16x25	6-20x25	2-24x24	4-16x25
12	2-20x20 2-16x25 1-16x20	4-20x25 2-16x25	6-16x20 3-20x25	2-24x12 2-20x20	1-16x20 2-16x25 2-20x20
14	4-16x20 2-20x25	8-16x25	6-20x20 3-20x25	2-24x12 3-20x20	4-16x20 2-20x25
17	6-16x20 2-16x25	8-20x25	3-20x25 9-20x20	1-24x12 3-24x24	6-16x20 2-16x25
21	8-16x20 2-16x25	10-20x25	3-20x25 12-20x20	5-24x20	8-16x20 2-16x25
25	12-16x20	6-20x25 6-16x25	6-20x25 9-20x20	4-24x12 5-20x20	12-16x20
31	7-16x20 7-16x25	8-16x25 12-16x20	8-20x25 12-20x20	10-20x20	7-16x20 7-16x25
35	14-16x25	16-20x25	28-16x25	2-24x12 8-24x24	14-16x25
41	6-16x20 12-20x20	20-20x25	32-16x25	2-24x12 8-24x24	6-16x20 12-20x20
50	7-16x20	28-16x25 14-16x25	35-16x25	15-20x20	7-16x20 14-16x25
63	10-16x25 12-20-25	30-20x25	49-16x25	20-20x20	10-16x25 12-20x25
73	6-20x20 18-20x25	36-20x25	42-20x25	—	—
86	21-20x25 7-20x20	42-20x25	49-20x25	—	—

WARNING: MAXIMUM BAG FILTER PRESSURE DROP IS 1 INCH WG. OPERATION OF THE UNIT AT A PRESSURE DIFFERENTIAL GREATER THAN THIS MAY CAUSE PERSONAL INJURY OR EQUIPMENT DAMAGE FROM COMBUSTION.

Trane recommends the use of optional disposable prefilters with high efficiency bag filters. Prefilters slide into mounting tracks just ahead of the bag filter and serve to prolong the life of bag filters. Figure 1 illustrates bag filter and prefilter installation. Complete the following to install high efficiency bag filters:

1. Ensure power is disconnected. Open filter section access door.

   WARNING: DISCONNECT POWER SOURCE BEFORE OPENING FILTER SECTION ACCESS DOOR. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY OR DEATH FROM ELECTRICAL SHOCK, HIGH PRESSURES OR MOVING PARTS.

2. Slide bag filters and flat prefilters into the appropriate filter tracks. Bag filters must be installed with pleats vertical to airflow.

3. Slide adjustable blockoff into filter track.

4. Close access door. If door can be closed without compressing the filters, adjust the blockoff by loosening its screws and sliding it towards the door. The door should squeeze the blockoff against the filters, compressing them together. Tighten the adjusting screws.

NOTE: *Filters must have an airtight seal to prevent air bypass. If using other than recommended filters, apply foam gasketing to the vertical edges of the filter holding frame for a tight seal.*

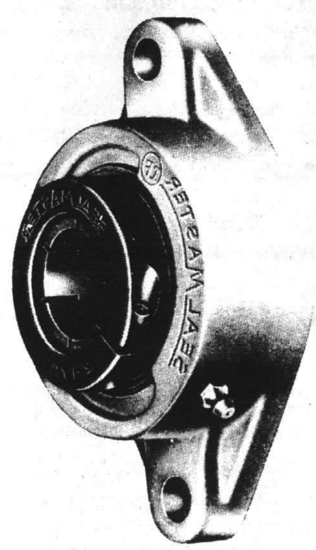


FIGURE 2 - Flange Type Bearing with Grease Fitting and Squeezeloc Tightener

TABLE 2 - Recommendations for Grease Lubricated Fan Bearings

OPERATING CONDITIONS	GREASING INTERVALS -20 F To 140 F	GREASING INTERVALS 140 F To 200 F
Clean, Dry	3-6 Months	1-3 Months
Dirty, Dry	1-3 Months	1-4 Weeks
Dirty, Wet, High Humidity	1-4 Weeks	1-14 Days
RECOMMENDED GREASES	**RECOMMENDED OPERATING RANGE**	
Texaco-Multi Fak #2	-20 F to 250 F	
Shell Alvania #2	-20 F to 250 F	
Mobil Mobilux #2	-20 F to 250 F	
Exxon Unirex #2	-20 F to 250 F	
Texaco Premium RB	-20 F to 250 F	
Mobil 532	-20 F to 250 F	
Exxon Beacon	-65 F to 250 F	
Keystone Keystone 84 H	-40 F to 225 F	

NOTE: Greases used should conform to NLGI No. 2 penetration.

FAN BEARING LUBRICATION

Fan bearings (see Figure 2) with grease fittings or with grease line extensions should be lubricated with a lithium base grease which conforms to NLGI Number 2 for consistency and which is free of chemical impurities. See Table 2 for recommended lubricants. Improper lubrication can result in early bearing failure.

To lubricate the fan bearings, complete the following:

1. Bearings are to be lubricated while unit is not running, disconnect main power switch.
2. Connect a manual grease gun to the grease line or fitting.
3. While turning the fan wheel manually, add grease, preferably when bearing is warm, until a light bead of grease appears at the bearing grease seal.

   NOTE: *On sizes 35 thru 86 CLCH or other size units with internal opposite drive side bearings, it will be necessary to remove unused bearing plate for observation of bearing grease seal.*

CAUTION: Do not over-lubricate bearings. Excessive pressure caused by overlubrication can displace bearing grease seals or cause grease to overheat the bearing, resulting in premature bearing failure.

WARNING: DISCONNECT ELECTRICAL POWER SOURCE BEFORE SERVICING THE UNIT. IF UNIT MUST BE ON FOR MAINTENANCE PROCEDURES, EXERCISE EXTREME CAUTION. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY OR DEATH FROM ELECTRICAL SHOCK OR ENTANGLEMENT IN MOVING PARTS.

FAN BEARING TIGHTENING INSTRUCTIONS (DOUBLE LOCK SETSCREW)

The pillow block bearing with double setscrew locking arrangement requires specific tightening instructions. See Figure 3. Complete the following.

1. Rotate the shaft until the double lock bearing setscrews are in the vertically up position as shown in Figure 4.
2. Without V-Belt tension, snug (hand tight) all four setscrews of the double lock bearing in the numerical sequence as shown in Figure 4.

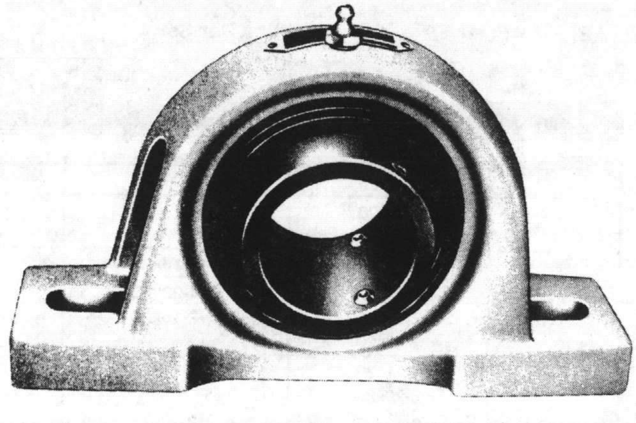


FIGURE 3 - Pillow Block Type Bearing with Grease Fitting and Double Lock Setscrew Arrangement

3. Torque each setscrew of the double lock bearing in the numerical sequence to 66 inch-pounds. See Figure 4.

FAN BEARING SELF-LOCKING COLLAR INSTALLATION

The pillow block bearing with self-locking collar arrangement is used on size 8-35 High Pressure Climate Changer Units. See Figure 5.

NOTE: *At or before start-up check the wiring of the three phase fan motor to assure proper shaft rotation. Incorrect fan rotation may loosen the locking collar resulting in pre-mature bearing failure.*

Complete the following recommended steps for bearing replacement.

1. Slip the shaft through the pillow block. Be certain the bearing is aligned in position along the shaft to eliminate any possibility of cramping loads.
2. Fasten the unit securely to the base using the proper bolt size.

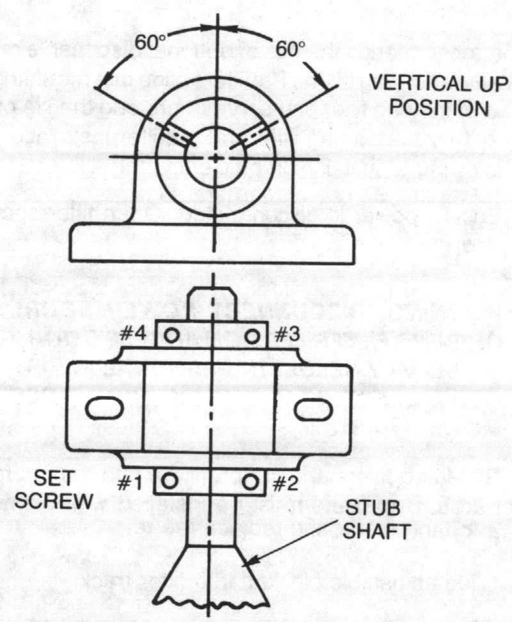


FIGURE 4 - Instruction Sketch for Pillow Block Bearing with Double Lock Setscrew

3. Manually rotate fan shaft several times to assure bearing alignment.
4. Place the self-locking collar on the shaft with its cam adjacent to the cam on the end of bearing's inner ring. Turn the collar in the direction of shaft rotation. The eccentric recessed cam will drop over and engage the corresponding cam on the bearing inner ring.
5. Using a light-weight hammer and drift pin inserted in the drift pin hole strike in the direction of shaft rotation to positively engage the collar. The wide inner ring is now locked to the shaft.
6. Tighten the setscrew to recommended torque. See Table 5.

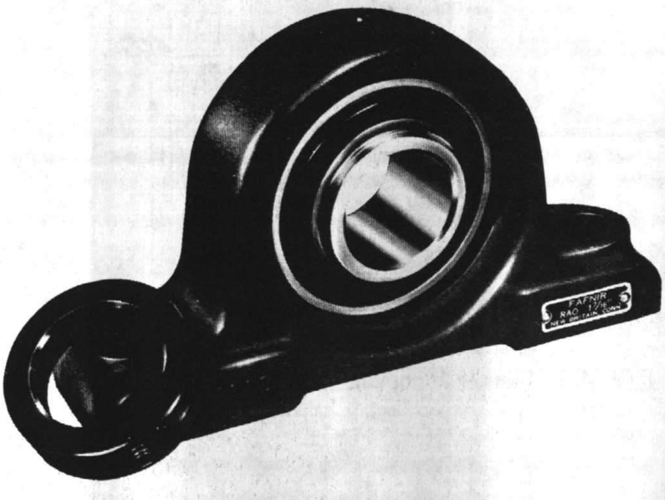


FIGURE 5 - Pillow Block Type Bearing with Grease Fitting and Self-Locking Collar Arrangement

FAN MOTORS

Inspect periodically for excessive vibration or temperature. Operating conditions will vary the frequency of inspection and lubrication. Table 3 lists recommended motor greasing intervals. Motor lubrication instructions are found on the motor tag or nameplate. If not available contact the motor manufacturer for instructions.

To relubricate the motor, complete the following:

WARNING: DISCONNECT POWER SOURCE FOR MOTOR LUBRICATION. FAILURE TO DO SO MAY RESULT IN INJURY OR DEATH FROM ELECTRICAL SHOCK OR MOVING PARTS.

1. Turn the motor off. Make sure it cannot accidentally restart.
2. Remove the relief plug and clean out any hardened grease.
3. Add fresh grease through the fitting with a low pressure grease gun.
4. Run the motor for a few minutes to expel any excess grease through the relief vent.
5. Stop the motor and replace the relief plug.

NOTE: *If excessive grease is plugged at the motor shaft, use less grease and/or extend the greasing interval.*

Refer to Table 4 for minimum torques of motor mounting and bearing bolts.

TABLE 3 - Motor Greasing Intervals

TYPE OF SERVICE	UP TO 7.5 HP MOTORS	10-40 HP MOTORS	50-150 HP MOTORS
8-16 Hrs., Clean, Dry	5 Years	3 Years	1 Year
12-24 Hrs., Moderate Dirt Or Moisture	2 Years	1 Year	6 Months
Severe - Very Dirty, High Temperature	6 Months	3 Months	2 Months

TABLE 4 - Minimum Hex Head Bolt Torques

BOLT SIZE	TORQUE - FOOT/POUNDS	
	GRADE 2	GRADE 5
¼" - 20 UNC	4	6
¼" - 28 UNF	4	7
5/16" - 18 UNC	8	14
5/16" - 24 UNF	9	16
⅜" - 16 UNC	14	24
⅜" - 24 UNF	16	28
7/16" - 14 UNC	30	42
7/16" - 20 UNF	35	45
½" - 13 UNC	40	69
½" - 20 UNF	47	83
9/16" - 12 UNC	57	99
9/16" - 18 UNF	68	118
⅝" - 11 UNC	86	150
⅝" - 18 UNF	101	176
¾" - 10 UNC	146	254
¾" - 16 UNF	173	301
⅞" - 9 UNC	206	358
⅞" - 14 UNF	244	422
1" - 8 UNC	289	500
1" - 14 UNF	347	602

NOTE: Grade 2 bolts have no markings on the capscrew. Grade 5 bolts have 3 radial dashes, 120 degrees apart.

TABLE 5 - Torques for Tightening Locking Screws, Bearings and Sheaves

TORQUE FOR TIGHTENING SETSCREWS				TORQUE FOR TIGHTENING SEALMASTER LOCKING COLLAR				
SET SCREW DIA.	HEX SIZE ACROSS FLATS	RECOM. TORQUE		COL-LAR	SCREW DIA.	HEX SIZE ACROSS FLATS	RECOM. TORQUE	
		INCH LBS.	FOOT LBS.				INCH LBS.	FOOT LBS.
¼"	⅛"	66	5.5	2-015B	8-32	⅛"	70	5.8
5/16"	5/32"	126	10.5	2-13B	8-32	⅛"	70	5.8
⅜"	3/16"	228	19.0	2-17B	10-24	9/64"	90	7.5
7/16"	7/32"	348	29.0					
½"	¼"	504	42.0					
⅝"	5/16"	1,104	92.0					

NOTE: Tighten bearing setscrews to the torque shown before running unit. Setscrews can loosen in shipment.

Fan motors should be stored indoors in a clean and dry atmosphere and on solid ground. The motor shaft should be turned occasionally to prevent brinelling of the bearings. If motors must be stored outdoors in varying, humid climate, use space heaters and cover the motors as completely as possible to keep them dry. If space heaters have not been installed and motors have been subjected to the elements for several months, the following steps are recommended before operating the motors:

1. Inspect bearings for moisture and rust. Replace bearings if necessary and repack with new grease.
2. Check motor winding. An acceptable reading is from 6 megohms to infinity. If reading is less than 5 megohms, windings should be dried out in an oven or by a blower.

3. Inspect the entire motor for rust and corrosion.
4. Lubricate the motor as instructed in this Maintenance manual, or as indicated by the maintenance tag on the motor.

SHEAVE ALIGNMENT

To prevent interference of the fan frame with the belt, make sure that the belt edge closest to the motor has the proper clearance from the fan frame, as shown in Figure 6.

Align the fan and motor sheaves by using a straightedge as shown in Figure 7. The straightedge must be long enough to span the distance between the outside edges of the sheaves. When the sheaves are aligned, the straightedge will touch both sheaves at points A through D. A string, drawn tight, may be used in the same manner. For uneven width sheaves, place a string in the center groove of both sheaves and pull tight. Adjust sheaves and tighten the sheave setscrews to the proper torques, given in Table 5.

Parallel operation of the fan and motor shafts is necessary to prolong belt life. Place a level on the shafts to check horizontal alignment. Shim if necessary.

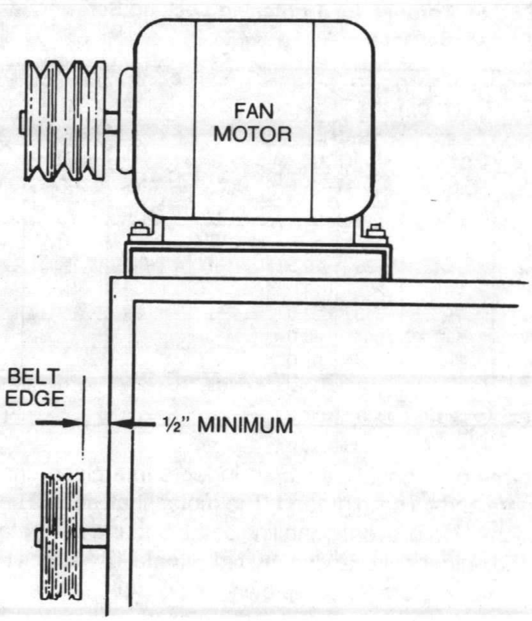


FIGURE 6 - Minimum Allowable Distance Between Frame Work and Fan Sheave

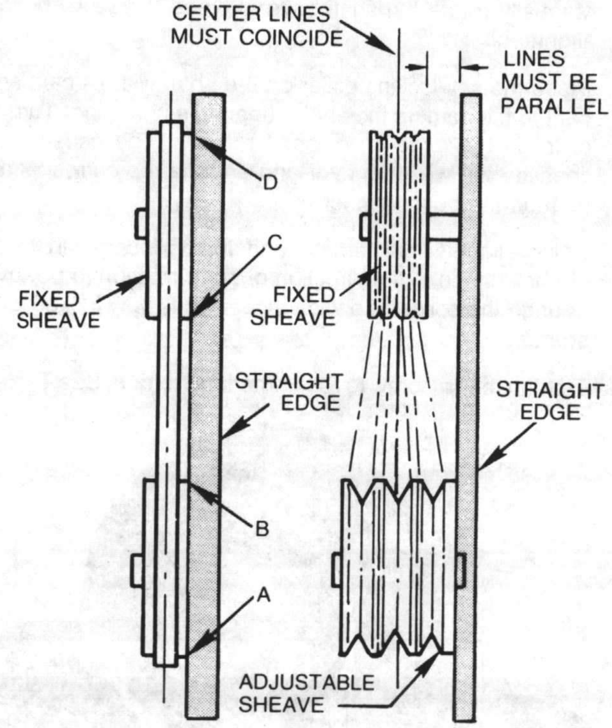


FIGURE 7 - Sheave Alignment

FAN ASSEMBLY SETSCREWS

Check and adjust fan wheel, bearing and sheave setscrews whenever a component is removed or an adjustment is made. Refer to Table 5 for recommended torques.

FAN WHEEL CLAMPS

The clamps that hold the fan hub on the shaft must be properly positioned and tightened to ensure safe fan operation.

NOTE: *On fans that are 20 inches or smaller, the clamps should be replaced whenever the wheel or shaft is replaced.*

On fans that are 20 inches or smaller, locate the two-piece clamp over the hub so that the hub tabs go through the clamp slots. Finger-tighten the two bolts evenly, then torque down both bolts **evenly** in small increments to 25 foot-pounds. The clamp flanges should meet at both bolt locations before 25 foot-pounds is reached.

On fans that are larger than 20 inches, finger-tighten the three bolts evenly, then torque down all three bolts **evenly,** in small increments, to 35 to 40 foot-pounds. Visually check the spacing between the three clamp flanges to make sure they are consistently tightened.

TABLE 6 - Values for K Factor (Belt Cross-Section Types)

BELT TYPE	A	B	C	D	E	3L	4L	5L	3V	5V	8V	AX	BX	CX	DX
"K" FACTOR	8	13	40	80	95	6	6	6	6	12	25	11	18	54	101

FAN BELT TENSION

NOTE: Fan belt tension should be checked at least twice during the first days of operation, since there is a rapid decrease in tension until belts are run in.

WARNING: DISCONNECT ELECTRICAL POWER SOURCE AND ALLOW ALL ROTATING EQUIPMENT TO STOP COMPLETELY BEFORE INSPECTING OR SERVICING THE UNIT. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY OR DEATH FROM ELECTRICAL SHOCK OR MOVING PARTS.

Proper belt tension is required to ensure maximum bearing and drive component life and is based on fan brake horsepower requirement. Use Chart 1 to find the proper tension and refer to the inset for an example. To use the chart, you must know:

1. Fan design bhp per belt (**not** motor hp)
2. Fan rpm
3. Fan sheave pitch diameter (Figure 8 - found by measuring where the middle of the belt rides in the sheave)
4. Type of belt cross-section (stamped on the belt)

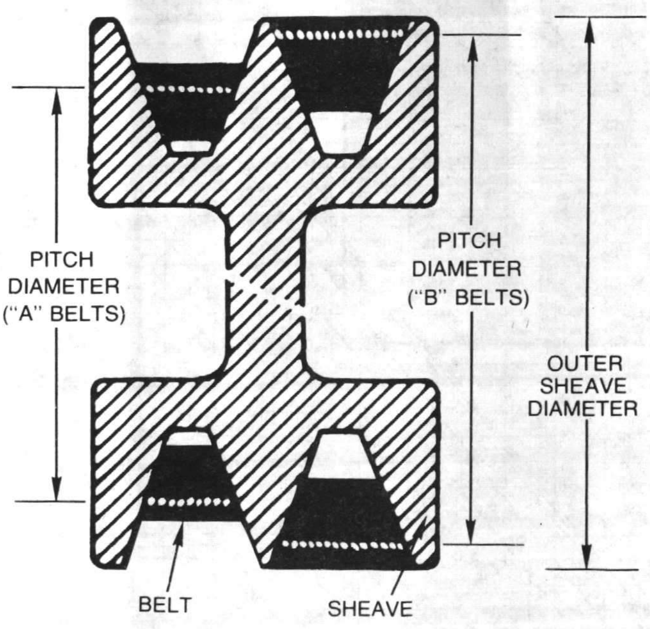


FIGURE 8 - Fan Sheave Pitch Diameter

As shown in the example of Chart 1, the correction tension (pounds force) is 9.6 pounds, at ½-inch deflection. Deflection is determined by dividing the belt span distance by 64, as shown in Figure 9.

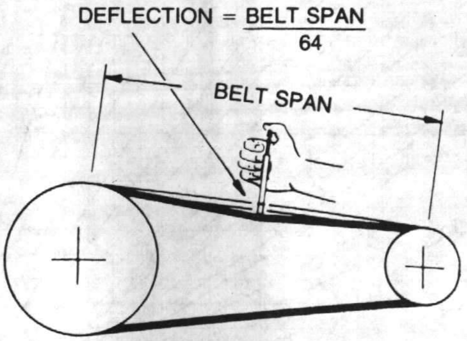


FIGURE 9 - Belt Tension Measurement

To measure belt tension, use a belt tensioner as shown in Figure 10. Determine actual deflection by depressing one belt with the belt tensioner and measuring the deflection relative to the other belts or to belt line. Adjust the belt tension to the correct pounds force and tighten all setscrews to the proper torques.

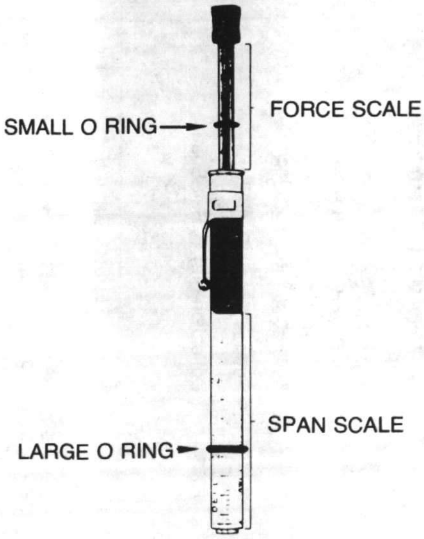
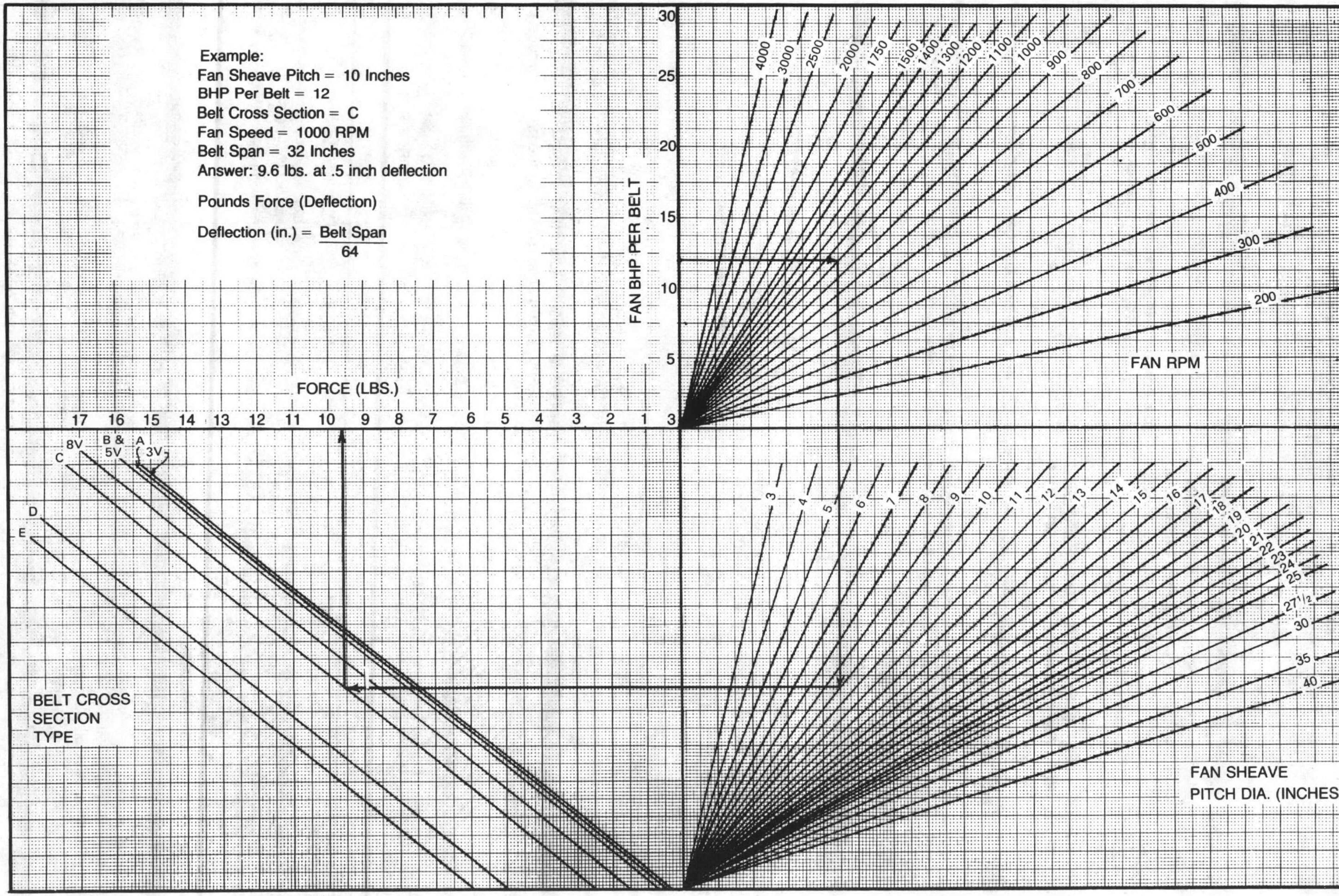


FIGURE 10 - Belt Tensioner

CHART 1 - Belt Tension



For belt cross-section types not given in Chart 1, refer to Table 6 and use the following equations to calculate correct belt tension:

$$F = \frac{T + K}{16}$$

where F = force measured in pounds at specific deflection

K = constant determined by belt cross-section type (See Table 6)

$$T = 24{,}750 \times \frac{\text{(fan hp per belt)}}{\text{(belt speed)}}$$

$$\text{Belt speed} = \frac{\text{(fan pitch diameter)}}{12} \times (\pi) \times \text{fan rpm (ft/min)}$$

For example, given the following:

Motor sheave pitch diameter: 16.8 inches, eight groove
Fan sheave pitch diameter: 19.8 inches, eight groove
Fan horsepower: 262.4 bhp
Fan rpm: 983 rpm
Belt type: 8V
Sheave span: 60.9 inches

$$\text{Belt speed} = \frac{19.8}{12} \times 3.14 \times 983 = 5092$$

$$T = 24{,}750 \times \frac{\text{(262.4 bhp/8 belts)}}{5092} = \frac{24{,}750 \times 32.8}{5092} = 159.4 \text{ lbs}$$

$$F = \frac{159.4 + 25}{16} = 11.5 \text{ lbs}$$

$$\text{Also, } D = \frac{\text{Belt span (inches)}}{64} = \frac{60.9}{64} = .95 =$$

approximately 15/16 inches

Therefore, the belt tensioner should read 11.5 pounds force at 15/16-inch deflection. This will yield 159.4 pounds force belt tension.

Belt tensions determined by using Chart 1 and Table 6 are minimum values. The correct operating tension for a V-belt drive is the lowest tension at which the belts will not slip under start-up or peak load conditions. It may be necessary, however, to increase the tension of some drives to reduce excessive belt flopping.

CAUTION: Do not over-tension the belts. Excessive tension will reduce fan and motor bearing life, accelerate belt wear and possibly cause shaft failure.

Remove the belt guard and clean the sheaves and belts with a dry cloth. Oil and grease should be kept away from the belts because they can cause deterioration and slippage. The use of belt dressing is **not** recommended.

COIL CLEANING

Coils should be kept clean to maintain maximum performance. If fins become dirty, they should be cleaned. Clean steam, hot water and water cooling coils with steam and detergent, hot water spray and detergent, or one of the commercially available chemical coil cleaners. Clean refrigerant coils with cold water and detergent or one of the commercially available chemical coil cleaners. Rinse coils thoroughly after cleaning.

WARNING: DO NOT USE STEAM OR HOT WATER TO CLEAN A REFRIGERANT COIL. IMPROPER APPLICATION OF HEAT MAY RESULT IN PERSONAL INJURY, DEATH OR EQUIPMENT DAMAGE DUE TO HIGH PRESSURE AND EXPLOSION.

COIL WINTERIZATION

Provisions must be made to drain those coils that are not in use when subjected to freezing temperatures.

CAUTION: Failure to properly drain and vent coils when not in use during freezing temperatures may result in coil freeze-up damage.

Coil types N, NS, and A, may be adequately drained in their pitched position in the unit. In coilless units, the coil, after field installation, is not pitched (unless special pitching coil support channel is ordered for steam coils) and may be adequately drained in their position in the unit.

(Type N is drainable through the return connection.) The installer should have provided appropriate piping for adequate drainage.

Type WL coils are not drainable in either pitched or level position. To drain these coils remove the vent and drain plugs and blow the coils out as completely as possible with compressed air. The coils should then be filled and drained several times with full strength glycol so that it will mix thoroughly with the water retained in the coil. Drain the coil out as completely as possible.

Coil types D, DD and K, plus W, P2, P4, P8, DL and LL are drainable in their factory-installed level position. Coil types D, DD, DL and LL also have Trane factory-installed drain and vent connections. See the Installation Manual for illustrated drain and vent connection locations.

Drainable coils installed in units containing coil types DL or LL will also have factory-installed drain and vent connections.

NOTE: *On units with stacked coils, there is a condensate follower located at the end of each coil connection. Figure 11 illustrates the location of the condensate follower provided at the end of the stacked coils.*

NOTE: *Coil type TT is drainable through its supply connection.*

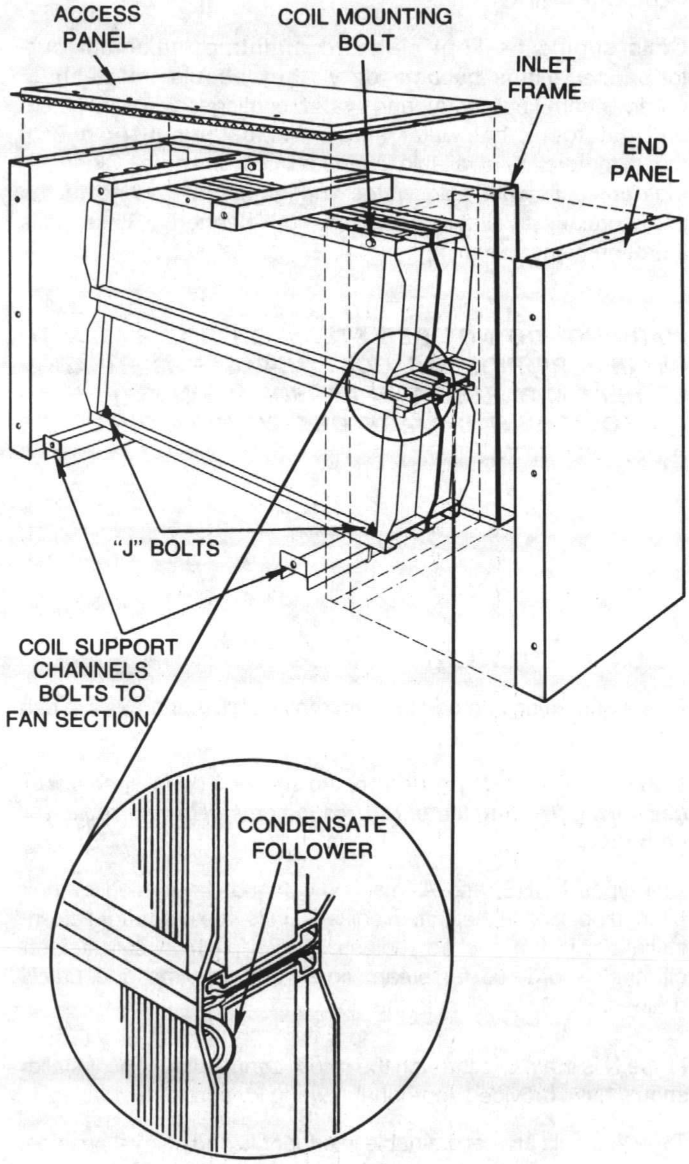


FIGURE 11 - Draw-Thru Coil Section Details with View of Condensate Follower

SPRAY HUMIDIFIER NOZZLE

If lime deposits have developed, clean by soaking the nozzle in an industrial cleaning solution intended for that purpose. Rinse thoroughly with water. Follow the application, safety and cleaning instructions of the industrial cleaner.

MANOMETER CALIBRATION

To check and adjust the calibration of the bag filter or roll filter manometer, complete the following:

1. Make sure the manometer is properly installed on the unit wall within three feet of the filter section. Drain oil from the gauge. Disconnect top tube.
2. Adjust the gauge until the bubble is centered in the spirit level. Tighten the mounting screws and check to be sure that the gauge remained level.
3. Turn the zero-adjust knob counterclockwise until it stops. Then turn it clockwise approximately three full turns so that there is room for adjustment in either direction.
4. Remove the fill plug and pour in needed gauge fluid until the fluid level is visible in the vicinity of zero on the scale. Adjust for exact zero setting with the zero knob and replace the fill plug.

   CAUTION: Use Dwyer red or blue oil only. Other fluids may damage the gauge.

5. Clean the gauge with a soft cloth and soap and water. Rinse carefully.

SPRAYED COIL WATER SYSTEM

To complete the yearly cleaning and check for sprayed coil spray systems, complete the following:

1. Clean the spray tank and the spray pump return line strainer. See Figure 12.
2. Check the spray float valve and pump pressure. Adjust the float so that the water level is 1/2-inch below the overflow pipe.
3. Check that the copper pipe is properly located in the overflow drain and is free of dirt, so that the spray tank water is continually being changed.
4. Clean spray nozzles, if necessary, and check for corrosion. Replace damaged nozzles.

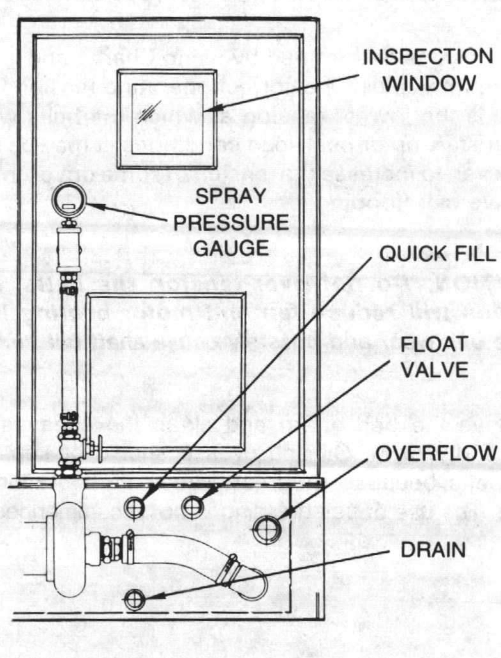


FIGURE 12 - Sprayed Coil Unit Tank Connections

THERMAL EXPANSION VALVE ADJUSTMENT

The importance of proper suction gas superheat cannot be over-emphasized. Accurate superheat measurements should be taken with other trouble analysis procedures to monitor refrigerant flow, coil efficiency and compressor protection. **Refer to compressor or condensing unit service literature for recommended superheat setting.**

Instruments

Because of the importance and sensitivity of superheat measurement and adjustment, the gauges used to measure suction pressure should be of the best quality available. Gauges that are permanently installed on the equipment should not be used. Trane recommends a good quality gauge on a standard refrigerant manifold set. To measure suction temperature, an electronic temperature tester is sufficient.

Measurement

In order to determine suction gas superheat, the pressure at the evaporator outlet must be measured and converted to saturated vapor temperature. Use a Refrigerant-22 pressure temperature conversion chart as given in Table 7 to convert pressure (psig) to temperature (degrees F). The computed saturated vapor temperature is then subtracted from the actual suction temperature, which is also measured on the suction line at the expansion valve sensing bulb location. The difference between these two temperature readings is the suction gas superheat reading.

NOTE: *If a pressure tap is not provided at the thermal expansion valve sensing bulb location, suction pressure may be measured at the compressor, if suction line pressure is added to the compressor pressure reading. Suction pressure at the compressor plus estimated suction line pressure loss equals an estimate of suction pressure at the thermal expansion valve sensing bulb location.*

To determine actual superheat, complete the following:

1. Cut the suction line insulation to gain access to the suction line at the sensing bulb. If Armaflex insulation is used, slit the insulation for the length of the temperature sensor.
2. Clean the line carefully and attach the electronic temperature sensor. Make sure the sensor is making good contact with the tube. Black electrical tape may be used to prevent sensor contact with ambient air.

   NOTE: *For accurate measurement, the temperature sensor* ***must*** *be properly installed and insulated. Make sure that the insulation covers the sensor completely and seal all connections to the pipe to keep ambient air from affecting the temperature readings.*

3. Install the pressure gauge to monitor suction pressure at the expansion valve sensing bulb location. If no pressure tap is provided, install the pressure gauge at the compressor and estimate the suction line pressure loss between the compressor and sensing bulb.
4. Operate the system for approximately 10 to 15 minutes in order for the expansion valve to stabilize.
5. To calculate superheat from pressure and temperature readings, compare the actual vapor temperature of the refrigerant as converted from the suction pressure reading (plus suction line pressure loss, if applicable) to the suction temperature measured by the electronic tester. See the examples given below.

EXAMPLE 1:

SUCTION PRESSURE = 66.0 psig (measured at expansion valve sensing bulb)
SUCTION TEMPERATURE = 52 F
SUCTION PRESSURE CONVERTED TO SATURATED VAPOR TEMPERATURE = 38 F
SUCTION SUPERHEAT = 52-38 = 14 F

EXAMPLE 2:

SUCTION PRESSURE = 65.0 psig (measured at the compressor)
ESTIMATED SUCTION LINE PRESSURE LOSS = 3 psi
TOTAL ESTIMATED SUCTION PRESSURE = 68 psig (at the sensing bulb)
SUCTION TEMPERATURE = 52 F
SUCTION PRESSURE CONVERTED TO SATURATED VAPOR TEMPERATURE = 40 F
SUCTION SUPERHEAT = 52-40 = 12 F

Adjustment

To increase the superheat reading, turn the adjusting stem of the expansion valve to close the valve and to limit the amount of refrigerant flowing into the evaporator. **Adjustment should be made at one-half turn at a time.** To

TABLE 7 - Refrigerant-22 Pressure/Temperature Conversion Chart

TEMPERATURE (DEGREES F)	SUCTION PRESSURE (PSIG)
26	49.9
27	51.2
28	52.4
29	53.6
30	54.9
31	56.2
32	57.5
33	58.8
34	60.1
35	61.5
36	62.8
37	64.2
38	65.6
39	67.1
40	68.5
41	70.0
42	71.4
43	73.0
44	74.5
45	76.0
46	77.6
47	79.2
48	80.8
49	82.4
50	84.0

decrease the superheat reading, increase refrigerant flow to the evaporator. Continue with tests and adjustments, one-half turn at a time, until an acceptable reading is obtained. Allow the system to re-stabilize for 10 minutes after each adjustment.

CAUTION: Incorrect superheat readings may be due to plugged filters or blocked refrigerant flow. Before making major adjustments to the expansion valve, check refrigerant level and filter/driers to ensure proper flow. Blocked filters may cause floodback to the compressor, damaging internal components.

TROUBLE ANALYSIS

SYSTEM CHECK

Before repairing or replacing any Climate Changer unit or component, complete the following simple checks. A trouble analysis chart follows this checklist. For more detailed information on the unit, refer to the Service Guide available through your local Trane Sales Office.

WARNING: DISCONNECT ELECTRICAL POWER BEFORE SERVICING OR INSPECTING THE UNIT. DISCONNECT POWER BEFORE REMOVING OR CONNECTING ELECTRICAL WIRES. ALLOW ALL ROTATING EQUIPMENT TO STOP BEFORE SERVICING THE UNIT. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY OR DEATH FROM ELECTRICAL SHOCK OR ENTANGLEMENT IN MOVING PARTS.

☐ 1. Electrical power is available to unit.

☐ 2. Unit is turned on.

☐ 3. Electrical routing and connections are correct. Refer to specific wiring diagrams provided on the unit.

☐ 4. Filters are clean and properly positioned.

☐ 5. Fan belt is not broken or slipping.

☐ 6. Fan sheaves are properly aligned.

☐ 7. Fan is not hitting housing or inlet cone.

☐ 8. Dampers are not stuck open or closed.

☐ 9. Ductwork connections are secure and airtight.

☐ 10. Piping has no leaks.

☐ 11. Coils are not clogged or frozen.

TROUBLE ANALYSIS CHARTS

Use the tables in this section to assist in identifying the cause or causes of a malfunction in Climate Changer® operation. The column headed RECOMMENDED ACTION will suggest repair procedures.

NOTE: *These tables are intended as a diagnostic aid only. For detailed repair procedures, contact your local Trane Service Company.*

WARNING: DISCONNECT ELECTRICAL POWER BEFORE INSPECTING OR SERVICING THE UNIT AND ALLOW ALL ROTATING EQUIPMENT TO STOP COMPLETELY. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY OR DEATH FROM ELECTRICAL SHOCK OR MOVING PARTS.

CLIMATE CHANGER® TROUBLE ANALYSIS

SYMPTOM	POSSIBLE CAUSE	RECOMMENDED ACTION
Motor fails to start.	Blown fuse or open circuit breaker.	Replace fuse or reset circuit breaker.
	Overload trip.	Check and reset overload.
	Improper wiring or connections.	Check wiring with diagram supplied on unit.
	Improper current supply.	Compare actual supply power with motor nameplate recommendations. Contact power company for adjustments.
	Mechanical failure.	Determine that motor and drive turn freely. Check bearings and lubrication.
	Short-circuited stator.	Indicated by blown fuses. Motor must be rewound.
	One phase of a three-phase motor is open.	Check line for open phase.
	Overloaded motor.	Reduce load or replace with larger motor.

SYMPTOM	POSSIBLE CAUSE	RECOMMENDED ACTION
Motor stalls.	Low line voltage.	Check across AC line. Correct voltage if possible.
	Overloaded motor.	Reduce load or replace with a larger motor.
Motor runs and then dies down.	Partial loss of line voltage.	Check for loose connections. Determine adequacy of main power supply.
	Stator shorts when motor warms up.	Replace stator.
Motor does not come up to speed.	Low voltage at motor terminals.	Check across AC line and correct voltage loss if possible.
	Line wiring to motor too small.	Replace with larger sized wiring.
	60 cycle motor connected to 50 cycle supply.	Replace with a 50 cycle motor.
Motor overheats.	Overloaded motor.	Reduce load or replace with a larger motor.
	Motor fan is clogged with dirt, preventing proper ventilation.	Remove fan cover, clean fan and replace cover.
	Three-phase motor has one phase open.	Check wiring. Secure all connections.
	Improper line voltage.	Check across AC line. Consult power company. Step transformer may be necessary.
	Worn bearings.	Replace bearings and seals.
Excessive motor noise.	Motor mounting bolts loose.	Tighten motor mounting bolts.
	Rigid coupling connections.	Replace with flexible connections.
	Worn motor bearings.	Replace bearings and seals.
	Fan rubbing on fan cover.	Remove interference in fan housing.
Rapid motor bearing wear.	Excessive overhung load due to over-tensioned drive.	Check belt tension and overhung load.
	Excessive overhung load due to a small diameter motor sheave.	Replace sheave with larger one.
Loose fan belt.	Motor is poorly positioned.	Adjust tension.
	Worn or damaged belt.	Replace belt or belt set. Check sheave alignment.
	Worn sheaves.	Replace sheaves.
Short belt life.	Worn sheaves.	Replace sheaves.
	Misaligned belt.	Realign drive with MVP sheave set at mean pitch diameter.
	Grease or oil on belts.	Check for leaky bearings. Clean belts and sheaves.
	Belt slipping.	Adjust tension.
	Belts rubbing.	Remove obstruction or realign drive for clearance.
	High ambient temperature.	Provide ventilation. Shield belts. Use gripnotch belts.

SYMPTOM	POSSIBLE CAUSE	RECOMMENDED ACTION
Low coil capacity. (CHILLED WATER)	Air is bypassing coil.	Prevent bypass with blockoffs.
	Coil tubes are blocked.	Clean and unblock tubes.
	Incorrect airflow.	Check fan operating conditions.
	Incorrect gpm.	Check water pumps, valves and lines for obstructions.
	Incorrect water temperature.	Provide proper water temperature.
Low coil capacity. (REFRIGERANT)	Air is bypassing coil.	Prevent bypass with blockoffs.
	Coil tubes are blocked.	Clean and unblock tubes.
	Incorrect airflow.	Check fan operating conditions.
	Expansion valve not operating.	Check sensing bulb location and TEV operation.
	Poor refrigerant distribution.	Check for blockage in distributor and tubes.
Low coil capacity. (STEAM)	Air is bypassing coil.	Prevent bypass with blockoffs.
	Tubes are blocked.	Clean and unblock tubes.
	Incorrect airflow.	Check fan operating conditions.
	Incorrect steam pressure.	Adjust pressure supply.
Fan does not operate.	Electrical.	Check fuses, electrical on-off switch, overload protector and voltage output.
	Mechanical.	Look for broken belts or loose pulleys. Make sure the fan blades are not stopped or obstructed by the fan housing.
Noisy fan.	Fan hitting inlet cone, cutoff, or housing.	Center fan in inlet cone. Secure cutoff in housing. Secure fan on shaft. Repair or replace damaged parts.
	Drive belts not operating properly.	Adjust belt tension. Check for matched set. Replace worn or broken belts and clean oily or dirty belts.
Bearing is excessively hot.	First start after relubrication. (grease distribution)	Allow machine to cool down and restart.
	Over-lubrication.	Clean surface of grease and purge.
	No lubricant.	Apply lubricant. Check bearings for damage.
	Excessive load or speed.	Replace with a larger bearing.
	Misaligned bearing.	Correct alignment. Check shaft level.

For further information on this product or other Trane products, refer to the "Trane Service Literature Catalog", ordering number IDX-IOM-1. This catalog contains listings and prices for all service literature sold by Trane. The catalog may be ordered by sending a $20.00 check to: The Trane Company, Service Literature Sales, 3600 Pammel Creek Road, La Crosse, WI 54601.

PRINTED BY PRODUCTION SERVICES — LA CROSSE

JH/DL

TRANE

INSTALLER'S GUIDE

BTA-IN-3

BLDG AS-202
AS-236

18-AC33D1
1st Printing, 1984

BTA—B or D CONDENSING UNITS
(36,000 - 72,000 BTUH)

ALL phases of this installation must comply with NATIONAL, STATE AND LOCAL CODES.

These instructions do not cover all variations in systems nor provide for every possible contingency to be met in connection with installation. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to The Trane Company, Dealer Products Group.

A. GENERAL

Check for transportation damage after unit is uncrated. Report promptly to the carrier, any damage found to the unit.

To determine the electrical power requirements of the unit, refer to the nameplate of the unit. The electrical power available must agree with that listed on the nameplate.

B. LOCATION & PREPARATION OF THE UNIT

1. The unit should be set on a level, reinforced concrete pad 2″ larger than the unit on all sides. (Approximate pad size is 35″ x 35″.) (See Figure 1.)

2. The concrete pad must NOT be in direct contact with any structure. Unit must be positioned a minimum of 12″ from any wall or surrounding shrubbery to insure adequate airflow. Clearance must be provided in front of control box (access panels) and other sides requiring service access in accordance with National and Local Codes. Also, the unit location must be far enough away from any structure to prevent roof run-off water from pouring directly on the unit.

3. The top discharge area must be unrestricted for at least five (5) feet above the unit.

4. Mount the unit on mounting pads (shipped with condensing unit) and install in accordance with instruction included with mounting pads.

5. When the outdoor unit is mounted on a roof, be sure the roof will support the unit's weight. Vibration isolation is recommended to prevent transmission to the building structure.

6. The maximum length of refrigerant lines from outdoor to indoor unit should NOT exceed eighty (80) feet.

7. If outdoor unit is mounted above the air handler, maximum lift should not exceed 80 feet (suction line). If air handler is mounted above condensing unit, maximum lift should not exceed 60 feet (liquid line).

NOTE: Refer to "Refrigerant Piping Guide" Pub. No. 22-3040 Tab 16 in "APPLICATION MANUAL."

8. Locate and install indoor coil or air handler in accordance with instruction included with that unit.

C. REFRIGERANT LINES

All "000" series condensing units have provisions for Field Fabricated lines. The indoor section may have Quik-Attach Couplings.

All "700" series condensing units are equipped with "Quik-Attach" line connectors. The use of precharged "Quik-Attach Lines" is recommended.

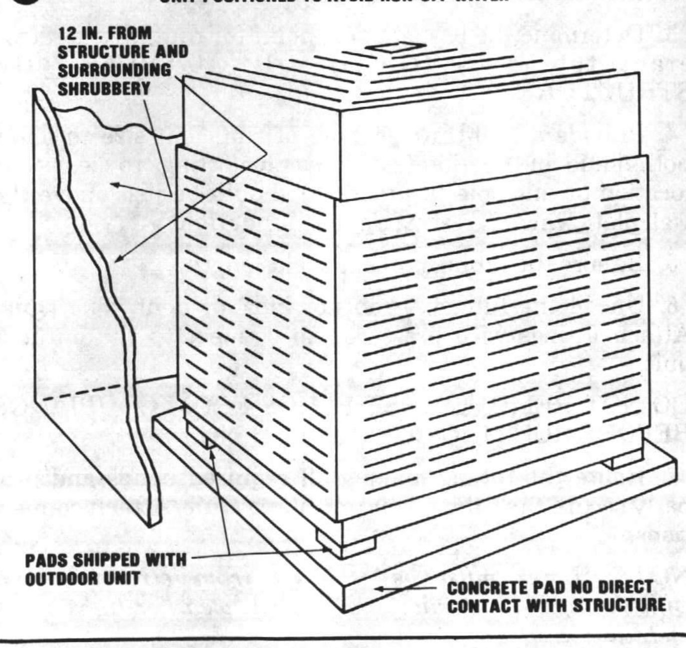
Standard tire-valve type pressure taps are provided on the precharged lines for installation and service use.

The indoor end of recommended refrigerant lines may be straight or with a 90 degree bend, depending upon situation requirements. This should be thoroughly checked out before ordering refrigerant lines.

The suction (gas) line must always be insulated.

1

TOP DISCHARGE—UNRESTRICTED 5 FT. ABOVE UNIT WITH UNIT POSITIONED TO AVOID RUN-OFF WATER

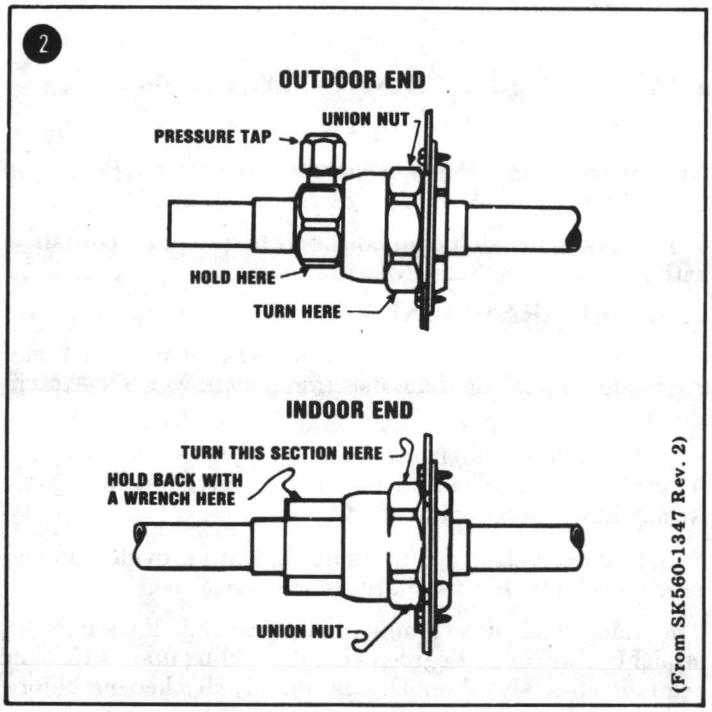


dwg. no. 21A125008 P06

C. INSTALLING REFRIGERANT LINES (Cont.)

The units are factory charged with the system charge required when using 10 feet of connecting line. The precharged lines are provided with the proper charge to accommodate their length. Unit nameplate charge is the total system charge with 25 feet of interconnecting lines.

If refrigerant charge adjustment is considered necessary, use the Charge Charts (Operating Instructions) accompanying the outdoor unit.



1. Determine the most practical way to run the lines.

2. Consider types of bends to be made and space limitations. *NOTE: Large diameter tubing will be very difficult to rebend once it has been shaped.*

3. Determine the best starting point for routing the refrigerant tubing — INSIDE OR OUTSIDE THE STRUCTURE.

4. Provide a pull-through hole of sufficient size to allow both liquid and suction (gas) lines plus fittings to clear. The location of this hole (if practical) should be just above the wall plate which is resting on the foundation.

5. Be sure the tubing is of sufficient length.

6. Uncoil the tubing — do not kink or dent. The Quik-Attach fittings with pressure tap connect to the outdoor unit.

DO NOT REMOVE DUST PLUGS FROM COUPLINGS BEFORE ROUTING COPPER TUBING.

7. Route the tubing making all required bends and properly secure the tubing before making Quik-Attach connections.

NOTE: Lines must be isolated from structure and pull-through hole must be sealed weather-tight after installation.

ATTACHING COUPLING QUIK-ATTACH

1. Remove the protective plugs from all fittings.

2. Oil the face and threads of the couplings with clean refrigerant oil before mating. Make sure that no dirt, water or other foreign material is permitted to adhere to the mating surfaces of the couplings before the halves are connected.

3. Engage the fittings by hand tightening the union nut until snug.

CAUTION: The male and female Quik-Attach fittings must be properly aligned to prevent cross threading.

4. Continue tightening with a wrench until the coupling halves bottom. A firm metal to metal contact will be felt.

5. Advance the union nut another 1/4 turn. This final turn is necessary to insure a proper metal seal of the coupling halves, forming a leak-proof joint. Do NOT continue to tighten the coupling as distortion of the coupling nut will result in a leak.

CAUTION: Correct tightening of the coupling is very important. Undertightening or overtightening will result in a coupling leak.

NOTE: For attaching the indoor connection, follow the instructions packaged with the indoor unit. See Figure 2 as a reference to the appearance of completed indoor Quik-Attach coupling installation.

D. FIELD FABRICATED REFRIGERANT LINES

The routing of the field fabricated lines is done making the same observations as for the precharged lines.

1. Minimize the use of sharp 90° bends.

2. Cut and fit tubing, then braze using accepted good brazing techniques.

3. Use a dry nitrogen purge and brazing alloy without flux for brazing.

4. Insulate the entire suction (gas) line and its fittings.

5. Do NOT allow uninsulated lines to come into contact with each other.

Upon completion of installation, evacuate, and/or purge the refrigerant lines before connecting to the outdoor unit. If purging with R-22 refrigerant, connect the indoor fittings and purge from the liquid line through the indoor coil and out the suction (gas) line pressure tap.

6. Using a manifold gauge, connect an external supply of R-22 to the gauge port tap on the liquid line valve. Position R-22 supply container so only the gas is used in purging.

7. Charge connecting lines and indoor coil to the gas pressure of R-22 supply.

8. Leak check brazed line connections using soap bubbles or halogen leak detector. Repair leaks (if any) after relieving pressure.

9. Close manifold gauge valve, depress valve stem in gauge port on suction (gas) line valve and bleed-off gas pressure in connecting lines and indoor coil down to 2 PSIG.

10. Repeat this purging described in steps 7 and 9 two additional times.

NOTE: When the outdoor temperature is below 60°F. and above 40°F., purge the connecting lines and indoor coil four times. When the outdoor temperature is below 40°F., purge the connecting line and indoor coil five times.

If refrigerant lines are to be field fabricated or if precharged lines have been altered in length, it will be necessary to adjust refrigerant, to the system upon completion of installation. Use the following table for recommended amount.

Tubing Sizes			Additional
Suction	Liquid	Tubing Length	Refrigerant
1-1/8″	3/8″	15′	5 oz.
1-1/8″	3/8″	25′	12 oz.
1-1/8″	3/8″	32′	18 oz.
1-1/8″	3/8″	40′	24 oz.
7/8″	3/8″	15′	4 oz.
7/8″	3/8″	25′	11 oz.
7/8″	3/8″	32′	16 oz.
7/8″	3/8″	40′	22 oz.
7/8″	5/16″	15′	3 oz.
7/8″	5/16″	25′	8 oz.
7/8″	5/16″	32′	11 oz.
7/8″	5/16″	40′	15 oz.
3/4″	5/16″	15′	2 oz.
3/4″	5/16″	25′	7 oz.
3/4″	5/16″	32′	10 oz.
3/4″	5/16″	40′	13 oz.
5/8″	1/4″	15′	–3 oz.
5/8″	1/4″	25′	0 oz.
5/8″	1/4″	32′	+2 oz.
5/8″	1/4″	40′	+4 oz.

Tubing lengths in excess of forty (40) feet use the following amount:
1-1/8″ and 3/8″ uses 3 oz. per each 4 ft.
7/8″ and 5/16″ uses 5 oz. per each 10 ft.
7/8″ and 3/8″ uses 7 oz. per each 10 ft.
3/4″ and 5/16″ uses 4 oz. per each 9 ft.
5/8″ and 1/4″ uses 1 oz. per each 4 ft.

E. LEAK CHECK

Check for leaks with an electronic leak detector or liquid soap. If no leaks are present, insulate the suction (gas) line fittings and exposed tubing to prevent sweating.

F. ELECTRICAL CONNECTIONS

WARNING: When installing or servicing this equipment, ALWAYS exercise basic safety precautions to avoid the possibility of electric shock.

1. All electrical lines, sizing, protection, and grounding must be in accordance with national and local electrical codes.
2. Install a separate disconnect switch at the outdoor unit.
3. Isolate conduit whenever vibration transmission may cause a noise problem within the building structure.
4. Be sure all connections are made tight and no wires exposed.
5. All electrical accessories must be installed and wired according to the instructions packaged with that accessory, (see typical Hook-Up diagrams on pages 4, 5 & 6).
6. Use color coded, low voltage, multi-wire cable to simplify low voltage connections between outdoor unit, indoor unit and room thermostat for easy identification.

G. ELECTRIC HEATERS

Electric heaters, if used, are to be installed in the air handling device according to the instructions accompanying the air handler and the heaters.

H. OPERATIONAL AND CHECKOUT PROCEDURES

Final phases of this installation are the unit Operational and Checkout Procedure which are found on pages 7 & 8 of this instruction.

I. COMPRESSOR SUMP HEAT

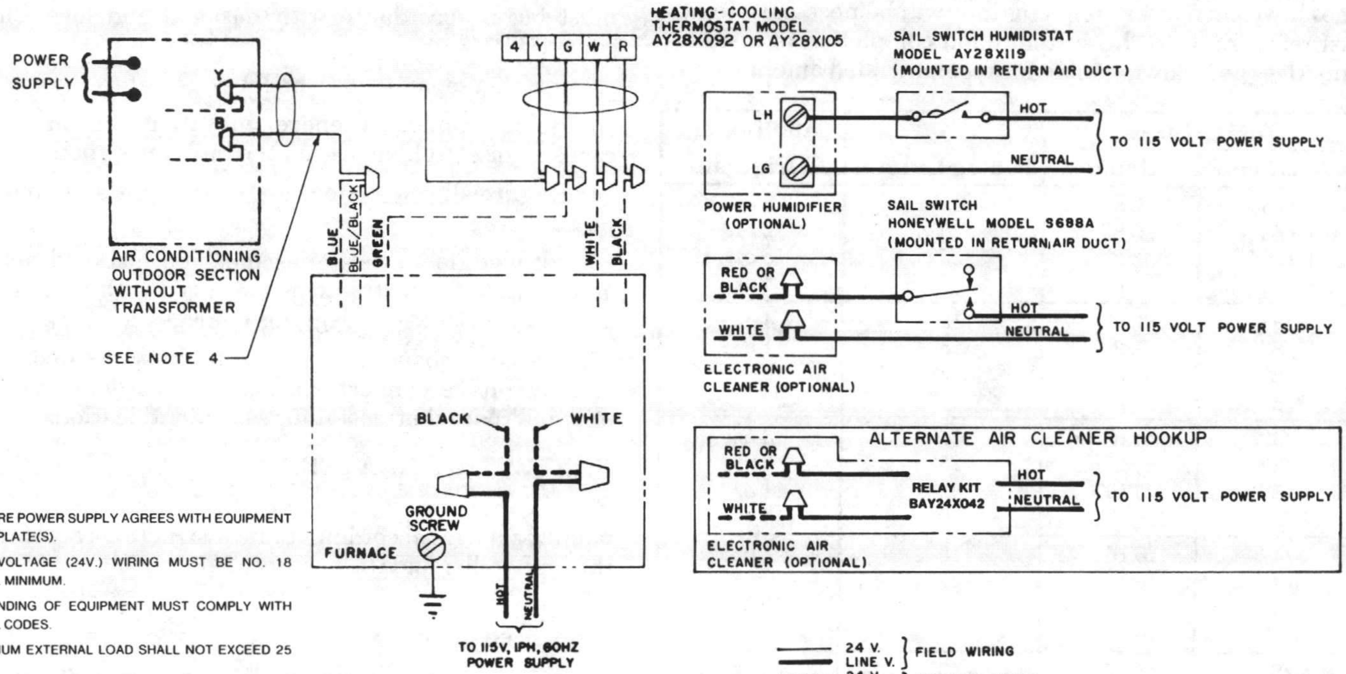
After all electrical wiring is complete, SET THE THERMOSTAT SYSTEM SWITCH IN THE OFF POSITION SO COMPRESSOR WILL NOT RUN, and apply power by closing the system main disconnect switch. This will activate the compressor sump heat. Do not change the Thermostat System Switch until power has been applied long enough to evaporate any liquid R-22 in the compressor (30 minutes for each pound of R-22 in the system as shown on the nameplate). Following this procedure will prevent compressor damage at the initial startup.

Record the "POWER APPLIED DATA" on the designated lines below:

Time _______________ A.M./P.M. Date _______________

By ______________________________
(Electrician)

FIELD WIRING DIAGRAM FOR BTA WITH FURNACE (TRANSFORMER IN FURNACE)



NOTES:

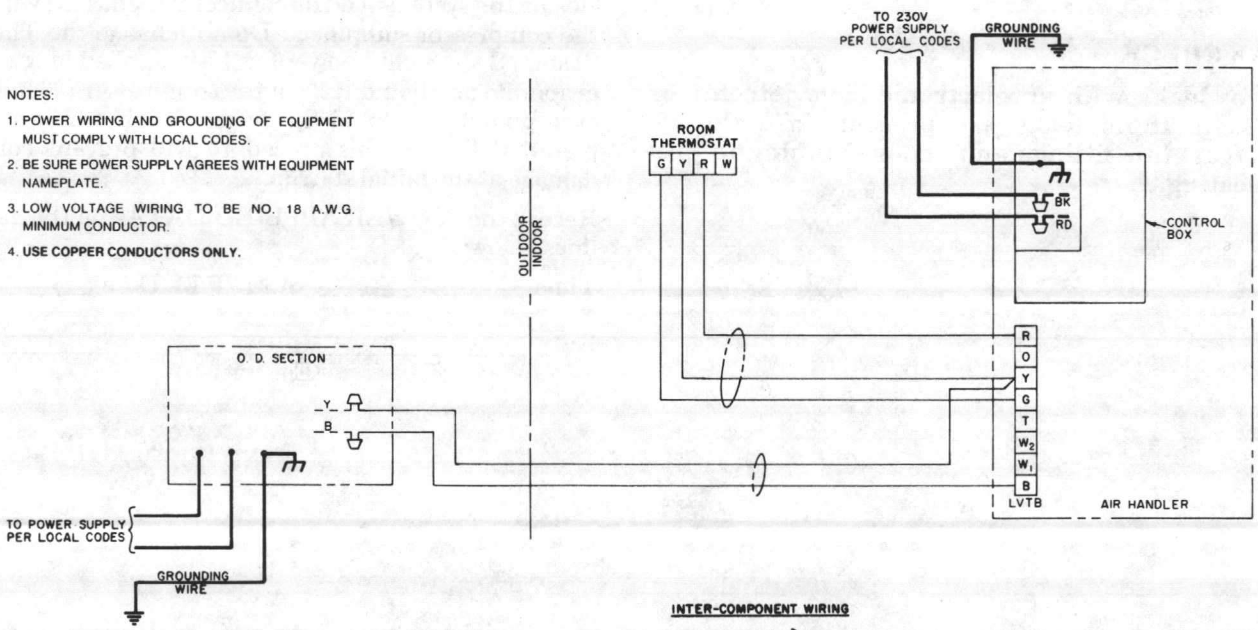
1. BE SURE POWER SUPPLY AGREES WITH EQUIPMENT NAMEPLATE(S).
2. LOW VOLTAGE (24V.) WIRING MUST BE NO. 18 A.W.G. MINIMUM.
3. GROUNDING OF EQUIPMENT MUST COMPLY WITH LOCAL CODES.
4. MAXIMUM EXTERNAL LOAD SHALL NOT EXCEED 25 VA.

From Dwg. 21B308116 Rev. 0

FIELD WIRING DIAGRAM FOR BTA WITH BWV,BWH BWE-C AIR HANDLERS, NO SUPPLEMENTARY HEAT

NOTES:

1. POWER WIRING AND GROUNDING OF EQUIPMENT MUST COMPLY WITH LOCAL CODES.
2. BE SURE POWER SUPPLY AGREES WITH EQUIPMENT NAMEPLATE.
3. LOW VOLTAGE WIRING TO BE NO. 18 A.W.G. MINIMUM CONDUCTOR.
4. USE COPPER CONDUCTORS ONLY.

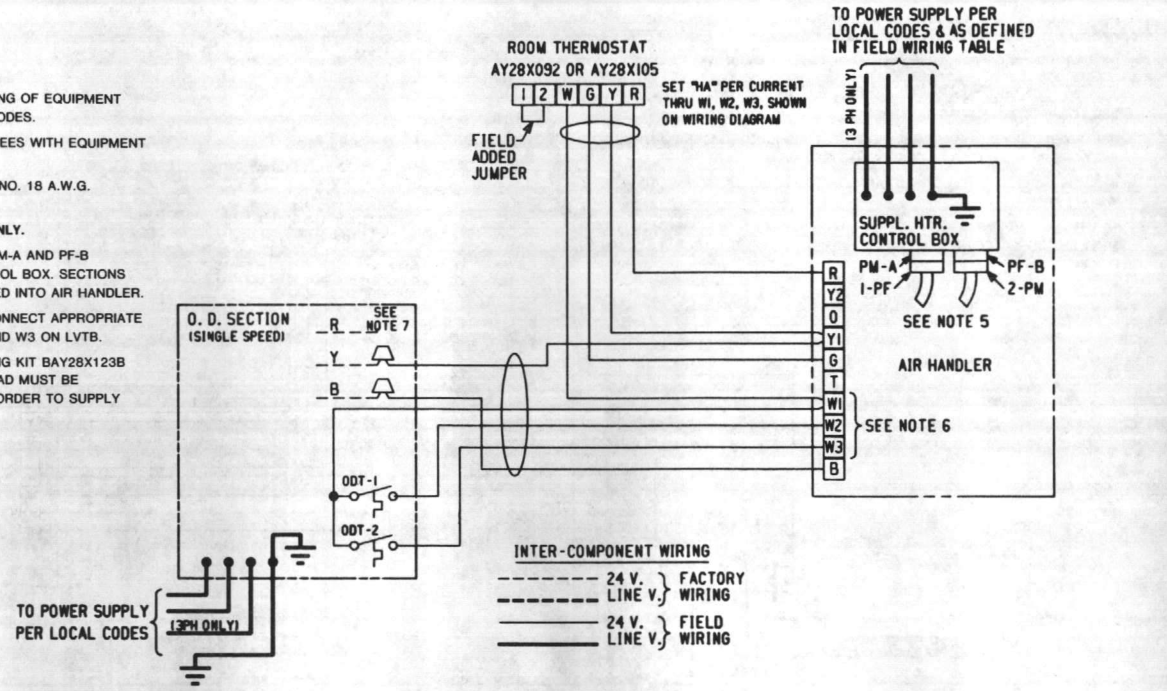


From Dwg. 21B126333 Rev. 1

FIELD WIRING DIAGRAM FOR BTA WITH BWV,BWH-A or P AIR HANDLERS

NOTES:

1. POWER WIRING AND GROUNDING OF EQUIPMENT MUST COMPLY WITH LOCAL CODES.
2. BE SURE POWER SUPPLY AGREES WITH EQUIPMENT NAMEPLATE.
3. LOW VOLTAGE WIRING TO BE NO. 18 A.W.G. MINIMUM CONDUCTOR.
4. **USE COPPER CONDUCTORS ONLY.**
5. POLARIZED PLUG SECTIONS PM-A AND PF-B ATTACHED TO HEATER CONTROL BOX. SECTIONS 1-PF AND 2-PM FACTORY WIRED INTO AIR HANDLER.
6. IF ODT IS NOT USED, THEN CONNECT APPROPRIATE JUMPERS FROM W1 TO W2 AND W3 ON LVTB.
7. TO USE LOW AMBIENT COOLING KIT BAY28X123B ON 3 PHASE MODELS, "R" LEAD MUST BE CONNECTED TO "Y" LEAD IN ORDER TO SUPPLY CONTROL VOLTAGE FOR KIT.

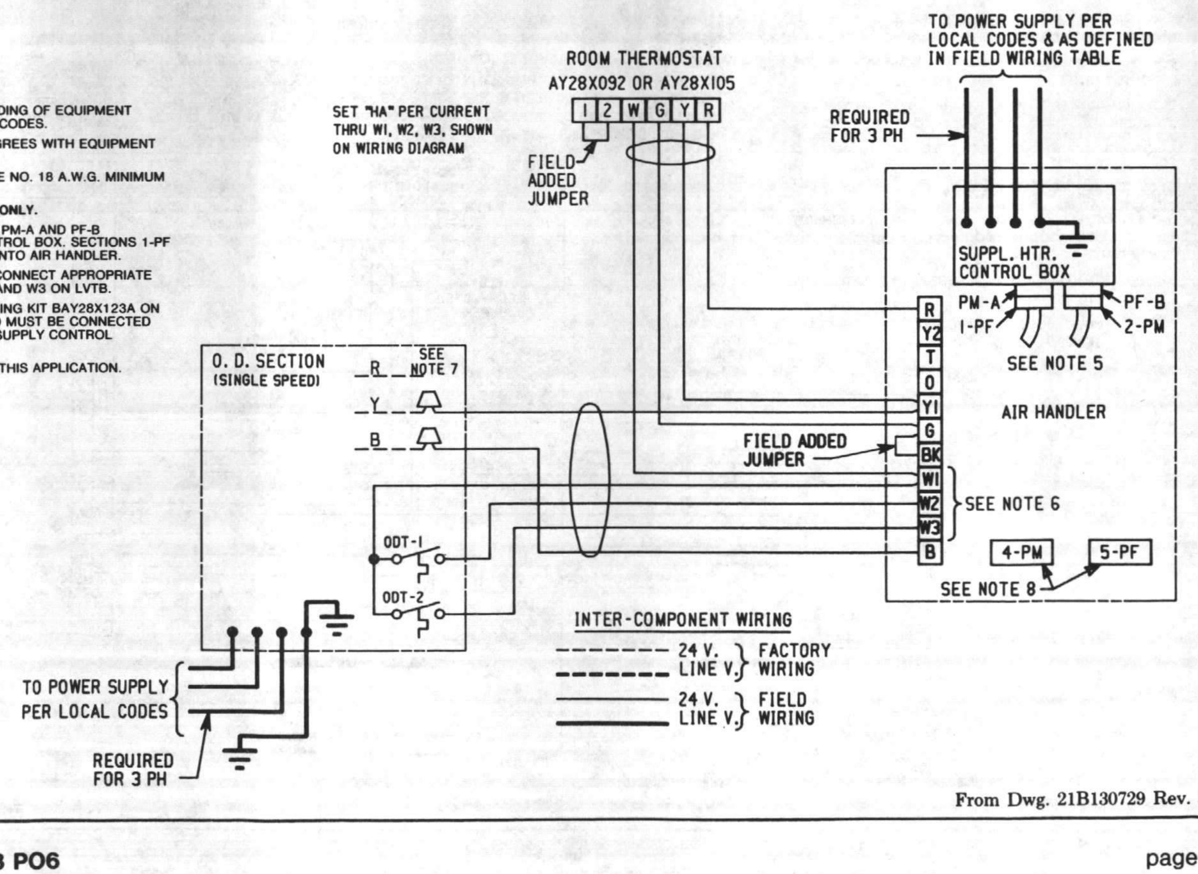


From Dwg. 21B131067 Rev. 1

FIELD WIRING DIAGRAM FOR BTA WITH BWV,BWH-P AIR HANDLERS AND SUPPLEMENTARY HEATERS (OVER 48 AMPS)

NOTES:

1. POWER WIRING AND GROUNDING OF EQUIPMENT MUST COMPLY WITH LOCAL CODES.
2. BE SURE POWER SUPPLY AGREES WITH EQUIPMENT NAMEPLATE.
3. LOW VOLTAGE WIRING TO BE NO. 18 A.W.G. MINIMUM CONDUCTOR.
4. **USE COPPER CONDUCTORS ONLY.**
5. POLARIZED PLUG SECTIONS PM-A AND PF-B ATTACHED TO HEATER CONTROL BOX. SECTIONS 1-PF AND 2-PM FACTORY WIRED INTO AIR HANDLER.
6. IF ODT IS NOT USED, THEN CONNECT APPROPRIATE JUMPERS FROM W1 TO W2 AND W3 ON LVTB.
7. TO USE LOW AMBIENT COOLING KIT BAY28X123A ON 3 PHASE MODELS, "R" LEAD MUST BE CONNECTED TO "Y" LEAD IN ORDER TO SUPPLY CONTROL VOLTAGE FOR KIT.
8. THESE PLUGS NOT USED IN THIS APPLICATION.

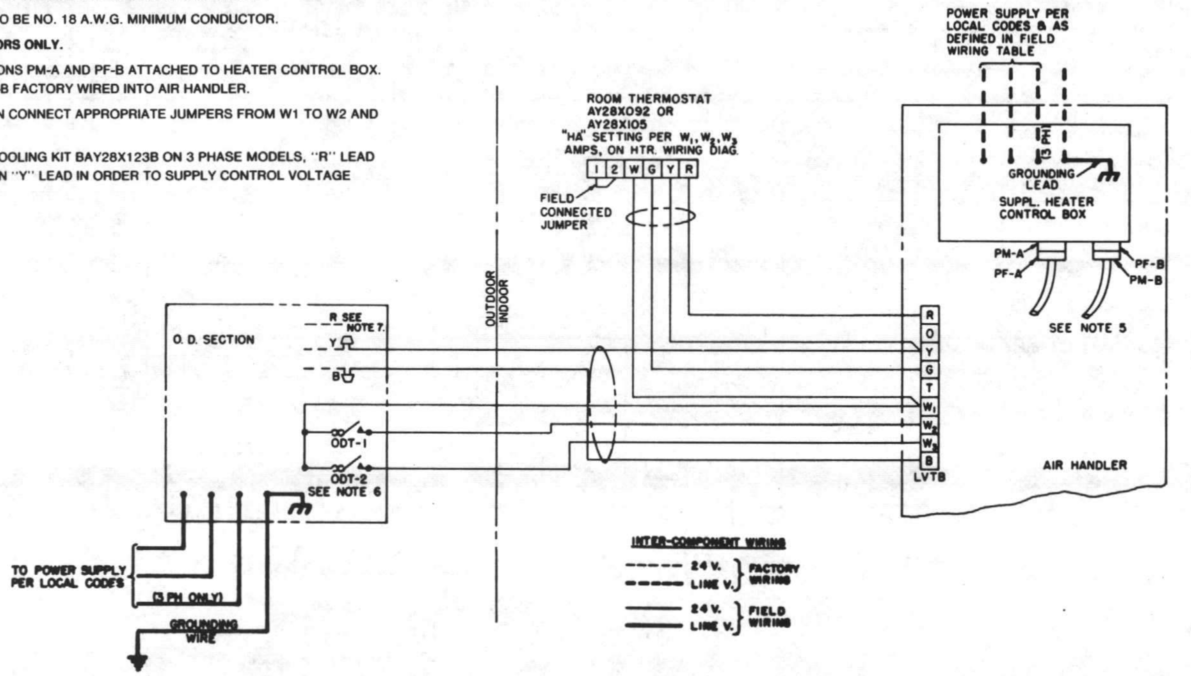


From Dwg. 21B130729 Rev. 3

FIELD WIRING DIAGRAM FOR BTA WITH BWE-C1 AIR HANDLERS AND SUPPLEMENTARY HEATERS

NOTES:

1. POWER WIRING AND GROUNDING OF EQUIPMENT MUST COMPLY WITH LOCAL CODES.
2. BE SURE POWER SUPPLY AGREES WITH EQUIPMENT NAMEPLATE.
3. LOW VOLTAGE WIRING TO BE NO. 18 A.W.G. MINIMUM CONDUCTOR.
4. **USE COPPER CONDUCTORS ONLY.**
5. POLARIZED PLUG SECTIONS PM-A AND PF-B ATTACHED TO HEATER CONTROL BOX. SECTIONS PF-A AND PM-B FACTORY WIRED INTO AIR HANDLER.
6. IF ODT IS OMITTED, THEN CONNECT APPROPRIATE JUMPERS FROM W1 TO W2 AND W3 ON LVTB.
7. TO USE LOW AMBIENT COOLING KIT BAY28X123B ON 3 PHASE MODELS, "R" LEAD MUST BE CONNECTED ON "Y" LEAD IN ORDER TO SUPPLY CONTROL VOLTAGE FOR KIT.

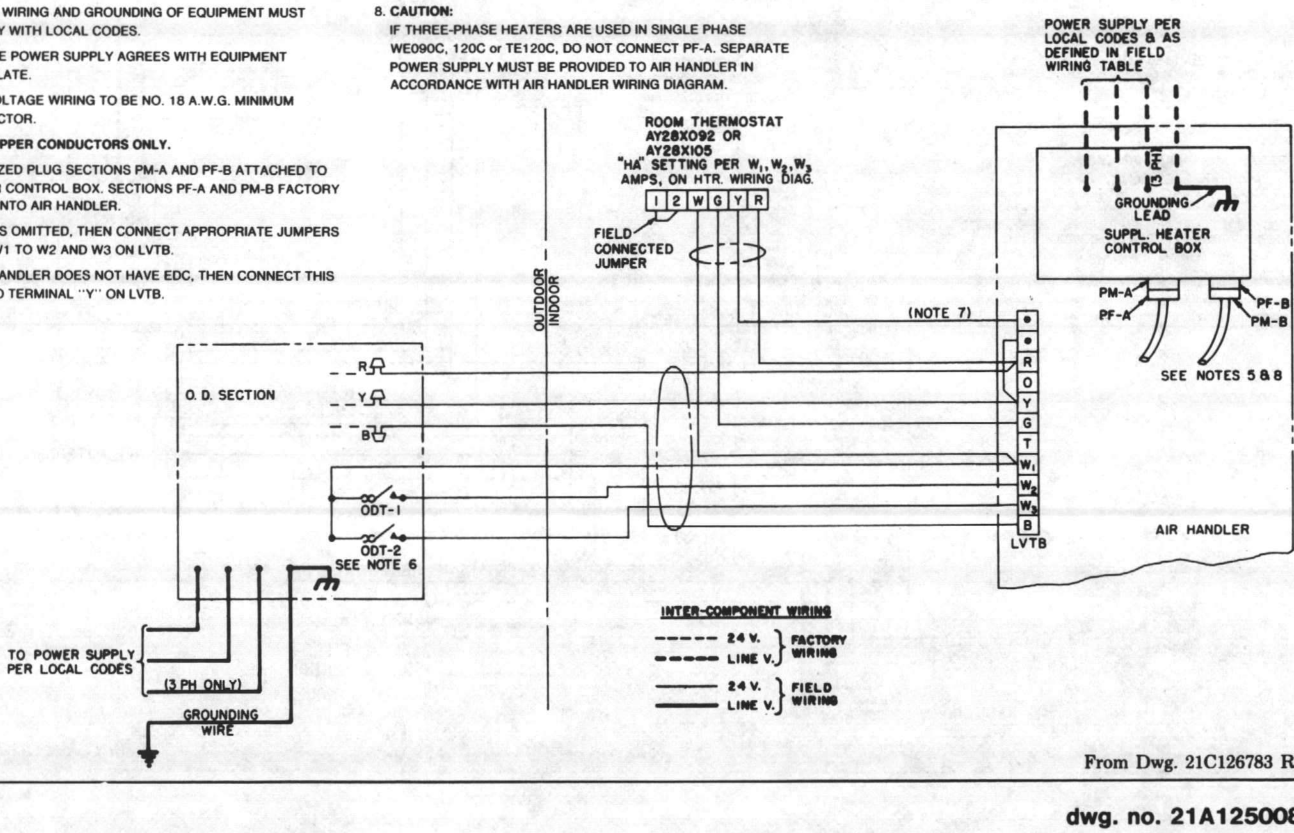


From Dwg. 21C126746 Rev. 2

FIELD WIRING DIAGRAM FOR BTA WITH BWE-C4 AIR HANDLERS AND SUPPLEMENTARY HEATERS

NOTES:

1. POWER WIRING AND GROUNDING OF EQUIPMENT MUST COMPLY WITH LOCAL CODES.
2. BE SURE POWER SUPPLY AGREES WITH EQUIPMENT NAMEPLATE.
3. LOW VOLTAGE WIRING TO BE NO. 18 A.W.G. MINIMUM CONDUCTOR.
4. **USE COPPER CONDUCTORS ONLY.**
5. POLARIZED PLUG SECTIONS PM-A AND PF-B ATTACHED TO HEATER CONTROL BOX. SECTIONS PF-A AND PM-B FACTORY WIRED INTO AIR HANDLER.
6. IF ODT IS OMITTED, THEN CONNECT APPROPRIATE JUMPERS FROM W1 TO W2 AND W3 ON LVTB.
7. IF AIR HANDLER DOES NOT HAVE EDC, THEN CONNECT THIS LEAD TO TERMINAL "Y" ON LVTB.
8. **CAUTION:** IF THREE-PHASE HEATERS ARE USED IN SINGLE PHASE WE090C, 120C or TE120C, DO NOT CONNECT PF-A. SEPARATE POWER SUPPLY MUST BE PROVIDED TO AIR HANDLER IN ACCORDANCE WITH AIR HANDLER WIRING DIAGRAM.



From Dwg. 21C126783 Rev. 1

dwg. no. 21A125008 PO6

CHECKOUT PROCEDURE WITH MAIN POWER DISCONNECTS CLOSED (ON)

Step No.	To Check	Indoor Thermostat Switch Setting					Component Operation				
		System Switch			Fan Switch		Indoor Blower Runs	Outdoor Fan Runs	Compress. Runs	Comp. Sump Heat	Furnace Heat Comes On
		Off	Cool①	Heat①	Auto	On					
1	Sump Heat	X			X					X	
2	Indoor Fan Operation	X				X	X			X	
3	Cooling Operation		X		X		X	X	X	X	
4	Check Performance & Charge		X		X		X	X	X	X	
		← USE CHARTS ATTACHED TO O.D. UNIT →									
5	Heating ②			X	X		X③			X	X
6	Inform owner on how to operate system and what to expect of it. At the same time deliver Owner's Use and Care Booklet.										

① Also set thermostat dial to call for cooling or heating as necessary.

② Check only necessary if heating unit is used for indoor section and wiring has been disturbed during installation of cooling equipment.

③ Allow time for furnace bonnet switch to heat and close.

CHECKOUT PROCEDURE

After installation has been completed, it is recommended that the entire system be checked against the following list;

1. Refrigerant Line, Leak checked .... [ ]
2. Suction Lines and Fittings properly insulated .... [ ]
3. Have all Refrigerant Lines been secured and isolated properly? .... [ ]
4. Have passages through masonry been sealed? if mortar is used, prevent mortar from coming into direct contact with copper tubing .... [ ]
5. Indoor coil drain line drains freely. Pour water into drain pan .... [ ]
6. Supply registers and return grilles open and unobstructed .... [ ]
7. Return air filter installed .... [ ]
8. Thermostat thermometer accuracy. Check against a reliable thermometer. Adjust per instructions with thermostat .... [ ]
9. Is correct speed tap being used? (Indoor blower motor) .... [ ]

SYSTEM OPERATIONAL CHECK

IMPORTANT: To prevent compressor damage which may result from the presence of LIQUID refrigerant in the crankcase these procedures should be followed at initial Start-Up and at anytime the power has been off for 12 hours or more.

1. Before proceeding with this "Operational Check", go to "Electrical Section" of this instruction to determine the time compressor heat has been "ON", and make entry on the designated lines, in Step 2.
2. Start-Up Time ________ A.M./P.M. Power Applied Time ________ A.M./P.M.
   Time Lapse ____________ Hours ________ Minutes.
3. If Steps 1 and 2 cannot be used, then place thermostat's system switch in the "OFF" position and apply power by closing system disconnect switch. This energizes compressor heat and evaporates the liquid in the crankcase. TO EVAPORATE LIQUID ALLOW AT LEAST ONE-HALF HOUR PER POUND (R-22), AS SHOWN ON UNIT NAMEPLATE.
4. Except as required for safety while servicing: DO NOT OPEN SYSTEM DISCONNECT SWITCH.
5. **After completing above procedures, turn to page 7 for Operational checkout of system(s).**

TAB PLACEMENT HERE

DESCRIPTION:

Condensing

Units

☐ Tab page did not contain hand written information

☒ Tab page contained hand written information
*Scanned as next image

Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

TRANE INSTALLER'S GUIDE

BLDG AS-236

18-AC30D5
1st Printing, 1987
TTB-IN-2

CONDENSING UNITS

XE 800
TTB CONDENSING UNITS
(12,000 — 24,000 NOMINAL BTUH)

All phases of this installation must comply with NATIONAL, STATE AND LOCAL CODES.

These instructions do not cover all variations in systems nor provide for every possible contingency to be met in connection with installation. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to The Trane Company, Dealer Products Group, Tyler, Texas.

A. GENERAL

The following instructions cover the TTB712-724 Condensing Units.

Check for transportation damage after unit is uncrated. Report promptly, to the carrier, any damage found to the unit.

B. LOCATION & PREPARATION OF THE UNIT

1. The unit should be set on a level, concrete pad at least as large as the unit base pan or larger.

2. The concrete pad must NOT be in direct contact with any structure. Unit must be positioned a minimum of 12" from any wall or surrounding shrubbery to insure adequate airflow. Clearance must be provided in front of control box (access panels) and any other side requiring service access to meet National and Local Codes. Also, the unit location must be far enough away from any structure to prevent roof run-off water from pouring directly on the unit.

3. The top discharge area must be unrestricted for at least five (5) feet above the unit.

4. Mount the unit on mounting pads (shipped with condensing unit).

5. When the outdoor unit is mounted on a roof, be sure the roof will support the unit's weight. Vibration isolation is recommended to prevent transmission to the building structure.

6. The maximum length of refrigerant lines from outdoor to indoor unit should NOT exceed eighty (80) feet.

7. If outdoor unit is mounted above the air handler, maximum lift should not exceed eighty (80) feet (suction line). If air handler is mounted above condensing unit, maximum lift should not exceed sixty (60) feet (liquid line).

NOTE: Refer to "Refrigerant Piping Guide" Pub. No. 22-3040 Tab 18 in "APPLICATION MANUAL."

8. Locate and install indoor coil or air handler in accordance with instruction included with that unit.

C. INSTALLING REFRIGERANT LINES

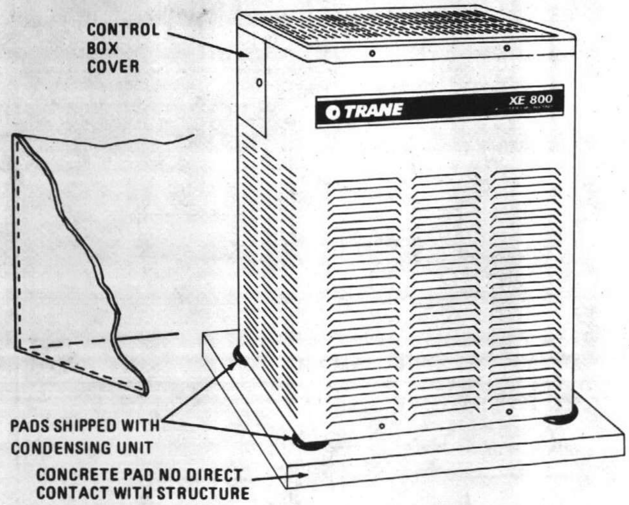
The following steps are to be considered when installing the refrigerant lines (steps apply to both "Precharged Quik-Attach Lines" & "Field Fabricated Lines").

Standard tire-valve type pressure taps are provided on the precharged lines for installation and service use.

There is a 90 degree bend on one end of recommended refrigerant line. Bent end to be installed either inside or outside depending on situation requirements. This should be thoroughly checked out before beginning installation.

The gas line must always be insulated.

1 TOP DISCHARGE—UNRESTRICTED 5 FT. ABOVE UNIT WITH UNIT POSITIONED TO AVOID RUN-OFF WATER



The units are factory charged with the system charge required when using 10 feet of connecting line. The precharged lines are provided with the proper charge to accommodate their length. Unit nameplate charge is the total system charge with 25 feet of interconnecting lines.

If refrigerant charge adjustment is considered necessary, use the Charge Charts accompanying the outdoor unit.

1. Determine the most practical way to run the lines.

2. Consider types of bends to be made and space limitations.

NOTE: Large diameter tubing will be very difficult to rebend once it has been shaped.

3. Determine the best starting point for routing the refrigerant tubing — INSIDE OR OUTSIDE THE STRUCTURE.

dwg. no. 21A140840 P01

C. INSTALLING REFRIGERANT LINES (Cont.)

4. Provide a pull-through hole of sufficient size to allow both liquid and gas lines plus fittings to clear. The location of this hole (if practical) should be just above the wall plate which is resting on the foundation.

5. Be sure the tubing is of sufficient length.

6. Uncoil the tubing — do not kink or dent. The Quik-Attach fittings with pressure tap connect to the outdoor unit.

DO NOT REMOVE DUST PLUGS FROM COUPLINGS BEFORE ROUTING COPPER TUBING.

7. Route the tubing making all required bends and properly secure the tubing before making Quik-Attach connections.

NOTE: Lines must be isolated from structure and pull-through hole must be sealed weather-tight after installation.

ATTACHING COUPLING QUIK-ATTACH

1. Remove the protective plugs from all fittings.

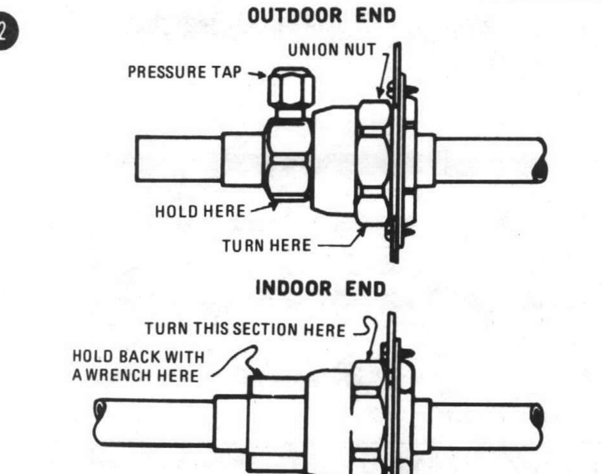
2. Oil the face and threads of the couplings with clean refrigerant oil before mating. Make sure that no dirt, water or other foreign material is permitted to adhere to the mating surfaces of the couplings before the halves are connected.

3. Engage the fittings by hand tightening the union nut until snug.

CAUTION: The male and female Quik-Attach fittings must be properly aligned to prevent cross threading.

4. Continue tightening with a wrench until the coupling halves bottom. A firm metal to metal contact will be felt, (See Figure 2).

2



(From SK560-1347 Rev. 2)

5. Advance the union nut another 1/4 turn. This final turn is necessary to insure a proper metal seal of the coupling halves, forming a leak-proof joint. Do NOT continue to tighten the coupling as distortion of the coupling nut will result in a leak.

CAUTION: Correct tightening of the coupling is very important. Undertightening or overtightening will result in a coupling leak.

NOTE: For attaching the indoor connection, follow the instructions packaged with the indoor unit. See Figure 2 as a reference to the appearance of completed indoor Quik-Attach coupling installation.

D. FIELD FABRICATED REFRIGERANT LINES

The routing of the field fabricated lines is done making the same observations as for the precharged lines.

1. Minimize the use of sharp 90° bends.

2. Cut and fit tubing, then braze using accepted good brazing techniques.

3. Use a dry nitrogen purge and silver brazing alloy without flux for brazing.

4. Insulate the entire gas line and its fittings.

5. Do NOT allow uninsulated lines to come into contact with each other.

6. Upon completion of installation, evacuate the refrigerant lines and indoor coil before connecting to the outdoor unit:

a. Attach appropriate hoses from manifold gauge to suction and liquid line pressure taps.

b. Attach center hose of manifold gauges to vacuum pump.

NOTE: Unnecessary switching of hoses and complete evacuation of all lines leading to sealed system can be accomplished by placing a "T" in manifold center hose and connecting branch hose to cylinder of R-22.

7. Evacuate until the micron gauge reads 350 microns.

8. Close off valve to vacuum pump and observe the micron gauge. If gauge pressure rises above 500 microns in one (1) minute, then evacuation is incomplete or system is leaking.

9. If vacuum gauge does not rise above 500 microns in one (1) minute the evacuation should be complete.

10. With vacuum pump and micron gauge blanked off, open valve on R-22 cylinder and charge refrigerant lines and indoor coil to tank pressure of R-22 supply.

11. Close valve on R-22 supply cylinder. Close valves on manifold gauge set and remove refrigerant charging hoses.

If refrigerant lines are to be field fabricated or if precharged lines have been altered in length, it will be necessary to adjust refrigerant, to the system upon completion of installation. Use the following table for recommended amount.

Tubing Size		Tubing Lengths	Refrigerant
Suction	Liquid		
5/8"	1/4"	15'	2 oz.
5/8"	1/4"	25'	5 oz.
5/8"	1/4"	32'	7 oz.
5/8"	1/4"	40'	9 oz.
3/4"	5/16"	15'	2 oz.
3/4"	5/16"	25'	7 oz.
3/4"	5/16"	32'	10 oz.
3/4"	5/16"	40'	13 oz.
Tubing lengths in excess of forty (40) feet. 5/8" and 1/4" uses 1 oz. per each 4 ft. 3/4" and 5/16" uses 4 oz. per each 9 ft.			

NOTE: The refrigerant charge shown on the condensing unit nameplate is the correct charge with up to twenty-five (25) feet of recommended precharged lines connecting the outdoor and indoor units.

E. ELECTRICAL CONNECTIONS

WARNING: When installing or servicing this equipment, ALWAYS exercise basic safety precautions to avoid the possibility of electric shock.

1. Power wiring and grounding of equipment must comply with local codes.

2. Power supply conductors to the outdoor unit must be in weatherproof insulation or conduit and must conform to local codes.

3. Install a separate disconnect switch at the outdoor unit.

4. Provide flexible electrical conduit whenever vibration transmisson may create a noise problem within the structure.

5. The use of color coded low voltage wire (24V. — 18 AWG minimum) is recommended to simplify connections between the outdoor unit, the thermostat and the indoor unit.

6. Mount the indoor thermostat in accordance with instruction included with the thermostat. Wire per appropriate Field Wiring diagram (included in these instructions).

7. If there is no fan relay in indoor unit, install one inside control compartment and wire per Field Wiring diagram.

8. The diagrams on page 3 & 4 represent typical Field Wiring of Matched Systems (for addition of supplementary electric heaters see Product Data).

F. COMPRESSOR SUMP HEAT

This unit is supplied from the factory with the optional compressor heat activated. The Seasonal Energy Efficiency Rating (SEER) is obtained WITHOUT the compressor heat energized. Compressor heat IS NOT required where connecting refrigerant lines are 25 feet or less in length. Disconnect the CRA capacitor as shown on the wiring diagrams to de-energize compressor heat.

Where connecting refrigerant line lengths exceed 25 feet activate the compressor heat per wiring diagram inside the unit control box.

Set the Thermostat System Switch in the off position so compressor will not run, and apply power by closing the main disconnect switch. This will activate the compressor sump heat. Do not change the Thermostat System Switch until power has been applied long enough to evaporate any liquid R-22 in the compressor (30 minutes for each pound of R-22 in the system as shown on the nameplate). Following this procedure will prevent compressor damage at initial start-up.

Record the "POWER APPLIED DATA" on the designated lines below:

Time ______________ A.M./P.M. Date ____________

By ______________________________

Electrician

G. OPERATIONAL AND CHECKOUT PROCEDURES

Final phases of this installation are the unit Operational and Checkout Procedure which are found on pages 5 & 6 of this instruction.

H. ELECTRIC HEATERS

Electric heaters, if used, are to be installed in the air handling device according to the instructions accompanying the air handler and the heaters.

I. START CONTROL KIT

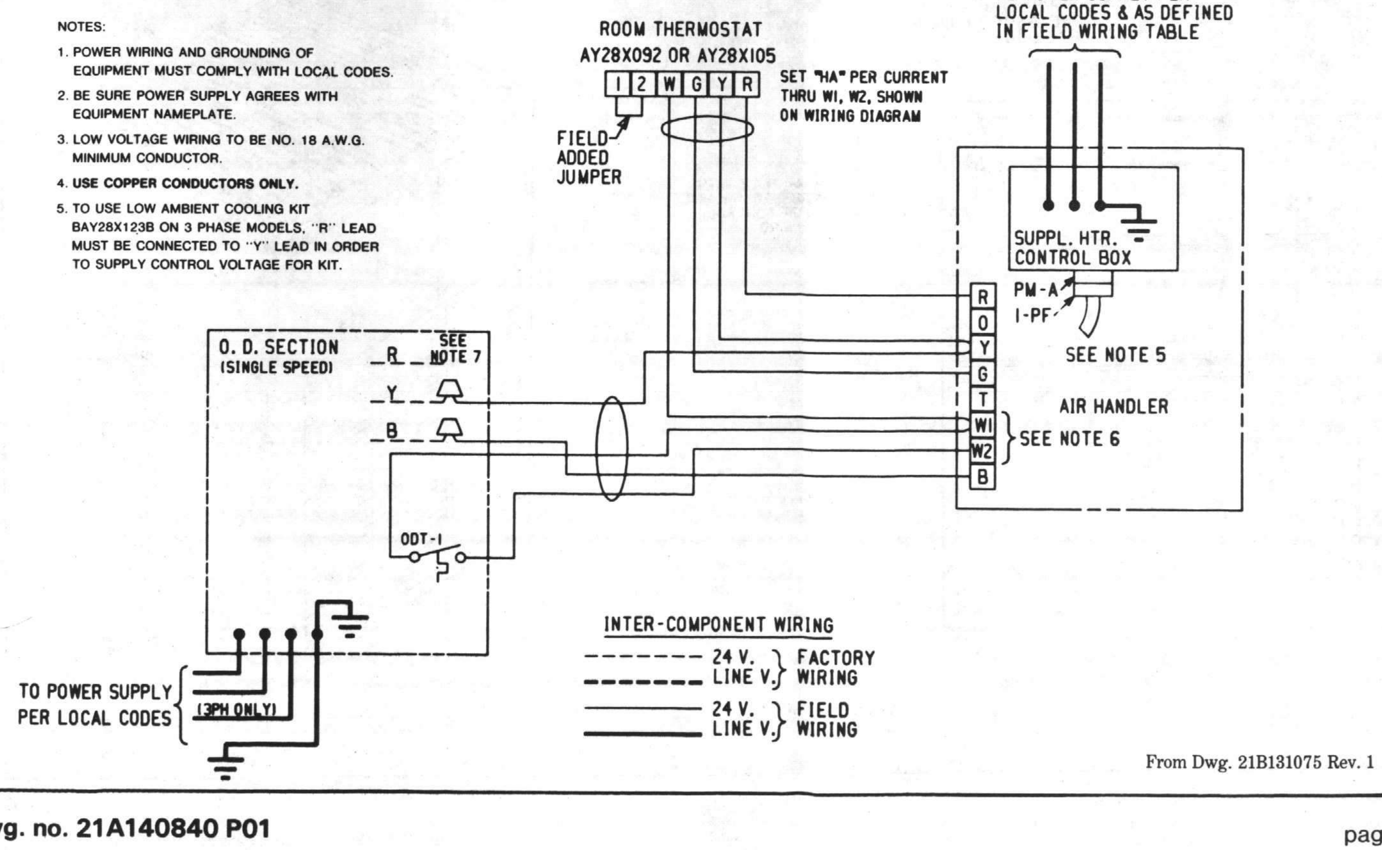
Provision is made on these units for a field installed BAY41X228 accessory quick start kit, as required. The kit is to be installed outside the cabinet of the unit.

CAUTION: These units require installation of a start kit if indoor unit is equipped with a non-equalizing expansion valve.

TTB USED WITH AIR HANDLER HAVING A TRANSFORMER

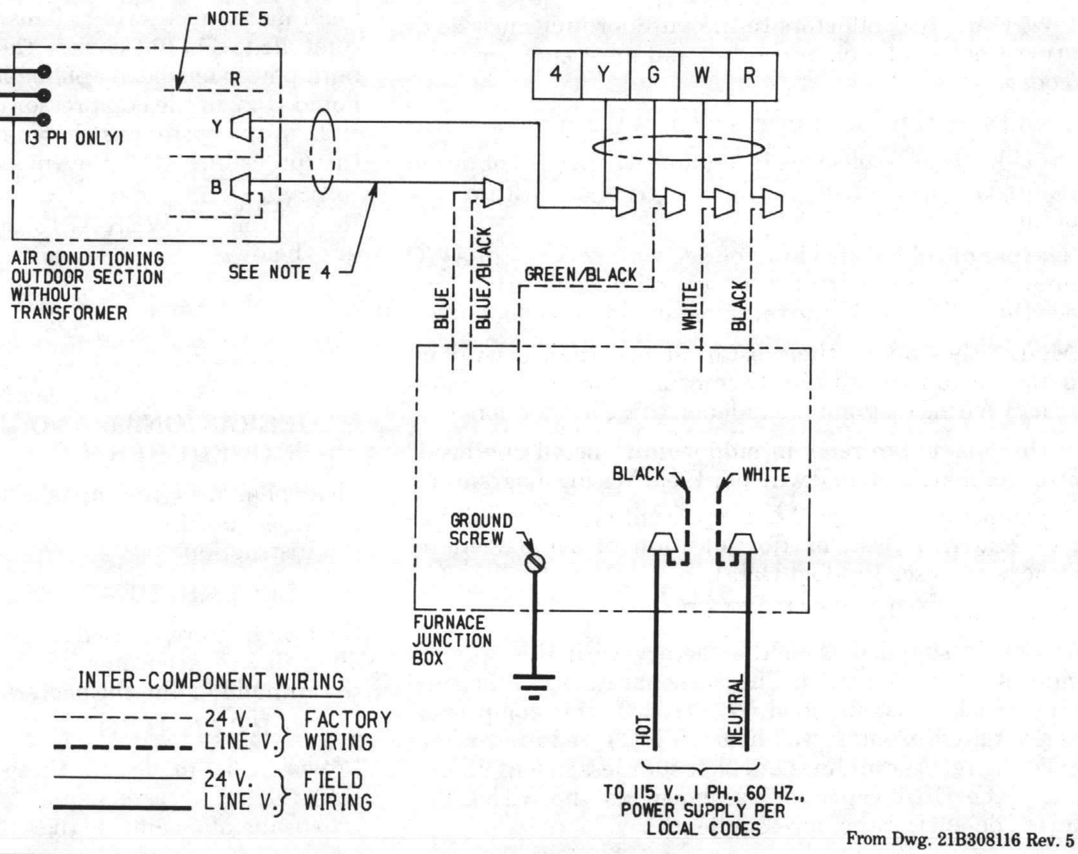
NOTES:

1. POWER WIRING AND GROUNDING OF EQUIPMENT MUST COMPLY WITH LOCAL CODES.
2. BE SURE POWER SUPPLY AGREES WITH EQUIPMENT NAMEPLATE.
3. LOW VOLTAGE WIRING TO BE NO. 18 A.W.G. MINIMUM CONDUCTOR.
4. USE COPPER CONDUCTORS ONLY.
5. TO USE LOW AMBIENT COOLING KIT BAY28X123B ON 3 PHASE MODELS, "R" LEAD MUST BE CONNECTED TO "Y" LEAD IN ORDER TO SUPPLY CONTROL VOLTAGE FOR KIT.



From Dwg. 21B131075 Rev. 1

FIELD WIRING DIAGRAM FOR TTB WITH A FURNACE

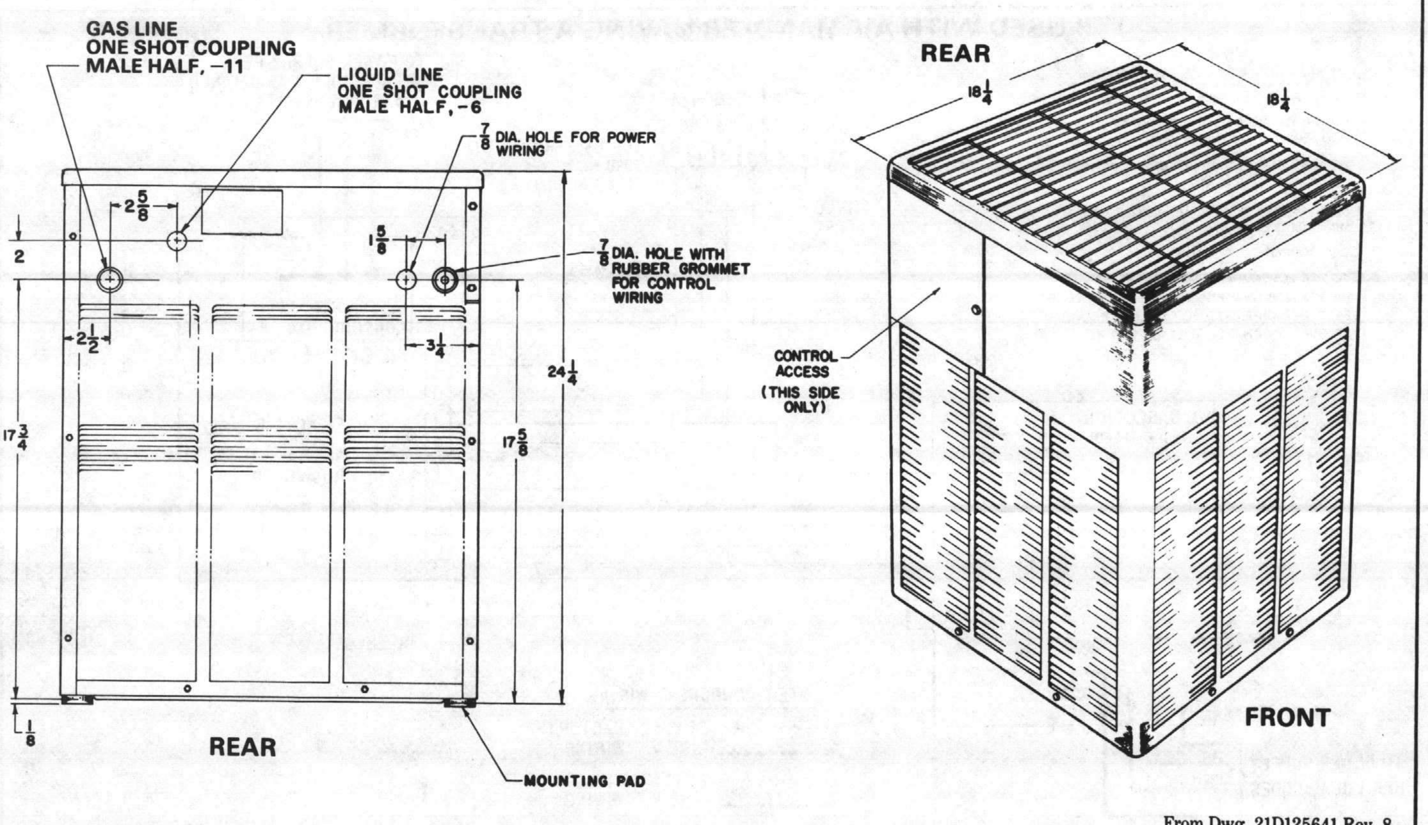


NOTES:

1. BE SURE POWER SUPPLY AGREES WITH EQUIPMENT NAMEPLATE(S).
2. LOW VOLTAGE (24V.) WIRING TO BE NO. 18 A.W.G. MIN.
3. GROUNDING OF EQUIPMENT MUST COMPLY WITH LOCAL CODES.
4. MAXIMUM EXTERNAL LOAD SHALL NOT EXCEED 25 VA.
5. TO USE LOW AMBIENT COOLING KIT, BAY28X123B, ON 3 PHASE MODELS, "R" LEAD MUST BE CONNECTED TO "Y" LEAD IN ORDER TO SUPPLY CONTROL VOLTAGE FOR KIT.

From Dwg. 21B308116 Rev. 5

TTB712-724 OUTLINE DRAWING



From Dwg. 21D125641 Rev. 8

CHECKOUT PROCEDURE WITH MAIN POWER DISCONNECTS CLOSED (ON)

Step No.	To Check	Indoor Thermostat Switch Setting					Component Operation				
		System Switch			Fan Switch		Indoor Blower Runs	Outdoor Fan Runs	Compress. Runs	Comp. Sump Heat	Furnace Heat Comes On
		Off	Cool①	Heat①	Auto	On					
1	Sump Heat④	X			X					X	
2	Indoor Fan Operation	X				X	X			X	
3	Cooling Operation		X		X		X	X	X		
4	Check Performance & Charge		X		X		X	X	X		
		← USE CHARTS ATTACHED TO O.D. UNIT →									
5	Heating ②			X	X		X③			X	X
6	Inform owner on how to operate system and what to expect of it. At the same time deliver Owner's Use and Care Booklet.										

①Also set thermostat dial to call for cooling or heating as necessary.

②Check only necessary if heating unit is used for indoor section and wiring has been disturbed during installation of cooling equipment.

③Allow time for furnace bonnet switch to heat and close.

④Unit is supplied with optional sump heat activated. If refrigerant lines exceed 25 feet, do not deactivate sump heat.

CHECKOUT PROCEDURE

After installation has been completed, it is recommended that the entire system be checked against the following list;

1. Refrigerant Line, Leak checked .... [ ]
2. Suction Lines and Fittings properly insulated .... [ ]
3. Have all Refrigerant Lines been secured and isolated properly? .... [ ]
4. Have passages through masonry been sealed? If mortar is used, prevent mortar from coming into direct contact with copper tubing .... [ ]
5. Indoor coil drain line drains freely. Pour water into drain pan .... [ ]
6. Supply registers and return grilles open and unobstructed .... [ ]
7. Return air filter installed .... [ ]
8. Thermostat thermometer accuracy. Check against a reliable thermometer. Adjust per instructions with thermostat .... [ ]
9. Is correct speed tap being used? (Indoor blower motor) .... [ ]

SYSTEM OPERATIONAL CHECK

IMPORTANT: To prevent compressor damage which may result from the presence of LIQUID refrigerant in the crankcase, these procedures should be followed at initial Start-Up and at anytime the power has been off for 12 hours or more.

1. Before proceeding with this "Operational Check," go to "Compressor Sump Heat Section" of this instruction to determine the time compressor has been "ON," and make entry on the designated lines, in Step 2.
2. Start-Up Time ________ A.M./P.M. Power Applied Time ________ A.M./P.M.
   Time Lapse ____________ Hours ________ Minutes.
3. If Steps 1 and 2 cannot be used, then place thermostat's system switch in the "OFF" position and apply power by closing system disconnect switch. This energizes compressor heat and evaporates the liquid in the crankcase. TO EVAPORATE LIQUID ALLOW AT LEAST ONE-HALF HOUR PER POUND (R-22), AS SHOWN ON UNIT NAMEPLATE.
4. Except as required for safety while servicing: DO NOT OPEN SYSTEM DISCONNECT SWITCH.
5. **After completing above procedures, turn to page 5 for Operational checkout of system(s).**

Library	Service Literature
Product Section	Unitary
Product	Split Systems A/C - Condensing Units
Model	TTB
Literature Type	Installer's Guide
Sequence	2
Date	June 1987
File No.	SV-UN-S/S-TTB-IN-2 6/87
Supersedes	
Ordering No.	

The Trane Company
Dealer Products Group
Troup Highway
Tyler, TX 75711

dwg. no. 21A140840 P01
P.I.

BLDGS AS-202
AS-236

TRANE REDDI FACTS

Air Conditioner
Model: BTA048D300A0

Library	Service Literature
Product Section	Unitary
Product	Split System A/C
Model	BTA
Literature Type	Service Facts
Sequence	13AA
Date	March 1987
File No.	SV-UN-S/S-BTA-SF-13AA 3/87
Supersedes	
Ordering No.	

IMPORTANT — This document is customer property and is to remain with this unit. Please return to service information pack upon completion of work.

PRODUCT SPECIFICATIONS

OUTDOOR UNIT	BTA048D300A
POWER CONNS. — V/Ph/Hz	200/230/3/60
Min. Brch. Cir Ampacity③	23.2
Br. Cir. — Max. (Amps)	35
Prot. Rtg. (Amps)	35
Noise Rating No.②	8.6
COMPRESSOR	Climatuff™
No. Used — No. Speeds	1 — 1
Volts/Ph/Hz	200/230/3/60
R.L. Amps — L.R. Amps	16.3 — 117
Brch. Cir. Selec. Cur. Amps	16.3
OUTDOOR FAN — Type	Propeller
Dia. (in.) — No. Used	22 — 1
Type Drive / No. Speeds	Direct — 1
CFM @ 0.0 in. w.g.④	4600
No. Motors — HP	1 — 0.50
Motor Speed R.P.M.	1075
Volts/Ph/Hz	200/230/1/60
F.L. Amps — L.R. Amps	2.8 — 8.4
OUTDOOR COIL — Type	Spine Fin™
Rows — F.P.I.	1 — 20
Face Area (sq. ft.)	19.5
Tube Size (in.)	1/2
REFRIGERANT	
Lbs. — R-22 (O.D. Unit)⑤	10 lb. 8 oz.
Factory Supplied	Yes
Line Size — in. O.D. Gas⑥	1.12
Line Size — in. O.D. Liq.⑥	0.38
DIMENSIONS	H x W x D
Outdoor Unit — Crated (in.)	39-3/16 x 32-7/16 x 34-3/16
WEIGHT	
Shipping (lbs.)	265
Net (lbs.)	257

① Rated in accordance with A.R.I. Standard 210.
② Rated in accordance with A.R.I. Standard 270.
③ Calculated in accordance with National Electric Code. Suitable for use with HACR circuit breakers or fuses.
④ Standard Air — Dry Coil — Outdoor.
⑤ This value approximate. For more precise value see unit nameplate and service instruction.
⑥ Max. linear length 80 ft; Max. lift - Suction 60 ft; Max lift - Liquid 60 ft. Max. length of precharged tubing 40 ft. For greater length refer to Refrigerant Piping Manual Pub. No. 22-3040.
⑦ Rated in accordance with D.O.E. test procedure.

SPLIT SYSTEM

OPTIONAL EQUIPMENT

OPTIONAL EQUIPMENT FOR OUTDOOR UNITS

Indoor Thermostats —
- Horizontal, Heat/Cool Only w/ Manual Switchover AY28X92
- Vertical, Cool Only w/Fan Switch AY28X104
- Vertical, Heat/Cool w/Manual Switchover AY28X105
- Horizontal, Heat/Cool BAY28X182

Outdoor Thermostat Kit
- Includes Thermostat AY28X125 and Mtg. Brkt., for 46°F. to -10°F. (Adjustable) BAY28X125A

Evaporator Defrost Control Kit Needed for Cooling Operation Between 55° and 40° AY28X79
Head Pressure Control Kit BAY28X123B
Head Pressure Control Kit BAY28X123C
Coupling Kit — 7/8" Tube (90° Bend), -11 Coupling, 3/8" Tube -6 Coupling BAY71X103
Coupling Kit — 7/8" Tube -11 Coupling, 3/8" Tube -6 Coupling BAY71X104
Coupling Kit — 1-1/8" Tube (90° Bend), -11 Coupling, 3/8" Tube -6 Coupling BAY71X105
Coupling Kit — 1-1/8" Tube -11 Coupling, 3/8" Tube -6 Coupling BAY71X106

TUBING INFORMATION

Tubing Sizes		Tubing Length	Additional Refrigerant
Suction	Liquid		
1-1/8"	3/8"	15'	5 oz.
1-1/8"	3/8"	25'	12 oz.
1-1/8"	3/8"	32'	18 oz.
1-1/8"	3/8"	40'	24 oz.

Tubing lengths in excess of forty (40) feet use the following amount:
1-1/8" and 3/8" uses 3 oz. per each 4 ft.

SAFETY NOTICE

THIS INFORMATION IS INTENDED FOR USE BY INDIVIDUALS POSSESSING ADEQUATE BACKGROUNDS OF ELECTRICAL AND MECHANICAL EXPERIENCE. ANY ATTEMPT TO REPAIR A CENTRAL AIR CONDITIONING PRODUCT MAY RESULT IN PERSONAL INJURY AND OR PROPERTY DAMAGE. THE MANUFACTURER OR SELLER CANNOT BE RESPONSIBLE FOR THE INTERPRETATION OF THIS INFORMATION, NOR CAN IT ASSUME ANY LIABILITY IN CONNECTION WITH ITS USE.

RECONNECT ALL GROUNDING DEVICES

ALL PARTS OF THIS PRODUCT CAPABLE OF CONDUCTING ELECTRICAL CURRENT ARE GROUNDED. IF GROUNDING WIRES, SCREWS, STRAPS, CLIPS, NUTS OR WASHERS USED TO COMPLETE A PATH TO GROUND ARE REMOVED FOR SERVICE, THEY MUST BE RETURNED TO THEIR ORIGINAL POSITION AND PROPERLY FASTENED.

DISCONNECT POWER BEFORE SERVICING

The Trane Company
Dealer Products Group • Troup Highway • Tyler, TX 75711

REDDI PARTS

COMPONENT	QTY.	DESCRIPTION	CATALOG #
Capacitor (CF)	1	5 MFD, 370V	WG20X26
Coil, Outdoor	1	Replacement	WW88X230
Compressor Internal Line Break (IOL) Internal Press. Relief (IPR)	1	CT50HK3A: FLA 20.0 LRA 117.0, Wind. res. @ 77°F. = .624 Ohms Opens on rise in winding temp. - Resets in 30-90 min. Open on 350# diff. between high & low side pressure	Order by unit model #
Contactor (MS)	1	Type DPST, Contacts 240V, FLA 25.0, LRA 125.0, Coil 24V, .95 A.In., .53 A.Hld., #3ARR8FE4	WW24X138
Drier	1	Suc. Line w/Sweat Fit., 30 Cu. In., 1⅛"x1⅛"	WW22X70
Drier	1	Liq. Line w/Sweat Fit., 8 Cu. In., ½" X ½"	WW22X101
Fan *	1	4 Blade, 22" Dia., 1/2" Bore, 30° CW Hub Up	* WW73X79
Motor	1	208/230V, 60 Hz., 1 Ph., Closed Shell, CCW, 1125 RPM, 1/2 HP, 1-Speed, FLA 3.0, LRA 12.0, Ball Bearings, Winding resistance — Ohms @ 77°F: Blk. to White 6.15/5.29 Brn. to Blk. 72.7/62.5	WW94X316
Relay, Sump Heater (SR) *	1	Type SPDT, Contacts 230V, FLA 5.0, LRA 15.0, Coil 230V., 177 A.In., 2.0 A. HLD., #KU1885	* WW24X158
Slinger	1	1/2" Dia. Bore	WW72X67
Sump Heater	1	230V, 65 W., Res. Heater, Cart. Type	WW08X65
Switch, Low Pressure Cut-Out (LPCO)	1	Cut-Out Pressure: Opens @ 8 ± 4 PSIG, Resets 25 ± 7 PSIG, #20PS100BE025G008D, T.I.	WW26X90
Thermostat	1 1 1 * 1	AY28X92, Heat/Cool, Manual, Horizontal AY28X104, Cool only, w/Fan Switch, Vertical AY28X105, Heat/Cool, Manual, Vertical BAY28X182, Single Stage, Heat/Cool	WY28X92 WY28X104 WY28X105 * WW28X182

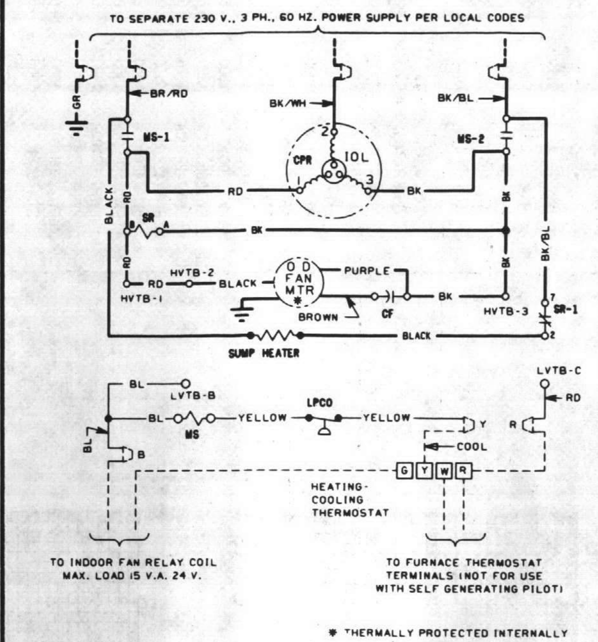
*New Part - Set Up Within The Last 18 Months

Parts List For Optional Head Pressure Control Kit

BAY28X123B&C

Auto Transformer	1	Carson #6131; @ 230V, Red 116.0 VAC, Orange 134.5 VAC, Yellow 200.0 VAC, @ 460V, Red 232.0 VAC, Orange 273.0 VAC, Yellow 400.0 VAC	WW32X57
Fuse * (Used only on BAY28X123C)	1	5 Amp, 600 Volt	* WW23X195
Pressure Switch (HPCO)	1	#20PS104DF280K160R, Opens @ 280 ± 10 PSIG, Closes @ 160 ± 10 PSIG	WW26X79
Relay, (ODFA)	1	Type SPDT, Contacts 240/480V, FLA 6/3, LRA 35/18, Coil 24V, .53/.61 A.In., .26/.31 A.Hld., #R8222B-1158	WW24X70
Relay (ODFB)	1	Type DPDT, Contacts 240V, 180 LRA, 30 FLA, Coil 24V, .615 A.In., .41 A.Hld., 50-60 Hz, P&B #PRD11AG1-24V	WW24X137
Thermostat (OFTA)	1	#20606L42-4111, Opens @ 55° ± 6°F., Closes @ 45° ± 6°F.	WW28X119
Thermostat (OFTB)	1	#20606L42-802, Opens @ 35° ± 6°F., Closes @ 25° ± 6°F.	WW28X120

SCHEMATIC DIAGRAM



BTA048D300A0

NOTES:

1. LOW VOLTAGE (24 V.) FIELD WIRING MUST BE NO. 18 AWG MINIMUM.
2. **USE COPPER CONDUCTORS.** IF ALUMINUM OR COPPER-CLAD ALUMINUM POWER WIRING IS USED, CONNECTORS WHICH MEET ALL APPLICABLE CODES AND ARE ACCEPTABLE TO THE INSPECTION AUTHORITY HAVING JURISDICTION SHALL BE USED.
3. TO USE WITH APPROVED SUPPLEMENTARY HEATERS, SEE WIRING DIAGRAM ON SUPPLEMENTARY HEATER CONTROL BOX.
4. RELAY ACCESSORY BAY24X042 MAY BE USED WITH THIS UNIT.

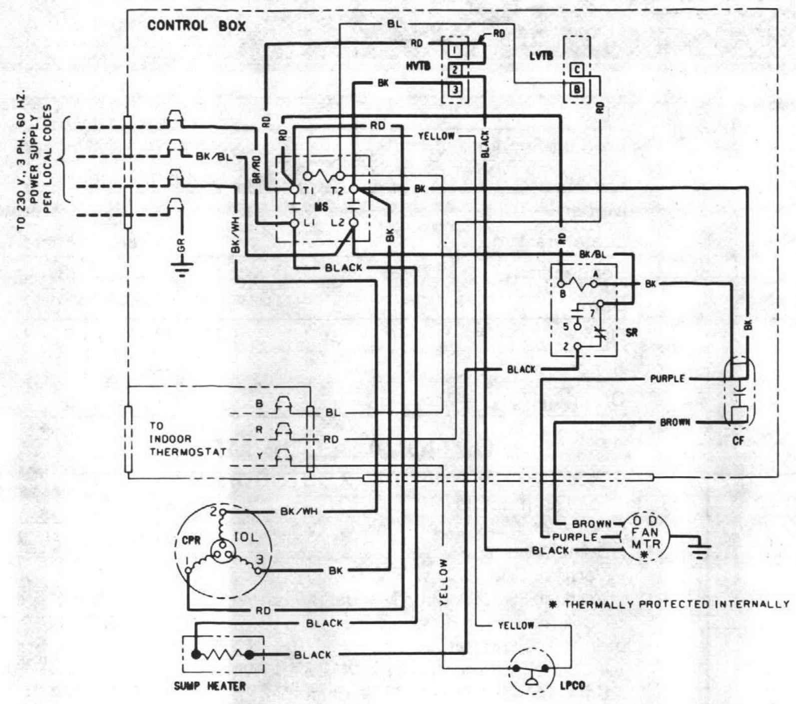
SUITABLE FOR USE WITH FIELD INSTALLED HOT WATER BANK BHW009A100B

NOTE

THREE PHASE MOTOR (S) FACTORY SUPPLIED IN THIS EQUIPMENT, PROTECTED UNDER PRIMARY SINGLE-PHASING CONDITIONS

From Dwg. 21D135817 P01

WIRING DIAGRAM



LEGEND

COLOR CODES BK/BL — COLOR OF WIRE / COLOR OF MARKER — Black Wire with Blue Marker

BK	Black	RD	Red	OR	Orange
BL	Blue	WH	White	GR	Green
BR	Brown	YL	Yellow	PR	Purple

SYMBOLS

L.V. Wiring — Factory - - - Field
H.V. Wiring — Factory - - - Field
L.V. Wiring —x— { Field Installed
H.V. Wiring —x— { Factory Wiring

Ground
Junction
Wire Nut or Connector
Coil
Capacitor
Contact (N.O.)
Internal Overload Protector
Pressure Sensing Switch
Resistor or Heating Element
Terminal
Terminal Board
Contact (SPDT)
Contact (N.C.)
Motor Winding

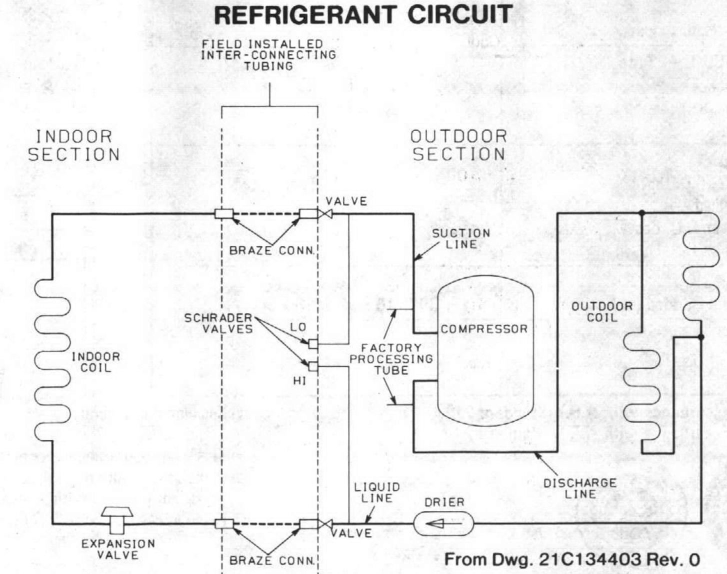
CF	Fan Capacitor
CN	Wire Connector
CPR	Compressor
HVTB	High Voltage Terminal Board
IOL	Internal Overload Protector
LPCO	Low Pressure Cut Out
LVTB	Low Voltage Terminal Board
MS	Compressor Motor Contactor
SR	Sump Heater Relay

TROUBLESHOOTING CHART — WHAT TO CHECK

SYSTEM FAULTS	POWER SUPPLY	HIGH VOLTAGE WIRING	COMPR. IOL	RUN CAPACITOR	START CAPACITOR	START RELAY	CONTACTOR CONTACTS	LOW VOLTAGE WIRING	CONTROL TRANSFORMER	CONTACTOR COIL	LOW VOLTAGE FUSE	STUCK COMPRESSOR	INEFFICIENT COMPRESSOR	REFRIGERANT UNDERCHARGE	REFRIGERANT OVERCHARGE	EXCESSIVE EVAP. LOAD	NONCONDENSABLES	RESTRICTED O.D. AIRFLOW	O.D. AIR RECIRCULATION	TXV STUCK OPEN	SUPERHEAT	RESTRICTED I.D. AIRFLOW	REF. CIRCUIT RESTRICTIONS
REFRIGERANT CIRCUIT																							
Liquid Pressure Too High															P		S	P	S				S
Liquid Pressure Too Low													S	P						S	S		S
Suction Pressure Too High													S		P	P				S	P		
Suction Pressure Too Low														S							S	P	S
Liquid Refrig. Floodback TXV System																				S	S		
Liquid Refrig. Floodback Capillary Tube System															P			S	S		S	P	
I.D. Coil Frosting														P								P	S
Compressor Runs Inadequate or No Cooling													S	P		P	S				S	P	S
ELECTRICAL																							
Compressor & O.D. Fan Do Not Start	P	P						S	P	P	P												
Compressor Will Not Start But O.D. Fan Runs		P	S	P	P	P						S											
O.D. Fan Won't Start		P		P																			
Compressor Hums But Won't Start		P		P	P	P	S					S											
Compressor Cycles on IOL		P	S	P	P	P	S					P	S	P	S	S		S			S		S
I.D. Blower Won't Start	P	S						S	P		P												

P Primary Causes **S Secondary Causes**

REFRIGERANT CIRCUIT



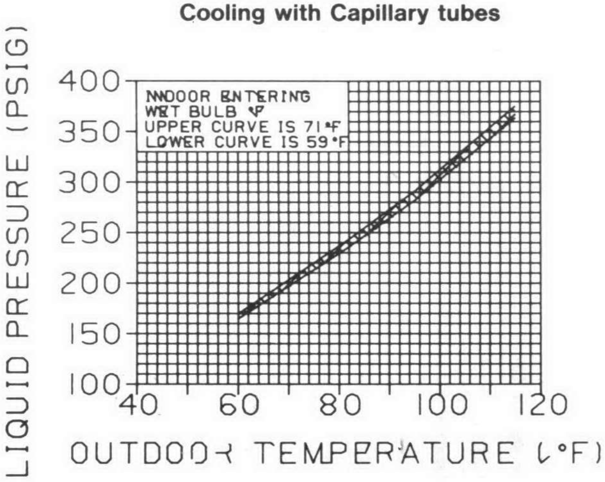
From Dwg. 21C134403 Rev. 0

SERVICE TIPS

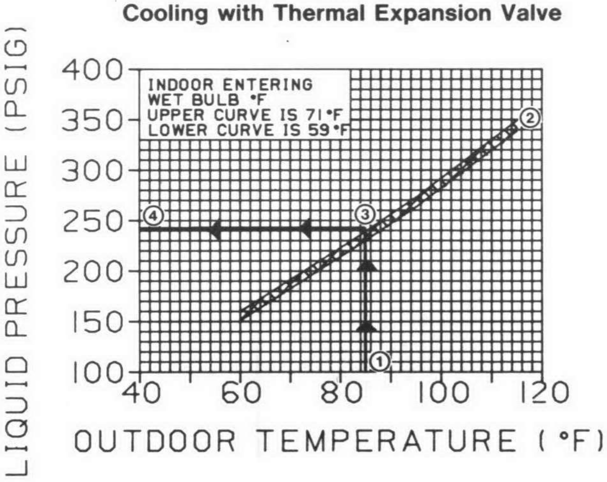
On this and other cooling only machines high side pressure is taken downstream of the condenser and liquid line drier. In the event of a restriction of either of these two components, charge can be added to cause the high side press to agree with the performance chart. However, discharge pressure becomes significantly higher, possibly causing the IPR to trip.

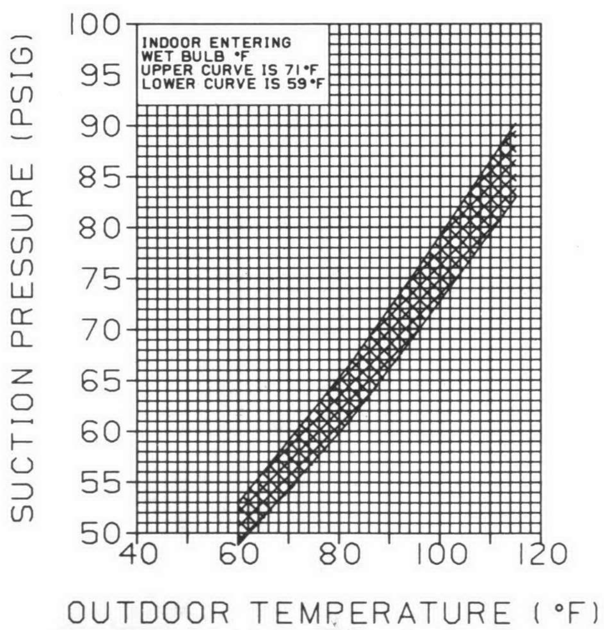
PERFORMANCE CURVES — BTA048D300A0 with Indoor Unit BXA048D300A; BXA748P3HPA. All data at Indoor CFM 1600. (With Interconnecting Lines of 1-1/8" O.D. Suction and 3/8" O.D. Liquid)

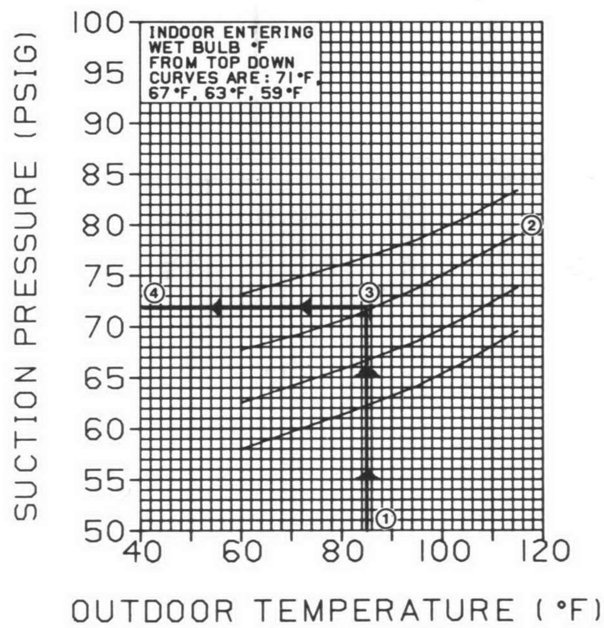
BXA048D300A
Cooling with Capillary tubes



BXA748P3HPA
Cooling with Thermal Expansion Valve







From Dwg. 21D136932 Rev. 0

COOLING PERFORMANCE TO BE CHECKED WHEN OUTDOOR TEMPERATURE IS ABOVE 65°F. AFTER OPERATING PRESSURES HAVE STABILIZED: MEASURE INDOOR WET BULB TEMP - OUTDOOR TEMP - LIQUID & SUCTION PRESSURES. LOCATE OUTDOOR TEMP ① LOCATE INDOOR WET BULB ② FIND INTERSECTION OF OD TEMP & ID W.B. ③ READ LIQUID OR SUCTION PRESSURE IN LEFT HAND COLUMN ④

ACTUAL LIQUID PRESSURE SHOULD BE ± 10 PSIG OF CHART
SUCTION PRESSURE SHOULD BE ± 3 PSIG OF CHART

EXAMPLE: ① OUTDOOR TEMP 85°F., ② INDOOR WET BULB 67°F.,
③ LIQUID PRESSURE @ 1600 CFM = 240 PSIG ④
③ SUCTION PRESSURE @ 1600 CFM = 72 PSIG ④

ALTERNATE INDOOR UNITS

COOLING WITH CAPILLARY TUBES

INDOOR UNIT	CFM	CORR. PRESS. S	CORR. PRESS. L
*BXA048A200A	1600	0	0
BXF048A200A	1600	0	0
BWH748A100A	1600	+3	+10
BWV748A100A	1600	+3	+10

COOLING WITH THERMAL EXPANSION VALVE

INDOOR UNIT	CFM	CORR. PRESS. S	CORR. PRESS. L
*BXA748P3HPA	1600	0	0
BXA742P3HPA	1575	−3	0
BXF748P3HPA	1600	0	0
BXA060A300A	1800	+3	0
BXA060P3HPA	1800	+6	0
BXH060P3HPA	1800	+6	0
BXF060A300A	1800	0	0
BWE060C100F	1800	+6	0
BWE060C300F	1800	+6	0
BWH742P100A	1575	0	0
BWV742P100A	1575	0	0
BWH748P100A	1600	0	0
BWV748P100A	1600	0	0
BWH760P100A	1800	+6	0
BWH754P100A	1800	+6	0
BWV760P100A	1800	+6	0
BWV754P100A	1800	+6	0

*BASE INDOOR UNIT FOR CURVES ON DRAWING 21D136932 Rev. 0
S - Suction L - Liquid

From Dwg. 21A136932 Rev. 0

TRANE **REDDI FACTS**

AS-236

Air Conditioner
Model: TTA060A300A0

Library	Service Literature
Product Section	Unitary
Product	Air Conditioners - Split System
Model	TTA
Literature Type	Service Facts
Sequence	4
Date	June 1987
File No.	SV-UN-S/S-TTA-SF-4 6/87
Supersedes	

IMPORTANT — This document is customer property and is to remain with this unit. Please return to service information pack upon completion of work.

PRODUCT SPECIFICATIONS

OUTDOOR UNIT	TTA060A300A0
PWR. CONNS. — V/Ph/Hz	200-230/3/60
Min. Brch. Cir. Ampacity③	25.2
Fuse Size — Max. (Amps)	40
Fuse Size — Recmd. (Amps)	40
COMPRESSOR	Climatuff™
No. Used — No. Speeds	1 — 1
Volts/Ph/Hz	200-230/3/60
R.L. Amps — L.R. Amps	18.6 — 118
Brch. Cir. Selec. Cur. Amps	18.6
OUTDOOR FAN — Type	Propeller
Dia. (in.) — No. Used	26 — 1
Type Drive — No. Speeds	Direct — 1
CFM @ 0.0 in. w.g.④	4030
No. Motors — HP	1 — 1/4
Motor Speed R.P.M.	825
Volts/Ph/Hz	200-230/1/60
F.L. Amps — L.R. Amps	1.9 — 3.3
OUTDOOR COIL — Type	Spine Fin™
Rows — F.P.I.	1 — 20
Face Area (sq. ft.)	26.92
Tube Size (in.)	.38
REFRIGERANT	
Lbs. — R-22 (O.D. Unit)⑤	10
Factory Supplied	Yes
Line Size — in. O.D. Gas⑥	1-1/8
Line Size — in. O.D. Liq.⑥	3/8
DIMENSIONS — Cratd (in.)	
H x W x D	37.5 x 40 x 36
WEIGHT	
Shipping (lbs.)	332
Net (lbs.)	314

①Rated in accordance with A.R.I. Standard 210.
②Rated in accordance with A.R.I. Standard 270.

OPTIONAL EQUIPMENT

OPTIONAL EQUIPMENT FOR CONDENSING UNITS

Indoor Thermostats —
- Horizontal, Heat/Cool only w/Manual Switchover AY28X92
- Horizontal, Heat/Cool w/Manual Switchover AY28X97A
- Horizontal, 2-Stage Heat/Cool w/Manual Switchover AY28X98A
- Vertical, Cool only w/Fan Switch AY28X104
- Vertical, Heat/Cool w/Manual Switchover AY28X105
- Horizontal, Heat/Cool BAY28X182

Evaporator Defrost Control Kit Needed for cooling operation between 55° and 40° AY28X79

Outdoor Thermostat Kit Includes Thermostat AY28X125 and Mtg. Brkt. — for 46°F. to −10°F. (Adjustable) BAY28X125A

Hot Water Bank BHW009A

Muffler for Hot Water Bank BAY41X219

Coupling Kit — 7/8" Tube (90° Bend), −11 Coupling, 3/8" Tube −6 Coupling BAY71X003

Coupling Kit — 7/8" Tube −11 Coupling, 3/8" Tube −6 Coupling BAY71X004

Coupling Kit — 1-1/8" Tube (90° Bend), −11 Coupling, 3/8" Tube −6 Coupling BAY71X005

Coupling Kit — 1-1/8" Tube −11 Coupling, 3/8" Tube −6 Coupling BAY71X006

Head Pressure Control Kit BAYLOAM100A

TUBING INFORMATION

Tubing Sizes			Additional
Suction	Liquid	Tubing Length	Refrigerant
1-1/8"	3/8"	15'	5 oz.
1-1/8"	3/8"	25'	12 oz.
1-1/8"	3/8"	32'	18 oz.
1-1/8"	3/8"	40'	24 oz.

Tubing lengths in excess of forty (40) feet use the following amount: 1-1/8" and 3/8" uses 3 oz. per each 4 ft.

③Calculated in accordance with currently prevailing National Electric Code.
④Standard Air — Dry Coil — Outdoor.
⑤This value approximate. For more precise value see unit nameplate and service instruction.
⑥Max. linear length 80 ft; Max. lift - Suction 60 ft; Max. lift - Liquid 60 ft. Max length of precharged tubing 40 ft. For greater length refer to Refrigerant Piping Manual Pub. No. 22-3040.
⑦Rated in accordance with D.O.E. test procedure. HSPF is at the minimum design requirement for Region IV.

SPLIT SYSTEM

[*] Power supply voltage limits

Voltage Limits Low — High	Max I.D. Temp. DB/HTG	Max I.D. Temp. DB/WB CLG	Max O.D. Temp. DB HTG	Max O.D. Temp. DB CLG
207 — 254	80	95/71	75	115
196 — 207(a)	80	95/71	75	105
187 — 196(b)	80	95/71	65	100

(a) I.D. Airflow between 400 & 450 CFM/TON.
(b) I.D. Airflow between 400 & 450 CFM/TON. Start kit required.
(c) Capacity reduction for unit operation at 208 volts vs. 230 volts is 1% approximately.

SAFETY NOTICE

THIS INFORMATION IS INTENDED FOR USE BY INDIVIDUALS POSSESSING ADEQUATE BACKGROUNDS OF ELECTRICAL AND MECHANICAL EXPERIENCE. ANY ATTEMPT TO REPAIR A CENTRAL AIR CONDITIONING PRODUCT MAY RESULT IN PERSONAL INJURY AND OR PROPERTY DAMAGE. THE MANUFACTURER OR SELLER CANNOT BE RESPONSIBLE FOR THE INTERPRETATION OF THIS INFORMATION, NOR CAN IT ASSUME ANY LIABILITY IN CONNECTION WITH ITS USE.

RECONNECT ALL GROUNDING DEVICES

ALL PARTS OF THIS PRODUCT CAPABLE OF CONDUCTING ELECTRICAL CURRENT ARE GROUNDED. IF GROUNDING WIRES, SCREWS, STRAPS, CLIPS, NUTS OR WASHERS USED TO COMPLETE A PATH TO GROUND ARE REMOVED FOR SERVICE, THEY MUST BE RETURNED TO THEIR ORIGINAL POSITION AND PROPERLY FASTENED.

DISCONNECT POWER BEFORE SERVICING

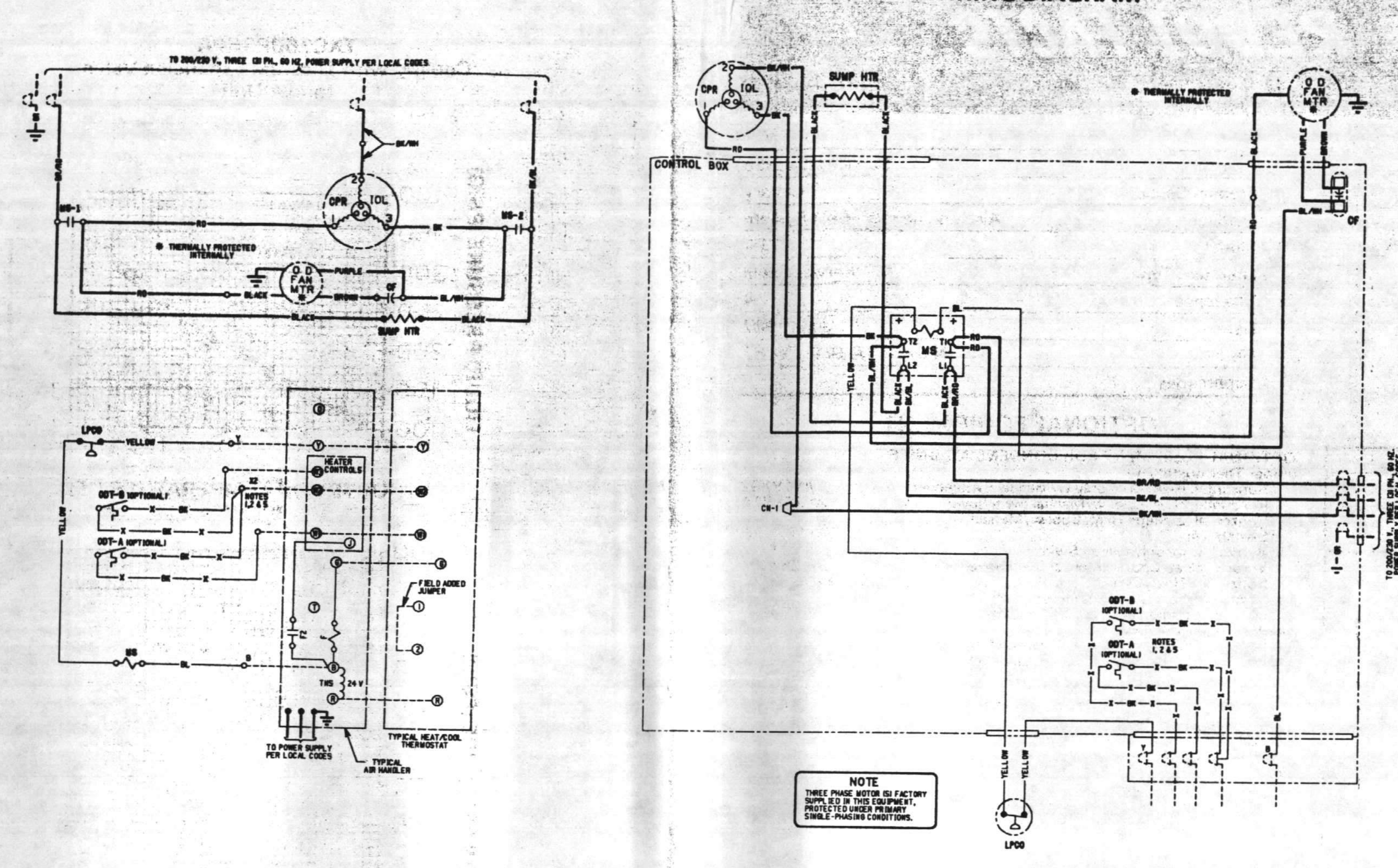
REDDI PARTS

COMPONENT	QTY.	DESCRIPTION	CAT. #
Capacitors (CF)	1	12.5 MFD, 370V	WG20X0029
Compressor Internal Line Break (IOL) Internal Press. Relief (IPR)	1	GP673-LM3-AA RLA 18.6 LRA 118, Wind. res. @ 77°F. = .565 Ohms Opens on rise in winding temp. - Resets in 30-90 min. Opens on 350# diff. between high & low side pressure	Order by unit model #
Contactor (MS)	1	Type DPST, Contacts 240V, FLA 25.0, LRA 125.0, Coil 24V., .53 A. Hld., #3ARR8C4	WW23X0138
Drier	1	Suction Line w/Sweat Fit., 30 Cu. In., 1-1/8" x 1-1/8"	WW22X0070
Drier	1	Liquid Line w/Sweat Fittings, 8 Cu. In., 3/8" x 3/8"	WW22X0088
Fan	1	3 blade 26" Dia., 1/2" bore, CCW, 19°	WW73X0102
Motor	1	200/230 V, 60 hz., 1 Ph., Closed Shell, 810 RPM, 1/4 HP, 1-Speed, FLA 1.9 LRA 3.3, Ball Bearings, CCW	WW94X0488
Sump Heater	1	230V, 65 WATTS, Resistance Heater, Cartridge Type	WW08X0065
Switch, Low Pressure Cut-Out (LPCO)	1	Opens @ 8 ± 4 PSIG, Resets 25 ± 7 PSIG, Type SPST, 28V, AC/DC-2 Amps, #20PS122KA025G008D	WW26X0090
Thermostat	1 1 1	AY28X92, Heat/Cool, Horizontal AY28X104, Cool Only, w/Fan Switch, Vertical AY28X105, Heat/Cool, Vertical	WY28X0092 WY28X0104 WY28X0105

SCHEMATIC DIAGRAM

TTA060A300A0

WIRING DIAGRAM



From Dwg. 21D141225 P02

LEGEND

BK/BL — Color of Wire; Black Wire with Blue Marker; Color of Marker

BK	Black	OR	Orange	YL	Yellow
BL	Blue	RD	Red	GR	Green
BR	Brown	WH	White	PR	Purple

24 V. / Line V. } Factory Wiring

24 V. / Line V. } Field Wiring

Field Installed Factory Wiring

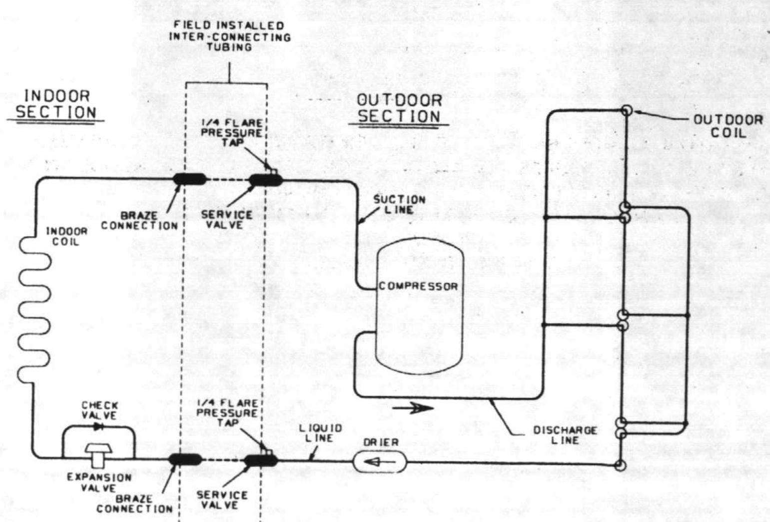
Ground
Junction
Wire Nut or Connector
Coil
Capacitor
Relay Contact (N.O.)
Relay Contact (N.C.)
Internal Overload Protector
Pressure Actuated Switch
Resistor or Heating Element
Motor Winding
Terminal
Terminal Board

CF	Fan Capacitor
CN	Wire Connector
CPR	Compressor
IOL	Internal Overload Protector
LPCO	Low Pressure Cut-Out
MS	Compressor Motor Contactor
ODT	Outdoor Thermostat

NOTES:

1. IF ODT-A IS NOT USED MAKE NO CONNECTIONS TO BK LEADS AT OD UNIT AND ADD JUMPER BETWEEN W1 & W2 AT A/H.
2. IF ODT-B IS NOT USED MAKE NO CONNECTIONS TO BK LEADS AT OD UNIT AND ADD JUMPER BETWEEN W2 & W3 AT A/H.
3. LOW VOLTAGE (24 V.) FIELD WIRING MUST BE 18 A.W.G. MIN.
4. **USE COPPER CONDUCTORS.** IF ALUMINUM OR COPPER-CLAD ALUMINUM POWER WIRING IS USED, CONNECTORS WHICH MEET ALL APPLICABLE CODES AND ARE ACCEPTABLE TO THE INSPECTION AUTHORITY HAVING JURISDICTION SHALL BE USED.
5. PROVISIONS FOR OPTIONAL "ODT'S" WILL VARY DEPENDING ON UNIT SIZE.
6. HEAD PRESSURE CONTROL BAYLOAM100A MAY BE USED WITH THIS UNIT.
7. RELAY ACCESSORY BAY42X042 MAY BE USED WITH THIS UNIT.

REFRIGERANT CIRCUIT



From Dwg. 21C141012 Rev. 0

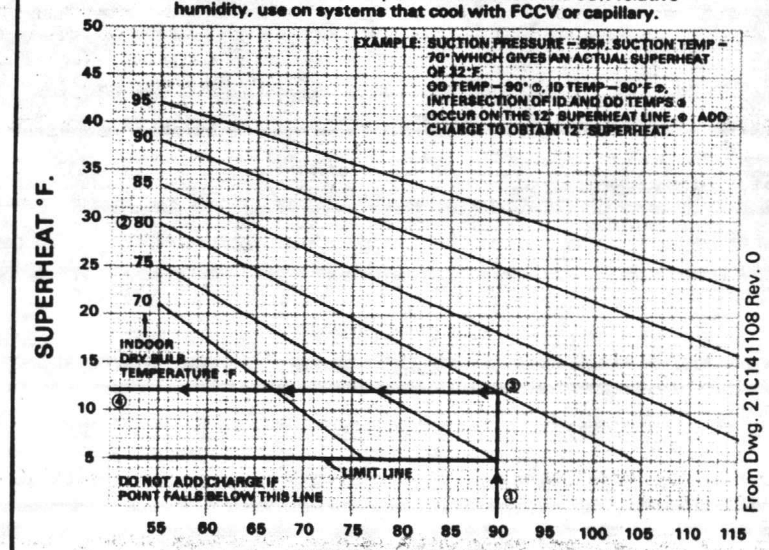
TROUBLESHOOTING CHART — WHAT TO CHECK

SYSTEM FAULTS	POWER SUPPLY	HIGH VOLTAGE WIRING	COMPR. IOL	RUN CAPACITOR	START CAPACITOR	START RELAY	CONTACTOR CONTACTS	LOW VOLTAGE WIRING	CONTROL TRANSFORMER	CONTACTOR COIL	LOW VOLTAGE FUSE	STUCK COMPRESSOR	INEFFICIENT COMPRESSOR	REFRIGERANT UNDERCHARGE	REFRIGERANT OVERCHARGE	EXCESSIVE EVAP. LOAD	NONCONDENSABLES	RESTRICTED O.D. AIRFLOW	O.D. AIR RECIRCULATION	TXV STUCK OPEN	SUPERHEAT	RESTRICTED I.D. AIRFLOW	REF. CIRCUIT RESTRICTIONS
REFRIGERANT CIRCUIT																							
Liquid Pressure Too High															P		S	P	S				S
Liquid Pressure Too Low													S	P						S	S		S
Suction Pressure Too High													S		P	P				S	P		
Suction Pressure Too Low														S							S	P	S
Liquid Refrig. Floodback TXV System																				S	S		
Liquid Refrig. Floodback Capillary Tube System															P			S	S		S	P	
I.D. Coil Frosting														P								P	S
Compressor Runs Inadequate or No Cooling													S	P		P	S				S	P	S
ELECTRICAL																							
Compressor & O.D. Fan Do Not Start	P	P						S	P	P	P												
Compressor Will Not Start But O.D. Fan Runs		P	S	P	P	P						S											
O.D. Fan Won't Start		P		P																			
Compressor Hums But Won't Start		P		P	P	P	S					S											
Compressor Cycles on IOL		P	S	P	P	P	S					P	S	P	S	S		S			S		S
I.D. Blower Won't Start	P	S						S	P		P												

P Primary Causes S Secondary Causes

SUPERHEAT CHARGING CHART

Chart based on 400 CFM/ton indoor airflow and 50% relative humidity, use on systems that cool with FCCV or capillary.

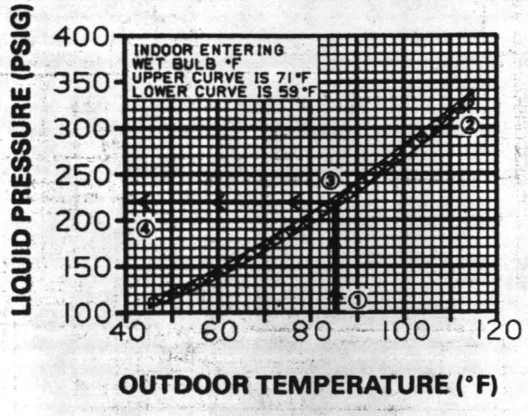


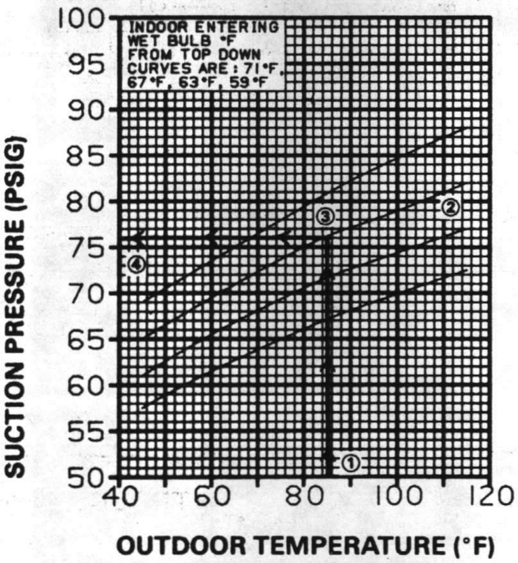
From Dwg. 21C141108 Rev. 0

Measure suction pressure, suction temperature at OD quick attach, ID & OD temps.
Determine from table what superheat should be for the ID & OD Temp. Example indicates 12° superheat.
Determine operating superheat with stabilized running conditions.
If operating superheat is:
- within 5° chart value charge is OK
- more than 5° above chart value add refrigerant
- more than 5° below chart value remove refrigerant

PERFORMANCE CURVES — TTA060A300A0

TXC760P3HPA
Cooling with Thermal Expansion Valve
Indoor Unit





From Dwg. 21D139920 Rev. 1

ALTERNATE INDOOR UNITS

COOLING WITH THERMAL EXPANSION VALVE

INDOOR UNIT	CFM	CORR. PRESSURE S	L
BWE060C100F	2000	−3	0
BWH748P100A	1800	−3	0
BWH754P100B	2000	0	0
BWH760P100A	2000	0	0
BWV748P100A	1800	−3	0
BWV754P100B	2000	0	0
BWV760P100A	2000	0	0
BXA060A300A	2000	−3	0
BXA060P3HPA	2000	0	0
BXA090A3HPA	2250	+3	0
BXA748P3HPA	1800	−3	0
BXF060A300A	2000	−3	0
BXF748P3HPA	1800	−3	0
BXH060P3HPA	2000	0	0
TWH764P100A	2000	+3	0
TWV764P100A	2000	+3	0
TXC748P3HPA	1800	−3	0
TXC760P3HPA*	2000	0	0
TXC072P300A	2250	+3	0

*BASE INDOOR UNIT FOR COOLING CURVES ON 21D139920

S - Suction L - Liquid

From Dwg. 21A139920 Rev. 0

COOLING PERFORMANCE TO BE CHECKED WHEN OUTDOOR TEMPERATURE IS ABOVE 65° F. AFTER OPERATING PRESSURES HAVE STABILIZED: MEASURE INDOOR WET BULB TEMP - OUTDOOR TEMP - LIQUID & SUCTION PRESSURES. LOCATE OUTDOOR TEMP ① LOCATE INDOOR WET BULB ② FIND INTERSECTION OF OD TEMP & ID W.B. ③ READ LIQUID OR SUCTION PRESSURE IN LEFT HAND COLUMN ④

ACTUAL LIQUID PRESSURE SHOULD BE ± 10 PSIG OF CHART
SUCTION PRESSURE SHOULD BE ± 3 PSIG OF CHART

EXAMPLE: ① OUTDOOR TEMP 85°F., ② INDOOR WET BULB 67°F.,
③ LIQUID PRESSURE @ 2000 CFM — 220 PSIG ④
③ SUCTION PRESSURE @ 2000 CFM — 76 PSIG ④

TAB PLACEMENT HERE

DESCRIPTION:

Air conditioning

unit

☐ Tab page did not contain hand written information

☒ Tab page contained hand written information
*Scanned as next image

Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

TRANE REDDI FACTS

BLDG AS-236

Library	Service Literature
Product Section	Unitary
Product	Split System - Air Conditioning
Model	TTB
Literature Type	Service Facts
Sequence	2A
Date	July 1987
File No.	SV-UN-S/S-TTB-SF-2A 7/87
Supersedes	

Air Conditioner
Model: TTB718A100A1

IMPORTANT — This document is customer property and is to remain with this unit. Please return to service information pack upon completion of work.

PRODUCT SPECIFICATIONS

OUTDOOR UNIT	TTB718A100A1
PWR. CONNS. — V/Ph/Hz	200/230/1/60
Min. Brch. Cir. Ampacity③	13
Fuse Size — Max. (Amps)	20
Fuse Size — Recmd. (Amps)	20
COMPRESSOR	Climatuff™
No. Used — No. Speeds	1 — 1
Volts/Ph/Hz	200/230/1/60
R.L. Amps — L.R. Amps	9.4 — 41
Brch. Cir. Selec. Cur. Amps	9.4
OUTDOOR FAN — Type	Propeller
Dia. (in.) — No. Used	14 — 1
Type Drive — No. Speeds	Direct — 1
CFM @ 0.0 in. w.g.④	1495
No. Motors — HP	1—1/8
Motor Speed R.P.M.	1650
Volts/Ph/Hz	230/1/60
F.L. Amps	.90
OUTDOOR COIL — Type	Spine Fin™
Rows — F.P.I.	1 — 20
Face Area (sq. ft.)	6.14
Tube Size (in.)	3/8
REFRIGERANT	
Lbs. — R-22 (O.D. Unit)⑤	3
Factory Supplied	Yes
Line Size — in. O.D. Gas⑥	5/8
Line Size — in. O.D. Liq.⑥	1/4
DIMENSIONS — Crated (in.)	
H x W x D	24.5 x 19.5 x 21
Uncrated	See Outline Dwg.
WEIGHT	
Shipping (lbs.)	115
Net (lbs.)	109

①**Rated in accordance with A.R.I. Standard 210.**
②**Rated in accordance with A.R.I. Standard 270.**

SPLIT SYSTEM

OPTIONAL EQUIPMENT

Indoor Thermostats —
- Heat/Cool — Horizontal AY28X92
- Cooling only with Fan Switch — Vertical AY28X104
- Heat/Cool — Vertical AY28X105

Evaporator Defrost Control Kit
- Needed for cooling operation Between 55° and 40° AY28X79

Coupling Kit — 5/8" Tube (90° Bend)
- Size −11 Coupling, 1/4" Tube - 6 Coupling BAY71X101

Coupling Kit — 5/8" Tube −11 Coupling,
- 1/4" Tube −6 Coupling BAY71X102

XT400 Electronic Thermostat BAYSTAT251
Remote Sensor BAYSTAT021
Start Kit BAY41X0228

AIR CONDITIONING UNIT

TUBING INFORMATION

Tubing Sizes			Additional
Suction	Liquid	Tubing Length	Refrigerant
5/8"	1/4"	15'	−3 oz.
5/8"	1/4"	25'	'+'0 oz.
5/8"	1/4"	32'	+2 oz.
5/8"	1/4"	40'	+4 oz.

Tubing lengths in excess of forty (40) feet use the following amount:
5/8" and 1/4" uses 1 oz. per each 4 ft.

③Calculated in accordance with Natl. Electric Code. Suitable for use with HACR circuit breakers or fuses.
④Standard Air — Dry Coil — Outdoor.
⑤This value approximate. For more precise value see unit nameplate and service instruction.
⑥Max. linear length 80 ft.; Max. lift - Suction 60 ft.; Max. lift - Liquid 60 ft. Max. length of precharged tubing 40 ft. For greater length refer to Refrigerant Piping Manual Pub. No. 22-3040.
⑦Rated in accordance with D.O.E. test procedure.

SAFETY NOTICE

THIS INFORMATION IS INTENDED FOR USE BY INDIVIDUALS POSSESSING ADEQUATE BACKGROUNDS OF ELECTRICAL AND MECHANICAL EXPERIENCE. ANY ATTEMPT TO REPAIR A CENTRAL AIR CONDITIONING PRODUCT MAY RESULT IN PERSONAL INJURY AND OR PROPERTY DAMAGE. THE MANUFACTURER OR SELLER CANNOT BE RESPONSIBLE FOR THE INTERPRETATION OF THIS INFORMATION, NOR CAN IT ASSUME ANY LIABILITY IN CONNECTION WITH ITS USE.

RECONNECT ALL GROUNDING DEVICES

ALL PARTS OF THIS PRODUCT CAPABLE OF CONDUCTING ELECTRICAL CURRENT ARE GROUNDED. IF GROUNDING WIRES, SCREWS, STRAPS, CLIPS, NUTS OR WASHERS USED TO COMPLETE A PATH TO GROUND ARE REMOVED FOR SERVICE, THEY MUST BE RETURNED TO THEIR ORIGINAL POSITION AND PROPERLY FASTENED.

DISCONNECT POWER BEFORE SERVICING

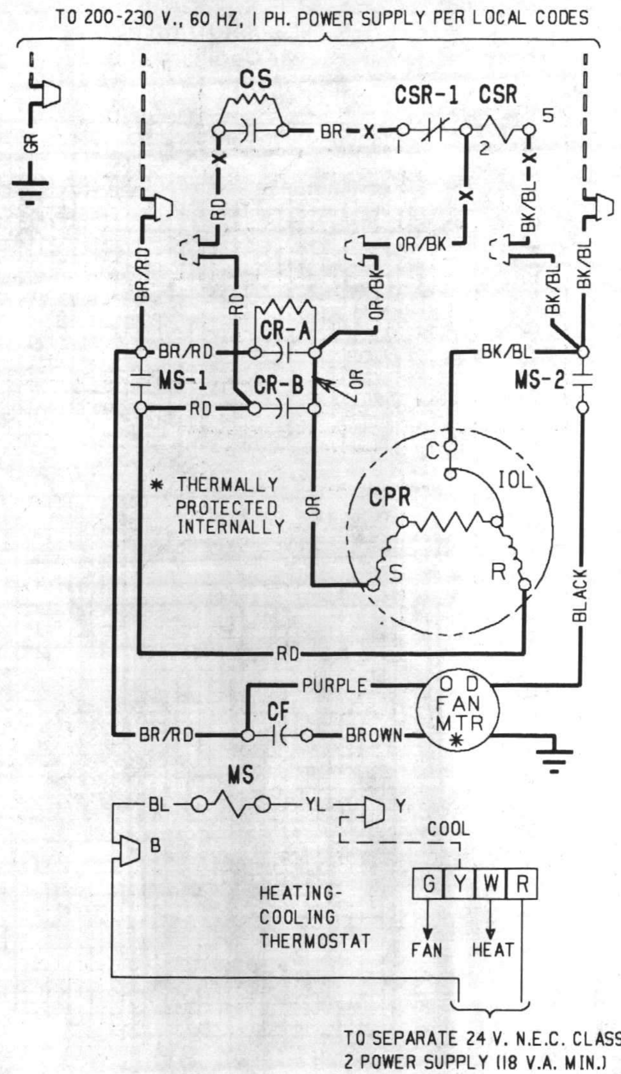
The Trane Company
Dealer Products Group • Troup Highway • Tyler, TX 75711

REDDI PARTS

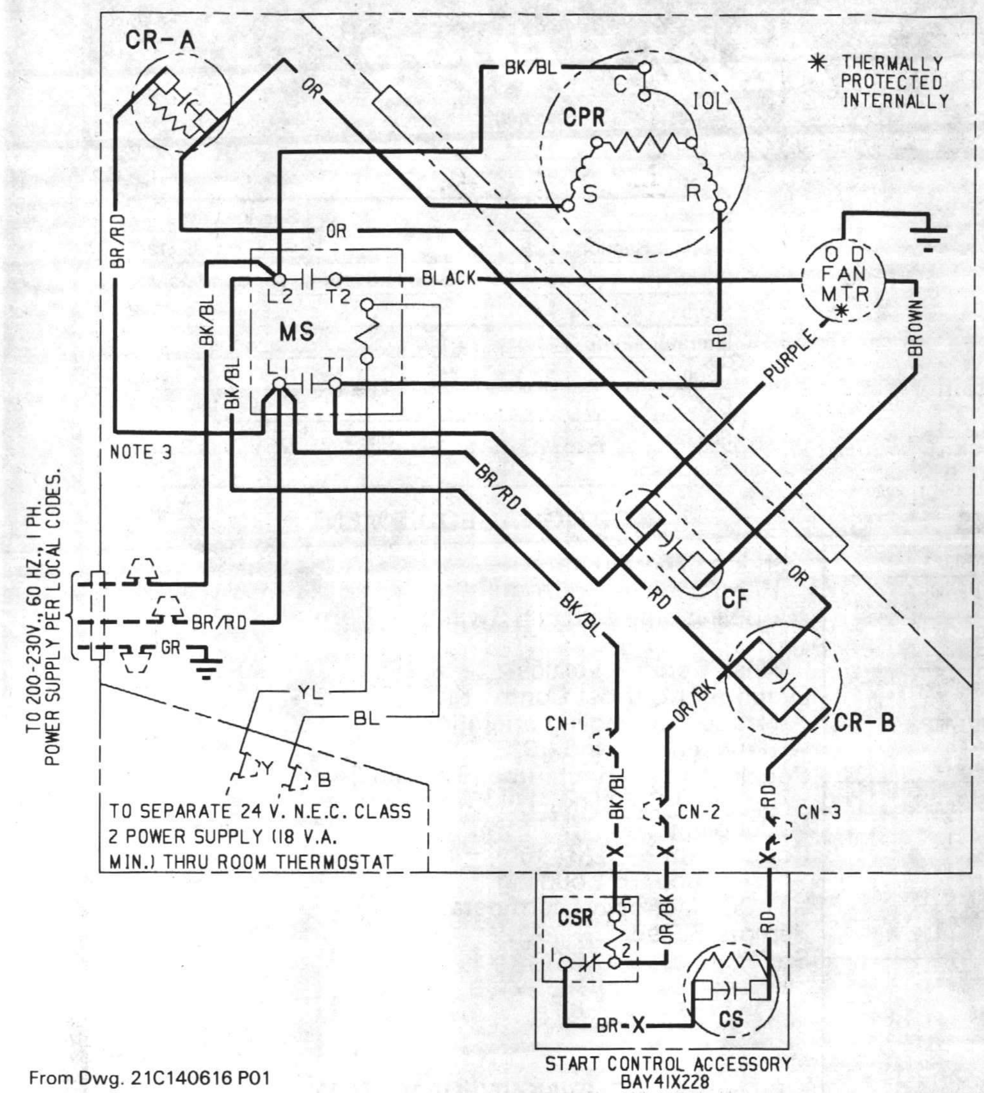
COMPONENT	QTY.	DESCRIPTION	CAT. #
Capacitors (CRA) (CRB) (CF)	1 1 1	25 MFD, 440V 5 MFD, 370V 4 MFD, 370V	WW20X0129 WG20X0026 WG20X0025
Coil, OD *	1	Replacement *	WW88X0388
Compressor Internal Line Break (IOL) Internal Press. Relief (IPR)	1	BH193-ABI-AA: FLA 9.4 LRA 41 Winding resistance @ 77°F.: Start 3.52 Ohms — Run 2.05 Ohms Opens on rise in winding temp. - resets in 30-90 minutes Opens on 350# differential between high & low side pressure	Order by unit model #
Contactor (MS)	1	Type DPST, Contacts 240V, FLA 18/8, LRA 90/18, Coil 24V, .64 A.In., .32 A. Hld., #3ARR9FE14	WW24X0026
Drier	1	Suction Line, w/Sweat Fittings, 30 Cu. In., 5/8" x 5/8"	WW22X0077
Drier	1	Liquid Line w/Sweat Fittings, 8 Cu. In., 3/8" x 3/8"	WW22X0088
Fan	1	3 Blade, 14" Dia., 1/2" Bore, CW, 30°, Hub Up	WW73X0072
Motor *	1	230V, 60 Hz., 1 Ph., Closed Shell, CCW, 1650 RPM, 1/8 HP, 1 SPD., FLA .9, LRA 2.2, Sleeve Bearings, Winding Resistance — OHMS @ 77°F. Blk to Pur 49.1/42.3, Blk to Brn 76.5/65.8 *	WW94X0412
Thermostat	1 1 1	AY28X92, Heat/Cool, Horizontal AY28X104, Cool only, w/fan Switch, Vertical AY28X105, Heat/Cool, Vertical	WY28X0092 WY28X0104 WY28X0105

*New Part - Set Up Within Last 18 Months.

SCHEMATIC DIAGRAM



TTB718A100A-1 WIRING DIAGRAM



From Dwg. 21C140616 P01

LEGEND

- 24 V. / Line V. — Factory Wiring
- 24 V. / Line V. — Field Wiring
- Field Installed Factory Wiring
- Ground
- Junction
- Wire Nut or Connector
- Coil
- Capacitor
- Relay Contact (N.O.)
- Relay Contact (N.C.)
- Internal Overload Protector
- Motor Winding
- Fuse
- Resistor or Heating Element

BK/BL — Color of Wire, Black Wire with Blue Marker, Color of Marker

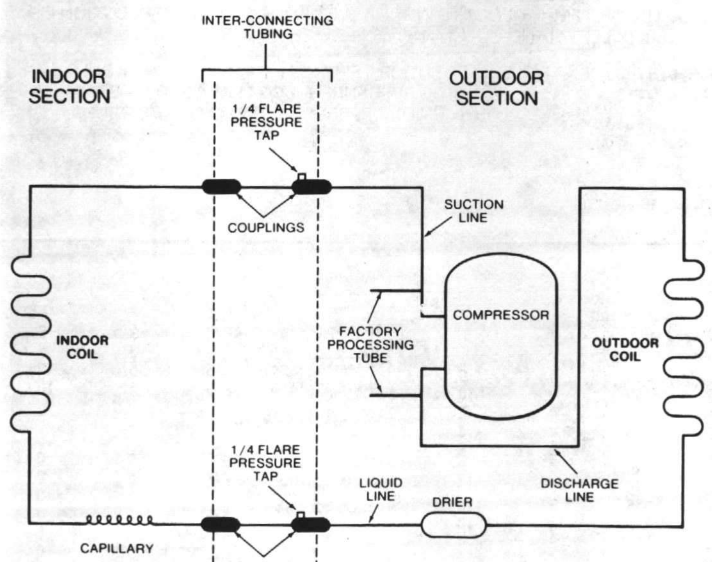
BK	Black	OR	Orange	YL	Yellow
BL	Blue	RD	Red	GR	Green
BR	Brown	WH	White	PR	Purple

CF	Fan Capacitor
CR	Run Capacitor
CPR	Compressor
CS	Start Capacitor
CRS	Capacitor Switching Relay
FU	Fuse
IOL	Internal Overload Protector
MS	Compressor Motor Contactor

NOTES:

1. LOW VOLTAGE (24 V) FIELD WIRING MUST BE 18 AWG MIN.
2. USE COPPER CONDUCTORS. IF ALUM. OR COPPER-CLAD ALUM. POWER WIRING IS USED, CONNECTORS WHICH MEET ALL APPLICABLE CODES AND ARE ACCEPTABLE TO THE INSPECTION AUTHORITY HAVING JURISDICTION SHALL BE USED.
3. TO DISCONNECT OPTIONAL SUMP HEAT MOVE BR/RD LEAD (FROM CR-A) FROM MS-LI TO MS-TI.

REFRIGERANT CIRCUIT



From Dwg. 21C134271 Rev. 0

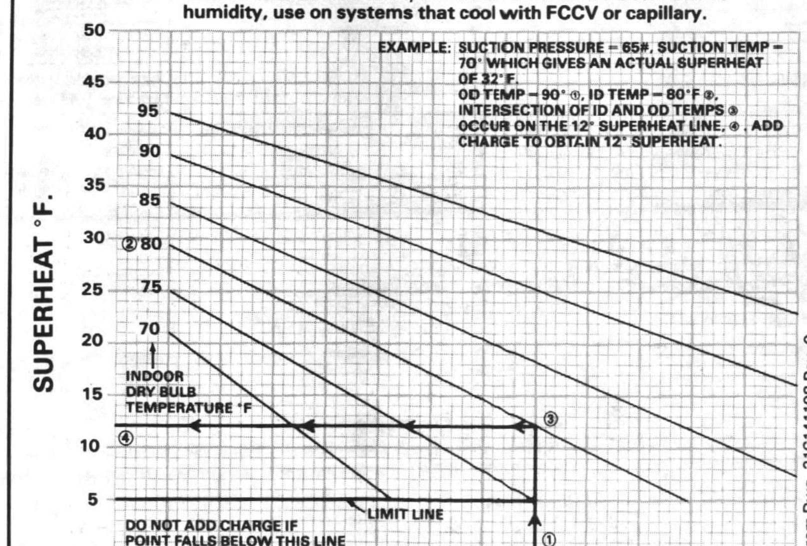
TROUBLESHOOTING CHART — WHAT TO CHECK

SYSTEM FAULTS	POWER SUPPLY	HIGH VOLTAGE WIRING	COMPR. IOL	RUN CAPACITOR	START CAPACITOR	START RELAY	CONTACTOR CONTACTS	LOW VOLTAGE WIRING	CONTROL TRANSFORMER	CONTACTOR COIL	LOW VOLTAGE FUSE	STUCK COMPRESSOR	INEFFICIENT COMPRESSOR	REFRIGERANT UNDERCHARGE	REFRIGERANT OVERCHARGE	EXCESSIVE EVAP. LOAD	NONCONDENSABLES	RESTRICTED O.D. AIRFLOW	O.D. AIR RECIRCULATION	TXV STUCK OPEN	SUPERHEAT	RESTRICTED I.D. AIRFLOW	REF. CIRCUIT RESTRICTIONS
REFRIGERANT CIRCUIT																							
Liquid Pressure Too High															P		S	P	S				S
Liquid Pressure Too Low													S	P						S	S		S
Suction Pressure Too High													S		P	P				S	P		
Suction Pressure Too Low														S							S	P	S
Liquid Refrig. Floodback TXV System																				S	S		
Liquid Refrig. Floodback Capillary Tube System															P			S	S		S	P	
I.D. Coil Frosting														P								P	S
Compressor Runs Inadequate or No Cooling													S	P		P	S				S	P	S
ELECTRICAL																							
Compressor & O.D. Fan Do Not Start	P	P						S	P	P	P												
Compressor Will Not Start But O.D. Fan Runs		P	S	P	P	P						S											
O.D. Fan Won't Start		P		P																			
Compressor Hums But Won't Start		P		P	P	P	S					S											
Compressor Cycles on IOL		P	S	P	P	P	S					P	S	P	S	S		S			S		S
I.D. Blower Won't Start	P	S						S	P		P												

P Primary Causes S Secondary Causes

SUPERHEAT CHARGING CHART

Chart based on 400 CFM/ton indoor airflow and 50% relative humidity, use on systems that cool with FCCV or capillary.



Measure suction pressure, suction temperature at OD quick attach, ID & OD temps.

Determine from table what superheat should be for the ID & OD Temp. Example indicates 12° superheat.

Determine operating superheat with stabilized running conditions.

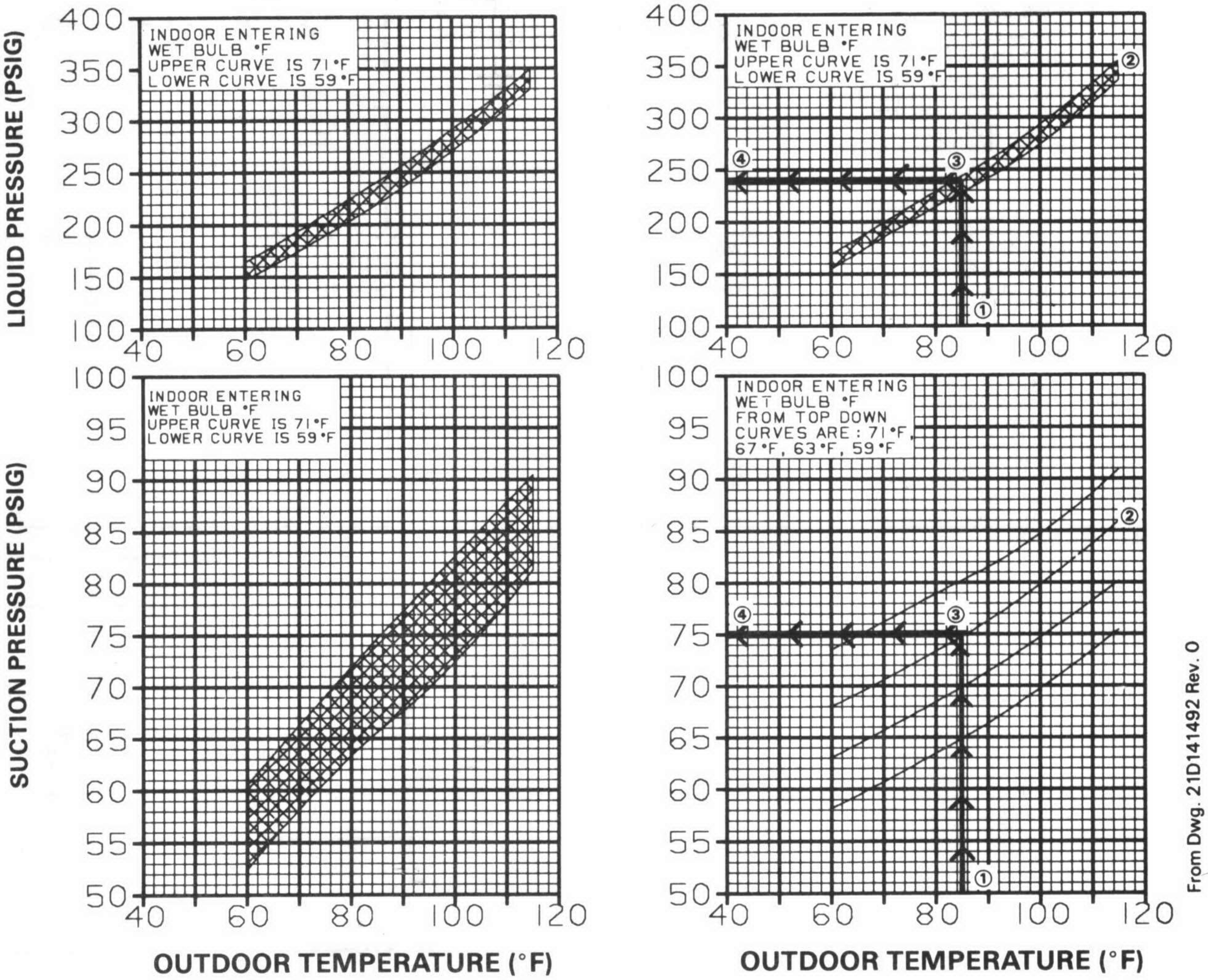
If operating superheat is:

- within 5° chart value charge is OK
- more than 5° above chart value add refrigerant
- more than 5° below chart value remove refrigerant
- if below 5° limit line, **do not add refrigerant**

PERFORMANCE CURVES — TTB718A100A1 with Indoor Unit BWH724P100A. All data at Indoor CFM 600. (With Interconnecting Lines of 5/8″ O.D. Suction and 1/4″ O.D. Liquid)

Cooling with FCCV or Capillary Tubes Indoor Unit TXC018A4HPA

Cooling with Thermal Expansion Valve Indoor Unit BWH724P100A



COOLING PERFORMANCE TO BE CHECKED WHEN OUTDOOR TEMP. IS ABOVE 75°F. HEATING PERFORMANCE CAN BE CHECKED WHEN THE OUTDOOR TEMP. IS BELOW 60°F.

TO CHECK COOLING PERFORMANCE, ALLOW PRESSURES TO STABILIZE AND MEASURE INDOOR WET BULB TEMP. — OUTDOOR TEMP. — HEAD AND SUCTION PRESSURES. LOCATE OUTDOOR TEMP. ① LOCATE INDOOR WET BULB ② FIND INTERSECTION OF OD TEMP. & ID W.B. ③ READ HEAD OR SUCTION PRESSURE IN LEFT HAND COLUMN ④

ACTUAL HEAD PRESSURE SHOULD BE ± 10 PSIG OF CHART
SUCTION PRESSURE SHOULD BE ± 3 PSIG OF CHART

EXAMPLE: ① OUTDOOR TEMP 85°F., ② INDOOR WET BULB 67°F.,
③ HEAD PRESSURE @ 600 CFM = 240 PSIG ④
③ SUCTION PRESSURE @ 600 CFM = 75 PSIG④

ALTERNATE INDOOR UNITS

COOLING WITH CAPILLARY TUBES

INDOOR UNIT	CFM	CORR. PRESS. S	L
BXA018A200A	600	0	0
BXA718P2HPA	600	0	0
BXA718D200A	600	0	0
BXA024A200A	675	2	4
BXA724M2HPA	675	2	4
BXA724D200A	675	2	4
BWU018A100B	600	0	0
BWU024A100B	675	2	4
BFW718A100A	450	−3	−6
BFW724A100A	675	4	8
BCW724A100A	675	4	8
BWH718A100A	600	2	4
BWV018A100E	600	2	4
BWV718A100E	600	2	4
BWV024A100E	675	3	6

COOLING WITH FCCV

TXC018A4HPA*	600	0	0
TXC012A4HPA	450	−9	−18
TXC024A4HPA	675	4	8
TXC025A4HPA	675	4	8
TXA025A4HPA	675	4	8
TXA725A4HPA	675	4	8
TXC030A4HPA	675	5	10
TXA030A4HPA	675	5	10
TXA730A4HPA	675	5	10
TWV018A140A	600	2	4
TWV718A140A	600	2	4
TWV024A140A	675	3	6
TWV724A140A	675	3	6
TWV025A140A	675	3	6
TWV725A140A	675	3	6
TWV030A140A	675	5	10
TWV730A140A	675	5	10
TWH018A140A	600	2	4
TWH718A140A	600	2	4
TWH024A140A	675	3	6
TWH724A140A	675	3	6
TWH030A140A	675	5	10
TWH730A140A	675	5	10

COOLING WITH TXV

BWH724P100A	675	0	0
BWU024B10GB	675	0	0
BWU030B10NA	675	0	0
BWV024P100E	675	0	0
BWH030P100A	675	3	6
BWV724P100E	675	0	0
BWV030P100E	675	3	6

*BASE INDOOR UNIT FOR CURVES ON DRAWING 21D141492 Rev. 0

S - Suction L - Liquid

From Dwg. 21A141492 Rev. 0

Bldgs AS-202
AS-236

TRANE™

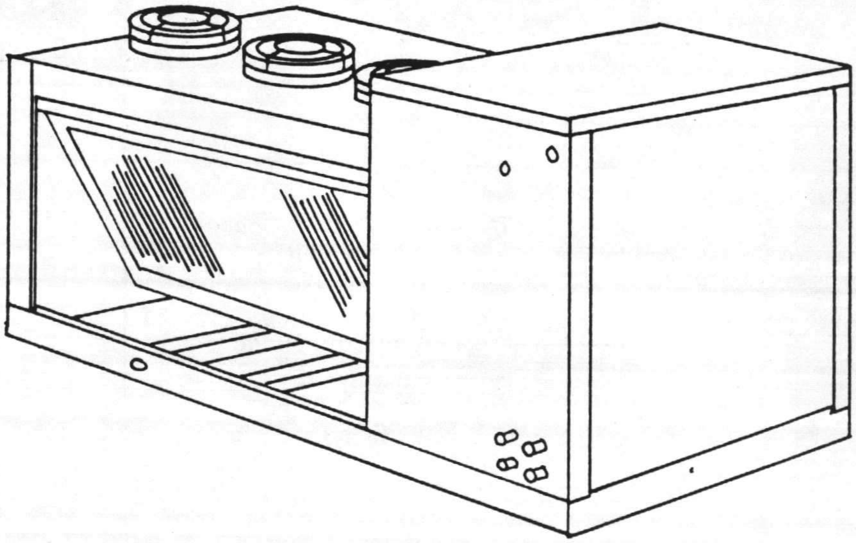
BTA-IN-5

INSTALLER'S GUIDE

Split System Condensing Units

Library	Service Literature
Product Section	Unitary
Product	Split System
Model	BTA
Literature Type	Installation
Sequence	5
Date	December 1986
File No.	SV-UN-S/S-BTA-IN-5 12/86
Supersedes	New

Models
BTA120D-AB
BTA150D-AB
BTA180D-AB
BTA180F-AB



Since The Trane Company has a policy of continuous product improvement, it reserves the right to change specifications and design without notice. The installation and servicing of the equipment referred to in this booklet should be done by qualified, experienced technicians.

18-AC60D4

Table of Contents

Subject	Page
Unit Model Number Description	2
General Information	3
Installation	3
Unit Installation	3
Receiving	3
Location and Clearances	3
Foundation	7
Rigging	7
Pre-Installation Leak Test	8
Refrigerant Piping	9
Recommended Line Sizes	9
Refrigerant Piping Guidelines	9
Liquid Line Components	10
Suction Line Components	10
Risers and Tube Routing	11
Electrical Wiring	12
Electrical Characteristics	13
Thermostat Installation	13
Installation Checklist	20
Start-Up	21
Pre-Start Checks	21
Initial Start-Up	21
Compressor Motor Checks	21
Voltage Imbalance Check	22
Start-Up Log	23

Unit Model Number Description

Trane LCG products are identified by a multiple-character model number that precisely identifies a particular type of unit. An explanation of this multiple-character number is shown below. It will enable the owner or Service Engineer to define operation, components and applicable accessories for a specific unit.

LCG Unit Model Nomenclature

1	2	3	4	5	6	7	8	9	10	11	12
B	T	A	1	2	0	D	3	0	0	A	A

Always "B"

Product Type

TA = Split System Cooling, Outdoor Unit

WE = Split System Cooling or Heat Pump, Convertible Indoor Unit

WV = Split System Cooling or Heat Pump, Verticle Indoor Unit

WH = Split System Cooling or Heat Pump, Horizontal Indoor Unit

Cooling Capacity (MBH)

090 = 90 MBH
120 = 120 MBH
180 = 180 MBH
240 = 240 MBH

Major Design Sequence

Electrical Characteristics

3 = 208-230/60/3
4 = 460/60/3
W = 575/60/3

Secondary Capacity and/or Factory Installed Options

00 = Not Used

Minor Design Sequence

Service Digit

General Information

Model BTA Condensing Units are designed for outdoor mounting with a vertical air discharge. They are usually installed on concrete slabs at ground level, but can also be used on a flat roof or a sloping roof with a properly built-up platform (making a level installation possible). Each unit is leak tested and evacuated at the factory, and shipped with a holding charge of Refrigerant-22. An access panel on the end of the unit provides access to the compressor section and access to the control box.

An Installation Checklist is provided at the end of this manual and should be completed after all installation procedures have been accomplished. This checklist should not be substituted for the detailed information given in appropriate sections of this manual.

Installation

Unit Installation

BTA unit dimensions, weights, and clearances are shown in Figures 1 through 3. Figure 4 illustrates various components of the split system condensing unit.

Receiving

When the unit is delivered to the jobsite, inspect all components for damage. Manually rotate the condenser fans to be sure they revolve freely. Report any damage or material shortage to the carrier and record this information on the bill of lading. File damage claims with the carrier, and notify the appropriate Trane sales office before installing a damaged unit. Any material shortages should also be reported directly to the Trane sales office.

Compare the electrical data on the unit nameplate with the ordering and shipping information to verify that the correct unit has been received.

Unit wiring diagrams and installation-operation-maintenance literature are shipped with the unit. Before unit start-up, read the provided literature to become familiar with the unit and its operation.

Location and Clearances

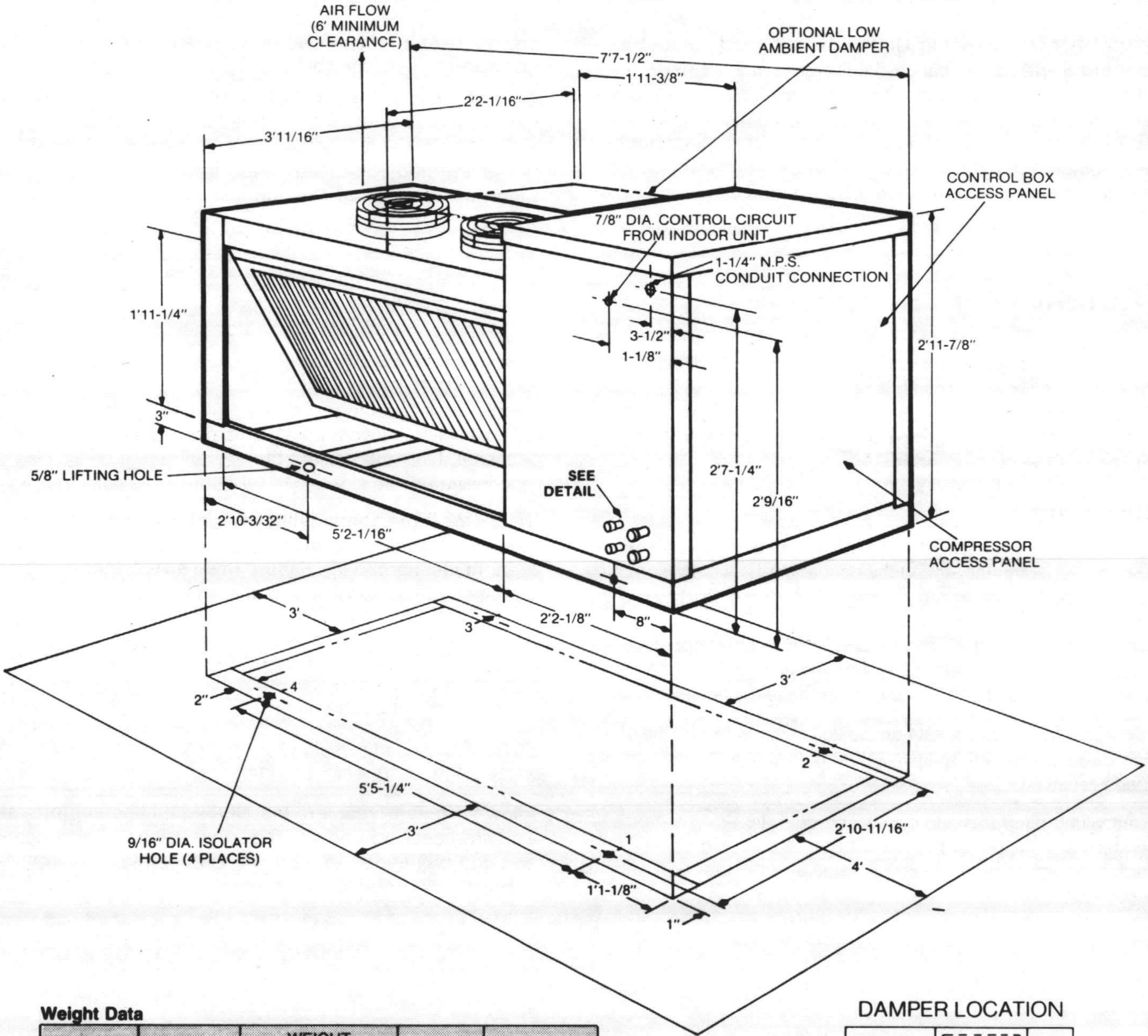
Select a location for the condensing unit where air will flow, without obstruction, upward through the coil and away from the fan discharge. Limit the length of refrigerant piping by locating the condensing unit as close to the evaporator as possible.

CAUTION: If the condensing unit must be placed under an overhang, take the necessary steps to avoid the recirculation of warm discharged air. Failure to do so will hinder the performance of the condensing unit and lead to unit damage.

Suggested air flow clearances and service clearances are given in Figures 1 through 3. If the unit is placed under an overhang, allow at least six feet of clearance above the unit to prevent recirculation of hot discharge air.

NOTE: *Four feet of service clearance must always be provided on the compressor end of the unit.*

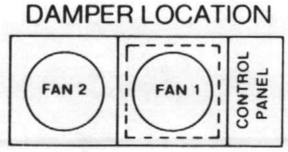
Allow sufficient space to install a liquid line shutoff valve with an access port next to the condensing unit. The access port will be needed to measure subcooling, as discussed in the MAINTENANCE manual.



Weight Data

MODEL	NO. OF COMPS.	WEIGHT CONCENTRATED ON LEG (LBS) 1	2	3	4	SHIPPING WEIGHT (LBS)	OPERATING WEIGHT (LBS)
BTA120D	Two 5-Ton	226	228	124	100	830	678

DAMPER LOCATION



Clearance Data

MODEL	SUGGESTED SERVICE CLEARANCE	SUGGESTED AIR FLOW CLEARANCES: SINGLE UNIT INSTALLATION	SIDE BY SIDE UNIT INSTALLATION	PIT INSTALLATION: MAX. PIT DEPTH	COIL CLEARANCE
BTA120D	4'-0"	3'-0"	6'-0"	3'-0"	6'-0"

REFRIGERANT
CONN. DETAIL

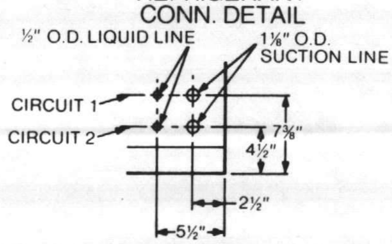
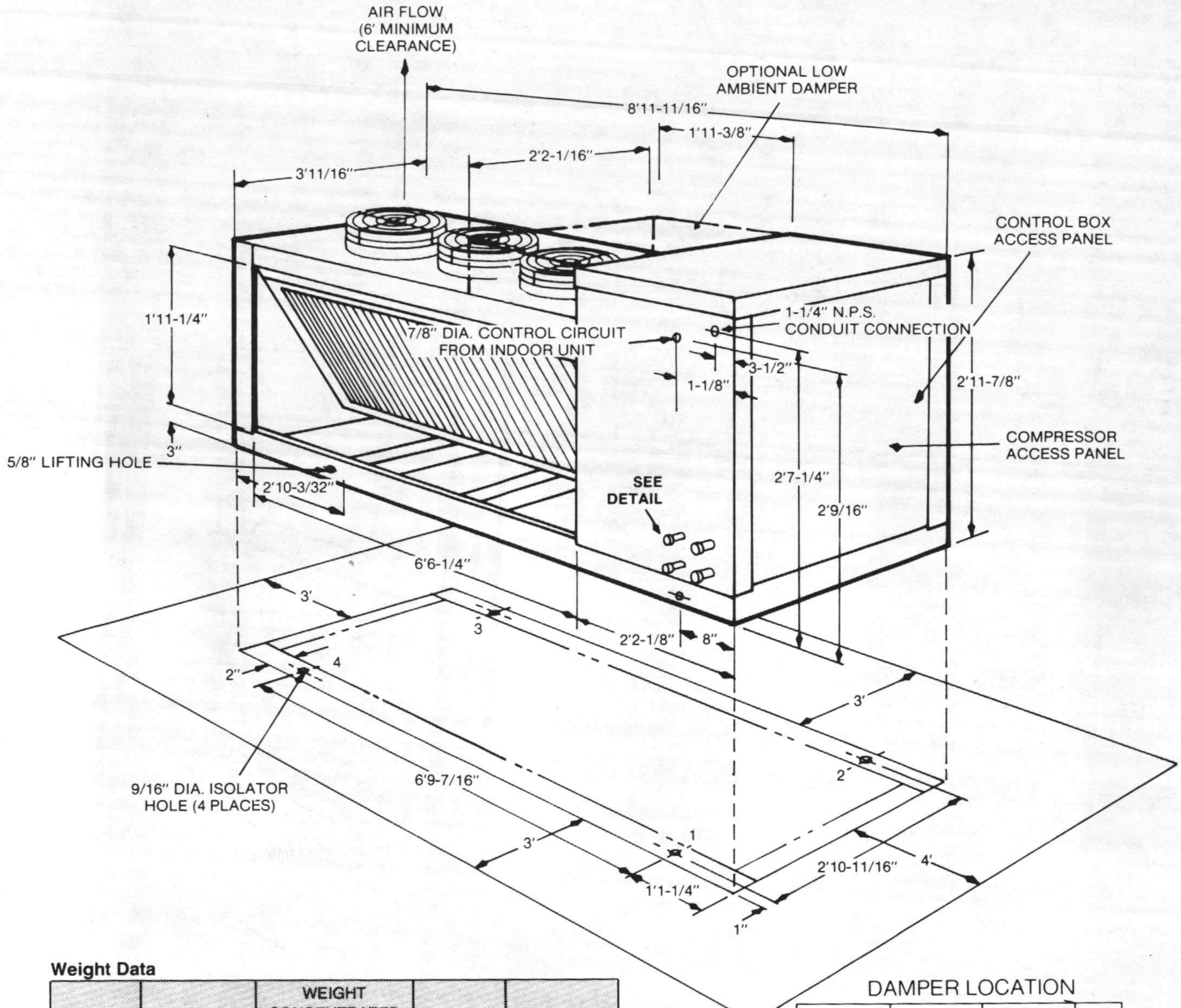


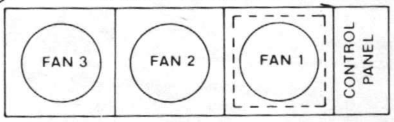
Figure 1 · Dimensions, Weights, and Clearances for BTA120D Units



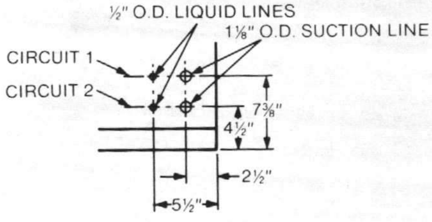
Weight Data

MODEL	NO. OF COMPS.	WEIGHT CONCENTRATED ON LEG (LBS) 1	2	3	4	SHIPPING WEIGHT (LBS)	OPERATING WEIGHT (LBS)
BTA150D	Two 6.25-Ton	256	259	138	119	960	772
BTA180D	Two 7.50-Ton	270	272	158	140	1020	840

DAMPER LOCATION



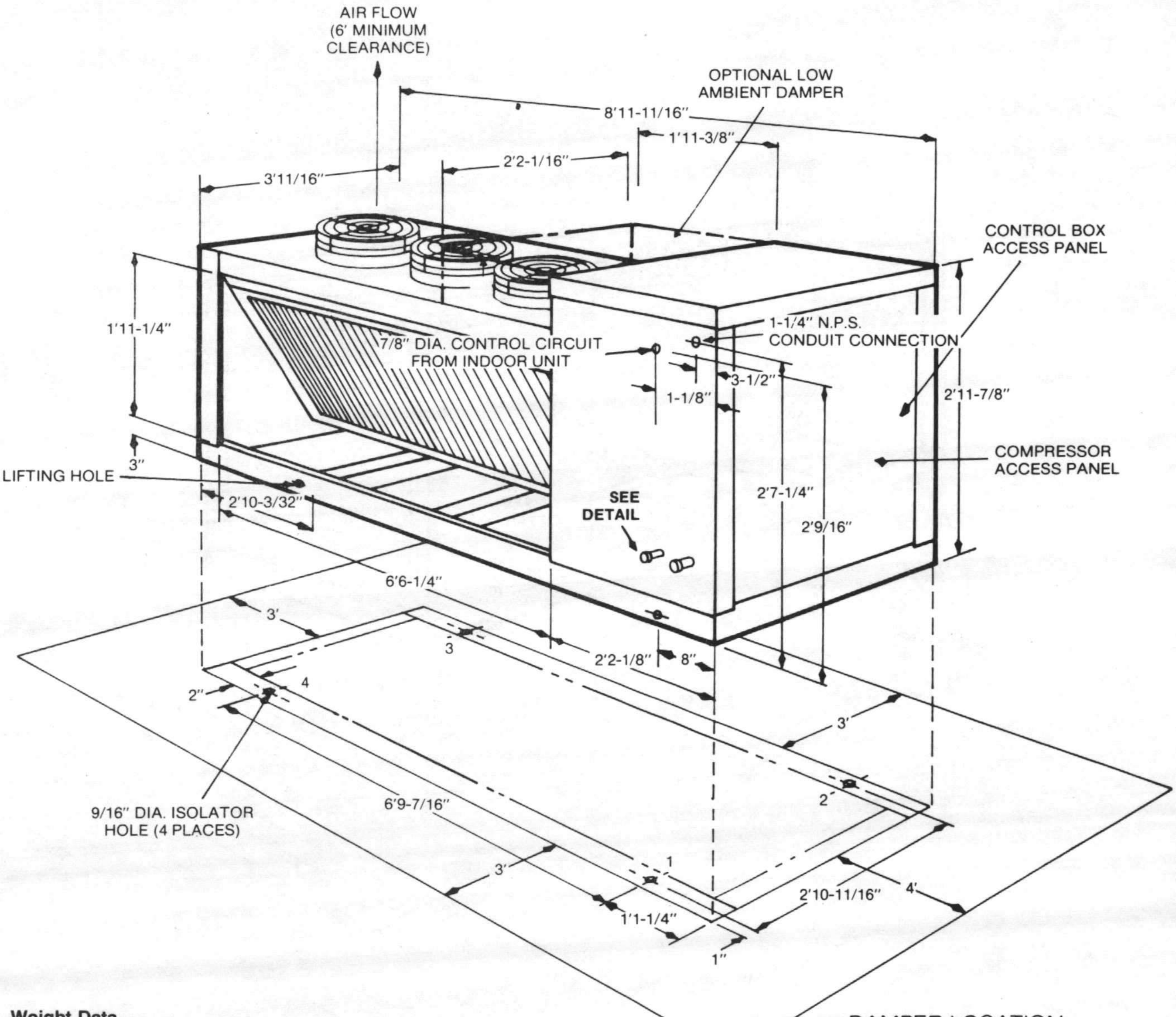
REFRIGERANT CONN. DETAIL



Clearance Data

MODEL	SUGGESTED SERVICE CLEARANCE	SUGGESTED AIR FLOW CLEARANCES: SINGLE UNIT INSTALLATION	SIDE BY SIDE UNIT INSTALLATION	PIT INSTALLATION: MAX. PIT DEPTH	COIL CLEARANCE
BTA150D	4'-0"	3'-0"	6'-0"	3'-0"	6'-0"
BTA180D	4'-0"	3'-0"	6'-0"	3'-0"	6'-0"

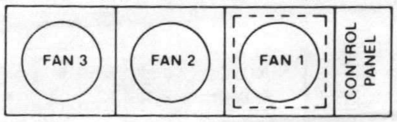
Figure 2 - Dimensions, Weights, and Clearances for BTA150D and 180D Units



Weight Data

MODEL	NO. OF COMPS.	WEIGHT CONCENTRATED ON LEG (LBS) 1	2	3	4	SHIPPING WEIGHT (LBS)	OPERATING WEIGHT (LBS)
BTA180F	One 15-Ton	271	273	158	140	1022	842

DAMPER LOCATION



Clearance Data

MODEL	SUGGESTED SERVICE CLEARANCE	SUGGESTED AIR FLOW CLEARANCES: SINGLE UNIT INSTALLATION	SIDE BY SIDE UNIT INSTALLATION	PIT INSTALLATION: MAX. PIT DEPTH	COIL CLEARANCE
BTA180F	4'-0"	3'-0"	6'-0"	3'-0"	6'-0"

REFRIGERANT CONN. DETAIL

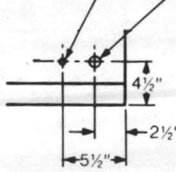


Figure 3 · Dimensions, Weights, and Clearances for BTA180F Units

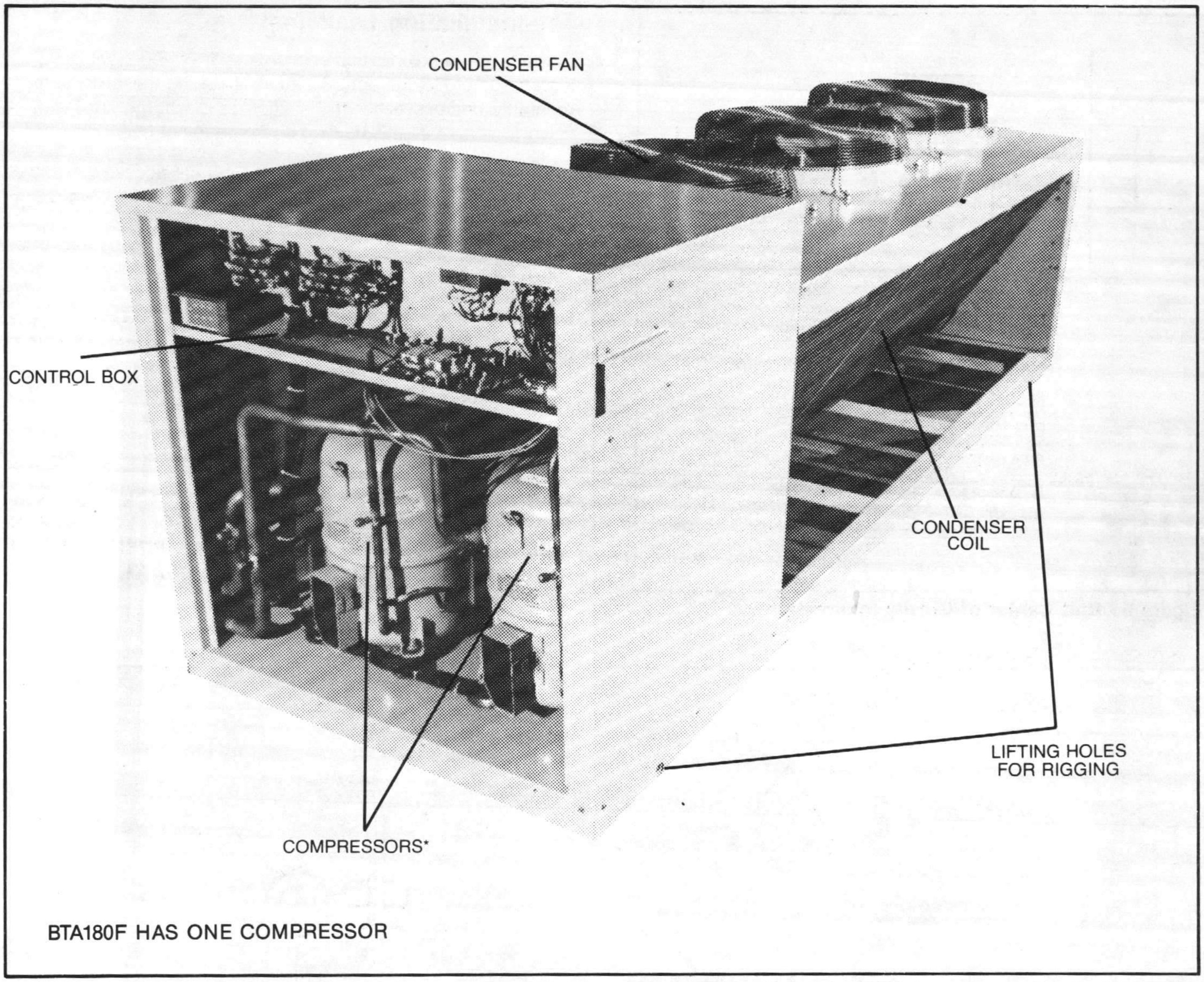


Figure 4 · BTA Component Identification

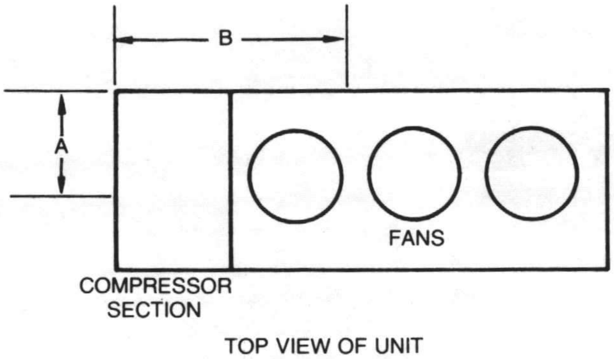
Foundation

If the unit is to be set on the ground, provide a four inch thick, level concrete slab for mounting. In rooftop applications, make sure the roof is strong enough to support the unit. Check with a roofing contractor for proper waterproofing installation practices to ensure that the roof does not develop leaks as a result of unit weight, vibration, and hot weather.

Rigging

Rig the unit using either belt or cable slings. The slings must be fastened to the unit at the four holes in the base rail of the unit, as shown in Figure 6. Use spreaders to protect the top of the unit when it is lifted. The point where the slings meet at the lifting hook must be at least six feet above the unit. Refer to Figure 5 for center of gravity information, and to Figure 6 for proper rigging procedures.

WARNING: TO PREVENT OVERSTRESSING THE BASE RAILS, THE UNIT SHOULD BE RIGGED AS SHOWN IN FIGURE 6 AND LIFTED AS SMOOTHLY AS POSSIBLE. FAILURE TO DO SO COULD RESULT IN SERIOUS PERSONAL INJURY AND DAMAGE TO THE UNIT.



MODEL	A	B
BTA120D	18.5"	33"
BTA150D	18.5"	39"
BTA180D	18.5"	41"
BTA180F	18"	40"

Figure 5 - Unit Center of Gravity Information

Pre-Installation Leak Test

Trane condensing units and evaporators are shipped with a holding charge of Refrigerant-22. Before installing these units, momentarily depress either the suction or discharge line access valve to verify that this holding charge has not been lost.

If no refrigerant escapes when depressing the access valve, the condensing unit should be leak tested to determine the source of refrigerant loss. Pressurize the unit to 100 psi with refrigerant, and use a halogen leak detector, halide torch, or soap bubbles to check for leaks. If a leak is found, release the test pressure and repair the leak. If no leak is found, use nitrogen to increase the test pressure to 150 psi and repeat the leak test. When repairing leaks, refer to "Brazing Procedures" in the MAINTENANCE PROCEDURES manual. Retest the unit to make sure the problem has been corrected.

NOTE: *It may be difficult to pressurize the unit to 100 psi with refrigerant if the ambient temperature is below 60 F.*

WARNING: DO NOT USE OXYGEN, ACETYLENE, OR AIR IN PLACE OF REFRIGERANT AND DRY NITROGEN FOR LEAK TESTING. A VIOLENT EXPLOSION WILL RESULT WHICH COULD CAUSE SERIOUS INJURY OR DEATH.

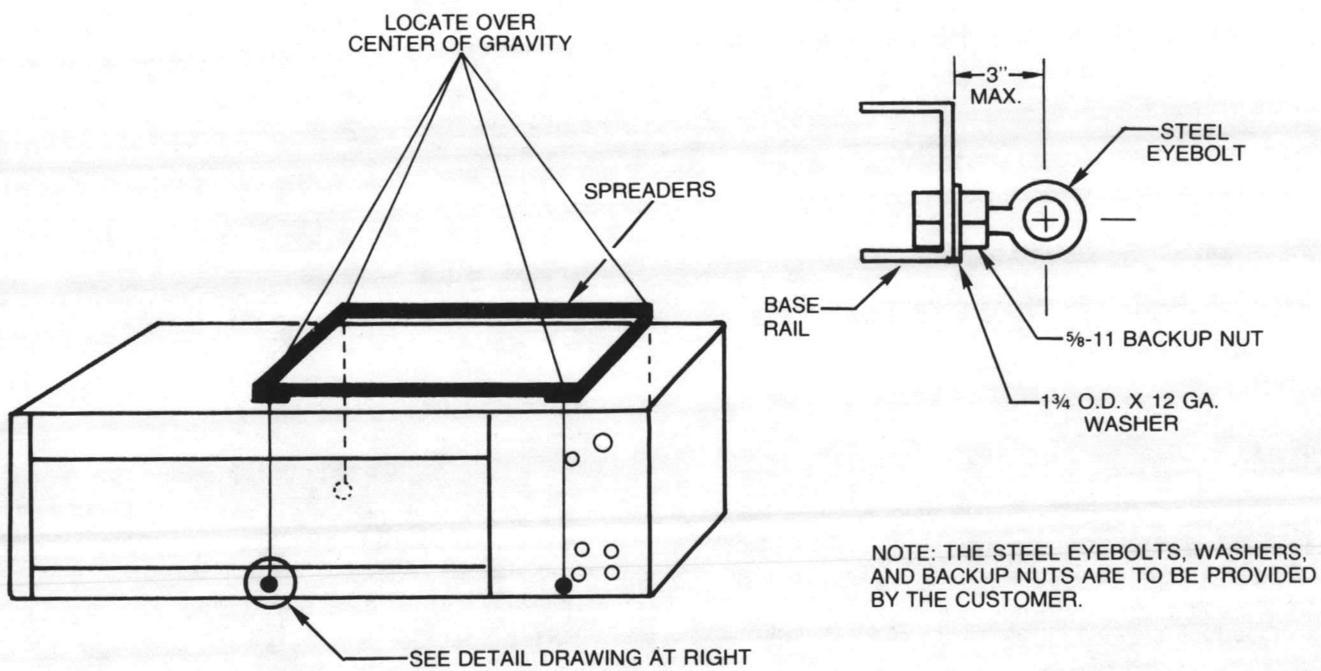


Figure 6 - Rigging the Unit

Refrigerant Piping

It is essential that refrigerant piping be properly sized and applied since these factors have a significant effect on system performance and reliability. On self-contained units, proper piping design is insured by the equipment manufacturer. However, split systems must operate with interconnecting lines which are selected and applied by the installer. If the interconnecting piping does not follow recommended guidelines, any system will be plagued by erratic performance, compressor failures, and other problems.

NOTE: *The piping should be sized and laid out according to the job plans and specifications. This should have been completed when components were selected for the system.*

Recommended Line Sizes

The interconnecting line sizes recommended by Trane are listed in Table 1. These tube sizes are within the velocity, pressure drop, and refrigerant charge limitations necessary for proper system operation. (The refrigerant charge limit is the maximum system charge recommended for a particular compressor, and is determined by the design of the compressor.) The line lengths in Table 1 are based on pressure drop and refrigerant charge limitations in the **liquid line**. Pressure drop limits assume that equivalent length equals two times the physical length. In most applications, this is a reasonable assumption. However, actual pressure drop must be calculated if one or more of the following situations exists:

1. LONG RISER: Installations with liquid line risers have an added pressure drop of 0.5 psi per foot of riser. If the riser is long, the system may require a larger diameter and/or shorter liquid line to ensure subcooling at the expansion valve.
2. EXCESSIVE BENDS, REDUCERS, VALVES: A larger than normal number of tube bends, reducers, and/or valves may increase equivalent length and pressure drop above the assumption of two times the physical length. Actual pressure drop should be calculated for these situations.

Trane recommends sizing the liquid line diameter as small as possible, while maintaining pressure drop within acceptable limits. This will minimize system charge and, therefore, have the general effect of increasing compressor life.

Trane recommends the use of Type L (medium wall) refrigerant tubing. Only refrigeration grade copper tubing should be used since it is available cleaned, dehydrated, and capped to avoid contamination prior to installation. Copper tubing used for plumbing usually has oil, grease, or other contaminants on the interior wall, and these can cause serious operating problems if not removed prior to installation. Tube size recommendations in this manual are based on Type L (medium wall) tubing.

Table 1 - Interconnecting Line Sizes

	LENGTH OF INTERCONNECTING LINES (FEET)							
CONDENSING	0-20		21-40		41-60		61-80	
UNIT	LINE SIZE — O.D. (INCHES)							
UNIT	LIQ.	SUCT.	LIQ.	SUCT.	LIQ.	SUCT.	LIQ.	SUCT.
BTA120D†	3/8	7/8	3/8	1-1/8	1/2	1-1/8	1/2	1-1/8
BTA150D†	3/8	7/8	3/8	1-1/8	1/2	1-1/8	1/2	1-3/8
BTA180D†	1/2	1-1/8	1/2	1-1/8	1/2	1-1/8	1/2	1-3/8
BTA180F	5/8	1-3/8	5/8	1-3/8	5/8	1-5/8		

NOTES:
1. For line lengths and risers greater than maximum recommended in table, refer to the Trane Refrigeration Manual.
2. Use type L (medium wall) A.C.R. copper tubing.

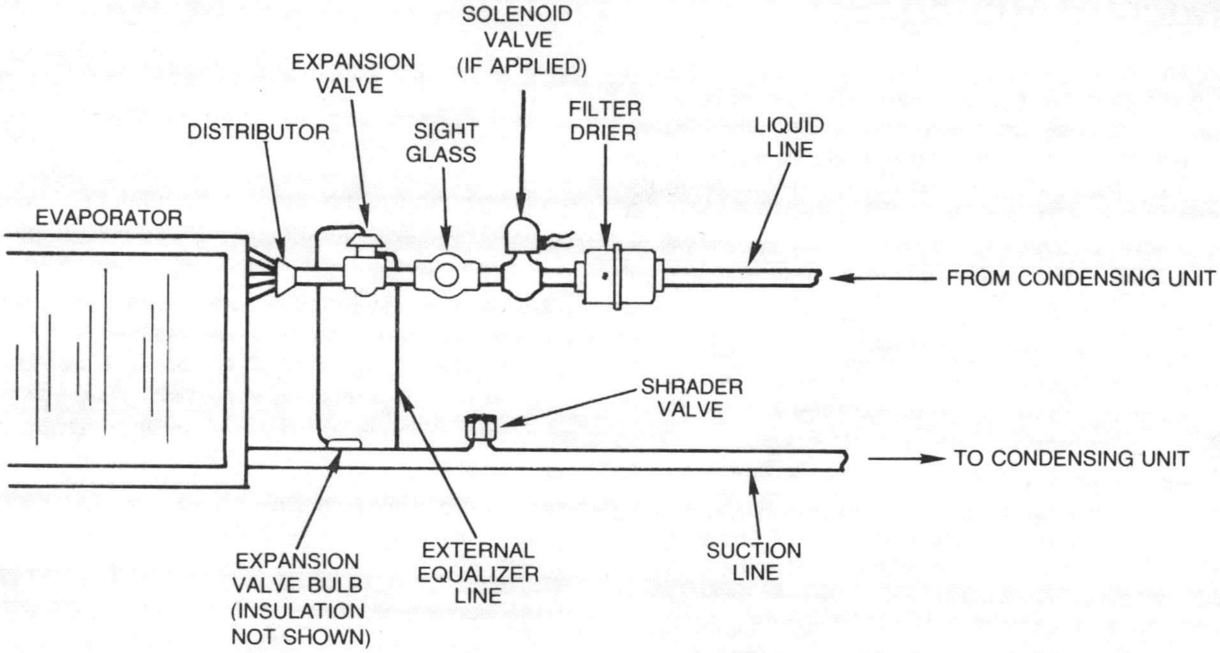
†2 line sets required.

Refrigerant Piping Guidelines

A. Maximum recommended line lengths:
Maximum linear length .... 80 Ft. (w/o accumulator)
Maximum suction line lift .... 60 Ft.
Maximum liquid line lift .... 60 Ft.

B. Maximum allowable pressure drops (R-22):
Suction line .... 3 psi
Liquid line .... 35 psi

Route refrigerant piping for minimum linear length, minimum number of bends and fittings (no reducers) and minimum amount of line exposed to outdoor ambients.



NOTE: INSTALL THE EXPANSION VALVE, SIGHT GLASS, SOLENOID VALVE, AND FILTER DRIER AS CLOSE TO THE EVAPORATOR AS POSSIBLE.

Figure 7 · Diagram of Refrigerant Piping Components in Liquid Line

Liquid Line Components

A properly sized liquid line filter drier must be installed upstream from the expansion valve. In addition, a moisture indicator/sight glass should be installed between the expansion valve and filter drier. Both of these components should be installed at the evaporator close to the expansion valve, as shown in Figure 7.

A shut-off valve (with access port) should be sized with the liquid line O.D. selected, and installed close to the condenser. Other valves, tube bends, and reducers should be minimized since these items tend to increase pressure drop and reduce subcooling at the expansion valve.

Liquid line receivers are not recommended on 10 to 15 ton systems since they increase the refrigerant charge.

The following points should be considered when connecting the evaporator to the BTA180F condensing unit.

1. It is recommended that the full evaporator coil be used during low speed compressor operation because of efficiency considerations.
2. In some installations, insufficient moisture removal may result when the full evaporator coil is used with the compressor on low speed.
3. In instances where the importance of moisture removal overrides efficiency considerations, one-half of the evaporator coil capacity can be shut off when the compressor switches to low speed.
4. If solenoid valves are required, they should be installed between the filter drier and sightglass in order to shutoff one-half of the evaporator coil capacity. On units where the solenoid valves are factory installed, the sightglass can be installed between the unit and filter drier. However, all of these components should be installed close to the expansion valve, and no more than one-half of the coil capacity should be shut off.

Suction Line Components

Trane does not recommend the use of suction line accumulators on 10 to 15 ton single compressor units because accumulators of sufficient size and quality are not available.

Suction line filter driers are not recommended as standard components when installing BTA condensing units. They may be necessary on systems that have experienced a compressor burn-out (refer to Trane Service Bulletin No. HCOM-SB-45).

On 10 to 15 ton systens, a suction line shut-off valve installed in the interconnecting tubing has little value, and is not recommended due to pressure drop considerations. Increased suction line pressure drop has a significant effect on system capacity and efficiency.

Risers and Tube Routing

Liquid Line

Liquid line riser lengths are limited only by the additional pressure drop (0.5 psi/ft) which results from the liquid column. No limit exists on the length of liquid line drops, and no special line sloping considerations are necessary.

Normally it is not necessary or desirable to insulate liquid lines. In most applications, the ambient temperature is lower than the refrigerant temperature, and has the desirable effect of increasing subcooling at the expansion valve. However, liquid lines routed through extremely high ambient environments (such as a boiler room) may reduce subcooling below acceptable levels. To minimize this loss, liquid lines passing through extremely warm spaces should be insulated. Increasing the liquid line size only tends to aggravate this problem.

Suction Line

The suction line sizes recommended in Table 1 will result in sufficient refrigerant vapor velocity to ensure good oil entrainment. It is also important to utilize good tube routing practices in order to ensure proper oil return to the compressor.

It is recommended that horizontal suction lines be pitched toward the compressor.

Insulate the suction line with 1/2-inch thick, closed cell neoprene insulation such as armaflex or similar material.

Brazing and Leak Testing

For proper brazing techniques when installing refrigerant piping, refer to "Brazing Procedures" in the MAINTENANCE manual.

After completing the installation of all refrigerant piping, the system should be thoroughly checked for possible leaks. Refer to "Leak Testing" in the MAINTENANCE manual.

Electrical Wiring

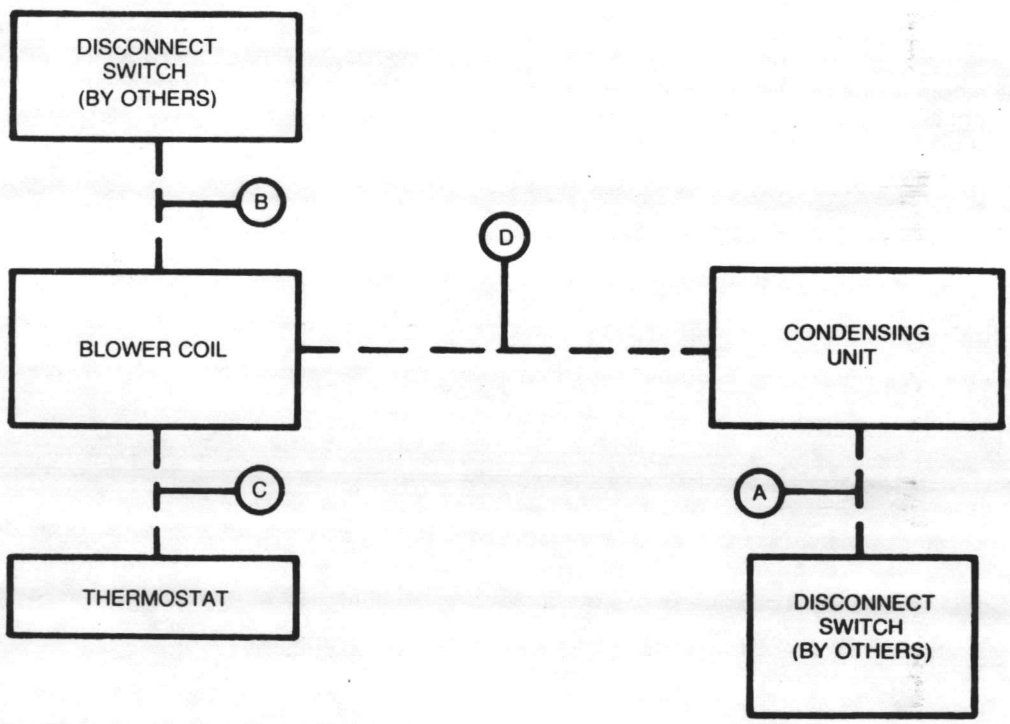
WARNING: OPEN THE ELECTRICAL POWER DISCONNECT SWITCH AND SECURE IN THAT POSITION BEFORE INSTALLING OR SERVICING THE UNIT. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY OR DEATH FROM ELECTRICAL SHOCK.

Install all field wiring, including the unit electrical ground, in accordance with the National Electrical Code and applicable local codes. Figure 8 provides a block diagram of the electrical connections to be made by the customer or installing contractor.

NOTE: *When connecting wires at the terminal block, make sure that all lugs are tight. Also check the terminal block and compressor contactor lugs that were wired at the factory.*

The unit wiring diagram is pasted on the back of the control box cover. Refer to Figures 1 and 2 for the locations of holes provided for electrical conduit entry on the unit. The locations of the electrical panel components are shown on the unit wiring diagram.

Table 2 lists the electrical characteristics for BTA120D to BTA180D, BTA180F units.



FIELD WIRING WHEN USED WITH A BACA UNIT:
A — 3 power wires, line voltage
B — 3 power wires, line voltage
C — Cooling only thermostat: 4 wires, 24 volts
— One-stage electric heat: add 1 additional wire, 24 volts
— Two-stage electric heat: add 2 additional wires, 24 volts
D — 4 wires, 24 volts

NOTE: Wiring shown with dash lines is to be furnished and installed by the customer. All customer-supplied wiring must be copper only and must conform to NEC and local electrical codes. Codes may require line of sight between disconnect switch and unit.

Figure 8 · Electrical Connections by Customer

Table 2 - Electrical Characteristics for BTA120D to BTA180D, BTA180F Units

	Unit Characteristics					Compressor Motor				Condenser Fan Motor			
Model	Electrical Characteristics [7]	Allowable Voltage	Min. Circuit Range [3,6]	Max. Fuse Amp. [2,6]	Recm'd Dual Element Fuse Size [4,6]	No.	RLA (Ea) [1]	LRA (Ea) [1]	KW (Ea) [1,5]	NO/ HP	FLA (Ea) [1]	LRA (Ea) [1]	KW (Ea) [1,5]
BTA120D300	208-230/60/3	187-254	53	70	60	2	19.0	115	6.0	2/.75	5.0	11.0	0.77
BTA120D400	460/60/3	416-508	29	35	35	2	10.6	50	6.0	2/.75	2.7	5.5	0.77
BTA120DW00	575/60/3	520-536	23	30	25	2	8.5	45	6.0	2/.75	1.8	4.4	0.77
BTA150D300	208-230/60/3	187-254	65	80	80	2	23.6	142	7.3	3/.50	4.1	9.5	0.60
BTA150D400	460/60/3	416-508	30	40	35	2	10.7	71	7.3	3/.50	2.1	4.8	0.60
BTA150DW00	575/60/3	520-635	24	30	30	2	8.6	57	7.3	3/.50	1.6	3.8	0.60
BTA180D300	208-230/60/3	187-254	73	100	80	2	27.1	156	8.9	3/.50	4.1	9.5	0.62
BTA180D400	460/60/3	416-508	34	45	40	2	12.3	79	8.9	3/.50	2.1	4.8	0.62
BTA180DW00	575/60/3	520-635	27	35	30	2	9.9	63	8.9	3/.50	1.6	3.8	0.62
BTA180F300	208-230/60/3	187-254	83	125	100	1	56.4	248	17.8	3/.50	9.5	9.5	0.62
BTA180F400	460/60/3	416-508	42	60	50	1	28.2	124	17.8	3/.50	4.8	4.8	0.62
BTA180FW00	575/60/3	520-635	33	50	40	1	22.6	100	17.8	3/.50	3.8	3.8	0.62

NOTES:
1. Electrical information is for each individual motor.
2. Maximum fuse size permitted by N.E.C. 440-22 is 225% of one compressor motor RLA plus the total RLA of the remaining motors in the circuit.
3. Minimum circuit ampacity is 125% of the RLA of one compressor motor plus the total RLA of the remaining motors in the circuit.
4. Recommended dual element fuse size is 150% of the RLA of one compressor motor plus the total RLA of the remaining motors in the circuit.
5. KW values are taken at conditions of 45 F saturated suction temperature at the compressor and 95 F ambient.
6. Local codes may take precedence.
7. Allowable range at unit terminal block.
8. Data given at high speed.

CAUTION: Use only copper conductors for supply power power wiring. Do not use aluminum conductors. Unit terminals are not designed to accept other than copper conductors.

NOTE: *For 208 volt operation, reconnect the control power transformer as shown on the unit wiring diagram. Cap the unused transformer lead with a wire nut.*

Fuses

Refer to the unit wiring diagram pasted on the inside of the control box cover for condenser fan and control circuit fuse specifications.

Thermostat Installation

Recommended wire sizes and lengths for installing the unit thermostat are provided in Table 3. The total resistance of these low voltage wires must not exceed one ohm. Any resistance in excess of one ohm may cause the control circuit to malfunction.

When selecting a thermostat location, be sure to choose a site in a frequently occupied area with good air circulation at an average temperature. The thermostat should be positioned approximately five feet above the floor and **must be level**.

Avoid mounting the thermostat in areas subject to the following:
— drafts or "dead" spots behind doors or in corners;
— hot or cold air from ducts;
— radiant heat from the sun, or from appliances;
— concealed pipes and chimneys;
— unheated or uncooled surfaces behind the thermostat, such as outside walls;
— in an area where the thermostat will be affected by a unit in another zone.

CAUTION: If an energy management device, time clock, or other power consuming device is used, a separate power supply must be provided for that device. Do not use the unit control circuitry, or damage to the unit may result.

Table 3 - Recommended Thermostat Wire Size

WIRE SIZE	MAXIMUM WIRE LENGTH
22 Gauge	30 Ft.
20 Gauge	50 Ft.
18 Gauge	75 Ft.
16 Gauge	125 Ft.
14 Gauge	200 Ft.

Table 4 - Air Handler Motor Electrical Data

Unit Model Number	Unit Electrical Characteristics	No. of Motors	Hp (Ea.)	Speed (Rpm)	FLA		LRA	
					200/230V	460V	200/230V	460V
BWE090C100E	200-230/60/1	1	1	3450	6.3	—	45.0	—
BWE090C400E	200-230 & 460/60/3	1	1	1725	3.8	1.9	21.2	10.6
BWE120C100E	200-230/60/1	1	2	3450	11.5	—	61.0	—
BWE120C400E	200-230 & 460/60/3	1	1½	1725	5.0	2.5	37.4	18.7
BTE120C100E	200-230/60/1	1	2	3450	11.5	—	61.0	—
BTE120C400E	200-230 & 460/60/3	1	1½	1725	5.0	2.5	37.4	18.7

Table 5 - BWH and BWV Unit Electrical Data

Unit Model Number	Unit Characteristics		Indoor Fan Motor			
	Electrical Characteristics	Voltage Utilization Range	No. Req'd.	Hp (Ea.)	Speed (Rpm)	FLA
BWH180B300C BWV180B300C	200-230/60/3	180-254	1	3	1725	9.0
BWH180B400C BWV180B400C	460/60/3	414-506	1	3	1725	4.4
BWH240B300C BWV240B300C	200-230/60/3	180-254	1	5	1725	15.2
BWH240B400C BWV240B400C	460/60/3	415-506	1	5	1725	6.6

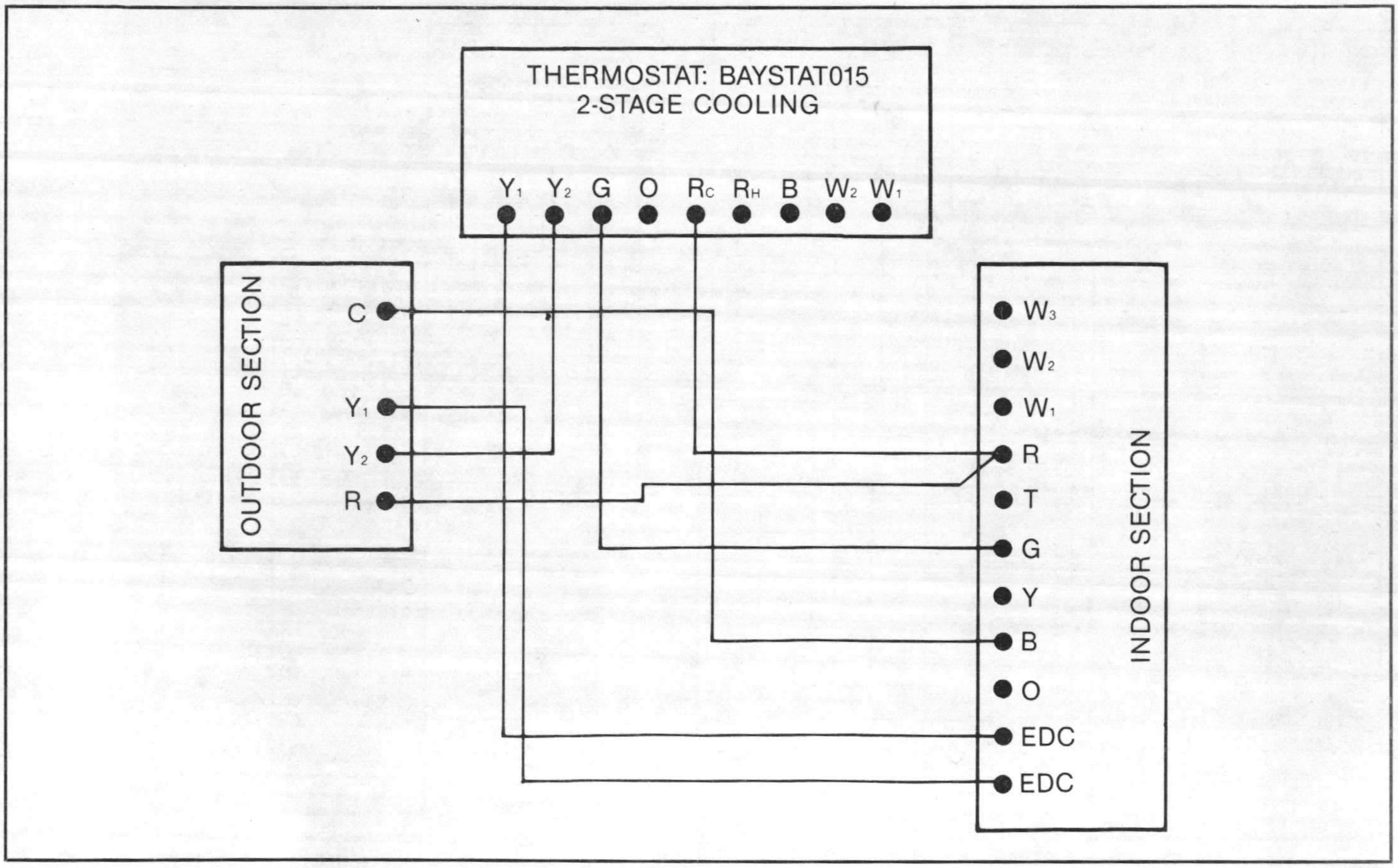


Figure 9 · Field Wiring for BTA120D with BTE120B Air Handler No Electric Heat

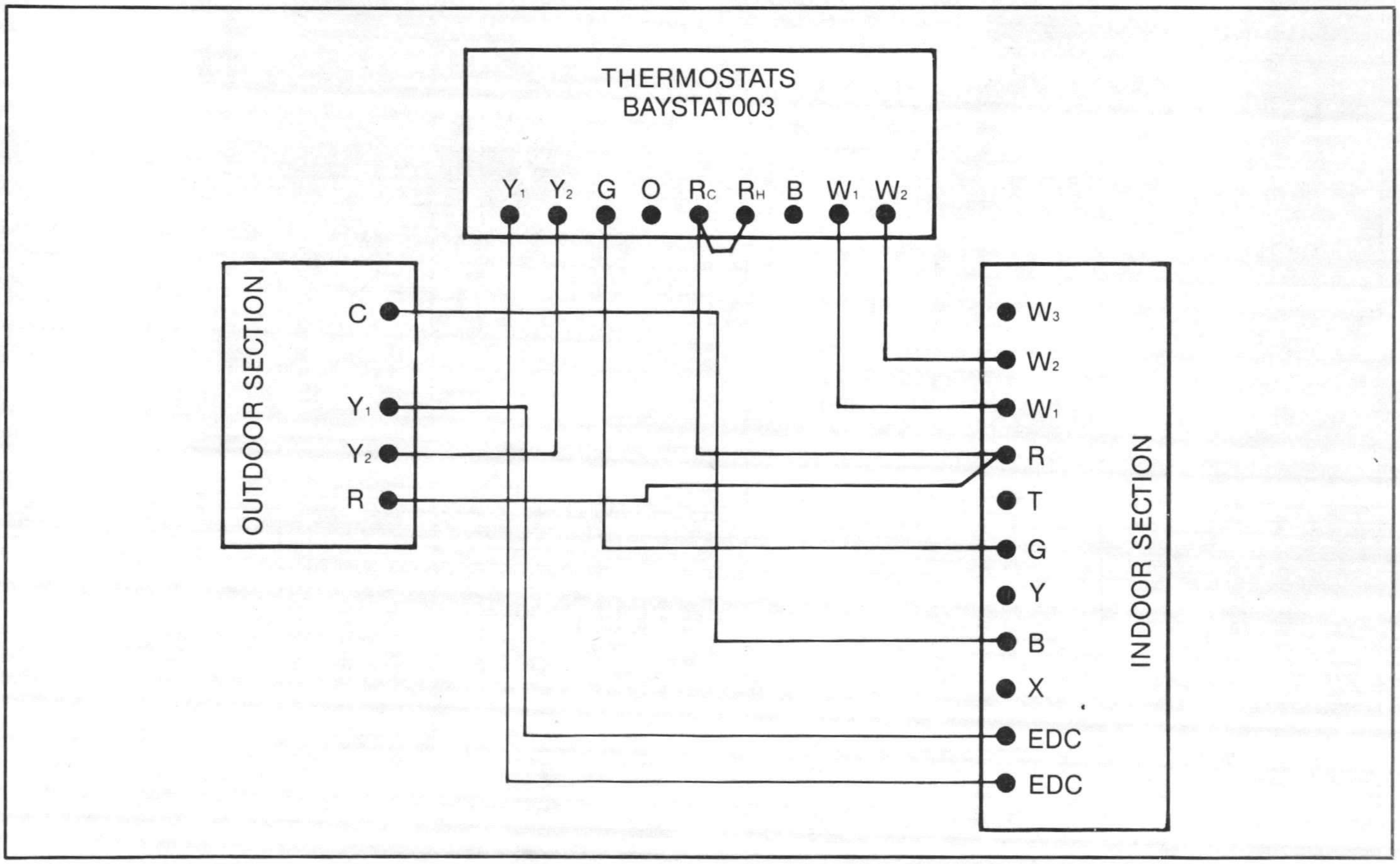


Figure 10 · Field Wiring for BTA120D with BTE120B Air Handler With Electric Heat

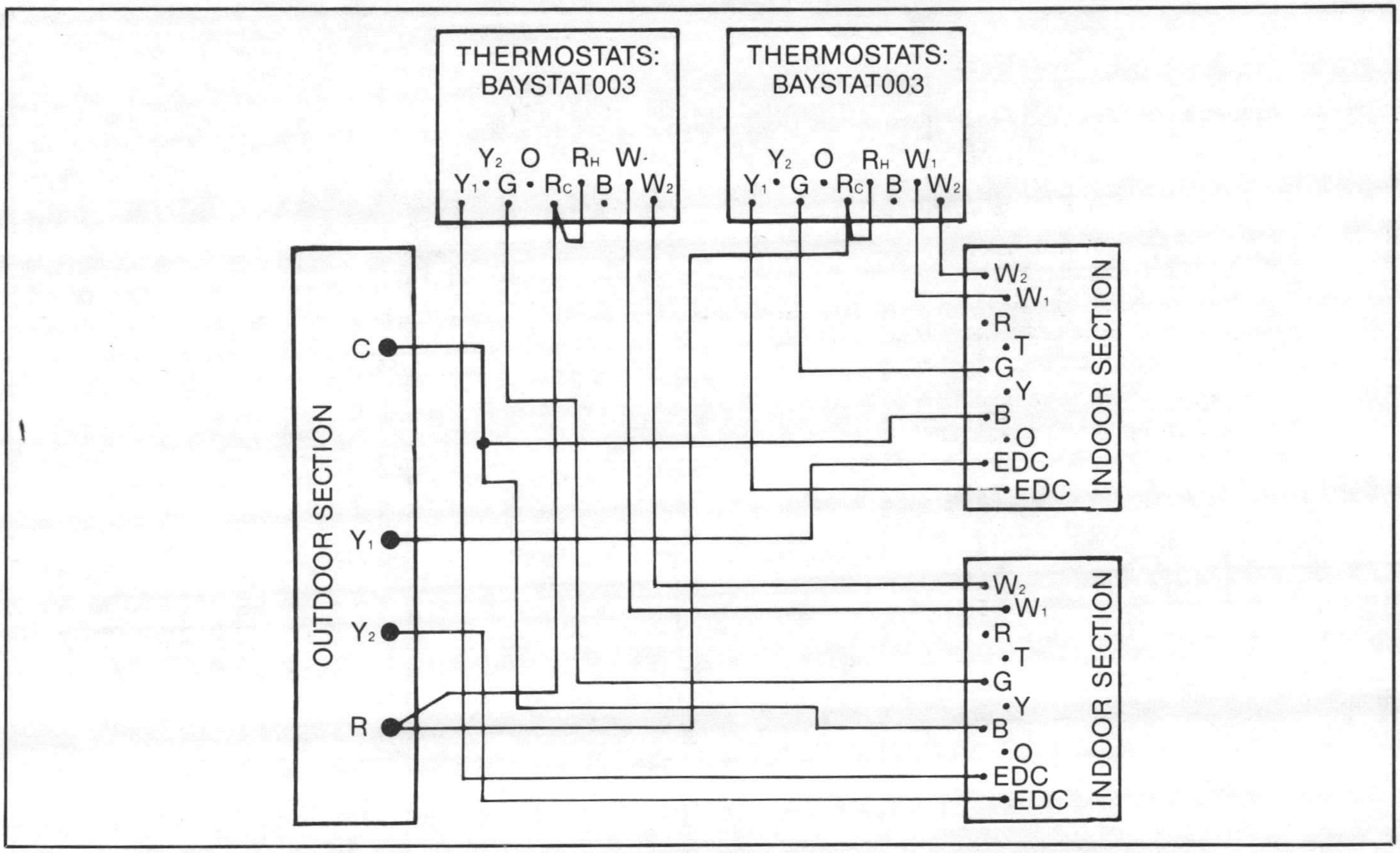
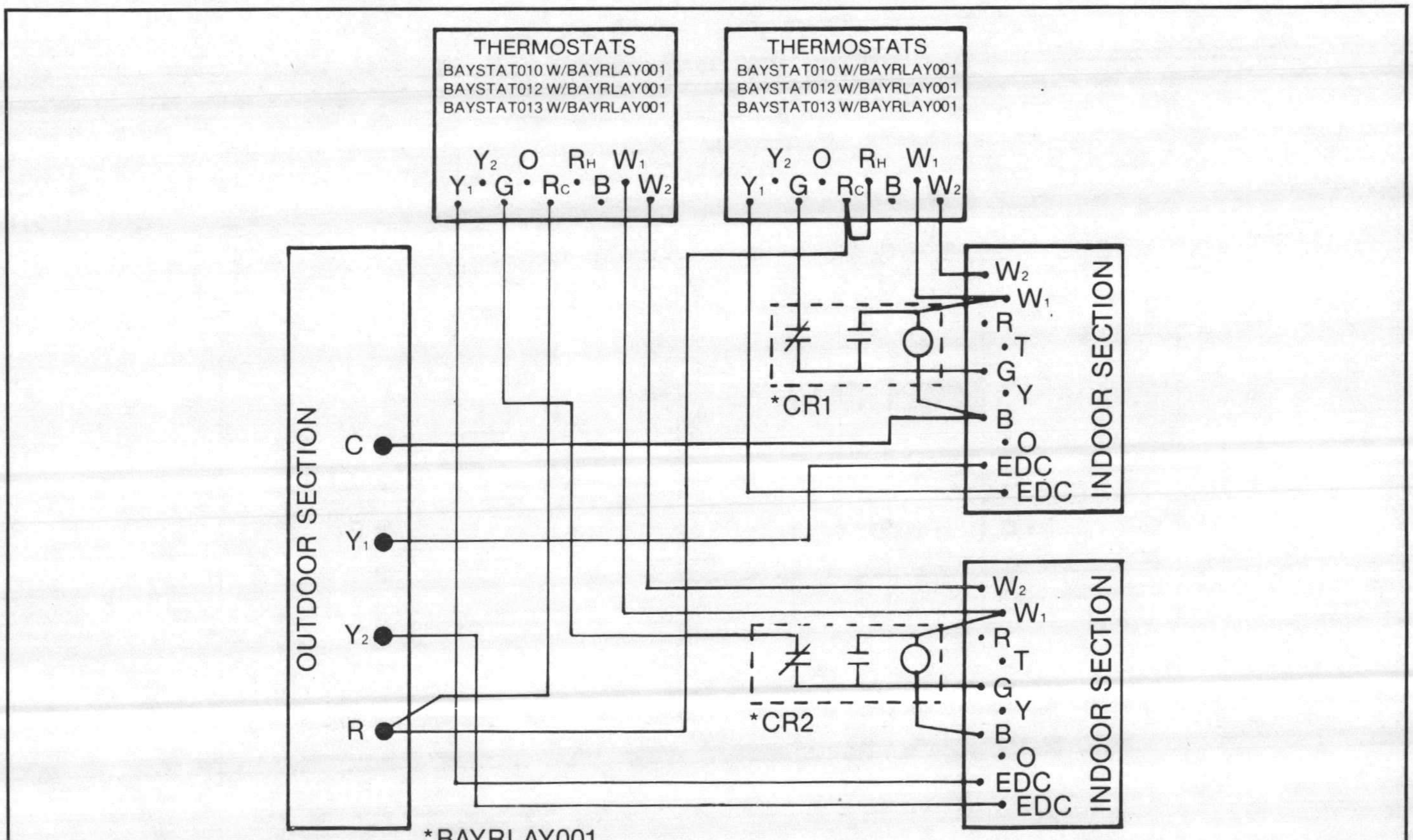


Figure 11 · Field Wiring for BTA150D and BTA180D With Two (2) BWE090C Air Handlers With Electric Heat



NOTES:
1. For low ambient operation, consult Trane representative.
2. For 1-step electric heat, omit wires between W_2 on thermostats and indoor units.

Figure 12 · Field Wiring for BTA150D and BTA180D With Two (2) BWE090C Air Handlers

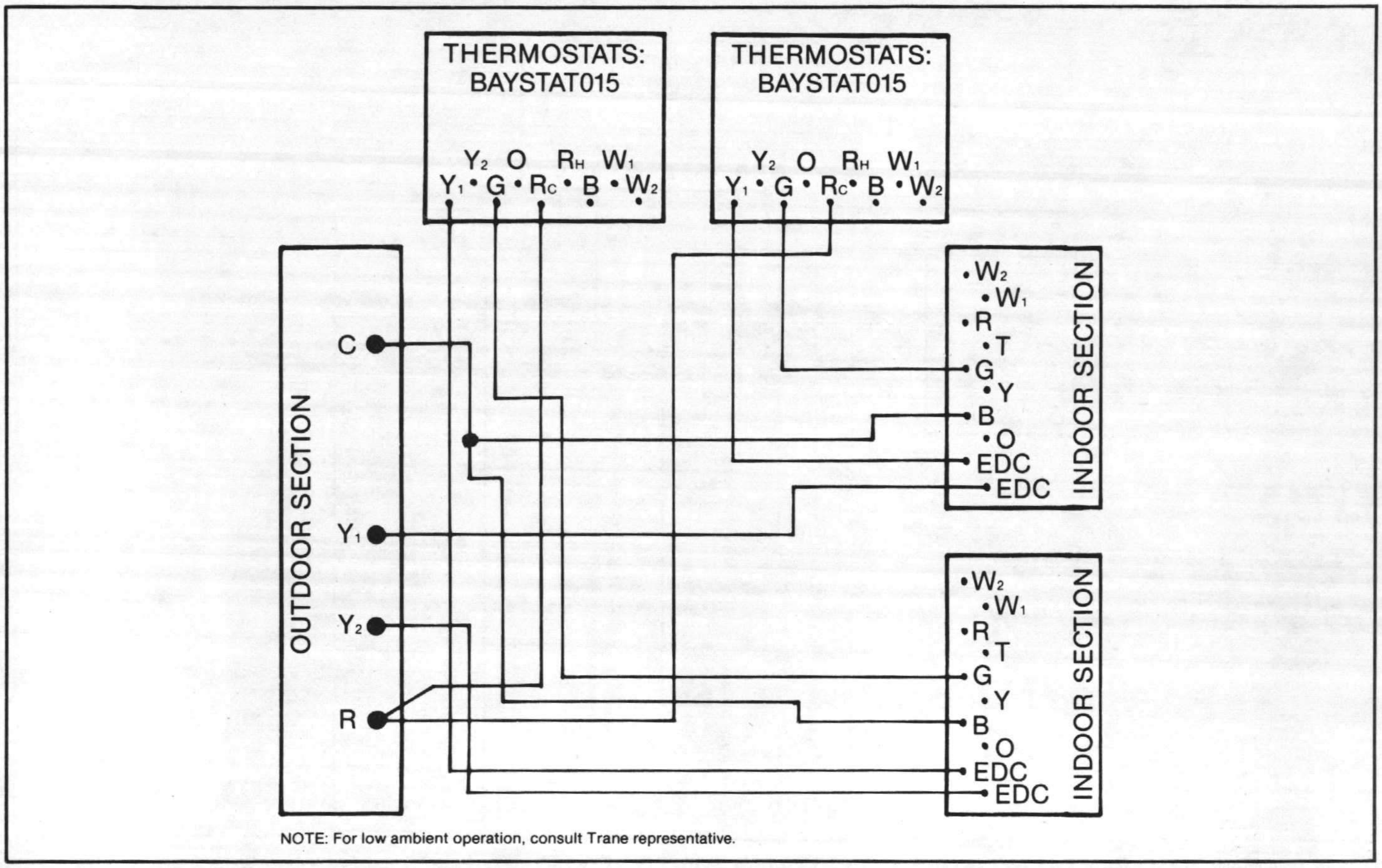


Figure 13 - Field Wiring for BTA150D and BTA180D With Two (2) BWE090C Air Handlers Without Electric Heat

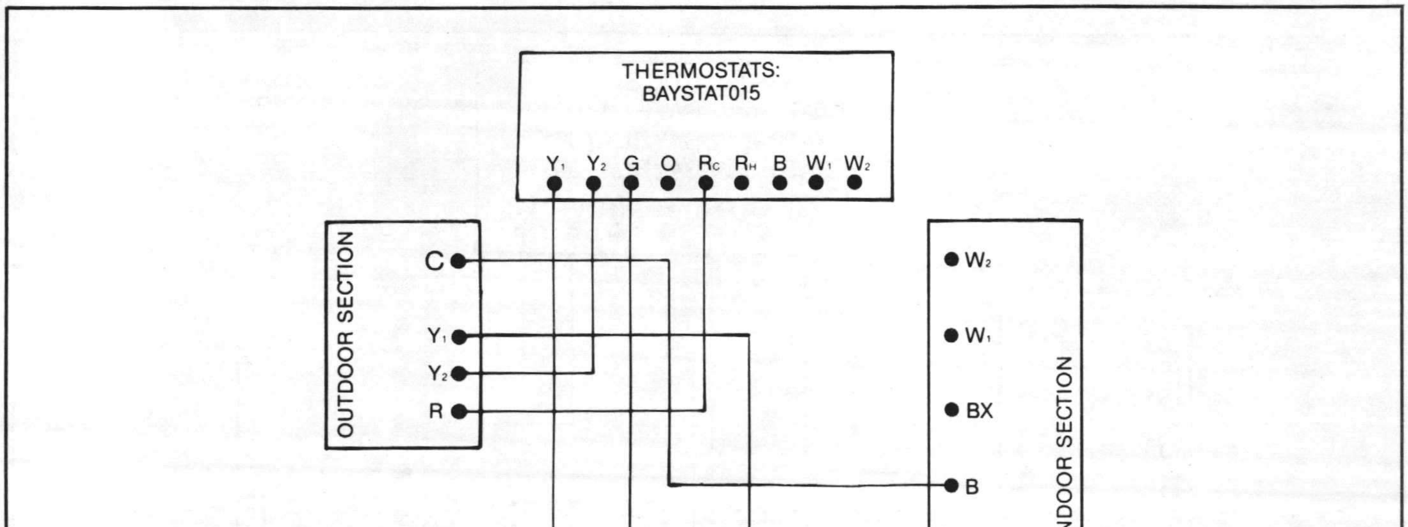


Figure 14 - Field Wiring for BTA150D, BTA180D and BTA180F With the BWV180B, BWH180B Air Handlers Without Electric Heat

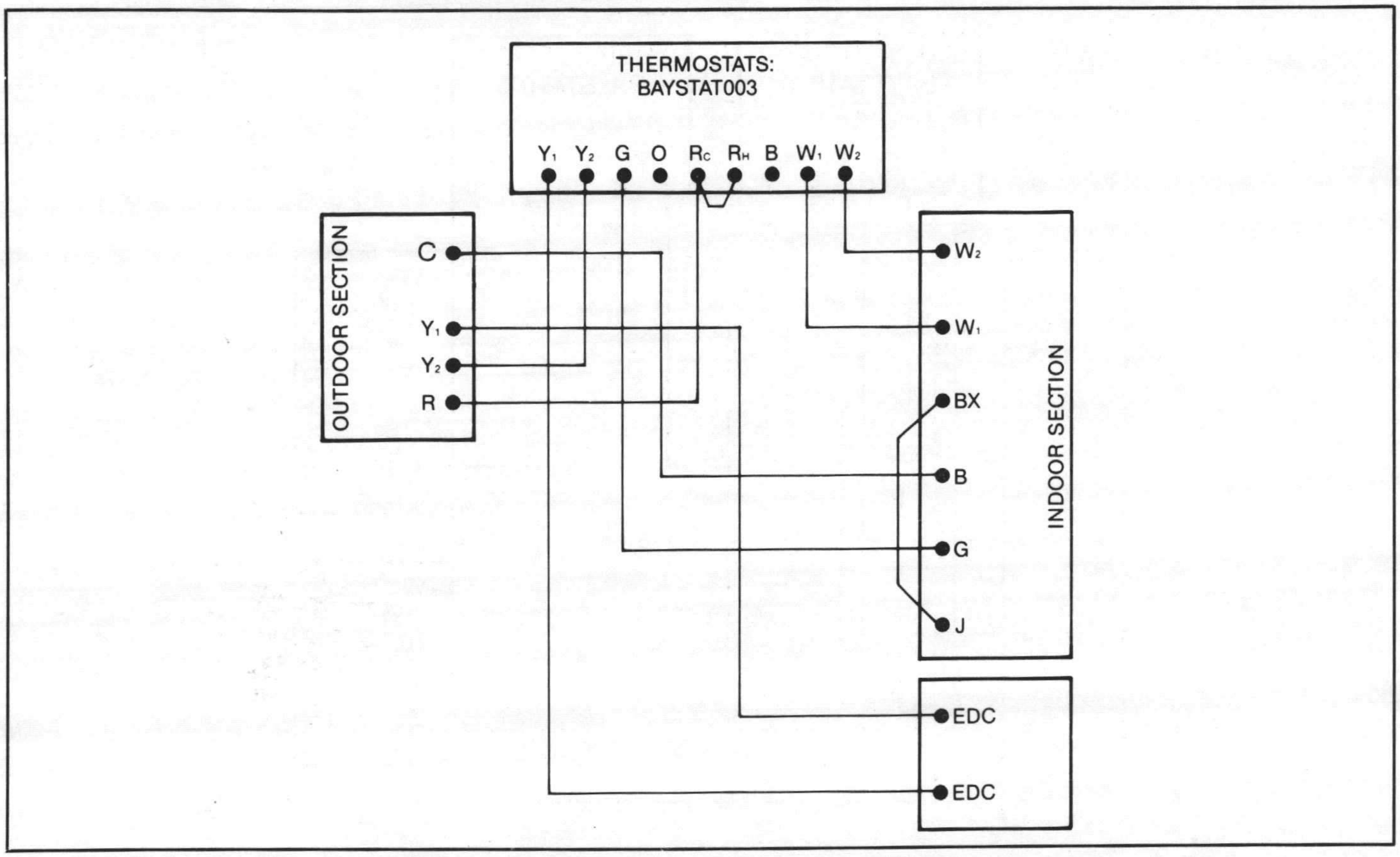
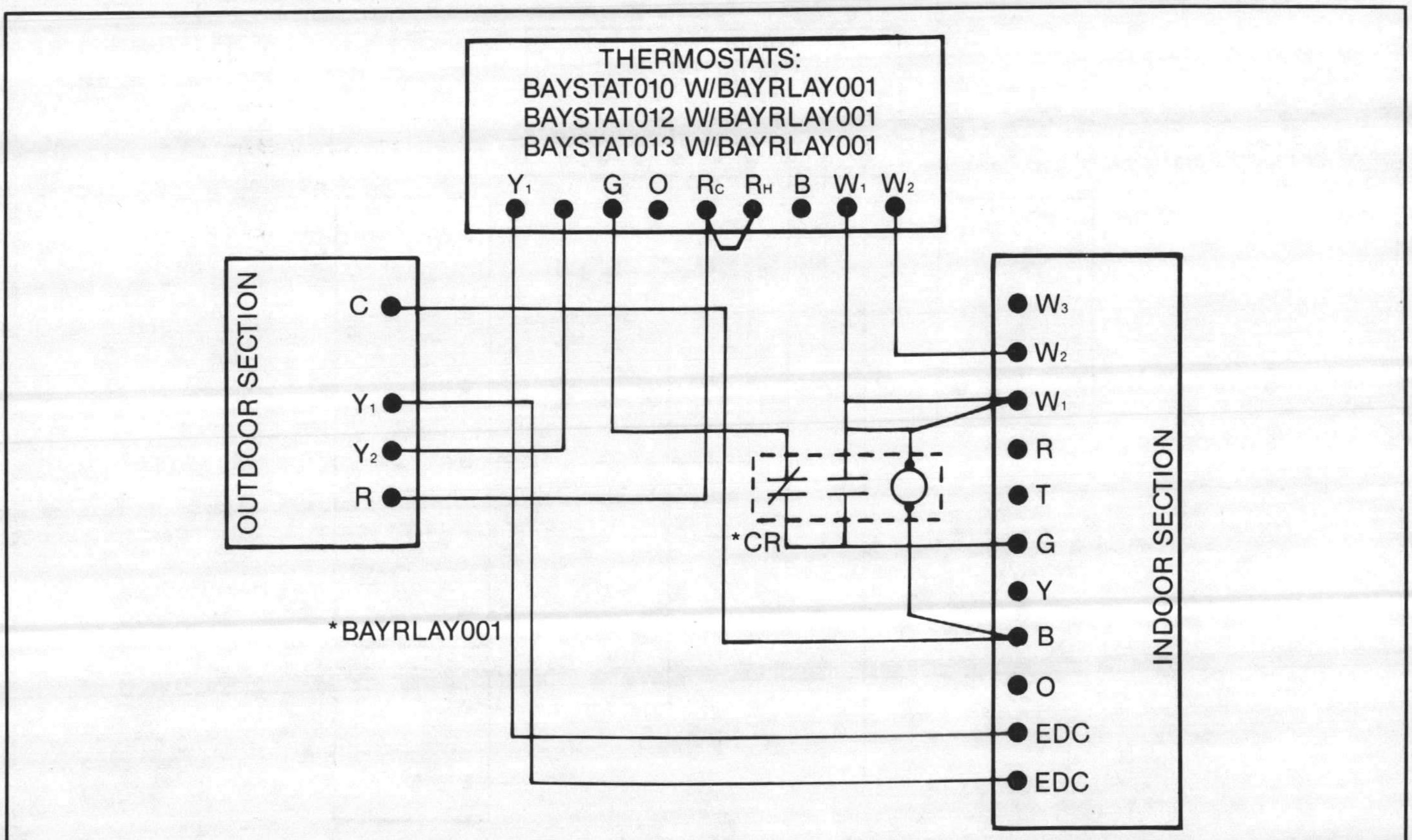


Figure 15 - Field Wiring for BTA150D, BTA180D and BTA180F With the BWV180B, BWH180B Air Handlers With Electric Heat



NOTE: For 1-step electric heat, omit wire between W_2 on thermostats and indoor unit.

Figure 16 - Field Wiring for BTA120D With BTE120B Air Handler

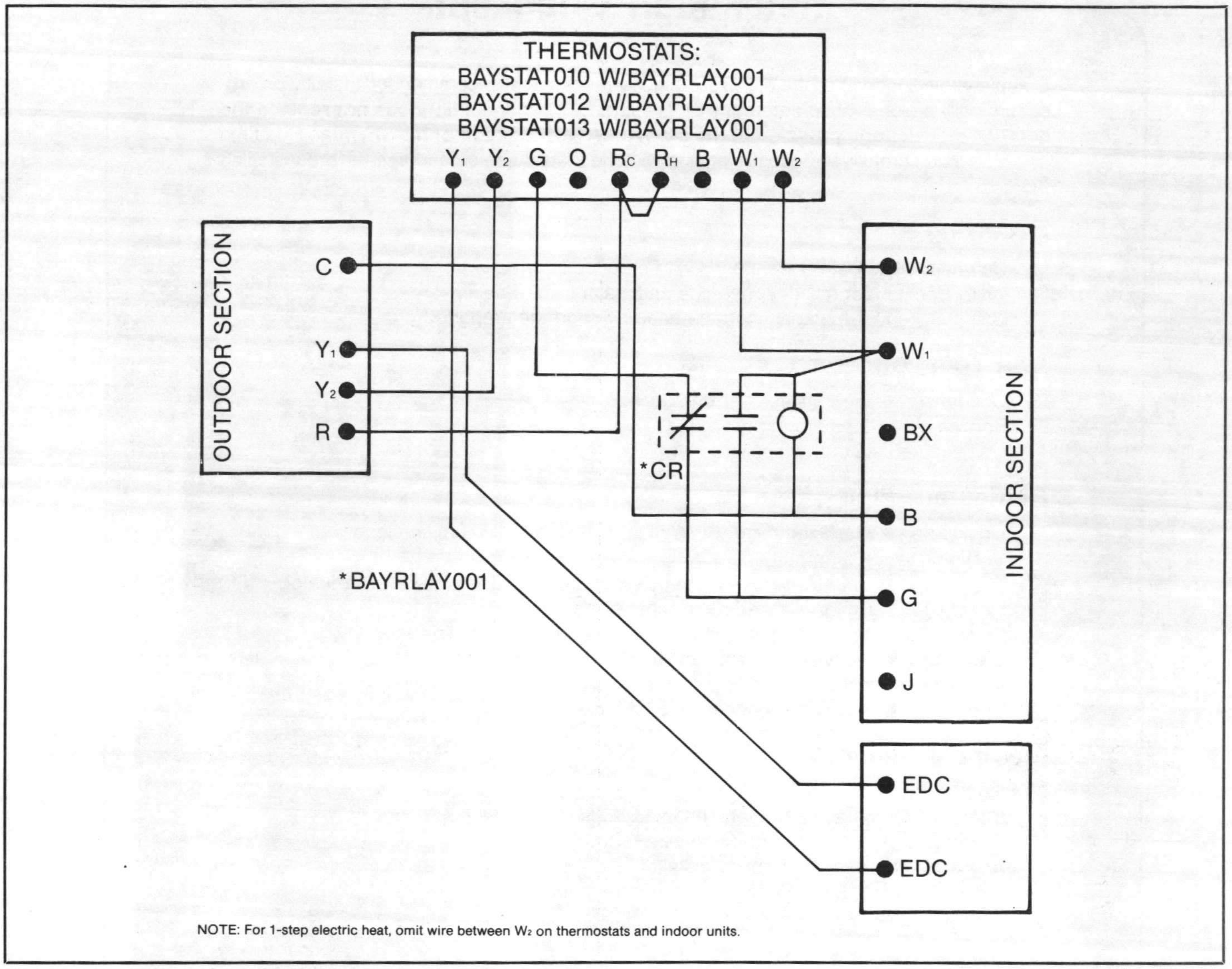


Figure 17 - Field Wiring for BTA150D, BTA180D and BTA180F With the BWV180B, BWH180F Air Handlers

Installation Checklist

Complete this checklist as the unit is installed to verify that all recommended installation procedures are accomplished before the unit is started. **This checklist does not replace the detailed instructions provided in the INSTALLATION section of this manual**. Read the entire section carefully to become familiar with the installation procedures **before** installing the unit.

Receiving

- ☐ Unit nameplate data corresponds with ordering information.
- ☐ Unit inspected for shipping damage and claim filed, if necessary.
- ☐ Unit checked for material shortage and any shortages reported.

Unit Location

- ☐ Condenser air clearances over unit good.
- ☐ Service clearances around unit good.
- ☐ Unit secured in correct location.

Refrigerant Piping

- ☐ Liquid line sized properly and within recommended maximum line length.
- ☐ Suction line sized properly.
- ☐ Thermostatic expansion valve properly sized and installed close to evaporator.
- ☐ Liquid line filter drier installed near expansion valve.
- ☐ Sight glass installed in liquid line between evaporator and filter drier.
- ☐ Liquid line access valve installed in liquid line close to condenser.
- ☐ Low ambient accessories installed, if necessary.
- ☐ Check all unit and piping connections for leaks.

Electrical Wiring

- ☐ Field installed wiring complies with all applicable codes.
- ☐ Compressor contactor and terminal block lugs checked for tightness.
- ☐ Thermostat properly mounted and wired.
- ☐ Any other accessories properly installed and wired.
- ☐ Grounding wires securely bonded to earth ground.

Start-Up

Pre-Start Checks

Before starting the unit, complete the procedures outlined below to make sure the unit is properly installed and ready for start-up.

WARNING: OPEN THE UNIT DISCONNECT SWITCH AND LOCK IT IN THAT POSITION TO PREVENT ACCIDENTAL START-UP. NEVER OPEN AN ACCESS PANEL TO INSPECT OR SERVICE THE UNIT WITHOUT FIRST OPENING THE DISCONNECT SWITCH. FAILURE TO DO SO MAY RESULT IN INJURY OR DEATH FROM ELECTRICAL SHOCK OR CONTACT WITH MOVING PARTS.

☐ 1. Inspect all electrical connections to be sure that the wires are securely attached to their terminals. Make sure that all wires are clear of any rotating parts, such as fan blades.

☐ 2. Check the condenser and evaporator fans. Fan blades must be secure on the motor shafts and must rotate freely. Airflow must be unobstructed.

☐ 3. Make sure the evaporator air filters are clean.

☐ 4. Check the evaporator and condenser coils to ensure that they are clean, that the fins are straight, and that there are no obstructions to airflow.

☐ 5. Check the voltage at the line side of the disconnect switch. It should be within 10 percent of the unit nameplate voltage.

Evacuation

After completing the "Pre-Start Checks," use a vacuum pump to remove air, moisture, and contaminants from the system. The system should be evacuated to a pressure of 500 microns or less. Refer to "Evacuation Procedures" in the MAINTENANCE manual.

Refrigerant Charging

With the system properly evacuated, determine the required charge of Refrigerant-22 and charge the system as outlined under "Refrigerant Charging" in the MAINTENANCE manual.

Oil Charge

The compressors on BTA120D to BTA180D, BTA180F units ship with a sufficient oil charge for systems that stay within the maximum line lengths listed in Table 1. As long as the maximum line length is not exceeded, the compressor will have adequate oil.

Initial Start-Up

Normally it is not necessary to energize the crankcase heater prior to intital start-up. However, if more than 30 minutes passes between refrigerant charging and initial start-up, a significant amount of refrigerant could migrate to the compressor. When there is a time lapse between charging and start-up, the crankcase heater should be energized for a minimum of eight hours before starting the unit.

CAUTION: Failure to energize the crankcase heater and wait eight hours before starting the unit may result in excessive foaming at start-up and possible damage to the compressor bearings.

Set the room thermostat as follows to start the unit:

1. Turn the thermostat selector switch to either COOL or AUTO, depending on the thermostat;
2. Place the thermostat fan switch in the AUTO position;
3. Set the thermostat at a point below room temperature.

The unit will operate automatically in response to cooling needs, as determined by the thermostat setting.

Compressor Motor Checks

With the compressor operating, check the amp draw. The amperage should not exceed the "Maximum Allowable Amps" listed in Table 7. The amp draw may be less than the value listed in the table.

Voltage at the compressor terminals must be within the "Allowable Voltage Range" listed in Table 7. If not, check the voltage at the unit terminal block and at the disconnect switch to determine if voltage problems are being caused by feeder line, loose terminals, or defective unit wiring.

Table 7 - Maximum Allowable Amp Draw

Condensing Unit	Electrical Characteristics	Allowable** Voltage Range	Max. Allowable Amps Matched Evap.	Oversized* Evap.
BTA120D300	208-230/60/3	187-253	24	—
BTA120D400	460/60/3	416-506	11	—
BTA120DW00	575/60/3	520-635	9	—
BTA150D300	208-230/60/3	187-253	—	30
BTA150D400	460/60/3	416-506	—	13
BTA150DW00	575/60/3	520-635	—	11
BTA180D300	208-230/60/3	187-253	31	36
BTA180D400	460/60/3	416-506	14	16
BTA180DW00	575/60/3	520-635	11	13
BTA180F300	208-230/60/3	187-254	66	67
BTA180F400	460/60/3	416-508	33	34
BTA180FW00	575/60/3	520-635	27	27

*Evaporator one size larger than condensing unit.
**Allowable voltage range at the unit terminal block.
***Compressor operating at high speed.

Voltage Imbalance Check

Voltage imbalance on three phase systems can cause motor overheating and eventual failure. Maximum allowable imbalance is two percent, which must be measured at the compressor terminals. Voltage imbalance is defined as 100 times the maximum deviation of the three voltages from the average, without regard to sign, divided by the average voltage. For example, if the three measured voltages are 221, 230 and 227, the average voltage would be:

$$\frac{221 + 230 + 227}{3} = 226 \text{ volts}$$

and the percent voltage imbalance would be:

$$\frac{100 \times (226-221)}{226} = 2.2\%$$

In this example, 2.2 percent imbalance is not acceptable and could result in as much as 20 percent current imbalance. This will increase the motor winding temperature, and thus decrease the life of the motor.

If more than 2.0 percent imbalance exists, check the voltage readings at the disconnect switch to determine if the imbalance is present in the incoming power lines. If so, the power company should be notified to correct it. If the imbalance is due to problems within the unit, check the unit electrical wiring connections.

Operating Pressures

Install pressure gauges on the discharge and suction line access valves next to the compressor. When the unit reaches stabilized operation, suction and discharge pressures can be read. Refer to "Operating Pressures" in the MAINTENANCE manual to compare the measured pressures with the normal system operating pressures.

Start-Up Log

DATE ____________

I. NAMEPLATE INFORMATION

Model No. ____________ Serial No. ____________

Voltage ____________ RLA ____________

II. COMPRESSOR(S)

A. VOLTAGE AT COMPRESSOR TERMINALS

Comp. No. 1: T1 ________ T2 ________ T3 ________

Comp. No. 2: T1 ________ T2 ________ T3 ________

Voltage Imbalance: Comp. No. 1 ________ Comp. No. 2 ________

B. AMP DRAW

Comp. No. 1: L1 ________ L2 ________ L3 ________

Comp. No. 2: L1 ________ L2 ________ L3 ________

III. OPERATING CONDITIONS

A. COMPRESSOR NO. 1

Discharge Pressure ________ Suction Pressure ________

Liquid Line Pressure ________ Suction Line Temp. ________

Liquid Line Temp. ________ Superheat ________

Subcooling ________ Evap. Entering Air Temp. (DB/WB) ________

Ambient Temp. ________ Evap. Discharge Air Temp. (DB/WB) ________

B. COMPRESSOR NO. 2

Discharge Pressure ________ Suction Pressure ________

Liquid Line Pressure ________ Suction Line Temp. ________

Liquid Line Temp. ________ Superheat ________

Subcooling ________ Evap. Entering Air Temp. (DB/WB) ________

Ambient Temp. ________ Evap. Discharge Air Temp. (DB/WB) ________

IV. CONTROLS

Fans Operating (Yes or No): Fan No. 1 ________ No. 2 ________ No. 3 ________

Crankcase Heater Operating (Yes or No): Comp. No. 1 ________ Comp. No. 2 ________

V. REFRIGERANT PIPING

Evacuation Level ________ System Charge ________

The Trane Company
Light Commercial Group
Guthrie Highway
Clarksville, TN 37040

AN AMERICAN—
STANDARD
COMPANY

Technical Literature Printed in USA

Bldgs AS-202
AS-236

TRANE™

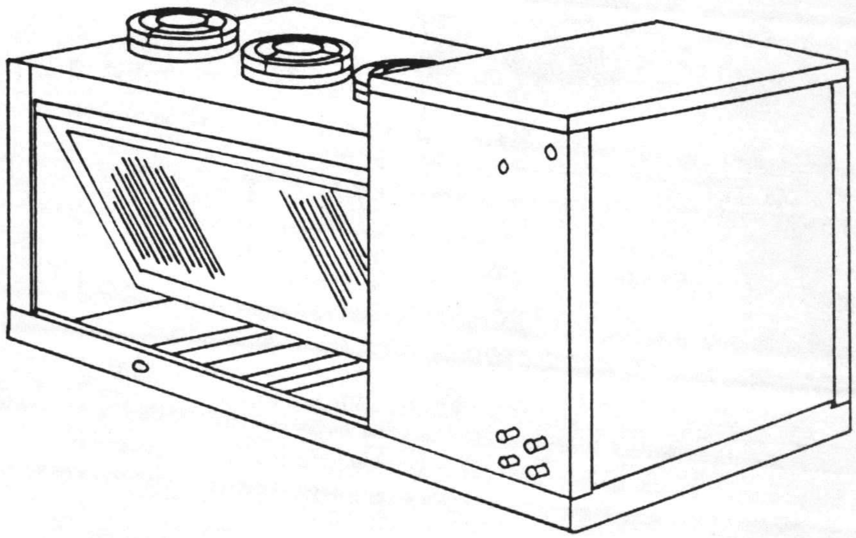
BTA-M-3

OPERATION/MAINTENANCE GUIDE

Split System Condensing Units

Library	Service Literature
Product Section	Unitary
Product	Split System
Model	BTA
Literature Type	Operation/Maintenance
Sequence	3
Date	December 1986
File No.	SV-UN-S/S-BTA-M-3 12/86
Supersedes	New

Models
BTA120D-AB
BTA150D-AB
BTA180D-AB
BTA180F-AB



Since The Trane Company has a policy of continuous product improvement, it reserves the right to change specifications and design without notice. The installation and servicing of the equipment referred to in this booklet should be done by qualified, experienced technicians.

22-5327-1

Table of Contents

Subject **Page**

Unit Model Number Description 2

General Information 3

Operation 3

Electrical Sequence of Operation 3

Dual Compressor Operation 3

Single Compressor, 2-Speed Operation 3

Safety Controls 9

Maintenance 10

Periodic Maintenance 10

Once A Month 10

Once A Year 10

Shutdown and Start-Up 10

Maintenance Log 11

Maintenance Procedures 12

Coil Cleaning 11

Control Testing 11

Evacuation 13

Leak Testing 14

Brazing Procedures 14

Refrigerant Charging 16

Checking Refrigerant Charge 16

Operating Pressures 17

Measuring Superheat 18

Measuring Subcooling 24

Troubleshooting 25

Unit Model Number Description

Trane LCG products are identified by a multiple-character model number that precisely identifies a particular type of unit. An explanation of this multiple-character number is shown below. It will enable the owner or Service Engineer to define operation, components and applicable accessories for a specific unit.

LCG Unit Model Nomenclature

1	2	3	4	5	6	7	8	9	10	11	12
B	T	A	1	2	0	D	3	0	0	A	A

Digit 1 — Always "B"

Digits 2, 3 — **Product Type**

TA = Split System Cooling, Outdoor Unit

WE = Split System Cooling or Heat Pump, Convertible Indoor Unit

WV = Split System Cooling or Heat Pump, Verticle Indoor Unit

WH = Split System Cooling or Heat Pump, Horizontal Indoor Unit

Digits 4, 5, 6 — **Cooling Capacity (MBH)**

090 = 90 MBH
120 = 120 MBH
180 = 180 MBH
240 = 240 MBH

Digit 7 — Major Design Sequence

Digit 8 — **Electrical Characteristics**

3 = 208-230/60/3
4 = 460/60/3
W = 575/60/3

Digits 9, 10 — **Secondary Capacity and/or Factory Installed Options**

00 = Not Used

Digit 11 — Minor Design Sequence

Digit 12 — Service Digit

General Information

Periodic Maintenance checklists are provided at the beginning of the MAINTENANCE manual for performing recommended maintenance. These checklists should not be substituted for the detailed information given in appropriate sections of this manual.

A Maintenance Log at the end of the "Periodic Maintenance" section enables the operator/serviceman to maintain a record of system operating data.

Operation

Electrical Sequence of Operation

The typical wiring diagrams provided in Figures 1 and 2 should be used only as a reference for the following discussion. For the actual wiring of your specific unit, refer to the wiring diagram pasted on the inside of the unit's control box cover.

System operation is controlled by a two-stage thermostat, depending upon the number of compressors in the system. Closing the unit disconnect switch supplies power to the control power transformer (T1), the compressor crankcase heaters (CCH1 and CCH2), and the line side of all control contactors.

Depending on the thermostat selected, it may be possible to operate the evaporator fan independently of the compressors by placing the thermostat fan switch in the ON position. This energizes the evaporator fan contactor, starting the fan. If the thermostat has a separate fan switch, moving that switch to the AUTO position will cause the evaporator fan to start in conjunction with the compressor whenever the thermostat calls for cooling.

Dual Compressor Operation

Sensing a need for cooling, the first stage cooling contacts of the thermostat will close. This supplies power to the compressor contactor solenoid coil (CC1), provided that the high pressure control, low pressure control, and reset relay contacts are closed.

The contacts of the compressor contactor close, energizing the first stage compressor, provided that the compressor internal motor winding thermostats are closed.

The compressor has only two leads broken by the compressor contactor. The third leg of the contactor energizes the condenser fan motors. The outdoor temperature determines the number of condenser fans that will start. A fan limit control (FLT) is electrically positioned between both fans #1 and #2 and fans #2 and #3. Depending on the position of these controls, one or more fans may start.

As the cooling load increases, the second stage contacts of the thermostat will close. This supplies power to the solenoid coil of the second stage compressor contactor (CC2), staring the second compressor.

Single Compressor, 2-Speed Operation

Sensing a need for cooling, the first stage cooling contacts of the thermostat will close. Assuming that no safety controls have tripped, this supplies power to the low speed compressor contactor coil (CCS) and outdoor fan relay coil (ODR). Safety controls in this circuit include the high pressure control (HPC), low pressure control (LPC), reset relay (RR), and compressor motor protection module (CMPM).

NOTE: *The compressor contactor cannot be re-energized on the BTA180F for four minutes after winding temperatures have returned to normal following cut-out on excessive temperature, current overload, or power interruption to Terminal T1 of the compressor motor protection module. This provides an anti-short cycle feature on the standard unit. The compressor cannot be re-energized for four minutes following termination of the cooling cycle. This is an option on the dual compressor units.*

Energizing the compressor contactor coil (CCS) closes the CCS contacts in the power circuit, and starts the compressor on low speed. Concurrently, outdoor fan relay coil ODR is energized. This starts the outdoor fan motor(s) by closing the ODR contact in the power circuit. The total number of condenser fans which will operate is dependent upon the outdoor ambient and the resulting position of the FLT switches (see Figure 2).

As the cooling load increases, the second stage contacts of the thermostat will close. This supplies power to the control relay coil (CR), which opens one set of contacts and closes the other on this single-pole, double-throw relay. This, in turn, de-energizes the low speed compressor contactor coil (CCS) and supplies power to the "tie point" compressor contactor coil (CCT) through normally closed auxiliary contacts CCS located in the control circuit. Auxiliary control circuit contacts CCT then close, and power is supplied to the high speed compressor contactor coil (CCF). After the low speed compressor contactor contacts (CCS) in the power circuit open, both the "tie point" and high speed compressor contactor contacts (CCT and CCF) close and the compressor motor switches from low to high speed.

It should be noted that the dual compressor contactor is both mechanically and electrically interlocked in order to protect the compressor motor from having both low and high speed windings energized at the same time. Electrically, this is accomplished with a normally closed auxiliary side switch (CCS) on the "tying" compressor contactor coil (CCT), and a double-pole, double-throw auxiliary side switch (CCT) on both the high and low speed compressor contactor coils (CCF and CCS). See Figures 3 and 4 for further details on this electrical connection.

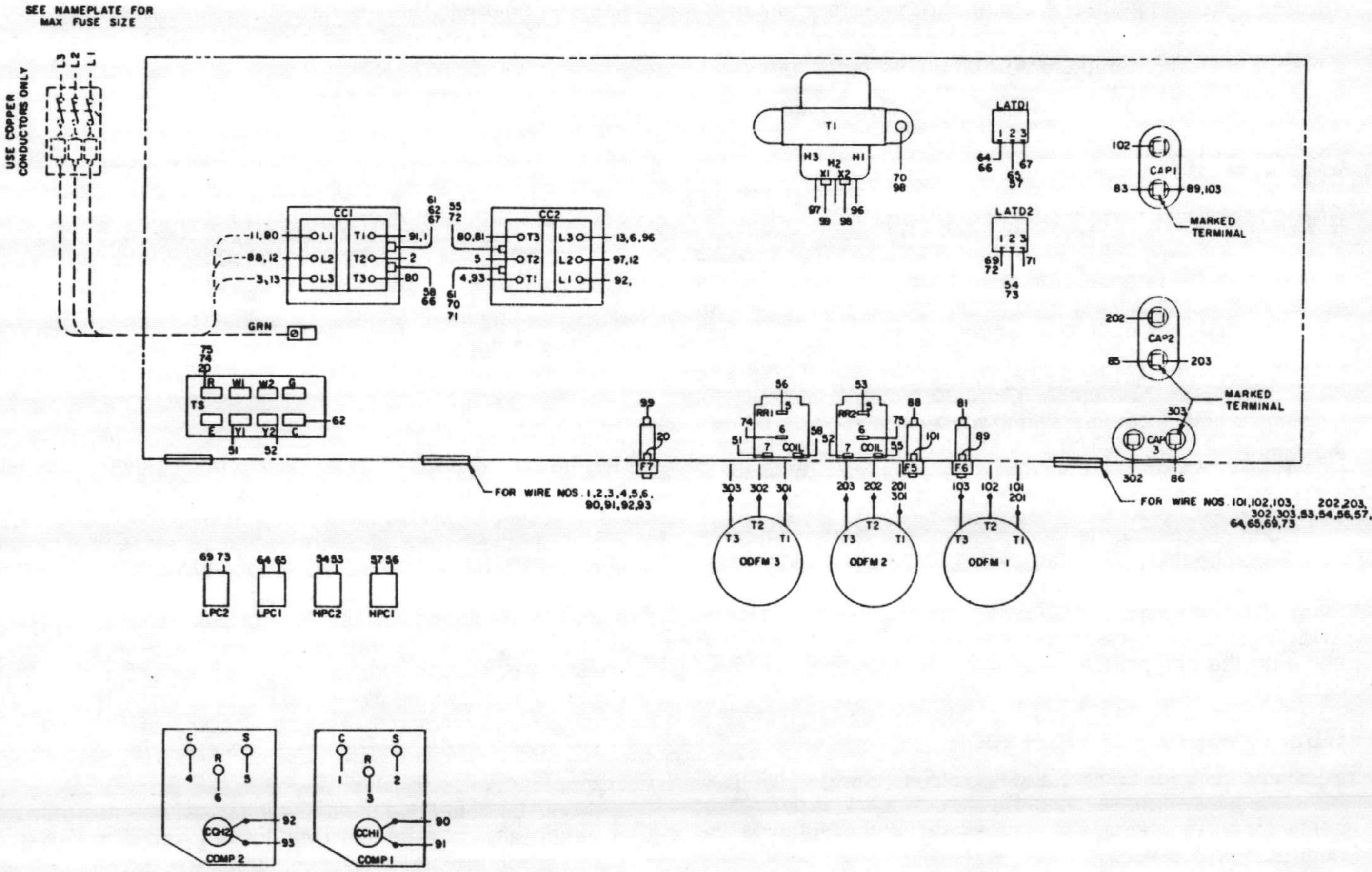
Normally, the compressor will start and operate on low speed before switching to high speed. However, the compressor can start on high speed if the difference between the thermostat setting and the space temperature is great enough. This will be the case in a "pull-down" situation where the unit has been disconnected from normal thermostat control for an extended period of time. It will also occur if the thermostat setting is lowered substantially while the system is off.

NOTE: *The compressor may not start in low speed when a differential pressure greater than 180 psig exists between the high and low side of the refrigerant circuit.*

BTA compressors include two-pole/four-pole motor hookup capability for two speed operation. The compressor operates at approximately 3500 RPM on high speed (two-pole), and at 1750 RPM on low speed (four-pole).

To achieve two speed operation, the motor windings are switched between a parallel connected (high speed) and series connected (low speed) motor winding through the use of low speed, high speed, and tie point contacts on the compressor contactor. This is shown in Figure 3 (high speed) and Figure 4 (low speed).

CAUTION: Extreme care must be taken when making wiring connections in the compressor terminal box. Incorrect hookup can result in immediate compressor failure when power is applied.



(CONTINUED ON NEXT PAGE)

LEGEND	
COMP	COMPRESSOR
CC	COMPRESSOR CONTACTOR
ODFM	OUTDOOR FAN MOTOR
TS	TERMINAL STRIP
T1	TRANSFORMER
F	FUSE
CAP	CAPACITOR
RR	RESET RELAY
HPC	HIGH PRESSURE CONTROL
CCH	CRANKCASE HEATER
LPC	LOW PRESSURE CONTROL
LATD	LOW AMBIENT TIME DELAY
FLT	FAN LIMIT T-STAT

TRANE FORM NO. 6-3563

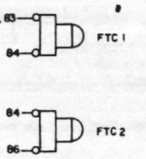
Figure 1 - Typical Unit Wiring Diagram (Dual Compressor Unit Shown)

WARNING

DISCONNECT ELECTRICAL POWER SOURCE TO PREVENT INJURY OR DEATH FROM ELECTRICAL SHOCK

CAUTION

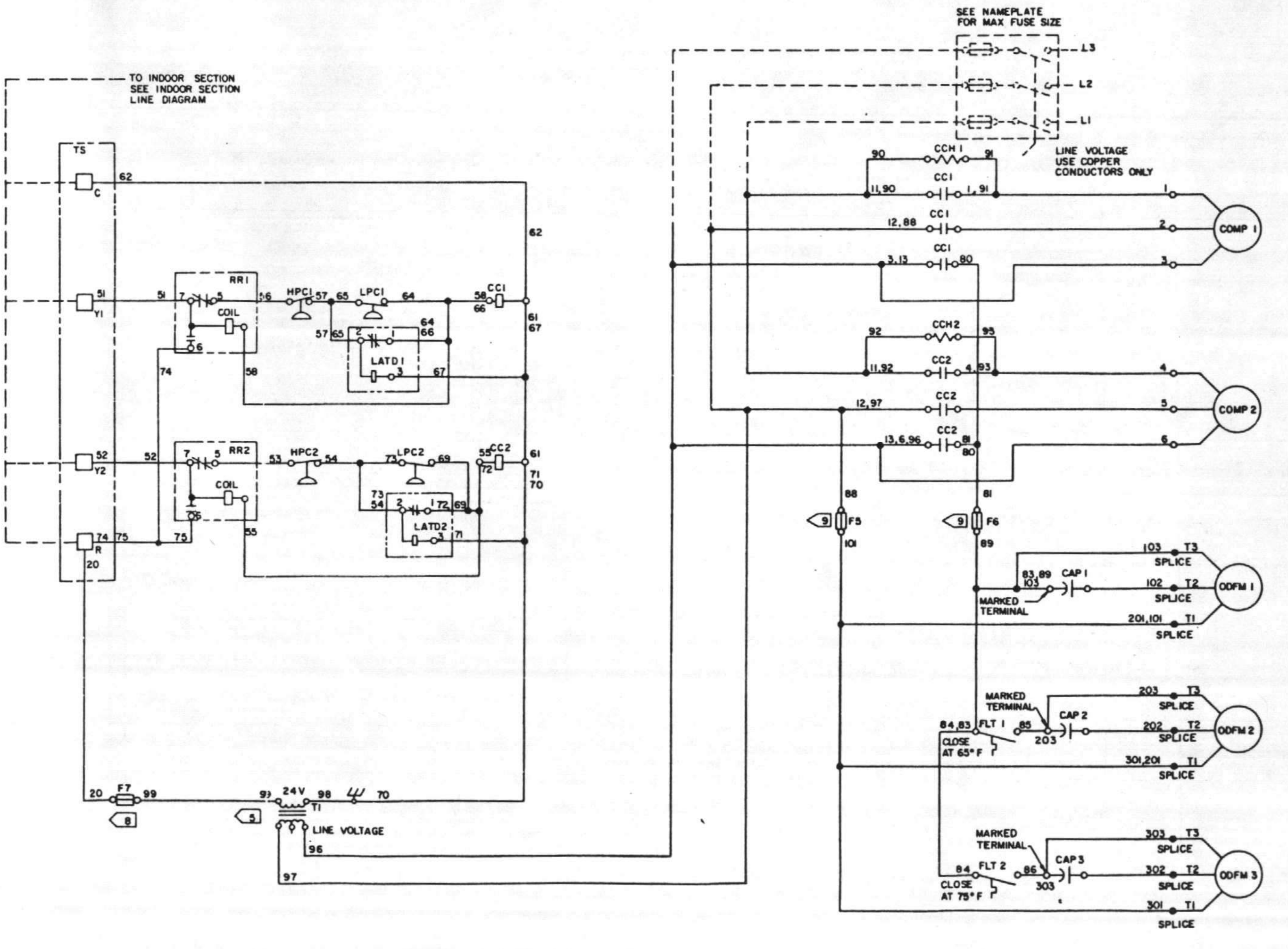
USE COPPER CONDUCTORS ONLY TO PREVENT EQUIPMENT DAMAGE



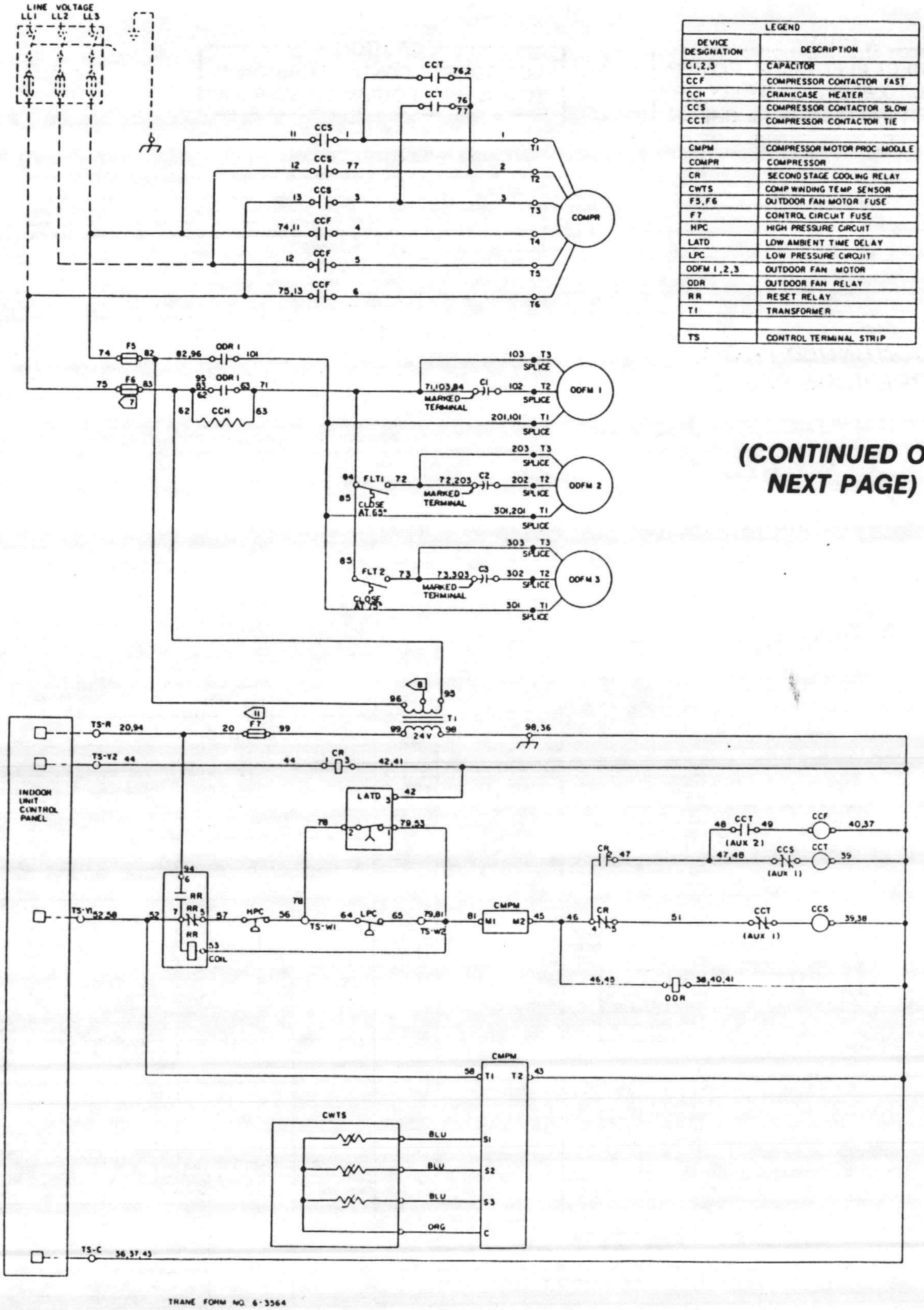
NOTES:

1. SEE NAMEPLATES OF ALL MOTORS FOR VOLTAGE BEFORE CONNECTING TO LINE
2. ALL COMPONENTS AND WIRES SHOWN DOTTED ARE SUPPLIED BY CUSTOMER
3. IF ANY OF THE ORIGINAL WIRES AS SUPPLIED WITH THIS UNIT MUST BE REPLACED, IT MUST BE REPLACED WITH APPLIANCE WIRING MATERIAL RATED 105° C OR EQUIVALENT
4. ALL CUSTOMER WIRING MUST BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES
5. ALL 208-230 VOLT UNITS WILL BE FACTORY WIRED FOR 230 VOLT APPLICATIONS. FOR 208 VOLT APPLICATIONS MOVE LEAD 97 FROM THE 240 VOLT TRANSFORMER TERMINAL TO THE 208 VOLT TERMINAL
6. THREE PHASE MOTORS ARE PROTECTED UNDER PRIMARY SINGLE PHASING CONDITIONS
7. EVAPORATOR APPLICATION TEMPERATURE RANGE +32°F TO +53.5°F
8. REPLACE F7 FUSE WITH BUSSMAN TYPE GLQ & GMQ 3 AMP 300V FUSES ONLY
9. REPLACE F5 AND F6 FUSES WITH 300V, 30 AMP TYPE SC FUSES ONLY
10. RESET RELAY WILL RESET WHEN POWER IS INTERRUPTED

(CONTINUED FROM PREVIOUS PAGE)



2306-3563



LEGEND	
DEVICE DESIGNATION	DESCRIPTION
C1,2,3	CAPACITOR
CCF	COMPRESSOR CONTACTOR FAST
CCH	CRANKCASE HEATER
CCS	COMPRESSOR CONTACTOR SLOW
CCT	COMPRESSOR CONTACTOR TIE
CMPM	COMPRESSOR MOTOR PROC MODULE
COMPR	COMPRESSOR
CR	SECOND STAGE COOLING RELAY
CWTS	COMP WINDING TEMP SENSOR
F5,F6	OUTDOOR FAN MOTOR FUSE
F7	CONTROL CIRCUIT FUSE
HPC	HIGH PRESSURE CIRCUIT
LATD	LOW AMBIENT TIME DELAY
LPC	LOW PRESSURE CIRCUIT
ODFM 1,2,3	OUTDOOR FAN MOTOR
ODR	OUTDOOR FAN RELAY
RR	RESET RELAY
T1	TRANSFORMER
TS	CONTROL TERMINAL STRIP

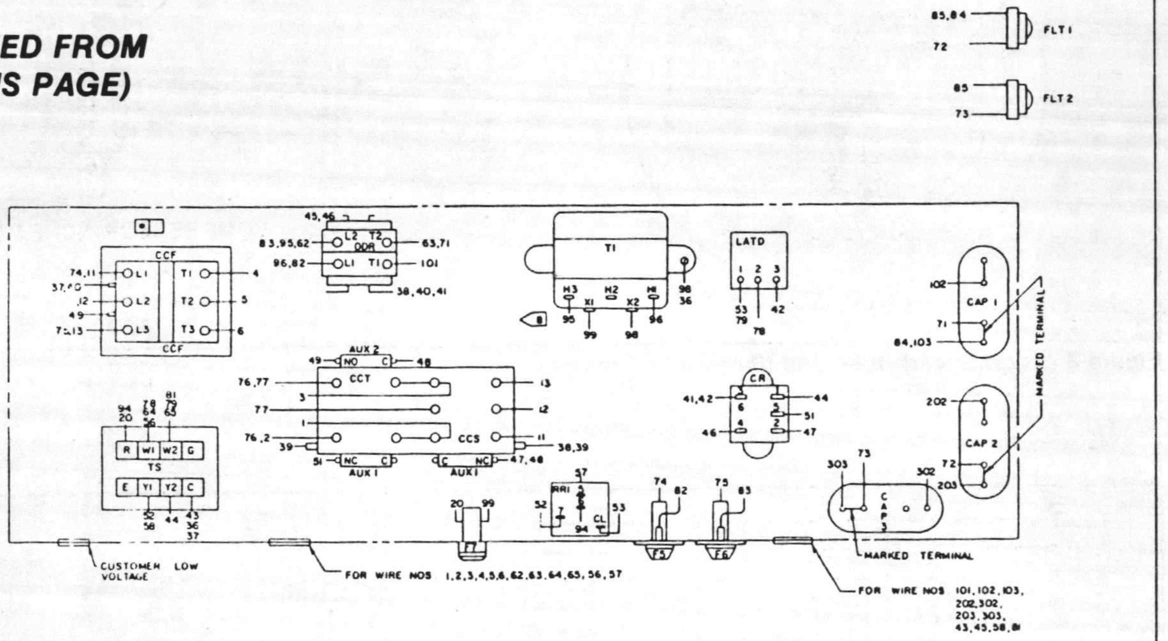
(CONTINUED ON NEXT PAGE)

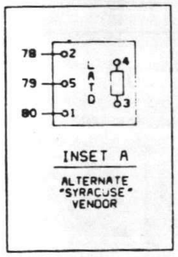
Figure 2 - Typical Unit Wiring Diagram (15 Ton Single Compressor Unit Shown)

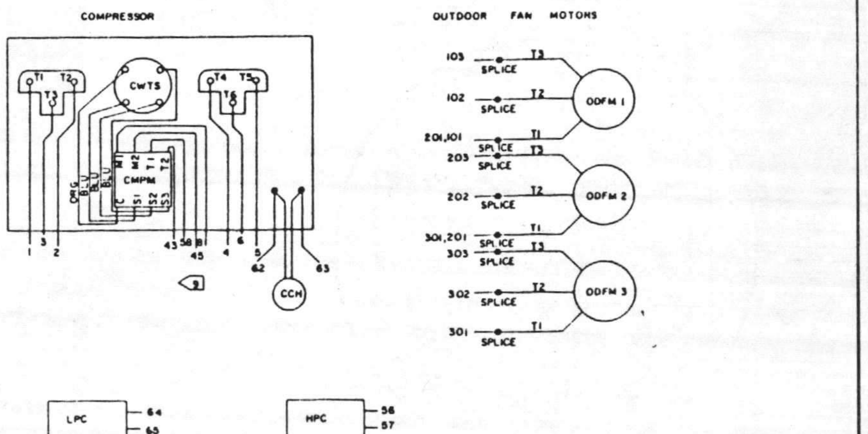
NOTES:

1. UNLESS OTHERWISE NOTED, ALL SWITCHES ARE SHOWN AT 25°C (77°F) AT ATMOSPHERIC PRESSURE AT 50% RELATIVE HUMIDITY, WITH ALL UTILITIES TURNED OFF AND AFTER A NORMAL SHUTDOWN HAS OCCURED. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. DASHED LINE ENCLOSURES AND/OR DASHED DEVICE OUTLINES INDICATE COMPONENTS PROVIDED BY THE FIELD. PHANTOM LINE ENCLOSURES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTIONS. NUMBERS ALONG THE RIGHT SIDE OF THE SCHEMATIC DESIGNATE THE LOCATION OF THE CONTACTS BY LINE NUMBER, AN UNDERLINED NUMBER INDICATES A NORMALLY CLOSED CONTACT.
2. ALL WIRING AND DEVICES SHOWN DASHED TO BE SUPPLIED AND INSTALLED BY THE CUSTOMER IN ACCORDANCE WITH LOCAL AND NATIONAL ELECTRICAL CODES.
3. IF ANY OF THE ORIGINAL WIRE, AS SUPPLIED WITH THIS UNIT, MUST BE REPLACED, REPLACE IT WITH APPLIANCE WIRING MATERIAL RATED AT 105°C OR EQUIVALENT.
4. THREE PHASE MOTORS ARE PROTECTED UNDER PRIMARY SINGLE PHASING CONDITIONS AND HAVE INTERNAL OVERLOAD PROTECTION.
5. FOR REMAINDER OF CONTROL CIRCUITS, SEE ELECTRICAL DIAGRAM LOCATED ON INDOOR UNIT CONTROL PANEL.
6. RESET RELAY WILL RESET WHEN POWER IS INTERRUPTED.
7. REPLACE F5 AND F6 FUSES WITH 300 VOLT, 30 AMP TYPE SC FUSES ONLY.
8. ALL 208-230 VOLT UNITS WILL BE FACTORY WIRED FOR 230 VOLT APPLICATION. FOR 208 VOLT APPLICATIONS MOVE LEAD 95 FROM THE 240 VOLT TRANSFORMER TERMINAL (H3) TO THE 208 VOLT TERMINAL (H2)
9. CMPM IS LOCATED IN THE COMPRESSOR JUNCTION BOX, TEXAS INSTRUMENT PN 15AA 1105A. COMPRESSOR CONTACTOR CANNOT BE RE-ENERGIZED FOR 4 MINUTES AFTER WINDING TEMPERATURES HAVE RETURNED TO NORMAL FOLLOWING CUT-OUT ON EXCESSIVE TEMPERATURE, CURRENT OVERLOAD OR POWER INTERRUPTION TO TERMINAL 'T1'.
10. EVAPORATOR APPLICATION TEMPERATURE RANGE: 32°F TO 53.5°F
11. REPLACE ONLY WITH BUSSMAN GLQ OR GMQ 3AMP 300V FUSES.

(CONTINUED FROM PREVIOUS PAGE)







WARNING

DISCONNECT ELECTRICAL POWER SOURCE TO PREVENT INJURY OR DEATH FROM ELECTRICAL SHOCK

CAUTION

USE COPPER CONDUCTORS ONLY TO PREVENT EQUIPMENT DAMAGE

IMPORTANT

ANTI-SHORT CYCLE FEATURE IS STANDARD ON THIS UNIT. COMPRESSOR CANNOT BE RE-ENERGIZED FOR 4 MINUTES FOLLOWING TERMINATION OF COOLING CYCLE.

CAUTION

DO NOT ENERGIZE UNTIL UNIT CHECK-OUT AND START-UP PROCEDURE HAS BEEN COMPLETED

2306-3564

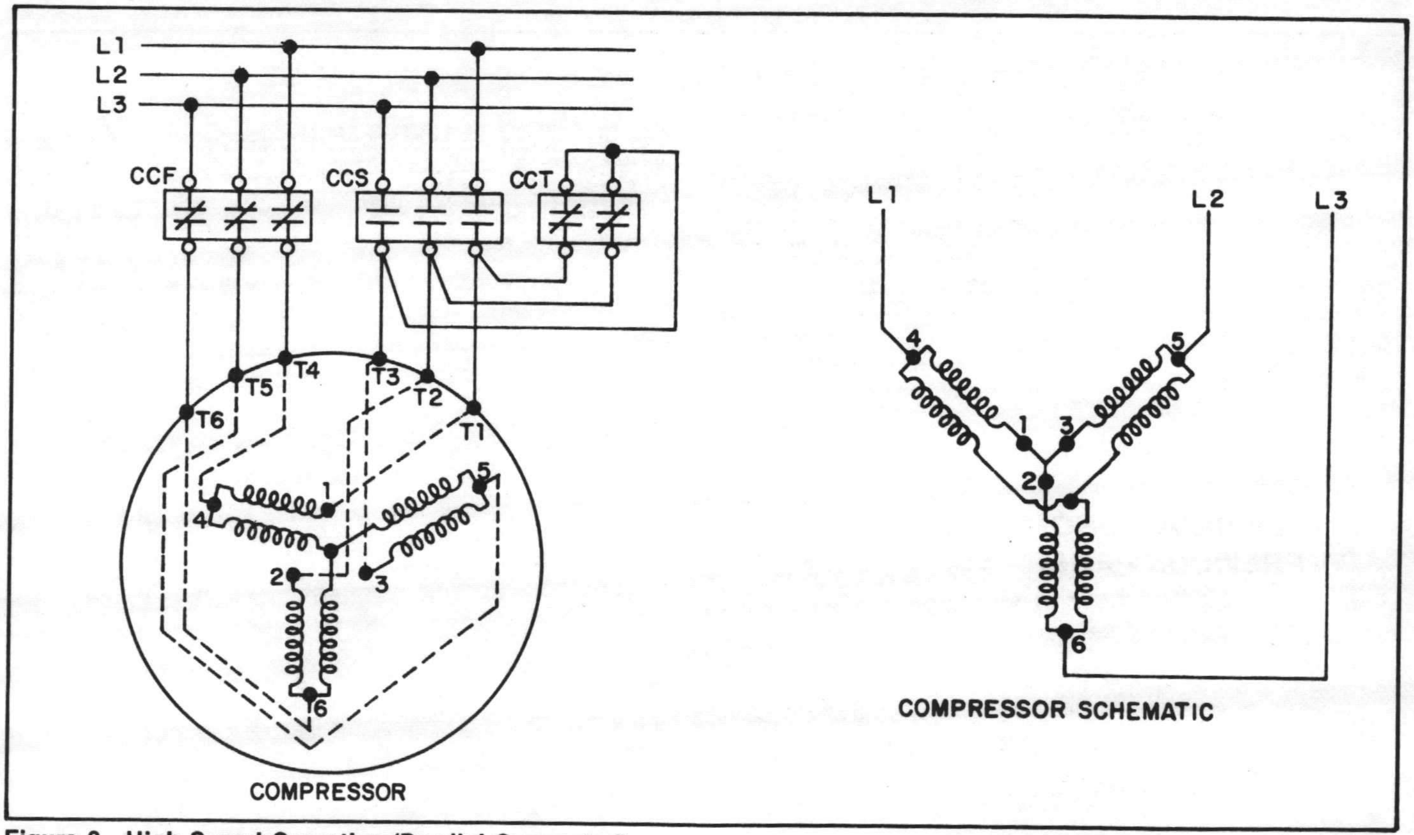


Figure 3 - High Speed Operation (Parallel Connected)

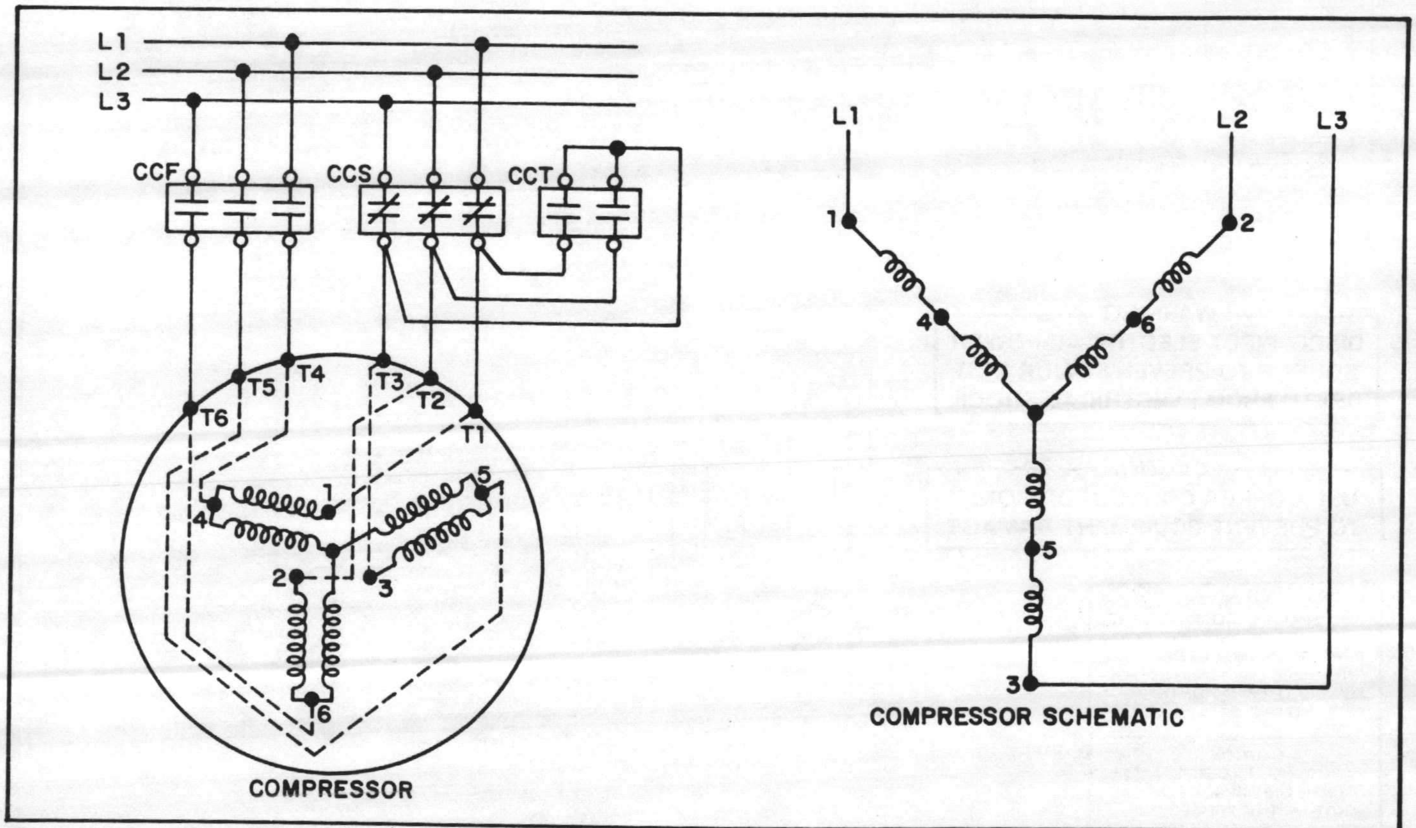


Figure 4 - Low Speed Operation (Series Connected)

Safety Controls

High Pressure Control

BTA150D, BTA180D and BTA180F units have an external high pressure control that prevents excessive compressor discharge pressures. This control opens the electrical control circuit, stopping compressor operation, if the condensing pressure becomes too high. Refer to Table 1 for control settings.

The compressors on BTA120D units are provided with an internal pressure relief valve which automatically vents hot gas onto the winding thermostat whenever condensing pressure becomes excessive. This heat causes the contacts of the winding thermostat to open, and compressor operation ceases until the thermostat cools enough for its contacts to close.

Low Pressure Control

All BTA120-180 units have an external low pressure control that stops compressor operation if the operating pressure is too low. Refer to Table 1 for control settings.

Reset Relay

Whenever the system is stopped by the high or low pressure control, the reset relay locks out the compressor contactor. This prevents the system from recycling until the condition causing the high or low pressure cut-out is corrected, and the relay is manually reset. To reset this relay, turn the room thermostat from COOL to OFF and then back to COOL, or open the unit disconnect switch and reclose it.

Fan Sequencing

Condenser fans are cycled on and off in response to ambient temperature in order to keep the capacity of the condenser relatively constant and to maintain proper system pressures. Figure 5 details the possible condenser fan operating modes.

Motor Overloads

All BTA120-180 units have internal compressor and condenser fan motor overloads. These overloads protect the motors from overheating and automatically reset as soon as they cool.

Condenser Fan Limit Control

The condenser fan limit control (FLT) is a temperature sensor that energizes and de-energizes the condenser fan in response to ambient temperature. As the ambient temperature decreases, the cooling capacity of the condenser increases. The cooling low ambient sensor turns off condenser fans to keep the capacity of the condenser constant and to maintain proper system pressures. Refer to Table 1 for control settings.

Table 1 - Control Settings

CONTROL	CUT-IN	CUT-OUT
High Pressure Control (All Units)	345 PSIG (20)	425 PSIG (±20)
Low Pressure Control (All Units)	48 PSIG (±7)	20 PSIG (±4)
FLT 10 Ton	75 F(±3)	65 F(±3)
FLT 12.5-15 Ton	75 F(±3)	65 F(±3)
FLT 12.5-15 Ton	65 F(±3)	55 F(±3)

FLT = Fan Limit Temperature Control

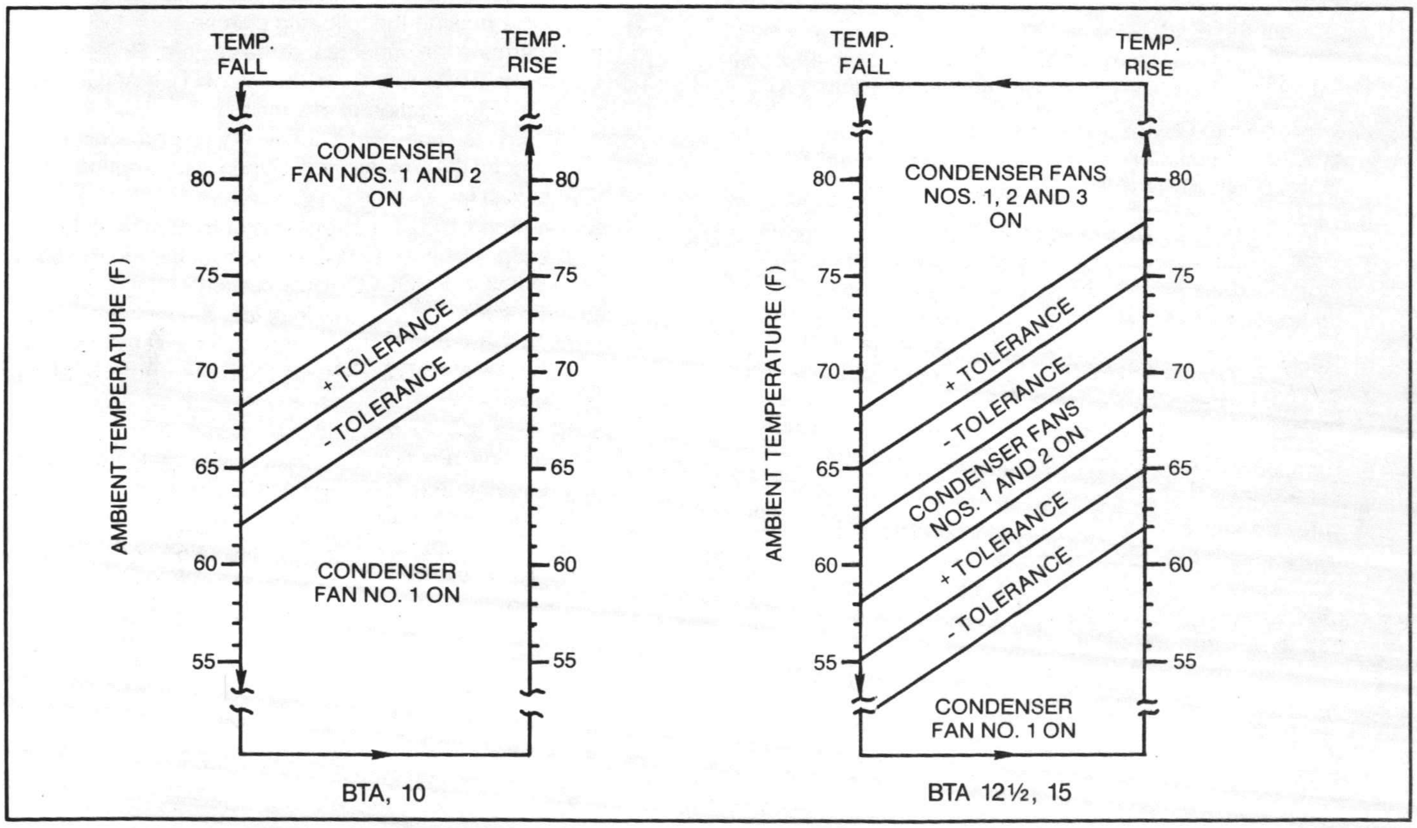


Figure 5 - Condenser Fan Operating Modes

Maintenance

Periodic Maintenance

Perform all of the indicated maintenance procedures at the intervals scheduled. This will prolong the life of the unit and reduce the possibility of costly equipment failure. A MAINTENANCE LOG is provided on page 12 of this manual for recording operating data on a regular basis.

Once a Month

Conduct the maintenance inspections outlined below on a monthly basis during the cooling season.

☐ 1. Inspect the evaporator coil air filters. Clean or replace if necessary.

☐ 2. Inspect the evaporator and condenser coils for dirt and foreign debris. If the coils appear dirty, clean them according to the instructions provided under "Coil Cleaning" in the MAINTENANCE PROCEDURES section of this manual.

Once a Year

The following maintenance practices must be performed at the beginning of each cooling season to ensure efficient unit operation.

WARNING: OPEN THE UNIT DISCONNECT SWITCH AND LOCK IT IN THAT POSITION TO PREVENT ACCIDENTAL START-UP. NEVER OPEN AN ACCESS PANEL TO INSPECT OR SERVICE THE UNIT WITHOUT FIRST OPENING THE DISCONNECT SWITCH. FAILURE TO DO SO MAY RESULT IN INJURY OR DEATH FROM ELECTRICAL SHOCK OR CONTACT WITH MOVING PARTS.

☐ 1. Inspect the evaporator coil air filters. Clean or replace if necessary. Depending on filter type and system application, filters may need to be serviced more frequently.

☐ 2. Clean both the evaporator and condenser coils. Follow the procedures outlined under "Coil Cleaning" in the MAINTENANCE PROCEDURES section of this manual.

☐ 3. With the unit disconnect switch open, check to see that each condenser and evaporator fan is securely fastened to its motor shaft. All fans should turn freely and airflow should be unobstructed.

☐ 4. Replace worn or frayed evaporator fan belts. Check the belt tension of the evaporator fans. A 1/2-inch deflection under light hand pressure is normal. Tighten if necessary.

☐ 5. Remove the condensing unit control box cover and inspect the panel wiring. All electrical connections should be secure. Inspect the compressor and condenser fan motor contactors. If the contacts appear severely burned or pitted, replace the contactor (refer to Figure 6). Do not clean the contacts. Inspect the condenser fan capacitors for visible damage.

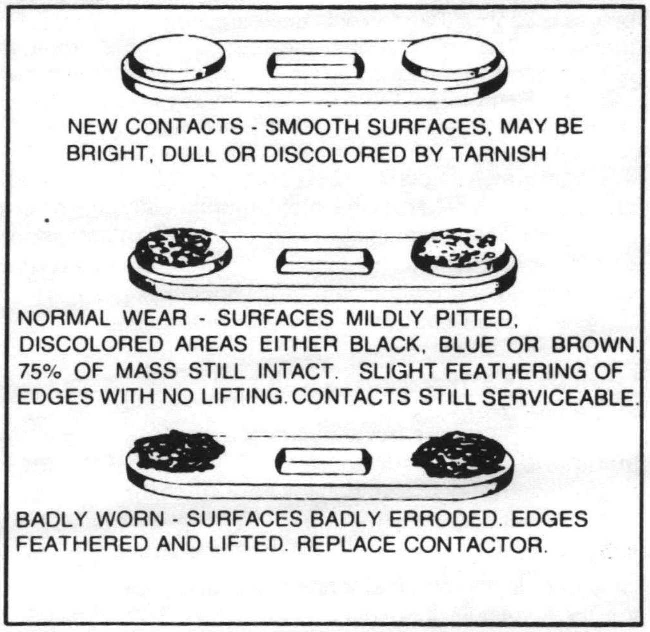


Figure 6 - Compressor Contactor Replacement Guide

☐ 6. Remove any accumulation of dust and dirt from the condensing unit.

☐ 7. Clean and inspect the drain pan of the evaporator unit. Make sure the drain piping is clear.

☐ 8. Check the superheat and subcooling.
   a. The condenser and evaporator coils must be clean before making the following checks.
   b. Determine the superheat of the system. Refer to "Measuring Superheat" in the MAINTENANCE PROCEDURES section of this manual.
   c. Adjust the superheat if necessary (instructions are provided in the "Measuring Superheat" section of this manual).
   d. When the superheat setting is correct, check the subcooling. Refer to "Measuring Subcooling" in the MAINTENANCE PROCEDURES section of this manual.
   e. If the subcooling is low, leak test the system to determine if there is a leak. Refer to "Leak Testing" in the MAINTENANCE PROCEDURES section of this manual.
   f. Charge the system with refrigerant if necessary. Instructions are provided under "Checking Refrigerant Charge" in the MAINTENANCE PROCEDURES section of this manual.
   g. Enter the operating pressures, superheat, and subcooling in the MAINTENANCE LOG provided on the following page.

Shutdown and Start-Up

Shutdown: Short Duration

The system can be shutdown for periods of short duration, such as over the weekend, by moving the thermostat selector switch to the OFF position and the fan switch to the AUTO position.

NOTE: *The unit disconnect switch should remain closed. This will permit the crankcase heater to continue to function, preventing refrigerant from condensing in the compressor oil sump.*

Start-Up: Short Duration

The system is returned to operation after a shutdown of short duration, such as over a weekend, by adjusting the thermostat setting to the desired temperature, placing the thermostat selector switch in the COOL or AUTO position, and setting the fan switch in either the AUTO or ON position.

Shutdown: Seasonal

For seasonal shutdown, open the unit electrical disconnect switch to prevent the unit from starting accidently.

Start-Up: Seasonal

To start the system after an extended period of shutdown, complete the following procedures.

1. Perform all of the "Once A Year" checks listed in the PERIODIC MAINTENANCE section of this manual.
2. Move the thermostat selector switch to OFF.
3. Close the electrical disconnect switch to the condensing unit. This will energize the compressor crankcase heater. If operating properly, the crankcase should be hot to the touch. Wait a minimum of eight hours before turning the room thermostat to the COOL position.

CAUTION: Failure to wait eight hours before turning the room thermostat to COOL may result in damage to the compressor bearings.

4. Start a dual compressor system by adjusting the thermostat setting to the desired temperature, placing the thermostat selector switch in the COOL or AUTO position, and placing the fan switch in either the AUTO or ON position.
5. Adjust the thermostat setting on a single compressor unit so that the compressor will be operating at high speed. Place the thermostat selector switch in either the COOL or AUTO position, and the fan switch in either the AUTO or ON position.
6. Place a clamp-on ammeter on each compressor lead and check the motor amperage. Amperage draw should not be greater than the "Maximum Allowable Amps" given in Table 9.
7. Place the clamp-on ammeter around either of the two leads from each outdoor fan motor run capacitor to determine if the run capacitor is open and must be replaced. The amp draw should not be greater than the nameplate rating for the condenser fan motors.
8. Lower the thermostat setting to the desired temperature.

Maintenance Procedures

This section of the manual describes specific maintenance procedures which must be performed as a part of the unit's maintenance program. Before performing any of these operations, however, be sure that power to the unit is disconnected unless otherwise instructed.

WARNING: WHEN MAINTENANCE CHECKS AND PROCEDURES MUST BE COMPLETED WITH THE ELECTRICAL POWER ON, CARE MUST BE TAKEN TO AVOID CONTACT WITH ENERGIZED COMPONENTS OR MOVING PARTS. FAILURE TO EXERCISE CAUTION WHEN WORKING WITH ELECTRICALLY-POWERED EQUIPMENT MAY RESULT IN SERIOUS INJURY OR DEATH.

Coil Cleaning

Condenser coils must be cleaned **at least once each year**, or more frequently if the unit is located in a "dirty" environment, to help maintain proper unit operating efficiency and reliability. The relationship between regular coil maintenance and efficient unit operation is outlined below:

1. Clean condenser coils minimize compressor head pressure and amperage draw, and promote system efficiency.
2. Clean evaporator coils minimize water carry-over and help eliminate frosting and/or compressor flood back problems.
3. Clean coils minimize required fan brake horsepower and maximize efficiency by keeping coil static pressure loss at a minimum.
4. Clean coils keep motor temperatures and system pressures within safe operating limits for good reliability.

Specific instructions for cleaning condenser coils are provided in the following paragraphs. Follow these instructions as closely as possible to avoid potential damage to the coils.

To clean refrigerant coils, the following equipment is required: a soft brush and either a garden pump-up sprayer or a high pressure sprayer. In addition, a high quality detergent must be used: suggested brands include SPREX A.C., OAKITE 161, OAKITE 166, and COILOX. Follow the manufacturer's recommendations for mixing to make sure the detergent is alkaline with a pH value less than 8.5.

1. Disconnect power to the unit.

WARNING: OPEN UNIT DISCONNECT SWITCH. FAILURE TO DISCONNECT UNIT FROM ELECTRICAL POWER SOURCE MAY RESULT IN SEVERE ELECTRICAL SHOCK, AND POSSIBLE INJURY OR DEATH.

2. Remove enough panels from the unit to gain access to the coil.
3. Protect all electrical devices such as motors and controllers from dust and water spray.
4. Straighten coil fins with a fin rake, if necessary.

MAINTENANCE LOG

DATE	AMBIENT TEMP. (F)	EVAPORATOR ENTERING AIR		COMPRESSOR (HIGH SPEED)		COMPRESSOR (LOW SPEED)		SUPERHEAT		SUBCOOLING (F)
		DRY BULB	WET BULB	SUCTION PRESSURE	DISCHARGE PRESSURE	SUCTION PRESSURE	DISCHARGE PRESSURE	CIRCUIT NO. 1 (F)	CIRCUIT NO. 2 (F)	

5. Use a soft brush to remove loose dirt and debris from both sides of the coil.
6. Mix the detergent with water according to the manufacturer's instructions. The detergent-and-water solution may be heated to a maximum of 150 F to improve its cleansing ability.

WARNING: DO NOT HEAT THE DETERGENT-AND-WATER SOLUTION TO TEMPERATURES IN EXCESS OF 150 F. HIGH-TEMPERATURE LIQUIDS SPRAYED ON THE COIL EXTERIOR WILL RAISE THE PRESSURE WITHIN THE COIL AND MAY CAUSE IT TO BURST, RESULTING IN POSSIBLE INJURY TO SERVICE PERSONNEL AND EQUIPMENT DAMAGE.

7. Place the detergent-and-water solution in the sprayer. If a high-pressure sprayer is used, be sure to follow these guidelines:

   - Minimum nozzle spray angle is 15 degrees.
   - Spray the solution perpendicular (at a 90 degree angle) to the coil face.
   - Keep the sprayer nozzle at least six inches from the coil.
   - Sprayer pressure must not exceed 600 psi.

CAUTION: Do not spray motors or other electrical components. Moisture can cause component failure.

8. Spray the leaving air side of the coil first, then spray the entering air side of the coil. Allow the detergent-and-water solution to stand on the coil for five minutes.
9. Rinse both sides of the coil with cool, clean water.
10. Inspect the coil. If it still appears to be dirty, repeat Steps 7, 8 and 9.
11. Replace all unit panels and parts, and restore electrical power to the unit.
12. Remove the protective covers installed in Step 3.

Control Testing

The following procedures can be used to check the operation of the high and low pressure controls. To determine operating pressures, attach gauges to the compressor suction and discharge access valves.

High Pressure Control

1. Open the unit electrical disconnect switch.
2. Disconnect the low voltage lead(s) from the condenser fan relay coil(s). This will de-energize the condenser fans.
3. On BTA150D-BTA180D units only, disconnect Y2 on the control box terminal strip when checking the high pressure control for Compressor No. 1. This will prevent the second compressor from running while checking the control in the first compressor circuit.
4. Close the unit disconnect switch and start the unit. On BTA180F units operate the compressor on high speed.

CAUTION: Be prepared to open the unit disconnect switch immediately if the compressor continues to run after the discharge pressure exceeds the high pressure control cut-out range. Failure to do so could damage the system.

5. Observe the rising discharge pressure. When the pressure reaches 425 psig (±20) as shown in Table 1, the compressor should shut off. If the pressure reaches 445 psig without the high pressure switch breaking, immediately open the unit disconnect switch. Check to make sure that the high pressure control attached to liquid line No. 1 is wired to low voltage circuit No. 1. Replace the faulty high pressure control.
6. On BTA150D-BTA180D units, repeat Steps 1 through 5 to test the high pressure control in the second compressor circuit. In place of Step 3, however, reconnect Y2 and disconnect Y1 on the control box terminal strip. This will prevent Compressor No. 1 from running while the control for the second compressor circuit is being tested.
7. Open the unit disconnect switch.
8. Reconnect the wires removed in Step 2 on single compressor units, on in Steps 2 and 6 on dual compressor units.
9. Allow the discharge pressure(s) to drop below the cut-in setting in Table 1, and close the unit disconnect switch. This will also close the reset relay that locked out the compressor contactor when the high pressure control tripped.
10. The unit should start. If not, allow the discharge pressure to decrease further and repeat Step 9.

Low Pressure Control

1. Open the unit electrical disconnect switch.
2. Disconnect the wire that goes to the indoor blower coil from either Terminal T or R on the control box terminal strip. This will de-energize the evaporator fans.
3. On BTA120D-BTA180D units only, disconnect Y2 on the control box terminal strip when checking the low pressure control for Compressor No. 1. This will prevent the second compressor from running while checking the control in the first compressor circuit.
4. Remove the wires from Terminal 2 on the low ambient time delay relay(s). Insulate the wire terminals with electrical tape.
5. Close the unit disconnect switch and start the unit.

CAUTION: Be prepared to open the unit disconnect switch immediately if the compressor continues to run after the suction pressure drops below the low pressure control cut-out range. Failure to do so could damage the compressor.

6. Observe the decreasing suction pressure. When the pressure drops to 20 psig (±4) as shown in Table 1, the compressor should shut off. If the pressure reaches 15 psig without the low pressure switch breaking, immediately open the unit disconnect switch. Replace the faulty low pressure control.
7. On BTA120D-BTA180D units, repeat Steps 1 through 6 to test the low pressure control in the second compressor circuit. In place of Step 3, however, reconnect Y2 and disconnect Y1 on the control box terminal strip. This will prevent Compressor No. 1 from running while the control for the second compressor circuit is being tested.

8. Open the unit disconnect switch.

9. Reconnect the wires removed in Steps 2 and 4 on single compressor units, or in Steps 2, 4, and 7 on dual compressor units.

10. Allow the suction pressure(s) to rise above the cut-in setting in Table 1, and close the unit disconnect switch. This will also close the reset relay that locked out the compressor contactor when the low pressure control tripped.

11. The unit should start. If not, allow the suction pressure to rise further and repeat Step 10.

Evacuation

For field evacuation, use a rotary-style vacuum pump capable of pulling a vacuum of 100 microns or less.

When hooking the vacuum pump to a refrigeration system, it is important to manifold the pump to both the high and low side of the system (liquid line access valve and compressor suction access valve). Follow the pump manufacturer's directions as to the proper methods of using the vacuum pump.

CAUTION: Do not, under any circumstances, use a megohm meter or apply power to the windings of a compressor while it is under a deep vacuum. In the rarified atmosphere of a vacuum, the motor windings can be damaged.

The lines used to connect the pump to the system should be copper and of the largest diameter that can practically be used. Using larger line sizes with minimum flow resistance can significantly reduce evacuation time. Rubber or synthetic hoses are not recommended for unit evacuation because they have moisture absorbing characteristics which result in excessive rates of outgassing and pressure rise during the standing vacuum test. This makes it impossible to determine if the unit has a leak, excessive residual moisture, or a continual or high rate of pressure increase due to the hoses.

An electronic micron vacuum gauge should be installed in the common line ahead of the vacuum pump shutoff valve, as shown in Figure 7. Close Valves B and C, and open Valve A. After several minutes, the gauge reading will indicate the minimum blank-off pressure the pump is capable of pulling. Rotary pumps should produce vacuums of less than 100 microns.

Open Valves B and C. Evacuate the system to a pressure of 500 microns or less. Once 500 microns or less is obtained, with Valve A closed, a time versus pressure rise should be performed. The maximum allowable rise over a 15 minute period is 200 microns. If the pressure rise is greater than 200 microns but levels off to a constant value, excessive moisture is present. If the pressure steadily continues to rise, a leak is indicated. Figure 8 illustrates three possible results of the time versus temperature rise check.

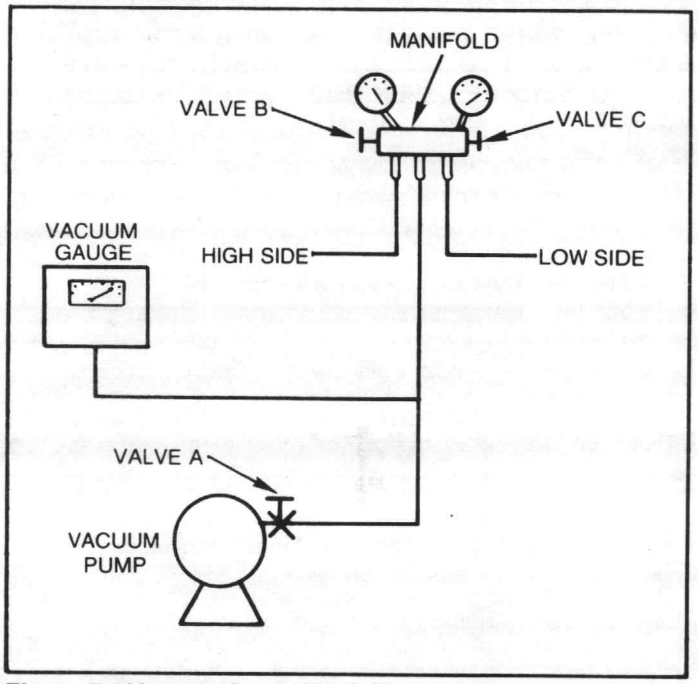


Figure 7 - Vacuum Pump Hook-Up

LEAK TESTING

When leak testing the unit, the following safety precautions must be observed:

WARNING: DO NOT WORK IN A CLOSED AREA WHERE REFRIGERANT OR NITROGEN MAY BE LEAKING. A SUFFICIENT QUANTITY OF VAPORS MAY BE PRESENT TO CAUSE PERSONAL INJURY. PROVIDE ADEQUATE VENTILATION.

WARNING: DO NOT USE OXYGEN, ACETYLENE, OR AIR IN PLACE OF REFRIGERANT AND DRY NITROGEN FOR LEAK TESTING. A VIOLENT EXPLOSION WILL RESULT WHICH COULD CAUSE SERIOUS INJURY OR DEATH.

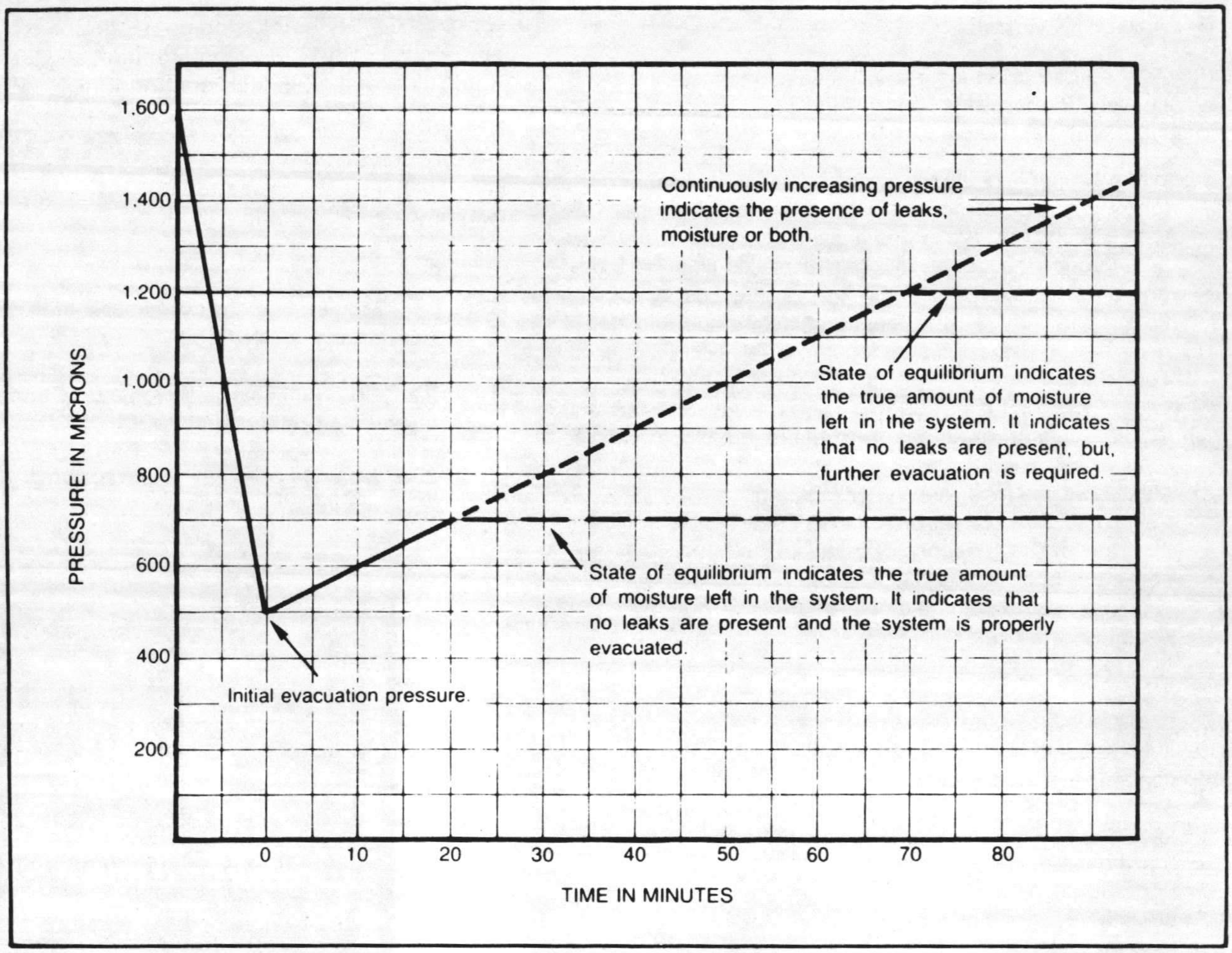


Figure 8 · Time vs. Pressure Rise after Evacuation

WARNING: ALWAYS USE A PRESSURE REGULATOR, VALVES, AND GAUGES TO CONTROL DRUM AND LINE PRESSURES WHEN PRESSURE TESTING THE SYSTEM. EXCESSIVE PRESSURES MAY CAUSE LINE RUPTURES, EQUIPMENT DAMAGE, OR AN EXPLOSION WHICH COULD RESULT IN PERSONAL INJURY OR DEATH.

Leak test the liquid line, evaporator, and suction line at pressures dictated by local codes.

CAUTION: Do not exceed 200 psig when leak testing the system.

1. Charge enough refrigerant into the system to raise the pressure to 100 psig.
2. Use a halogen leak detector or halide torch to check for leaks. Be thorough in this test, checking the interconnecting piping joints, the evaporator unit, and the condensing unit.
3. If a leak is found during the testing, release the test pressure, break the connection, and remake it as a new joint. Refer to the "Brazing Procedures" in this section of the manual for proper brazing techniques.
4. If no leak is found, use nitrogen to increase the test pressure to 150 psig, and repeat the leak test. Soap bubbles should be used to check for leaks when nitrogen is added. If a leak is found after increasing the pressure to 150 psig with nitrogen, release the test pressure and repair the leak.
5. Retest the system to make sure the new connection is solid.
6. If a leak is suspected after the system has been fully charged with refrigerant, use a halogen leak detector, halide torch, or soap bubbles to check for leaks.

Brazing Procedures

Proper brazing techniques are essential when installing refrigerant piping. The following factors should be kept in mind when forming sweat connections.

1. When copper is heated in the presence of air, copper oxide forms. To prevent copper oxide from forming inside the tubing during brazing, sweep an inert gas, such as dry nitrogen, through the tubing. Nitrogen displaces air in the tubing and prevents oxidation of the interior surfaces. A nitrogen flow of one to three cubic feet per minute is sufficient to displace the air. Use a pressure regulating valve or flow meter to control the flow.
2. Ensure that the tubing surfaces to be brazed are clean, and that the ends of the tubes have been carefully reamed to remove any burrs.
3. Make sure the inner and outer tubes of the joint are symmetrical and have a close clearance, providing an easy slip fit. If the joint is too loose, the tensile strength of the connection will be significantly reduced. The overlap distance should be equal to the diameter of the inner tube.
4. Wrap the body of each refrigerant line component with a wet cloth to keep it cool during brazing. Also move line insulation and tube grommets away from the joints. Excessive heat can damage these components.
5. If flux is used, apply it sparingly to the joint. Excess flux will contaminate the refrigerant system.
6. Apply heat evenly over the length and circumference of the joint. The entire joint should become hot enough to melt the brazing material.
7. Begin brazing when the joint is hot enough to melt the brazing rod. The hot copper tubing, not the flame, should melt the rod.
8. Continue to apply heat around the circumference of the joint until the brazing material is drawn into the joint by capillary action, making a mechanically sound and gas-tight connection. Remove the brazing rod as soon as a complete fillet is formed to avoid possible restriction in the line.
9. Visually inspect the connection after brazing to locate any pin holes or crevices in the joint. The use of a mirror may be required, depending on joint location.

Refrigerant Charging

Once the system is properly installed, leak tested and evacuated, refrigerant charging can begin. Liquid refrigerant must be charged into the system through the liquid line access valve, with the compressor shut off.

Refrigerant should be charged into the system by weight. Use an accurate scale or a charging cylinder to determine the exact weight of the refrigerant entering the system. Failure to use either a scale or charging cylinder can lead to under-charging or over-charging, resulting in unreliable operation.

The weights of refrigerant required for the evaporator unit and the condensing unit are given in Table 2. The weight of refrigerant required for the system piping can be determined by measuring the refrigerant lines and using the data in Table 3. The total system operating charge is calculated by adding the charge weight requirements of each part of the system. Refer to the following example.

EXAMPLE: The installation consists of a BTA180D condensing unit, a BWV180B evaporator unit, and 30 feet of 1/2 inch liquid line and 1-3/8 inch suction line.

BTA180D	= 163 oz./circuit
BWV180D	= 94 oz./circuit
Liquid Line (1.137 oz./ft.) x (30 ft.)	= 34 oz./circuit
Suction Line (.203 oz./ft.) x (30 ft.)	= 6 oz./circuit
Total Charge Per Circuit	255 oz./circuit

Since the 15 ton system has two circuits, the total system operating charge required is 510 oz.

Table 2 - Refrigerant charge Weights for Condensing and Evaporator Units

CONDENSING UNIT	CHARGE (IN OUNCES OF R-22)	EVAPORATOR UNIT	CHARGE (IN OUNCES OF R-22)
BTA120D	268 (134/circuit)	BTE120B	112 (56/circuit)
BTA150D	256 (128/circuit)	BWE090C (Two)	158 (79/circuit)
		BWV180B	188 (94/circuit)
BTA180D	326 (163/circuit)	BWE090C (Two)	158 (79/circuit)
		BWV180B	188 (94/circuit)
BTA180F	326	BWV180B	188 (94/circuit)

Table 3 - Refrigerant Line Charge Weights (Ounces/Foot)

TUBE O.D. (INCHES)	LIQUID LINE	SUCTION LINE
3/8	0.610	
1/2	1.137	
5/8	1.827	
3/4	2.738	0.056
7/8		0.078
1 1/8		0.133
1 3/8		0.203
1 5/8		0.288

WARNING: DO NOT APPLY FLAME TO A REFRIGERANT DRUM IN AN ATTEMPT TO INCREASE THE DRUM PRESSURE. UNCONTROLLED HEAT MAY CAUSE EXCESSIVE DRUM PRESSURES AND AN EXPLOSION MAY RESULT.

WARNING: SHOULD LIQUID REFRIGERANT COME IN CONTACT WITH THE SKIN, THE INJURY SHOULD BE TREATED AS IF THE SKIN HAS BEEN FROSTBITTEN OR FROZEN. SLOWLY WARM THE AFFECTED AREA WITH LUKEWARM WATER.

Proceed as follows to charge the system with refrigerant.

1. Charge liquid refrigerant into the liquid line of the No. 1 compressor circuit, using the liquid line access valve. The vacuum within the system will draw some of the required refrigerant into the system. If the pressure within the system equalizes with the pressure in the charging cylinder before the required charge has been drawn in, proceed to Step 2.

   NOTE: *On 10, 12.5, and 15 ton units, this charging process must be repeated for compressor circuit No. 2.*

2. If the system cannot be completely charged by liquid refrigerant entering the system liquid line as outlined in Step 1, complete the process by charging **gaseous refrigerant** into the suction line. However, at least part of the charge must be in the system prior to starting the compressor. Proceed as follows:

   a. Close the liquid line valve on the manifold gauge set.

   b. Connect the manifold gauge set to the suction and discharge access valves (shown in Figure 9). The manifold valves should be closed.

   c. Turn the refrigerant drum upright so that gaseous refrigerant is drawn off the top.

   d. Start the unit by following the procedures outlined in the INITIAL START-UP section of this manual.

   e. With the condensing unit operating, slowly open the suction line valve on the manifold gauge set. The remainder of the refrigerant will be drawn into the system.

CAUTION: Do not allow liquid refrigerant to enter the suction line. Excessive liquid will damage the compressor.

Checking Refrigerant Charge

Before taking measurements to determine if the system is correctly charged with refrigerant, verify that all other aspects of the system operation are proper. The following conditions must be checked and satisfied.

1. Check the evaporator and condenser fans to ensure that they are rotating in the proper direction, that the fan blades do not have dirt buildup, and that each fan is turning at the proper RPM. Make sure that the evaporator fan RPM is correct for the airflow desired and for the external static pressure being imposed by the duct system.
2. Make sure the evaporator air filters are clean.
3. Check the evaporator and condenser coils to ensure that they are clean, that the fins are straight, and that there are no obstructions to airflow.
4. Measure the suction line superheat and adjust the expansion valve, if necessary. (Refer to "Measuring Superheat" in the MAINTENANCE PROCEDURES section of this manual.) The expansion valve superheat setting must be between 12 and 16 F.

Visually inspect the liquid line sight glass to see if clear liquid is present. Bubbles in the liquid line sight glass indicate either low refrigerant charge, excess liquid line pressure drop, or excess liquid line heat gain.

CAUTION: A clear sight glass does NOT necessarily mean the system has sufficient refrigerant.

After verifying that the system is operating properly, determine if the refrigerant charge is correct. This is accomplished by checking both system operating pressures **and** subcooling leaving the condensing unit.

CAUTION: It is not sufficient to check only operating pressures or only subcooling. Both must be in the acceptable range in order to establish correct system charge.

Operating Pressures:

Measure the suction and discharge line pressures and compare these readings with the normal operating pressures listed in Figures 10-13 and Tables 4-6. Refer to "Operating Pressures" in the MAINTENANCE PROCEDURES section of this manual.

Subcooling:

Determine the system subcooling. (Refer to "Measuring Subcooling" in the MAINTENANCE PROCEDURES section of this manual.) If the system is properly charged, subcooling at the liquid line access valve should be 14 to 19 F.

The system is low on refrigerant if: 1) the suction and discharge pressures are lower than the normal operating pressures as determined from Figures 10-13 and Tables 4-6 **and** 2) liquid subcooling is low (less than 14-19 F on Dual Compressor Units and less than 18-30 F on Single Compressor Units.

The system is overcharged with refrigerant if: 1) the suction and discharge pressures are higher than normal operating pressures **and** 2) liquid subcooling is high (greater than 14-19 F on Dual Compressor Units and greater than 18-50 F on Single Compressor Units.

CAUTION: If both the suction and discharge pressures are low but subcooling is in the acceptable range, the system has a problem other than a shortage of refrigerant. Do not add refrigerant. Refer to the TROUBLESHOOTING section of this manual.

Adding Refrigerant:

Use the suction line access valve to add refrigerant to a system with a low charge, making sure that only refrigerant vapor enters the suction line. Continue to add refrigerant until the subcooling is between 14 and 19 F. At this point, the operating pressures should be within the limits defined by Figures 10-13 and Tables 4-6.

Removing Refrigerant:

If the system is overcharged, some refrigerant must be removed to lower the subcooling to the 14-19 F range. Refrigerant should be discharged from the system slowly to keep oil loss at a minimum. The liquid line access valve can be depressed to remove refrigerant. However, refrigerant should not be discharged into the atmosphere.

WARNING: DO NOT ALLOW REFRIGERANT TO COME IN CONTACT WITH THE SKIN. IF THIS OCCURS, THE INJURY SHOULD BE TREATED AS IF THE SKIN HAS BEEN FROSTBITTEN OR FROZEN. SLOWLY WARM THE AFFECTED AREA WITH LUKEWARM WATER.

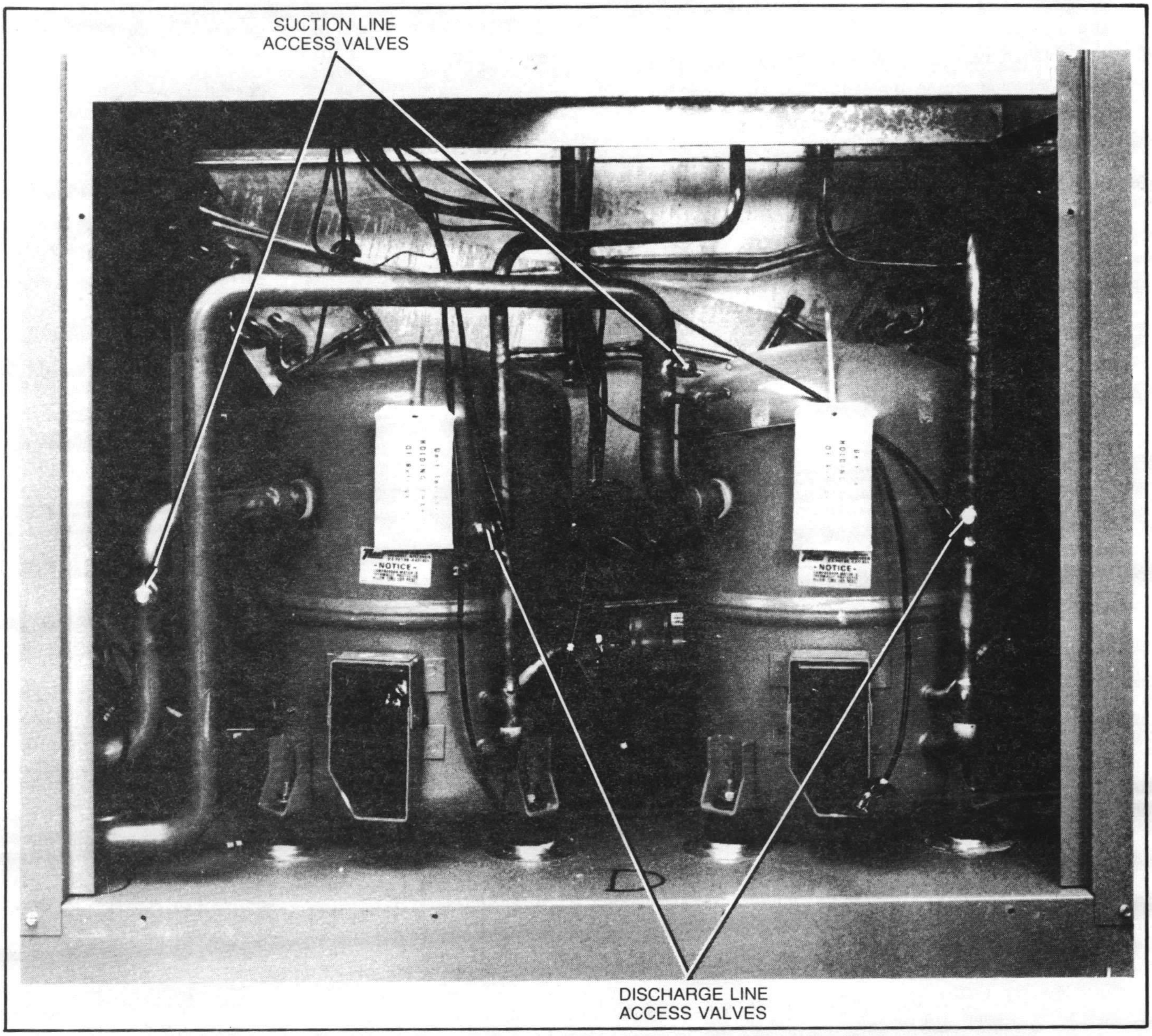


Figure 9 - Compressor Suction and Discharge Access Valves (Dual Compressor Unit Shown)

Operating Pressures

Operating pressure data can be used to determine if the system is operating properly. System malfunctions — such as low airflow, line restrictions, incorrect refrigerant charge, malfunctioning expansion valve, damaged compressor, and so on — will result in pressure variations which are outside the normal range. If the condensing unit and evaporator are checked individually, as described below, the operating pressures can be used to determine which side of the system (high side or low side) is malfunctioning. In addition, the relationship of suction vs. discharge pressure, as well as whether these pressures are higher or lower than expected, will provide valuable clues for determining the specific problem(s).

CAUTION: Operating pressure data, by itself, cannot be used to accurately charge a system. Charging by weight is preferred. If this is not feasible, a combination of operating pressures and subcooling measurement is necessary to properly charge the system. Refer to "Checking Refrigerant Charge" in the MAINTENANCE section of this manual.

Unfortunately, many application variables exist which affect operating pressures. These include indoor dry bulb and wet bulb temperature, outside dry bulb temperature, suction line pressure drop, and evaporator airflow. Since these variables can give misleading results, it is not recommended that operating pressures be used as the sole check of system operation. Further, the following conditions must be satisfied before checking system operating pressures.

1. The outdoor ambient temperature must be between 65 and 105 F. At ambient temperatures outside of this range, meaningful operating pressures cannot be measured.
2. The relative humidity of the air entering the evaporator must be above 40%. If it is less than 40%, meaningful operating pressures cannot be measured.
3. **All** condenser fans must be operating. If necessary, jumper the low ambient fan switches. Be sure to remove the jumpers when the measurements are completed.
4. Do not take measurements if the system includes a low ambient damper and/or hot gas bypass.

Use the following procedure to check operating pressures.

1. Condensing Unit Performance:
   a. Measure pressures (psig) at the suction and discharge line access valves next to the compressor.
   b. Measure the dry bulb air temperature (F) entering the condenser coil.
   c. If the outside ambient is between 65 and 105 F, enter the appropriate graph in Figures 10-13 at the measured suction pressure and condenser ambient. Read the corresponding discharge pressure.
   d. The measured discharge pressure should be within ±7 psi of the graph pressure. If the difference is greater than ±7 psi, the **condensing unit** performance is unacceptable. Refer to the TROUBLESHOOTING section of this manual.

Table 4 - Compressor Suction Pressures (psig)

			CONDENSER AMBIENT, F														
			65			75			85			95			105		
			WET BULB, F			WET BULB, F			WET BULB, F			WET BULB, F			WET BULB, F		
CONDENSING UNIT	EVAPORATOR	EVAP. AIRFLOW (SCFM)	57	65	72	57	65	72	57	65	72	57	65	72	57	65	72
			COMPRESSOR SUCTION PRESSURE (PSIG)														
BTA120D	BTE120B	4000	59	69	79	60	71	81	62	72	83	63	74	84	65	76	86
BTA150D	(2) BWE090C	5000	59	69	79	61	71	81	62	73	83	64	75	85	66	77	87
	BWV180B	5000	61	71	82	62	73	84	64	75	85	66	77	87	68	79	90
BTA180D	(2) BWE090C	6000	58	68	78	60	70	80	61	72	82	63	74	84	65	76	86
	BWV180B	6000	60	70	80	61	72	82	63	74	84	65	76	86	66	77	88
BTA180F	BWV180B	6000	57	67	76	59	69	78	61	71	81	63	73	83	65	75	86

NOTES:
1. Table only good for relative humidity of air entering evaporator greater than 40%.
2. Interpolation between wet bulb temperatures is allowable. Do not extrapolate outside range given.

2. Evaporator Performance:
   a. Measure the actual **wet bulb** temperature (F) of the air entering the evaporator. Be sure to measure the mixed air condition if outside air is being ducted in.
   b. Find the correct combination of condensing unit and evaporator in Table 4. Match the condenser entering air temperature (measured in Step 1b) with the evaporator wet bulb temperature (measured in Step 2a) to determine the correct suction pressure.
   c. Use Table 5 to correct the suction pressure (from Table 4) for the line sizes used in your installation.
   d. Use Table 6 to correct the suction pressure (from Step 2c) for the airflow of your evaporator.
   e. The measured suction pressure at the compressor should be within ±2 psi of the corrected pressure from Tables 4-6. If not, improper **system** operation is indicated. Refer to the TROUBLESHOOTING section of this manual.

CAUTION: Table 4 is not accurate if the relative humidity of evaporator entering air is less than 40%, or if an evaporator/condensing unit combination other than those listed is used.

Table 5 - Suction Pressure Correction for Line Size (PSI)

CONDENSING UNIT	7/8" O.D. SUCTION LINE LENGTH, FEET 0*	25	50	75	100	125*
BTA120D	+0.4	−1.0	−2.4	−3.6	−4.7	−5.8
BTA150D	+0.6	−1.6	−3.6	−5.4	−6.9	−8.4
BTA180D	+0.3	−2.5	−5.0	−7.1	−8.9	−10.6
CONDENSING UNIT	**1-1/8" O.D. SUCTION LINE LENGTH, FEET 0***	**25**	**50**	**75**	**100**	**125***
BTA120D	+0.4	0	−0.4	−0.8	−1.1	−1.5
BTA150D	+0.6	0	−0.6	−1.2	−1.8	−2.3
BTA180D	+0.3	−0.5	−1.3	−2.0	−2.7	−3.4
CONDENSING UNIT	**1-3/8" O.D. SUCTION LINE LENGTH, FEET 0***	**25**	**50**	**75**	**100**	**125***
BTA120D	+0.4	+0.3	+0.1	0	−0.2	−0.3
BTA150D	+0.6	+0.4	+0.2	0	−0.3	−0.5
BTA180D	+0.3	0	−0.2	−0.5	−0.8	−1.1
BTA180F	−0.7	−1.7	−2.6	−3.4	−4.2	−4.9
CONDENSING UNIT	**1-5/8" O.D. SUCTION LINE LENGTH, FEET 0***	**25**	**50**	**75**	**100**	**125***
BTA180F	+0.4	0	−0.4	−0.8	−1.2	−1.6

*0 and 125 feet provided for interpolation purposes only.

Table 6 - Suction Pressure Correction for Airflow (PSI)

COND.	PERCENT OF RATED EVAPORATOR AIRFLOW								
UNIT	-20%	-15%	-10%	-5%	0%	+5%	+10%	+15%	+20%
BTA120D	-2.8	-2.0	-1.3	-0.6	0	+0.6	+1.1	+1.6	+2.1
BTA150D	-2.6	-1.9	-1.2	-0.6	0	+0.5	+1.0	+1.5	+1.9
BTA180D	-2.6	-1.9	-1.2	-0.6	0	+0.5	+1.0	+1.4	+1.9
BTA180F	-2.5	-1.8	-1.2	-0.6	0	+0.5	+1.0	+1.4	+1.8

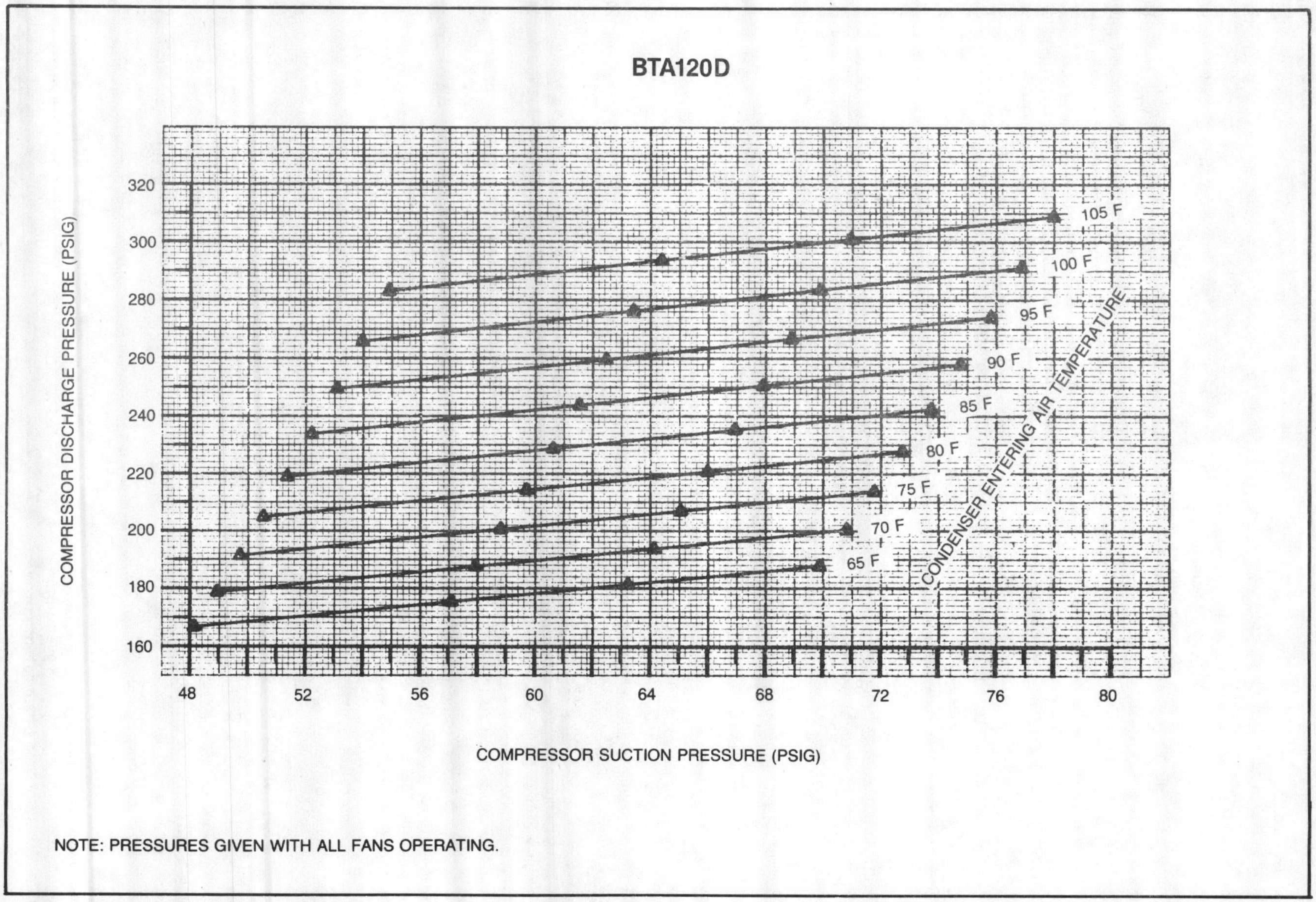


Figure 10 · BTA120D Operating Pressures

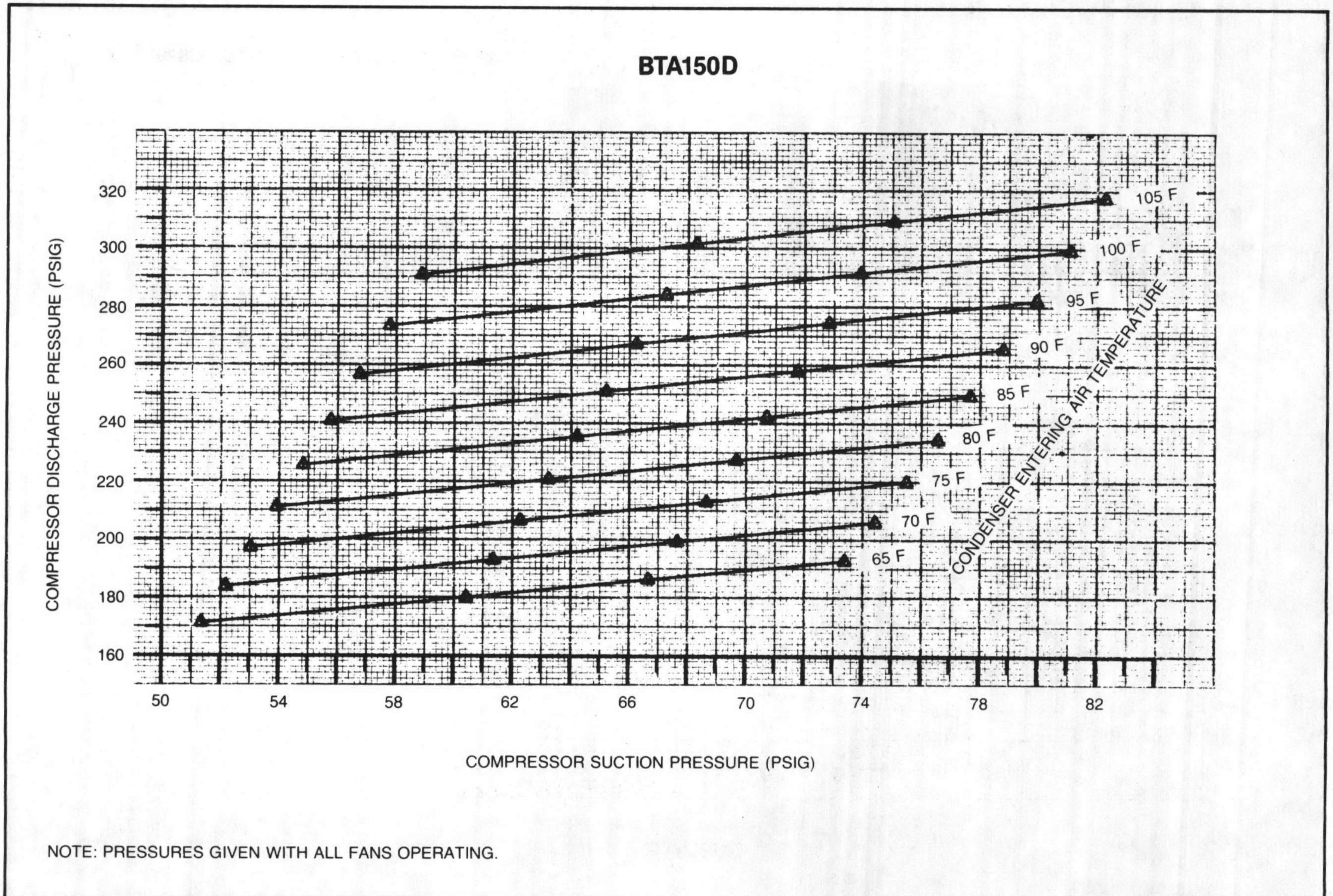


Figure 11 - BTA150D Operating Pressures

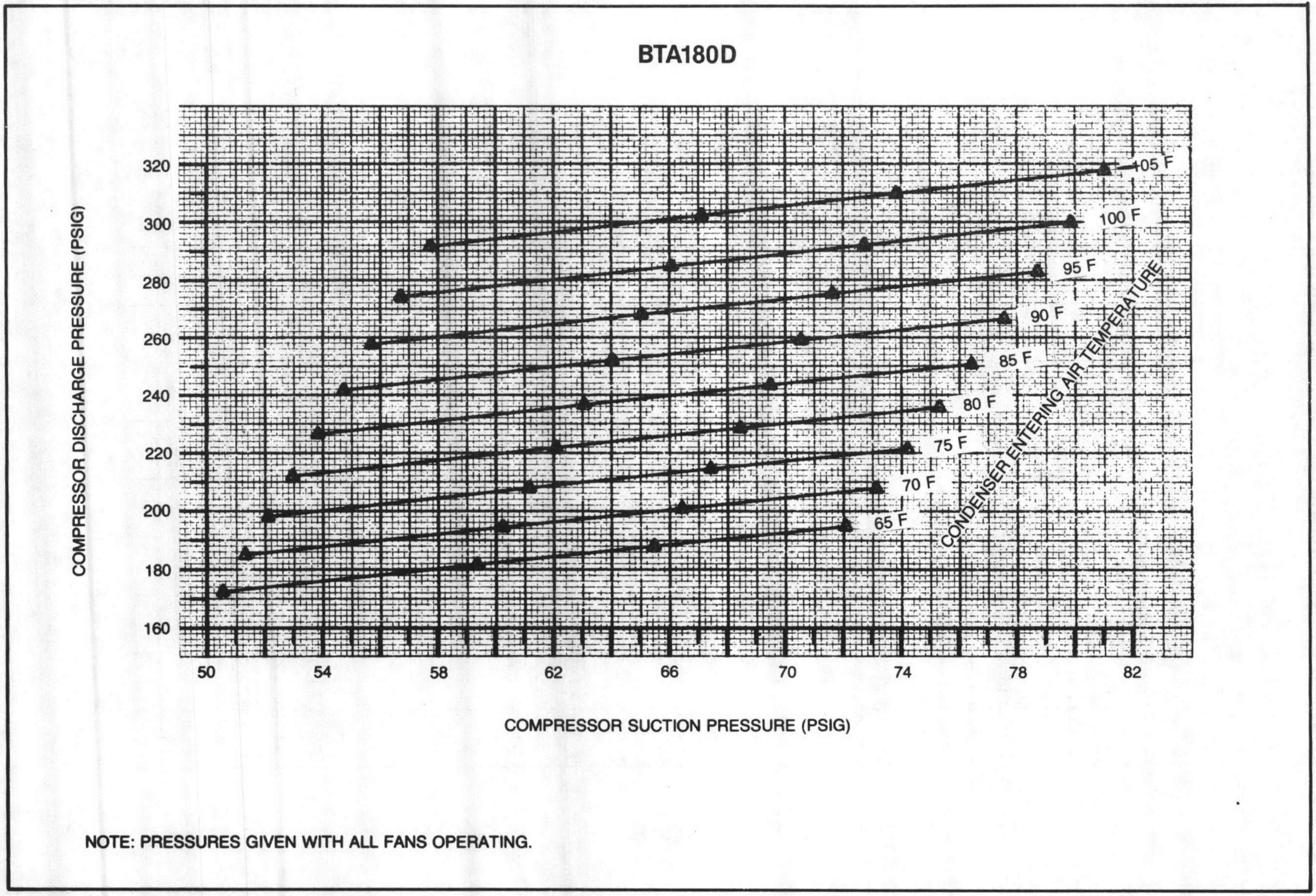
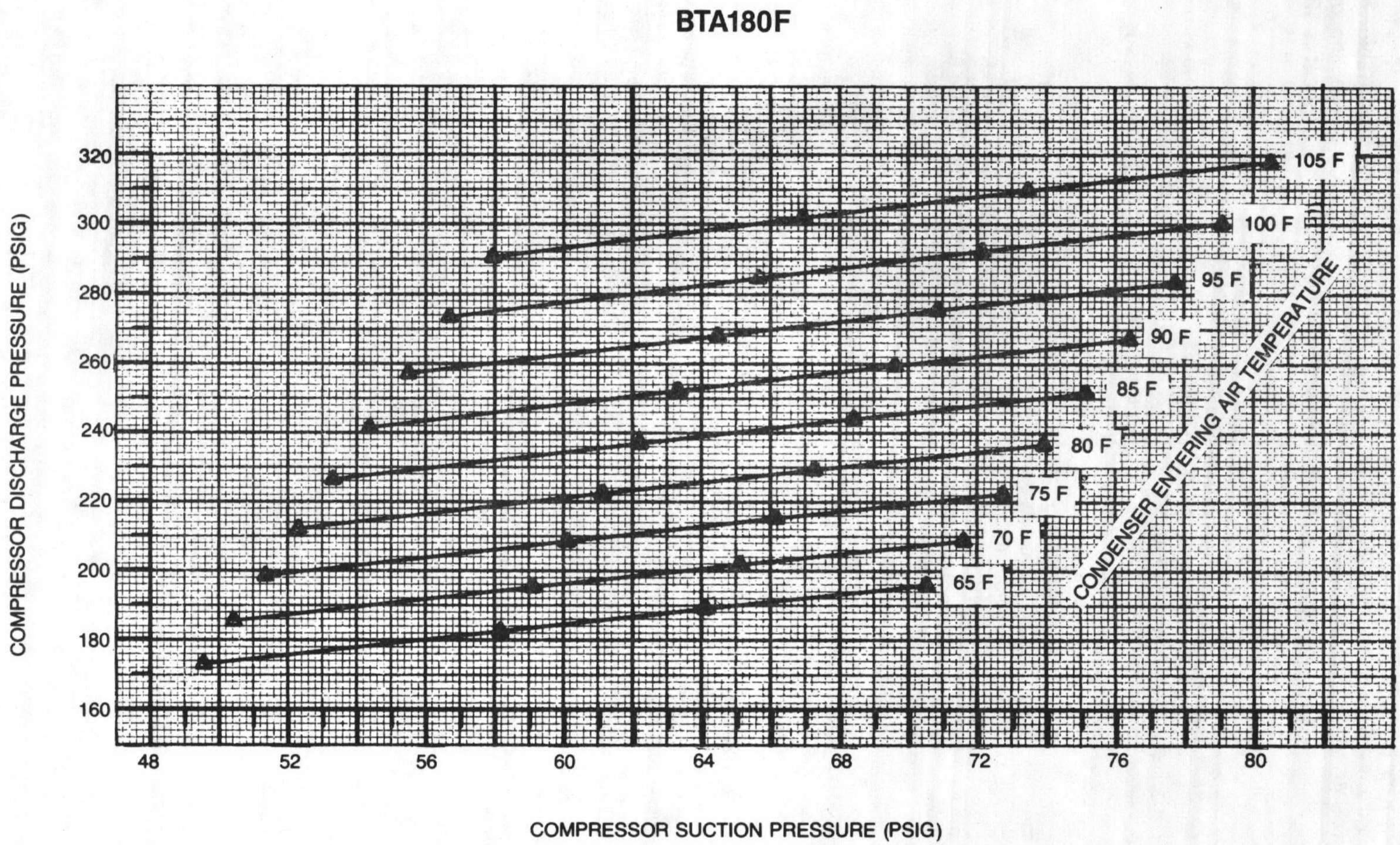


Figure 12 · BTA180D Operating Pressures



NOTE: PRESSURES GIVEN WITH ALL FANS OPERATING.

Figure 13 · BTA180F Operating Pressures

Measuring Superheat

The "safe" setting range for suction gas superheat on Trane equipment is 12 to 16 degrees at the evaporator. Settings within this range will allow for measurement error. Superheats below 12 degrees can cause refrigerant flood back which could lead to serious compressor damage. Superheat readings above the 16 degree measurement reduce system efficiency by reducing the effective evaporator surface.

To determine suction gas superheat, the pressure at the outlet of the evaporator must be measured and then converted to saturated vapor temperature by using a Refrigerant-22 pressure/temperature chart. The saturated vapor temperature can then be subtracted from the actual suction temperature, which is measured on the suction line close to the expansion valve bulb. The difference between the two temperatures is known as suction gas superheat. On most Trane fan/coil units an access valve has been provided close to the expansion valve bulb. To obtain an accurate reading, this access valve must be utilized when determining suction gas superheat.

Instruments to Use:

1. The gauge used to measure suction pressure should be of the best quality available. Gauges permanently installed on the equipment should not be used. A good quality gauge on a standard refrigerant manifold set is recommended.

2. To measure suction temperature, an electronic temperature tester will be sufficient. Testers manufactured by Robinnaire, Annie, and Thermal are among those available. Glass thermometers do not have sufficient contact area to give accurate readings.

Procedure:

In most cases it is desirable to use a single distributor evaporator with the BTA condensing unit, thereby utilizing one expansion valve. When the system has only one expansion valve, the following procedure should be used for measuring superheat.

1. Cut the suction line insulation to gain access to the suction line. If armaflex is used, it is best to cut around the circumference of the tubing.
2. Clean the line carefully and attach the electronic temperature sensor. Black electrical tape works well when securing the sensor of the temperature tester to the suction line. (Make sure the sensor is making good contact with the tube.)
3. Rejoin the armaflex and seal with plastic tape to prevent sensor contact with ambient air.

   NOTE: *For measurement accuracy the temperature sensor* ***must*** *be installed and insulated properly. Make sure the armaflex extends at least six inches on both sides of the sensor location. Seal both ends of the armaflex to keep ambient air from getting under the insulation and affecting the temperature readings.*

4. Install a pressure gauge to monitor suction pressure.
5. Operate the system for approximately 10 to 15 minutes to be sure that the expansion valve has time to stabilize.
6. To measure superheat, compare the saturated vapor temperature of the refrigerant converted from the suction pressure reading (see Table 7) to the actual temperature measured at the line by the electronic tester. Proper suction superheat is 12 to 16 degrees.

EXAMPLE:
Suction Pressure = 66.0 psig
Suction Temperature = 52 F
Suction Pressure converted to Saturated Vapor Temperature (from Table 11) = 38 F
Suction Superheat = (Actual Line Temp.) – (Saturated Vapor Temp.)
= (52 F) – (38 F)
= 14 F

If initial suction superheat readings fall below 12 degrees, the adjusting stem on the expansion valve should be adjusted clockwise to close the valve, limiting the flow of refrigerant to the evaporator and thus increasing superheat. Adjustment should be made a half turn at a time. Conversely, if the initial suction superheat reading is greater than 16 degrees, the adjusting stem on the expansion valve should be adjusted counterclockwise to open the valve, increasing the flow of refrigerant to the evaporator and thus decreasing superheat. Adjustments should be made until an acceptable reading is obtained. The system should be allowed to restabilize for 10 minutes after each adjustment.

Table 7 · Pressure/Temperature Conversions for Calculating Suction Line Superheat

SATURATED TEMPERATURE	PRESSURE USING REFRIGERANT-22
30	54.9
31	56.2
32	57.5
33	58.8
34	60.1
35	61.5
36	62.8
37	64.2
38	65.6
39	67.1
40	68.5
41	70.0
42	71.4
43	73.0
44	74.5
45	76.0
46	77.6
47	79.2
48	80.8
49	82.4
50	84.0

Measuring Subcooling

The following conditions must be satisfied before checking subcooling.

1. The outdoor ambient temperature must be between 65 and 105 F. At ambient temperatures outside of this range, meaningful operating pressures cannot be measured.
2. The relative humidity of the air entering the evaporator must be above 40%. If it is less than 40%, meaningful operating pressures cannot be measured.
3. The compressor must be operating on high speed.
4. **All** condenser fans must be operating. If necessary, jumper the low ambient fan switches. Be sure to remove the jumpers when the measurements are completed.
5. Do not take measurements if the system includes a low ambient damper and/or hot gas bypass.

The proper setting range for liquid subcooling is 18 to 30 F on BTA180F units. Determine the system subcooling as follows:

1. Measure the liquid line pressure at the liquid line access valve installed inside the condensing unit. Convert this pressure reading to saturated temperature by using a Refrigerant-22 pressure/temperature chart (refer to Table 8).
2. Measure the actual liquid line temperature on the liquid line close to the access valve. To ensure an accurate reading, clean the line thoroughly where the electronic temperature sensor will be attached. Glass thermometers do not have sufficient contact area to give accurate readings. After securing the sensor to the line, wrap the sensor and line with insulation to prevent contact with ambient air.
3. Determine the system subcooling by subtracting the actual liquid line temperature (measured in Step 2) from the saturated liquid temperature (calculated in Step 1).
4. If the system is properly charged, subcooling at the liquid line access valve should be 18-30 F on BTA180F units and 14-19 F on BTA120D-BTA180D units.

Table 8 - Pressure/Temperature Conversion for Calculating Liquid Line Subcooling

SATURATED TEMPERATURE	PRESSURE USING REFRIGERANT-22
70	121.4
75	132.2
80	143.6
85	155.7
90	168.4
95	181.8
100	195.9
105	210.8
110	226.4
115	242.7
120	259.9
125	277.9
130	296.8
135	316.6
140	337.2
145	358.9
150	381.5

Table 9 - Maximum Allowable Amps

Condensing Unit	Electrical Characteristics	Allowable** Voltage Range	Max. Allowable Amps Matched Evap.	Oversized* Evap.
BTA120D300	208-230/60/3	187-253	24	—
BTA120D400	460/60/3	416-506	11	—
BTA120DW00	575/60/3	520-635	9	—
BTA150D300	208-230/60/3	187-253	—	30
BTA150D400	460/60/3	416-506	—	13
BTA150DW00	575/60/3	520-635	—	11
BTA180D300	208-230/60/3	187-253	31	36
BTA180D400	460/60/3	416-506	14	16
BTA180DW00	575/60/3	520-635	11	13
BTA180F300	208-230/60/3	187-253	66	67
BTA180F400	460/60/3	416-506	33	34
BTA180FW00	575/60/3	520-635	27	27

*Evaporator one size larger than condensing unit.
**Allowable voltage range at the unit terminal block.

Troubleshooting

The Troubleshooting Chart on the following pages is provided to serve as an aid for identifying the cause of any system malfunctions that may occur. The chart is divided into three columns:

— the "SYMPTOM" column describes the behavior the unit is exhibiting;
— the "PROBABLE CAUSE" column identifies possible sources of malfunction;
— the "RECOMMENDED ACTION" column indicates the procedures required to correct the malfunction.

If operating difficulties are encountered, make the following preliminary checks before referring to the Troubleshooting Chart:

☐ Check the thermostat to ensure that it is properly set, receiving control power, and "making/breaking" on a call for heating or cooling.

☐ Verify that the unit is receiving electrical supply power, and that the fuses are intact.

☐ Check the filters to make sure they are positioned properly, and free of dirt and debris.

After completing the checks listed above, inspect the system for other obvious causes of trouble such as broken fan belts, a clogged condenser coil, or restricted air ducts. If everything appears to be in order, but the unit still fails to operate properly, refer to the appropriate section of the Troubleshooting Chart.

NOTE: *The Troubleshooting Chart which follows is provided solely as a guide for determining the cause of mechanical failure or malfunction. When mechanical problems do occur, Trane recommends that trained service personnel be contacted to help ensure proper diagnosis and repair of the unit.*

WARNING: OPEN THE UNIT DISCONNECT SWITCH AND LOCK IT IN THAT POSITION TO PREVENT ACCIDENTAL START-UP. NEVER OPEN AN ACCESS PANEL TO INSPECT OR SERVICE THE UNIT WITHOUT FIRST OPENING THE DISCONNECT SWITCH. FAILURE TO DO SO MAY RESULT IN INJURY OR DEATH FROM ELECTRICAL SHOCK OR CONTACT WITH MOVING PARTS.

TROUBLESHOOTING CHART

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
A. Compressor does not start, and does not hum. Condenser fans do not operate.	1. No power to unit.	1. Check for the following: a. Disconnect switch open. b. Fuses blown.
	2. No call for cooling.	2. Check for the following: a. Defective thermostat. b. Broken or improper control wiring. c. Blown control power fuse.
	3. Anti-recycle timer has not timed out (if installed).	3. Wait at least five minutes for the anti-recycle timer to time out.
	4. Compressor motor protection module cut out.	4. Check motor windings for open circuit after allowing cool-down time. Refer to Symptom F, "Compressor motor protection module cut out".
	5. Unit locked out by reset relay.	5. Check for the following: a. Excessive discharge pressure. Refer to Symptom L, "Discharge pressure too high". b. Defective high pressure control. c. Low suction pressure. Refer to Symptom I, "Suction pressure too low". d. Defective low pressure control. e. Defective reset relay contacts.
AA. Compressor does not start, and does not hum. Condenser fans operate.	1. Compressor contactor will not close.	1. Check for the following: a. Defective compressor contactor. b. Improper wiring.
	2. Defective compressor.	2. Replace faulty compressor.

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
B. Compressor hums, but will not start.	1. Low voltage at the compressor.	1. Check for the following: a. A single blown fuse. b. Low line voltage. c. Defective compressor contactor. d. Loose wiring connections.
	2. Defective compressor.	2. Check for the following: a. Open motor winding. b. Excessive amp draw on all phases.
C. Compressor fails to switch to high speed.	1. No call for second stage of cooling.	1. Check for the following: a. Setpoint too low. b. Defective thermostat. c. Broken or improper control wiring.
	2. Compressor contactor will not close.	2. Same as AA-1.
	3. Defective compressor.	3. Same as AA-2.
D. Compressor short cycles.	1. Intermittent contact in control circuit.	1. Check for the following: a. Defective relay contacts. b. Loose wiring connections.
	2. Poor thermostat placement.	2. Refer to "Thermostat Installation" in the ELECTRICAL WIRING section of this manual.
	3. Defective anti-recycle timer.	3. Replace compressor motor protection module.

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
E. Compressor runs continuously.	1. Unit undersized for load (cannot maintain space temperature).	1. Check for cause of excessive load.
	2. Compressor fails to switch to high speed.	2. Refer to Symptom C.
	3. Thermostat setpoint too low.	3. Readjust thermostat.
	4. Defective thermostat or control wiring (conditioned space too cold).	4. Replace thermostat. Replace or repair control wiring.
	5. Welded contacts on compressor contactor.	5. Repair or replace contactor.
	6. Leaky valves in compressor (indicated by operation at abnormally low discharge and high suction pressures).	6. Replace compressor.
	7. Shortage of refrigerant (indicated by reduced capacity coupled with high superheat, low subcooling, and low suction pressure).	7. Find and repair refrigerant leak. Recharge system.
F. Compressor motor protection module cut out.	1. Excessive load on evaporator (indicated by high supply air temperature).	1. Check for the following: a. Excessive airflow. b. High return air temperature.
	2. Lack of motor cooling (indicated by excessive superheat).	2. Check for the following: a. Improper expansion valve setting. b. Faulty expansion valve. c. Restriction in liquid line.
	3. Improper voltage at compressor.	3. Check for the following: a. Low or unbalanced line voltage. b. Loose power wiring. c. Defective compressor contactor.
	4. Internal parts of compressor damaged.	4. Replace compressor.
G. Compressor is noisy.	1. Internal parts of compressor damaged or broken (compressor knocks).	1. Replace compressor.
	2. Liquid floodback (indicated by abnormally cold suction line).	2. Check and adjust superheat.
	3. Liquid refrigerant in the compressor at start-up (indicated by an abnormally cold compressor shell).	3. Replace crankcase heater.

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
H. System short of capacity.	1. Low refrigerant charge (indicated by low subcooling and high superheat).	1. Add refrigerant.
	2. Clogged filter drier (indicated by temperature change in refrigerant line through drier).	2. Replace filter drier or core of drier.
	3. Incorrect thermostatic expansion valve setting.	3. Readjust expansion valve.
	4. Expansion valve stuck or obstructed (indicated by high superheat and high space temperature).	4. Repair or replace expansion valve.
	5. Low evaporator airflow.	5. Check filters. Adjust airflow.
	6. Noncondensibles in system.	6. Evacuate and recharge system.
	7. Leaky valves in compressor (indicated by operation at abnormally low discharge and high suction pressures).	7. Replace compressor.
I. Suction pressure too low.	1. Shortage of refrigerant (indicated by high superheat and low subcooling).	1. Find and repair refrigerant leak. Recharge system.
	2. Thermostat set too low (indicated by low discharge pressure and low space temperature).	2. Readjust thermostat.
	3. Low airflow.	3. Check for clogged filters, incorrect fan speed, or high duct static pressure.
	4. Clogged filter drier.	4. Check for frosting on filter drier. Replace if necessary.
	5. Expansion valve power assembly has lost charge.	5. Repair or replace expansion valve power head assembly.
	6. Obstructed expansion valve (indicated by high superheat).	6. Clean or replace valve.
J. Suction pressure too high.	1. Excessive cooling load (indicated by high supply air temperatures).	1. See Symptom E, "Compressor runs continuously".
	2. Overfeeding of expansion valve (indicated by abnormally low superheat and liquid flooding to compressor).	2. Adjust superheat setting and check to see that remote bulb is properly attached to suction line.
	3. Suction valves broken in open position (indicated by noisy compressor).	3. Replace compressor.
	4. Compressor on low speed.	4. Refer to Symptom C.

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
K. Discharge pressure too low.	1. Shortage of refrigerant (indicated by low subcooling and high superheat plus bubbles in sight glass).	1. Repair leak and recharge system.
	2. Broken or leaky compressor discharge valves (indicated by suction and discharge pressures that equalize rapidly after shutdown).	2. Replace compressor.
	3. Condenser fan control stuck in closed position (contacts closed when temperature is below 60 F).	3. Replace defective control.
	4. Unit running below minimum operating ambient.	4. Provide adequate heat pressure controls or a unit ambient lockout switch.
	5. Low ambient damper stuck open (indicated by low discharge pressure).	5. Repair or replace damper operator.
L. Discharge pressure too high.	1. Too little or too warm condenser air; restricted air flow.	1. Clean coil. Check fan and motors for proper operation.
	2. Air or noncondensible gas in system (indicated by exceptionally hot condenser and excessive discharge pressure).	2. Evacuate and recharge system.
	3. Overcharge of refrigerant (indicated by high subcooling, low superheat, and high suction pressure).	3. Remove excess refrigerant.
	4. Excessive system load.	4. Reduce load.
	5. Defective condenser fan or fan control (indicated by one fan off and high condenser pressure).	5. Repair or replace fan or control.
	6. Defective or inoperative low ambient dampers.	6. Repair or replace defective parts.

The Trane Company
Light Commercial Group
Guthrie Highway
Clarksville, TN 37040

AN AMERICAN—
STANDARD
COMPANY

BTA-M-3

Technical Literature Printed in USA

TRANE™ **BTA-SF-26A**

Bldgs AS-202 & AS-236

SERVICE FACTS

Since The Trane Company has a policy of continuous product improvement, it reserves the right to change specifications and design without notice. The installation and servicing of the equipment referred to in this booklet should be done by qualified, experienced technicians.

Split System Condensing Unit

Library	Service Literature
Product Section	Unitary
Product	Split System
Model	BTA
Literature Type	Service Facts
Sequence	26A
Date	December 1986
File No.	SV-UN-S/S-BTA-SF-26A 12/86
Supersedes	

Model
BTA180D300AB

IMPORTANT - This document is customer property and is to remain with this unit. Please return to service information pack upon completion of work.

SAFETY NOTICE

THIS INFORMATION IS INTENDED FOR USE BY INDIVIDUALS POSSESSING ADEQUATE BACKGROUNDS OF ELECTRICAL AND MECHANICAL EXPERIENCE. ANY ATTEMPT TO REPAIR A CENTRAL AIR CONDITIONING PRODUCT MAY RESULT IN PERSONAL INJURY AND/OR PROPERTY DAMAGE. THE MANUFACTURER OR SELLER CANNOT BE RESPONSIBLE FOR THE INTERPRETATION OF THIS INFORMATION, NOR CAN IT ASSUME ANY LIABILITY IN CONNECTION WITH ITS USE.

RECONNECT ALL GROUNDING DEVICES

ALL PARTS OF THIS PRODUCT CAPABLE OF CONDUCTING ELECTRICAL CURRENT ARE GROUNDED. IF GROUNDING WIRES, SCREWS, STRAPS, CLIPS, NUTS OR WASHERS USED TO COMPLETE A PATH TO GROUND ARE REMOVED FOR SERVICE, THEY MUST BE RETURNED TO THEIR ORIGINAL POSITION AND PROPERLY FASTENED.

DISCONNECT POWER BEFORE SERVICING

INDOOR THERMOSTAT

Thermostat	System Switch	Fan Switch	Cool Steps	Heat Steps
BAYSTAT010*	Auto	Auto	2	2
BAYSTAT011	Auto	N.A.	2	2
BAYSTAT012	Manual	Auto	2	1
BAYSTAT013	Manual	Auto	2	2
BAYSTAT015	Auto	Auto	2	None

*BAYRLAY001 must be used in conjunction with this thermostat.

Night Setback: BAYSTAT003

Coil Guard: BAYGARD004

Isolators: BAYISLT001
BAYISLT002

Low Ambient Damper: BAYLOAM001A

SERVICE PARTS

COMPONENT	QTY.	DESCRIPTION	DPG CAT. #	CSG PART #
Capacitors (CAP)	3	5.0 MFD, 440V	WW20X0108	CPT-119
Compressors (COMP)	2	208-230/60/3, FLA 27.1, Trane CRHH-075J	WW77X0750	COM-1649
Contactors (compressor) (CC)	2	Type 3PST, Contacts: Ind. FLA 40, Res. Amps 50, LRA @ 240 = 240, LRA @ 480 = 200, Coil: 24V, Inrush V.A. 50, Sealed V.A. 6.5	WW30X116	#CTR-522
Drier	2	Liquid Line w/Sweat Fittings, 16 c.u. in., ½" x ½"	WW22X0096	DHY-152
Fan	3	3 Blade, 20" Dia., ½" Dia. Bore, CW	WW73X0077	FAN-661
Fuse (control) (F7)	2	Dual Element, 3 Amps, 300V	WG23X0070	FUS-200
Fuse (F5,F6) (outdoor fan)	2	Dual Element, 30 amps, 300V	WW23X0212	FUS-92
Condenser Motor (ODFM)	3	208/230V, 60 Hz., 1 Ph., Dripproof Shell, CCW, 1625 Rpm, ½ H.P., 1-speed, FLA 4.1, LRA 9.5, type PSC	WW94X620	##MOT-2360
Relay (reset) (RR)	2	Type SPDT, Contact Rating: Pilot Duty, Coil Voltage: 24 V.A.C.	WW24X0171	RLY-657
Slinger	3	½" Dia. Bore	WW72X0048	SLG-31
Control Switch High Pressure (HPC)	2	Cut-out Pressure: Opens @ 425 ± 20 PSIG, Resets @ 325 ± 20 PSIG	WW26X0068	CNT-510
Control Switch Low Pressure (LPC)	2	Cut-out Pressure: Opens @ 20 ± 4 PSIG, Resets @ 50 ± 5 PSIG	WW26X0095	CNT-542
Condenser Fan Limit Control (FLT)	1	Type SPST, Switch Opens @ 55 ± 3 F. Closes @ 65 ± 3 F, Rating @ 240 V = 10 Amps	WW28X238	CNT-959
Condenser Fan Limit Control (FLT)	1	Type SPST, Switch Opens @ 65 ± 3 F. Closes @ 75 ± 3 F, Rating @ 240 V = 10 Amps	WW28X0250	THT-500
Time Delay Relay (LATD)	2	Time Delay 240 Sec., Input Voltage 24V, Output Rating 1 Amp.	WW24X0116	RLY-858
Transformer (T)	1	Primary 208/240V, Secondary 24V, Class II, Rating 60 V.A., Primary 60 Hz.	WW32X0066	TRR-398
Crankcase Heater (CCH)	1	230V, 60W	WW08X0088	HTR-1225
SERVICE REPLACEMENT PARTS				
Drier, Liquid	2	Liquid line w/sweat fittings, 16 Cu. In., ½" x ½"	WW22X096	DHY-152
Drier, Suction	2	Suction line w/sweat fittings, 30 Cu. In., 1⅛" x 1⅛"	WW22X070	DHY-180

#Standardized Part. First time replacement requires Side Switch, SWT-528, includes Holding Coil, COL-3601.
##Standardized Part. First time replacement requires Capacitor, CPT-230.

NOTE:
CSG refers to the Commercial Systems Group and DPG refers to the Dealer Product Group of The Trane Company. The CSG and DPG part numbers shown side by side above are not necessarily interchangeable for applications other than documented in this bulletin. Both are approved for service of the product listed. Inventories to support your needs are available to you through both Trane divisions.

Operation

Electrical Sequence of Operation

The typical wiring diagrams provided in Figures 1 and 2 should be used only as a reference for the following discussion. For the actual wiring of your specific unit, refer to the wiring diagram pasted on the inside of the unit's control box cover.

System operation is controlled by a two-stage thermostat, depending upon the number of compressors in the system. Closing the unit disconnect switch supplies power to the control power transformer (T1), the compressor crankcase heaters (CCH1 and CCH2), and the line side of all control contactors.

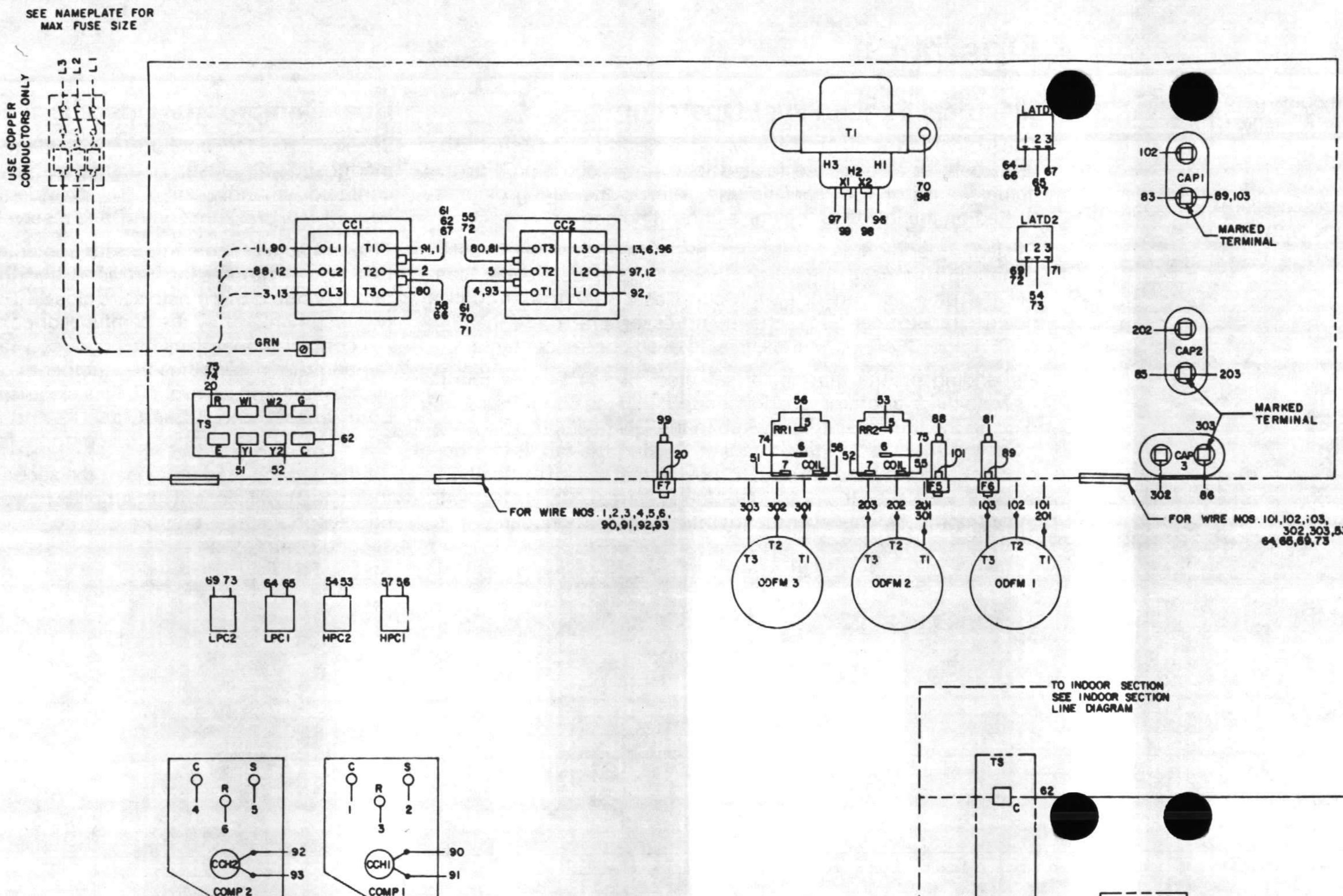
Depending on the thermostat selected, it may be possible to operate the evaporator fan independently of the compressors by placing the thermostat fan switch in the ON position. This energizes the evaporator fan contactor, starting the fan. If the thermostat has a separate fan switch, moving that switch to the AUTO position will cause the evaporator fan to start in conjunction with the compressor whenever the thermostat calls for cooling.

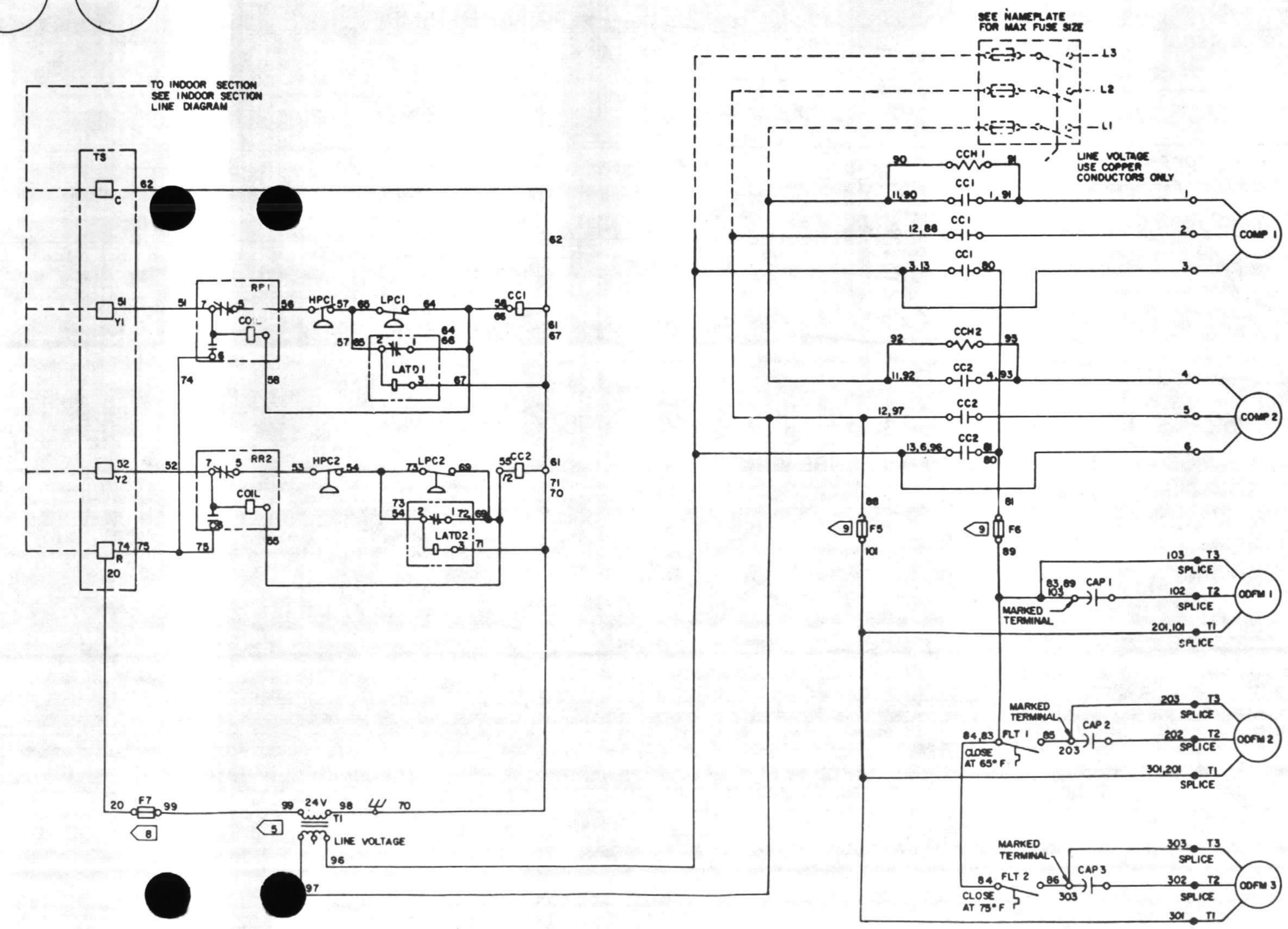
Dual Compressor Operation

Sensing a need for cooling, the first stage cooling contacts of the thermostat will close. This supplies power to the compressor contactor solenoid coil (CC1), provided that the high pressure control, low pressure control, and reset relay contacts are closed.

The contacts of the compressor contactor close, energizing the first stage compressor, provided that the compressor internal motor winding thermostats are closed. The compressor has only two leads broken by the compressor contactor. The third leg of the contactor energizes the condenser fan motors. The outdoor temperature determines the number of condenser fans that will start. A fan limit control (FLT) is electrically positioned between both fans #1 and #2 and fans #2 and #3. Depending on the position of these controls, one or more fans may start.

As the cooling load increases, the second stage contacts of the thermostat will close. This supplies power to the solenoid coil of the second stage compressor contactor (CC2), starting the second compressor.





LEGEND	
COMP	COMPRESSOR
CC	COMPRESSOR CONTACTOR
ODFM	OUTDOOR FAN MOTOR
TS	TERMINAL STRIP
T1	TRANSFORMER
F	FUSE
CAP	CAPACITOR
RR	RESET RELAY
HPC	HIGH PRESSURE CONTROL
CCH	CRANKCASE HEATER
LPC	LOW PRESSURE CONTROL
LATD	LOW AMBIENT TIME DELAY
FLT	FAN LIMIT T-STAT

NOTES:

1. SEE NAMEPLATES OF ALL MOTORS FOR VOLTAGE BEFORE CONNECTING TO LINE
2. ALL COMPONENTS AND WIRES SHOWN DOTTED ARE SUPPLIED BY CUSTOMER
3. IF ANY OF THE ORIGINAL WIRES AS SUPPLIED WITH THIS UNIT MUST BE REPLACED, IT MUST BE REPLACED WITH APPLIANCE WIRING MATERIAL RATED 105° C OR EQUIVALENT
4. ALL CUSTOMER WIRING MUST BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES
5. ALL 208-230 VOLT UNITS WILL BE FACTORY WIRED FOR 230 VOLT APPLICATIONS. FOR 208 VOLT APPLICATIONS MOVE LEAD 97 FROM THE 240 VOLT TRANSFORMER TERMINAL TO THE 208 VOLT TERMINAL
6. THREE PHASE MOTORS ARE PROTECTED UNDER PRIMARY SINGLE PHASING CONDITIONS
7. EVAPORATOR APPLICATION TEMPERATURE RANGE +32°F TO +53.5°F
8. REPLACE F7 FUSE WITH BUSSMAN TYPE GLQ & GMQ 3 AMP 300V FUSES ONLY
9. REPLACE F5 AND F6 FUSES WITH 300V, 30 AMP TYPE SC FUSES ONLY
10. RESET RELAY WILL RESET WHEN POWER IS INTERRUPTED

2306-3563

Normal Operating Pressures

To determine the proper head and suction pressure refer to Figure A.

1. Determine that the system CFM is the same as listed in Figure A.
2. Determine the evaporator entering air dry and wet bulb temperatures by using a sling psychrometer.
3. Determine the outdoor ambient at temperature entering the condensor.
4. Find the intersection of the outdoor ambient temperature and the evaporator DB and WB temperatures. From that point, go vertically to find the correct suction pressure and horizontally to find the correct head pressure.
5. Refer to the troubleshooting section of the Operation/Maintenance Guide for additional information if the head pressure is more than ±10 PSIG and the suction pressure is more than ±3 PSIG.

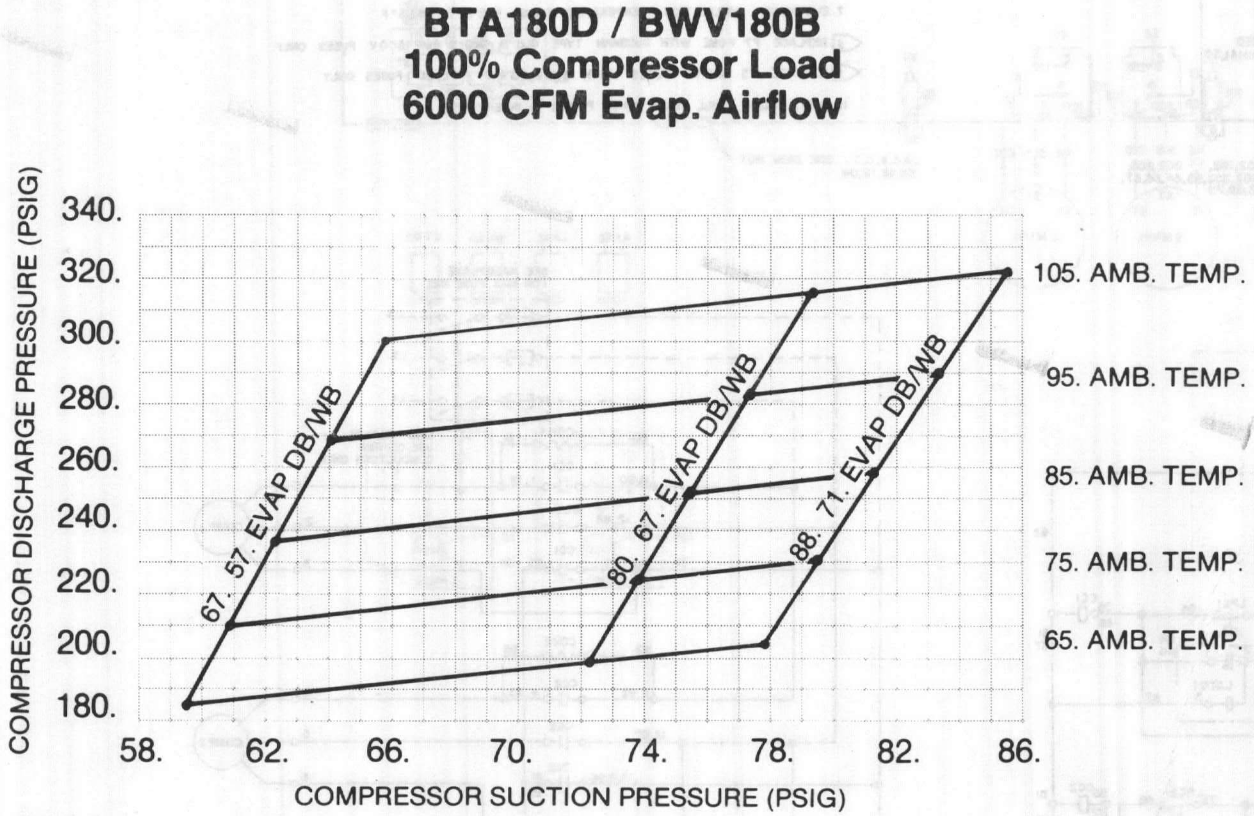


Figure A

PRODUCT SPECIFICATIONS BTA180D

Outdoor Unit Indoor Unit	Rated w/208-230
Ratings Cooling MBH Indoor Airflow (CFM) Power Input (KW) EER Noise Rating No.	 190.0 6000 23.5 8.2 8.8
Power Conns. - V/Ph/Hz Min. Brch. Cir. Ampacity Br. Cir - Max. (Amps) Recommended Dual Element (Amps)	208-230/3/60 73 100 80
Compressor No. Used - No. Speeds Volts/Ph/Hz R.L. Amps. - L.R. Amps	Model H/ CRHH-075J-AE 2/1 208-230/3/60 27.1/76
Outdoor Fan - Type No. Used/Dia. (In.) Type Drive/No. Speeds CFM @ O.O. in W.G. No. Motors - H.P. Motor Speed Rpm Volts/Ph/Hz F.L. Amps	Propeller 3/20 Direct/1 12131 3/.5 1625 208-230/1/60 4.1
Outdoor Coil - Type Rows/F.P.I. Face Area (Sq Ft) Tube Size	Plate Fin 3/13 26.0 3/8″
Refr. Line Size Suction Liquid	1.125 3/8″
Outdoor Unit Dimen. Crated	43 x 43 x 112
Shipping Weight (Lbs)	1020
Net Weight (Lbs)	840

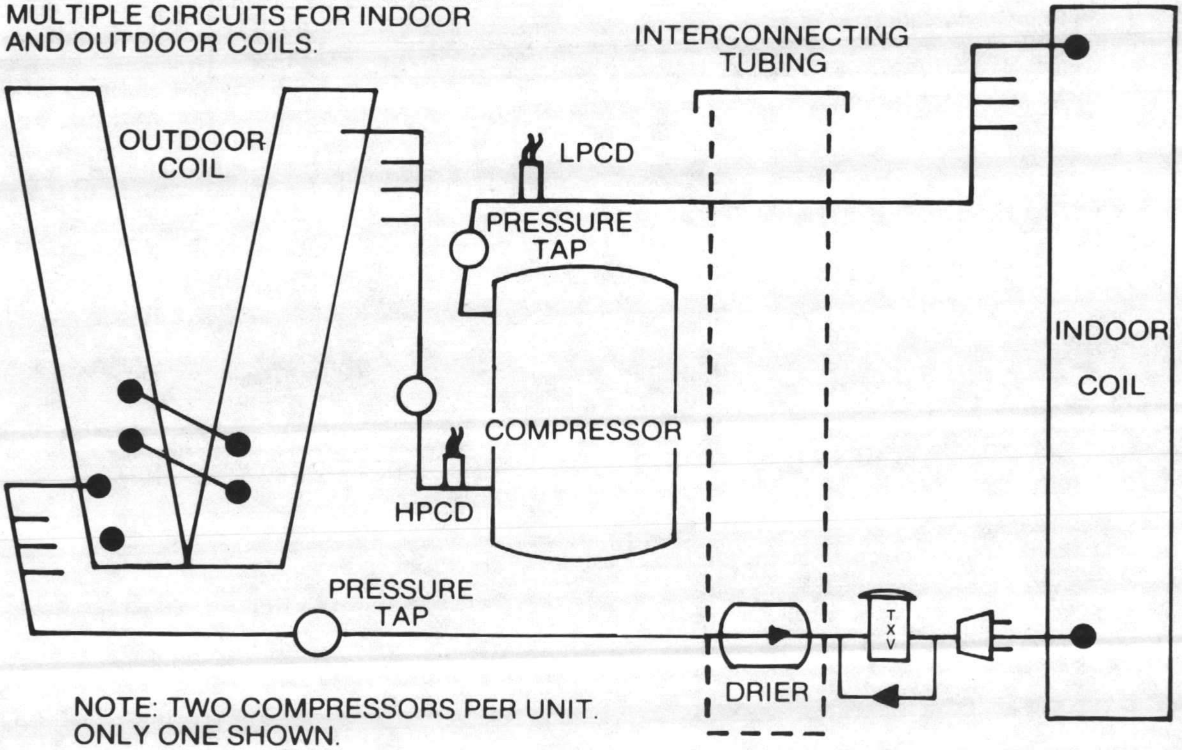
TROUBLESHOOTING CHART — WHAT TO CHECK

SYSTEM FAULTS	POWER SUPPLY	HIGH VOLTAGE WIRING	COMPR. IOL	RUN CAPACITOR	START CAPACITOR	START RELAY	CONTACTOR CONTACTS	LOW VOLTAGE WIRING	CONTROL TRANSFORMER	CONTACTOR COIL	LOW VOLTAGE FUSE	STUCK COMPRESSOR	INEFFICIENT COMPRESSOR	REFRIGERANT UNDERCHARGE	REFRIGERANT OVERCHARGE	EXCESSIVE EVAP. LOAD	NONCONDENSABLES	RESTRICTED O.D. AIRFLOW	O.D. AIR RECIRCULATION	TXV STUCK OPEN	SUPERHEAT	RESTRICTED I.D. AIRFLOW	REF. CIRCUIT RESTRICTIONS
REFRIGERANT CIRCUIT																							
Liquid Pressure Too High															P		S	P	S				S
Liquid Pressure Too Low													S	P						S	S		S
Suction Pressure Too High													S		P	P				S	P		
Suction Pressure Too Low														S							S	P	S
Liquid Refrig. Floodback TXV System																				S	S		
Liquid Refrig. Floodback Cápillary Tube System															P			S	S		S	P	
I.D. Coil Frosting														P								P	S
Compressor Runs Inadequate or No Cooling													S	P		P	S				S	P	S
ELECTRICAL																							
Compressor & O.D. Fan Do Not Start	P	P						S	P	P	P												
Compressor Will Not Start But O.D. Fan Runs		P	S	P	P	P						S											
O.D. Fan Won't Start		P		P																			
Compressor Hums But Won't Start		P		P	P	P	S					S											
Compressor Cycles on IOL		P	S	P	P	P	S					P	S	P	S	S		S			S		S
I.D. Blower Won't Start	P	S						S	P		P												

P Primary Causes **S** Secondary Causes

REFRIGERANT CIRCUIT — BTA180D300A

NOTE: ONLY ONE CIRCUIT SHOWN. MULTIPLE CIRCUITS FOR INDOOR AND OUTDOOR COILS.



NOTE: ONLY ONE CIRCUIT SHOWN.

TAB PLACEMENT HERE

DESCRIPTION:

Central cooling

Package System

☐ Tab page did not contain hand written information

☑ Tab page contained hand written information
*Scanned as next image

Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

TRANE™

BTC-IN-3A

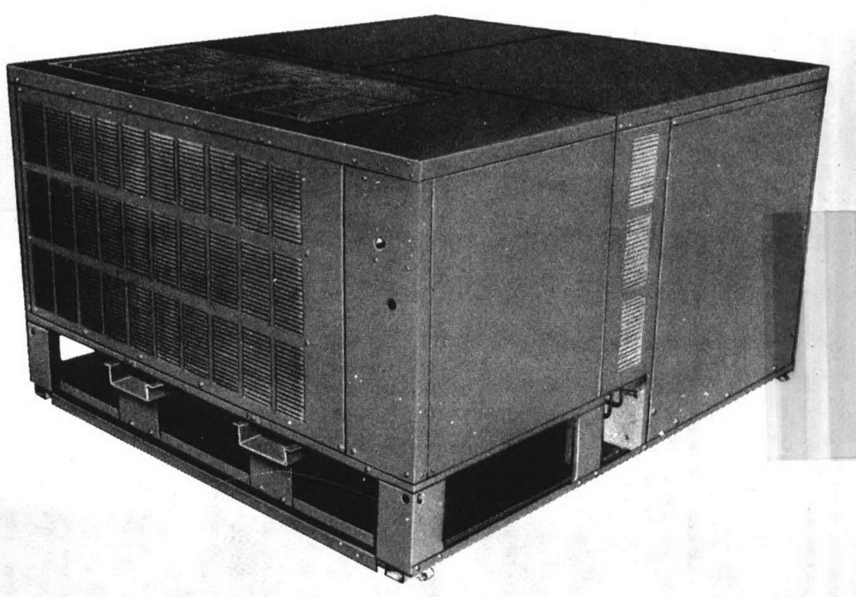
BLDG # AS-502

INSTALLER'S GUIDE

Cooling Unit Packed System-Downflow 7-1/2 - 10 Ton

Library	Service Literature
Product Section	Unitary
Product	Rooftop Air Conditioning
Model	BTC
Literature Type	Installer's Guide
Sequence	3A
Date	March 1986
File No.	SV-UN-RT-BTC-IN-3A 3/86
Supersedes	BTC-IN-3 7/85

Models:
BTC090, 120F-G
BTC090, 120F-H



Since The Trane Company has a policy of continuous product improvement, it reserves the right to change specifications and design without notice. The installation and servicing of the equipment referred to in this booklet should be done by qualified, experienced technicians.

18-AB60D4
Dwg. No. A723591 P01
2nd Printing 1986

Literature change history
BTC-IN-3A (March 1986)
Revised manuals for models carrying CSA certification

ALL phases of this installation must comply with NATIONAL, STATE & LOCAL CODES.

This booklet of instructions covers the BTC090 & 120F Single Package Cooling Units. The format of this booklet is designed to give the installer an easy reference to all phases of an installation. Whether the installation is done by one installer, or combination of tradesmen, the order of the instruction should be followed.

These instructions do not purport to cover all possible contingencies to be met in connection with installation. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to The Trane Company.

NOTE: Do not destroy or mutilate this booklet on completion of your phase of installation. Leave booklet at unit (weather protected) for remaining installation.

A. INSPECTION

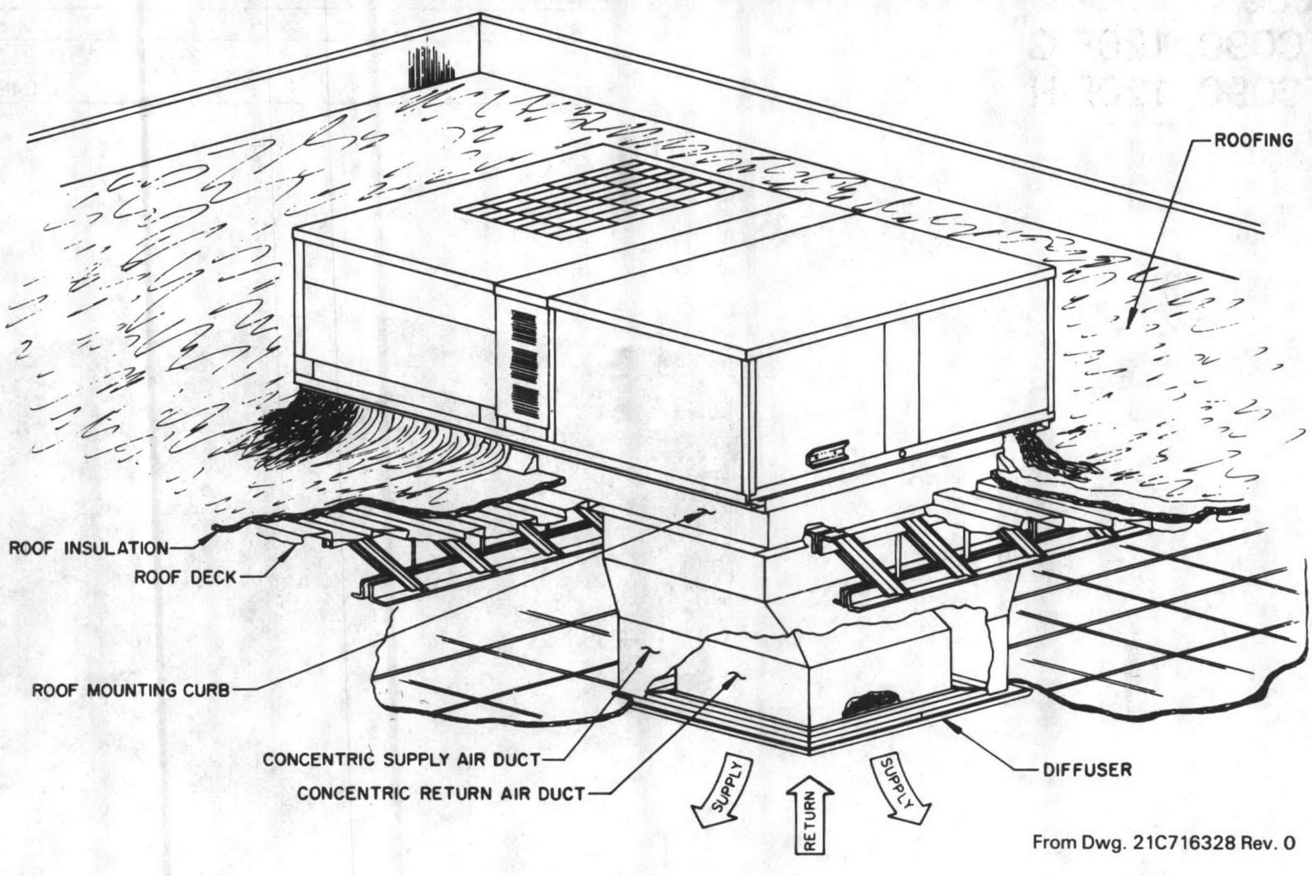
1. Check for damage after unit is unloaded. Report promptly, to the carrier, any damage found to unit. Do not drop unit.

CAUTION: A set of "spreader bars" is required when hoisting the unit (prevents damage to sides and top). A 4″ standard width steel channel is recommended.

2. Check unit nameplate to determine if unit is correct for application intended. Power supply must be adequate for the unit and all accessories such as heaters and damper motor, if installed.

3. Check to be sure the refrigerant charge has been retained during shipment. Access to 1/4″ flare pressure taps may be gained by removing compressor compartment access panel.

B. LOCATIONS AND RECOMMENDATIONS



TYPICAL ROOFTOP INSTALLATION

The Roof Mounting Curb is (factory assembled BAYCURB015) (field assembled BAYCURB014), or a field fabricated curb must be assembled and in place before unit is hoisted to the roof.

Roof Mounting Curb (frame) must be installed on a flat, level section of the roof (max. of 1/4″ per foot pitch), providing a level mounting surface for the unit. In addition, provide sufficient height above the roof to prevent water from entering unit.

1. Be sure the mounting curb spans structural members (trusses) of the roof, thereby providing sufficient support for weight of the unit, curb and duct(s) plus any accessories (factory or field installed). See illustrations on pages 2 and 3.

NOTE: If any internal accessories are to be added to the unit, it should be done at the shop if at all practical.

2. The space above the outdoor air discharge section of unit should be unrestricted, see outline drawing for clearance.

B. LOCATIONS AND RECOMMENDATIONS (Cont.)

3. There must be at least 36″ service clearance on sides of the unit and at least 42″ from outdoor coil side to walls or other restrictions to airflow.

a. Unit should be positioned so Roof-Run-Off water does not pour directly on unit.

4. For "Roof Top Application," unit must be elevated above roof with a mounting Curb or Frame.

5. Exhaust vents or other sources of contaminated air should not be near unit air inlet, if outside air is to be introduced as make-up air or the economizer ventilation feature is to be used.

6. Check the handling facilities to insure the safety of personnel and the unit(s).

7. **CAUTION MUST BE TAKEN AT ALL TIMES TO AVOID PERSONAL INJURIES AND/OR DAMAGE TO EQUIPMENT.**

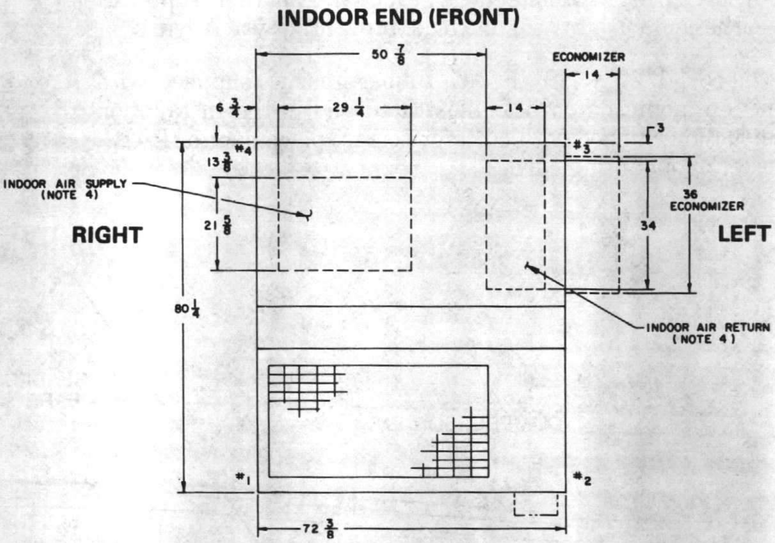
BTC090, 120F OUTLINE DRAWING

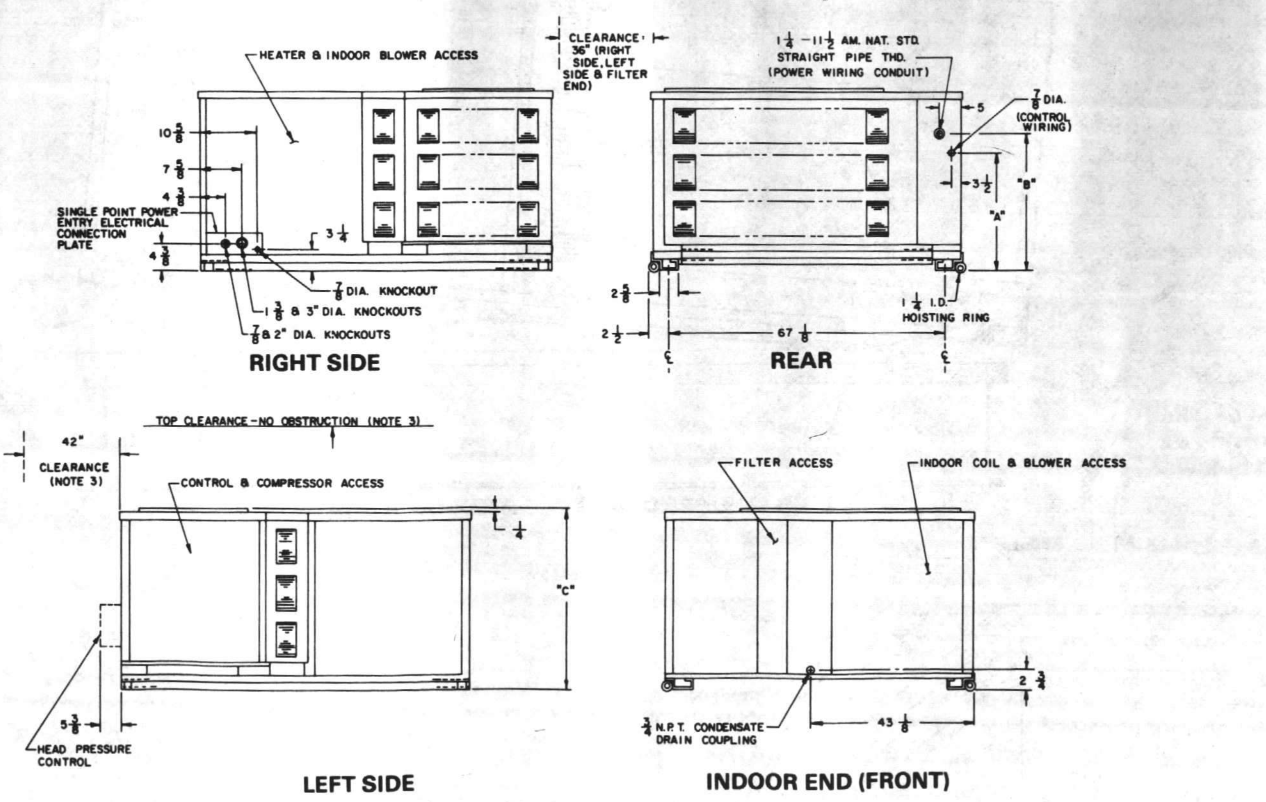
(All dimensions are in inches)

MODEL NO.	APPROX. CORNER WEIGHT — LB #1	#2	#3	#4	"A"	"B"	"C"
BTC090F	265	318	265	212	29-1/2	34-1/2	43-5/8
BTC120F	280	336	280	225	32	37	46-1/8

NOTES:

1. SEE CURB BAYCURB015 FOR DUCT FLANGE DIMENSION OR BAYDUCT001 CONCENTRIC SUPPLY & RETURN DUCT FOR DIMENSIONS.
2. IF TRANE CURB IS NOT USED, SEE INSTALLER'S GUIDE FOR DUCT STARTER DIMENSIONS.
3. COMBUSTIBLE CONSTRUCTION, SERVICE AND OPERATING CLEARANCES 36" TO COMPRESSOR. FILTER AND HEATER CONTROL SIDES, 42" TO CONDENSOR INLET SIDE. TOP CLEARANCE - NO OBSTRUCTION.
4. INDOOR AIR SUPPLY AND RETURN OPENINGS ARE NOT THE DUCT SIZES. SEE CURB OUTLINE FOR DUCT SIZES.





From Dwg. 21D723909 Rev. 0

C. UNIT MOUNTING

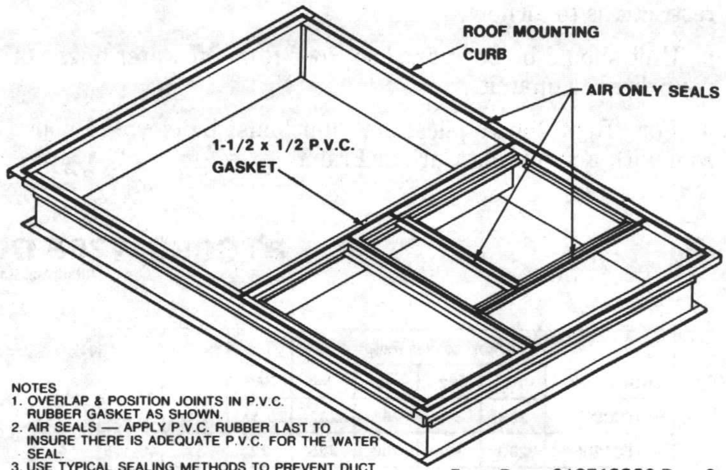
IMPORTANT: The insulated deck for use with Roof Mounting Curb BAYCURB015 or BAYCURB014 is secured, at the factory, to the bottom of the unit, under the outdoor coil section and requires NO field assembly. See Installation Instruction shipped with Curb for proper installation of roof-top accessories.

1. When the Curb and air ducts have been properly installed, the unit is ready to be hoisted to the roof and set into position. **(CAUTION: "Spreader Bars" must be used when hoisting unit.)**

2. Apply a bead of architectural grade caulking (field supplied) at corners of curb to seal all voids, preventing water leaks.

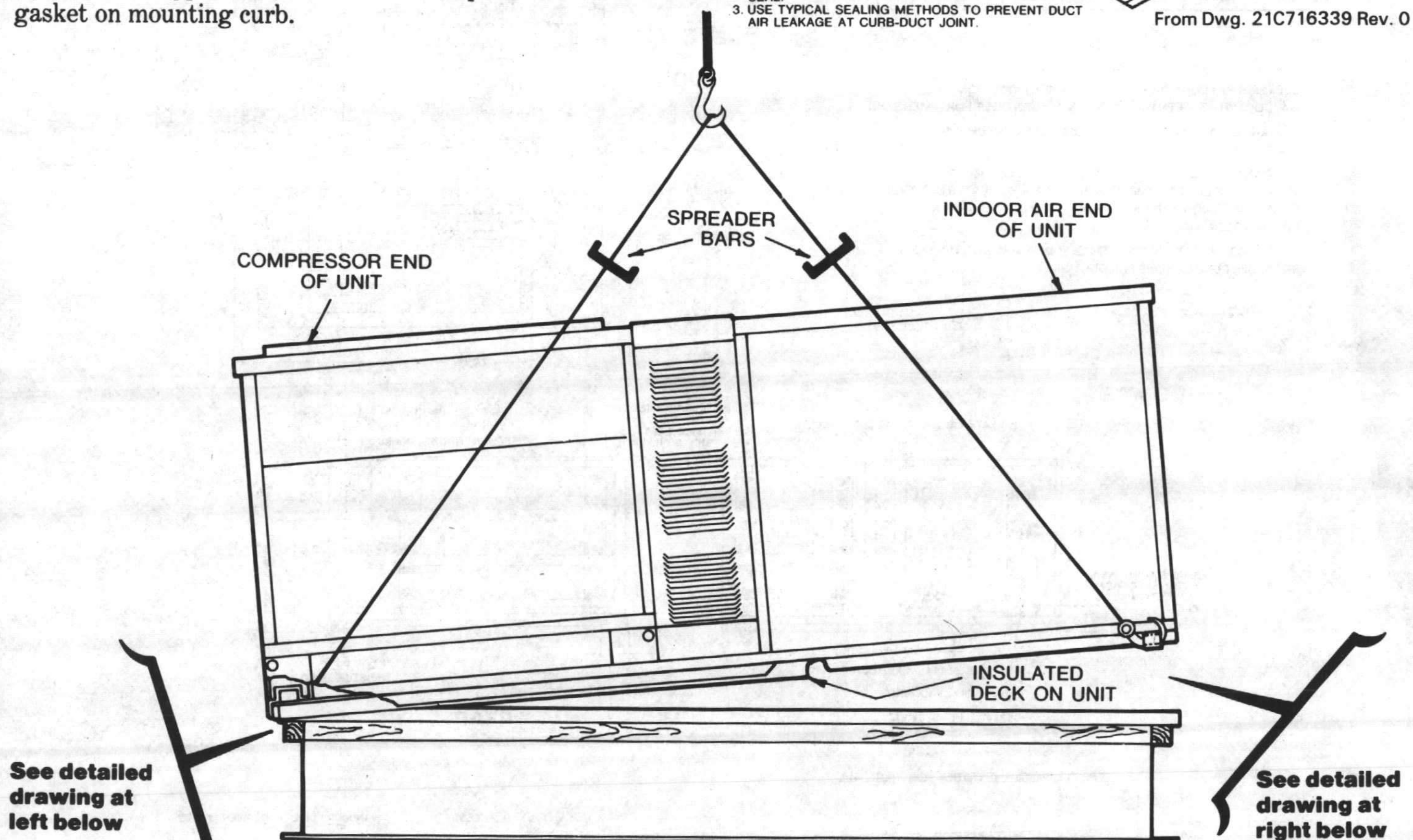
3. Place 1-1/2" x 1/2" P.V.C. rubber gasket (supplied with unit) on mounting curb as illustrated and in the Installation Instruction shipped with curb for correct placement of P.V.C. gasket on mounting curb.

P.V.C. RUBBER GASKET
POSITION FOR UNIT PLACEMENT

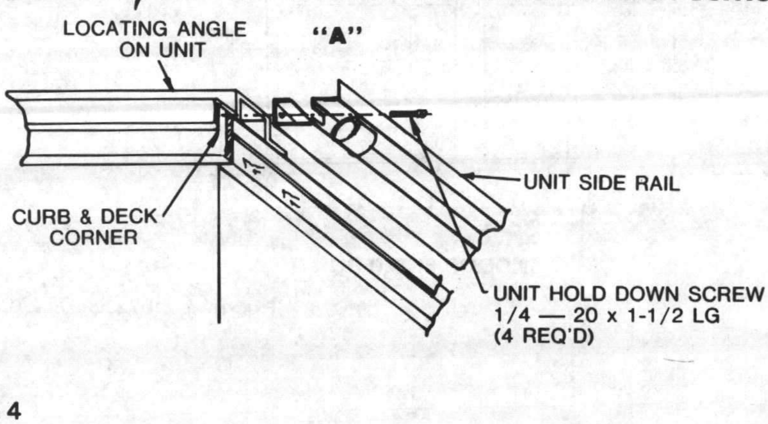


NOTES
1. OVERLAP & POSITION JOINTS IN P.V.C. RUBBER GASKET AS SHOWN.
2. AIR SEALS — APPLY P.V.C. RUBBER LAST TO INSURE THERE IS ADEQUATE P.V.C. FOR THE WATER SEAL.
3. USE TYPICAL SEALING METHODS TO PREVENT DUCT AIR LEAKAGE AT CURB-DUCT JOINT.

From Dwg. 21C716339 Rev. 0



UNIT BEING LOWERED INTO POSITION ON MOUNTING CURB



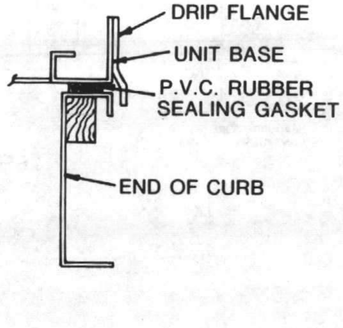


FIGURE 2

C. UNIT MOUNTING (Cont.)

IMPORTANT: The unit must be **lowered** into position. The P.V.C. rubber gasket on the curb flange permits the unit to be repositioned if required, without destroying the P.V.C. rubber gasket affixed to mounting curb.

4. PLACING UNIT ON MOUNTING CURB — There is a locating angle (bracket) on the bottom of the unit, located across the compressor end. This locating angle (bracket) is formed to fit the mounting curb at the compressor end. See illustration "A" on page 4.

With the unit side rails astraddle mounting curb, and locating angle (bracket) in contact with the end of the curb, and by maintaining contact at this point as unit is lowered, the unit will align itself on the curb.

5. The unit side rails at the indoor air end of the unit will be straddling the roof mounting curb an equal amount on each side of the curb.

6. Insert the four(4) 1/4-20 x 1-1/2″ long hold-down screws shipped with curb. See illustration "A" on page 4.

IMPORTANT: Remove and discard the two (2) Baffles from rear of unit, at the fork lift channel area.

7. After unit has been set in place and secured, proceed to Electrical Connections section of instructions.

D. ELECTRICAL CONNECTIONS

1. To determine the electrical power requirements of the unit, refer to the nameplate of the unit. The electrical power available must agree with that listed on the nameplate.

2. Provide an approved weatherproof disconnect either on side of unit or within close proximity.

3. The power supply lines must be run in weather-tight conduit to the disconnect, and into unit control box or Single Power Entry box. Provide strain relief for all conduit with suitable connectors.

4. Provide flexible conduit supports whenever vibration transmission may cause a noise problem within the building structure.

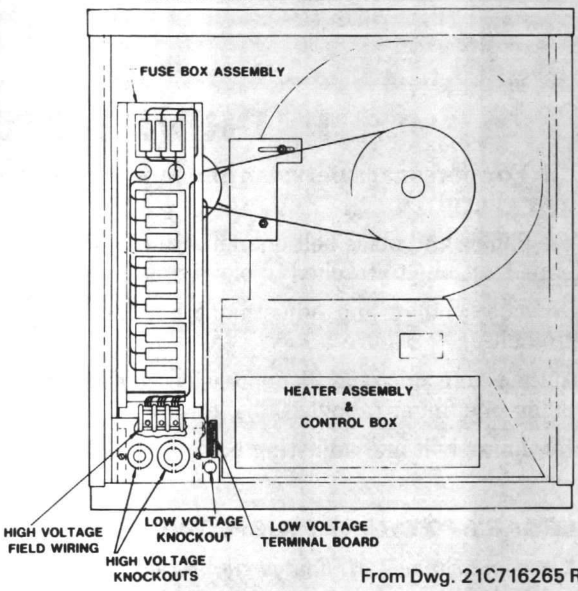
5. Be sure all connections are made tight and no naked wires are exposed.

6. Ground the unit internally as provided, see wiring diagram for location.

7. All electrical accessories must be installed and wired according to the instructions packaged with that accessory.

8. Factory option on (BTC090, 120F) downflow models with factory installed heaters (special order) "single circuit power entry." See illustration.

SINGLE BRANCH CIRCUIT POWER ENTRY ON UNITS WITH FACTORY INSTALLED ELECTRIC HEATERS



From Dwg. 21C716265 Rev. 0

The above electrical installation instructions items 1 thru 6 should be followed when making electrical connection to power entry box terminal block on units with Single Branch Circuit Power Entry.

9. Use color coded, low voltage, multi-wire cable to simplify circuiting between unit and room thermostat.

10. Refer to the Field Wiring Diagrams on pages 9 and 10 for electrically connecting unit and room thermostat together.

11. After all electrical wiring is complete, SET THE THERMOSTAT SYSTEM SWITCH IN THE OFF POSITION SO COMPRESSOR WILL NOT RUN, and apply power by closing the system main disconnect switch. This will activate the compressor sump heat. Do not change the Thermostat System Switch until power has been applied long enough to evaporate any liquid R-22 in the compressor oil (30 minutes for each pound of R-22 in the system as shown on the nameplate). Following this procedure will prevent compressor damage at the initial start-up.

Record the "POWER APPLIED DATA" on the designated lines below.

Time __________ AM Date ______________
PM

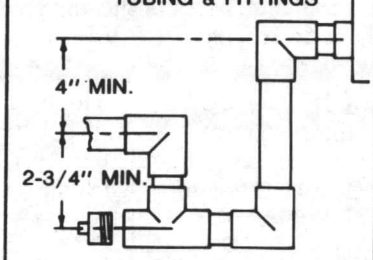
By ______________________________
(Electrician)

E. CONDENSATE DRAIN PIPING

Do not use reducing fittings in the drain lines. The condensate drain line must be:

1. Made of 3/4″ pipe size.
2. Pitched -1/4″ per foot to provide free drainage to convenient drain system.
3. Trapped — a pipe tee and clean out plug should be installed.
4. Must not be connected to closed drain system.

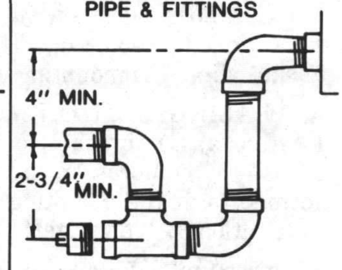
3/4″ PVC OR COPPER TUBING & FITTINGS



MATERIALS

1	TEE
3	90° ELL
1	PLUG
1	6″ NIPPLE
2	2″ NIPPLE
1	3/4″ NPT TO PVC OR COPPER ADAPTOR

3/4″ GALVANIZED PIPE & FITTINGS



MATERIALS

1	TEE
1	PLUG
3	STREET ELL
1	5-1/2″ NIPPLE

F. DRIVE BELT ADJUSTMENT

DANGER: For personal safety, fan and motor must not be rotating or energized.

1. Remove panels and place belt on motor and blower pulleys, (Unit shipped with belt attached to blower pulley only.)
2. Loosen motor hinge and adjustment bolt and lift motor pulley into belt. (See Figure 3.)
3. Adjust belt tension to a 1″ depression midway between pulleys using one finger (about 10 lbs. force).
4. Tighten hinge bolt and adjusting bolt.

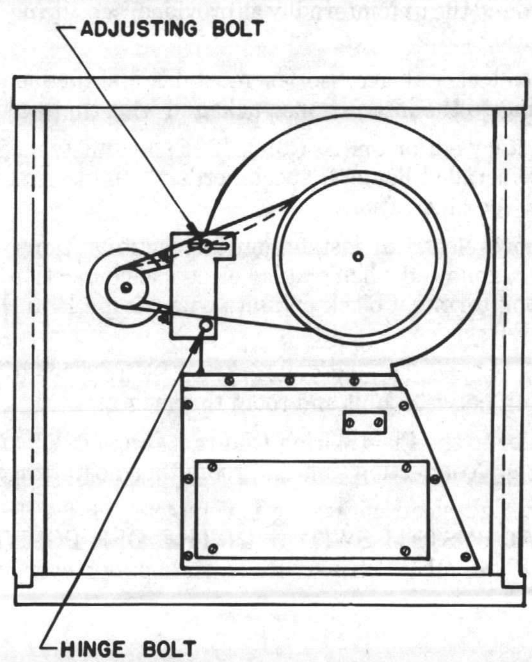
IF NECESSARY TO CHANGE AIRFLOW:

NOTE: Caution, consult airflow performance data in Data/ Submittal to prevent overloading indoor blower motor.

1. Remove belt.
2. Loosen set screw that secures adjustable section of pulley.
3. Turn adjustable section of pulley until it meets stationary section.
4. Turn adjustable section of pulley in a reverse direction until set screw is in line with nearest flat. This position is zero (0) turns open.
5. Adjust pulley section to the required turns open to provide required airflow. Tighten set screw to secure adjustable section.
6. Reinstall belt.
7. Check that fan and motor pulleys are properly aligned and check belt tension.

AIRFLOW TABLE

Unit Model No.	BTC090F	BTC120F
Min. Airflow CFM (Electric Heat)	3000	4000
Max. Airflow CFM (Cooling)	3375	4500



INDOOR BLOWER AND DRIVE MOTOR

FIGURE 3

G. FILTER INSTALLATION

Shipped with each unit are four (4) 1″ thick filters, located in the Filter Racks. Access to the filters is made by removing the filter access panel (see Figure 1) and sliding filter from rack.

NOTE: Units equipped with economizer damper section or 0-100% Fresh Air Damper section must be equipped with permanent cleanable filters.

1. ACCESS — Place the System Switch of the Room Thermostat or Disconnect Switch in the "OFF" position and remove the filter section access panel.

2. Check that filters are clean.

NOTE: Do not operate unit without these filters in place.

H. AIR DUCTS

All conditioned air duct work must be insulated to minimize heating and cooling duct losses. Use a minimum of 2″ of insulation with a vapor barrier. The outside duct work must be weatherproofed between the unit and the building and should be insulated with a minimum of 2″ of insulating material.

I. CHECKOUT AND OPERATIONAL PROCEDURE

Final phases of this installation are the unit Operational and Checkout Procedures which are found on pages 11 and 12 of this instruction.

ECONOMIZER CONTROL CHECK-OUT

1. Set minimum position potentiometer (if used) to allow outdoor air damper to go to FULLY closed position. Potentiometer located on top of damper drive motor. (OPEN ▲ & ▼ CLOSE).

2. The following check-out steps for the economizer can be performed only if the outdoor air conditions are to the left of shaded area on psychrometric chart. See Chart.

3. Set indoor thermostat to satisfied position and apply power to unit.

4. Set minimum position potentiometer (MPP) to full open position. Outdoor air damper should open approximately half way.

5. Set MPP to close position. Outdoor air damper should close.

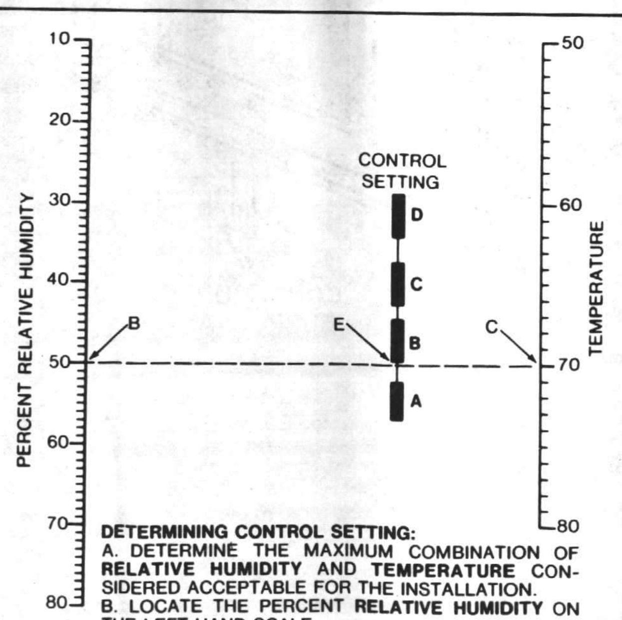
6. Set indoor thermostat to call for cooling.

CAUTION: Compressor will start. Avoid rapid cycling of compressor during check-out of economizer dampers.

7. Set mixed air control to 10° below outdoor temperature (factory set at 55°F.) and turn the enthalpy control knob to the "A" setting (full clockwise). If the outdoor temperature is less than 75°, the compressor will stop and outdoor damper will move to full open. If outdoor temperature is too high for enthalpy control to switch, the wires to terminals 1 and 3 on the control can be switched to verify proper operation. See illustration on page 8 for location of enthalpy control knob.

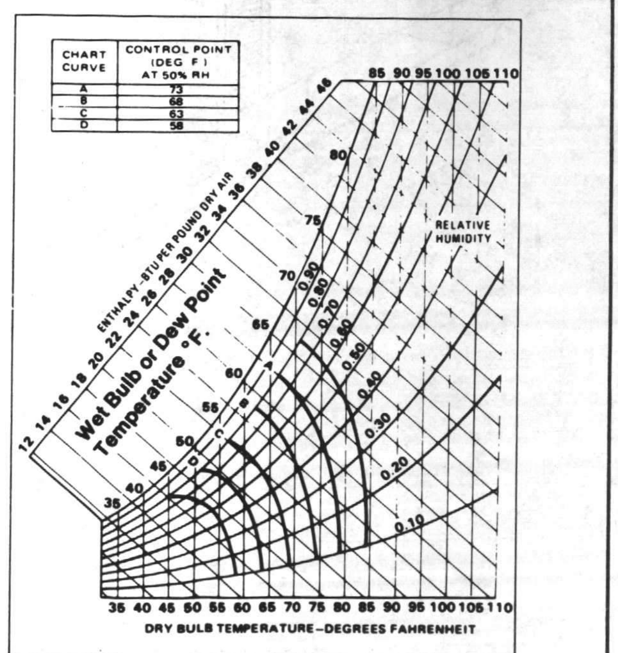
8. Set indoor thermostat to satisfied position, stopping indoor blower. Fresh air damper will close and return air damper will open.

ENTHALPY CONTROL SELECTION CHART



DETERMINING CONTROL SETTING:
A. DETERMINE THE MAXIMUM COMBINATION OF **RELATIVE HUMIDITY** AND **TEMPERATURE** CONSIDERED ACCEPTABLE FOR THE INSTALLATION.
B. LOCATE THE PERCENT **RELATIVE HUMIDITY** ON THE LEFT HAND SCALE.
C. LOCATE THE AIR **TEMPERATURE** (DRY BULB) ON RIGHT HAND SCALE.
D. DRAW A STRAIGHT LINE BETWEEN THESE TWO POINTS.
E. ADJUST THE ENTHALPY CONTROL TO THE SETTING INDICATED ON THE **CONTROL SETTING** SCALE.

ECONOMIZER CONTROL SELECTION & PSYCHROMETRIC CHART



Below set point — Economizer will function.

Above set point — Compressor will operate.

ECONOMIZER CONTROL CHECK-OUT (Cont.)

9. Set indoor thermostat to call for cooling. Allow time for fresh air damper to open completely. Turn enthalpy control knob counter-clockwise past "D" position. Fresh air damper will close completely.

10. Determine the supply air temperature required for your application and set the "mixed air control" to that temperature. Normally it will be 55°F. to 65°F. (factory set at 55°F.). Set the enthalpy control per illustration below. If maximum combination of relative humidity and temperature is not known, set enthalpy control to the "B" setting.

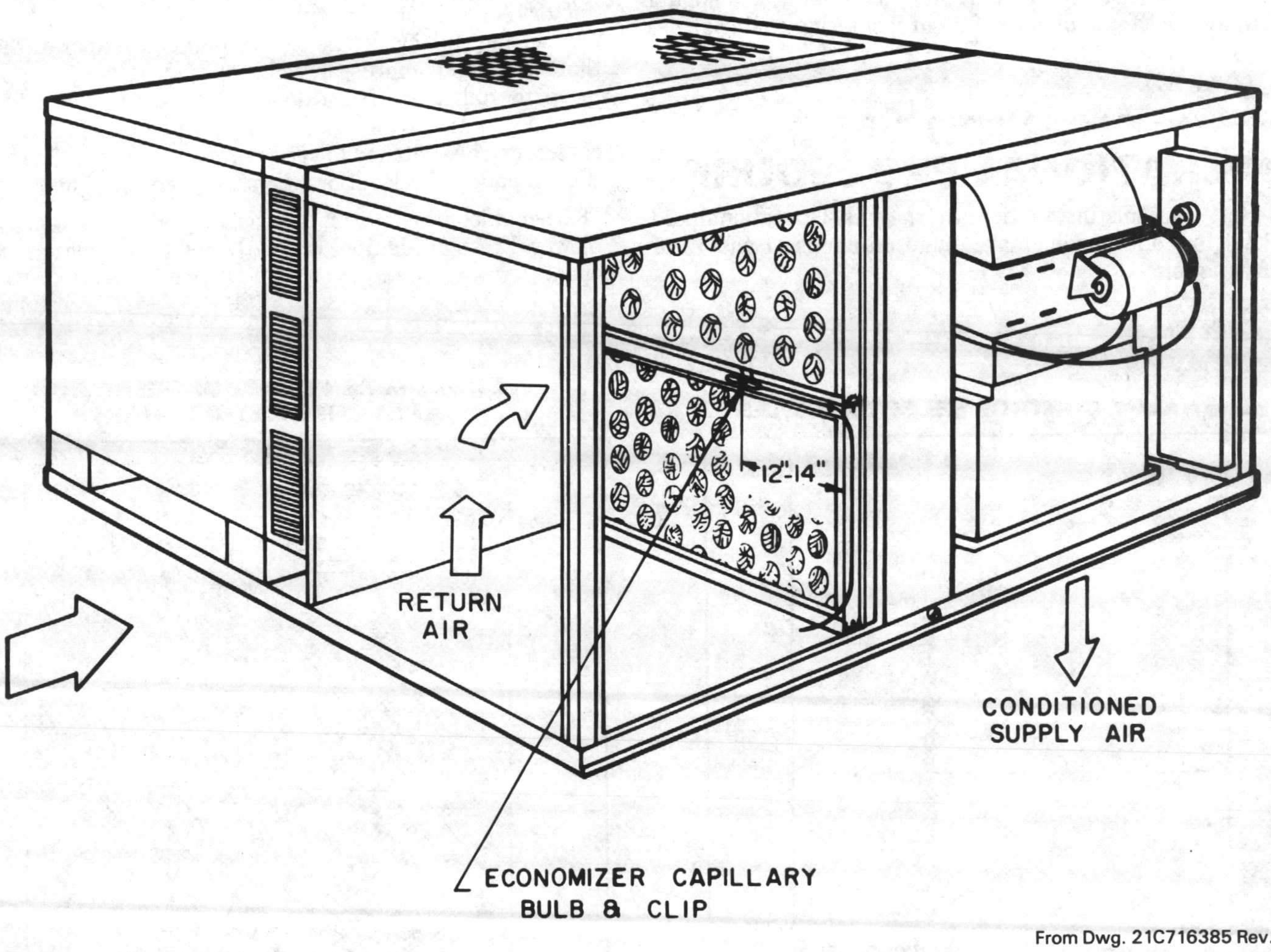
11. Without a call for cooling, ADJUST the minimum position potentiometer, if used, to provide the minimum fresh air desired (fresh air ventilation).

ECONOMIZER/DAMPER SYSTEM

The economizer accessory is factory assembled and is composed of the following items: 0-100% fresh air damper, damper drive motor, pre-set damper linkage, enthalpy control, high and low voltage polarized plug for electrical connections. The barometric relief damper is a separate accessory.

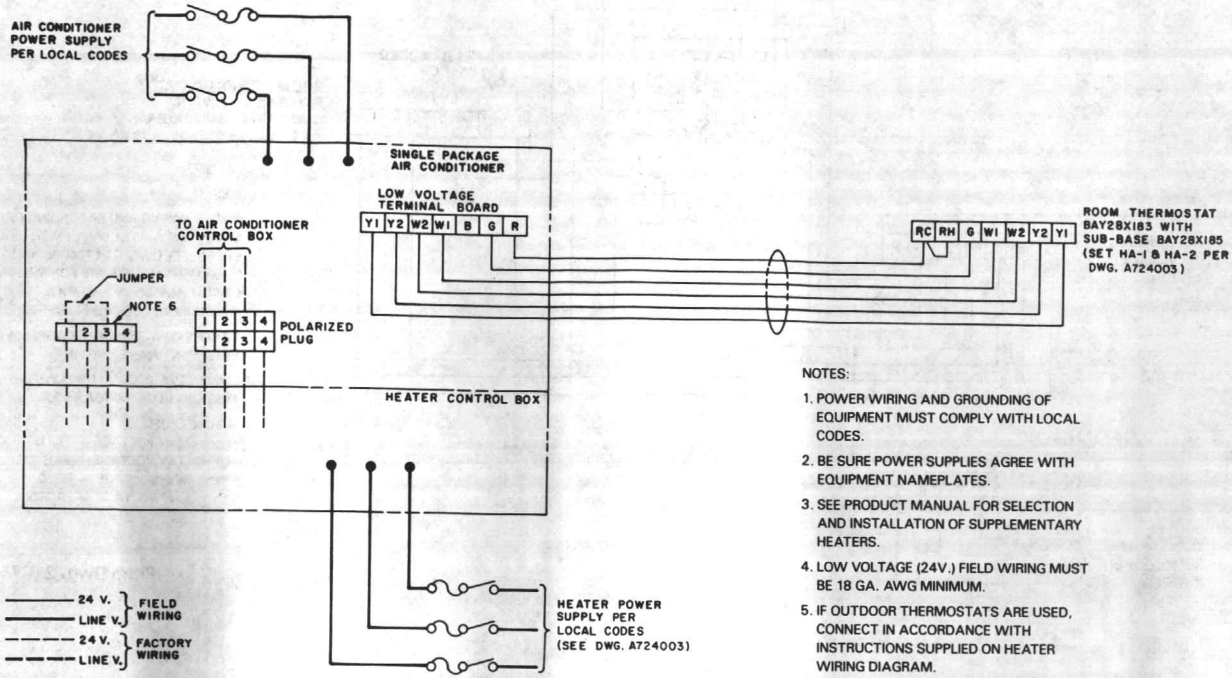
The system is completely automatic. When outdoor air temperature is low enough, the economizer can be utilized for free cooling by its switching off the compressor and bringing in outdoor air on a call for cooling from the room thermostat.

The enthalpy control is a humidity biased, outdoor dry bulb temperature device to provide good comfort control to conditioned space. The damper motor operates on 200/230/460 volt power source. The polarized plug will match the voltage of the unit to the correct voltage tap in the damper motor. See illustration below which depicts airflow during the free cooling cycle.



From Dwg. 21C716385 Rev. 1

FIELD WIRING DIAGRAM FOR BTC090,120F WITH SUPPLEMENTARY HEATERS AND MANUAL THERMOSTAT

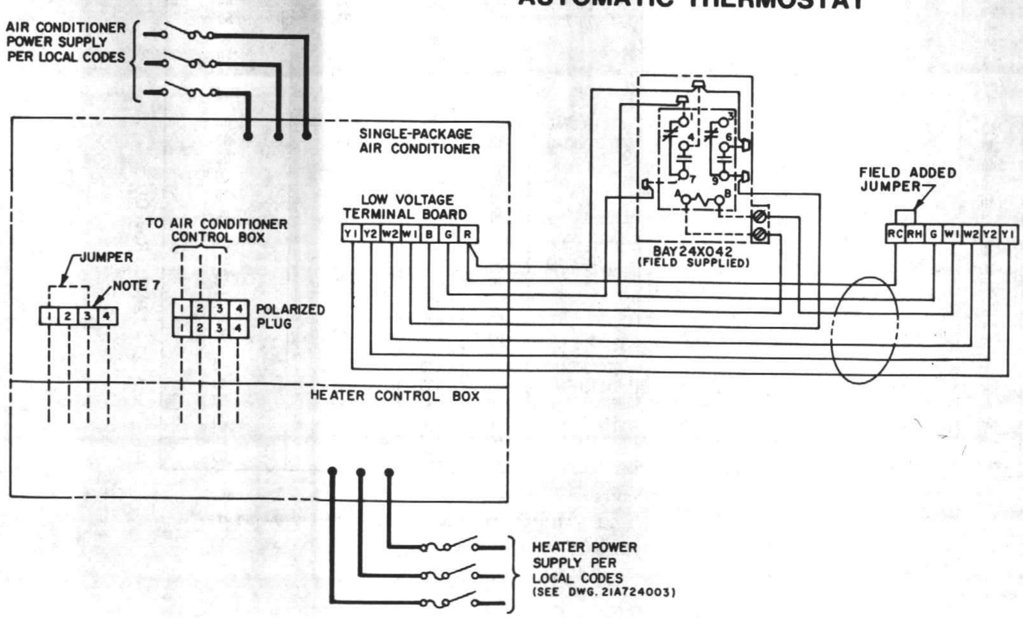


NOTES:

1. POWER WIRING AND GROUNDING OF EQUIPMENT MUST COMPLY WITH LOCAL CODES.
2. BE SURE POWER SUPPLIES AGREE WITH EQUIPMENT NAMEPLATES.
3. SEE PRODUCT MANUAL FOR SELECTION AND INSTALLATION OF SUPPLEMENTARY HEATERS.
4. LOW VOLTAGE (24V.) FIELD WIRING MUST BE 18 GA. AWG MINIMUM.
5. IF OUTDOOR THERMOSTATS ARE USED, CONNECT IN ACCORDANCE WITH INSTRUCTIONS SUPPLIED ON HEATER WIRING DIAGRAM.
6. THIS POLARIZED PLUG HAVING BROWN AND WHITE LEADS IS ONLY ON HEATERS HAVING SUFFIX "A" AFTER MODEL NO. LEAVE JUMPER BETWEEN TERMINALS 1 & 3 FOR THIS APPLICATION.

From Dwg. 21C756592 Rev. 0

FIELD WIRING DIAGRAM FOR BTC090,120F WITH SUPPLEMENTARY HEATERS AND AUTOMATIC THERMOSTAT



NOTES:

1. POWER WIRING AND GROUNDING OF EQUIPMENT MUST COMPLY WITH LOCAL CODES.
2. BE SURE POWER SUPPLIES AGREE WITH EQUIPMENT NAMEPLATES.
3. SEE PRODUCT MANUAL FOR SELECTION AND INSTALLATION OF SUPPLEMENTARY HEATERS.
4. LOW VOLTAGE (24V) FIELD WIRING MUST BE 18GA. AWG MINIMUM.
5. WIRING LEGEND:
   - LOW VOLTAGE - FIELD
   - LOW VOLTAGE - FACTORY
   - LINE VOLTAGE - FIELD
   - LINE VOLTAGE - FACTORY
6. IF OUTDOOR THERMOSTATS ARE USED, CONNECT IN ACCORDANCE WITH INSTRUCTIONS SUPPLIED ON HEATER WIRING DIAGRAM.
7. THIS POLARIZED PLUG HAVING BROWN AND WHITE LEADS IS ONLY ON HEATERS HAVING SUFFIX "A" OR "B" AFTER MODEL NO. LEAVE JUMPER BETWEEN TERMINALS 1 AND 3 FOR THIS APPLICATION.

HEATER KW	THERMOSTAT①		HEATER AMPS/LINE②	
	HA-1	HA-2	280/240V	480V
10	.36	—	20.8/24	12
20	.36	—	41.6/48	24
30	.36	.36	62.4/72	36
40	.36	.36	83.2/96	48
50	.12	.12	104/120	60
60	.12	.12	125/144	72

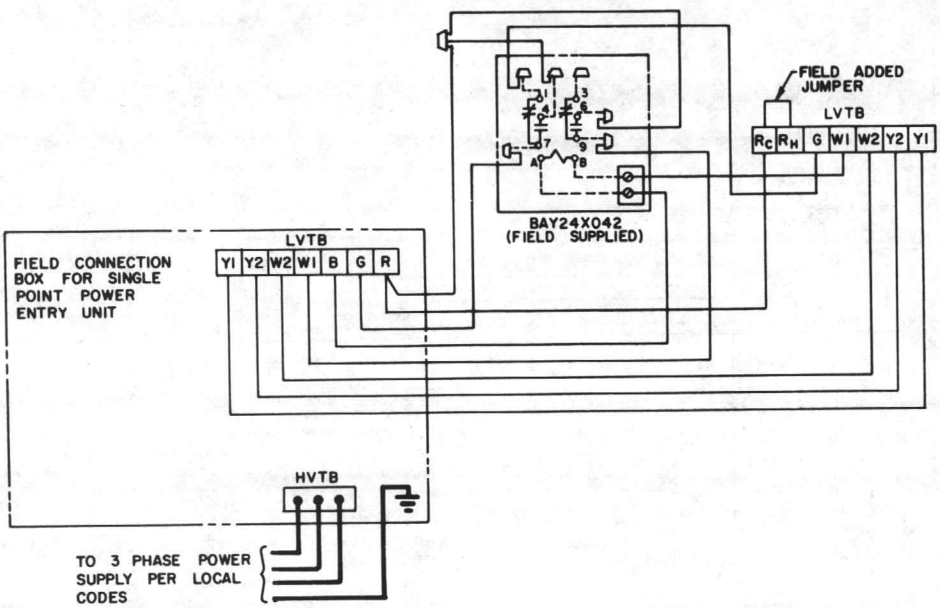
NOTES:

1. SEE HEATER WIRING DIAGRAM ON HEATER.
2. SEE HEATER INSTALLED NAMEPLATE ON UNIT.
3. HA SETTINGS NOT REQUIRED WITH HEAT PUMPS.

From Dwg. 21A724003 Rev. 0

From Dwg. 21C756626 Rev. 0

FIELD WIRING DIAGRAM FOR BTC090,120F WITH SINGLE BRANCH CIRCUIT POWER ENTRY AND FACTORY INSTALLED ELECTRIC HEATERS



NOTES:

1. POWER WIRING AND GROUNDING OF EQUIPMENT MUST COMPLY WITH LOCAL CODES. SEE DWG. 21A724005 AND EQUIPMENT NAMEPLATE FOR MIN. CIRCUIT AMPACITY AND MAX. OVERCURRENT DEVICE VALUES.
2. BE SURE POWER SUPPLIES AGREE WITH EQUIPMENT NAMEPLATES.
3. LOW VOLTAGE (24V.) FIELD WIRING MUST BE 18 GA. MINIMUM.
4. WIRING LEGEND:
   - LOW VOLTAGE — FIELD
   - LOW VOLTAGE — FACTORY
   - LINE VOLTAGE — FIELD
   - LINE VOLTAGE — FACTORY

From Dwg. 21C756638 Rev. 0

UNIT MODEL	① HEATERS KW	① HEATERS VOLTS	① MIN. CIR. AMPACITY	① MAX. (RECM.) FUSE SIZE
BTC090C300 BTC090F300	10	240	45	60
	20	240	64	70
	30	240	94	100
	40	240	124	125
	50	240	154	175
	60	240	184	200
BTC090C3A0 BTC090F3A0	10	240	46	60
	20	240	67	70
	30	240	97	100
	40	240	127	150
	50	240	157	175
	60	240	187	200
BTC090C400 BTC090F400	10	480	22	30
	20	480	32	35
	30	480	47	50
	40	480	62	70
	50	480	77	80
	60	480	92	100
BTC090C4A0 BTC090F4A0	10	480	23	30
	20	480	33	35
	30	480	48	50
	40	480	63	70
	50	480	78	80
	60	480	93	100

UNIT MODEL	① HEATERS KW	① HEATERS VOLTS	① MIN. CIR. AMPACITY	① MAX. (RECM.) FUSE SIZE
BTC120C300 BTC120F300	10	240	60	80
	20	240	66	80
	30	240	97	100
	40	240	127	150
	50	240	157	175
	60	240	187	200
BTC120C3A0 BTC120F3A0	10	240	60	80
	20	240	67	80
	30	240	99	100
	40	240	129	150
	50	240	159	175
	60	240	189	200
BTC120C400 BTC120F400	10	480	26	35
	20	480	33	40
	30	480	48	50
	40	480	63	70
	50	480	78	80
	60	480	93	100
BTC120C4A0 BTC120F4A0	10	480	30	40
	20	480	34	40
	30	480	49	50
	40	480	64	70
	50	480	79	80
	60	480	94	100

From Dwg. 21A724005 Rev. 0

NOTES:

1. SEE HEATER NAMEPLATE AND HEATER INSTALLED NAMEPLATE FOR KW/VOLTS.

CHECKOUT PROCEDURE WITH MAIN POWER DISCONNECTS CLOSED (ON)

Step No.	To Check	Indoor Thermostat Switch Setting					Component Operation						
		System Switch ①			Fan Switch		Indoor Blower Runs	Outdoor Fan Runs	Compressor "A" Runs	Compressor "B" Runs	Comp. Sump Heater	Electric Heaters (Warm Supply Air)	Economizer
		Off	Cool	Heat	Auto	On							
1	Sump Heat	X			X						X		
2	Indoor Fan Operation	X				X	X				X		
3	Cooling (1st Stage)		X		X		X	X	④		X		④
4	Cooling (2nd Stage)		X③		X		X	X	④	④	X		④
5	Check Performance & Charge		X		X		X	X	X	X	X		
		← USE CHARTS ATTACHED TO O.D. UNIT →											
6	Heating ②(1st Stage)			X	X		X				X	X	
7	Heating ⑤(2nd Stage)			X	X		X				X	X	
8	Inform owner on how to operate system and what to expect of it. Set thermostat to desired operating position before leaving.												

① Also Set thermostat dial to call for cooling or heating as necessary.

② Check, only, if an Accessory Electric Heater has been installed.

③ Turn Temperature Selector lever down until 2nd compressor starts.

④ If the unit is equipped with Economizer system either the compressor or the Economizer will operate. See page 10

⑤ Not applicable if 20 KW (or less) Accessory Electric Heater has been installed.

CHECKOUT PROCEDURE

After installation has been completed, it is recommended that the entire system be checked against the following list:

1. Check for secure anchoring if it is Roof Top or Ground Level application . . . . [ ]
2. Check all field wiring to make sure connections are: (1) secured tightly, (2) electrically insulated, (3) isolated from each other and other metal parts and (4) unit has been properly grounded . . . . [ ]
3. Check that all penetration holes in structure have been closed with flashing or equivalent in accordance with local building codes . . . . [ ]
4. Check power supply to see that it is correct for unit requirements . . . . [ ]
5. Check to be sure all tools and debris around, on top, or under unit have been removed . . . . [ ]
6. Check thermostat's thermometer accuracy (check against reliable thermometer). Adjust per instructions with thermostat . . . . [ ]
7. Check for return air filter installation and that the supply and return registers are not blocked [ ]
8. Check that drain lines are draining freely. (Pour water in drain pans.) . . . . [ ]
9. Check for proper belt tension and adjustment on pulleys. (See Blower Adjustment in instructions) . . . . [ ]
10. Check that unit panels are in place and secured . . . . [ ]

FINAL AND OPERATIONAL CHECK

IMPORTANT: To prevent compressor damage which may result from the presence of LIQUID refrigerant in the crankcase, these procedures should be followed at initial Start-Up and at any time the power has been off for 12 hours or more.

1. Before proceeding with this "Operational Check," go to "Electrical Section" of this instruction to determine the time sump heater has been "ON," and make entry on the designated lines, in Step 2.
2. Start-Up Time __________ A.M./P.M. Power Applied Time __________ A.M./P.M. Time Lapse __________ Hours __________ Minutes.
3. If Steps 1 and 2 cannot be used, then place thermostat's system switch in the "OFF" position and apply power by closing system disconnect switch. This energizes compressor heat and evaporates the liquid in the crankcase. TO EVAPORATE LIQUID ALLOW AT LEAST ONE-HALF HOUR PER POUND (R-22), AS SHOWN ON UNIT NAMEPLATE.
4. Except as required for safety while servicing: DO NOT OPEN SYSTEM DISCONNECT SWITCH.
5. **After completing above procedures, turn to page 11 for Operational checkout of system(s).**

SUPPLEMENTARY HEATERS CHECKOUT PROCEDURES, IF INSTALLED

IS HEATER CIRCUITED ACCORDING TO "NEC" & LOCAL CODES?

1. Be sure the disconnect switch is "OFF" and safety label (if any) is attached . . . . [ ]
2. Check on field high and low voltage wiring for sound connections, correct terminals and grounding according to codes . . . . [ ]
3. Check circuit(s) protection (if field supplied) for proper size per nameplate specifications . . . [ ]
4. Check control box panel —— in place and secured . . . . [ ]

NOTE: OPERATION OF HEATERS MUST BE CHECKED DURING THE OPERATION CHECK OF THE TOTAL SYSTEM.

The Trane Company
Light Commercial Unitary Division
Guthrie Highway
Clarksville, TN 37040

Technical Literature Printed in U.S.A.
P.I.

TRANE™

BTC-M-3A

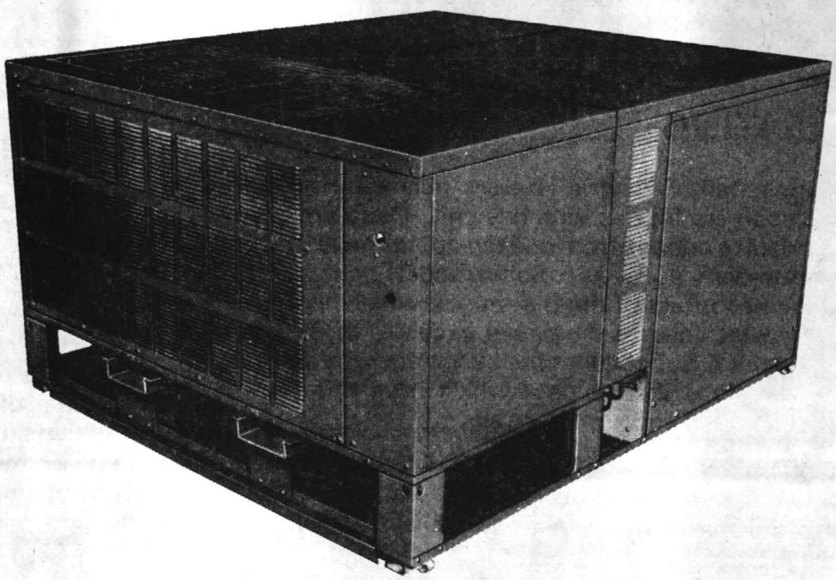
BLDG # AS-502

OPERATION/MAINTENANCE GUIDE

Central Cooling Package System 7½ to 10 Ton

Library	Service Literature
Product Section	Unitary
Product	Rooftop Air Conditioning
Model	BTC
Literature Type	Operation/Maintenance
Sequence	3A
Date	March 1986
File No.	SV-UN-RT-BTC-M-3A 3/86
Supersedes	BTC-M-3 7/85

Models:
BTC090,120C or F-G
BTC090,120C or F-H



Since The Trane Company has a policy of continuous product improvement, it reserves the right to change specifications and design without notice. The installation and servicing of the equipment referred to in this booklet should be done by qualified, experienced technicians.

22-5308-1
Dwg. No. A722625P01
2nd Printing 1986

Literature Change History
BTC-M-3A (March 1986)
Revised manual for models carrying CSA Certification.

A single package unit is designed primarily for cooling. Supplemental heat may be used to provide for heating loads. The sequence of operation is as follows:

COOLING

With the disconnect in the "ON" position, current is supplied to the sump heaters and control transformer. The sump heater supplies heat to the compressor to prevent liquid refrigerant from migrating to the compressor during the "OFF" cycle. The transformer steps down the voltage from 200, 230V and 460V to 24V on the low voltage control circuit.

The cooling cycle is energized on a call for cooling, the first stage mercury contact closes completing a circuit through the low voltage side of the transformer that is marked R on the schematic. With the system switch in the automatic position and the cooling contact closed, voltage is supplied to the Y terminal in the low voltage circuit and from the Y terminal to the main starter, provided the High Pressure Cutout, & the Evaporator Defrost Control contacts are closed. The circuit is completed to the other side of the transformer. When energized, the main starter will close the high voltage circuit to the outdoor fans & the compressor.

The indoor blower is picked up simultaneously through the G terminal of the thermostat, which provides a circuit through the thermostat to the fan relay closing F contacts in the blower motor circuit.

Provided all fuses are O.K. and overloads are not tripped, the unit will operate and refrigerant will flow as a hot gas from the compressor to the outdoor coil where it is condensed into a liquid. From there it passes through a dryer to the evaporator Expansion Valve and on into the evaporator coil where it removes (absorbs) heat from the air that is being moved over the coil surface. The heated gas then returns to the compressor to repeat the cycle again.

These units have an evaporator defrost control which prevents ice build up on the indoor coil (which would reduce the capacity of the unit). This control cuts off the compressor when its temperature setting is reached and allows the indoor air to continue to pass through the coil thereby defrosting the coil. At the evaporator defrost control reset setting, the compressor will start again. This condition normally only exists at low outdoor ambients.

There is an outdoor fan thermostat in the inboard fan (A) circuit which will open if the outdoor temperature falls below its setting (50°F.), thereby stopping this fan and allowing the condensor temperature and pressure to build up to a more normal, efficient operating level. If the OD temperature increases above 60°F., the thermostat will again close and start the fan.

HEATING

Supplemental Electric Heaters may be installed as accessories for use with this unit. There are several models to choose from and the operation of the models may vary as follows: Some models operate off the heating contact of the thermostat which energizes a relay which closes the power circuit to the first bank of heaters. Subsequent banks are energized through the outdoor thermostats which have different ON temperature and separate relays.

Supplementary Heaters are installed at the outlet of the indoor blower. Depending on the size of electric heater used, they could be operated as either single or two stage heaters. A polarized plug is used to plug into the thermostat circuit; however, each bank of heaters has its own circuit fuses in the high voltage line circuit. On a call for heat, the first stage is energized through the (W1) terminal and the closing of the (TSH-1) thermostat heating contact. This circuit picks up (LA) lock-in relay, which in turn energizes both the AH and BH contactors. The wiring diagrams show an (ER) Electric Heat relay. This is only required when heaters are used on Heat Pump systems. On cooling only units it should be disregarded. Provided all limit switches are closed, the contacts of both these contactors will close the high voltage circuit to the first two banks of heaters simultaneously; however, only the first bank of heaters will be energized. This is the first stage heating. If the room temperature should drop another degree the second stage thermostat contact (TSH-2) will close — picking up the second lock-in relay (LB) thereby energizing the second two contactors (CH) and (DH). Since the last (ODT) outdoor thermostat has been jumpered, the last bank of heaters will be energized so as to provide additional heat at ID temperatures above 45°F. As soon as the outdoor temperature drops to the settings of the ODT's still in the circuit, the other banks of heaters will be energized in turn.

It is important to note that the first and second stage lock-in relays are wired in series with the indoor fan relay contact. Therefore, if the fan relay has not been energized, the electric heaters will not function. There must be indoor airflow at all times when the electric heaters are energized. Should airflow be interrupted at any time, temperature would increase to the limit switch (TCO) or fuse setting cutting off the heaters until airflow can be restored.

FRESH AIR DAMPER DAMPER MOTOR CONTROL

To provide for fresh air and to take advantage of cool outdoor air either of two damper controls may have been added to the system along with both return air and fresh air dampers.

One of these controls consists of a damper motor which is operated by a potentiometer located on a wall in the conditioned space which is manually set at desired percent of fresh air. On still another, the control is automatic using an economizer control which operates the opening and closing of the dampers using a capillary tube thermostat which senses the temperature of the return air as it enters the cooling coil. It opens and closes the dampers to maintain a temperature setting selected on the control of the damper motor.

Both the condensing units and the Damper controls are picked up through the cooling contacts of the Thermostat; therefore, once the thermostat is satisfied, both will shut down and the dampers will return to the minimum open set position. Maximum operating economy with minimum equipment expenditure can be realized by operating the system in response to a signal from the thermostat. In heating, the economizer is automatically locked out and the dampers return to minimum air for ventilation. When the outdoor air temperature is below the changeover temperature, the compressor is locked out. If the cooling contacts close, the dampers are modulated by the mixed air temperature controller. When the outdoor air temperature is above changeover temperature the outdoor air dampers are closed to their minimum position and the compressor is controlled by the thermostat.

The damper motor is proportional acting and will position the damper at any point between fully open and fully closed to the demands of the mixed air controller.

An enthalpy economizer switch is used to control the air dampers. It responds to both the dry bulb temperature and humidity, allowing the use of outdoor air at a higher temperature for free cooling when the humidity is low. It functions as the first stage of cooling. On a call for cooling and if the outdoor air is below set point of the enthalpy control, the dampers are operated by the controller and the outdoor air is allowed to enter and mix with the recirculated air. If the indoor temperature increases the second stage cooling contact will close and start the compressor. If the outdoor air enthalpy increases to the set point of the entalpy controller the dampers will return to minimum ventilation air position.

OPERATING INSTRUCTIONS

There are three basic types of thermostats used to control indoor temperature with a central air conditioner. (1) The COOLING ONLY thermostat controls the central air conditioner only. (2) COOLING ONLY with a fan system switch and (3) the HEATING/COOLING thermostat controls both the central air conditioner and heating system.

Identify your thermostat from the pictures on page four (4). Note the location of the temperature selector dial, the "fan switch", the "fan system switch" and the "system switch". Also note that all thermostats have a "temperature selector dial", some thermostats have a "fan switch" and all HEAT/COOL thermostats included a "system switch". (All thermostats also include a thermometer to indicate room temperature.)

THERMOSTAT OPERATION

1. **TO SELECT COOLING** — Heat/Cool thermostat — position "system switch" to COOL position. Cooling Only with system fan switch - position switch to AUTO position. Note that on both types of thermostats when the switch is in the "OFF" position the cooling system is in-operative.
2. **TO SELECT THE DESIRED TEMPERATURE (all thermostats)** — Simply position the temperature selector until the pointer indicates the desired temperature. If "COOLING" has been selected and the room temperature is above the temperature you have selected, your central air conditioner will begin to supply conditioned air and will continue to do so until the selected temperature has been reached.

   If "HEATING" has been selected and the room temperature is below the temperature you have selected, the heating system will operate and continue to operate until the selected temperature has been reached.
3. **TO SELECT FAN OPERATION (thermostats with fan switch)** — Position fan switch to "AUTO" for normal fan operation. With the fan switch in this position, the fan will operate as required by the cooling or heating system, automatically. Note that the fan switch has only two

THERMOSTAT OPERATION (CON'T)

positions, "ON" and "AUTO." The word "FAN" is used to identify the switch only. Best results are usually obtained with the fan switch in the "AUTO" position for both heating and cooling. However, if continuous fan operation is desired, position the fan switch to the "ON" position. (Note — thermostats which do not have the fan switch feature will operate the fan on "AUTO" only.)

System fan switch is the same as above when in "AUTO" position; for continuous fan operation set switch to "FAN" position.

After the System has been installed it is put through an "OPERATIONAL CHECK-OUT" procedure. However, there could be a significant time lapse prior to occupancy of the structure. During this time there may have been a power interruption, therefore, if the unit is not operating at the time of occupancy, read and follow instructions under COOLING; item b.

If these has been no discontinuance of power after the initial start-up, the unit will need only periodic maintenance, and manual changing of the room thermostat to "HEAT" or "COOL" as required.

When using the Automatic Thermostat, manually changing to "HEAT" or "COOL" is not required.

COOLING — The System (when in "Cooling") will begin removing heat and humidity immediately after it cycles on, but may require several hours to obtain desired conditions. In order to control both temperature and humidity, it is desirable to permit the equipment to operate automatically (controlled by thermostat).

Use exhaust fans and hoods in areas where excessive heat or humidity is generated.

CAUTION: Exhaust fans and/or heat producing equipment are normally taken into account when sizing System equipment. Any additional exhaust fans or heat producing equipment will require:

1. Additional cooling/heating equipment or
2. Some means of controlling the loss of conditioned air from the space.

Do not block supply or return registers.

Let the thermostat control the System. The use of window shades, venetian blinds, awnings, etc. will keep out the direct rays of sunlight, and reduce the load on the unit.

To shut down the system for vacation:

a. Position System Switch to the "OFF" position. **Do not turn power off at main disconnects.** The compressor utilizes crankcase heaters that operate on line voltage.
b. If the power to the compressor has been off for more than four hours position the System Switch to the "OFF" position and do not put the system in operation until power has been restored to the compressor's (crankcase heaters) for at least 1/2 hour per pound of refrigerant in unit. (See unit nameplate.)

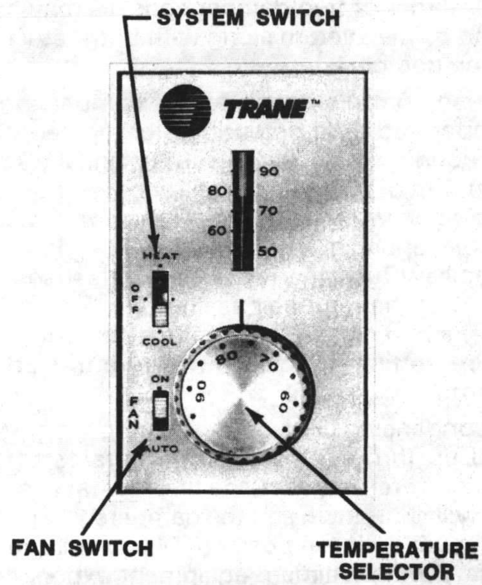


FIGURE 1

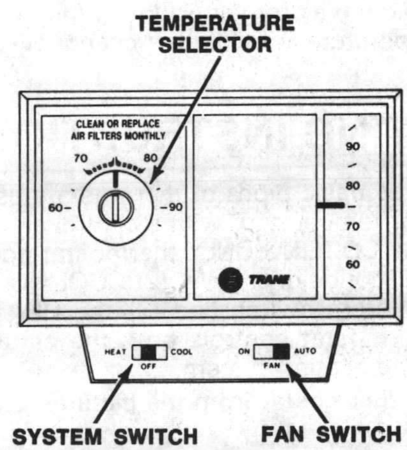


FIGURE 2

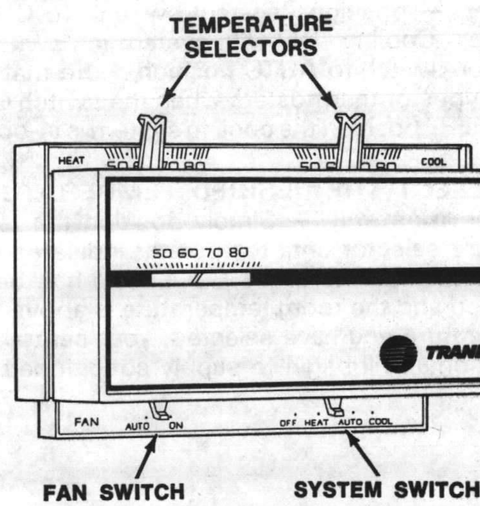
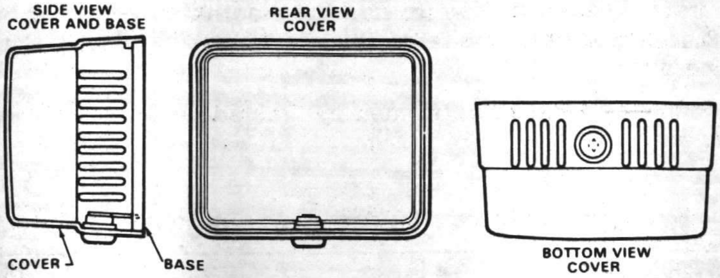


FIGURE 3

LOCKING COVER

The locking cover as shown below, is an optional accessory. It fits over your thermostat, and is locked with a key. It is designed to prevent any tampering or accidental shifting of the exposed Selector Levers, Fan or System switches, once they have been properly set.



PROTECTIVE CONTROLS

NOTE: ALL OF THESE CONTROLS MAY NOT BE INSTALLED ON YOUR UNIT, CHECK ELECTRICAL SCHEMATIC

EVAPORATOR DEPROST CONTROL (EDC)

This control is located in the indoor section of the Package Unit, or in the Air Handler of Split Units. The control's sensing tube is imbedded vertically in the evaporator coil, near the center. This device will stop the compressor if the indoor coil temperature drops below its setting. The indoor air will still circulate across the coil, bringing the temperature of the coil back up to the cut-in temperature of the evaporator defrost control.

LOW PRESSURE CUT-OUT (LPCO)

This control's sensor is located in the suction (gas) line, near the compressor. This control will stop the compressor and the condenser fans if suction pressure drops below the Low Pressure Cut-Out setting. Once the suction pressure has returned to normal, the compressor and condenser fans will cycle back on.

INTERNAL PRESSURE RELIEF VALVE (IPR)

The compressor design incorporates an internal pressure relief valve. The valve operates on a pressure difference between the discharge and suction pressure to prevent compressor overloading, thereby prolonging the life of compressor.

EXTERNAL OVERLOAD PROTECTOR (XOL)

This thermal device is located in the compressor terminal box. It will shut off the compressor if the compressor current draw exceeds its setting.

INTERNAL OVERLOAD PROTECTOR (IOL)

This device is a current/thermal actuated warp switch, imbedded in the compressor motor windings. It will shut off the compressor if the temperature of the compressor motor windings exceeds its design trip temperature.

COMPRESSOR MOTOR THERMOSTAT (TM)

This device is a circuit breaker temperature switch imbedded in the compressor motor windings. It will shut off the compressor if the temperature of the compressor motor windings exceeds its design trip temperature.

NOTE: These safety devices (XOL, IOL, & TM) will put the compressor back in operation once the compressor motor heat has dropped below the trip setting; however, a check of the refrigerant and electrical systems should be made to determine the cause, and THEN CORRECTED!!!

INSPECTIONS

A routine of monthly and seasonal inspections should be established. On the page below is a chart to help in a thorough check of the unit and its operation.

CAUTION: For your personal safety be sure to turn the electric power off at the main disconnects for both SYSTEM and HEATER accessories before removing any access panels, or attempting any maintenance, inspection, or service operation.

CAUTION: These procedures should be performed by Trained Technicians only. Normal precautions should be observed in making each check.

SUGGESTED CHECKLIST FOR ROUTINE INSPECTION

COMPONENTS	CHECK
1. Thermostat Operation	a. Anticipator Setting(s) may be found on the unit wiring/schematic diagram located on inside of control box cover. b. Proper Calibration
2. Loose, Worn or Misaligned Pulley	Visually check and replace or adjust as required.
3. Loose, Worn Fan Belt(s)	Visually check and replace or adjust as required.
4. Loose Electrical connections	Visually check and tighten or replace terminal leads if needed.
5. Wiring deterioration	Visually check and replace as required.
6. Refrigerant Oil Traces	Check for refrigerant leaks.
7. Torn Insulation	Visually check and replace as required.
8. Loose or lost Screws	Visually check and tighten or replace where needed.
9. Unusual Noise or Vibration	Determine cause and correct by adjustment or replacement of defective part.
10. Dirty or clogged Air Filters	Check for accumulated dirt and debris, clean or replace.
11. Crankcase Heater Operation	Heater should be hot to the touch (if power is on). *NOTE: Power should be available to the sump heater continuously or for at least 1/2 hour per lb. of refrigerant, prior to start-up of compressor.*
12. Painted Surfaces	Visually check, clean and paint as required.
13. Roof Flashing and Caulking	Visually check, repair as necessary.
14. A suggested form for recording routine inspection will be found on page 13.	Fill in data when maintenance is performed

VENTILATION

Too much ventilation may result in:

1. Excessive equipment loading.
2. Higher operating cost.
3. Loss of indoor temperature and humidity control.

Too little ventilation may result in:

1. Excessive smoke, fumes and odors.
2. Stale air.

1. **AIR FILTER**

Filters should be inspected each month and cleaned or replaced as required.

NOTE: If you have a clogged filter indicator light on your thermostat (ask your installing dealer), clean or replace filters when the light indicates.

Filters must be located in the return air system. If you are not sure of the location, ask your installing contractor or servicing dealer to show you where they are located and how to replace them.

Filter types and How to Clean:

A. Plastic Foam Type — Wash in warm water and reinstall.

B. Glass Fiber (Throwaway) — Replace as often as required.

C. Aluminum (Coated Type) — Wash in soap and water and allow to dry; spray with coating as per manufacturer's instruction

2. **OILING OF MOTORS**

A. INDOOR BLOWER MOTOR —

Some blower motors used for indoor airflow require oiling once each year. Use a good grade of SAE 20 nondetergent oil. Six (6) to ten (10) drops in each of the two bearings is usually sufficient. Most motors are permanently lubricated and require no oiling. (If your motor has oil holes or tubes, it should be oiled.)

B. OUTDOOR FAN MOTOR —

Outdoor motors having oil ports should be oiled by your servicer annually, using same grade and quantity of oil used for indoor motors.

NOTE: Ball bearing type motors are permanently lubricated and will not require oiling with normal usage.

C. COMPRESSOR MOTOR —

The compressor motor is part of the sealed system and requires no oiling.

3. **BELT DRIVE BLOWERS**

Check fan belt tension and examine the belt for cracks, breaks, or misalignment at least twice a year. (1/2 to 1" free movement midway between the pulleys is the proper tension). Replace any belt that shows damage or excessive wear. Check belt tension after two weeks of use as a new belt will stretch and may require adjusting.

Where multiple belts are used, all belts should be replaced when one or more shows excessive wear or defects. This assures equal tension on all belts. Buy matched sets for best performance.

4. **CLEANING HEAT TRANSFER COILS**

Check all refrigerant coils at least twice each year and clean as required.

Coils may be cleaned by use of:

A. Steam (low pressure)

B. Detergent and Water

C. Compressed Air

CAUTION:

Care must be used when cleaning coils to avoid damage to fins. Be especially careful with Spine Fin™ coils.

5. **CLEANING BLOWER WHEELS**

Check blower wheels ever six months and clean as required. **Do not** attempt to clean blower wheel unless all power to unit is **OFF!**

Method of Cleaning:

A. Vacuum Cleaner or brush

B. Water and detergent

C. Compressed air

6. **CONDENSATE DRAIN LINE**

The condensate drain system should be visually inspected each time the air filters are inspected (minimum of once each month). If there is any evidence of water overflow, drain lines should be cleaned and/or condensate pump checked for proper operation.

7. **FRESH AIR DAMPERS**

A. Fixed Dampers:

If fixed or preset dampers are used to introduce fresh air into the building, it may require seasonal adjustment to obtain proper airflow and maximum comfort in the conditioned space.

Dampers should be inspected periodically for obstruction to airflow.

B. Motorized — Automatic Dampers:

Dampers and linkage should be inspected and lubricated at least once each year.

Control circuit and motors should be checked once each year for proper operation.

8. **GENERAL INSPECTION**

In addition to items 1 thru 7, it is a good maintenance practice to physically and visually check the following during routine or periodic inspection.

9. **TORN OR DAMAGED INSULATION**

Insulation should be secured to the metal surface at all times. If insulation has been torn it may be re-attached by using duct tape. If pieces are missing then the missing section must be replaced.

10. **FLASHING OR CAULKING**

Wherever it has been necessary to penetrate the exterior surface of the structure, some type of weather-proofing must be done to the cavity. Check to be sure these places are sealed against the weather.

SERVICE

To service a unit efficiently the servicer must be able to diagnose the problem and its cause. Some of the causes and effects you should be aware of are listed on pages 8 and 9.

For proper procedures and replacing of parts it is recommended that "SERVICE MANUAL" 18-BB09E1, and "SERVICE PROCEDURES MANUAL" 18-HH03E1 be obtained through your Trane Sales and Distribution Centers.

DIAGNOSTIC CHART FOR COOLING

COOLING PROBLEMS	POSSIBLE CAUSE	WHAT TO CHECK
A INDOOR AND OUTDOOR EQUIPMENT INOPERATIVE	1. Power off	Check disconnect, fuses or breakers
	2. Defective control voltage transformer or wiring	Check for control voltage. Repair or replace.
	3. Defective thermostat	Replace thermostat
B INDOOR BLOWER MOTOR WILL NOT START — COMPRESSOR OPERATES	1. (a) Faulty unit wiring (b) Loose wiring connections	(a) Check wiring per wiring diagram (b) Tighten terminals and wiring connections
	2. Defective fan relay, capacitor or contactor	Check control voltage. Replace defective component.
	3. Defective motor	Check current draw of motor.
C INDOOR BLOWER MOTOR CYCLES ON INTERNAL PROTECTOR	1. Improper voltage	Check voltage at motor terminals
	2. Defective motor	Check current draw of motor
	3. Belts too tight	Loosen so belts can be depressed 3/4"
	4. Motor overloading	Adjust pulley - Replace with larger motor
D LOW INDOOR AIRFLOW	1. Dirty filters	Clean or replace
	2. Dirty coils	Check visually - clean or replace
	3. Improper pulley adjustment.	Adjust for proper airflow
E COMPRESSOR WILL NOT START BUT INDOOR BLOWER OPERATES	1. Incorrect thermostat setting	Adjust thermostat
	2. Compressor overloads or internal thermostat open	Check supply voltage, current draw each winding.
	3. High or low pressure cut out open — whichever used	Reset and check head or suction pressures
F COMPRESSOR MOTOR HUMS BUT WILL NOT START	1. Low voltage	Check voltages at each compressor terminal when compressor trying to start
	2. Compressor motor has open or shorted windings	Make continuity check with a reliable ohmmeter. (make sure compressor has cooled enough to permit internal motor protectors to reset).
	3. Tight compressor. (mechanical stall)	Condemn and replace compressor only after all methods of starting compressor electrically have failed.
G SHORT CYCLING OF COMPRESSOR	1. Defective thermostat	Replace thermostat
	2. Safety controls tripping.	Check controls
	3. Compressor overloads tripping.	Compressor amperage & overloads
H COMPRESSOR OPERATES CONTINUOUSLY (INDOOR TEMPERATURE BELOW THERMOSTAT SETTING)	1. Improperly adjusted or defective thermostat	Adjust or replace
	2. Defective compressor contactor	Welded contacts

DIAGNOSTIC CHART FOR COOLING (CON'T)

COOLING PROBLEMS	POSSIBLE CAUSE	WHAT TO CHECK
I COMPRESSOR OPERATES CONTINUOUSLY (INDOOR TEMPERATURE ABOVE THERMOSTAT SETTING)	1. Low refrigerant charge	Check suction & head pressures
	2. Low suction pressure	(See reasons for low pressure)
	3. High head pressure	(See reasons for high pressure)
	4. Improperly sized equipment	Check for capacity requirements
	5. High return air temperatures	Check fresh air intake
	6. Defective compressor	Check operating pressures & amperage
J LOW SUCTION PRESSURE	1. Dirty filters	Clean or replace
	2. Insufficient air	Check dampers and registers Check pulley setting. Check for loose blower belts. Check for dirty coils
	3. Low refrigerant charge	Check for leaks and repair
	4. Faulty expansion valve	Replace defective valve or power element
	5. Defective fan motor	Replace motor or repair
K HIGH SUCTION PRESSURE	1. Excessive load on unit	Check for high indoor air flow Check for high return air temperature
	2. Defective compressor	Check for low head pressure Check for low amperage draw
	3. High head pressure	Check for condensor air flow Check for excessive refrigerant
	4. Faulty expansion valve	Replace defective valve or power element
L HIGH HEAD PRESSURE	1. Excessive load on unit	Check for high indoor air flow Check for high return air temperature
	2. Condenser surface clogged or dirty	Clean
	3. Defective condenser fan motor	Repair or replace
	4. Overcharge of refrigerant	Check performance chart. Purge gas until conditions balance and correspond to chart

DIAGNOSTIC CHART FOR HEATING

HEATING PROBLEMS	POSSIBLE CAUSE	WHAT TO CHECK
M INDOOR AIRFLOW PROBLEMS	SEE A, B, C & D COOLING PROBLEMS	
N ELECTRIC HEATERS INOPERATIVE	1. Power off	Check disconnects, fuses & breakers
	2. Heating element	Check voltage at heater terminals Check continuity of fuseable link and heating element. Replace defective component
ELECTRIC HEATERS INOPERATIVE	3. Relay	Check control voltage & replace relay if defective
	4. Temperature protective devices	Check airflow, replace TCO or fuseable link if defective
	5. Thermostat adjustment	Adjust or replace
	6. Defective control voltage transformer or wiring	Check for control voltage. Repair or replace
	7. Outdoor thermostat	Adjust or replace

TROUBLE SHOOTING

ERRATIC OPERATING PRESSURES

Causes:

Low suction presure is usually caused by:
1. Low indoor airflow (dirty filters, coil, undersized duct, blower too slow, etc.)
2. Undercharge of refrigerant.
3. Defective expansion valve.
4. Low side restriction.
5. Plugged filter-drier
6. Light indoor coil loading (low temperature air entering evaporator).

High suction pressure is usually caused by:
1. High indoor airflow.
2. Overcharge of refrigerant.
3. Expansion valve.
4. Non-condensables in system.
5. Heavy indoor coil loading (high temperature air entering evaporator).
6. Defective compressor valves.

Low head pressure is usually caused by:
1. Low refrigerant charge.
2. Light evaporator and/or condenser loads (low indoor and/or outdoor temperatures).
3. Defective compressor valves.

High head pressure is usually caused by:
1. An overcharge of refrigerant.
2. Non-condensables in the system.
3. Low condenser airflow (coil dirty or obstructed, fan too slow, etc.).
4. Excessive evaporator loading (high temperature air entering evaporator).
5. High temperature air entering condenser.
6. Recirculation of condenser air.

CHECKING CONTROL CIRCUIT

1. With the power off — Using an ohmmeter or test light check for continuity through each control or protective device. (Be sure to remove the leads of the device before checking.) Open Circuit — Determine why the switch is open. Rarely is the device itself defective.
2. Using a voltmeter — caution — with the power on check incoming voltage (Step 1). If OK, touch the leads to the terminals of each device. No voltage reading indicates an open switch or device. Determine why the switch is open. Rarely is the device itself defective.

AIRFLOW — INDOOR AND OUTDOOR

1. **GENERAL** — Insufficient or incorrect airflows account for a large portion of service calls. The largest contributors to airflow problems are:
   a. dirty or plugged filters
   b. dirty or plugged coils
   c. broken, worn or loose fan belts
   d. dirty blower wheels
   e. insufficient supply or return ducts or grilles.

   Most of the above are best prevented or eliminated by regular maintenance. Checks should become second nature to the serviceman and the customer. Check these items when making service or maintenance checks.
2. **CHECKING AIRFLOW** — The best indicator of airflow problems is the unit normal operating pressures. Failure of the pressures to equal the chart values usually indicates airflow problems. Examples: (a) Suction pressure low, head pressure normal — insufficient indoor airflow; (b) Suction pressure normal, head pressure high — insufficient outdoor airflow.
3. **CLEANING OF FOULED COILS** — As the unit is used, dust, dirt and various other foreign materials accumulate on the outdoor coils. Sooner or later this accumulation becomes so great that it affects the operation of the unit causing a reduction in airflow, insufficient cooling or heating complaints, reduction in capacity, tripping of the overload and possible eventual failure of the compressor. The time required for fouling to cause these problems varies according to the atmosphere in which the unit is installed and according to the application. For instance, the unit located in a heavy industrial area will foul up faster than one located in a strictly residential suburban area.
   Fouled coils can only be corrected by cleaning. The fundamentals involved in cleaning are:
   a. Removing parts from the air conditioner to gain access to the condenser.
   b. Protection of electrical components from cleaning solution used.
   c. Cleaning by use of some solution.
   d. Reassembling.

Protection of Electrical Components — If the electrical components are not removed, they must be protected during the cleaning process by use of waterproof Pliofilm, rubber sheets, or some equivalent method.

Pressure Tank Cleaning — A pressure spray tank having a flexible rubber hose of adequate length for ease of manipulations can be used for condenser cleaning. Adjust spray head to a relatively fine spray and apply. Apply mixture liberally to all surfaces possible. Areas not wetted by the cleaner may not clean satisfactorily. Allow cleaner to soak in for a few minutes — shorter or longer depending upon the amount and kind of soil present. Rinse liberally with as high a water pressure as is obtainable on plate fin surface. For spine fin surface use reduced water pressure. It is recommended to use only the water pressure from the hose without the nozzle attached in order to prevent flattening of spines.

The detergents recommended for the pressure tank method are mild general purpose cleaners developed to wet a wide variety of soils and belong to a class introduced several years ago as "waterless cleaners." They have passed simple lab tests as being innocuous in so far as corrosion is concerned and are considered free rinsing. They are available in all major cities, or orders can be filled elsewhere in a matter of days. Kelite Spray White or Oakite Spray used in proportions of 1 part detergent to 4 parts water (preferably hot, but not required) are satisfactory.

Steam Cleaning — Steam cleaning equipment may be used to do the actual cleaning, rather than the pressure spray tank. Steam cleaning will do a better job and is more impressive to the customer. Steam cleaning equipment can be put on a trailer or installed in a truck as local conditions warrant. The detergents satisfactory for steam cleaning equipment are: Oakite 202 or Kelite Formula 89.

REFRIGERANT LEAKS

1. Equipment necessary for leak testing
   a. Leak Detector.
   b. Halide torch leak detector.
   c. Soap solution.
2. To check for leaks
   a. Connect a pressure gauge to the compressor low side purge fitting. If the gauge registers a positive pressure, proceed with the test. If the gauge indicates the system to be out of gas, add sufficient R-22 to pressurize the system, then proceed with the test.
   b. Using the leak detector (follow the directions furnished with the detector) check all joints, pressure switch capillaries, etc., for leaks or;
   c. Using a halide torch check all joints etc. A leak will show up as a change in color of the torch flame — A green flame indicates small leak — A rising brilliant blue flame indicates larger leak, or:
   d. Using soap solution smear soap on joints, etc. — A rising bubble pin points the leak.
   e. Hints and Tips
      1. The presence of oil on lines, fittings, etc., usually indicates a leak.
      2. Very small leaks may be found by pressurizing the system with 300# pressure of dry nitrogen. After the leak is located, bleed the refrigerant charge. Some units may be pumped down or disconnected. Repair the leak by, brazing or tightening, whichever is appropriate. Evacuate and recharge the system.

STATIC ELECTRICITY NOISE

Motor and blower assemblies are normally free of any static electricity discharge due to the care taken in design and manufacture. Regardless of how much care is taken, however, a problem of this type is still a possibility.

A ground wire is imbedded in the motor resilient mounting; grounding is completed through the frame of the equipment. The equipment, naturally, is grounded as a part of the electrical installation. Despite these precautions there may be cases where the rotating components of blower assemblies become static collectors. This can result in a static electricity discharge that may cause noise interference in radios, some television sets, hi-fidelity phonographs, etc.; this will be apparent only when the equipment is operating. The staccato noise of this static arc can become quite annoying; the only solution is additional grounding.

CHECKING CONTROL TRANSFORMER

1. Power off — using a test light or ohmmeter
   a. Disconnect transformer leads
   b. Check continuity through primary windings — open circuit — replace transformer.
   c. Check continuity through secondary windings — open circuit — replace fuse or transformer.
2. Power on — using a voltmeter
   a. Check primary input voltage
   b. Check secondary output voltage — no voltage — replace fuse or transformer.

LIQUID LINE DRIER

Check the temperature drop across the drier — if there is a noticeable temperature drop, the drier is clogged and should be replaced.

Two types of driers, flare and brazed, have been used. To change from brazed to flare, adapters are available from your distributor or may be improvised by careful piping practices.

CHECKING FOR REFRIGERANT RESTRICTIONS

1. Capillary tube or expansion valve — A restricted capillary tube results in:
   a. Low suction pressure **(may trip out low pressure switch)**
   b. Icing or frosting of the cap tube
   c. Loss of capacity
   d. Insufficient temperature drop across evaporator
2. Liquid Line — A restricted liquid line results in:
   a. Low Suction pressure (may pump down completely)
   b. Loss of capacity

   Probable locations of restrictions are:

   a. Drier
   b. Liquid line shut off valve
   c. Kinked tubing
   d. Strainer

The location of the restrictions will be indicated by a definite temperature difference across the restriction.

3. Discharge line and condenser — These restrictions result in:
   a. High head pressure **(may trip out high pressure switch)**
   b. Loss of capacity

MAINTENANCE & SERVICE LOG

Model ____________________

Serial Number ____________________ Date Installed ____________________

Location ____________________

OPERATIONAL CHECK	CHECK AIR FILTERS	OIL MOTORS	INSPECT BELTS	INSPECT INDOOR COILS	INSPECT OUTDOOR COILS	INSPECT BLOWER WHEELS	INSPECT CONDENSATE DRAINS	CHECK DAMPER SETTINGS
Date By								
Date By								
Date By								
Date By								
Date By								
Date By								
Date By								
Date By								
Date By								

DATE OF FAILURE	TYPE OF FAILURE	DATE OF FAILURE	TYPE OF FAILURE

The Trane Company
Light Commercial Unitary Division
Guthrie Highway
Clarksville, TN 37040

Technical Literature Printed in U.S.A.
P.I.

TAB PLACEMENT HERE

DESCRIPTION:

Air Conditioners

☐ Tab page did not contain hand written information

☑ Tab page contained hand written information
*Scanned as next image

Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

BLDG # A5-502

BTC-SF-29B

TRANE™

Library	Service Literature
Product Section	Unitary
Product	Rooftop Air Conditioning
Model	BTC
Literature Type	Service Facts
Sequence	29B
Date	May 1986
File No.	SV-UN-RT-BTC-SF-29B 5/86
Supersedes	

SERVICE FACTS

Since The Trane Company has a policy of continuous product improvement, it reserves the right to change specifications and design without notice. The installation and servicing of the equipment referred to in this booklet should be done by qualified, experienced technicians.

Air Conditioner
Model: BTC120F300HB
BTC120F3A0HB

IMPORTANT — This document is customer property and is to remain with this unit. Please return to service information pack upon completion of work.

D - PACKAGE COOLING

PRODUCT SPECIFICATIONS

MODEL	BTC120F
RATINGS (Cooling) ①	
BTUH	120000
Indoor Airflow (CFM)	4000
Power Input (Kw)	13.90
EER ⑥	8.65
Noise Rating No. ②	8.8
POWER CONNS. — V/Ph/Hz	200-230/3/60
Min. Brch. Cir Ampacity ③	60
Br. Cir. — Max. (Amps.)	80
Prot. Rtg. — Recmd. (Amps)	80
COMPRESSOR	Climatuff™
No. Used — No. Speeds	2 — 1
Volts/Ph/Hz	200-230/3/60
R.L. Amps — L.R. Amps	19 — 125
Brch. Cir. Selec. Cur. Amps	20.5
OUTDOOR COIL — Type	Spine Fin
Rows /F.P.I.	1 / 20
Face Area (sq. ft.)	38.5
Tube Size (in.)	1/2
INDOOR COIL — Type	Plate Fin
Rows / F.P.I.	4 / 13.5
Face Area (sq. ft.)	9.5
Tube Size (in.)	1/2
Refrigerant Control	Expansion Valve
Drain Conn. Size (in.)	3/4 NPT
OUTDOOR FAN — Type	Propeller
No. Used / Dia. (in.)	2 / 22
Type Drive / No. Speeds	Direct / 1
CFM @ 0.0 in. w.g. ④	9000
No. Motors — HP	2 — 1/2
Motor Speed R.P.M.	1100
Volts/Ph/Hz	200-230/1/60
F.L. Amps	3.8

MODEL	BTC120F
INDOOR FAN — Type	Centrifugal
Dia. x Width (in.)	15 x 15
No. Used	1
Drive / Speeds (No.)	Belt / Adjustable
CFM vs. in. w.g. ⑤	See Fan Perf.
No. Motors — HP	1 — 1-1/2
No. Motors — HP Hi Static Opt.	1 — 2
Motor Speed R.P.M.	1725
Volts/Ph/Hz	230/3/60
F.L. Amps	5.0
FILTER — Furnished?	1 in. Low Velocity
Type Recommended	
Lo Vel.	
(No.-Size-Thk.)	4-20x20 — 1 or 2 in.
Hi Vel.	
(No.-Size-Thk.)	- -
REFRIGERANT	
Charge (lbs. of R-22)	Left (11.0)/Right (10.1)
DIMENSIONS	H x W x D
Crated (in.)	47.5 x 76 x 83
WEIGHT	
Shipping (lbs.) — Net (lbs.)	1222 / 1190

OPTIONAL EQUIPMENT

Indoor Thermostats —
- Single-Stage Heat/Cool AY28X182
- Two-Stage Heat/Cool AY28X183
- Two-Stage Cooling AY28X186

Sub-Bases —
- Automatic or Manual Seasonal Changeover (For use w/AY28X183) AY28X184
- Manual Changeover (For use w/AY28X182, 183) AY28X185
- Auto Seasonal Changeover (For use w/AY28X182, 183, 186) AY28X187

Head Pressure Control BAY28X123C
Fan Control Relay Kit BAY24X42

①**Rated in accordance with A.R.I. Standard 240.**
②**Rated in accordance with A.R.I. Standard 270.**
③Calculated in accordance with Natl. Electric Code. Suitable for use with HACR circuit breakers or fuses. ④Standard Air — Dry Coil — Outdoor. ⑤Standard Air — Wet Coil — Indoor. ⑥Rated in accordance with D.O.E. test procedure.

[*] Power supply voltage limits

Voltage Limits Low	High	Max I.D. Temp. DB/WB	Max O.D. Temp. DB
207	254	95/71	115
196	207 (a)	95/71	105
187	196 (b)	95/71	100

(a) O.D. Fan must be on high speed. Indoor airflow must not exceed 450 CFM/TON.
(b) O.D. fan must be on high speed. Indoor airflow must not exceed 450 CFM/TON. Start kit must be used.
(c) Capacity reduction for unit operation at 208 volts vs. 230 volts is 1% approximately.

SINGLE PACKAGE

SAFETY NOTICE

THIS INFORMATION IS INTENDED FOR USE BY INDIVIDUALS POSSESSING ADEQUATE BACKGROUNDS OF ELECTRICAL AND MECHANICAL EXPERIENCE. ANY ATTEMPT TO REPAIR A CENTRAL AIR CONDITIONING PRODUCT MAY RESULT IN PERSONAL INJURY AND OR PROPERTY DAMAGE. THE MANUFACTURER OR SELLER CANNOT BE RESPONSIBLE FOR THE INTERPRETATION OF THIS INFORMATION, NOR CAN IT ASSUME ANY LIABILITY IN CONNECTION WITH ITS USE.

RECONNECT ALL GROUNDING DEVICES

ALL PARTS OF THIS PRODUCT CAPABLE OF CONDUCTING ELECTRICAL CURRENT ARE GROUNDED. IF GROUNDING WIRES, SCREWS, STRAPS, CLIPS, NUTS OR WASHERS USED TO COMPLETE A PATH TO GROUND ARE REMOVED FOR SERVICE, THEY MUST BE RETURNED TO THEIR ORIGINAL POSITION AND PROPERLY FASTENED.

DISCONNECT POWER BEFORE SERVICING

Dwg. No. A724331P01

3rd Printing 1986

SERVICE PARTS

COMPONENT	QTY.	DESCRIPTION	DPG CAT. #	CSG MNEMONIC #
Blower Wheel	1	15" D x 15" W x 1" Bore, CW	WW74X74	WHL-320
Capacitors (CFA-CFB)	2	7.5 MFD, 440V	WW20X134	CPT-265
Compressor Internal Line Break (IOL) Internal Press. Relief (IPR)	2	CT56HL3AX1: FLA 21.8 LRA 125.0, Wind. res. @ 77°F. = .620 Ohms Open on rise in winding temp. - Resets in 30-90 min. Open on 350# diff. between high & low side pressure	Order by unit model #	COM-2309
Contactor (MS-1)	1	Type DPST, Contacts 230/460/600V, Amps Ind./Res. 40/50, LRA 240/200/160, Coil 24V 3.2 A.In., .36 A.Hld.	WW30X93	CTR-576
Contactor (MS-2) •	1	Type DPST, Contacts 240/480V, FLA 30, LRA 180/150, Coil 24V,	• WW30X108	CTR-577
Distributor (ID/OD)	2	1/2" Inlet - 4 Outlets - 1/4"	WW51X156	DST-134
Drier	2	Suc. Line w/Sweat Fit., 30 Cu. In., 1-1/8" x 1-1/8"	WW22X70	DHY-185
Drier	2	Liq. Line w/Sweat Fit., 8 Cu. In., 3/8"x3/8"	WW22X88	DHY-144
Evaporator Defrost Control (EDC)	1	120/240V, 10/5 FLA, 60/30 LRA, In @ 60° ±2°F., Out @ 25°±2°F.	WW26X62	SWT-507
Expansion Valve	2	3/8" In, 1/2" Out, Sweat, 5 Ton, 30" Cap, Ext. Equal., 90°, Superheat 45 ± 2 PSIG	WW51X240	VAL-2470
Fan	2	3 Blade, 22" Dia., 1/2" Bore, Hub up, CW, 34°	WW73X69	FAN-1214
Fuse (FU)	1	Red Cap, Dual Element, 3.2 Amp,	WG23X70	FUS-273
Motor (ID)	1	230/460V, 60 Hz., 3 Ph., Open Shell, Rev., 1725 RPM, 1-1/2 HP, FLA 5.6/2.8, LRA 37.4/18.7, Ball Bearing, 1-Speed, Winding Resistance — Ohms @ 77°F.: Hi Voltage 11.1/9.5, Line To Line	WW94X214	MOT-2293
Motor (ODA/ODB) •	2	200/230V, 60 Hz., 1 Ph., Closed Shell, CCW, 1100 RPM, 1/2 HP, 1-speed, FLA 3.8/3.3, LRA 6.2, Winding Resistance — Ohms @ 77°F.: Blk. to Blu. 8.4/7.4; Blk. to Brn. 41.3/35.5	• WW94X413	MOT-2578
Outdoor Fan Thermostat (OFT)	1	240 V.A.C., 5 FLA, 30 LRA, Contacts Open @ 50°±5°F., Reset @ 60°±5°F.	WW28X110	THT-413
Pulley, Motor	1	4.2" D, 5/8" Bore, Pitch Varies From, 3.9" to 2.9"	WW34X2	SHE-641
Pulley, Blower	1	8.93" D x 1.0" Bore, 9.0 Pitch, 6 Spokes	WW34X52	SHE-733
Relay, Aux. (AR)	1	Type SPDT, w/Add. N/O Contacts, Contacts 230V, FLA 5.0, LRA 15.0, Coil 24V, .153 A.In., .084 A.Hld.	WW24X99	RLY-918
Relay (F)	1	Type 3PST, Contacts 240/480V, FLA 20/20, LRA 68/34, Coil 24V, 2.10 A.In., .35 A.Hld.	WW30X83	RLY-1005
Shaft	1	26.32" Lg. x 1" D	WW15X39	SHF-913
Slinger	2	1/2" Dia. Bore	WW72X67	SLG-53
Sub-Bases •	1	AY28X184, Auto/Manual Changeover	• WW28X184	BAS-398
•	1	AY28X185, Manual Changeover	• WW28X185	BAS-399
•	1	AY28X187, Auto Changeover	• WW28X187	BAS-400
Sump Heater	2	230V, 65 W., Res. Heater, Cart. Type	WW08X65	HTR-1221
Switch, Low Pressure Cut-Out (LPCO)	2	Cut-Out Pressure: Opens @ 8 ± 4 PSIG, Resets 25 ± 7 PSIG	WW26X90	SWT-506
Thermostat •	1	BAY28X182, Single Stage, Heat/Cool	• WW28X182	THT-457
•	1	BAY28X183, 2-Stage Heat/Cool	• WW28X183	THT-463
•	1	BAY28X186, Two-Stage Cool	• WW28X186	THT-465
Transformer (TNS)	1	24V, Class 2, Rating 75 VA, Pri. 60 Hz.	WG32X39	TRR-385

*New Part - Set Up Within The Last 18 Months.

SERVICE PARTS

PARTS LIST FOR OPTIONAL HEAD PRESSURE CONTROL KIT BAY28X123C

COMPONENT	QTY.	DESCRIPTION	DPG CAT. #	CSG MNEMONIC #
Auto Transformer	1	@ 230V, Red 116.0 VAC, Orange 134.5 VAC, Yellow 200.0 VAC, @ 460V, Red 232.0 VAC, Orange 273.0 VAC, Yellow 400.0 VAC	WW32X57	TRR-440
Fuse •	1	5 Amp, 600 Volt	• WW23X195	FUS-272
Pressure Switch (HPCO)	1	Opens @ 280 ± 10 PSIG, Closes @ 160 ± 10 PSIG	WW26X79	SWT-593
Relay (ODFA)	1	Type PDT, Contacts 240/480V, FLA 6/3, LRA 35/18, Coil 24V, .53/.61 A.In., .26/.31 A.Hld., #R8222B-1158	WW24X70	RLY-886
Relay (ODFB)	1	Type DPDT, Contacts 240V, 180 LRA, 30 FLA, Coil 24V, .615 A.In., .41 A.Hld., 50-60 Hz	WW24X137	RLY-1002
Thermostat (OFTA)	1	Opens @ 55° ± 6°F., Closes @ 45° ± 6°F.	WW28X119	THT-458
Thermostat (OFTB)	1	Opens @ 35° ± 6°F., Closes @ 25° ± 6°F.	WW28X120	THT-459

*New Part - Set Up Within The Last 18 Months.

NOTE: USE THE FOLLOWING COMPONENTS AS CORRESPONDING PARTS WHEN ORDERING FOR HI-STATIC MODEL

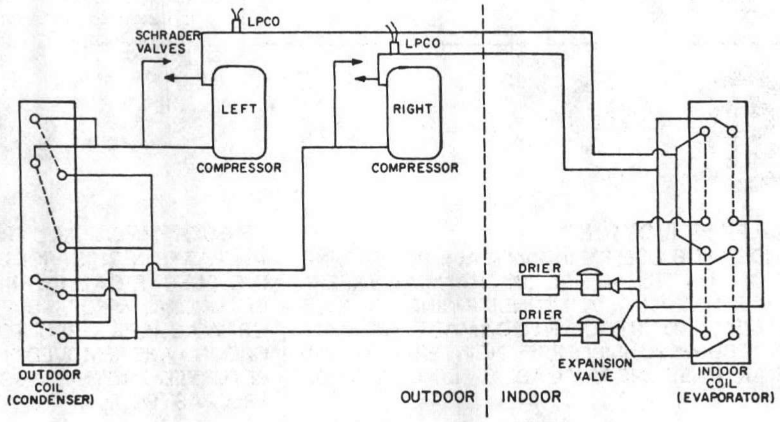
BTC120F3AOHB

COMPONENT	QTY.	DESCRIPTION	DPG CAT. #	CSG MNEMONIC #
Motor (ID)	1	230/460V, 60 Hz., 3 Ph., Open Shell, Rev., 1725 RPM, 2 HP, FLA 6.6/3.3, LRA 48.2/24.1, Ball Bearing, 1-Speed, Winding Resistance — Ohms @ 77°F.: (Hi-Voltage) 1-2 7.79/6.93, 1-3 7.79/6.93, 2-3 7.79/6.93	WW94X230	MOT2705
Pulley, Motor	1	4.75" D, 7/8" Bore, Var. Pitch 4.4-3.4 on 0-5 Turns, Browning #IVM-50/IVP-50	WW34X56	SHE-737

*New Part - Set Up Within The Last 18 Months.

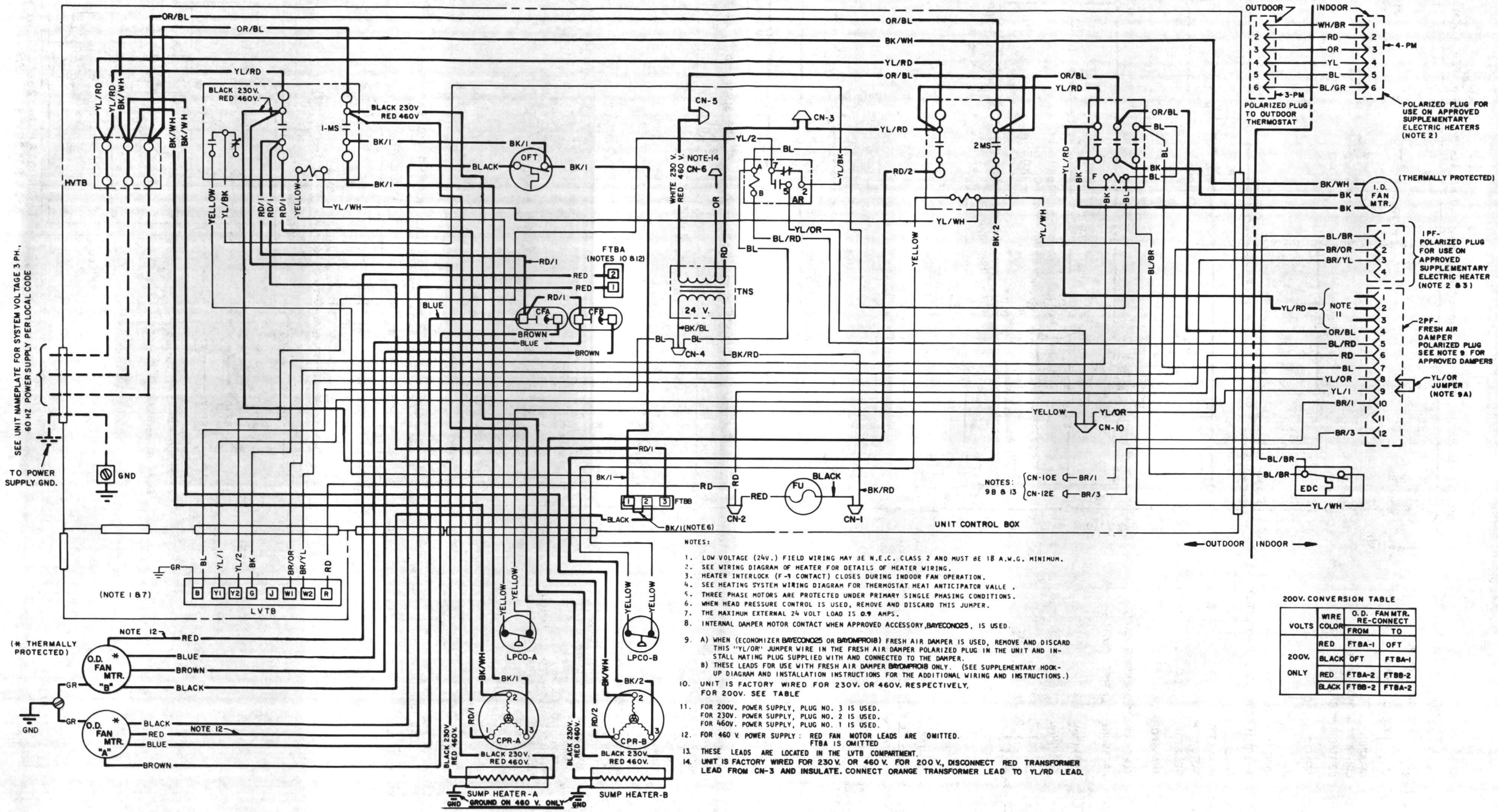
NOTE:
CSG refers to the Commercial Systems Group and DPG refers to the Dealer Product Group of The Trane Company. The CSG and DPG part numbers shown side by side above are not necessarily interchangeable for applications other than documented in this bulletin. Both are approved for service of the product listed. Inventories to support your needs are available to you through both Trane divisions.

REFRIGERANT CIRCUIT



From Dwg. 21A723908 Rev. 0

WIRING DIAGRAM BTC120F



NOTES:

1. LOW VOLTAGE (24V.) FIELD WIRING MAY BE N.E.C. CLASS 2 AND MUST BE 18 A.W.G. MINIMUM.
2. SEE WIRING DIAGRAM OF HEATER FOR DETAILS OF HEATER WIRING.
3. HEATER INTERLOCK (F-1 CONTACT) CLOSES DURING INDOOR FAN OPERATION.
4. SEE HEATING SYSTEM WIRING DIAGRAM FOR THERMOSTAT HEAT ANTICIPATOR VALUE .
5. THREE PHASE MOTORS ARE PROTECTED UNDER PRIMARY SINGLE PHASING CONDITIONS.
6. WHEN HEAD PRESSURE CONTROL IS USED, REMOVE AND DISCARD THIS JUMPER.
7. THE MAXIMUM EXTERNAL 24 VOLT LOAD IS 0.9 AMPS.
8. INTERNAL DAMPER MOTOR CONTACT WHEN APPROVED ACCESSORY, BAYECON025, IS USED.
9. A) WHEN (ECONOMIZER BAYECON025 OR BAYDMPR018) FRESH AIR DAMPER IS USED, REMOVE AND DISCARD THIS "YL/OR" JUMPER WIRE IN THE FRESH AIR DAMPER POLARIZED PLUG IN THE UNIT AND INSTALL MATING PLUG SUPPLIED WITH AND CONNECTED TO THE DAMPER.
   B) THESE LEADS FOR USE WITH FRESH AIR DAMPER BAYDMPR018 ONLY. (SEE SUPPLEMENTARY HOOK-UP DIAGRAM AND INSTALLATION INSTRUCTIONS FOR THE ADDITIONAL WIRING AND INSTRUCTIONS.)
10. UNIT IS FACTORY WIRED FOR 230V. OR 460V. RESPECTIVELY.
    FOR 200V. SEE TABLE
11. FOR 200V. POWER SUPPLY, PLUG NO. 3 IS USED.
    FOR 230V. POWER SUPPLY, PLUG NO. 2 IS USED.
    FOR 460V. POWER SUPPLY, PLUG NO. 1 IS USED.
12. FOR 460 V. POWER SUPPLY : RED FAN MOTOR LEADS ARE OMITTED.
    FTBA IS OMITTED
13. THESE LEADS ARE LOCATED IN THE LVTB COMPARTMENT.
14. UNIT IS FACTORY WIRED FOR 230 V. OR 460 V. FOR 200 V., DISCONNECT RED TRANSFORMER LEAD FROM CN-3 AND INSULATE. CONNECT ORANGE TRANSFORMER LEAD TO YL/RD LEAD.

200V. CONVERSION TABLE

VOLTS	WIRE COLOR	O.D. FAN MTR. RE-CONNECT FROM	TO
200V. ONLY	RED	FTBA-1	OFT
	BLACK	OFT	FTBA-1
	RED	FTBA-2	FTBB-2
	BLACK	FTBB-2	FTBA-2

From Dwg. 21D756526 P01

SCHEMATIC DIAGRAM

BTC120F

LEGEND

- 24 V. / LINE V. — FACTORY WIRING
- 24 V / LINE V. — FIELD WIRING
- GROUND
- CONTACT NORMALLY OPEN
- CONTACT NORMALLY CLOSED
- CONTACTS-SPDT
- CAPACITOR
- WIRE NUT OR CONNECTOR
- INTERNAL OVERLOAD PROTECTOR
- FUSE
- MAGNETIC COIL
- MOTOR WINDING
- RESISTOR OR HEATING ELEMENT
- TRANSFORMER
- TEMPERATURE SENSING SWITCH
- PRESSURE SENSING SWITCH
- TERMINAL BOARD
- TERMINAL
- MALE / FEMALE — POLARIZED PLUG

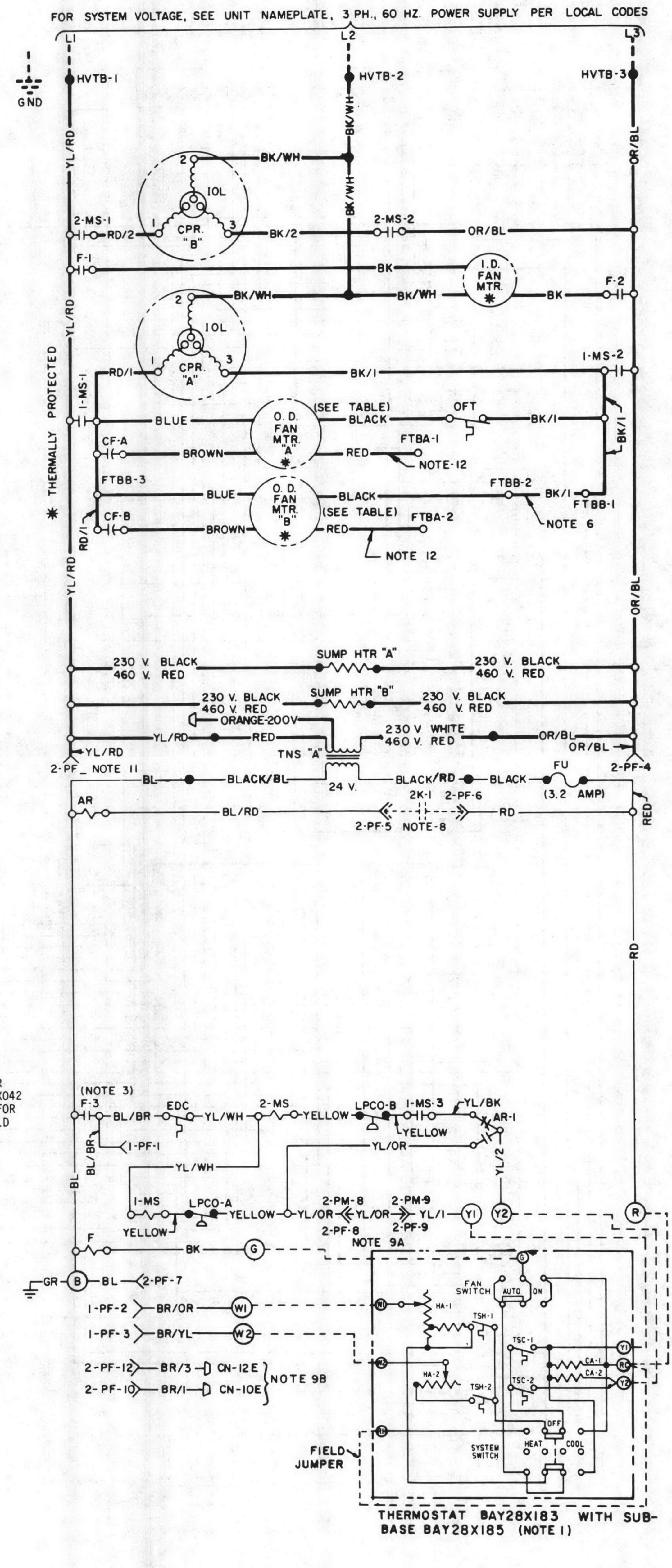
COLOR OF WIRE
BK/BL BLACK WIRE WITH BLUE MARKER
COLOR OF MARKER

BK	BLACK	RD	RED	OR	ORANGE
BL	BLUE	WH	WHITE	GR	GREEN
BR	BROWN	YL	YELLOW		

AR	AUXILIARY RELAY
CF_	FAN MOTOR CAPACITORS
CN_	WIRE CONNECTOR
CPR	COMPRESSOR
EDC	EVAPORATOR DEFROST CONTROL
F	INDOOR FAN RELAY
FTB_	FAN TERMINAL BOARD
FU	FUSE
GND	GROUND
HTR	HEATER
HVTB	HIGH VOLTAGE TERMINAL BOARD
IOL	INTERNAL OVERLOAD PROTECTOR
LPCO	LOW PRESSURE CUT OUT
LVTB	LOW VOLTAGE TERMINAL BOARD
MS	COMPRESSOR MOTOR CONTACTOR
MTR	MOTOR
OFT	OUTDOOR FAN THERMOSTAT
PF_	POLARIZED PLUG - FEMALE CONTACT
PM_	POLARIZED PLUG - MALE CONTACT
TNS	TRANSFORMER

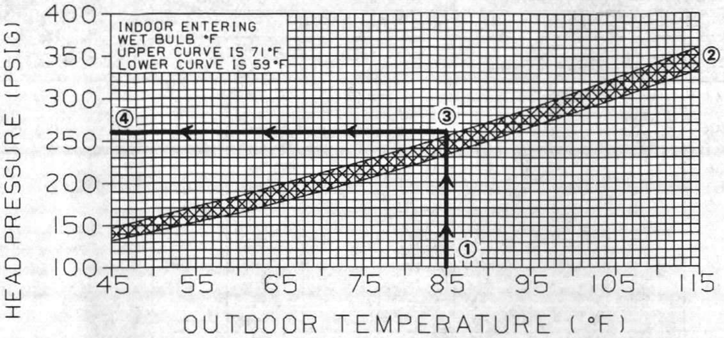
NOTES:

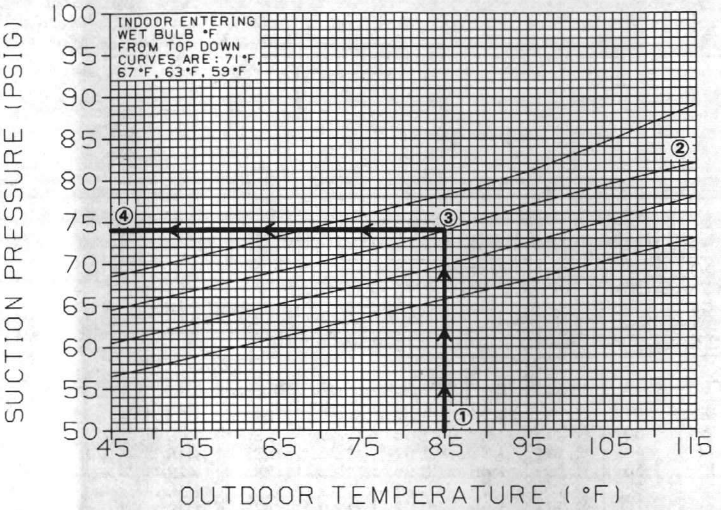
1. WHEN AUTOMATIC SUBBASES BAY28X184 OR BAY28X187 ARE USED, RELAY KIT BAY24X042 MUST BE USED TO PROVIDE "G" SIGNAL FOR ELECTRIC HEATING OPERATION. SEE FIELD WIRING DIAGRAM.



From Dwg. 21C756518 P01

PRESSURE CURVES — BTC120F





COOLING PERFORMANCE TO BE CHECKED WHEN OUTDOOR TEMPERATURE IS ABOVE 55°F. AFTER OPERATING PRESSURES HAVE STABILIZED: MEASURE INDOOR WET BULB TEMP. — OUTDOOR TEMP. — HEAD & SUCTION PRESSURES.
LOCATE OUTDOOR TEMP. ① LOCATE INDOOR WET BULB ② FIND INTERSECTION OF OD TEMP. & ID W.B. ③ READ HEAD OR SUCTION PRESSURE IN LEFT HAND COLUMN ④ (SELECT PROPER INDOOR CFM)

ACTUAL HEAD PRESSURE SHOULD BE ± 10 PSIG OF CHART
SUCTION PRESSURE SHOULD BE ± 3 PSIG OF CHART

EXAMPLE: ① OUTDOOR TEMP 85°F., ② INDOOR WET BULB 67°F.,
③ HEAD PRESSURE @ 4000 CFM = 260 PSIG ④
③ SUCTION PRESSURE @ 4000 CFM = 74 PSIG ④

NOTE:
1. FOR OPERATION WITH ONLY **ONE OUTDOOR FAN:** USE CHARTS AT OUTDOOR TEMPERATURE 25° HIGHER THAN ACTUAL TEMPERATURE.
2. FOR OPERATION WITH ONLY **ONE COMPRESSOR:** INCREASE HEAD PRESSURE 5 PSIG AND SUCTION PRESSURE 5 PSIG.

From Dwg. 21C723907 Rev. 0

PRESSURE DROP CHARACTERISTICS
ELECTRIC HEATERS

AIRFLOW, CFM	NUMBER OF RACKS (See table at the right) 1	2	3
	AIR PRESSURE DROP, in. w.g.		
2000	0.01	0.02	0.03
2200	—	—	—
2400	—	0.03	0.04
2600	—	—	0.05
2800	0.02	0.04	0.06
3000	—	—	—
3200	—	0.05	0.07
3400	—	—	0.08
3600	0.03	0.06	0.09
3800	—	0.07	0.10
4000	0.04	0.08	0.12
4200	—	0.09	0.13
4400	0.05	0.10	0.15
4600	—	0.11	0.16
4800	0.06	0.12	0.18
5000	0.07	0.13	0.20

HEATER MODEL NO.	NOMINAL RATING	NO. OF RACKS
BAY96X241A BAYHTRA310	10 KW	1
BAY96X242A BAYHTRA320	20 KW	1
BAY96X243A BAYHTRA330	30 KW	2
BAY96X244A BAYHTRA340	40 KW	2
BAY96X245B BAYHTRA350	50 KW	3
BAY96X246B BAYHTRA360	60 KW	3

From Dwg. 21A723873 Rev. 0

INDOOR FAN PERFORMANCE FOR BTC120F300HB

	MOTOR PULLEY TURNS OPEN (FACTORY SETTING, 2)& BLOWER SPEED — RPM											
	0 & 725		1 & 690		2 & 655		3 & 620		4 & 585		5 & 550	
	EXTERNAL STATIC PRESSURE (in. w.g.) AND BRAKE HORSEPOWER (BHP)①											
AIRFLOW, CFM	PRESS	BHP	PRESS	BHP	PRESS	BHP	PRESS	BHP	PRESS	BHP	PRESS	BHP
2600	0.91	.97	0.81	.89	0.71	.81	0.62	.75	0.52	.72	0.43	.70
2800	0.89	1.03	0.79	.95	0.69	.85	0.59	.78	0.49	.75	0.39	.72
3000	0.86	1.09	0.76	1.00	0.66	.90	0.55	.82	0.44	.79	0.34	.75
3200	0.83	1.16	0.72	1.06	0.61	.97	0.50	.87	0.39	.83	0.28	.79
3400	0.79	1.23	0.67	1.12	0.56	1.03	0.45	.92	0.33	.87	0.22	.83
3600	0.74	1.30	0.62	1.19	0.51	1.09	0.39	.99	0.27	.92	0.15	.87
3800	0.68	1.37	0.56	1.26	0.45	1.15	0.32	1.05	0.20	.98	0.07	.92
4000	0.62	1.45	0.50	1.33	0.38	1.22	0.25	1.11	0.12	1.04	—	—
4200	0.55	1.53	0.43	1.41	0.30	1.29	0.17	1.18	0.04	1.10	—	—
4400	0.46	1.61	0.34	1.49	0.21	1.37	0.08	1.26	—	—	—	—
4600②	0.36	1.69	0.24	1.57	0.11	1.45	—	—	—	—	—	—
4800②	0.26	1.78	0.14	1.66	0.01	1.54	—	—	—	—	—	—
5000②	0.16	1.87	0.04	1.75	—	—	—	—	—	—	—	—

① 1-1/2 HP. motor limit, (class B insulation).
2450 Watts at 230V & 460V
2150 Watts at 200V
② Water blow-off limit: 4600 CFM

From Dwg. 21A723878 Rev. 0

INDOOR FAN PERFORMANCE HIGH STATIC (BTC120F3A0HB)

	WET COIL, 1" GLASS FIBER FILTERS MOTOR PULLEY TURNS OPEN (FACTORY SETTING, 3) BLOWER SPEED — RPM											
	0 & 960		1 & 915		2 & 870		3 & 825		4 & 780		5 & 735	
	EXTERNAL STATIC PRESSURE (In. of Water) AND BRAKE HORSEPOWER (BHP)*											
AIRFLOW CFM	PRESS	BHP	PRESS	BHP	PRESS	BHP	PRESS	BHP	PRESS	BHP	PRESS	BHP
2600	1.66	1.50	1.52	1.41	1.38	1.31	1.23	1.21	1.07	1.12	0.92	1.03
2800	1.64	1.60	1.50	1.49	1.36	1.39	1.21	1.28	1.05	0.19	0.90	1.09
3000	1.62	1.69	1.48	1.58	1.33	1.47	1.19	1.37	1.02	1.26	0.87	1.15
3200	1.60	1.79	1.45	1.67	1.30	1.56	1.16	1.45	0.99	1.33	0.84	1.23
3400	1.57	1.90	1.42	1.77	1.27	1.65	1.12	1.54	0.96	1.42	0.80	1.30
3600	1.53	2.01	1.38	1.87	1.23	1.74	1.08	1.62	0.92	1.49	0.75	1.38
3800	1.49	2.13	1.34	1.98	1.19	1.84	1.04	1.70	0.87	1.58	0.69	1.45
4000	1.44	2.26	1.30	2.10	1.15	1.95	0.99	1.80	0.81	1.66	0.63	1.54
4200	1.38	2.38	1.24	2.21	1.09	2.05	0.92	1.90	0.74	1.76	0.56	1.62
4400	1.31	2.51	1.17	2.33	1.01	2.16	0.84	2.00	0.65	1.85	0.48	1.70
4600**	1.23	2.64	1.09	2.45	0.93	2.28	0.75	2.11	0.56	1.95	0.39	1.79
4800**	1.14	2.76	1.00	2.57	0.84	2.39	0.66	2.22	0.47	2.05	0.29	1.85
5000**	1.04	2.90	0.91	2.70	0.75	2.52	0.57	2.34	0.38	2.16	0.19	1.98

* 2 Hp. Motor Limit, (Class B Insulation): 2800 Watts.
** Water Blow-Off Limit: 4600 CFM
NOTES:
1. Fan motor heat: MBh = 3.15 x fan bhp, also: Kw (Mechanical output) = hp x .7457
Kw (Electrical input) = (hp x .7457) Motor Efficiency
Motor Efficiency = 80%

SUPPLEMENTARY HEATERS

Model Number	Power Supply V/O/HZ	KW Rating 208-240 V	Nominal BTU/H
BAY96X241A BAYHTRA310	208-240/3/60	7.48-9.96	25,500-34,000
BAY96X242A BAYHTRA320	208-240/3/60	14.96-19.92	51,000-68,000
BAY96X243A BAYHTRA330	208-240/3/60	22.44-29.88	76,600-102,000
BAY96X244A BAYHTRA340	208-240/3/60	29.92-39.84	102,100-136,000
BAY96X245B BAYHTRA350	208-240/3/60	37.40-49.80	127,600-170,000
BAY96X246B BAYHTRA360	208-240/3/60	44.88-59.76	153,200-204,000

From Dwg. 21A724006 Rev. 0

TAB PLACEMENT HERE

DESCRIPTION:

Roof top

Accessories

☐ Tab page did not contain hand written information

☑ Tab page contained hand written information
*Scanned as next image

Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

TRANE™

ACCSY-IN-8A
18-HE60D15

BLDG# AS-502

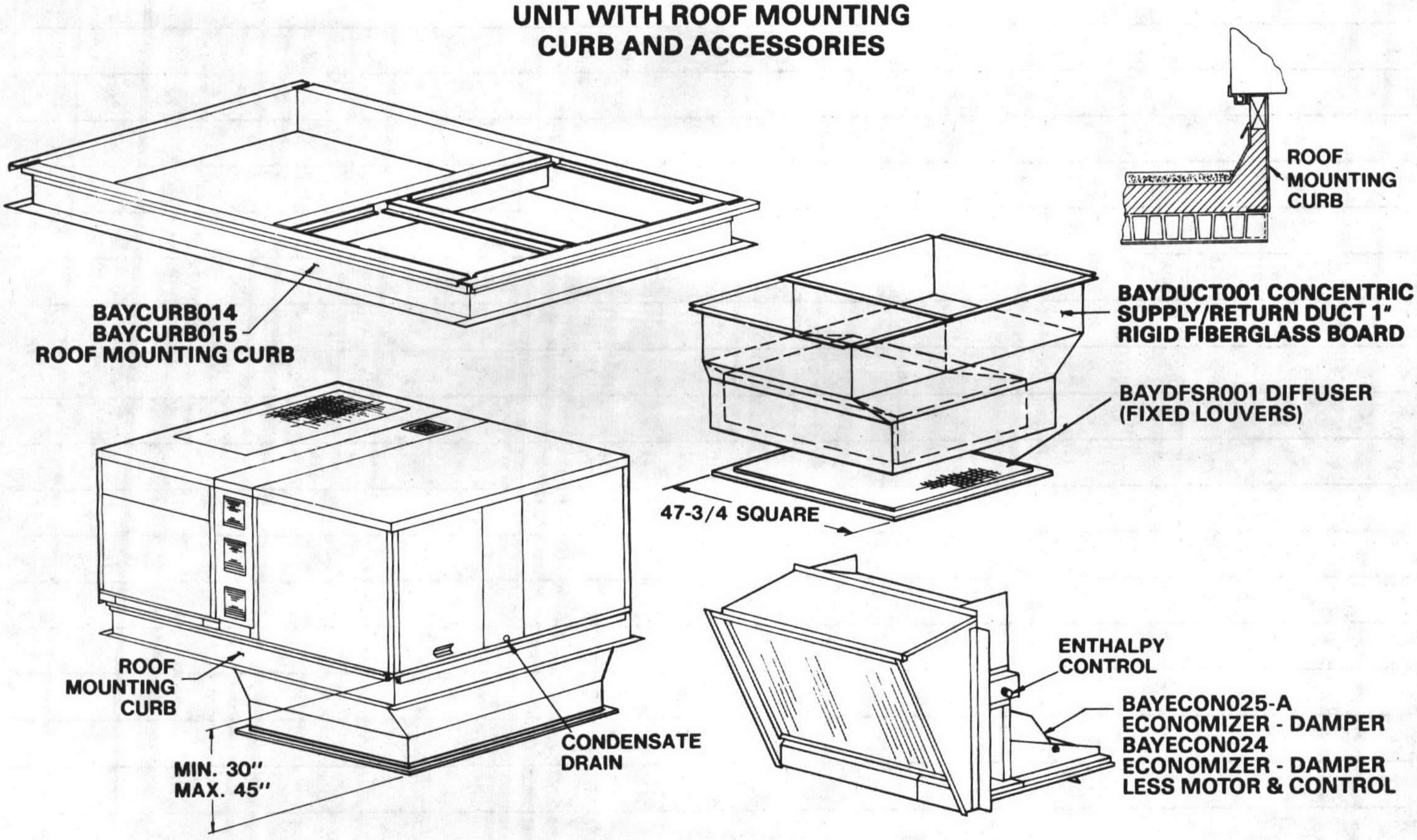
INSTALLER'S GUIDE

Rooftop Accessories

Rooftop Accessories
BYC,BTC,BWC090-120F
For use with
7-1/2 and 10 Ton
Single Package

Library	Service Literature
Product Section	Unitary
Product	Unitary Accessories
Model	Econ., Roof Curbs, Ducts, Diffusers
Literature Type	Installer's Guide
Sequence	8A
Date	March 1987
File No.	SV-UN-ACC-ACCSY-IN-8A 3/87
Supersedes	

UNIT WITH ROOF MOUNTING CURB AND ACCESSORIES



Since The Trane Company has a policy of continuous product improvement, it reserves the right to change specifications and design without notice. The installation and servicing of the equipment referred to in this booklet should be done by qualified, experienced technicians.

dwg. no. 21A725195 P01

This booklet covers the Rooftop accessories listed for the 7½ and 10 ton models only SINGLE PACKAGE UNITS.

These instructions are organized into four (4) stages for an easy step by step procedure.

The FIRST stage covers the: ROOF MOUNTING CURB (or Frame) BAYCURB014 or BAYCURB015 (BAYCURB014 is to be field assembled) (BAYCURB015 is factory assembled, with insulation on the inside of the side and end rails) on pages 4 thru 6.

The SECOND stage covers the: CONCENTRIC SUPPLY/ RETURN DUCT BAYDUCT001 on page 7.

The THIRD stage covers the: FLUSH MOUNTED SQUARE DIFFUSER BAYDFSR001 on page 9.

The FOURTH stage covers the mounting of the following: BAYECON025-A Automatic Economizer Dampers, Drive Motor and Enthalpy Control (0-100% outdoor air); BAYECON024 Economizer Dampers, less Drive Motor and Control (0-100% outdoor air) (see pages 10-13); BAYBARM007 Barometric Relief Damper, to be used with BAYECON025-A, also BAYECON024 if required.

BAYDMPR018 Motorized Fresh Air Damper. See page 14-15.

For instructions related to the Single Package Unit, refer to the instructions packaged with that unit.

These instructions do not purport to cover all variations in systems nor to provide for every possible contingency to be met in connection with installation. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to The Trane Company.

Check for transportation damage after accessory is uncrated. Report promptly, to the carrier, any damage found to the kit.

NOTE: The roof mounting curb (frame) not only provides a support for the unit, but permits an easy penetration of the roof for the connecting ductwork. The roof mounting curb provides for proper flashing and sealing by the roofing contractor as approved by National Roofing Contractors Association.

NOTES

GENERAL — LOCATIONS AND RECOMMENDATIONS

1. Adequate support must be provided beneath the roof mounting curb for the entire length. The total weight of the unit, curb and duct plus any accessories must be considered when selecting and placing the curb on the roof.

2. Be sure location of the roof mounting curb will allow needed service clearance around unit when the unit is in place. (As illustrated.)

IMPORTANT: The illustrations below have dimensions on the concentric supply/return duct, to emphasize that the duct extends out past the end of curb below roof deck, when installed. Check for clearance for duct inside the structure.

3. **Roof Mounting Curb (frame) must be installed on a flat, level section of the roof (maximum of 1/4″ per foot pitch), providing a level mounting surface for the unit, even though the roof is not level. If the pitch of the roof exceeds 1/4″ per foot it will be necessary for the contractor to construct a sub-base on which to install the roof mounting curb level.**

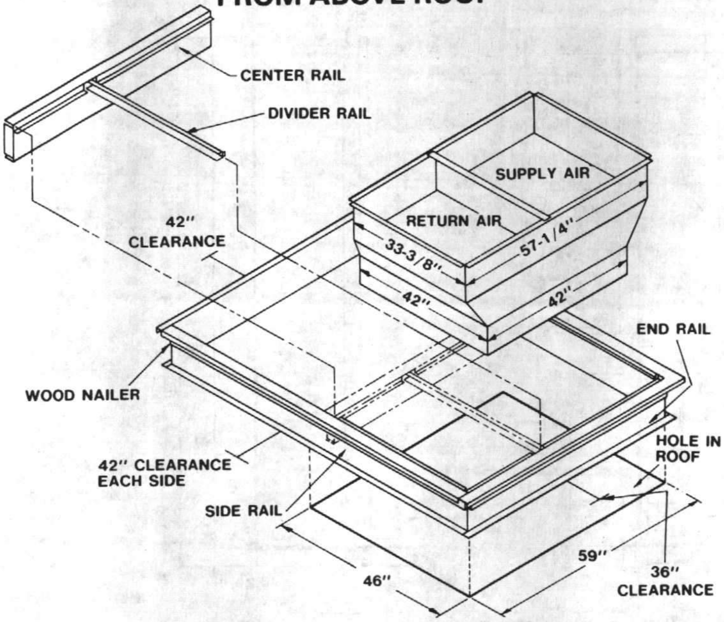
4. Do not locate the mounting curb near exhaust vents or other sources of contaminated air that could enter unit air inlets. Although unit is water proof, guard against water runoff from higher overhanging structures.

5. Field Fabricated Ductwork — Secure all ducts to building structure. Use flexible duct connectors between unit and ducts.

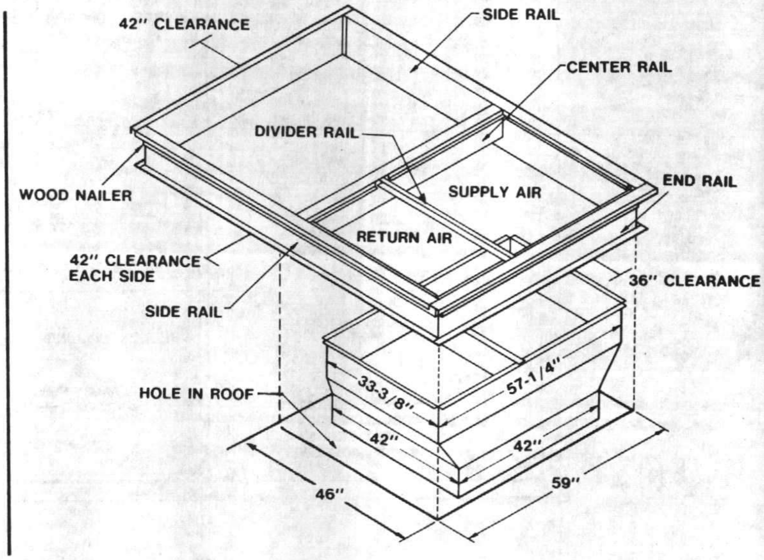
Ducts passing thru unconditioned space must be insulated and covered with a vapor barrier.

REQUIRED CLEARANCE FOR UNIT INSTALLATION AND ROOF PENETRATION HOLE

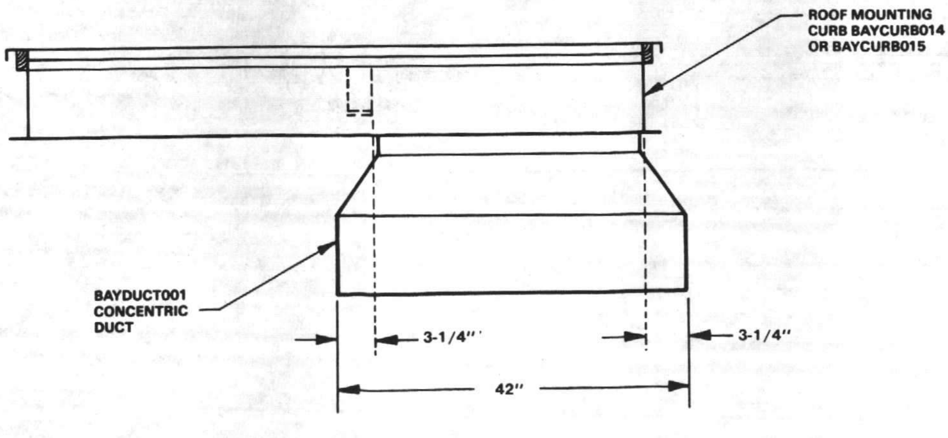
CONCENTRIC SUPPLY & RETURN DUCT FROM ABOVE ROOF



CONCENTRIC SUPPLY & RETURN DUCT FROM BELOW ROOF



CURB AND CONCENTRIC DUCT ASSEMBLED



FIRST STAGE INSTALLATION

ROOF MOUNTING CURB

ROOF PENETRATION HOLE SIZE REQUIRED

CAUTION: The opening must be covered temporarily to prevent anyone or anything from falling thru the opening. Follow this safety precaution when working in other areas of installation, and leaving the job site overnight or for any extended period of time.

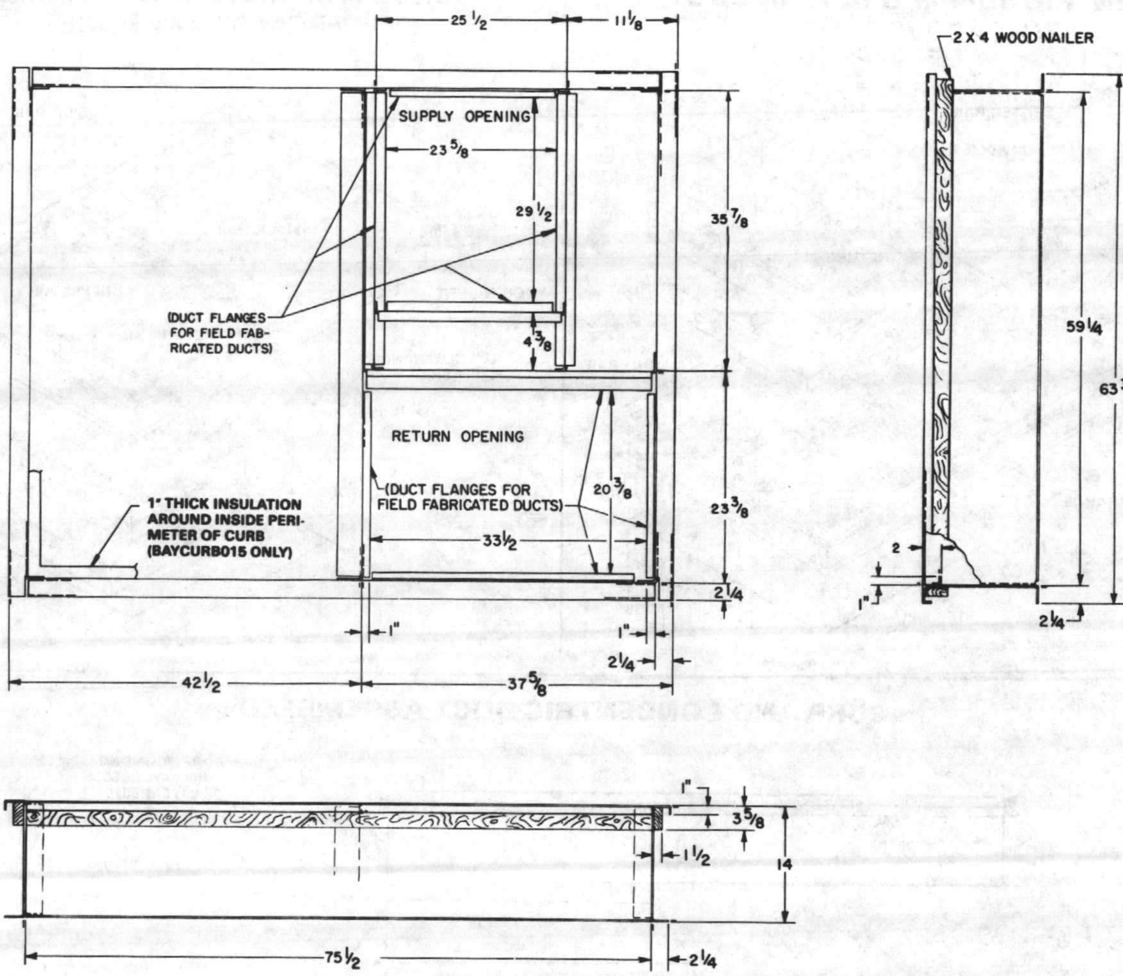
1. When installing the Concentric Supply Return Duct (BAYDUCT001) from below or above the mounting curb, a hole size of 59″ W. x 46″ L. must be provided in the roof to insert and secure the flanges of the duct to the mounting curb as illustrated on page 2 and below. When installing Field Fabricated ducts from below or above the mounting curb, a hole size of 59″ W. x 40″ is recommended to insert and secure the flanges of the duct to the mounting curb as illustrated on page 2 and below. When field fabricated ducts are used, the dimensions may be reduced to accommodate ducts and installation clearance needed. See the Supply and Return Air Openings as illustrated below.

2. The Field Fabricated supply and return Ducts are: Supply air duct 29-7/16″ x 23-9/16″ with 3/4″ flanges. Return air duct 20-5/16″ x 33-7/16″ with 3/4″ flanges. See shaded area of illustration below.

3. All duct work must be installed in accordance with the National Fire Protection Association Standards No. 90A and 90B.

4. The BAYCURB015 Roof Mounting Curb is factory assembled, with insulation on the inside perimeter of curb.

BAYCURB015 ROOF MOUNTING CURB OUTLINE



dwg. no. 21A725195 P01

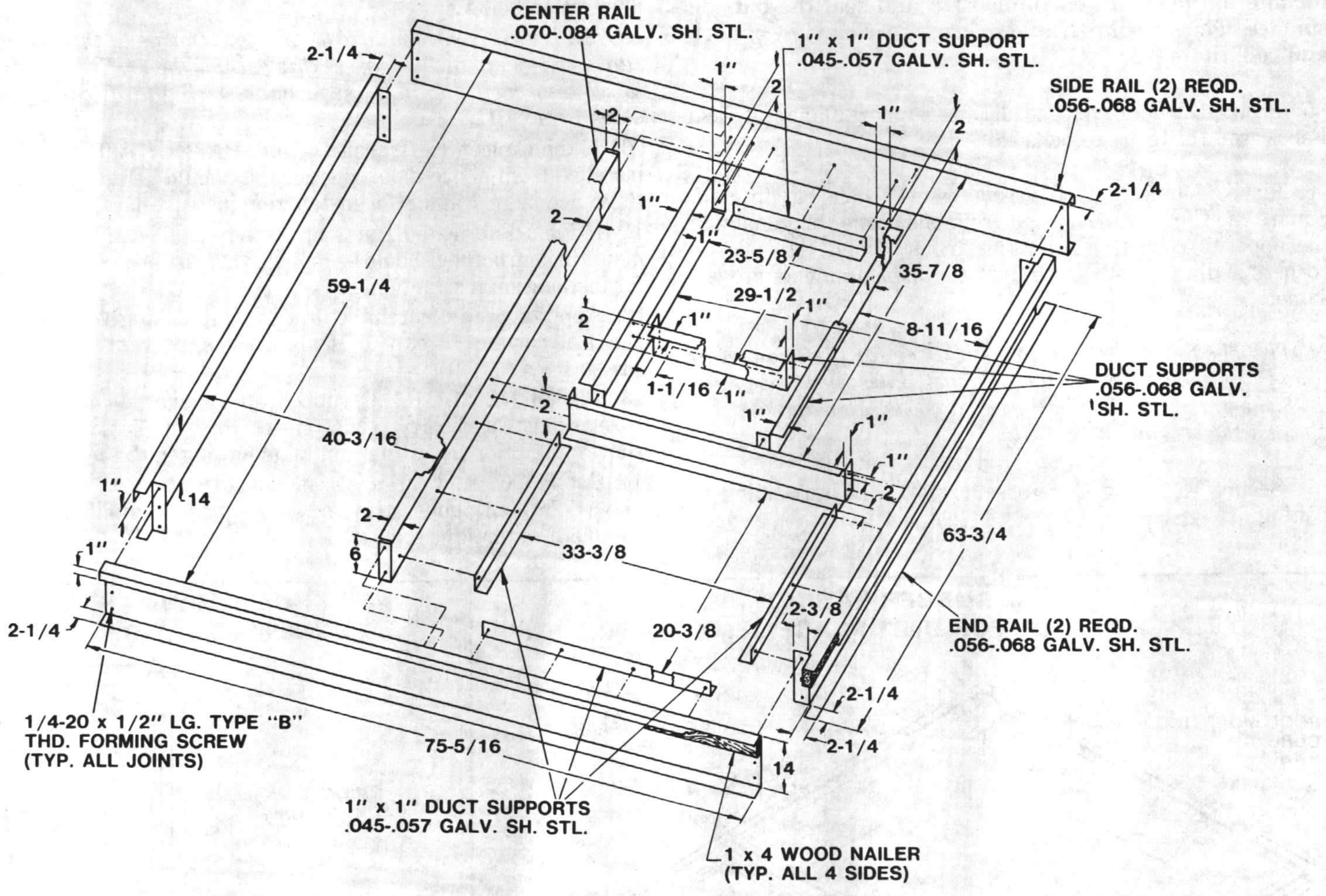
BAYCURB014 ROOF MOUNTING CURB ASSEMBLY

1. Remove the components of the mounting curb from carton and separate pieces from each other.

2. Layout, separate pieces on flat surface close to area where it will be used. See illustrations to determine proper placement of parts. Assemble by snapping clips on End Rails, Side Rails and Center Rail into the slots provided on the mating parts of mounting curb.

3. Secure these parts by driving (1/4 - 20 x 1/2″ long type "B") thread forming screws thru holes provided in mating part.

4. There are four (4) 1″ x 1″, three (3) 1″ x 2″ Duct Support Flanges and one (1) 2″ x 2″ Divider Rail with a flange for return air duct. All of the above can be placed and secured to the Side Rails, End Rail, Center Rail and each other (indoor section) by driving sheet metal screws through holes provided.



COMPONENT DRAWING

BAYCURB014 ROOF MOUNTING CURB

The BAYCURB014 Roof Mounting Curb is shipped disassembled with the components to be assembled on the job site as illustrated. This assembly includes the following components (check list before starting job).

Note: The Insulated Deck is secured to the bottom of the 7-1/2, 10 ton "F-A" units at the factory and requires no field assembling.

CONTENTS

- 2—End Rails
- 2—Side Rails
- 1—Center Rail (Hood Support)
- 4—1″ x 1″ Duct Support Flanges
- 3—1″ x 2″ Duct Support Flanges
- 1—Divider Rail with a Flange for Return Air Duct.
- 1—Bag of Bolts & Screws
- 4—Wood Nailers (Attached)
- 4—¼-20 x 1½″ long Hold Down Screws (Not Shown)
- 3—Rolls 1½ x ½ P.V.C. Rubber Gasket (shipped with unit)

ROOF MOUNTING CURB (Cont.)

NOTE: Remove and discard one (1) 1" x 1" and three (3) 1" x 2" Duct Support Flanges in the supply air section if concentric duct (BAYDUCT001) is to be installed from below the curb. There are three (3) 1" x 1" Duct Support Flanges shipped with and attached to the flange of the concentric duct (BAYDUCT001). Secure each 1" x 1" Duct Support Flange to the roof mounting curb in their respective location as shipped. Screws are provided to secure duct support flanges to curb.

IMPORTANT: The BAYCURB014 does not have insulation on inside perimeter of curb. To prevent condensation from forming on inside of curb, insulate and seal the outside surface of curb as illustrated in cross section view of curb and roof (item 8).

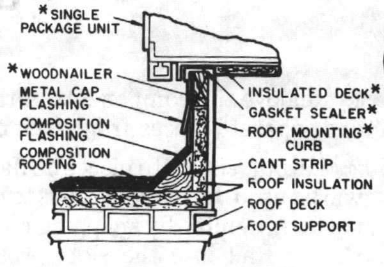
5. Secure Divider Baffle and all Duct Support Flanges if Field Fabricated Ducts are to be used.

6. Place Mounting Curb assembly over hole cut in roof. Square the Curb by measuring from one corner diagonally to the opposite corner. Repeat this measurement of opposite corners and adjust the Curb until the measurements are the same.

NOTE: The top of the End Rails, Center Rail, Divider Rail (and Supply Air 1" x 2" Duct Flanges if used) must be flush with the top of the Curb to insure a good water and air seal against the bottom of the unit.

7. Secure Mounting Curb assembly to roof by welding or bolting.

8. Install flashing and roofing as illustrated in accordance with local codes. A typical section of insulation, roof and mounting curb is shown at right.



*ITEMS AVAILABLE FROM THE TRANE COMPANY

9. Leave the four (4) ¼-20 x 1½ long Hold Down Screws attached to the curb temporarily as they will not be needed until after the unit has been placed on the curb. See illustration below.

NOTE: If unit is not ready to be set into position at this time, stop work on mounting curb at this point. When unit is ready to set into position, and just prior to setting unit, complete steps 10 thru 14.

10. If the Concentric Transition Duct BAYDUCT001 is to be installed from above mounting curb, it should be done at this time. See page 7 and 8 for installation instructions.

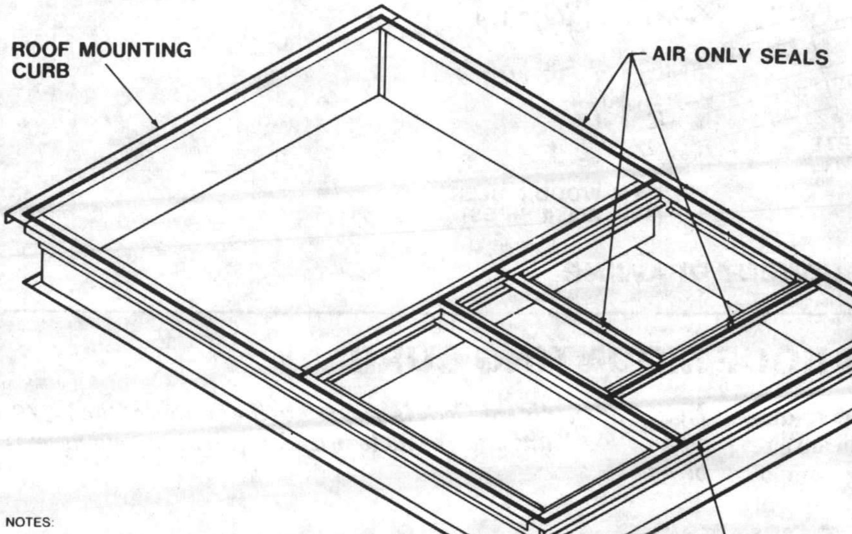
11. If Field Fabricated Ducts are to be installed from above mounting curb, they should be installed at this time. See page 8 for installation instructions.

12. Apply a bead of architectural grade caulking (field supplied) at corners of curb to seal all voids, preventing water leaks.

13. Place 1-1/2 x 1/2 P.V.C. rubber tape (gasket) on mounting curb as illustrated below P.V.C. gasket to be applied to curb as shown just prior to setting unit on mounting curb.

14. All P.V.C. rubber gasket (supplied with unit) must be applied in continuous strips or overlapped 1" minimum for complete watertight seal.

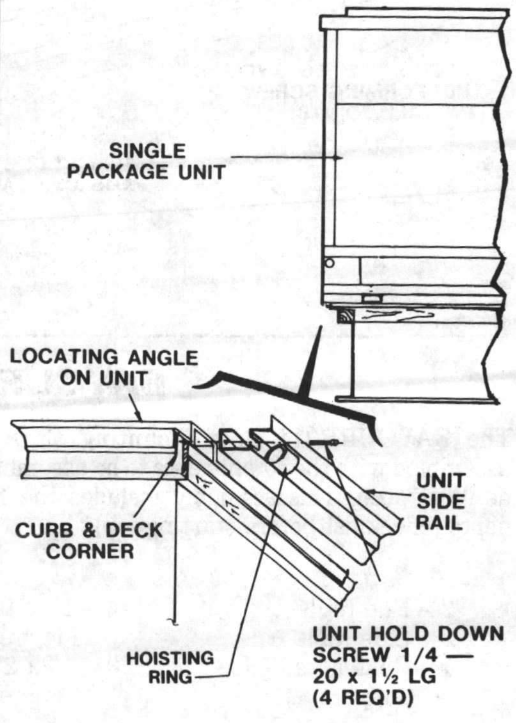
P.V.C. RUBBER GASKET POSITION FOR UNIT PLACEMENT



NOTES:

1. OVERLAP & POSITION JOINTS IN P.V.C. RUBBER GASKET AS SHOWN.
2. AIR SEALS — APPLY P.V.C. RUBBER LAST TO INSURE THERE IS ADEQUATE P.V.C. FOR THE WATER SEAL.
3. USE TYPICAL SEALING METHODS TO PREVENT DUCT AIR LEAKAGE AT CURB-DUCT JOINT.

HOLD DOWN SCREW LOCATION



ROOF MOUNTING CURB (Cont.)

IMPORTANT
To set unit into position on Roof Mounting Curb, refer to unit's Installer's Guide BTC-IN-3 (18-AB60D4), BWC-IN-3 (18-BB60D4)

SECOND STAGE INSTALLATION

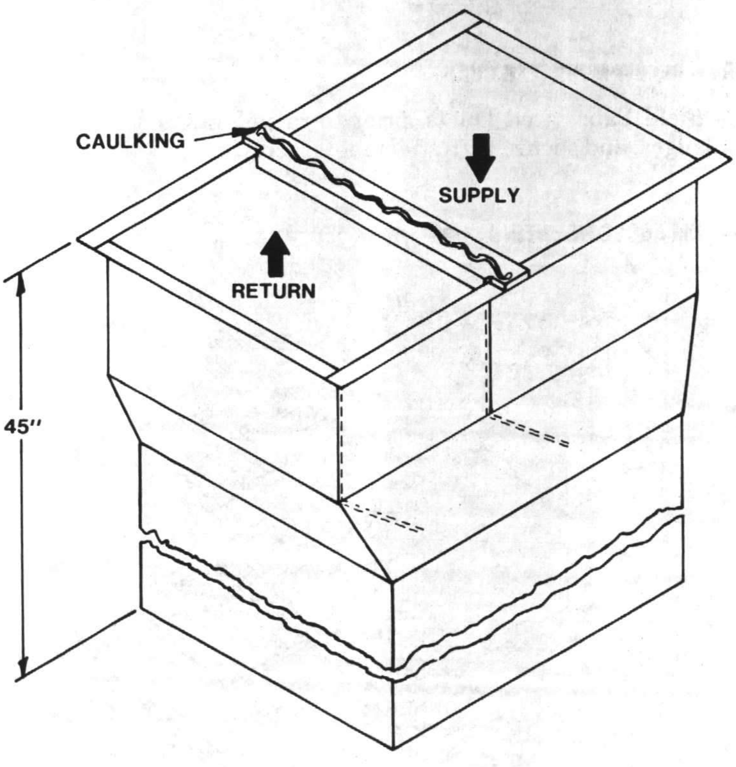
BAYDUCT001 CONCENTRIC SUPPLY/RETURN DUCT

The BAYDUCT001 Supply/Return Duct may be installed from above prior to setting the unit in place or from below (i.e. inside the building) after setting the unit in place.

IMPORTANT: When concentric duct BAYDUCT001 is used, remove and discard one (1) 1″ x 1″ and three (3) 1″ x 2″ duct support flanges from the supply air section. There are three (3) 1″ x 1″ duct support flanges shipped with and attached to the concentric duct (BAYDUCT001). Secure each 1″ x 1″ Duct Support Flange to the roof mounting curb in their respective location as shipped, secured to the concentric duct flanges. Screws are provided to secure duct support flanges to curb.

INSTALLING FROM ABOVE BAYCURB014 or BAYCURB015 CURB

1. Remove the screws that secure the center rail to each side rail and remove the screws that secure the divider rail to the end rail. Save the center rail, divider rail and screws for later use. See illustration on page 3.



BAYDUCT001
SUPPLY & RETURN DUCT

2. Apply a good grade of weatherproof caulking on Flange Support to obtain a good air seal. See illustration at top of page 8.

3. Orient the Supply/Return Duct with respect to the unit's supply and return sections.

4. Lower Duct into roof opening. See illustration at top of page 8.

5. Apply a small bead of caulking on the flange between the supply and return air sections of concentric duct (BAYDUCT001) to form an air tight seal.

6. Replace the center rail and divider rail removed in step one (1) by reversing the procedure. The duct support flanges on the center rail should be under the flange of the concentric duct flange.

7. Install screws in flange to secure concentric duct BAYDUCT001 to Curb.

INSTALLING FROM BELOW BAYCURB014 CURB ONLY

IMPORTANT: Due to the insulation on the inside parameter of BAYCURB015 roof mounting curb, there is not enough room for the flange of the concentric supply and return duct to be installed from below the curb.

1. Apply a good grade of caulking on End Flange support, See illustration at top of page 8.

2. Orient the Supply/Return Duct with respect to the Unit's Supply/Return Sections.

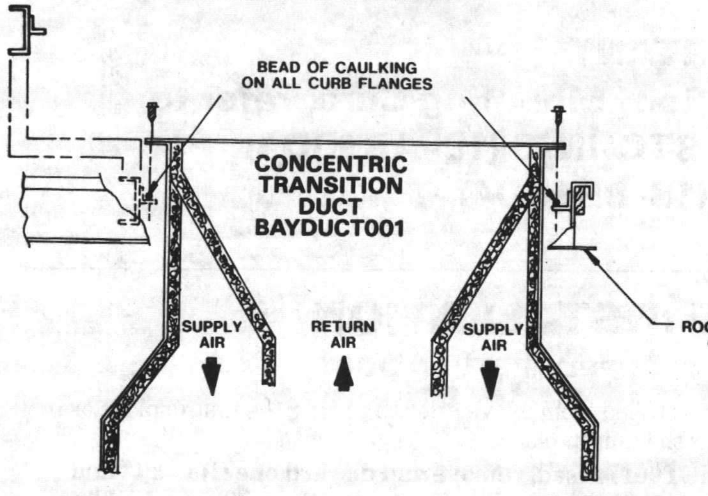
3. Apply caulking to the duct flange edge (side next to the center rail). See illustration at top of page 8.

4. Slip the side that will be against the END RAIL up over the Duct Flange Support as shown in illustration at top of page 8.

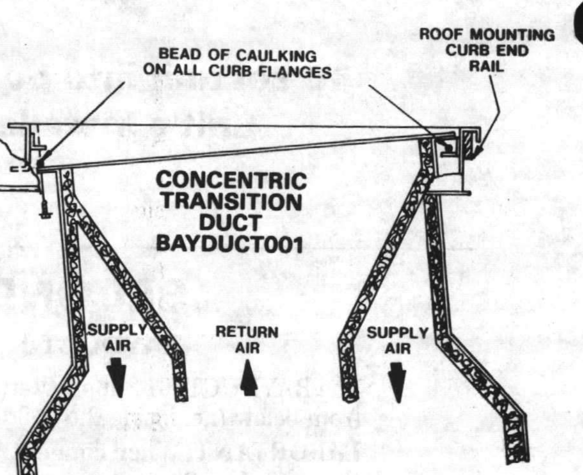
5. Pivot Duct upward until stopped by support flange on the curb center rail flange.

6. Install screws in flange to secure.

CONCENTRIC SUPPLY & RETURN DUCT FROM ABOVE ROOF



CONCENTRIC SUPPLY & RETURN DUCT FROM BELOW ROOF



ROOF MOUNTING CURB
FIELD FABRICATED (SIDE X SIDE) DUCTS

1. Field Fabricated Ducts may be installed from either below or above the Mounting Curb. See illustration below.

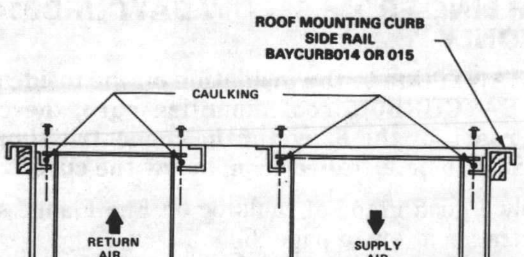
SIDE X SIDE DUCTS INSTALLED FROM ABOVE MOUNTING CURB

2. Apply a continuous bead of caulking on Duct Support Flanges, prior to lowering Field Fabricated Ducts into position on Duct Support Flanges. Make assembly secure with sheet metal screws See illustration below.

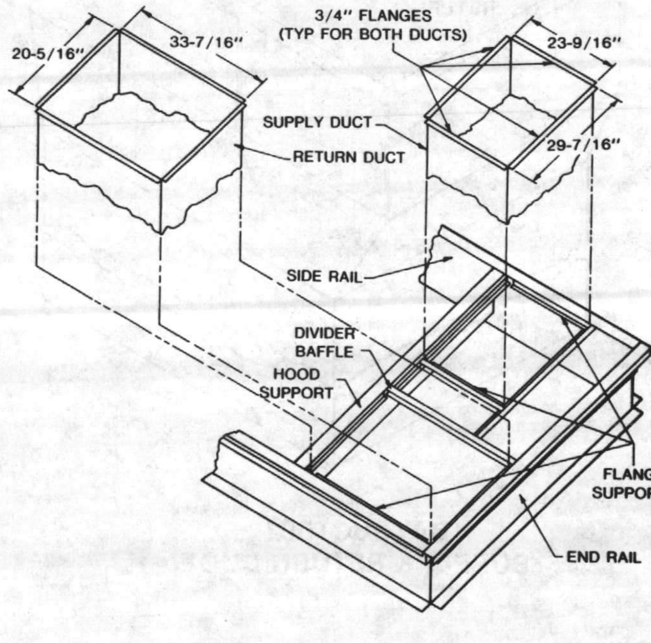
SIDE X SIDE DUCTS INSTALLED FROM BELOW MOUNTING CURB

3. Apply a continuous bead of caulking on flanges of Field Fabricated Ducts, prior to raising ducts thru opening in roof and place against Duct Support Flanges, and secure with sheet metal screws.

SIDE X SIDE DUCTS INSTALLED FROM ABOVE MOUNTING CURB



FIELD FABRICATED SIDE BY SIDE DUCTS INSTALLED FROM ABOVE CURB



THIRD STAGE INSTALLATION
BAYDFSR001
FLUSH MOUNTED SQUARE DIFFUSER

This AIR DIFFUSER is designed to be used with CONCENTRIC SUPPLY AND RETURN DUCT BAYDFSR001. It fits directly to the ceiling and secures to the ducts. To simplify installation, a bridge mounting system built into the diffuser frame, allows both the supply and return ducts to be attached to the frame while the core is removed. This eliminates the necessity of separating the supply and return sections of the core to attach the duct . . . just install frame, attach both ducts and insert core . . . easily done with stud hangers and quarter-turn fasteners. See illustration below.

1. Cut duct off or extend with comparable material, to desired length. Measure from ceiling line back 1-1/2″.

2. Remove center part of grille, which is held into the frame by 1/4 turn fasteners.

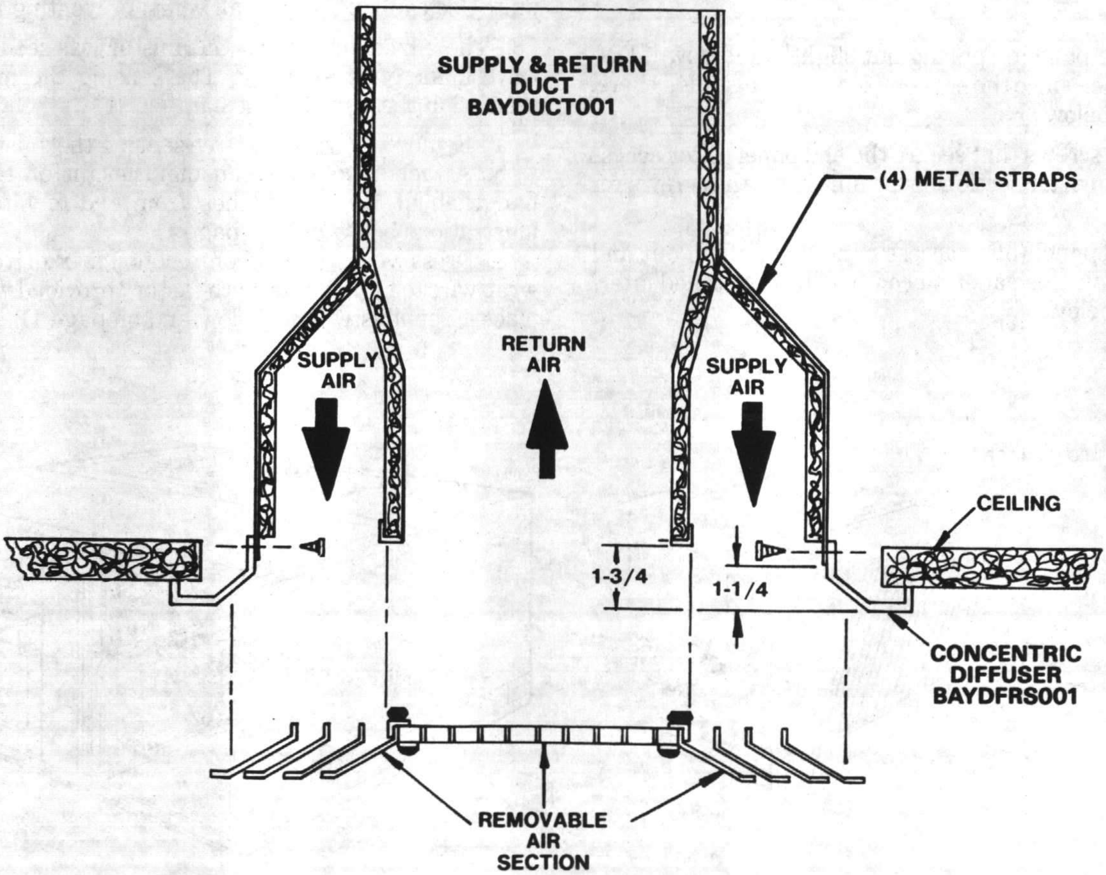
3. Press diffuser crossbar frame in proper position to make impressions for crossbar slots (use chalk if necessary) cut slots approximately 1-1/2″ in duct.

4. The SUPPLY AND RETURN DUCT has 4 metal straps extending down outer sides. With the frame held tight against the ceiling, and the straps taut, drill hole through strap and crossbar frame of diffuser, as shown in illustration.

5. Secure all four straps to diffuser with sheet metal screws.

6. Replace Supply Return Air Grille removed in Step 2.

DIFFUSER AND CONCENTRIC SUPPLY/RETURN DUCT



FOURTH STAGE INSTALLATION
BAYECON025-A AUTOMATIC ECONOMIZER
0-100% FRESH AIR DAMPER

GENERAL

This instruction covers the installation of the 0-100% fresh air damper in the BYC, BTC, BWC090,120F models. These air conditioning units are designed for downflow application only.

The economizer is factory assembled for ease of installation. The motor and its linkage are factory installed and adjusted.

NOTE: Do not make any adjustments to the damper drive linkage. Linkage has been factory set for correct operation.

INSPECTION

Check carefully for any shipping damage. If damaged, this must be immediately reported to, and claims made against, the transportation company. Replace damaged parts with authorized parts only.

INSTALLATION RECOMMENDATIONS

1. Access - **Place the Disconnect Switch(es) in the "OFF" position.** Remove the screws that secure the side panel of the return air section of the unit. Save the screws for securing the economizer later.

2. Remove side panel by pulling out slightly and down. Discard the side panel, since the economizer will be installed there. See illustration below.

3. Remove the screws that secure the end panel (filter access panel), of the return air section of the unit. Save the screws for later use.

4. Remove end panel (filter access panel) by pulling out and slightly down. Save this panel, since it will be reinstalled later. See illustration below.

NOTE: If an economizer is used with a factory installed drive motor, remove jumper plug from the polarized plug and discard. The polarized plug is located at the top and near the outlet end of the filter rack in the unit.

5. There are two (2) angle panels shipped with BAYECON025-A and BAYECON024 economizer; the wider angle panel is to be installed across the top side panel opening of the BYC,BTC,BWC120 models. The narrow angle panel is to be installed across the top side panel opening of BYC,BTC,BWC090 models. Select the appropriate panel and insert edge of panel under the top side flange of return air section, and secure with screws removed in step No. 1. See illustration below.

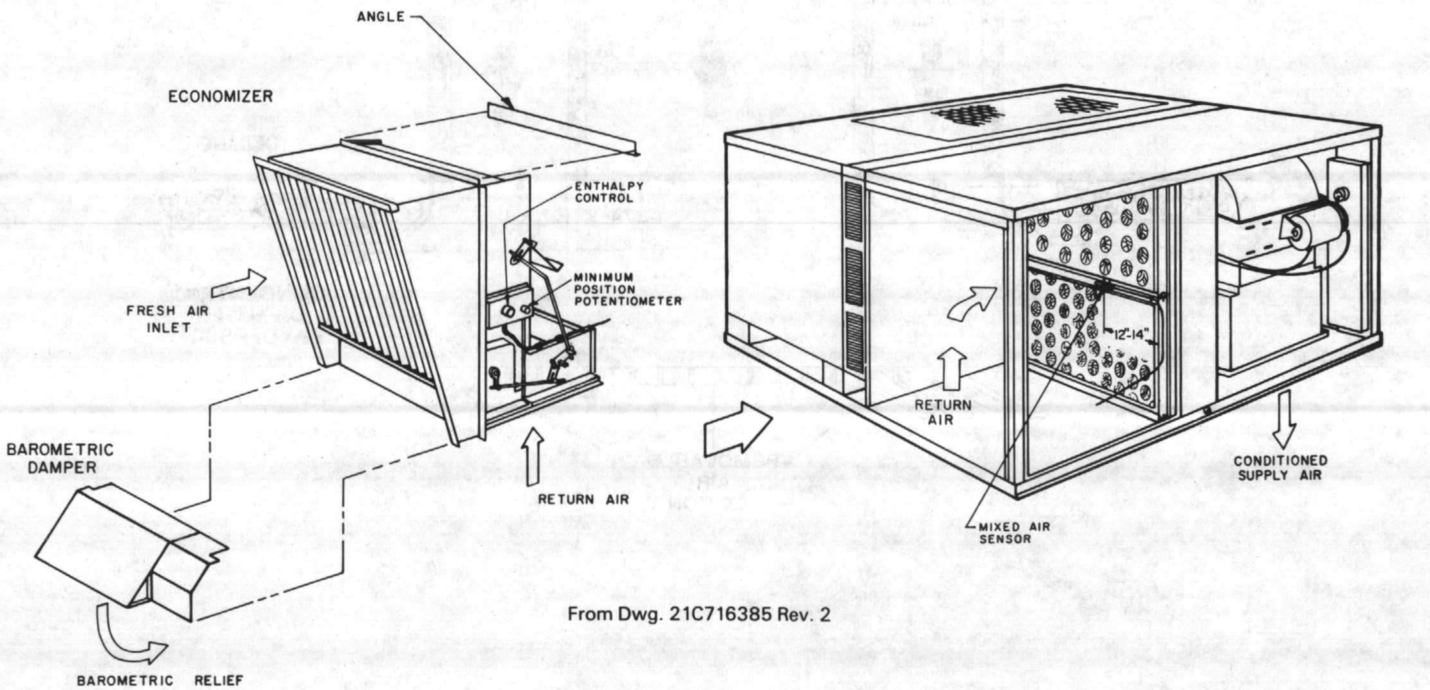
NOTE: The panel and economizer has a factory applied gasket provided.

6. Insert the economizer into side panel opening of the return air section of the unit. See illustrations below and on page 11.

7. Secure economizer to unit with screws provided. Form a water tight seal between the flanges of the economizer and unit. Use caulking to seal all voids, preventing water leaks.

8. The mixed air sensing thermistor was secured to damper drive linkage for shipping. The sensing thermistor must be secured in the mixed air stream.

   a. Remove tie wrap and free sensing thermistor and wiring.
   b. Attach mixed air sensing thermistor to filter frame flange about 12 to 14 inches from end of filter frame. See illustrations below and on page 11.
   c. Dress wires away from economizer drive linkage. Tie wrap wire to filter frame, with factory provided wire ties, in two places. See illustrations below and on page 11.

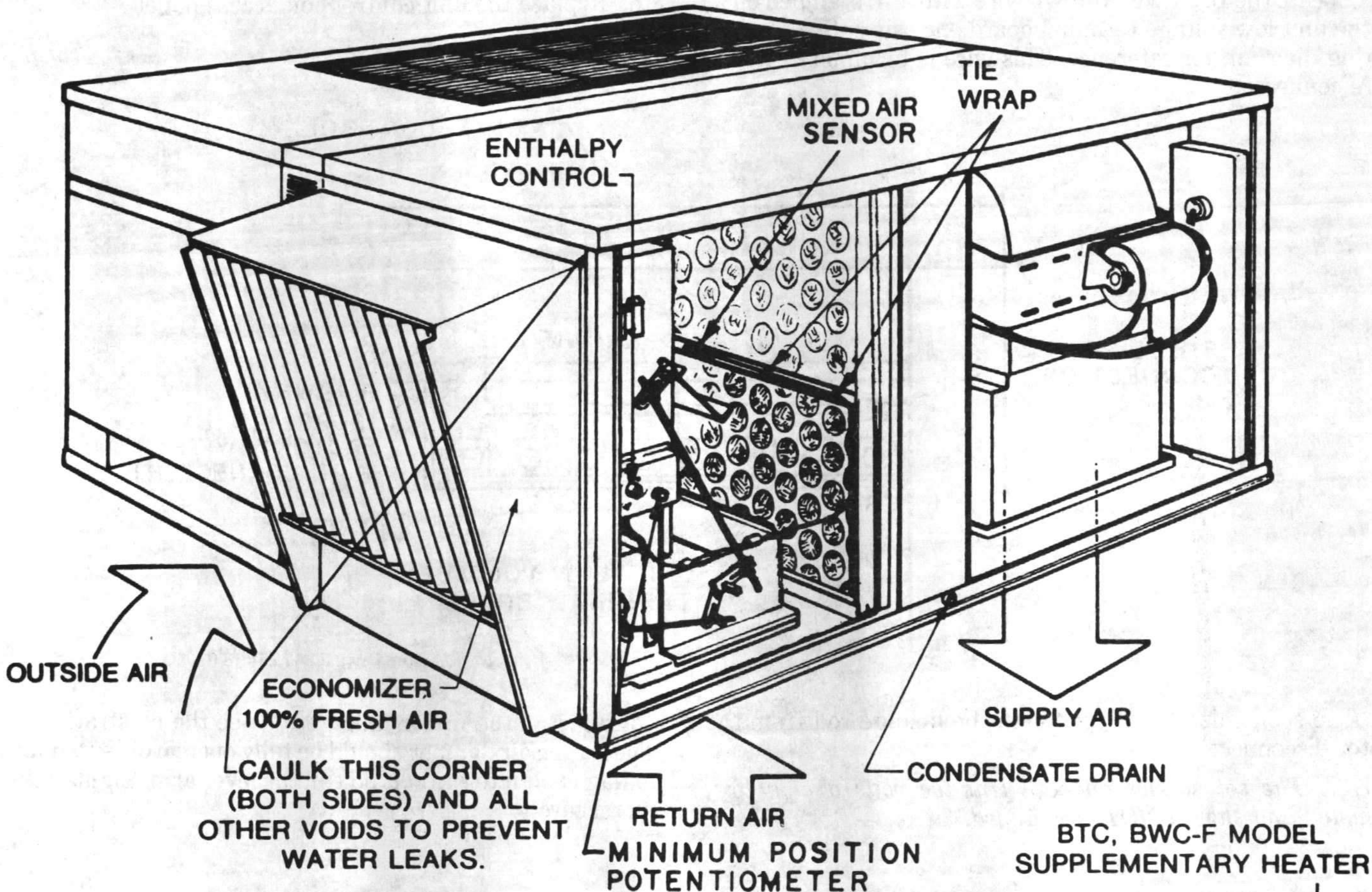


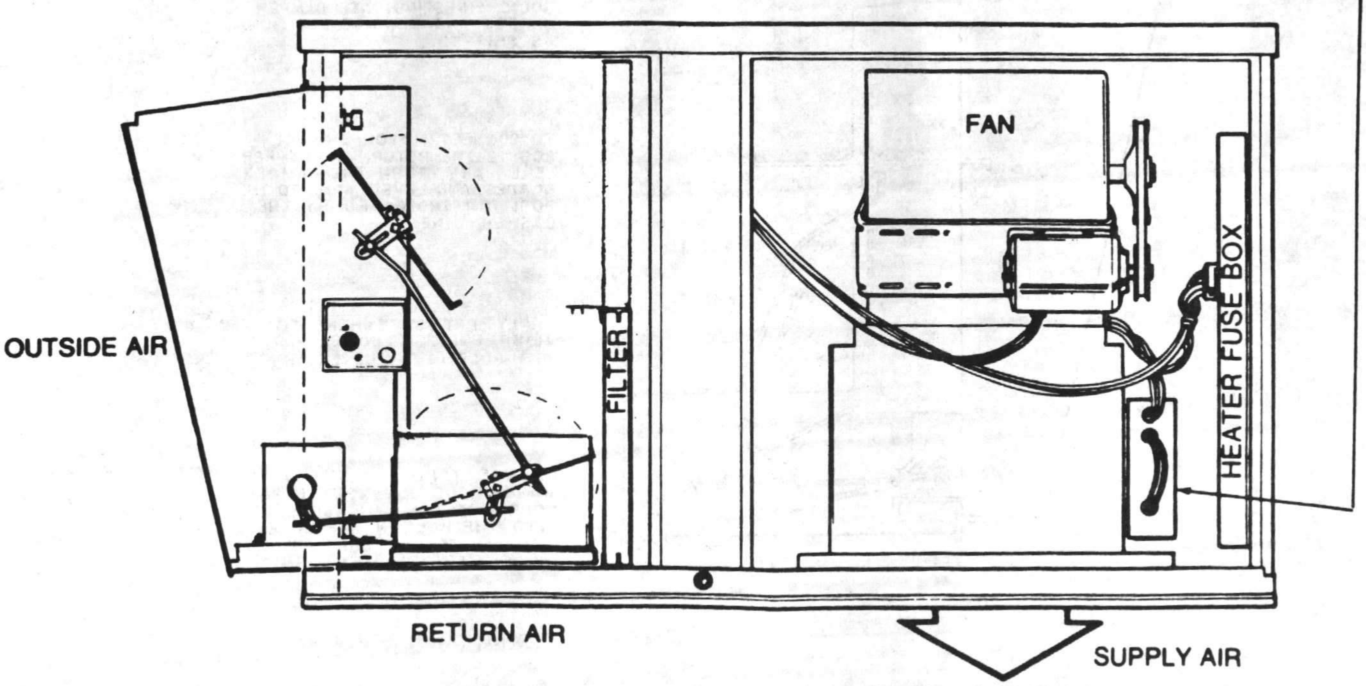
From Dwg. 21C716385 Rev. 2

0-100% FRESH AIR DAMPER (CONT.)

IMPORTANT: If economizer control adjustments are desired, it should be done at this time. Economizer factory settings are:
1. The mixed air control is set to modulate between 50°F and 56°F. (not field adjustable)
2. The enthalpy control is set at "B" position.
3. The minimum position of damper opening is set for 0% fresh air intake (fresh air damper fully closed when economizer is not enabled).

NOTE: Permanent type filters must be used with economizer.





From Dwg. 21B719526 Rev. 0

IMPORTANT:

9. Make electrical connections to the economizer by mating the polarized plug of the economizer to the polarized plug of the unit; where the jumper was removed. The damper motor operates on the 24V unit transformer. To complete the 24V circuit to the damper motor, follow the steps outlined below:

a. Disconnect power to the unit.

b. Remove the access panel to the unit control box.

c. Locate the BR/1 wire (brown wire with a '1' stamped on it) in the unit low voltage terminal board enclosure. See the unit wiring diagram for reference. This wire is terminated with a wire connector.

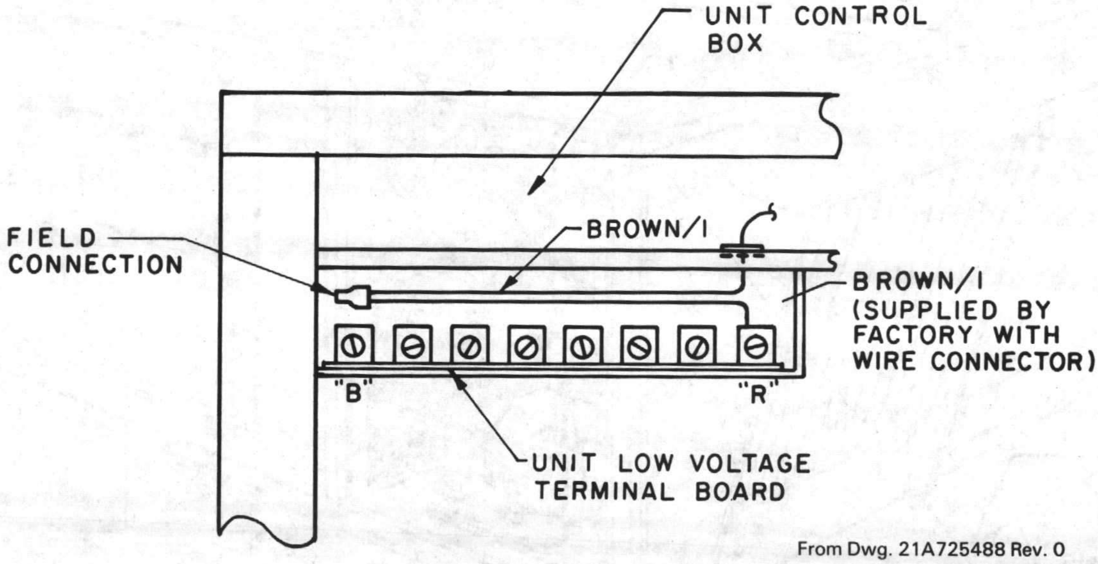
d. Cut the wire connector off of the wire and strip the wire approx. 1/2".

e. Remove the BR/1 wire and wire connector from the bag supplied with the economizer.

f. Crimp both stripped ends of the BR/1 wires together using the factory supplied connector. See the illustration below.

g. Connect the spade terminal of the factory supplied BR/1 wire to the 'R' terminal on the unit low voltage terminal board.

h. Replace the unit control box access panel.

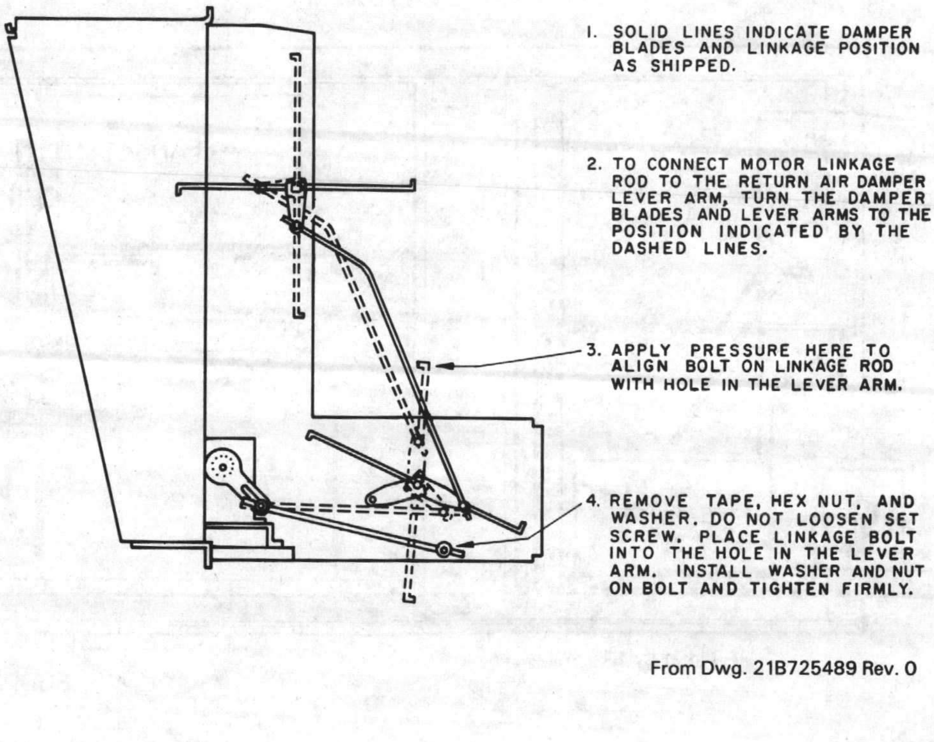


From Dwg. 21A725488 Rev. 0

10. The economizer is shipped with the linkage rod from the motor disconnected.

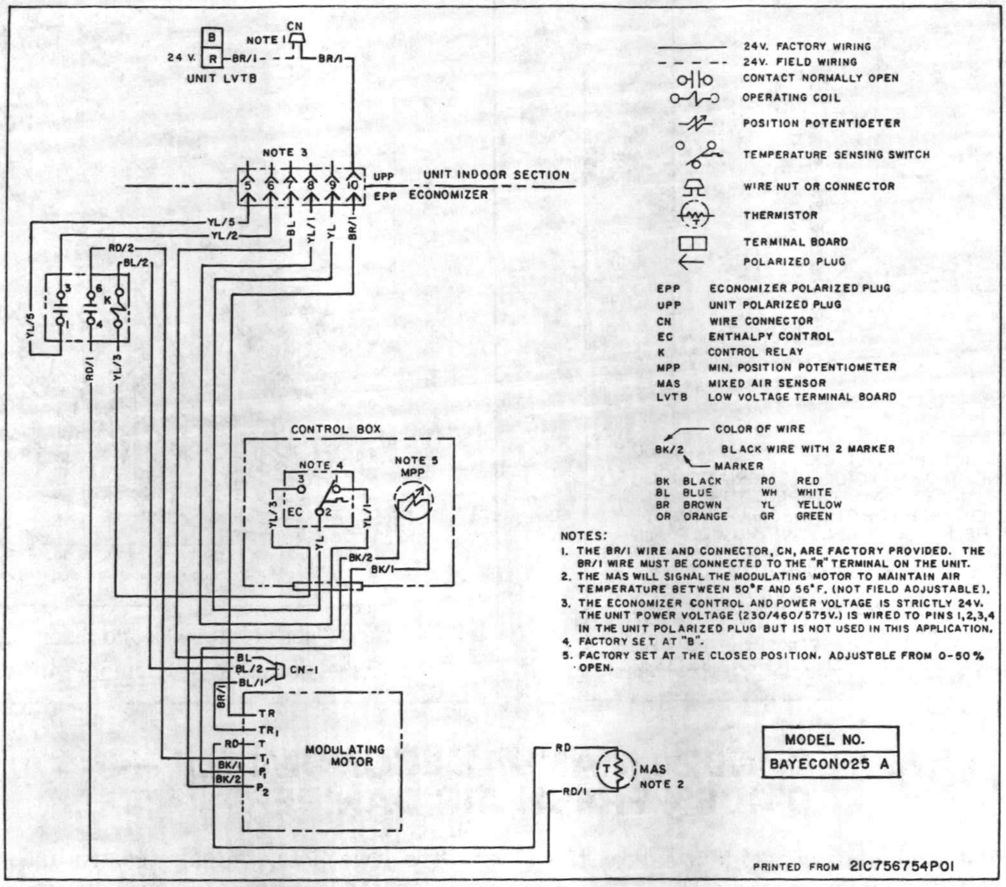
NOTE: The set screws on both linkage rods are factory adjusted and should NOT be changed.

To re-install the motor linkage rod see the illustration below. The return air damper should be fully open in order to place the linkage bolt into the bolt hole in the lever arm. Tighten the hex nut securely.



From Dwg. 21B725489 Rev. 0

11. Replace the end panel (filter access panel) and secure with screws saved from step No. 3 on page 10. See illustration on page 11.



ECONOMIZER CONTROL CHECK-OUT

1. Set the minimum position potentiometer (if used) to allow outdoor air damper to go to FULLY closed position. Potentiometer is on enthalpy control cover. (OPEN ↑ & CLOSE ↓).

2. The following check-out steps for the economizer can be performed only if the outdoor air conditions are to the left of shaded area on psychrometric chart. See Chart below.

3. Set indoor thermostat to satisfied position and apply power to unit.

4. Set minimum position potentiometer (MPP) to full open position. Outdoor air damper should go to full open.

5. Set MPP to close position. Outdoor air damper should close.

6. Set indoor thermostat to call for cooling.

CAUTION: Compressor will start. Avoid rapid cycling of compressor during check-out of economizer dampers.

7. This economizer is factory set for mixed air temperature between 50°F and 56°F. Turn the enthalpy control knob to the "A" setting (full clockwise). If the outdoor temperature is less than 75°F., the compressor will stop and outdoor damper will move to full open. If outdoor temperature is too high for enthalpy control to switch, the wires to terminals 1 and 3 on the control can be switched to verify proper operation. See illustrations on page 11 for location of enthalpy control knob.

8. Set indoor thermostat to satisfied position, stopping indoor blower. Fresh air damper will close and return air damper will open.

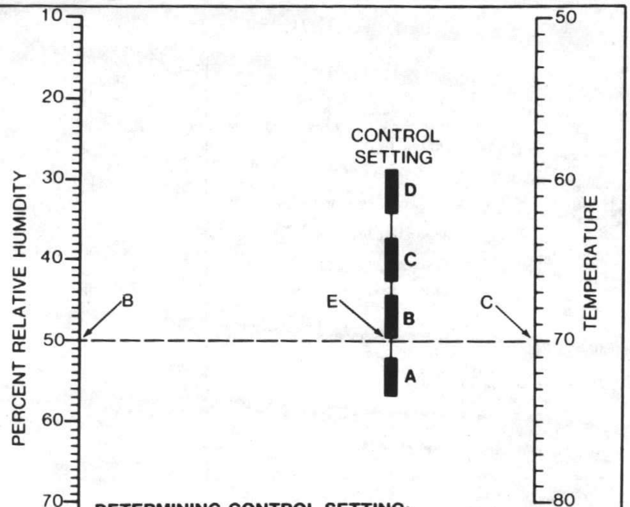
9. Set indoor thermostat to call for cooling. Allowing time for fresh air damper to open completely. Turn enthalpy control knob counter-clockwise past "D" position. Fresh air damper will close completely if temperature and humidity are above "D" position.

10. Set the enthalpy control per illustration below. If maximum combination of relative humidity and temperature is not known, set enthalpy control to the "B" setting.

11. Without a call for cooling, ADJUST the minimum position potentiometer, if used, to provide the volume of fresh air required (fresh air ventilation).

CAUTION: DO NOT SET MINIMUM POSITION TO PROVIDE OVER 50% VOLUME OF FRESH AIR.

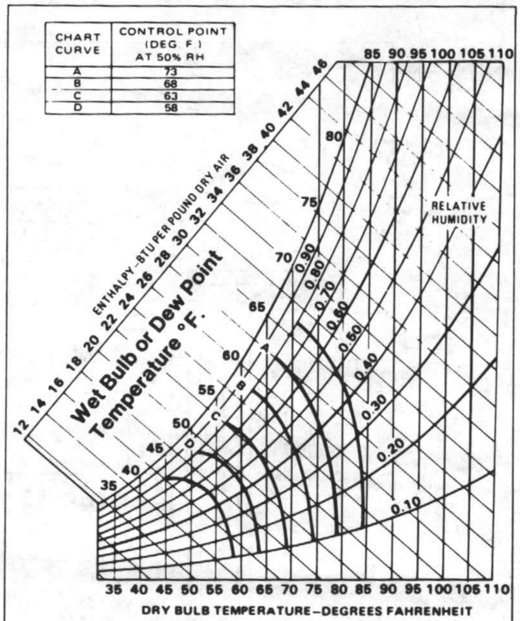
ENTHALPY CONTROL SELECTION CHART



DETERMINING CONTROL SETTING:
A. DETERMINE THE MAXIMUM COMBINATION OF **RELATIVE HUMIDITY** AND **TEMPERATURE** CONSIDERED ACCEPTABLE FOR THE INSTALLATION.
B. LOCATE THE PERCENT **RELATIVE HUMIDITY** ON THE LEFT HAND SCALE.
C. LOCATE THE AIR **TEMPERATURE** (DRY BULB) ON RIGHT HAND SCALE.
D. DRAW A STRAIGHT LINE BETWEEN THESE TWO POINTS.
E. ADJUST THE ENTHALPY CONTROL TO THE SETTING INDICATED ON THE **CONTROL SETTING** SCALE.

ECONOMIZER CONTROL SELECTION & PSYCHOMETRIC CHART

CHART CURVE	CONTROL POINT (DEG F) AT 50% RH
A	73
B	68
C	63
D	58



Below set point — Economizer will function.
Above set point — Compressor will operate.

BAYECON024 MANUAL ECONOMIZER — 0-100% FRESH AIR DAMPER

1. The BAYECON024 Economizer is identical to the BAYECON025 with the following exception:

2. The drive motor, enthalpy control and polarized plug were omitted from BAYECON024 economizer.

BAYBARM007 BAROMETRIC RELIEF DAMPER

1. The BAYBARM007 Barometric Relief Damper is to be used with BAYECON025 and BAYECON024 economizer accessory, if required with your particular application.

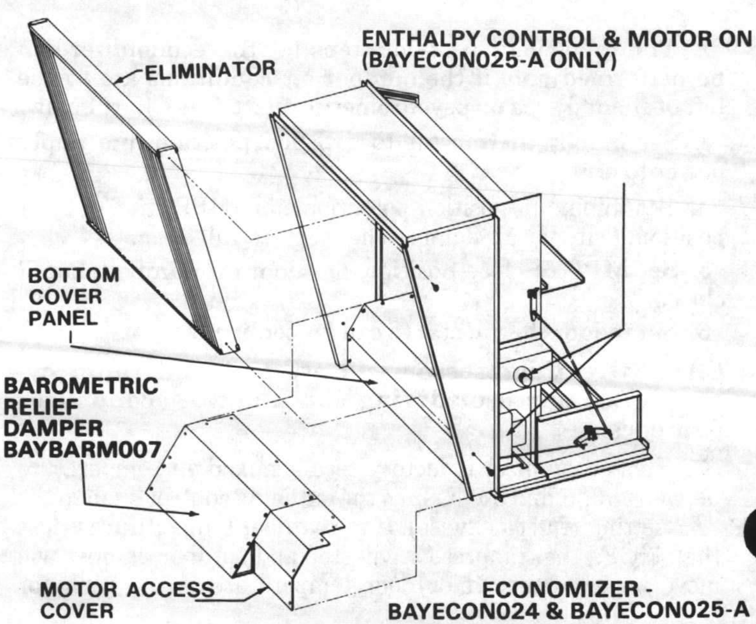
2. Remove the Eliminator from the economizer by removing two (2) screws from each side of economizer, which secure the eliminator in the economizer. Save the eliminator and screws for later use. See illustration at right.

3. Remove bottom cover panel from economizer after the eliminator has been removed. Remove screws from the entire perimeter of the bottom cover panel. Discard the cover panel and save the screws for securing the barometric relief damper BAYBARM007.

4. Place the Barometric Relief Damper (BAYBARM007) into the economizer as illustrated at right. Secure the Barometric Relief Damper to the economizer by inserting screws through all clearance holes along the entire perimeter of the BAYBARM007 damper cover.

Insert four (4) screws through clearance holes in barometric damper cover, to secure motor barrier to barometric damper cover. There are two (2) clearance holes for screws in the left side panel of the economizer, insert a screw in each hole to secure the left end of the barometric damper BAYBARM007 to the economizer.

5. Reinstall and secure the Eliminator in the economizer by reversing the procedure outlined in step 2 above.



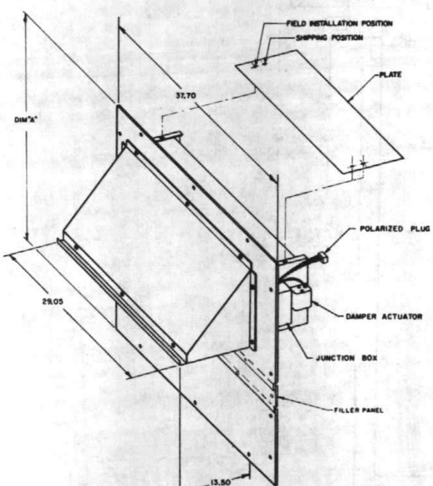
BAYDMPR018 MOTORIZED FRESH AIR DAMPER

For those applications which require it, a motorized fresh air damper BAYDMPR018 accessory can be installed and made functional by the following steps.

1. Secure bottom panel to the top panel of BAYDMPR018 with screws provided. See Illustration below.

1A. For use on BYC,BTC/BWC090F units, secure the bottom panel to the top panel of BAYDMPR018 with screws provided. See illustration below.

1B. For use on BYC,BTC/BWC120F units, secure wider filler panel to top panel of BAYDMPR018 with screws provided. Then attach bottom panel to lower edge of filler panel. See illustration below.



From Dwg. 21C722921 P01

NOTE: Make sure that all screws are tight, so that gasket forms a water tight seal.

2. Access to unit - Place the power disconnect switch(es) in the "OFF" position. Remove the screws that secure side panel of return air section of the unit.

3. Remove side panel by pulling out slightly and down. Discard the side panel since the BAYDMPR018 fresh air damper will be installed there.

4. Remove the screws that secure the end panel (filter access panel) of return air section of unit. Save screws for later use.

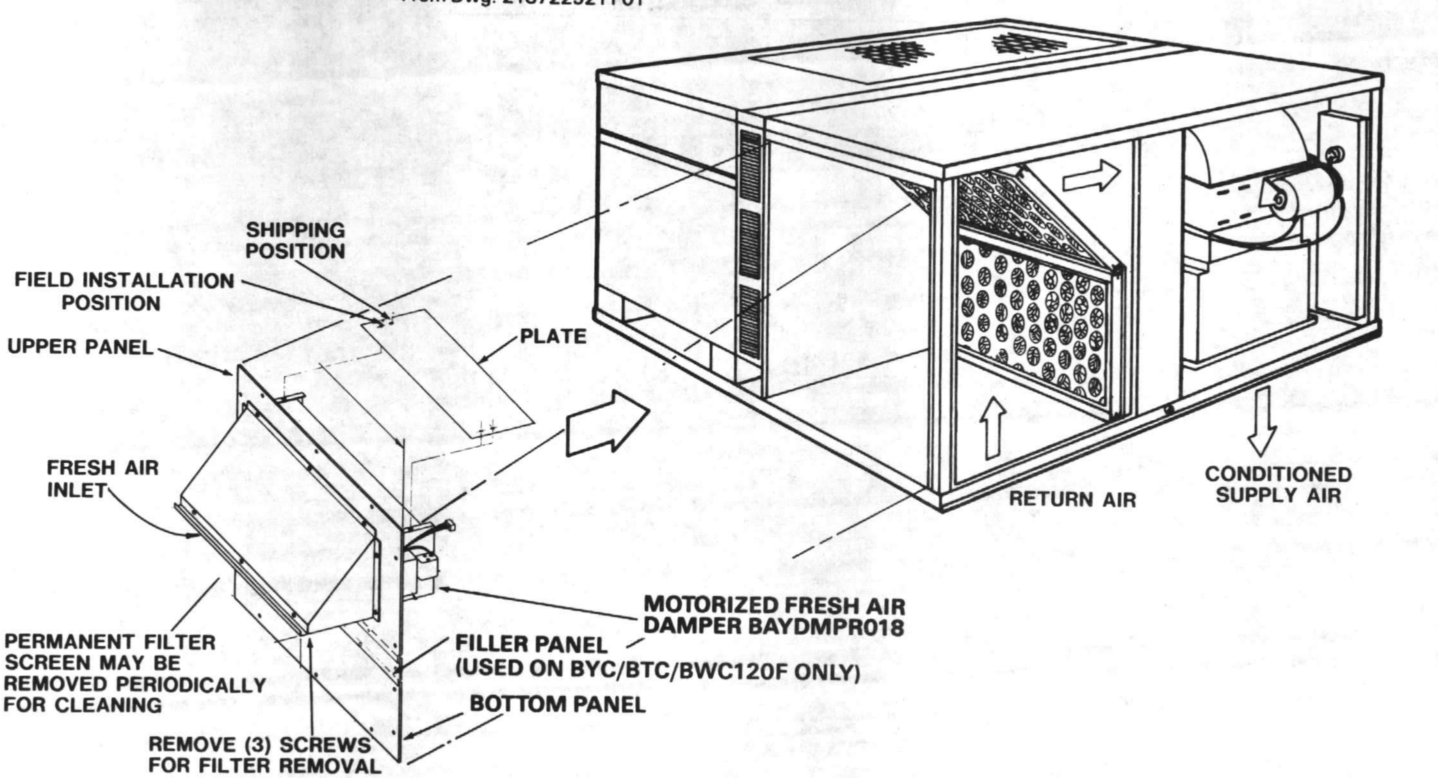
5. Remove the end panel (filter access panel) by pulling out slightly and down. Save this panel, since it will be reinstalled later.

6. Remove jumper plug from the polarized plug and discard. The polarized plug is located at the top and near the outlet end of the filter rack in the unit.

IMPORTANT: Remove two (2) screws and position plate on top of blade enclosure as shown in illustration. Secure with two (2) screws. PLATE MUST BE REPOSITIONED PRIOR TO INSTALLATION OF DAMPER TO UNIT.

7. Insert the BAYDMPR018 damper assembly into side panel opening of the return air section of unit. See illustration below.

8. Secure damper and panel assembly to unit with screws provided. Form a water tight seal between the flanges of the panel and unit. Use caulking to seal all voids, preventing water leaks.



dwg. no. 21A725195 P01

BAYDMPR018 MOTORIZED FRESH AIR DAMPER (Cont.)

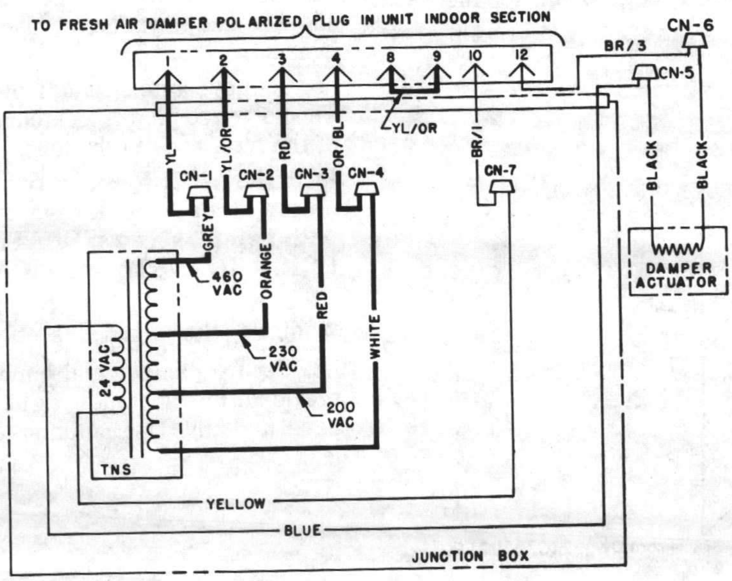
9. Make the electrical connection to the damper by mating the polarized plug of the damper to the polarized plug of the unit where the jumper plug was removed.

The damper motor operates on 200/230, or 460 volt power source. The polarized plug will match the voltage of the unit to the voltage of the damper activator (motor).

10. Replace the end panel (filter access panel) and secure with screws saved from Step 4.

11. The motorized damper requires a field supplied and installed control. The control is to be connected to BR/1 and BR/3 wire leads in the unit electrical control compartment by the low voltage terminal board.

12. Place the power disconnect switch(es) in the "ON" position.



TAB PLACEMENT HERE

DESCRIPTION:

Fresh Air

Dampers

☐ Tab page did not contain hand written information

☑ Tab page contained hand written information
*Scanned as next image

Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

FRESH AIR DAMPERS

TRANE™

BLDG # AS-502

INSTALLER'S GUIDE

0-25% Fresh Air Dampers

Library	Service Literature
Product Section	Unitary
Product	Unitary Accessories
Model	Economizers, Dampers, Motors, Low Ambient
Literature Type	Installer's Guide
Sequence	25
Date	July 1985
File No.	SV-UN-ACC-DMPR-IN-25 785
Supersedes	

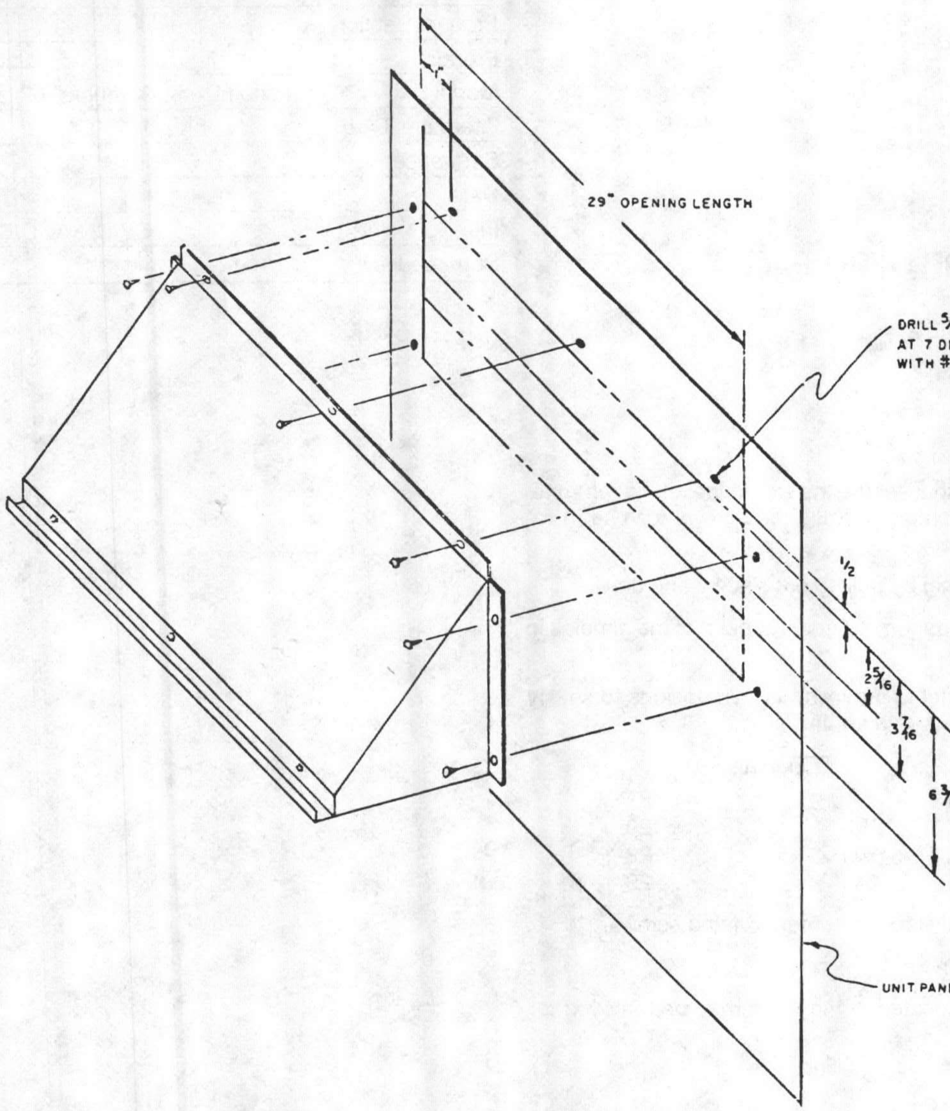
BAYDMPR023
(BTC/BWC090, 120 F-G)

1. Remove the screws that secure the side panel of the return air section (panel has dimples). Save the screws for use in re-installing the panel.
2. Remove the side panel by pulling out slightly and down.
3. Drill 5/32" diameter engagement holes at each of the dimples in the panel.
4. Cut a hole in the panel to the following dimensions to satisfy fresh air requirement (see diagram 1):

Fresh Air Requirements	Opening Size H	W
10%	2 5/16	29
15%	3 7/16	29
25%	6 3/8	29

5. Attach hood to panel with #10 thread forming screws.
6. Re-install panel on unit.
7. The aluminum filter located in the hood may be removed for cleaning.

18-HE60D18
1st Printing



FRESH AIR REQUIREMENT

PER CENT	OPENING SIZE
10%	2 5/16 X 29
15%	3 7/16 X 29
25%	6 3/8 X 29

TAB PLACEMENT HERE

DESCRIPTION:

Time Delay

Relay

☐ Tab page did not contain hand written information

☒ Tab page contained hand written information
*Scanned as next image

Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

TRANE INSTALLER'S GUIDE

ASCT-IN-3
18-HF10D2
1st Printing, 1984

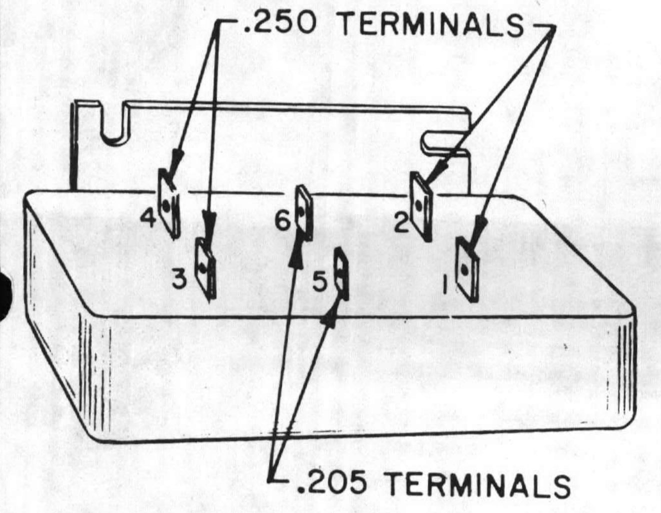
TIME DELAY RELAY (BAY41X171A)

BLDG #AS-502

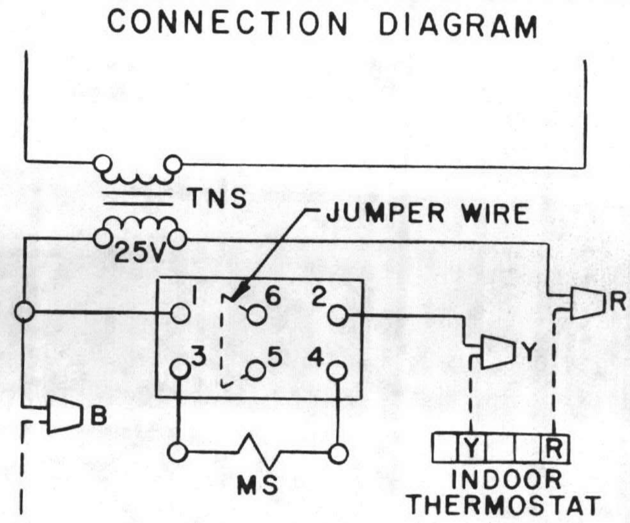
This accessory may be installed on any compressor bearing outdoor section using 24VAC contactor coil.

This accessory MUST be installed in a weather protected area within the unit cabinet, such as the control box, the fan orifice plate, etc.

CAUTION:
BE SURE ALL POWER TO THE UNIT IS OFF BEFORE REMOVING ANY PANELS OR GRILLES FROM THE UNIT.



From Dwg. 21A135913 PO1



From Dwg. 21A135914 PO1

Once the location has been determined, install the kit as follows:

1. Use enclosed screws or back out any convenient screws and slip the slotted foot-plate (see Fig. 1) under the screw head, and retighten screw.
2. Wire the accessory according to the Connection Diagram in Fig. 2. (The spade terminals of the accessory are numbered as shown on the diagram).
3. This time delay has dual (5 or 7 minute) time capability. For 5 minute delay connect brown jumper to terminals 5 and 6. For 7 minute time delay, jumper should be left disconnected.
4. After completion of installation apply appropriate label denoting 5 or 7 minute time delay inside control panel. Secure all panels, grilles, etc., and restore power to unit.
5. Place unit in cooling mode and wait for stabilized running conditions. Turn thermostat to "OFF" momentarily and observe the "cycling-on" time (compressor should cycle on in 5 or 7 minutes after Evaporator fan cycles on).

The Trane Company
Dealer Products Group • Troup Highway • Tyler, TX 75711

TAB PLACEMENT HERE

DESCRIPTION:

Quick Attach

Coupling Kit

☐ Tab page did not contain hand written information

☒ Tab page contained hand written information
*Scanned as next image

TRANE™

INSTALLER'S GUIDE

ACCSY-IN-19
18-HE26D1
1st Printing, 1987

BLDG AS-502

QUIK-ATTACH TO BRAZE COUPLING KITS BAY71X001A THRU 006A AND BAY71X011A, 012A

ALL phases of this installation must comply with NATIONAL, STATE, AND LOCAL CODES.

1. These coupling kits are packaged in a plastic envelope. Remove couplings from envelope and check diaphram on ends of couplings for damage.
2. Attach coupling ends to indoor unit (or outdoor unit) per following instructions.
   a. Remove dust cap.
   b. Make sure that no dirt or foreign material is permitted to get onto mating surfaces of coupling halves before connecting them together. Oil the face and threads of the coupling halves with clean refrigerant oil before mating.
   c. Start tightening union nut by hand while holding tube rigid with the other hand.

NOTE: Keep pressure tap in upright position at all times.

   d. When union nut is securely anchored to coil, use holdback wrench on flats of base nut (see Figure 2 below) and with second wrench on union nut tighten until nut is seated. A firm metal to metal contact will be felt.
   e. Then advance the union nut another ¼ turn. This final turn is necessary to insure a proper metal seal of coupling halves, forming a leakproof joint. Do not continue to tighten the coupling as distortion of the coupling nut will result in a leak.
3. After assembly of couplings, follow instructions shipped with outdoor unit to complete refrigerant piping installation.

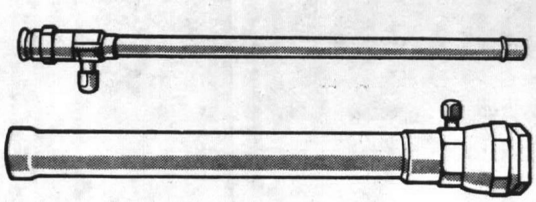
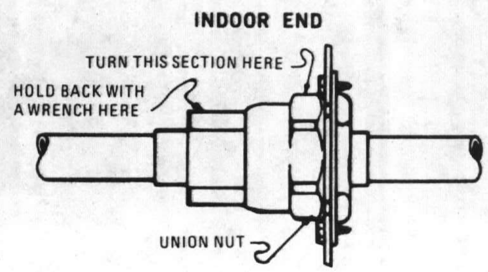


Figure 1

QUIK CONNECT COUPLING



(From Dwg. SK560-1347 Rev. 2)

The male and female Quik-Attach fittings must be properly aligned to prevent cross threading.

Figure 2

dwg. no. 21A130456 P04

Library	Service Literature
Product Section	Unitary
Product	Unitary Accessories
Model	Miscellaneous
Literature Type	Installer's Guide
Sequence	19
Date	August 1987
File No.	SV-UN-ACC-ACCSY-IN-19 8/87
Supersedes	

The Trane Company
Dealer Products Group
Troup Highway
Tyler, TX 75711

dwg. no. 21A130456 P04

TAB PLACEMENT HERE

DESCRIPTION:

Split System

Condensing Unit

☐ Tab page did not contain hand written information

☒ Tab page contained hand written information
*Scanned as next image

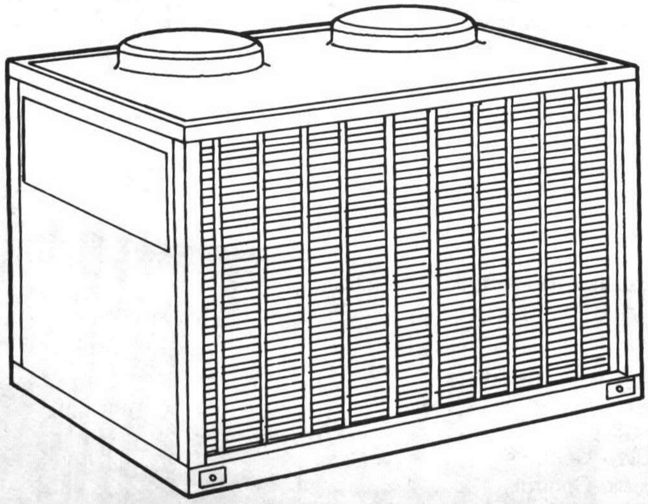
Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

BLDG # AS-3502

TRANE® AIR CONDITIONING	FILE INFORMATION DIVISION TAB - TRANE REFRIGERATION PRODUCTS PRODUCT TAB - UNITARY SPLIT SYSTEM AIR CONDITIONERS MODEL TAB - Model RAUB LITERATURE ITEM - Installation, Operation, Maintenance	LITERATURE FILE NO. **RAUB-IOM-3** INST.- OPER.- MAIN.

Since the Trane Company has a policy of continuous product improvement, it reserves the right to change specifications and design without notice. The installation and servicing of the equipment referred to in this booklet should be done by qualified, experienced technicians.

MARCH 1983
Supersedes RAUB-IN-10 Dated November 1980, RAUB-IN-10A Dated March 1981, RAUB-IN-13 Dated January 1981, and RAUB-M-10 Dated November 1980



SPLIT SYSTEM CONDENSING UNITS

RAUB 20 THROUGH 60-TONS
A, B, C DESIGN SEQUENCE

COMMERCIAL AIR CONDITIONING DIVISION
LA CROSSE, WISCONSIN 54601-7599
PRINTED IN U.S.A.

TABLE OF CONTENTS

ITEM	PAGE
MODEL NUMBER DESCRIPTION	4
GENERAL INFORMATION	6
INSTALLATION	6
Shipping and Receiving	6
Location and Clearances	6
Foundation	7
Handling and Rigging	16
Pre-Installation Leak Test	16
Refrigerant Piping	16
Line Sizes	16
Liquid Line Components	17
Risers and Tube Routing	18
Suction Line	18
Refrigerant Piping Installation Instructions	18
Units Mounted on Isolators	20
Units Without Isolators	20
Thermostatic Expansion Valve Selection	29
Brazing, Leak Testing	29
Electrical Wiring	29
Electrical Data	29-30
Thermostat Installation (Electronic Controls)	38
Duct Sensor Installation	38
Installation Checklist	39
Pre-Start Checks	39
Evacuation	39
Refrigerant Charging	39
Start-Up, Two-Step Controls	39
Start-Up, Electronic Controls	39
Initial Start-Up Checks	40
Compressor Oil Charge	40
Crankcase Heater	40
Compressor Motor	40
Voltage Imbalance	40
Operating Pressures	41
Expansion Valve Superheat	41
Unloading Sequence	41
Start-Up Log	42

OPERATION 43
System Control 43
Units Shipped With Two-Step Controls 43
Units Shipped with Electronic Thermostat Controls 43
RAUB/EVPA System 43
Fan Sequencing 44
Thermostats 44
Electrical Sequence of Operation 45
Control Settings 48
Safety and Operating Controls 48
MAINTENANCE 50
Periodic Maintenance 50
Maintenance Log 51
Shutdown and Start-up 52
Maintenance Procedures 52
Coil Cleaning 52
Control Testing 53
Evacuation Procedures 53
Leak Testing 54
Brazing Procedures 54
Refrigerant Charging 54
Checking Refrigerant Charge 56
Operating Pressures 57
Thermostatic Expansion Valve Adjustment and Superheat Measurement 66
Measuring Subcooling 67
Compressor Oil Charge 67
Troubleshooting 67

RAUB MODEL NUMBER DESCRIPTION

Trane products are identified by a multiple character model number that precisely identifies a particular type of unit. An explanation of the multiple character RAUB number is listed below to enable the owner or service engineer to define the specific operation, components and options.

R A U B C 2 0 3 A B 1 0 A

UNIT TYPE
R = CONDENSING UNIT

CONDENSER
A = AIR COOLED

AIRFLOW
U = UP FLOW

DEVELOPMENT SEQUENCE
B = SECOND

NOMINAL CAPACITY
C20 = 20 TONS
C25 = 25 TONS
C30 = 30 TONS
C40 = 40 TONS
C50 = 50 TONS
C60 = 60 TONS

POWER SUPPLY
1 = 460/60/3 PWS
2 = 575/60/3 PWS
3 = 230/60/3 PWS
4 = 460/60/3 XL
6 = 200/60/3 PWS
A = 380/50/3 PWS
B = 415/50/3 PWS

MISCELLANEOUS
A = UNIT DISCONNECT SWITCH
B = HOT GAS BYPASS PROVISION
F = PRESSURE GAUGES
H = COPPER FINS
1 = SPRING ISOLATORS
2 = RUBBER-IN-SHEAR ISOLATORS
3 = FLOW SWITCH

AGENCY APPROVAL
0 = NONE
1 = UL
2 = CSA

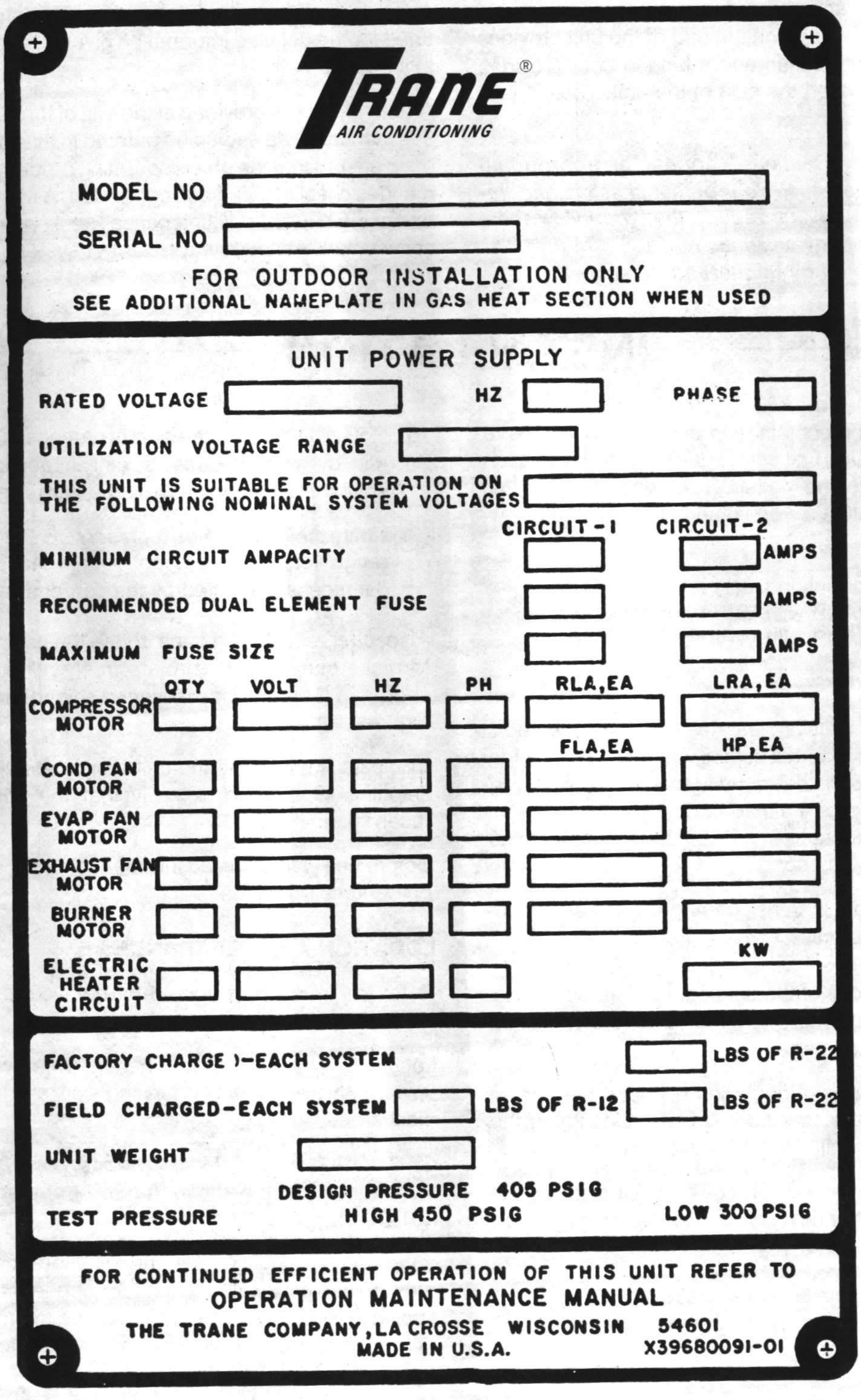
AMBIENT CONTROL
0 = STD
1 = 0 F

DESIGN SEQUENCE
A = FIRST
B = SECOND
C = THIRD

SYSTEM CONTROL
A = TWO STEP CONTROL
B = MULTI-STEP CONTROL
C = ELECTRONIC - ROOM STAT
E = ELECTRONIC SUPPLY AIR VAV
F = EVPA CONTROL PANEL

RAUB UNIT NAMEPLATE

The RAUB unit nameplate is located in the upper left hand corner of the control box end of the unit. It lists the model number, electrical information, refrigerant type and charge, unit weight and other specific, important unit information.



GENERAL INFORMATION

Model RAUB condensing units are designed for outdoor mounting with a vertical air discharge. They are usually installed on a flat roof but can also be installed on a concrete slab at ground level. In either case, the unit must be installed so that it is level to within ± 2-inches side to side and end to end. Each unit is leak-tested and evacuated at the factory, and shipped with a holding charge of Refrigerant-22. An access panel on the end of the unit provides access to the compressor section and a hinged door provides access to the control panel on the side of the unit. Table 1 provides general data.

NOTE: *"Warnings" and "Cautions" appear at appropriate places in this instruction manual. Your personal safety and the proper operation of this machine require that you follow them carefully. The Trane Company assumes no liability for installations or servicing performed by unqualified personnel.*

An Installation Checklist is provided at the end of the INSTALLATION section of this manual and should be completed after all installation procedures have been accomplished. Periodic Maintenance checklists are provided at the beginning of the MAINTENANCE section of this manual for performing recommended maintenance. These checklists should not be substituted for the detailed information given in appropriate sections of this manual.

A Start-Up Log is provided at the end of the START-UP section of this manual. Data should be entered in this log during initial start-up to ensure that the unit is operating properly and that all recommended checks have been completed. A Maintenance Log at the end of the "Periodic Maintenance" section enables the operator/serviceman to maintain a record of system operating data.

INSTALLATION

The installation information contained in this manual applies to the Model RAUB condensing unit only. Supplemental installation instructions are provided for the Model BRCB evaporator unit and for RAUB/EVPA and RAUB/VAV equipment. Refer to the following publications:

BRCB-M-1 for BRCB information.
RAUB-IN-11 for Model RAUB with EVPA control option.
RAUB-IN-12 for Model RAUB with VAV control option.

SHIPPING AND RECEIVING

Model RAUB condensing units are leak-tested and evacuated at the factory and then shipped with a holding charge of R-22 refrigerant. Inspect each unit as it is delivered to the job site for any in-transit damage. All shipments are made F.O.B. Trane Company manufacturing plant, therefore claims for shipping damage must be filed with the delivering carrier.

To protect against loss from in-transit damage, complete the following upon receipt of the unit:

1. Inspect individual pieces of the shipment before accepting. Check for rattles, bent corners, or other visible damage or indications of shipping damage.
2. If a shipment has apparent damage, inspect it throughout before accepting. Make specific notations concerning the damage on the freight bill. Do not refuse delivery.
3. Inspect the unit for concealed damage before it is stored and as soon as possible after delivery. Concealed damage must be reported within 15 days.
4. Do not move damaged material from the receiving location. It is the receiver's responsibility to provide reasonable evidence that concealed damage did not occur after delivery.
5. If concealed damage is discovered, stop uncrating the shipment. Retain all internal packing, cartons and crates. Take photographs of the damaged equipment, if possible.
6. Notify the carrier's terminal of damage immediately by phone and by mail. Request a joint inspection of the damaged equipment immediately by the carrier and consignee.
7. Notify the Trane sales representative of the damage and arrange for repair. Do not repair the unit, however, until damage is inspected by the carrier's representative.

Also, after receiving the unit, rotate the condenser fans manually to make sure that they rotate freely. Check for any materials shortage. If ordered, accessories ship in the positions shown in Figures 1 through 3.

Compare the data on the unit nameplate with the ordering and shipping information to verify that the correct unit has been received.

Before unit start-up, read this manual to become familiar with the unit and its operation.

LOCATION AND CLEARANCES

Refer to Figures 4 through 8 for detailed unit dimensions, connections and clearances.

Locate the condensing unit where air will flow without obstruction upward through the condensing coil and away from the fan discharge.

CAUTION: If unit is placed under an overhang, allow at least 6-feet of clearance above the unit to prevent recirculation of hot discharge air.

If the unit is being placed near a wall or other obstruction which may hinder airflow, the minimum condenser air clearances as shown in Figures 4 through 8 must be maintained. Increase the minimum condenser air clearance to 16 feet if:

1. The installation has obstructions on two or more sides.
2. The installation includes more than one unit (side by side installation).

If the condensing unit is to be installed in a well, increase the minimum condenser air clearance to 16 feet and make sure that the fan assemblies protrude out of the well and above ground level. Refer to Figure 9.

NOTE: *FOUR FEET OF SERVICE CLEARANCE SHOULD BE MAINTAINED ON THE COMPRESSOR SIDE OF THE CONDENSING UNIT.*

FOUNDATION

When the unit is about to be set on the ground, place it above the snow line and above any possible blowing debris. Provide concrete footings or foundation for support. Support is not needed around the total perimeter of the unit; only at the four or six mounting feet around the unit. Construct the footings in accordance with the loading data given in Figures 4 through 8. Install isolators, if desired, or hold-down bolts in the footings to anchor the unit. Refer to Figures 10 and 11 for spring isolator and isolation pad selection and location. Figure 12 gives isolator dimensions.

For rooftop installations, make certain the roof is strong enough to adequately support the unit and to avoid the transmission of vibration. Table 1 lists unit operating weights. To reduce vibration transmission into the building, the use of isolators should be considered. Anchor the unit to the roof with hold-down bolts or isolators. Check with a roofing contractor for proper waterproofing installation practices to ensure that the roof does not develop leaks as a result of the unit weight, vibration or hot weather.

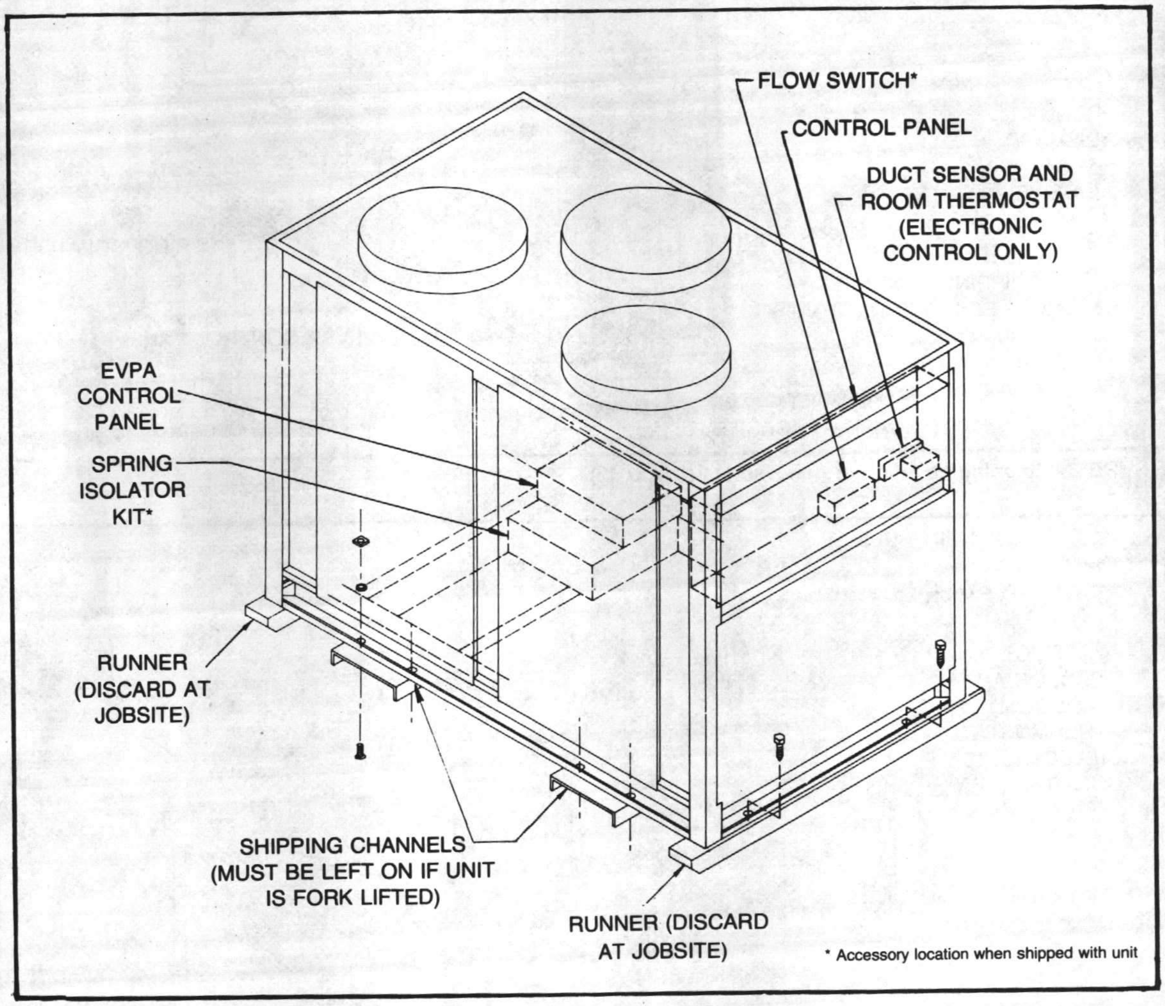


FIGURE 1 - Shipping Location of Accessories (RAUB 20 to 30)

TABLE 1 - General Data

MODEL	UNIT WEIGHTS (LBS.) SHIPPING	UNIT WEIGHTS (LBS.) OPERATING	REFRIGERANT TYPE	REFRIGERANT HOLDING CHG. (LBS.)	REFRIGERANT OPERATING CHG. (LBS.)	REFRIGERANT PUMPDOWN STORAGE (LBS.)	CONDENSER FANS AND MOTORS NO.	CONDENSER FANS AND MOTORS FAN DIA. (IN.)	CONDENSER FANS AND MOTORS MOTOR HP (EA.)	COMPRESSOR NO.	COMPRESSOR TYPE	COMPRESSOR OIL CHG. PER COMP. (PINTS)[2]
RAUB 20	1,765	1,745	R-22	1.3	28	67	2	26	1.0	1	Hermetic	19
RAUB 25	1,945	1,925	R-22	1.3	31	76	3	26	1.0	1	Hermetic	19
RAUB 30	2,155	2,145	R-22	1.5	40	96	3	26	1.0	1	Hermetic	19
RAUB 40	3,140	3,090	R-22	1.3[1]	29[1]	68[1]	4	26	1.0	2	Hermetic	19[1]
RAUB 50	3,620	3,660	R-22	1.3[1]	31[1]	71[1]	6	26	1.0	2	Hermetic	19[1]
RAUB 60	3,770	3,720	R-22	1.5[1]	40[1]	92[1]	6	26	1.0	2	Hermetic	19[1]

NOTE:
1. Per refrigeration system.
2. Assumes system tubing previously wetted with oil.

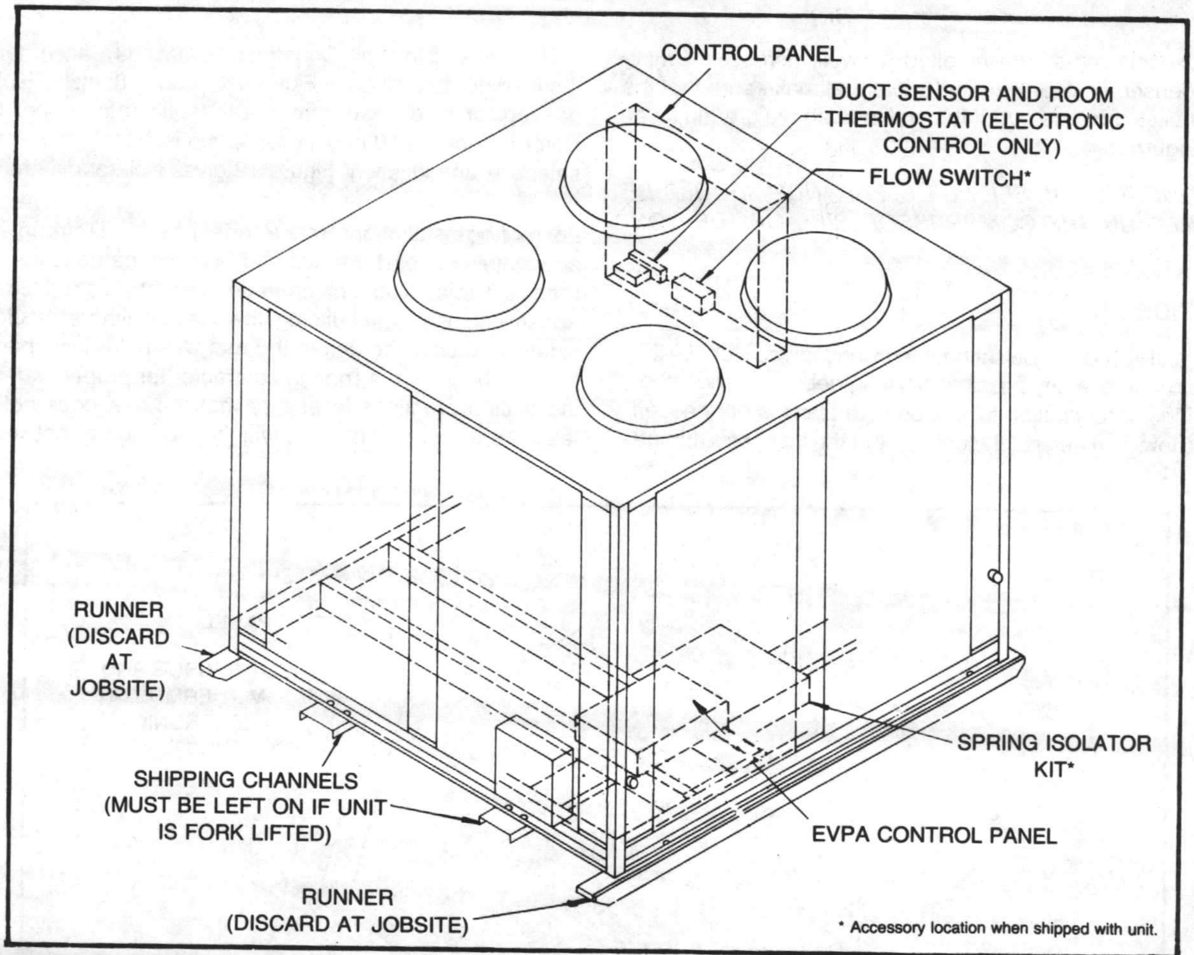


FIGURE 2 - Shipping Location of Accessories (RAUB 40)

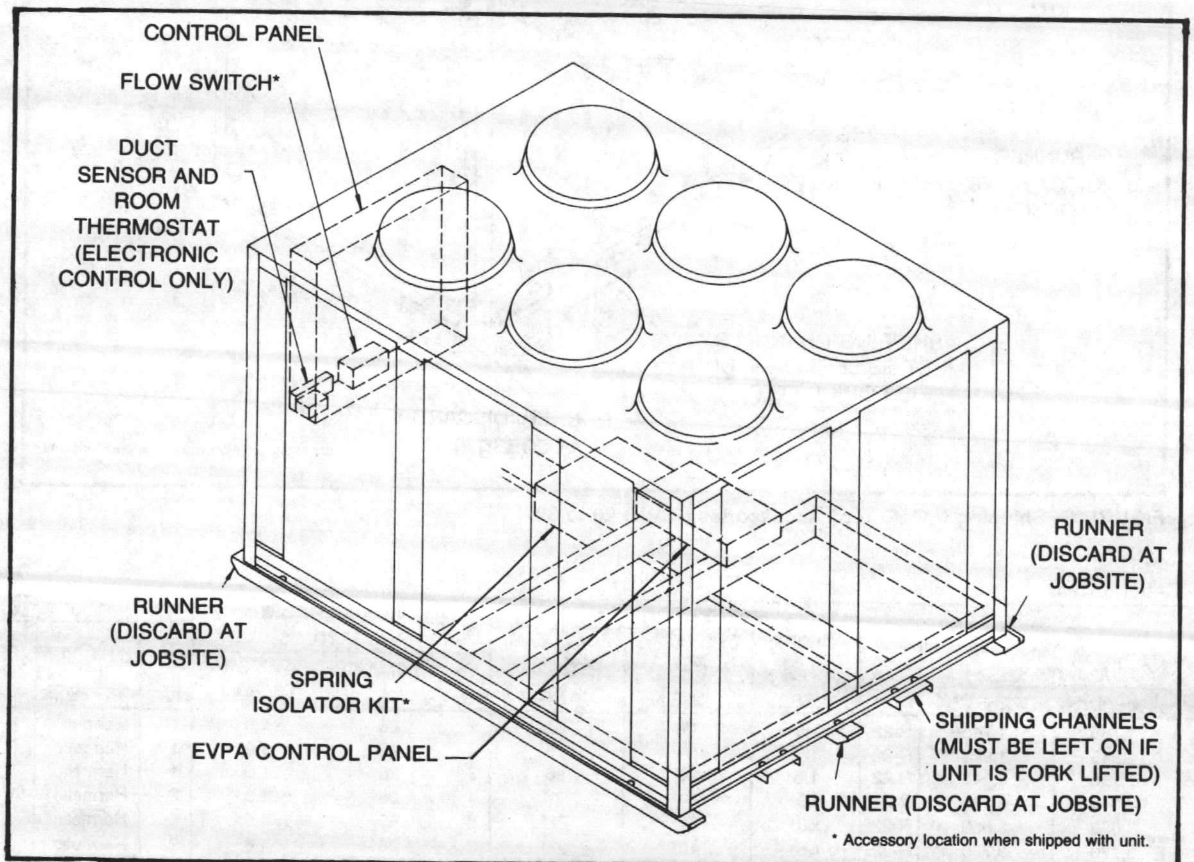
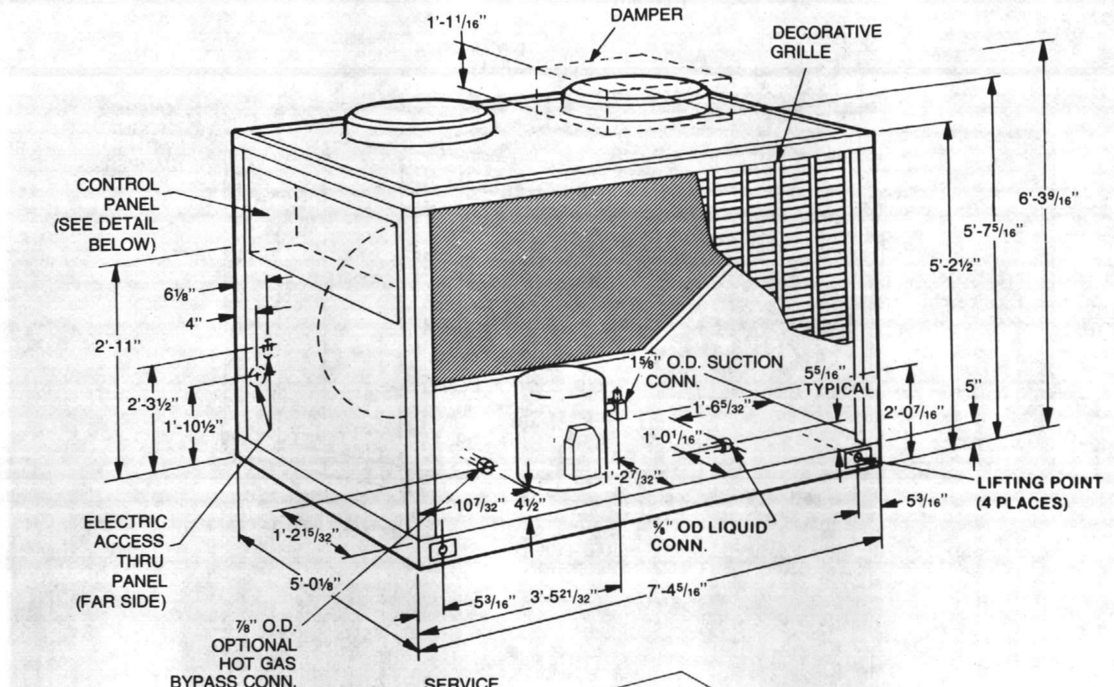
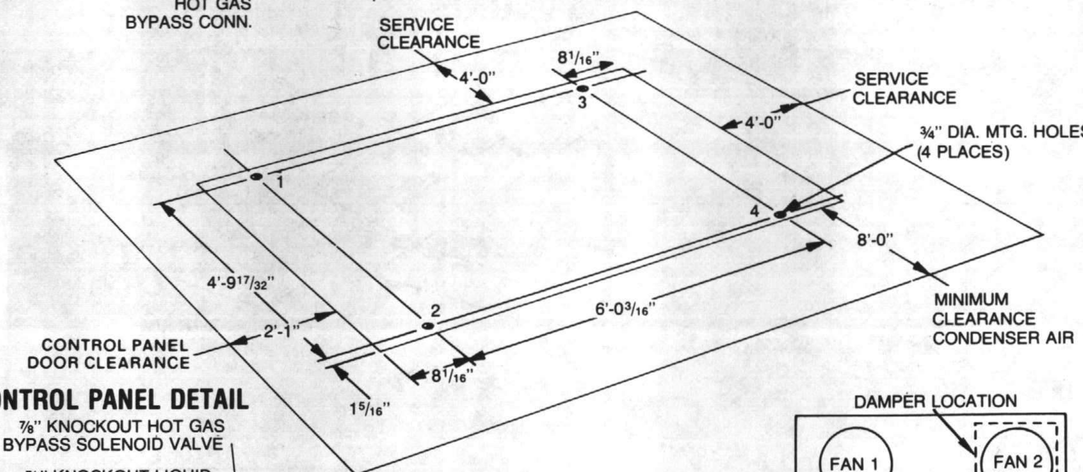
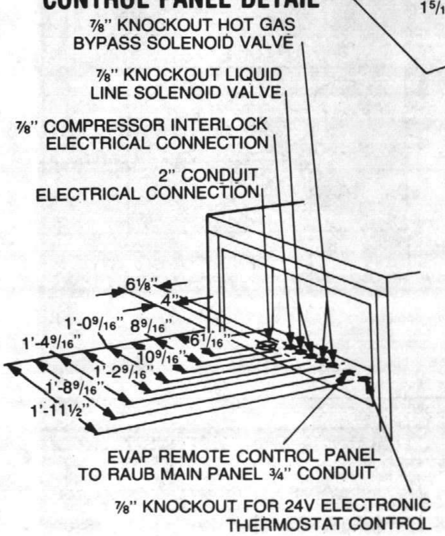


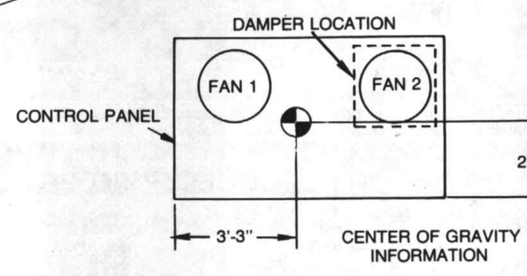
FIGURE 3 - Shipping Location of Accessories (RAUB 50 and 60)





CONTROL PANEL DETAIL





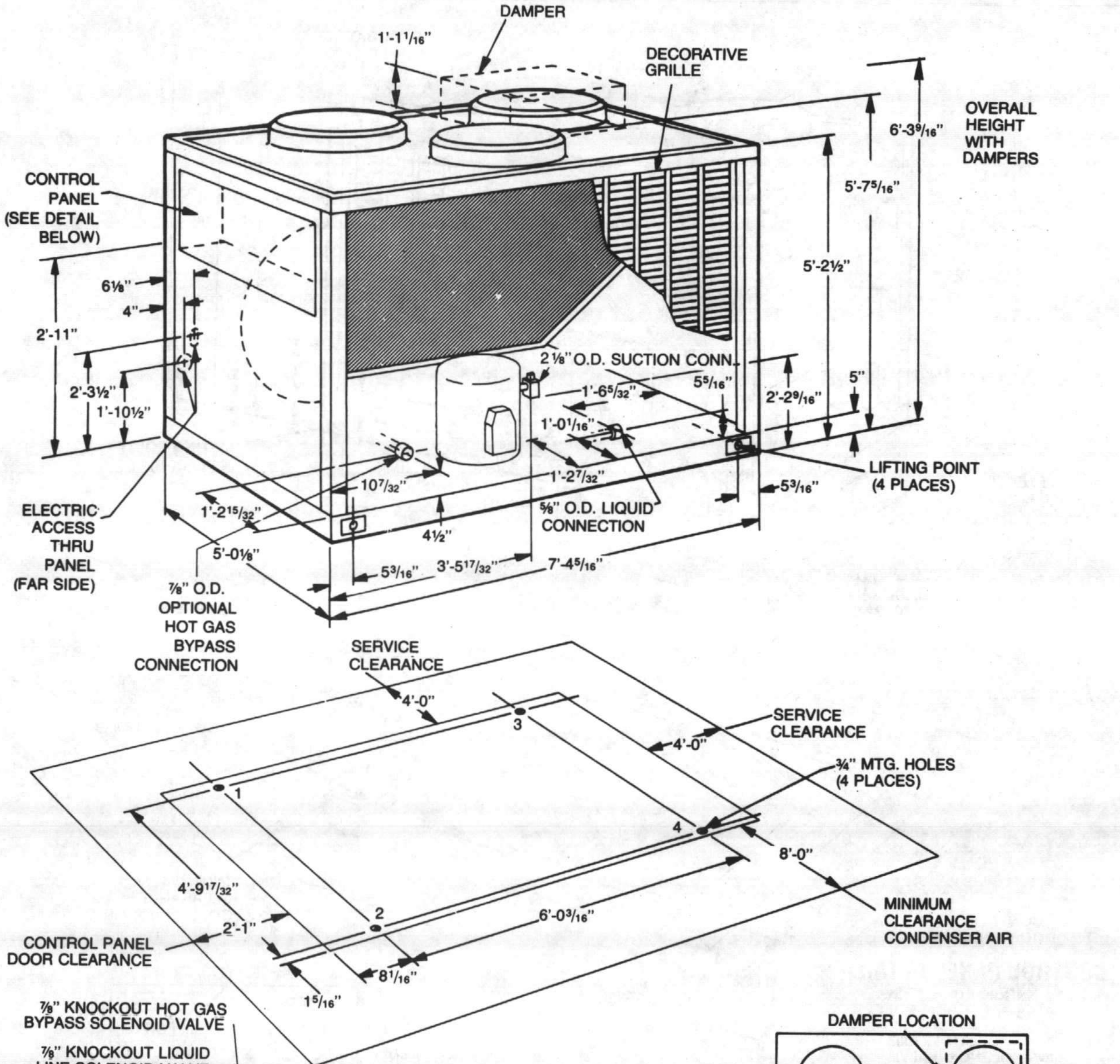
CLEARANCE DATA

SUGGESTED SERVICE CLEARANCE	SUGGESTED AIR FLOW CLEARANCES			
	SINGLE UNIT INSTALLATION	SIDE BY SIDE UNIT INSTALLATION	PIT INSTALLATION MAX. DEPTH	PIT INSTALLATION COIL CLEARANCE
4'-0"	8'-0"	16'-0"	5'-2½"	16'-0"

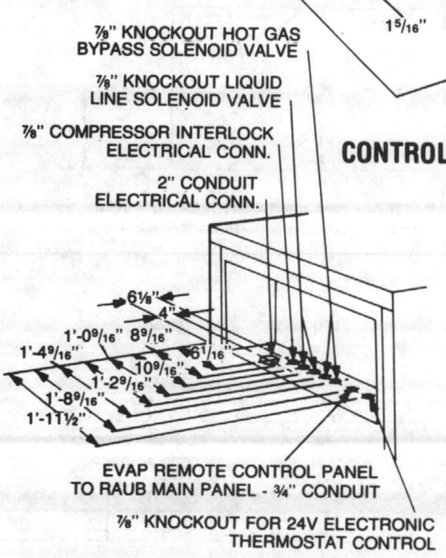
WEIGHTS

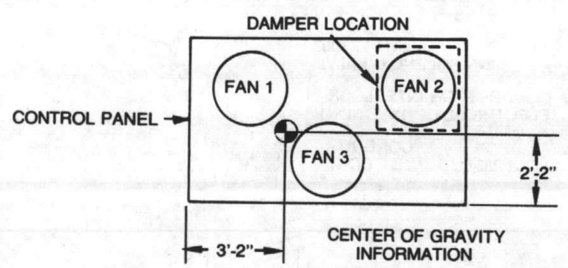
MODEL	NO. OF COMPRESSORS	WEIGHT CONCENTRATED ON LEG 1	2	3	4	OPERATING WEIGHT (LB)	SHIPPING WEIGHT (LB)
RAUB-C20	One 20-Ton K	430	570	320	425	1745	1765

FIGURE 4 - Dimensional Data, RAUB-C20



CONTROL PANEL DETAIL





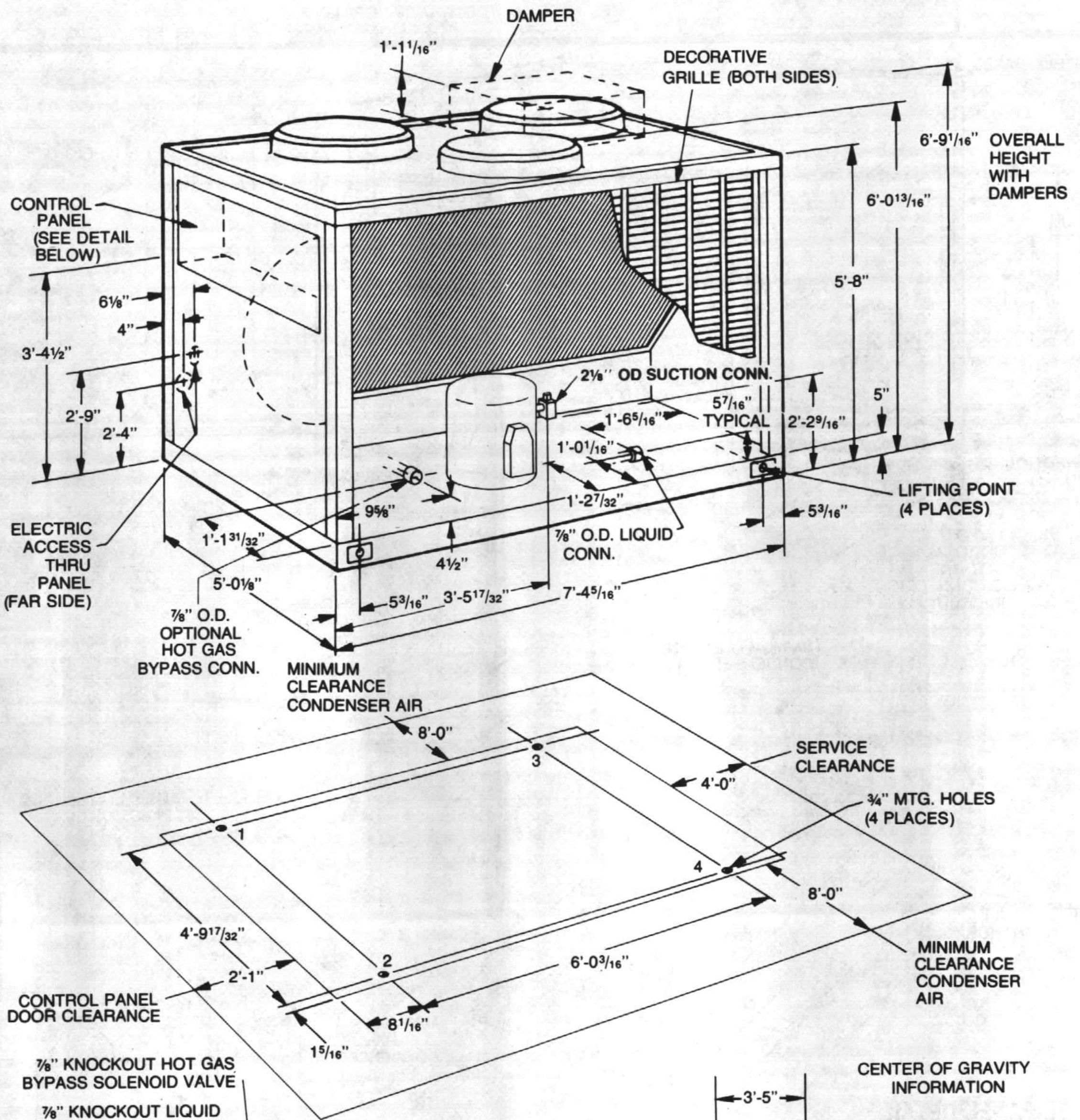
CLEARANCE DATA

SUGGESTED SERVICE CLEARANCE	SUGGESTED AIRFLOW CLEARANCES			
	SINGLE UNIT INSTALLATION	SIDE BY SIDE UNIT INSTALLATION	PIT INSTALLATION	
			MAX DEPTH	COIL CLEARANCE
4'-0"	8'-0"	16'-0"	5'-2½"	16'-0"

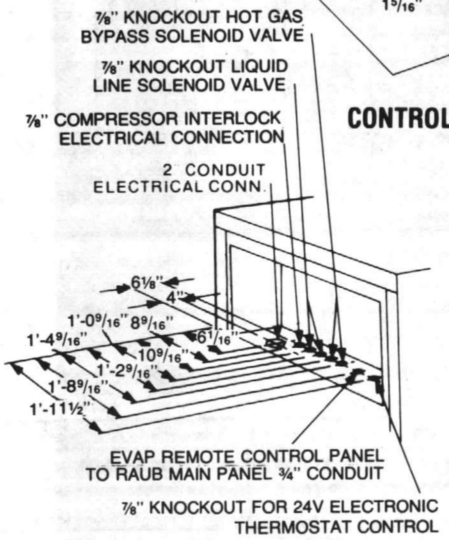
WEIGHTS

MODEL	NO. OF COMPRESSORS	WEIGHT CONCENTRATED ON LEG				OPERATING WEIGHT	SHIPPING WEIGHT
		1	2	3	4		
RAUB-C25	One 25-Ton K	465	660	330	470	1925	1945

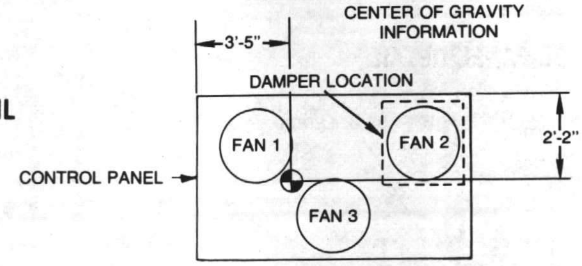
FIGURE 5 - Dimensional Data, RAUB-C25



CONTROL PANEL DETAIL



CENTER OF GRAVITY INFORMATION



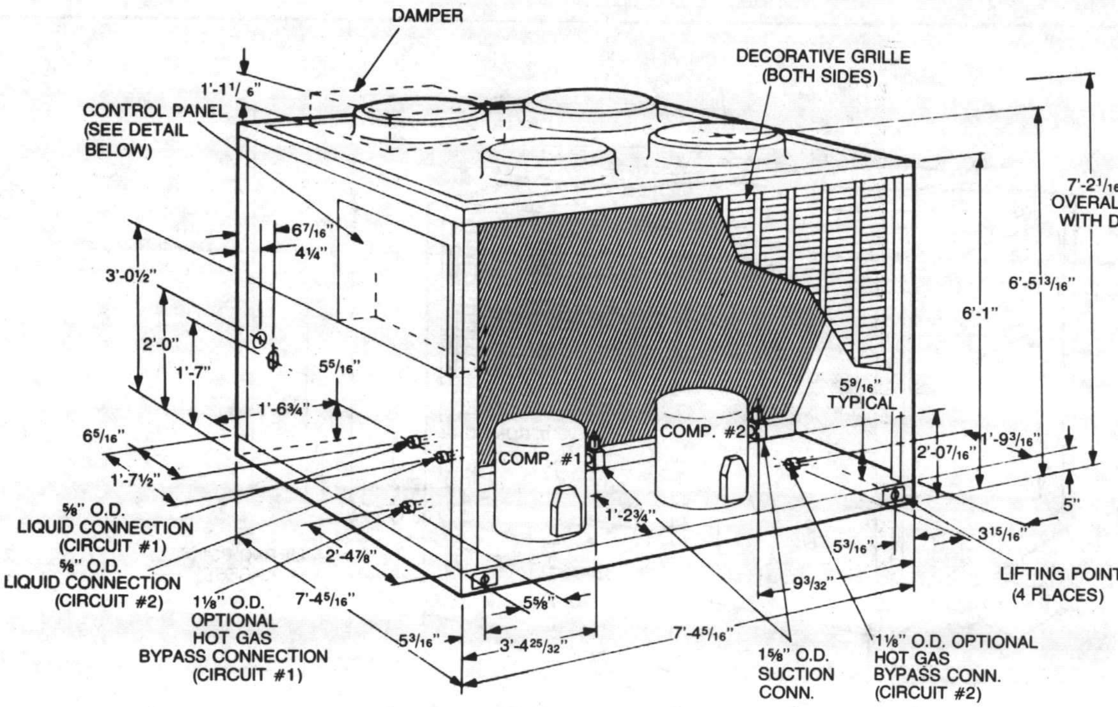
CLEARANCE DATA

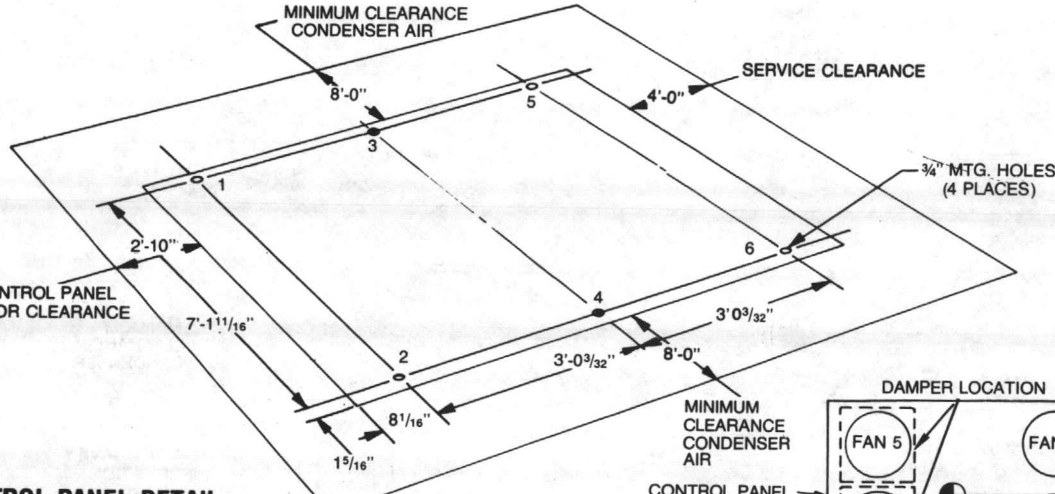
SUGGESTED SERVICE CLEARANCE	SUGGESTED AIRFLOW CLEARANCES			
	SINGLE UNIT INSTALLATION	SIDE BY SIDE UNIT INSTALLATION	PIT INSTALLATION MAX. DEPTH	PIT INSTALLATION COIL CLEARANCE
4'-0"	8'-0"	16'-0"	5'-8"	16'-0"

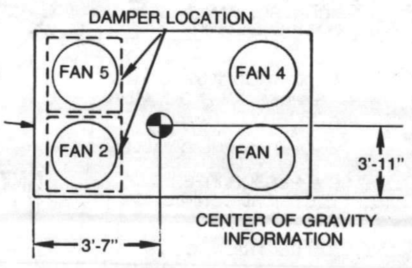
WEIGHTS

MODEL	NO. OF COMPRESSORS	WEIGHT CONCENTRATED ON LEG 1	2	3	4	OPERATING WEIGHT (LBS)	SHIPPING WEIGHT (LBS)
RAUB-C30	One 30-Ton K	540	715	380	510	2145	2155

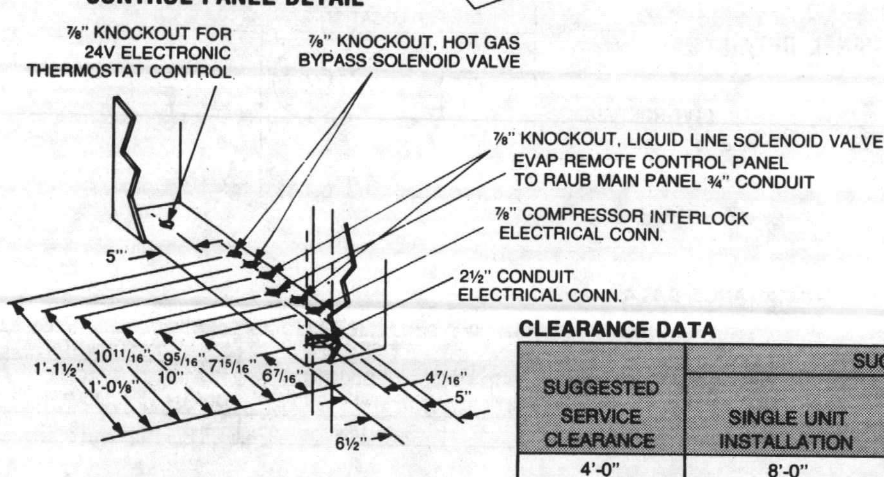
FIGURE 6 - Dimensional Data, RAUB-C30







CONTROL PANEL DETAIL



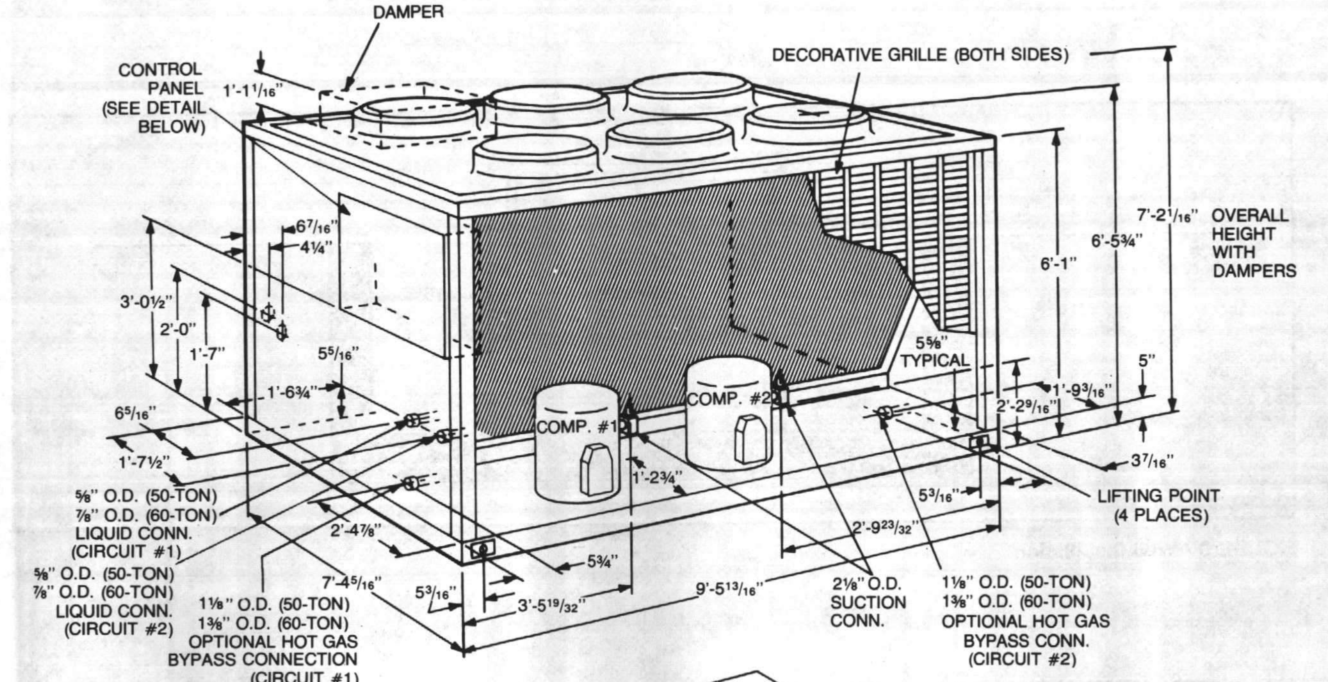
CLEARANCE DATA

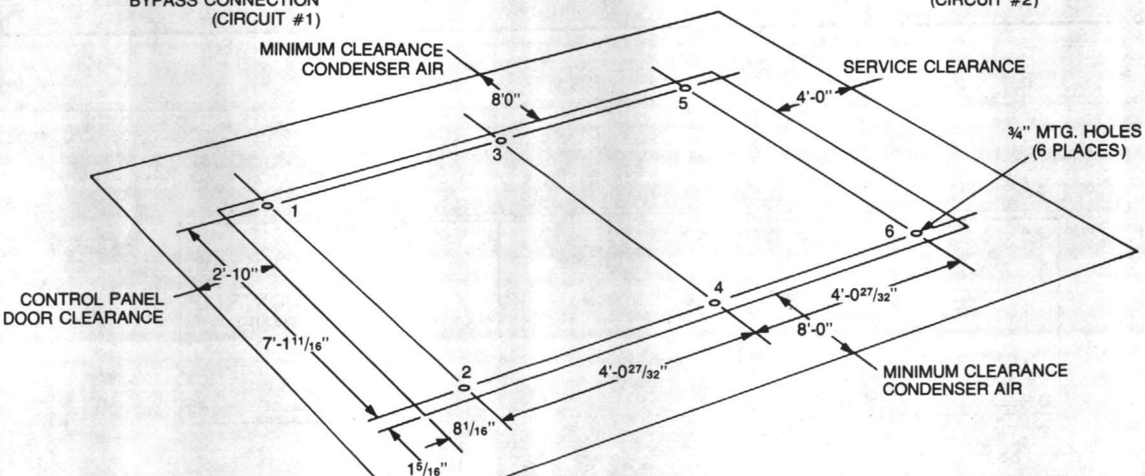
SUGGESTED SERVICE CLEARANCE	SUGGESTED AIRFLOW CLEARANCES			
	SINGLE UNIT INSTALLATION	SIDE BY SIDE UNIT INSTALLATION	PIT INSTALLATION MAX. DEPTH	PIT INSTALLATION COIL CLEARANCE
4'-0"	8'-0"	16'-0"	5'-8"	16'-0"

WEIGHTS

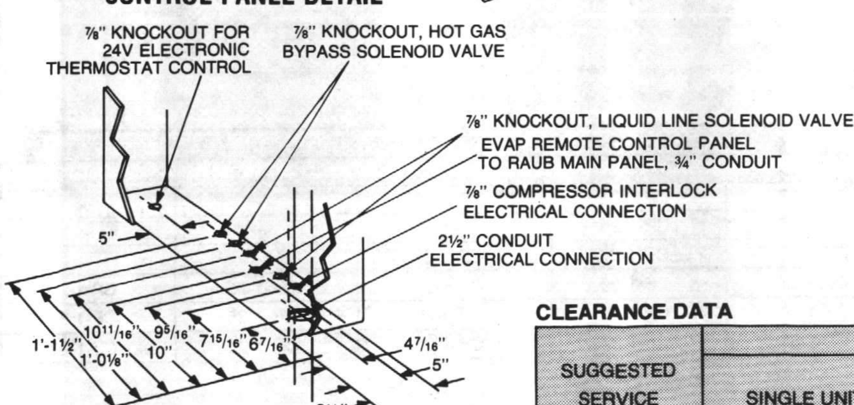
MODEL	NO. OF COMPRESSORS	WEIGHT CONCENTRATED ON LEG 1	2	3	4	5	6	OPERATING WEIGHT (LBS)	SHIPPING (LBS)
RAUB-C40	Two 20-Ton K	430	655	400	620	390	595	3090	3140

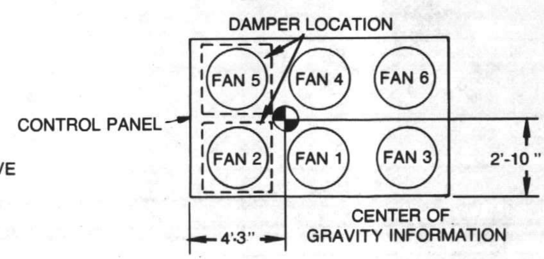
FIGURE 7 - Dimensional Data, RAUB-C40





CONTROL PANEL DETAIL





CLEARANCE DATA

SUGGESTED SERVICE CLEARANCE	SUGGESTED AIRFLOW CLEARANCES			
	SINGLE UNIT INSTALLATION	SIDE BY SIDE UNIT INSTALLATION	PIT INSTALLATION MAX. DEPTH	PIT INSTALLATION COIL CLEARANCE
4'-0"	8'-0"	16'-0"	6'-1"	16'-0"

WEIGHTS (LBS).									
MODEL	NO. OF COMPRESSORS	WEIGHT CONCENTRATED ON LEG 1	2	3	4	5	6	OPERATING WEIGHT (LBS)	SHIPPING WEIGHT (LBS)
RAUB-C50	Two 25-Ton K	535	865	450	735	370	600	3555	3620
RAUB-C60	Two 30-Ton K	560	905	475	765	390	625	3720	3770

FIGURE 8 - Dimensional Data, RAUB C50 and C60

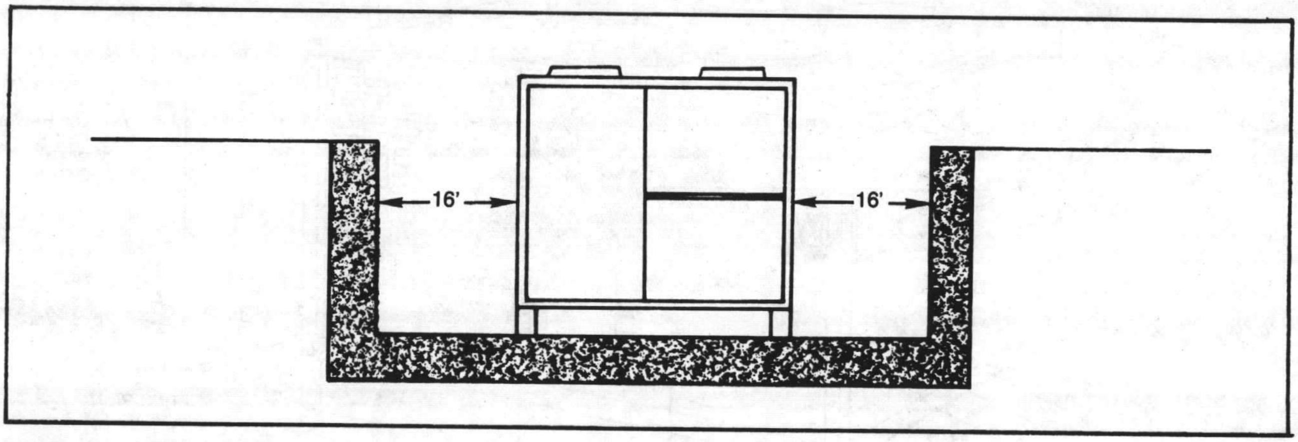
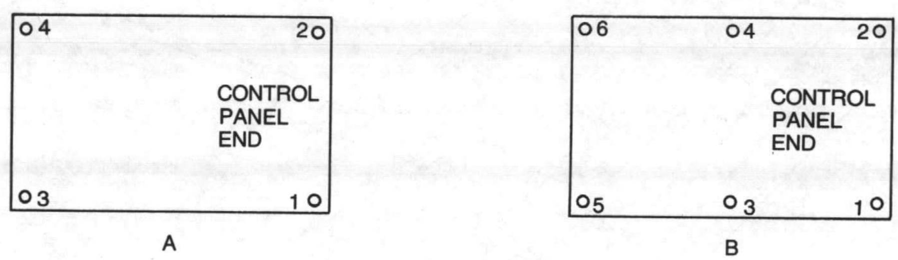
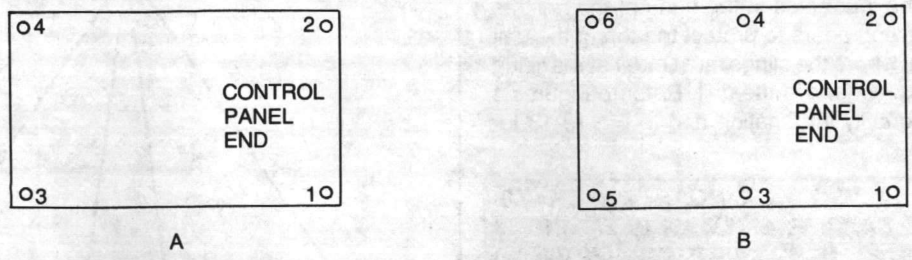


FIGURE 9 - Well Installation



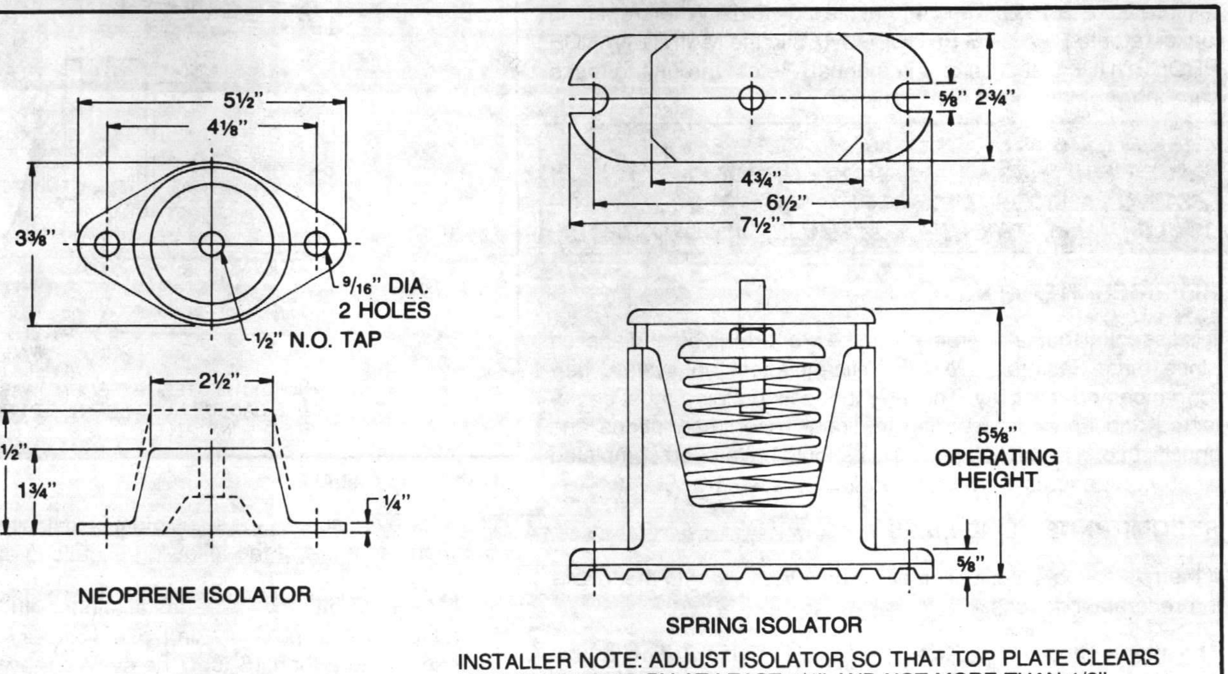
UNIT	FIG	MOUNTING LOCATION & ISOLATOR PART NO.					
		LOC 1	LOC 2	LOC 3	LOC 4	LOC 5	LOC 6
RAUB-C20	A	CP-1-26	CP-1-27	CP-1-25	CP-1-26	—	—
RAUB-C25	A	CP-1-26	CP-1-27	CP-1-25	CP-1-26	—	—
RAUB-C30	A	CP-1-27	CP-1-28	CP-1-26	CP-1-27	—	—
RAUB-C40	B	CP-1-26	CP-1-27	CP-1-26	CP-1-27	CP-1-26	CP-1-27
RAUB-C50	B	CP-1-26	CP-1-28	CP-1-26	CP-1-28	CP-1-25	CP-1-27
RAUB-C60	B	CP-1-27	CP-1-31	CP-1-27	CP-1-28	CP-1-26	CP-1-28

FIGURE 10 - Spring Isolator Selection and Location



UNIT	FIG	MOUNTING LOCATION & ISOLATOR PART NO.					
		LOC 1	LOC 2	LOC 3	LOC 4	LOC 5	LOC 6
RAUB-C20	A	R-3 RED	R-3 GRN	R-3 RED	R-3 RED	—	—
RAUB-C25	A	R-3 RED	R-3 GRN	R-3 RED	R-3 RED	—	—
RAUB-C30	A	R-3 GRN	R-3 GRAY	R-3 RED	R-3 GRN	—	—
RAUB-C40	B	R-3 RED	R-3 GRN	R-3 RED	R-3 GRN	R-3 RED	R-3 GRN
RAUB-C50	B	R-3 GRN	R-3 GRAY	R-3 RED	R-3 GRAY	R-3 RED	R-3 GRN
RAUB-C60	B	R-3 GRN	R-3 GRAY	R-3 RED	R-3 GRAY	R-3 RED	R-3 GRN

FIGURE 11 - Isolation Pad Selection and Location



INSTALLER NOTE: ADJUST ISOLATOR SO THAT TOP PLATE CLEARS LOWER HOUSING BY AT LEAST 1/4" AND NOT MORE THAN 1/2".

FIGURE 12 - Isolator Dimensions

HANDLING AND RIGGING

All 20 through 60-ton RAUB units can be lifted with a fork truck provided that the middle shipping channels are left under the unit (refer to Figures 1 and 3). Any time a fork truck is used, the forks **must** protrude beyond the width of the unit.

Rig the unit using either belts or cable slings. The slings must be fastened to the unit at the four holes in the base of the unit, as shown in Figure 13. Use spreaders to protect the top of the unit when it is lifted. The point where the slings must meet at the lifting hook must be at least six feet above the unit. Refer to Figures 4 through 8 for center-of-gravity information and to Figure 13 for proper rigging procedures.

WARNING: TO PREVENT OVERSTRESSING THE BASE RAILS, THE UNIT SHOULD BE RIGGED AS SHOWN IN FIGURE 13 AND LIFTED AS SMOOTHLY AS POSSIBLE. FAILURE TO DO SO COULD RESULT IN SERIOUS PERSONAL INJURY AND DAMAGE TO THE UNIT.

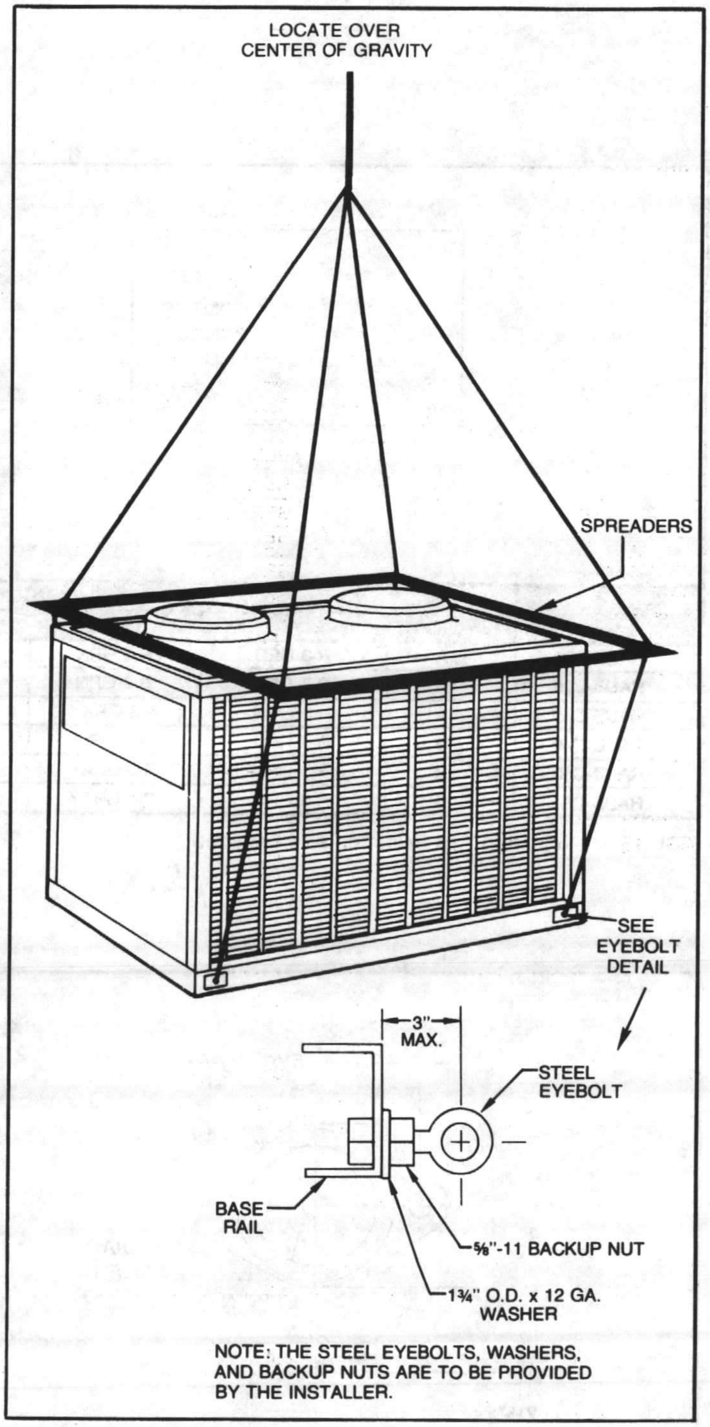


FIGURE 13 - Rigging

PRE-INSTALLATION LEAK TEST

Trane condensing units and some evaporators are shipped with a holding charge of Refrigerant-22. Before installing these units, momentarily open the service port in either the suction or discharge line access valve to verify that the holding charge has not been lost.

If no refrigerant escapes when opening the service port, the condensing unit should be leak tested to determine the source of refrigerant loss. Pressurize the unit to 100 psi with refrigerant and use a halogen leak detector, halide torch or soap bubbles to check for leaks. If a leak is found, release the test pressure and repair the leak. If no leak is found, use nitrogen to increase the test pressure to 150 psi and repeat the leak tests. When repairing leaks, refer to BRAZING PROCEDURES in the MAINTENANCE PROCEDURES section of this manual. Retest the unit to make sure the problem has been corrected.

WARNING: DO NOT USE OXYGEN, ACETYLENE OR AIR IN PLACE OF REFRIGERANT AND DRY NITROGEN FOR LEAK TESTING. A VIOLENT EXPLOSION WILL RESULT WHICH COULD CAUSE SERIOUS PERSONAL INJURY OR DEATH.

REFRIGERANT PIPING

It is essential that refrigerant piping be properly sized and applied since these factors have a significant effect on system performance and reliability. The interconnecting piping must be selected and applied according to Trane recommendations and specifications on the job plan. This should have been completed when components were selected for the system.

RECOMMENDED LINE SIZES

If there is no job specification or piping layout, refer to the following recommendations.

The interconnecting line sizes are listed in Table 2. These tube sizes are within the velocity, pressure drop and refrigerant charge limitations necessary for proper system operation. (The refrigerant charge limitation is the maximum system charge for a specific compressor and is determined by the design of the compressor). The line lengths in Table 2 are based on pressure drop and refrigerant charge limitations in the **liquid line**. Pressure drop limits assume that equivalent length equals two times the physical length. In most applications this is a reasonable assumption. However, actual pipe sizes must be calculated (see EB-S/S-38) if one or more of the following situations exist:

1. LONG LIQUID RISER — installations with liquid line risers have an added pressure drop of 0.5 psi per foot of riser. If the riser is more than 15-feet, the system may require a larger diameter and/or shorter piping run to ensure adequate subcooling at the expansion valve.

2. EXCESSIVE BENDS, REDUCERS, VALVES — a greater than normal number of tube bends, reducers, and/or valves may increase the equivalent length and pressure drop above the assumption of two times the physical length. Actual pressure drop should be calculated for these situations.

3. LONG PIPING LENGTHS — for total piping lengths greater than the lengths given in Table 2, larger liquid lines may be required. However, guidelines specified in Engineering Bulletin EB-S/S-38 must be followed.

Trane recommends the use of Type L (medium wall) refrigerant tubing. Only refrigerant grade copper tubing should be used since it is available cleaned, dehydrated and capped to avoid contamination prior to installation. Copper tubing used for plumbing usually has oil, grease or other contaminants on the interior wall and these can cause serious operating problems if not removed prior to installation. Tube size recommendations in this manual are based on Type L (medium wall) tubing.

LIQUID LINE COMPONENTS

A properly sized liquid line filter drier must be installed upstream from the expansion valve. In addition, a moisture indicator/sight glass should be installed between the expansion valve and filter drier. Both of these components should be installed at the evaporator close to the expansion valve as shown in Figure 14.

The number of other valves, reducers and tube bends should be minimized as these items tend to increase the pressure drop and reduce subcooling at the expansion valve.

At least one liquid line solenoid valve must be installed on each refrigerant circuit. With unloaded compressor operation, max-

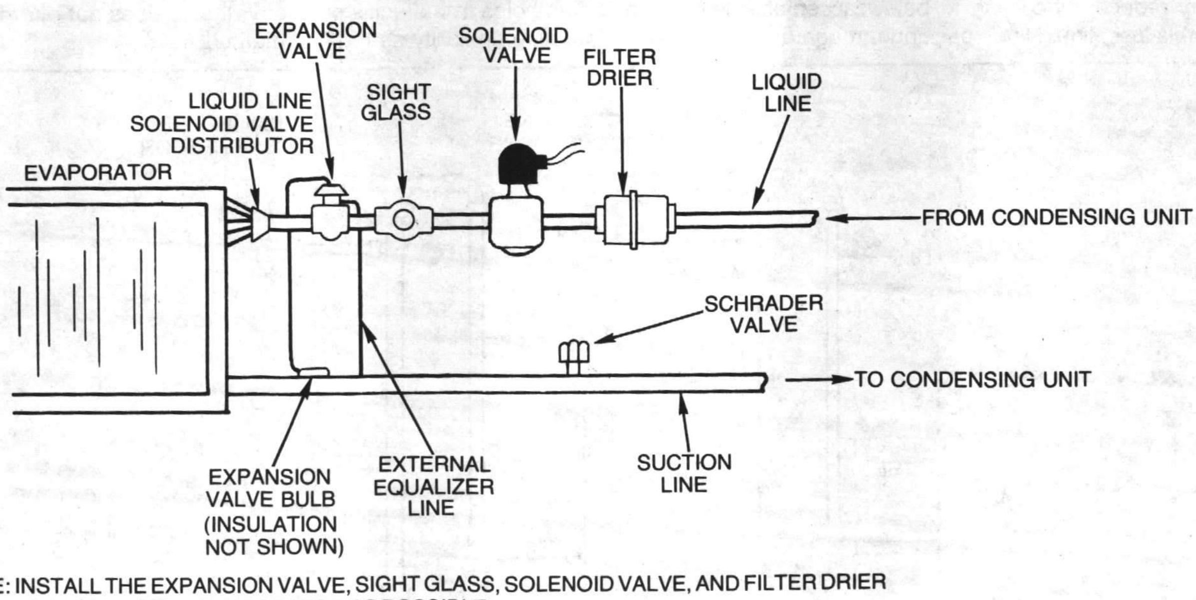
TABLE 2 - Interconnecting Line Sizes+

CONDENSING UNIT	LENGTH OF INTERCONNECTING LINES (FT)**																			
	0-20		21-40		41-60		61-80		81-100		101-120		121-140		141-160		161-180		181-200	
	LINE SIZE — O.D. (IN.)																			
	LIQ	SUCT	LIQ	SUCT	LIQ	SUCT	LIQ	SUCT	LIQ	SUCT	LIQ	SUCT	LIQ	SUCT	LIQ	SUCT	LIQ	SUCT	LIQ	SUCT
RAUB-C20	⅝	1⅝	⅝	1⅝	⅝	1⅝	⅝	2⅛	⅝	2⅛	⅞	2⅛	⅞	2⅛	⅞	2⅛	⅞	2⅛	⅞	2⅛
RAUB-C25	⅝	1⅝	⅝	1⅝	⅝	2⅛	⅝	2⅛	⅞	2⅛	⅞	2⅛	⅞	2⅛	⅞	2⅛	⅞	2⅛	—	—
RAUB-C30	⅞	1⅝	⅞	2⅛	⅞	2⅛	⅞	2⅛	⅞	2⅛	⅞	2⅛	⅞	2⅛	—	—	—	—	—	—
RAUB-C40*	⅝	1⅝	⅝	1⅝	⅝	1⅝	⅝	2⅛	⅝	2⅛	⅞	2⅛	⅞	2⅛	⅞	2⅛	⅞	2⅛	⅞	2⅛
RAUB-C50*	⅝	1⅝	⅝	1⅝	⅝	2⅛	⅝	2⅛	⅞	2⅛	⅞	2⅛	⅞	2⅛	⅞	2⅛	⅞	2⅛	—	—
RAUB-C60*	⅞	1⅝	⅞	2⅛	⅞	2⅛	⅞	2⅛	⅞	2⅛	⅞	2⅛	⅞	2⅛	—	—	—	—	—	—

* Two line sets required.

** For vertical suction riser, suction line size in shaded region must either be reduced to 1⅝, or double riser must be utilized (see Engineering Bulletin EB-S/S-38).

+ Refer to Engineering Bulletin No. EB-S/S-38 for applications with liquid line riser greater than 15 feet, or for line lengths greater than listed in table.



NOTE: INSTALL THE EXPANSION VALVE, SIGHT GLASS, SOLENOID VALVE, AND FILTER DRIER AS CLOSE TO THE EVAPORATOR AS POSSIBLE.

FIGURE 14 - Diagram of Refrigerant Piping Components in Liquid Line

imum system efficiency is achieved with a full evaporator coil. However, this can result in poor system moisture removal capacity. Generally, moisture removal is not a problem with 1/2 compressor loading, but can be of concern with RAUB 25 and 30 ton condensing units which unload to 1/3 capacity on each compressor. On these units, better moisture removal capacity can be achieved by separating the refrigerant coil into two equal sections and shutting off half of the coil when the compressor is at 1/3 loading.

Factory-installed solenoid valves are provided on BRCB evaporators to shut off one-half of the evaporator coil. When other air-to-air low sides are utilized a solenoid valve can be installed between the filter drier and sight glass in order to shut off one-half of the evaporator coil. On units where the solenoid valves are factory-installed, it is permissible to install the sight glass between the unit and the filter drier. However, all of these components should be installed close to the expansion valve and no more than one-half of the coil should be shut off.

Liquid line refrigerant velocities should be kept below 5-7 feet per second in order to prevent "liquid hammer" because of the liquid line solenoid valves. However, this is a secondary consideration, and it is more important to insure that compressor refrigerant charge limits are not exceeded.

RISERS AND TUBE ROUTING

Liquid line riser lengths are limited only by the additional pressure drop (0.5 psi/ft.) which results from the liquid column. No limit exists on the length of liquid line drops and no special line sloping considerations are necessary.

Normally it is not necessary or desirable to insulate liquid lines. In most applications the ambient temperature is lower than the refrigerant temperature and has the desirable effect of increasing subcooling at the expansion valve. However, liquid lines routed through extremely high ambient environments (such as a boiler room) may reduce subcooling to below acceptable levels. To minimize this loss, liquid lines passing through extremely warm (above 110 F) areas should be insulated. Increasing liquid line size will only tend to aggravate this problem.

SUCTION LINE

The suction line sizes recommended in Table 2 will result in sufficient refrigerant vapor velocity to ensure good oil entrainment. It is also important to utilize good tube routing practices to ensure proper oil return to the compressor. Where suction lines must rise more than four feet, a "P" trap should be used at the base of the riser in order to facilitate oil return. This P-trap should be repeated for each 25 feet of riser. However, it is critical that no long traps be used which could accumulate significant quantities of oil. In other words, line traps should be constructed with no horizontal length in the bottom. Two street ells may be directly connected together to form this P-trap.

It is not recommended that horizontal suction lines be pitched towards the compressor. However, they should be reasonably level to prevent the oil from pooling in the line close to the compressor during the OFF cycle. Vertical risers should be no larger than 1-5/8-inch O.D. on 20 through 60-ton RAUB units even if horizontal runs are 2-1/8-inch O.D. If pressure drop in the 1-5/8-inch riser is unacceptable, double risers should be utilized as shown in Figure 15. In this case, the small riser should be 1-5/8-inch O.D. and the large riser should be 2-1/8-inch O.D. On dual compressor 40-60 ton RAUB units, some of the compressors may not unload. In this case, a 2-1/8 inch suction line riser is acceptable.

Insulate the suction line with 1/2-inch thick closed cell neoprene insulation such as Armaflex or similar material. Do not run the suction and liquid line in contact with each other without insulation between them.

REFRIGERANT PIPING INSTALLATION INSTRUCTIONS

One of two methods may be used to properly route piping within the unit. The first method requires the use of unit isolators, yet provides a direct and flexible means of routing the piping. The second method does not require isolators, but necessitates cutting holes in the unit's cabinetry. It also does not offer as much routing flexibility as the first method.

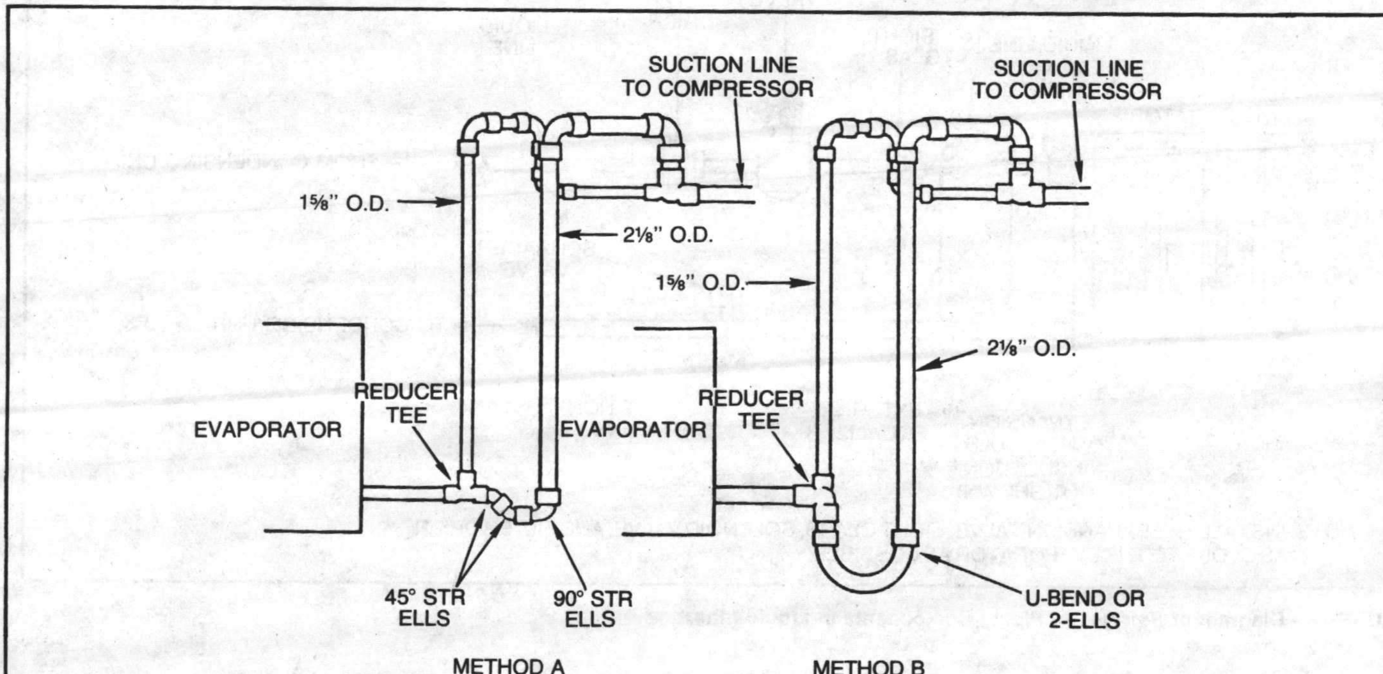


FIGURE 15 - Double Riser Suction Line

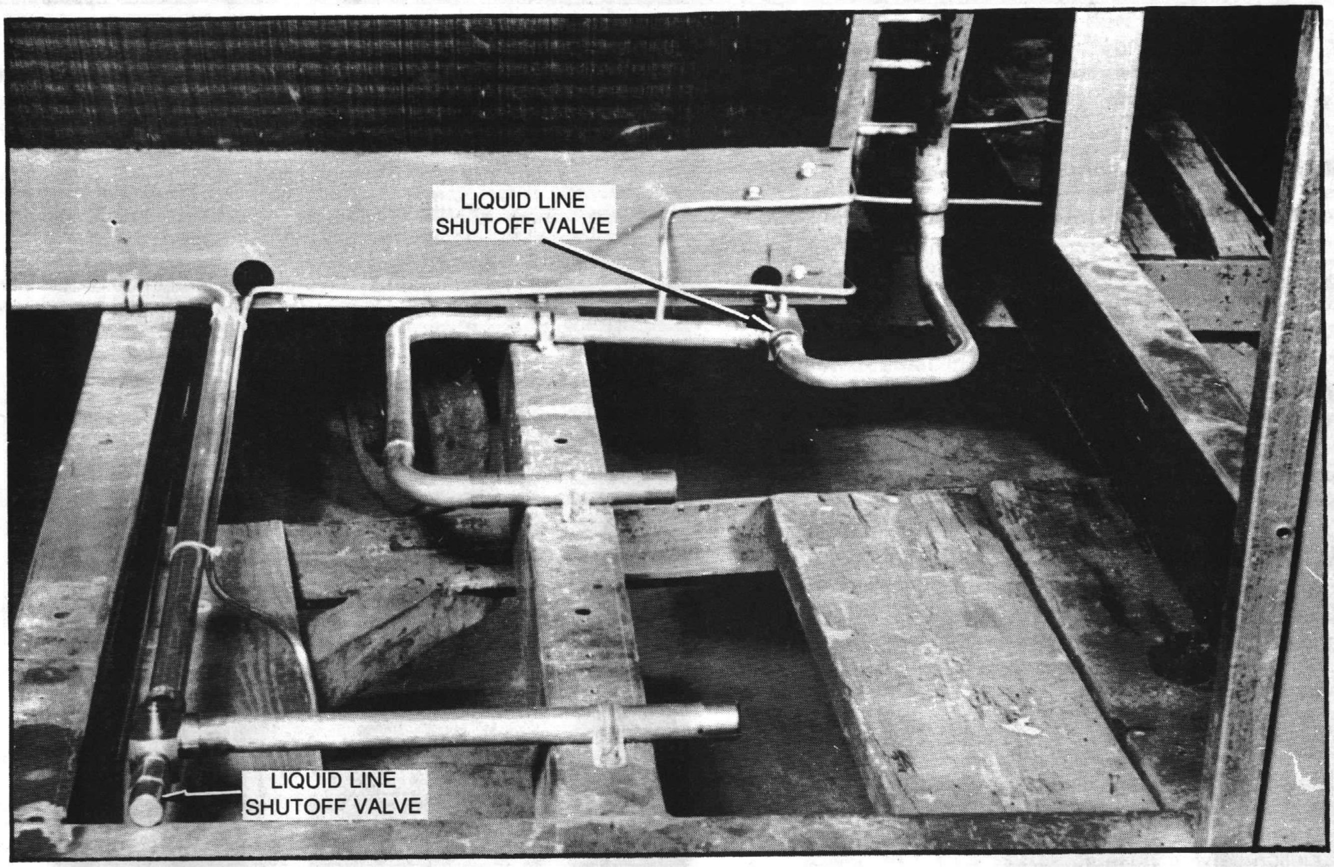


FIGURE 16 - Liquid Line(s) Piping (40, 50 and 60-Ton Units)

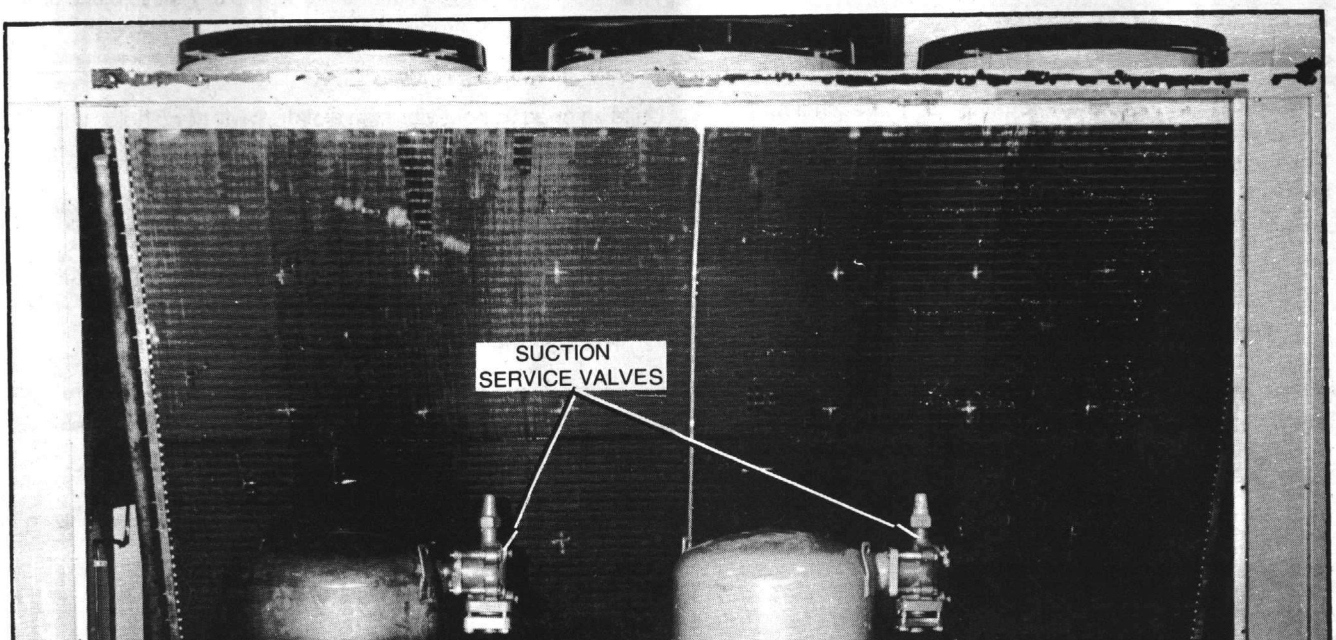


FIGURE 17 - Suction Line(s) Piping

NOTE: *In addition to the following instructions, the refrigerant piping should be installed in accordance with the discussion presented in Engineering Bulletin EB-S/S-38 and this manual.*

IMPORTANT: *Leave a 4 to 5-foot clearance in front of the compressor section for compressor removal.*

Units Mounted On Isolators

Field refrigerant piping can be routed under the framework on units equipped with isolators. Piping the unit in this manner takes a minimum amount of copper and allows the flexibility of running the piping unobstructed in any direction once it is dropped below the unit framework. **A 5-1/2-inch minimum clearance must be provided between the unit base and the isolator base for routing insulated suction line.** Units equipped with spring isolators have sufficient clearance, however, units equipped with neoprene isolators will need 4-inch blocks placed under each isolator to meet the specified clearance.

RAUB 20 to 60-ton condensing units have refrigerant connections at the liquid line stubs and at the compressor suction service valves. Figure 18 illustrates the connection points in the 20, 25 and 30-ton units and Figure 19 shows the points in the 40, 50 and 60-ton machines.

Procedure:

1. Remove all decorative grilles from the unit.
2. Release the unit's holding charge.
3. Remove the suction flange(s) and closure plates from the suction service valve(s).
4. Remove the cap(s) from the liquid line stub connections.
5. Proceed to pipe the liquid line(s) as shown in Figures 18 and 19.
6. Two 90-degree elbows are required to drop each liquid line below the unit framework. Once the drop is made, run the liquid line(s) to the desired location in accordance with the guidelines presented in the Trane Engineering Bulletin EB-S/S-38 and this manual.
   a. Allow at least a 1-1/2-inch clearance between the liquid line(s) and any surface or obstruction to prevent direct line contact and possible noise transmission.
   b. Clamp the liquid line(s) at a location no less than 3-feet and no more than 6-feet from the stub locations.
7. Once the liquid line(s) has been formed, braze all connections.
8. Proceed to pipe the suction line(s) as shown in Figures 18 and 19.

WARNING: NEVER USE A TORCH ON A REFRIGERANT LINE UNTIL IT HAS BEEN DETERMINED THAT ALL GAS HAS BEEN ELIMINATED FROM THE LINE – UNSAFE PRESSURES COULD RESULT CAUSING A VIOLENT EXPLOSION AND SERIOUS PERSONAL INJURY OR DEATH. BE SURE THE AREA IS WELL VENTILATED.

CAUTION: Pump dry nitrogen through the system refrigeration piping whenever brazing is in progress. Failure to do this will permit oxides to form and accumulate in the refrigerant system resulting in equipment damage.

9. Run the suction line(s) vertically downward to the base of the unit.
10. A 90-degree elbow will be required to run each suction line horizontally below the unit framework.
11. Run the suction line(s) to the desired location in accordance with the guidelines presented in Trane Engineering Bulletin EB-S/S-38 and this manual.
    a. Allow at least a 1-1/2-inch clearance between the line(s) and any surface or obstruction to prevent direct line contact and possible noise transmission.
    b. Clamp the line(s) at a location no less than 10-feet and no more than 15-feet from the suction service valve(s) to prevent noise transmission and provide adequate support.
12. With each suction valve coupling removed from its service valve, braze the coupling to the suction line.

WARNING: NEVER USE A TORCH ON A REFRIGERANT LINE UNTIL IT HAS BEEN DETERMINED THAT ALL GAS HAS BEEN ELIMINATED FROM THE LINE – UNSAFE PRESSURES WOULD RESULT CAUSING AN EXPLOSION AND SERIOUS PERSONAL INJURY OR DEATH. BE SURE THE AREA IS WELL VENTILATED.

CAUTION: Pump dry nitrogen through the system refrigerant piping whenever brazing is in progress. Failure to do this will permit oxides to form and accumulate in the refrigerant system resulting in equipment damage.

13. Bolt each suction line up to its service valve and reposition the line.
14. Proceed brazing the connections with the line in place or with the connections referenced and the line removed.

Units Without Isolators

Units shipped without vibration isolators will need holes cut in the cabinetry in order to route field refrigerant piping. The following procedure should be used.

20 to 30-Ton Units

1. Remove the decorative grilles enclosing the compressor section.
2. Release the unit's holding charge.
3. Remove the suction flange and closure plates from the suction service valve.
4. Remove the cap from the liquid line stub connection.
5. Cut holes in the center support and filler post as shown in Figure 20.
6. Pipe the liquid line as illustrated in Figure 21.
7. Run the liquid line through the appropriate hole location using two lengths of liquid line, one coupling and one 90-degree elbow.
8. Center the line in the opening.
9. Clamp the liquid line to the unit base rail just ahead of the notched out hole.
10. Run the line to the desired location and proceed brazing the connections with the line in place or with the connections referenced and the line removed.

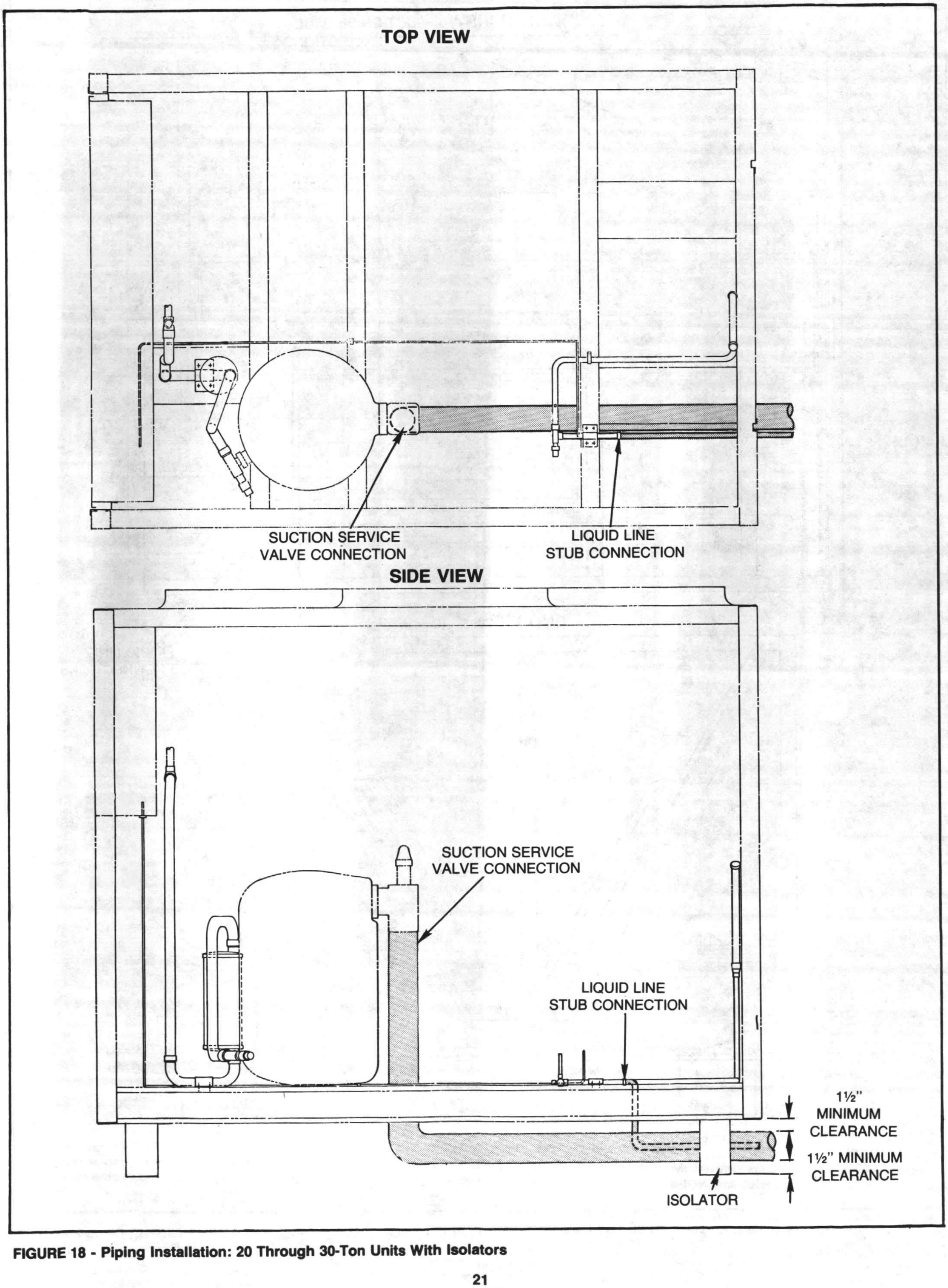


FIGURE 18 - Piping Installation: 20 Through 30-Ton Units With Isolators

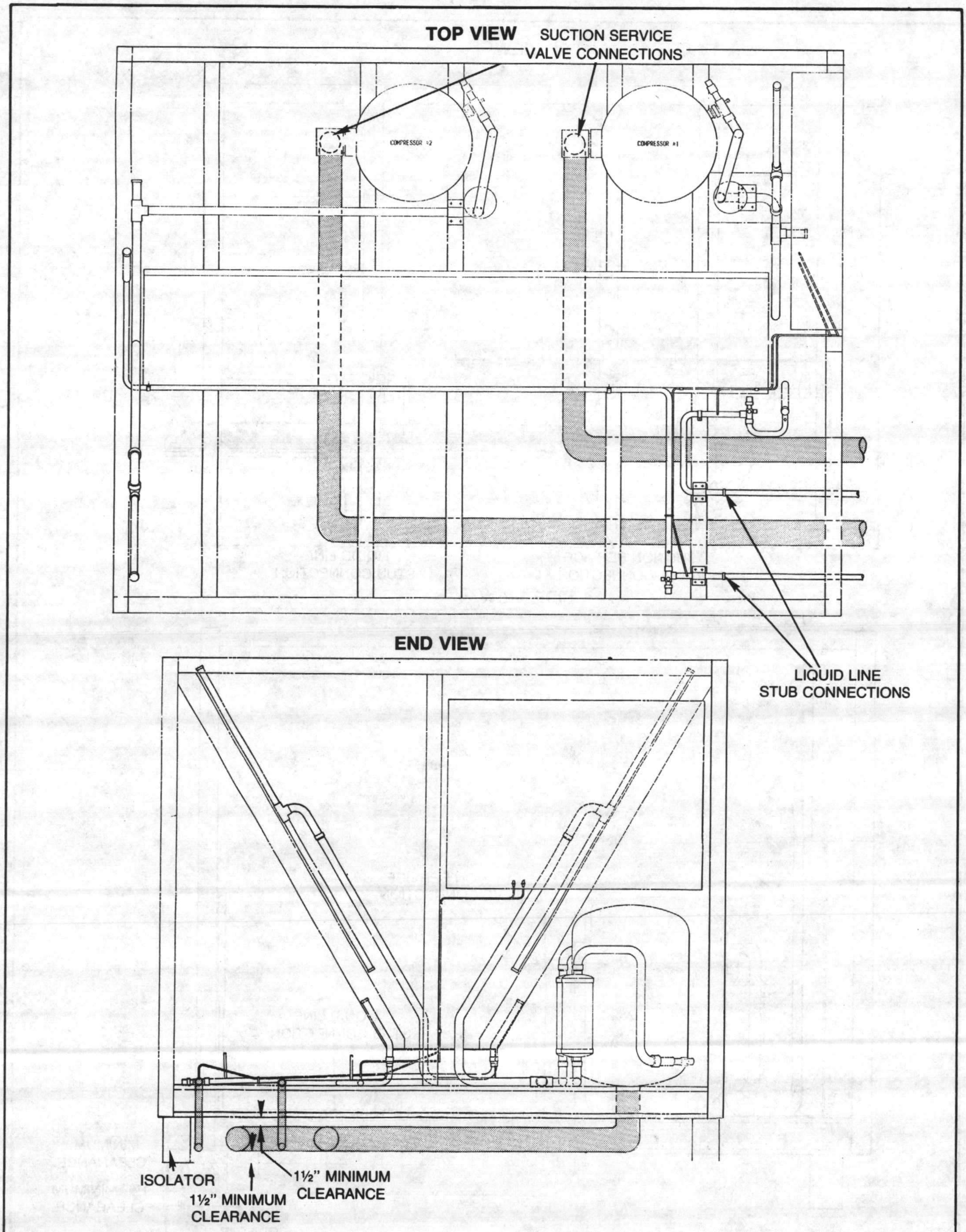


FIGURE 19 - Piping Installation: 40 Through 60-Ton Units Equipped With Isolators

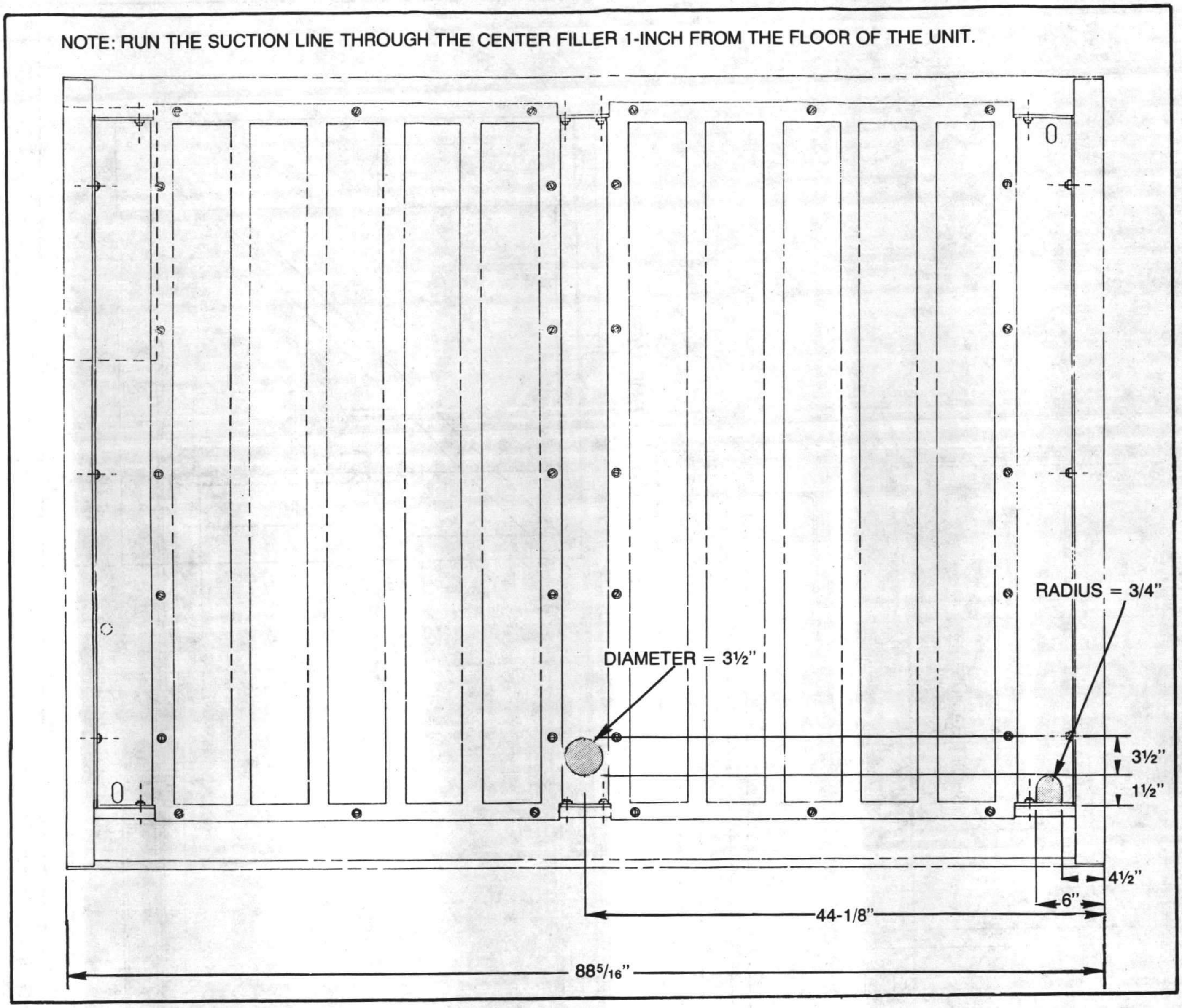


FIGURE 20 - Hole Locations: 20 Through 30-Ton Units

WARNING: NEVER USE A TORCH ON A REFRIGERANT LINE UNTIL IT HAS BEEN DETERMINED THAT ALL GAS HAS BEEN ELIMINATED FROM THE LINE – UNSAFE PRESSURES COULD RESULT CAUSING A VIOLENT EXPLOSION AND SERIOUS PERSONAL INJURY OR DEATH. BE SURE THE AREA IS WELL VENTILATED.

CAUTION: Pump dry nitrogen through the system refrigerant piping whenever brazing is in progress. Failure to do this will permit oxides to form and accumulate in the refrigerant system which may cause damage to the refrigeration system.

11. Proceed piping the suction lines as shown in Figure 21.
12. Pipe the line through the appropriate hole, using two lengths of pipe, a short radius street elbow and a 45-degree elbow. See Figure 21.
13. Center the suction line in the hole.
14. Run the line to the desired location in accordance with the guidelines presented in Trane Engineering Bulletin EB-S/S-38 and this manual.
    a. Allow at least a 1-1/2-inch clearance between the liquid line(s) and any surface or obstruction to prevent direct line contact and possible noise transmission.
    b. Clamp the liquid line(s) at a location no less than 3 feet and no more than 6 feet from the stub locations.
15. With each suction valve coupling removed from its service valve, braze the coupling to its respective suction line.

WARNING: NEVER USE A TORCH ON A REFRIGERANT LINE UNTIL IT HAS BEEN DETERMINED THAT ALL GAS HAS BEEN ELIMINATED FROM THE LINE – UNSAFE PRESSURES COULD RESULT. BE SURE THE AREA IS WELL VENTILATED.

CAUTION: Pump dry nitrogen through the system refrigerant piping whenever brazing is in progress. Failure to do this will permit oxides to form and accumulate in the refrigerant system which may cause damage to the refrigeration system.

16. Bolt each suction line up to its service valve and reposition the line(s).
17. Finish brazing the connections with the line in place or with the connections referenced and the line removed.

SIZE	A
20 Ton	41-21/32"
25 Ton	41-17/32"
30 Ton	40-21/32"

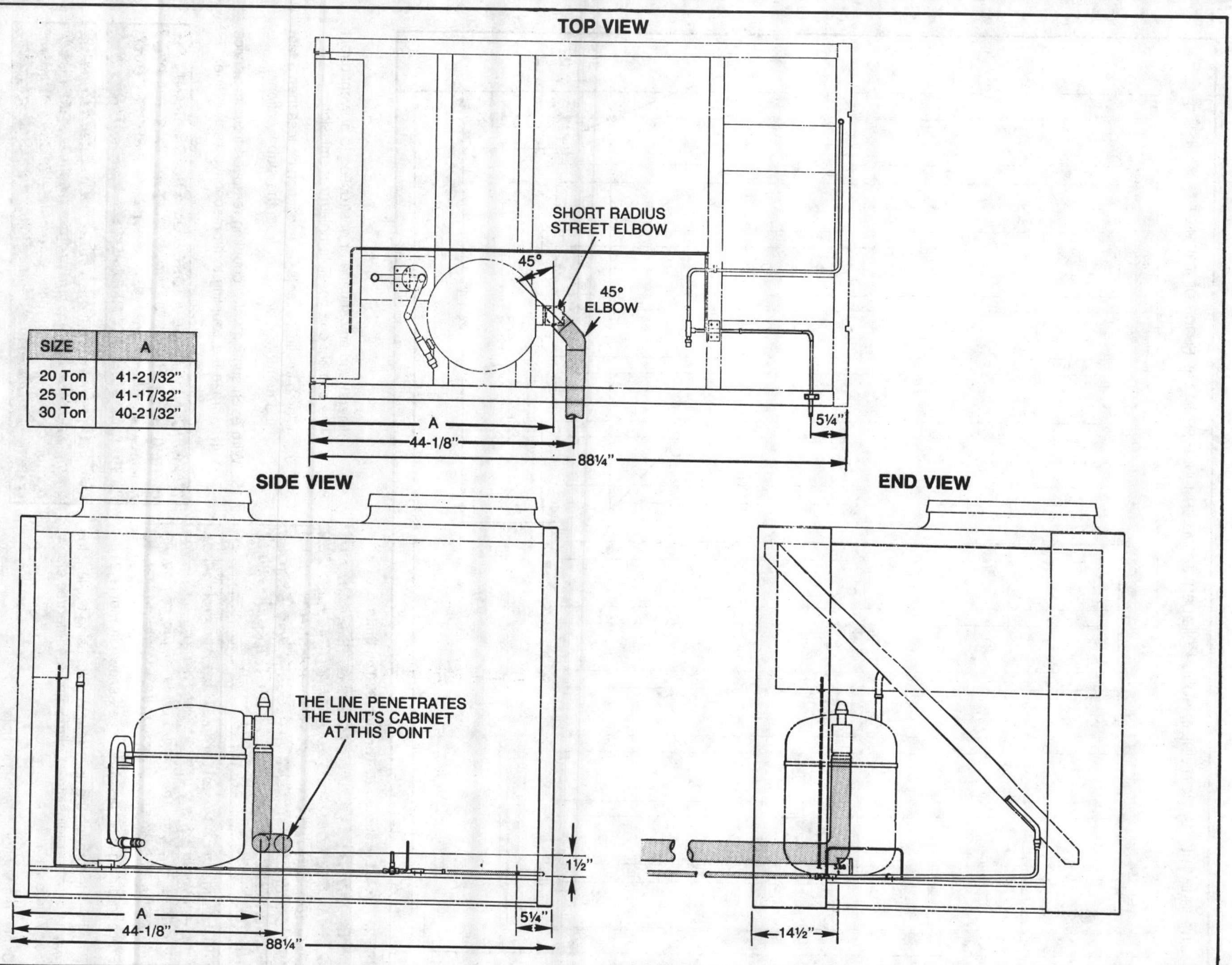
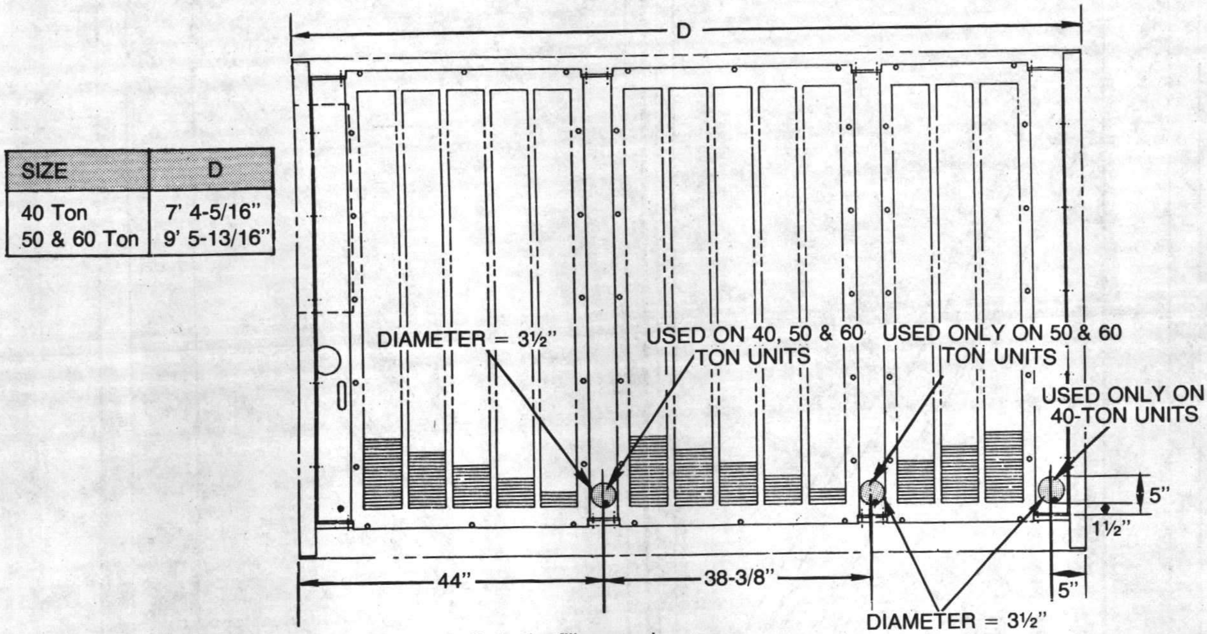


FIGURE 21 - Piping Installation: 20 Through 30-Ton Units Without Isolators



NOTE: The holes should be centered horizontally in the filler panels. (Dimensions are not critical.)

FIGURE 22 - Suction Line Hole Locations: 40 Through 60-Ton Units Without Isolators

40 to 60-Ton Units

1. Remove the decorative grilles enclosing the compressor section and the liquid line stub locations.
2. Release the unit's holding charge.
3. Remove the suction flanges and closure plates from the suction service valves.
4. Remove the caps from the liquid line stub connections.
5. Cut holes in the filler and condenser section end panels as illustrated in Figures 22 and 23.
6. Proceed to pipe the liquid lines as shown in Figures 24 and 25.
7. Pipe the liquid lines through the two holes, using two couplings and straight lengths of pipe.
8. Center the lines in their respective holes.
9. Clamp both liquid lines to the unit's base just ahead of the notched out holes with standard straps and sheet metal screws.
10. Run the lines to the desired location in accordance with the guidelines presented in Trane Engineering Bulletin EB-S/S-38 and this manual. Proceed to braze the connections with the lines in place or with the connections referenced and the lines removed.

WARNING: NEVER USE A TORCH ON A REFRIGERANT LINE UNTIL IT HAS BEEN DETERMINED THAT ALL GAS HAS BEEN ELIMINATED FROM THE LINE – UNSAFE PRESSURES COULD RESULT. BE SURE THE AREA IS WELL VENTILATED. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SERIOUS PERSONAL INJURY.

CAUTION: Pump dry nitrogen through the system refrigerant piping whenever brazing is in progress. Failure to do this will permit oxides to form and accumulate in the refrigerant system which may cause damage to the refrigeration system.

11. Provide no less than 3 feet and no more than 6 feet of line between the unit and the first clamp location to prevent noise transmission and also to provide adequate support.
12. Cut holes in the compressor section filler panels as shown in Figures 22 and 23. The hole locations will vary with unit tonnage.
13. Proceed to pipe the suction lines as illustrated in Figures 24 and 25.
14. Pipe the suction lines through each hole, using two pipe lengths, a 90-degree street elbow and a 45-degree elbow for each line.

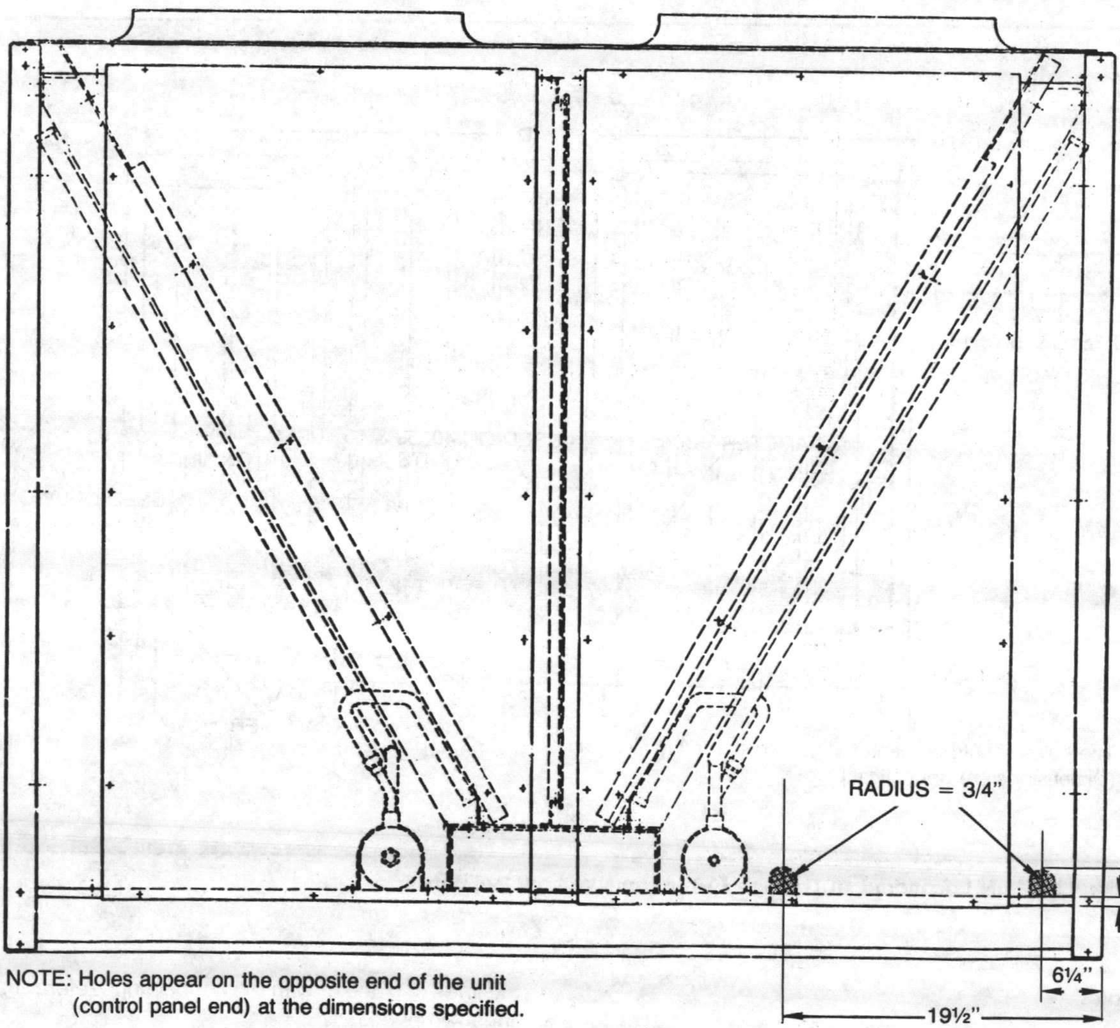


FIGURE 23 - Liquid Line Hole Locations: 40 Through 60-Ton Units Without Isolators

15. Center each suction line in its respective hole.
16. Run the lines to the desired location in accordance with the guidelines presented in the Trane Engineering Bulletin EB-S/S-38 and this manual.
    a. Allow at least 1-1/2-inch clearance between the lines and any surface or obstruction to prevent direct line contact.
    b. To prevent noise transmission and provide adequate support, allow no less than 10-feet and no more than 15-feet of suction line between the suction service valves and the first clamp locations.
17. With each suction service valve coupling removed from its valve, braze each coupling to its respective suction line.

WARNING: NEVER USE A TORCH ON A REFRIGERANT LINE UNTIL IT HAS BEEN DETERMINED THAT ALL GAS HAS BEEN ELIMINATED FROM THE LINE – UNSAFE PRESSURES COULD RESULT CAUSING A VIOLENT EXPLOSION AND SERIOUS PERSONAL INJURY OR DEATH. BE SURE THE AREA IS WELL VENTILATED.

CAUTION: Pump dry nitrogen through the system refrigerant piping whenever brazing is in progress. Failure to do this will permit oxides to form and accumulate in the refrigerant system which may cause damage to the refrigeration system.

18. Bolt each suction line up to its service valve and reposition the lines.
19. Proceed to braze the connections with the lines in place or with the connections referenced and the lines removed.

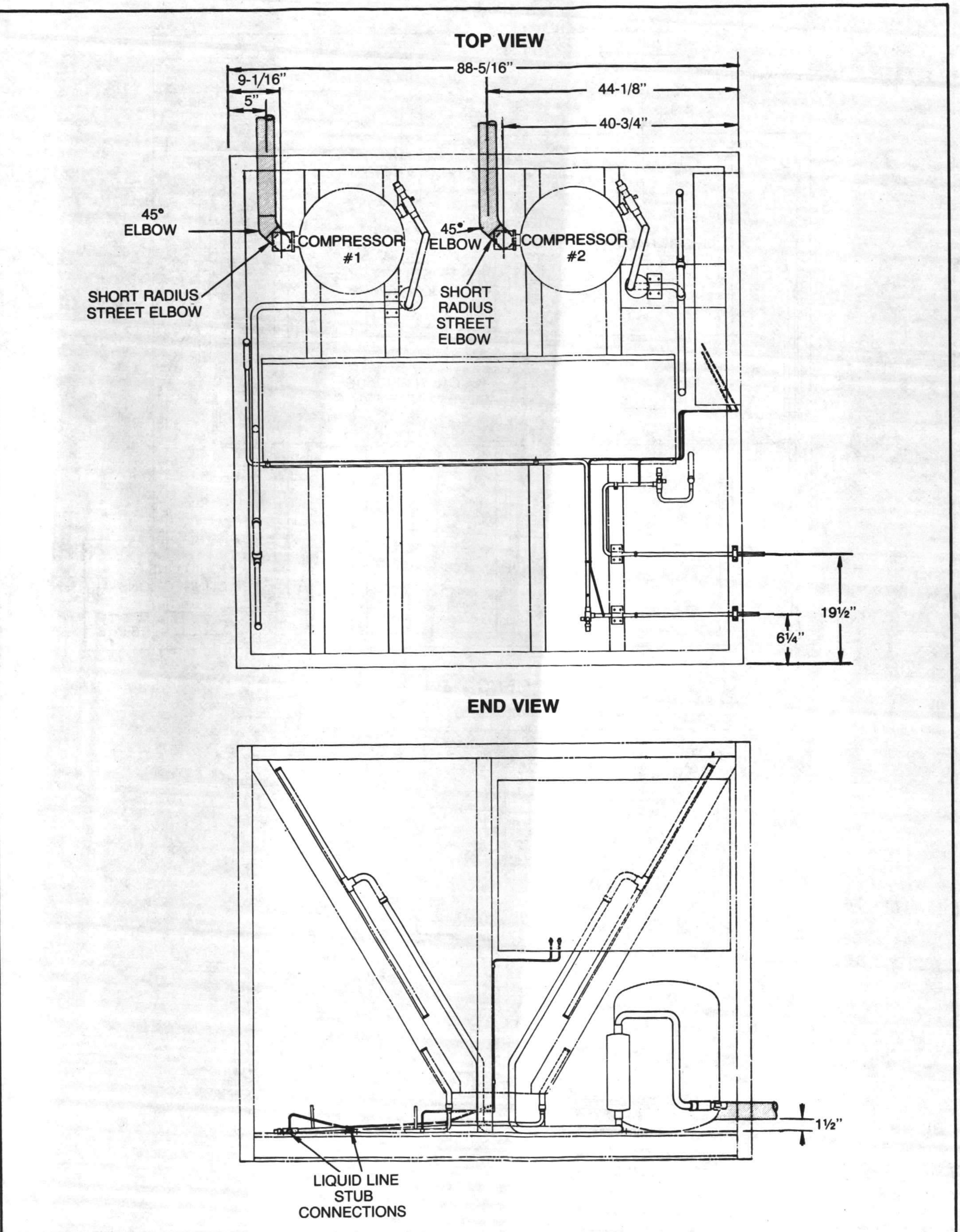


FIGURE 24 - Piping Installation: 40-Ton Units Without Isolators

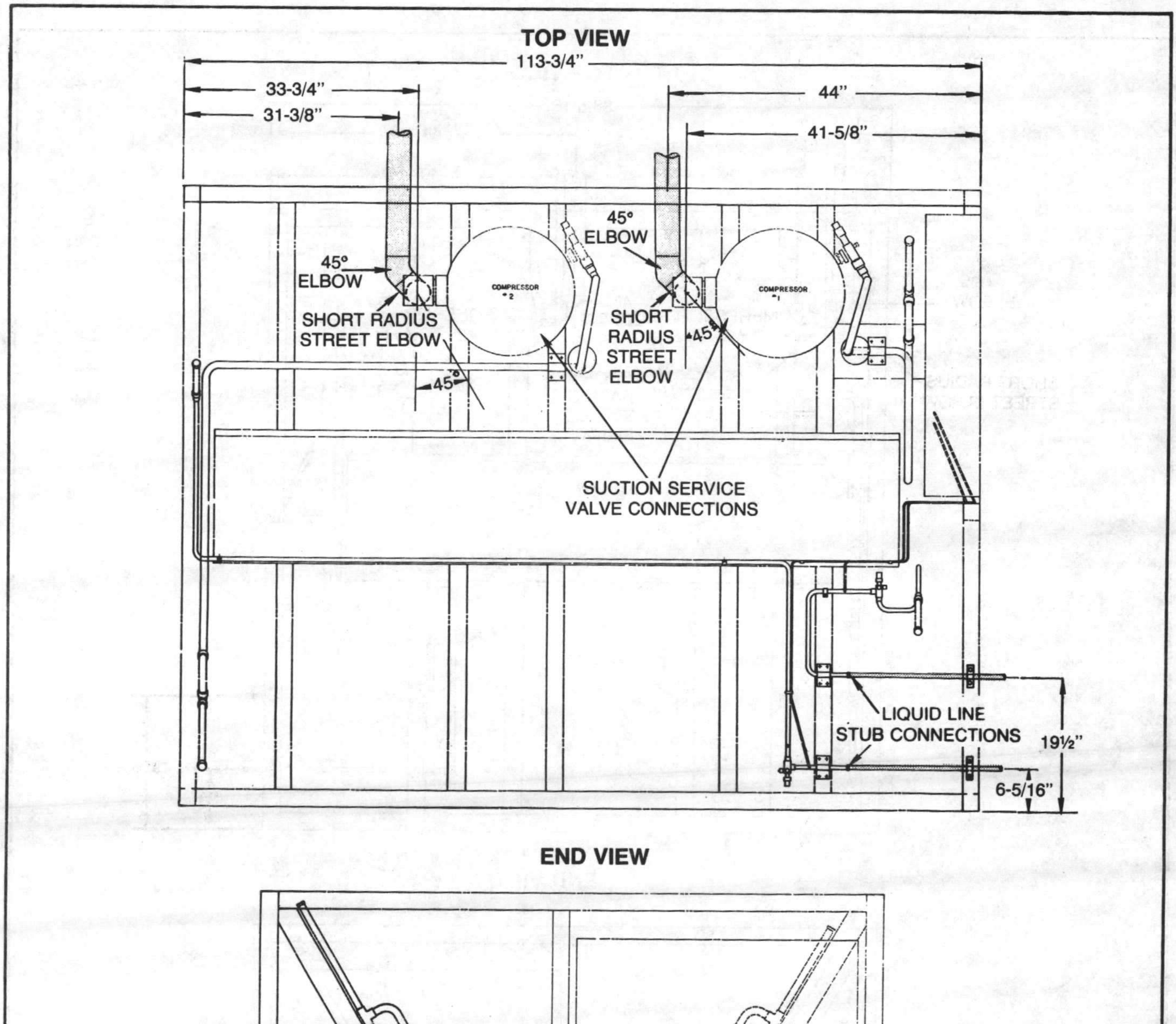


FIGURE 25 - Piping Installation: 50 and 60-Ton Units Without Isolators

THERMOSTATIC EXPANSION VALVE SELECTION

The thermostatic expansion valve is a modulating valve designed to regulate the rate of refrigerant flow into the evaporator in exact proportion to the rate of refrigerant evaporation. This can be done such that refrigerant superheat leaving the evaporator is held relatively constant. In order to maximize compressor reliability, Trane recommends that expansion valves be adjusted to achieve approximately 12 F superheat leaving the evaporator at rating point conditions (80/67 - 95 F). Refer to "Thermostatic Expansion Valve Adjustment and Superheat Measurement" in the MAINTENANCE PROCEDURES section of this manual for the recommended superheat adjustment procedures.

Trane recommends that externally equalized valves be utilized in order to compensate for pressure drop between the expansion valve and superheat control point at the evaporator outlet.

Thermostatic expansion valves are more likely to hunt at low system versus valve capacity conditions where the valve pin is close to the valve seat. This is more pronounced on larger tonnage valves and on systems with unloading compressors. Both major expansion valve manufacturers have a balance-ported valve which tend to overcome this problem. The Trane Company recommends this feature (when valve sizing allows) in order to maintain satisfactory superheat control down to lower valve loading conditions.

Various bulb charges are available and are described in valve supplier catalogs. Trane recommends the use of VGA charge (Sporlan) or straight W charge (Alco) on RAUB 20 through 60-ton systems. These charges provide smooth control at air conditioning conditions and are less prone to charge migration than the conventional gas charge.

Thermostatic expansion valves are rated by the valve manufacturer in accordance with A.R.I. Standard 750 and A.N.S.I. Standard B60.1. Capacity application ratings (tons) are given for varying evaporator suction temperatures (F) and valve pressure drops (PSI). Catalog values assume liquid entering the valve **at all times** and a liquid temperature of 100 F. Correction factors are provided for liquid temperatures other than 100 F.

Thermostatic expansion valves must be selected considering actual operating conditions rather than nominal valve and system capacities. Valve capacity is a function of evaporator saturated suction temperature leaving the evaporator, liquid temperature entering the expansion valve, and valve pressure drop. Pressure drop across the valve is the difference between compressor discharge and suction pressures, less pressure drops in the discharge line, condenser, subcooler, liquid line, suction line, evaporator, distributor tubes and distributor. Valves should normally be selected so that actual system capacity is 70 to 100 percent of valve rated capacity at design conditions.

Normally, the factory superheat setting (static superheat) is made with the valve pin starting to move away from the seat. Valves are generally designed so that an increase in superheat from 4 to 6 F over the factory static superheat setting is necessary for the valve pin to open to its rated position. Valves in this size range are rated at approximately 75 percent of full stroke to provide a reserve. Valves with a balance port feature can provide satisfactory control with loads 15 to 25 percent of nominal valve capacity.

Recommended expansion valve selections for RAUB 20 through 60-ton systems are given in Table 3. These selections assume two expansion valves per evaporator and Trane Type F coils which have Alco venturi type distributors. Other assumptions are detailed in Table 3.

CAUTION: For proper performance, consult the valve manufacturers catalog for valve and distributor installation recommendations, or for valve sizing procedures on systems with a different configuration than assumed in Table 3.

BRAZING AND LEAK TESTING

For proper brazing techniques when installing refrigerant tubing, refer to BRAZING PROCEDURES in the MAINTENANCE section of this manual.

After completing the installation of all refrigerant piping, the system should be thoroughly checked for possible leaks. Refer to LEAK TESTING in the MAINTENANCE section of this manual.

ELECTRICAL WIRING

WARNING: BEFORE WORKING ON THIS OR ANY ELECTRICAL EQUIPMENT, DISCONNECT ALL ELECTRICAL POWER. FAILURE TO DO SO MAY RESULT IN SERIOUS PERSONAL INJURY OR DEATH DUE TO ACCIDENTAL ELECTRIC SHOCK.

Install all electrical wiring in conformance with local and national electrical codes. Ground the unit in accordance with local codes. A grounding lug is provided in the unit control panel. Make certain that all connection and contactor lugs are tight.

Figures 26 and 27 illustrate typical field wiring required for 20 through 60 ton Model RAUB condensing units with standard controls. Figures 28 through 31 illustrate typical field wiring for 20 through 60 ton units with electronic controls.

NOTE: *THESE DIAGRAMS ARE "TYPICAL FIELD WIRING" ONLY. THE ACTUAL AS WIRED DIAGRAMS FOR YOUR UNIT, INCLUDING FIELD WIRING AND CONNECTION AND SCHEMATIC WIRING DIAGRAMS, ARE LOCATED INSIDE THE MAIN CONTROL PANEL ACCESS DOOR.*

ELECTRICAL DATA

Table 4 lists the electrical characteristics for RAUB 20 through 60-ton units.

CAUTION: The Trane Company recommends only the use of copper conductors with this equipment. Use of other than copper conductors may result in galvanic corrosion and possible damage to the equipment.

TABLE 3 - Recommended Expansion Valve Selections

CONDENSING UNIT MODEL NO.	NO. OF VALVES	NO. OF CIRC.	SPORLAN SELECTION			ALCO SELECTION		
			VALVE NO.	INLET (ODF)	OUTLET (ODF)	VALVE NO.	INLET (ODF)	OUTLET (ODF)
RAUB-C20	2	8	OVE-10-VGA	5/8	7/8, 1 1/8	TRAE10HW	5/8 - 1 3/8	7/8 - 1 3/8
RAUB-C25	2	12	OVE-15-VGA	7/8	1 1/8	TRAE15HW	5/8 - 1 3/8	7/8 - 1 3/8
RAUB-C30	2	12	OVE-15-VGA	7/8	1 1/8	TRAE15HW	5/8 - 1 3/8	7/8 - 1 3/8
RAUB-C40	2	16	OVE-20-VGA	7/8	1 3/8	TRAE20HW	5/8 - 1 3/8	7/8 - 1 3/8
RAUB-C50	2	18	OVE-30-VGA	1 1/8	1 3/8	TRAE30HW	5/8 - 1 3/8	7/8 - 1 3/8
RAUB-C60	2	20	OVE-30-VGA	1 1/8	1 3/8	TRAE30HW	5/8 - 1 3/8	7/8 - 1 3/8

NOTES:

1. Assumes 2 ALCO venturi type distributors and 5/16" x 30" distributor tubes.
2. Assumes coil sized to provide between 35 F and 45 F saturated suction at rating point condition (80/67 - 95 F).
3. Assumes liquid lines and components sized within guidelines specified in Trane Engineering Bulletin EB-S/S-38 on interconnecting lines.

TABLE 4 - Electrical Data

MODEL	UNIT VOLTAGE[1]	COMPRESSOR MOTOR				CONDENSER FAN MOTOR					UNIT CHARACTERISTICS[6]			
		NO.	RLA[2]	LRA[2 3 9]	KW INPUT[2 7]	NO.	HP (EA.)	RLA[2]	LRA[2]	KW INPUT[2]	UNIT RLA	MAX. FUSE SIZE	MIN. CIRCUIT AMP.[5]	RECOMMENDED DUAL ELEMENT FUSE SIZE[8]
RAUB-C206	200/60/3	1	75.4	396	22.1	2	1.0	4.1	20.7	0.95	81.8	175	102.5	110
RAUB-C203	230/60/3	1	65.6	344	22.1	2	1.0	3.6	18.0	0.95	71.2	150	89.2	100
RAUB-C201	460/60/3	1	32.8	172	22.1	2	1.0	1.8	9.0	0.95	35.6	70	44.6	50
RAUB-C204	460/60/3	1	32.8	172	22.1	2	1.0	1.8	9.0	0.95	35.6	70	44.6	50
RAUB-C202	575/60/3	1	26.2	138	22.1	2	1.0	1.4	7.2	0.95	28.4	60	35.6	40
RAUB-C20A	380/50/3	1	34.0	166	18.1	2	0.7	1.6	8.0	0.70	35.2	70	45.7	50
RAUB-C20B	415/50/3	1	31.1	181	18.1	2	0.7	1.7	7.5	0.70	32.3	70	42.3	50
RAUB-C256	200/60/3	1	91.5	426	27.2	3	1.0	4.1	20.7	0.95	101.8	200	126.7	150
RAUB-C253	230/60/3	1	79.6	370	27.2	3	1.0	3.6	18.0	0.95	88.6	175	110.3	125
RAUB-C251	460/60/3	1	39.8	185	27.2	3	1.0	1.8	9.0	0.95	44.3	90	55.2	60
RAUB-C254	460/60/3	1	39.8	185	27.2	3	1.0	1.8	9.0	0.95	44.3	90	55.2	60
RAUB-C252	575/60/3	1	31.8	148	27.2	3	1.0	1.4	7.2	0.95	35.3	70	44.0	50
RAUB-C25A	380/50/3	1	41.5	178	21.8	3	0.7	1.6	8.0	0.70	43.7	90	56.7	60
RAUB-C25B	415/50/3	1	38.0	195	21.8	3	0.7	1.7	7.5	0.70	40.1	90	52.6	60
RAUB-C306	200/60/3	1	109.0	489	32.5	3	1.0	4.1	20.7	0.95	121.8	250	148.6	175
RAUB-C303	230/60/3	1	94.8	425	32.5	3	1.0	3.6	18.0	0.95	106.0	200	129.3	150
RAUB-C301	460/60/3	1	47.4	213	32.5	3	1.0	1.8	9.0	0.95	53.0	110	64.7	70
RAUB-C304	460/60/3	1	47.4	213	32.5	3	1.0	1.8	9.0	0.95	53.0	110	64.7	70
RAUB-C302	575/60/3	1	37.9	170	32.5	3	1.0	1.4	7.2	0.95	42.3	80	51.6	60
RAUB-C30A	380/50/3	1	50.0	205	26.2	3	0.7	1.6	8.0	0.70	52.3	110	67.3	80
RAUB-C30B	415/50/3	1	45.8	224	26.2	3	0.7	1.7	7.5	0.70	48.0	100	62.4	70
RAUB-C406	200/60/3	2	75.4	396	22.1	4	1.0	4.1	20.7	0.95	163.6	250	186.1	200
RAUB-C403	230/60/3	2	65.6	344	22.1	4	1.0	3.6	18.0	0.95	142.4	225	162.0	175
RAUB-C401	460/60/3	2	32.8	172	22.1	4	1.0	1.8	9.0	0.95	71.2	110	81.0	90
RAUB-C404	460/60/3	2	32.8	172	22.1	4	1.0	1.8	9.0	0.95	71.2	110	81.0	90
RAUB-C402	575/60/3	2	26.2	138	22.1	4	1.0	1.4	7.2	0.95	56.8	90	64.6	70
RAUB-C40A	380/50/3	2	34.0	166	18.0	4	0.7	1.6	8.0	0.70	70.2	110	82.9	90
RAUB-C40B	415/50/3	2	31.1	181	18.0	4	0.7	1.7	7.5	0.70	64.4	100	76.8	80
RAUB-C506	200/60/3	2	91.5	426	27.2	6	1.0	4.1	20.7	0.95	203.6	300	230.5	250
RAUB-C503	230/60/3	2	79.6	370	27.2	6	1.0	3.6	18.0	0.95	177.2	250	200.7	200
RAUB-C501	460/60/3	2	39.8	185	27.2	6	1.0	1.8	9.0	0.95	88.6	125	100.4	110
RAUB-C504	460/60/3	2	39.8	185	27.2	6	1.0	1.8	9.0	0.95	88.6	125	100.4	110
RAUB-C502	575/60/3	2	31.8	148	27.2	6	1.0	1.4	7.2	0.95	70.6	110	80.0	80
RAUB-C50A	380/50/3	2	41.5	178	21.7	6	0.7	1.6	8.0	0.70	87.4	125	103.0	110
RAUB-C50B	415/50/3	2	38.0	195	21.7	6	0.7	1.7	7.5	0.70	80.2	125	95.7	100
RAUB-C606	200/60/3	2	109.0	489	32.5	6	1.0	4.1	20.7	0.95	243.6	350	269.9	300
RAUB-C603	230/60/3	2	94.8	425	32.5	6	1.0	3.6	18.0	0.95	212.0	300	234.9	250
RAUB-C601	560/60/3	2	47.4	213	32.5	6	1.0	1.8	9.0	0.95	106.0	150	117.5	125
RAUB-C604	460/60/3	2	47.4	213	32.5	6	1.0	1.8	9.0	0.95	106.0	150	117.5	125
RAUB-C602	575/60/3	2	37.9	170	32.5	6	1.0	1.4	7.2	0.95	84.6	125	93.7	100
RAUB-C60A	380/50/3	2	50.0	205	26.2	6	0.7	1.6	8.0	0.70	104.6	150	122.1	125
RAUB-C60B	415/50/3	2	45.8	224	26.2	6	0.7	1.7	7.5	0.70	96.0	150	113.3	125

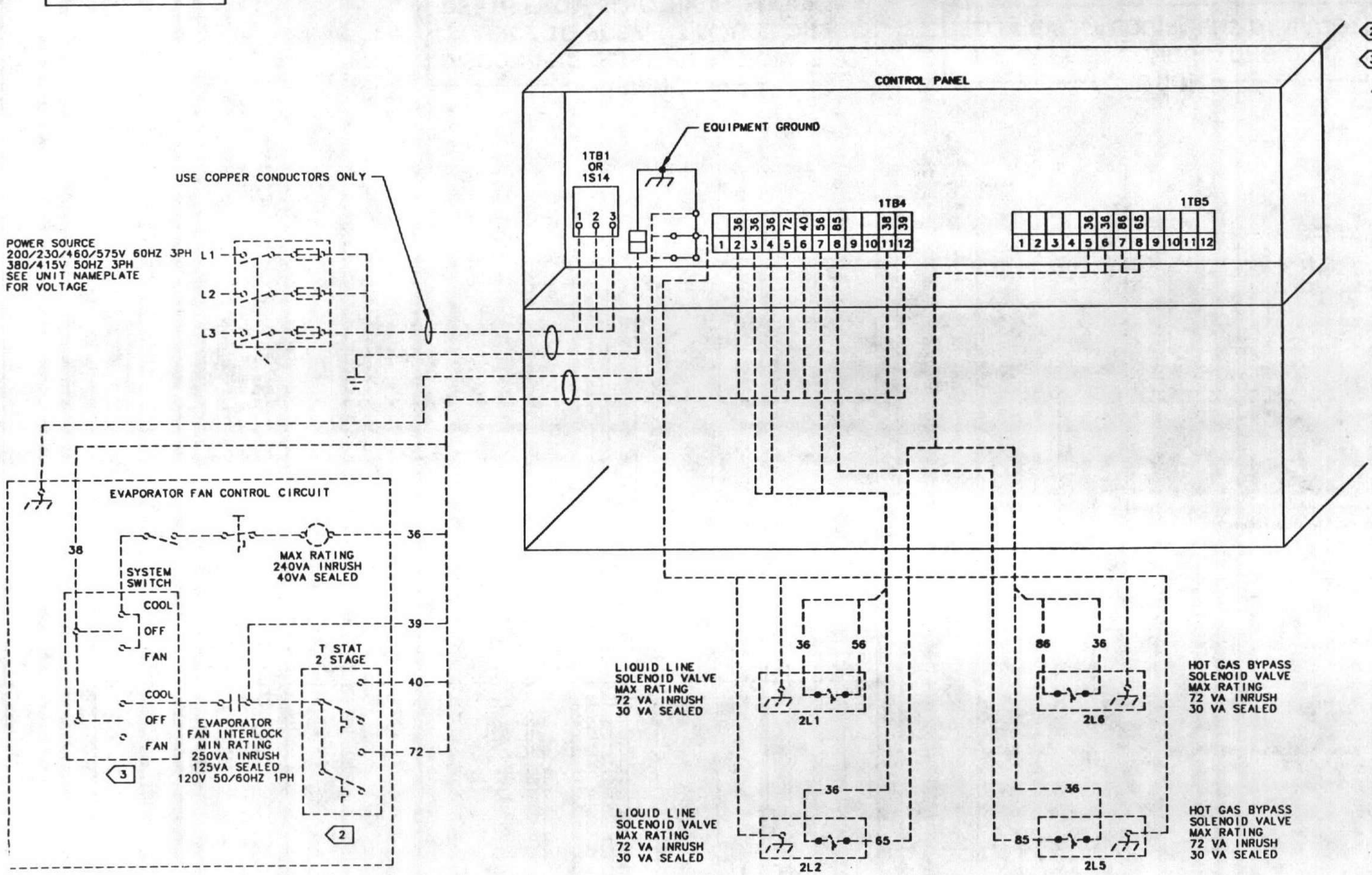
NOTES:

1. Voltage is three phase, 60 or 50 hertz. Range is plus or minus 10 percent of nominal voltage.
2. Electrical information is for each individual motor.
3. Part winding starters standard on all 200 and 230-volt units for incremental start.
4. Maximum fuse size permitted by N.E.C. 440-22 is 225 percent of one compressor motor RLA plus the total RLA of the other motors in circuit. Select the next smaller standard fuse size.
5. Minimum circuit ampacity equals the RLA of one compressor times 1.25 plus the total RLA of the remaining motors.
6. Local codes may take precedence.
7. Compressor kw at 95 F ambient and 45 F saturated suction temperature.
8. Recommended dual element fuse size is 150 percent of the RLA of one compressor plus the RLA of the remaining motors. Select the next smaller fuse size unless the number exceeds the next smaller fuse size plus 90 percent of the increment to the next larger fuse. If so, then select the next larger fuse size.
9. All unit voltages use part winding starters except the 460/60/3 which may be either part winding starter or across the line starter. All unit nameplates will show only across the line locked rotor amps.

CAUTION
DO NOT ENERGIZE
UNIT UNTIL CHECK-OUT
AND START-UP PROCEDURE
HAS BEEN COMPLETED

NOTES:

1. ALL WIRING AND DEVICES SHOWN DASHED TO BE SUPPLIED AND INSTALLED BY THE CUSTOMER IN ACCORDANCE WITH LOCAL ELECTRICAL CODES.
2. SUGGESTED THERMOSTAT-PENN T25A OR EQUIVALENT
3. SUGGESTED SWITCH-CUTLER HAMMER 7562K53 2PDT OR EQUIVALENT.
4. CONDENSER FAN MOTORS PROTECTED UNDER PRIMARY SINGLE-PHASING CONDITIONS.



CONDENSER FAN FUSE (1F1-1F2-1F3, CLASS K5)						
UNIT VOLTAGE	200	230	380	415	460	575
TIME DELAY						
"A" DESIGN SEQUENCE	30A	30A	15A	15A	15A	15A
"B", "C" DESIGN SEQUENCE	15A	15A	15A	15A	15A	15A
CONTROL POWER FUSE						
1F7	TYPE S			6.2 A		

WARNING
DISCONNECT ELECTRICAL POWER SOURCE TO PREVENT INJURY OR DEATH FROM ELECTRICAL SHOCK

CAUTION
USE COPPER CONDUCTORS ONLY TO PREVENT EQUIPMENT DAMAGE

FIGURE 26 - Field Wiring, Two Step Controls (20, 25 and 30-Ton Units)

NOTE:
1. ALL WIRING AND DEVICES SHOWN DASHED TO BE SUPPLIED AND INSTALLED BY THE CUSTOMER IN ACCORDANCE WITH LOCAL ELECTRICAL CODES.
2. SUGGESTED THERMOSTAT - PENN T25A OR EQUIVALENT
3. SUGGESTED SWITCH - CUTLER-HAMMER 7562K53 2PDT OR EQUIVALENT
4. CONDENSER FAN MOTORS PROTECTED UNDER PRIMARY SINGLE PHASING CONDITIONS.

CAUTION
DO NOT ENERGIZE UNIT UNTIL CHECK-OUT AND START-UP PROCEDURE HAS BEEN COMPLETED

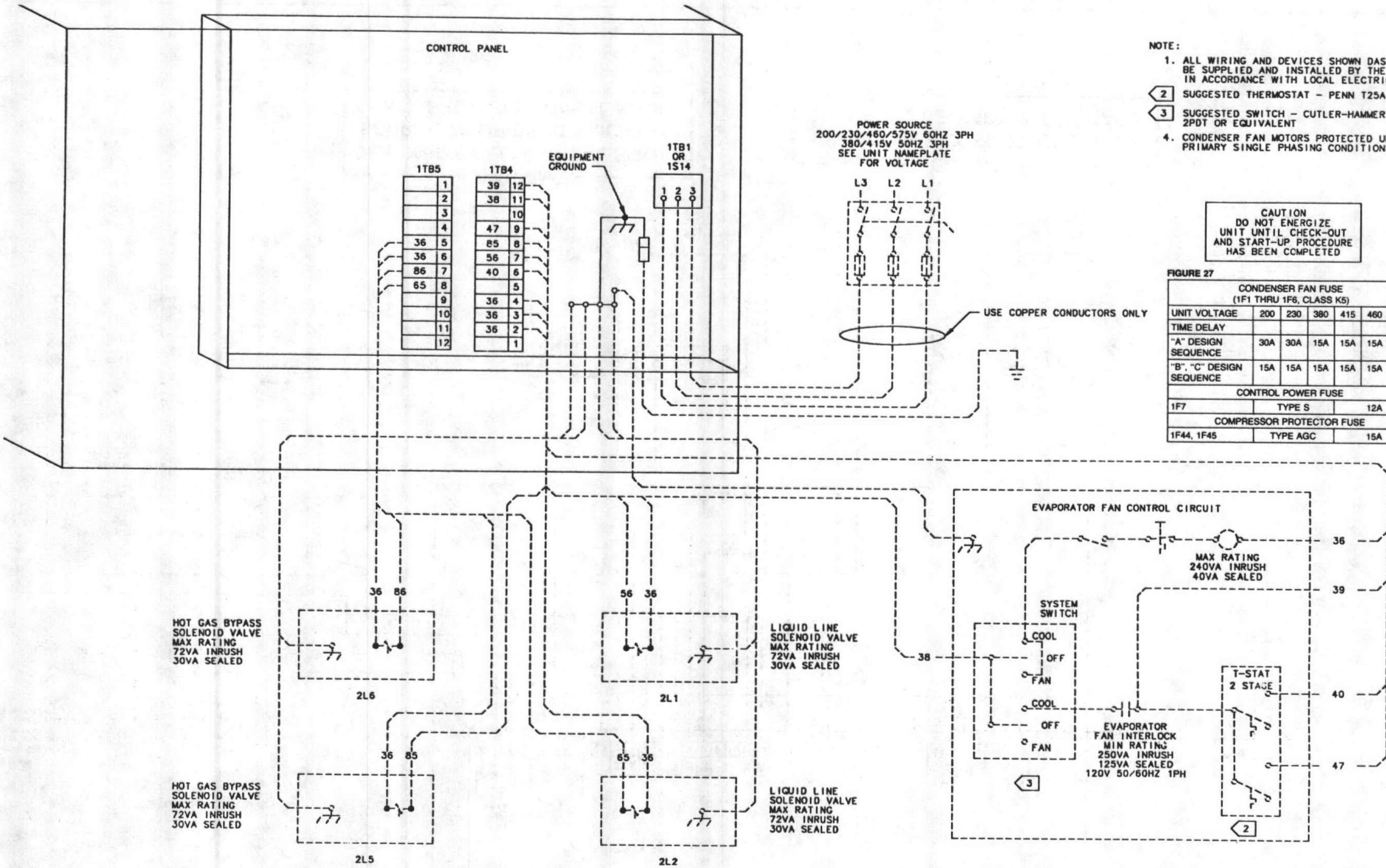


FIGURE 27

CONDENSER FAN FUSE (1F1 THRU 1F6, CLASS K5)						
UNIT VOLTAGE	200	230	380	415	460	575
TIME DELAY						
"A" DESIGN SEQUENCE	30A	30A	15A	15A	15A	15A
"B", "C" DESIGN SEQUENCE	15A	15A	15A	15A	15A	15A
CONTROL POWER FUSE						
1F7	TYPE S			12A		
COMPRESSOR PROTECTOR FUSE						
1F44, 1F45	TYPE AGC			15A		

WARNING
DISCONNECT ELECTRICAL POWER SOURCE TO PREVENT INJURY OR DEATH FROM ELECTRICAL SHOCK

CAUTION
USE COPPER CONDUCTORS ONLY TO PREVENT EQUIPMENT DAMAGE

FIGURE 27 - Field Wiring: Two Step Controls (40, 50 and 60-Ton Units)

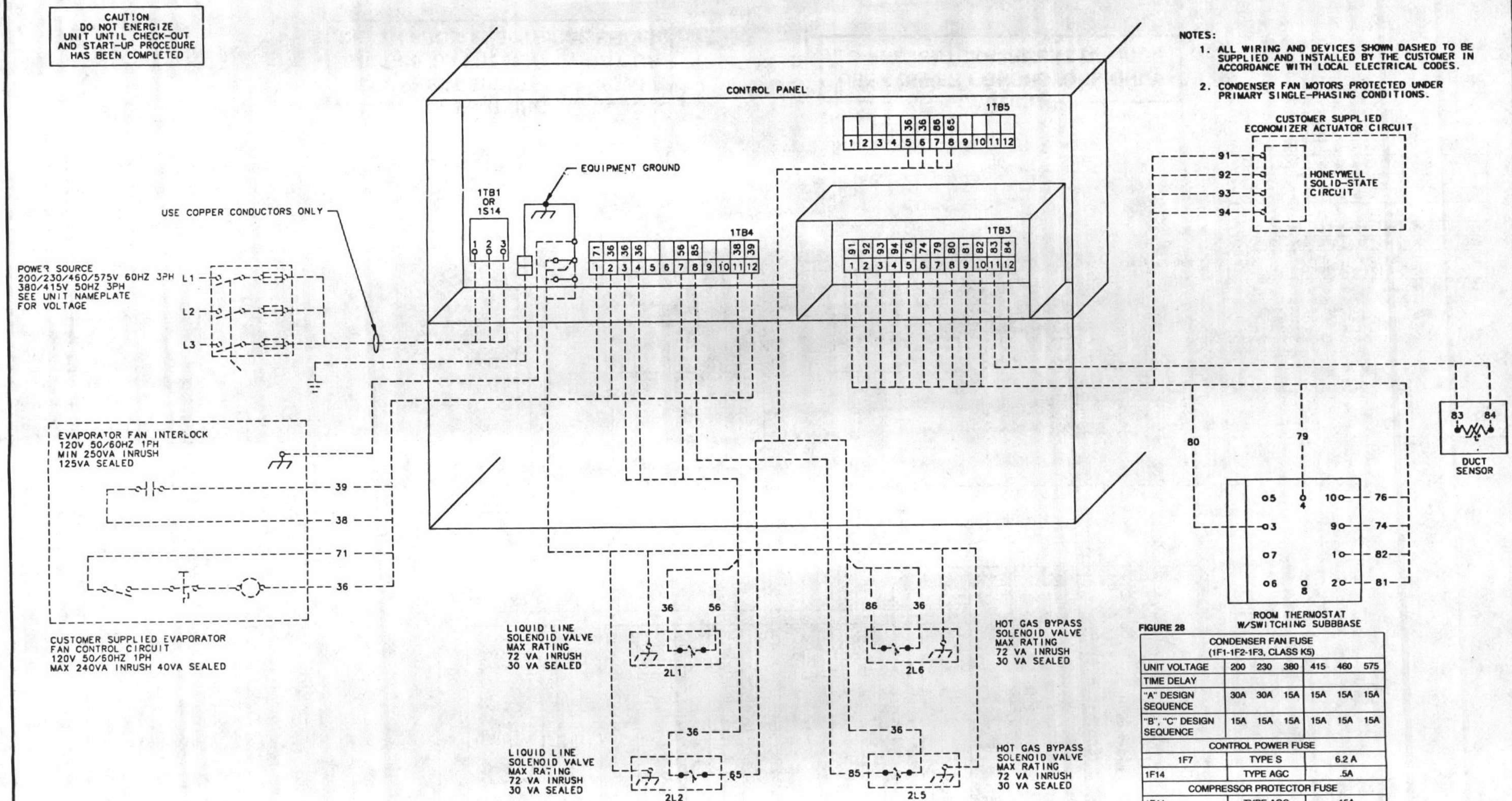


FIGURE 28

CONDENSER FAN FUSE (1F1-1F2-1F3, CLASS K5)						
UNIT VOLTAGE	200	230	380	415	460	575
TIME DELAY						
"A" DESIGN SEQUENCE	30A	30A	15A	15A	15A	15A
"B", "C" DESIGN SEQUENCE	15A	15A	15A	15A	15A	15A
CONTROL POWER FUSE						
1F7	TYPE S			6.2 A		
1F14	TYPE AGC			.5A		
COMPRESSOR PROTECTOR FUSE						
1F44	TYPE AGC			15A		

WARNING

DISCONNECT ELECTRICAL POWER SOURCE TO PREVENT INJURY OR DEATH FROM ELECTRICAL SHOCK

CAUTION

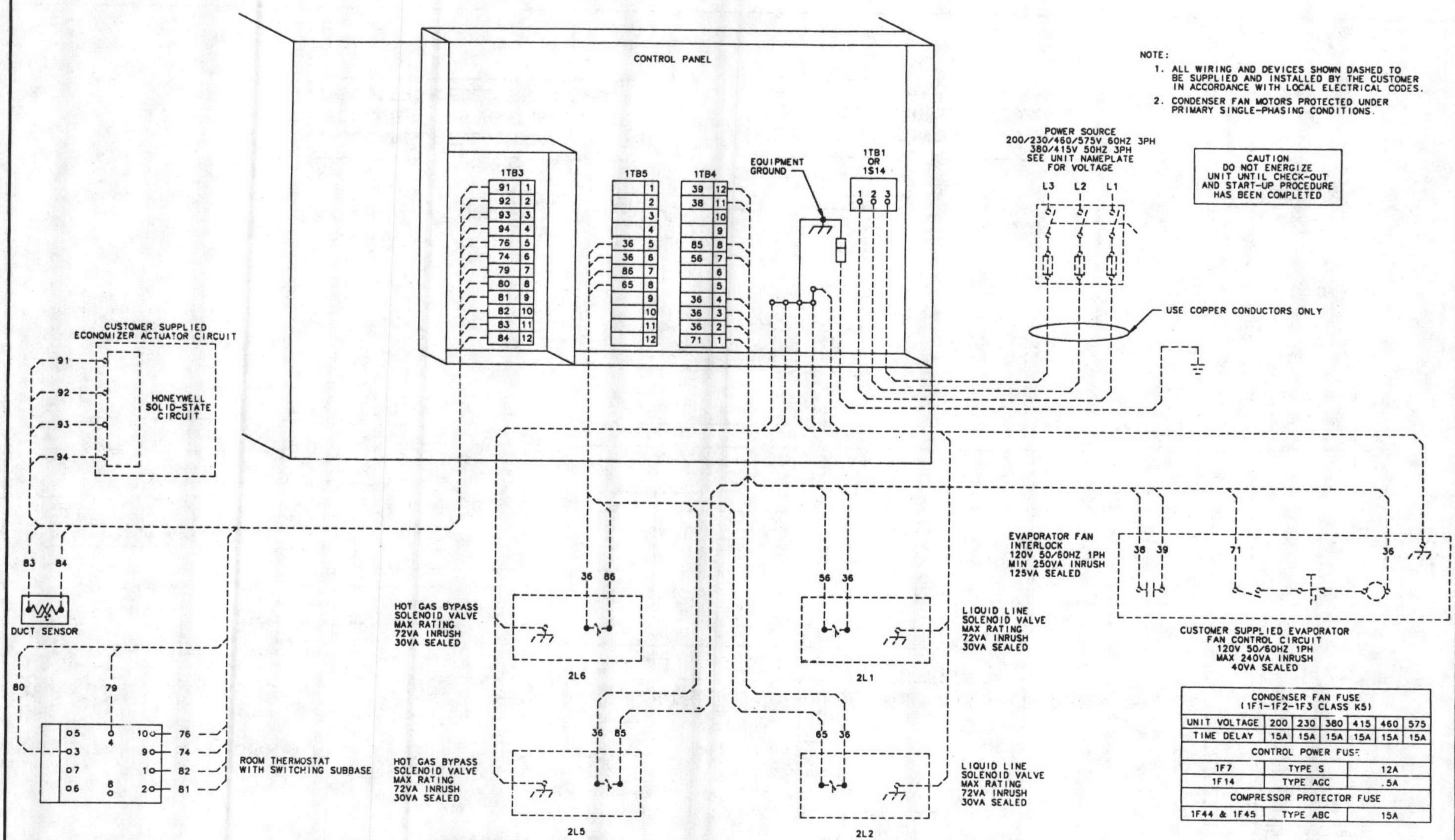
USE COPPER CONDUCTORS ONLY TO PREVENT EQUIPMENT DAMAGE

FIGURE 28 - Field Wiring, Electronic Thermostat Controls (20, 25 and 30-Ton Units)

NOTE:

1. ALL WIRING AND DEVICES SHOWN DASHED TO BE SUPPLIED AND INSTALLED BY THE CUSTOMER IN ACCORDANCE WITH LOCAL ELECTRICAL CODES.
2. CONDENSER FAN MOTORS PROTECTED UNDER PRIMARY SINGLE-PHASING CONDITIONS.

CAUTION
DO NOT ENERGIZE UNIT UNTIL CHECK-OUT AND START-UP PROCEDURE HAS BEEN COMPLETED



CONDENSER FAN FUSE (1F1-1F2-1F3 CLASS K5)						
UNIT VOLTAGE	200	230	380	415	460	575
TIME DELAY	15A	15A	15A	15A	15A	15A
CONTROL POWER FUSE						
1F7	TYPE S		12A			
1F14	TYPE AGC		.5A			
COMPRESSOR PROTECTOR FUSE						
1F44 & 1F45	TYPE ABC		15A			

WARNING

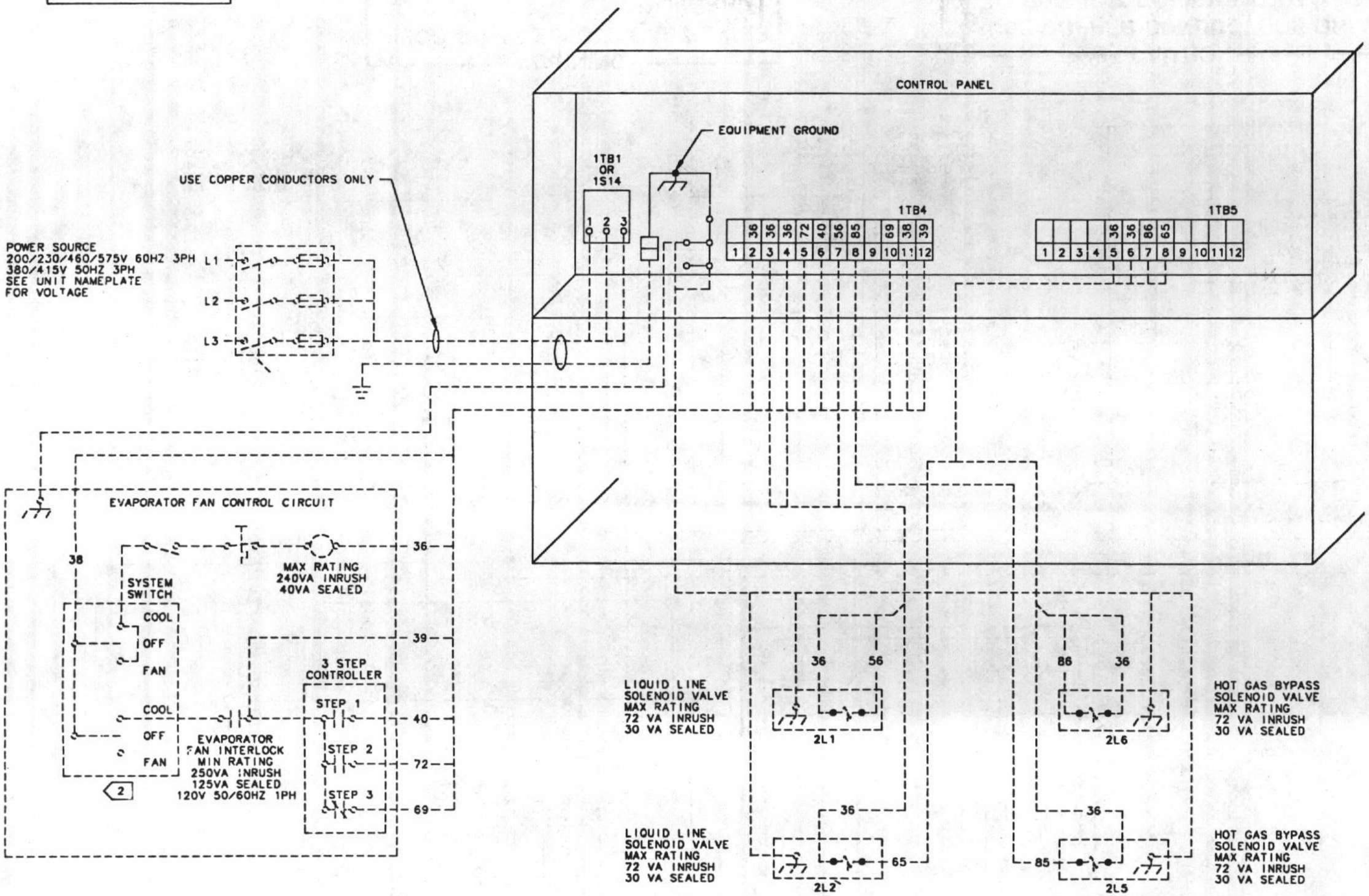
DISCONNECT ELECTRICAL POWER SOURCE TO PREVENT INJURY OR DEATH FROM ELECTRICAL SHOCK

CAUTION

USE COPPER CONDUCTORS ONLY TO PREVENT EQUIPMENT DAMAGE

FIGURE 29 - Field Wiring, Electronic Thermostat Controls (40, 50 and 60-Ton Units)

CAUTION
DO NOT ENERGIZE
UNIT UNTIL CHECK-OUT
AND START-UP PROCEDURE
HAS BEEN COMPLETED

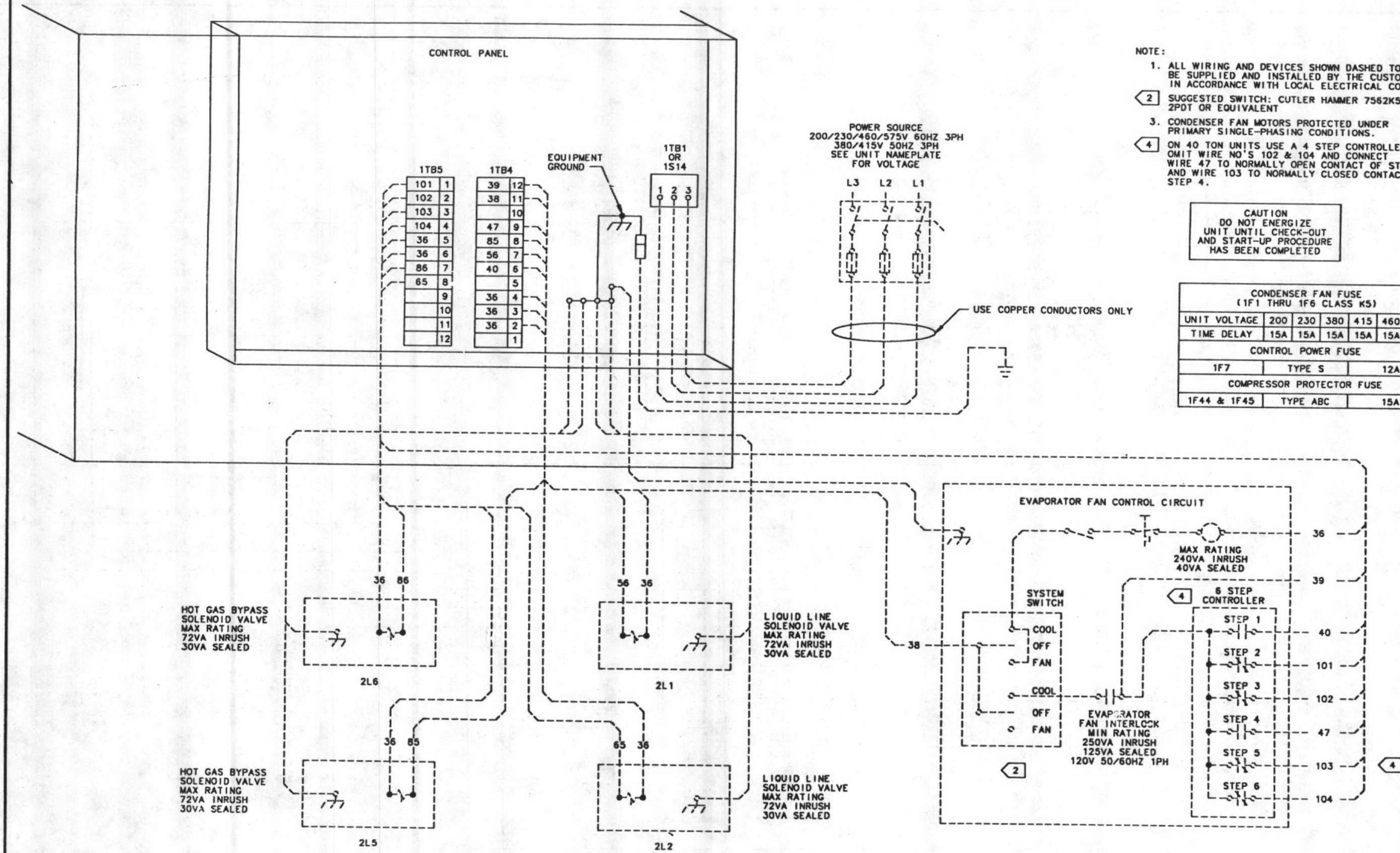


NOTES:

1. ALL WIRING AND DEVICES SHOWN DASHED TO BE SUPPLIED AND INSTALLED BY THE CUSTOMER IN ACCORDANCE WITH LOCAL ELECTRICAL CODES.
2. SUGGESTED SWITCH: CUTLER HAMMER 7562K53 2PDT OR EQUIVALENT.
3. CONDENSER FAN MOTORS PROTECTED UNDER PRIMARY SINGLE-PHASING CONDITIONS.

CONDENSER FAN FUSE (1F1-1F2-1F3 CLASS K5)						
UNIT VOLTAGE	200	230	380	415	460	575
TIME DELAY	15A	15A	15A	15A	15A	15A
CONTROL POWER FUSE						
1F7	TYPE S			6.2A		
COMPRESSOR PROTECTOR FUSE						
1F44	TYPE ABC			15A		

FIGURE 30 - Field Wiring, Multi-Step Controls (25 and 30-Ton Units)



NOTE:

1. ALL WIRING AND DEVICES SHOWN DASHED TO BE SUPPLIED AND INSTALLED BY THE CUSTOMER IN ACCORDANCE WITH LOCAL ELECTRICAL CODES.
2. SUGGESTED SWITCH: CUTLER HAMMER 7562K53 2PDT OR EQUIVALENT
3. CONDENSER FAN MOTORS PROTECTED UNDER PRIMARY SINGLE-PHASING CONDITIONS.
4. ON 40 TON UNITS USE A 4 STEP CONTROLLER. OMIT WIRE NO'S 102 & 104 AND CONNECT WIRE 47 TO NORMALLY OPEN CONTACT OF STEP 3 AND WIRE 103 TO NORMALLY CLOSED CONTACT OF STEP 4.

CAUTION
DO NOT ENERGIZE UNIT UNTIL CHECK-OUT AND START-UP PROCEDURE HAS BEEN COMPLETED

CONDENSER FAN FUSE (1F1 THRU 1F6 CLASS K5)						
UNIT VOLTAGE	200	230	380	415	460	575
TIME DELAY	15A	15A	15A	15A	15A	15A
CONTROL POWER FUSE						
1F7	TYPE S			12A		
COMPRESSOR PROTECTOR FUSE						
1F44 & 1F45	TYPE ABC			15A		

WARNING
DISCONNECT ELECTRICAL POWER SOURCE TO PREVENT INJURY OR DEATH FROM ELECTRICAL SHOCK

CAUTION
USE COPPER CONDUCTORS ONLY TO PREVENT EQUIPMENT DAMAGE

FIGURE 31 - Field Wiring, Multi-Step Controls, (40, 50 and 60-Ton Units)

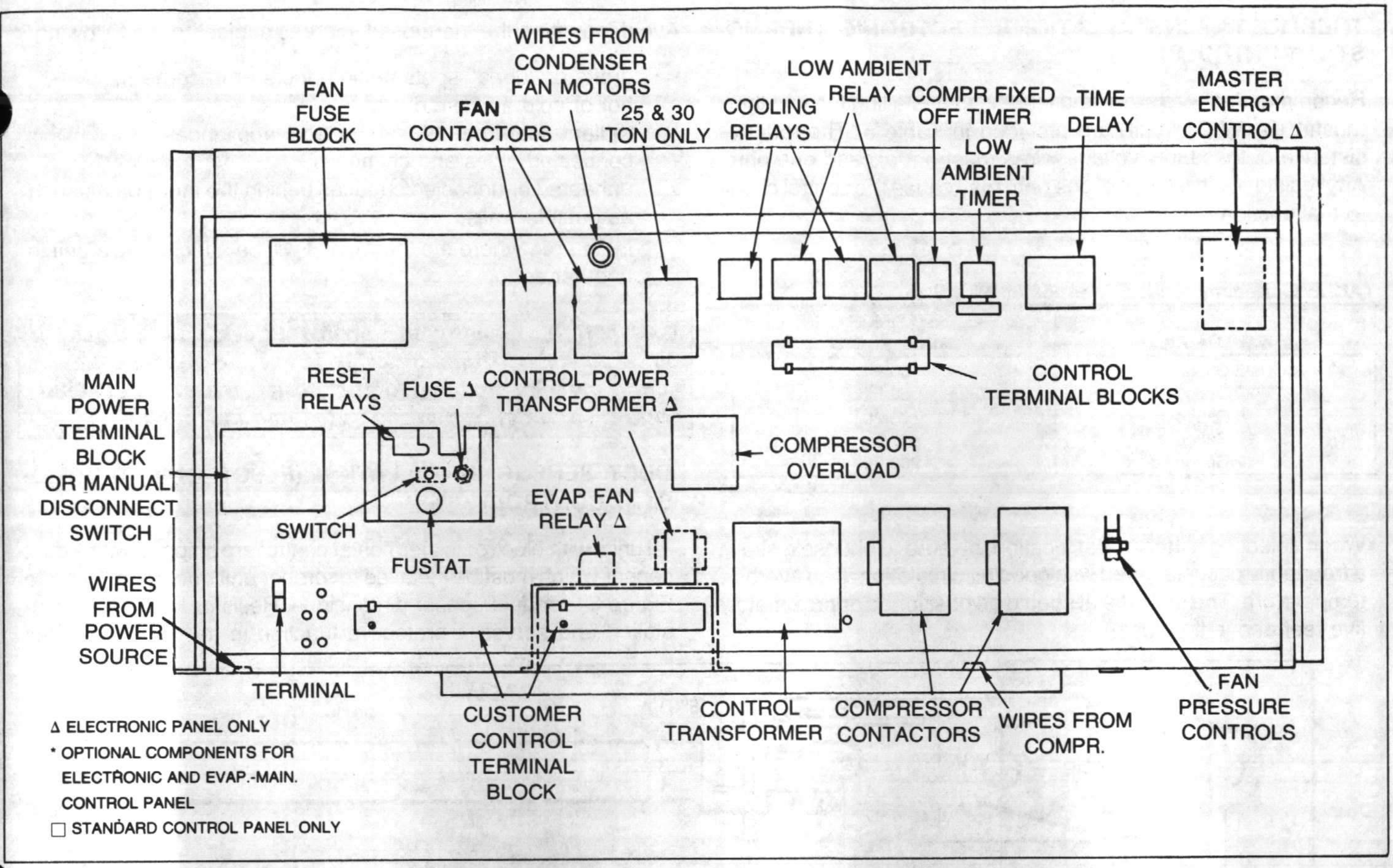


FIGURE 32 - Control Panel (20, 25 and 30-Ton Units)

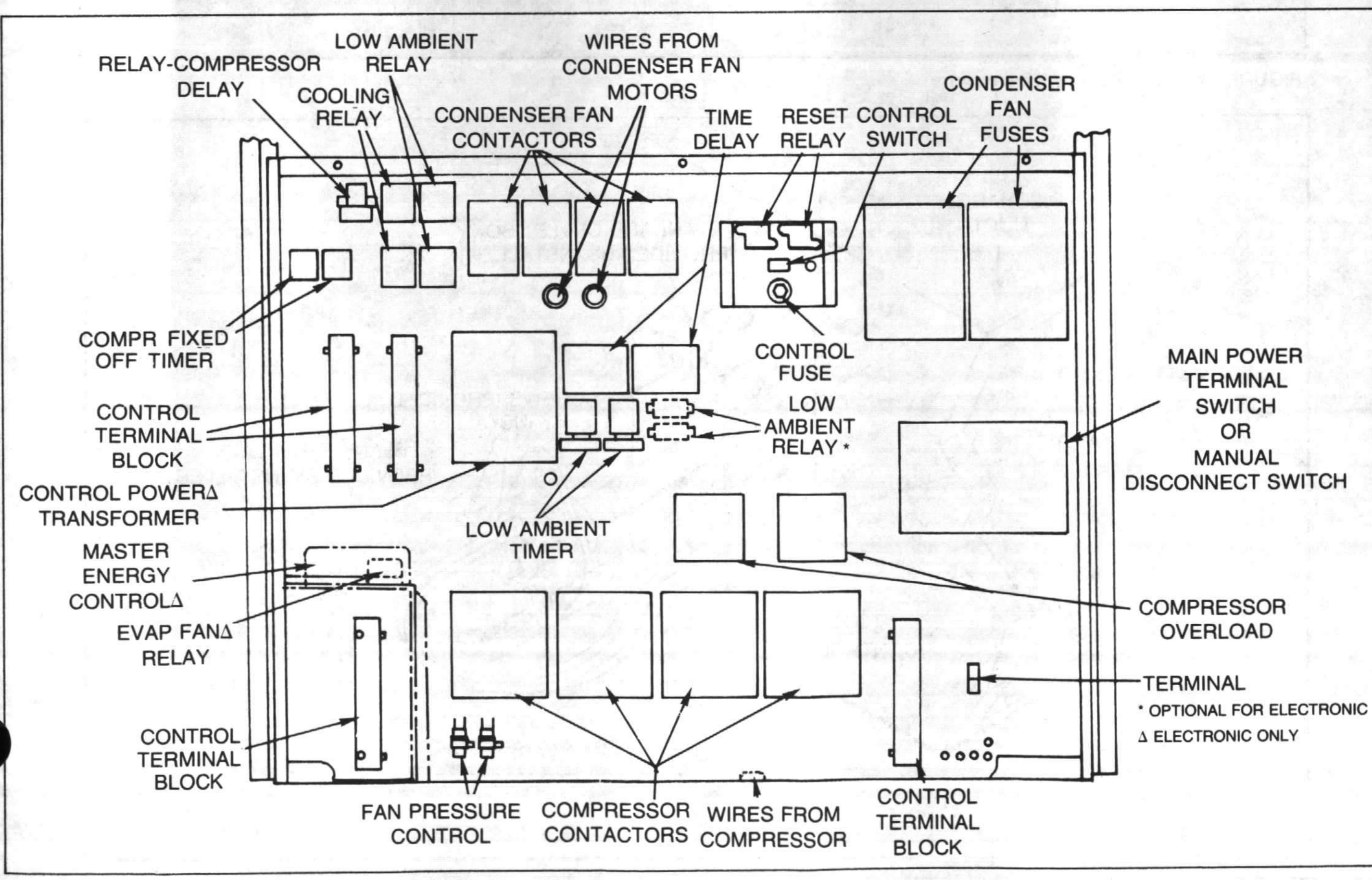


FIGURE 33 - Control Panel (40, 50 and 60-Ton Units)

THERMOSTAT INSTALLATION (ELECTRONIC THERMOSTAT CONTROLS)

Recommended wire sizes and lengths for installing the unit thermostat (24 VAC circuit) are provided in Table 5. The total resistance of these low voltage wires must not exceed one ohm. Any resistance in excess of one ohm may cause the control circuit to malfunction.

TABLE 5 - Recommended Thermostat Wire Size

WIRE GAUGE	MAXIMUM WIRE LENGTH
22 Gauge	30 Ft.
20 Gauge	50 Ft.
18 Gauge	75 Ft.
16 Gauge	125 Ft.
14 Gauge	200 Ft.

When selecting a thermostat location, be sure to choose a site in a frequently occupied area with good air circulation at an average temperature. The thermostat should be positioned approximately five feet above the floor.

Avoid mounting the thermostat in areas subject to the following:

- drafts or "dead" spots behind doors or in corners;
- hot or cold air from ducts;
- radiant heat from the sun, or from appliances;
- concealed pipes and chimneys;
- unheated or uncooled surfaces behind the thermostat, such as outside walls;
- in an area where the thermostat will be affected by a unit in another zone.

CAUTION: If an energy management device, time clock, or other power consuming device is used, a separate power supply must be provided for that device. Do not use the unit control circuitry, or damage to the unit may result.

DUCT SENSOR INSTALLATION (ELECTRONIC THERMOSTAT CONTROL)

All units with electronic thermostat control are shipped with a duct sensor which must be installed for proper unit operation. Refer to Figure 34 for duct sensor dimensions. Resistor R1 is factory installed and serves a protective function in the event the duct

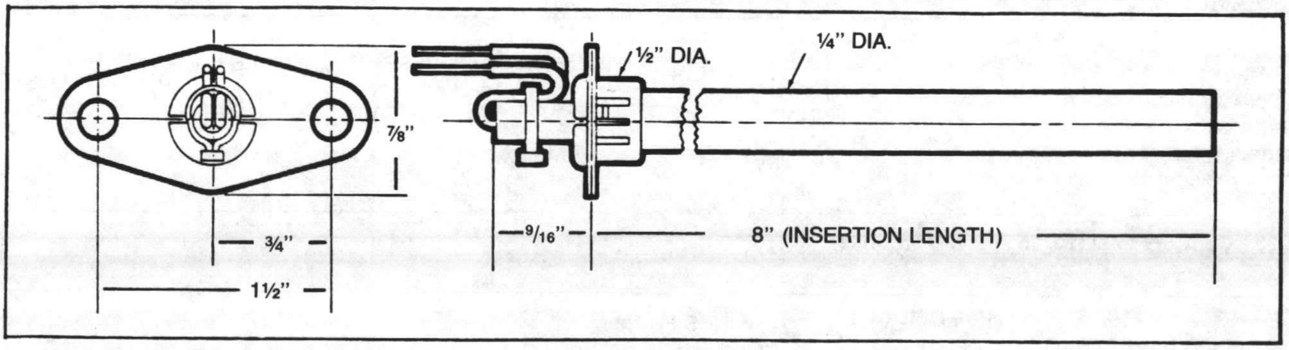


FIGURE 34 - Duct Sensor Dimensions

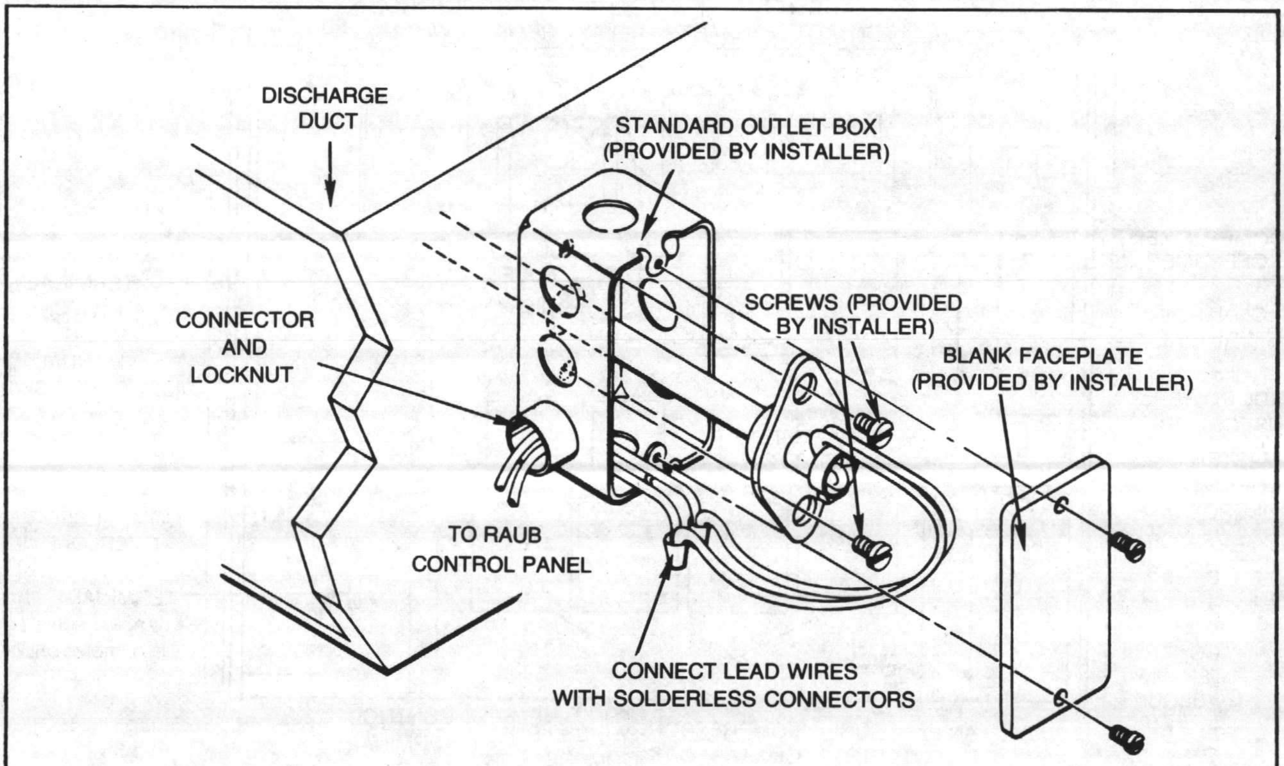


FIGURE 35 - Duct Sensor Assembly

sensor is not installed. Use the following procedure when installing the duct sensor:

1. Remove resistor 1R1 from Terminals 1TB5-11 and 1TB5-12.
2. Mount the duct sensor (2RT1) in an average temperature location at the outlet of the supply air ductwork. See Figure 35. If an economizer or heating section is incorporated in the system, the duct sensor must be located downstream (after mixing has occurred).
3. Connect the leads of the duct sensor across terminals 1TB5-11 and 1TB5-12.

NOTE: *When an economizer is being used with these controls, the duct sensor must be installed.*

INSTALLATION CHECKLIST

Complete this checklist as the unit is installed to verify that all recommended installation procedures are accomplished before the unit is started. **This checklist does not replace the detailed instructions provided in the INSTALLATION section of this manual.** Read the entire section carefully to become familiar with the installation procedures **before** installing the unit.

RECEIVING

- ☐ Unit nameplate data corresponds with ordering information.
- ☐ Unit inspected for shipping damage and claim filed, if necessary.
- ☐ Unit checked for material shortage and any shortages reported.

UNIT LOCATION

- ☐ Condenser air clearances over unit good.
- ☐ Service clearances around unit good.
- ☐ Unit secured in correct location.

REFRIGERANT PIPING

- ☐ Liquid line sized properly and within recommended maximum line length.
- ☐ Suction line sized properly.
- ☐ Thermostatic expansion valve properly sized and installed close to evaporator.
- ☐ Liquid line filter drier installed near expansion valve.
- ☐ Sight glass installed in liquid line between evaporator and filter drier.
- ☐ Low ambient accessories installed, if necessary.
- ☐ Check all unit and piping connections for leaks.

ELECTRICAL WIRING

- ☐ Field installed wiring complies will all applicable codes.
- ☐ Compressor contactor and terminal block lugs checked for tightness.
- ☐ Thermostat properly mounted and wired.
- ☐ Any other accessories properly installed and wired.
- ☐ Grounding wires securely bonded to earth ground.
- ☐ Duct sensor(s) properly installed (units with electronic thermostat controls or supply air controls).

PRE-START CHECKS

Before starting the unit, complete the procedures outlined below to make sure that the unit is properly installed and ready for start-up.

WARNING: OPEN THE UNIT DISCONNECT SWITCH AND LOCK IT IN THAT POSITION TO PREVENT ACCIDENTAL START-UP. NEVER OPEN AN ACCESS PANEL TO INSPECT OR SERVICE THE UNIT WITHOUT FIRST OPENING THE DISCONNECT SWITCH. FAILURE TO DO SO MAY RESULT IN INJURY OR DEATH DUE TO ACCIDENTAL ELECTRICAL SHOCK OR ENTANGLEMENT IN MOVING PARTS.

1. Inspect all electrical connections to be sure that the wires are securely attached to their terminals. Make sure that all wires are clear of any rotating parts such as fan blades.
2. Check the condenser and evaporator fans. Fan blades must be secure on the motor shafts and must rotate freely. Airflow must be unobstructed.
3. Make sure the evaporator air filters are clean.
4. Check the evaporator and condenser coils to ensure that they are clean, that the fins are straight, and that there are no obstructions to airflow.
5. Check the voltage at the line side of the disconnect switch. The voltage must be within 10 percent of the unit nameplate voltage.
6. Check the compressor oil level sight glass. If oil is not visible and the unit has not yet been operated, add oil. The oil level must be visible in the sight glasses. If the unit has been operated and no oil is visible, determine the reason for the shortage before adding oil.

EVACUATION

After completing the PRE-START CHECKS use a vacuum pump to remove air, moisture and contaminants from the system. The system should be evacuated to a pressure of 500 microns or less. Refer to EVACUATION PROCEDURES in the MAINTENANCE PROCEDURES section of this manual.

REFRIGERANT CHARGING

With the system properly evacuated, determine the required charge of Refrigerant-22 and charge the system as outlined under REFRIGERANT CHARGING in the MAINTENANCE PROCEDURES section of this manual.

START-UP, TWO-STEP CONTROLS

Set the room thermostat as follows to start the unit:

1. Turn the System Control switch to cool.
2. Set the thermostat at a point below room temperature.

The unit will operate automatically in response to cooling needs as determined by the thermostat setting.

START-UP, ELECTRONIC THERMOSTAT CONTROLS

To start the system:

1. Close the unit disconnect switch.
2. Place the thermostat sub-base fan switch in the AUTO position. Fan operation is continuous in the ON or AUTO position.
3. Place the thermostat sub-base system switch in the COOL position.

4. Lower the room thermostat to a setting below the room temperature.

5. Close the control circuit switch 1S1.

The unit will operate automatically in response to the cooling needs as determined by the thermostat setting.

INITIAL START-UP CHECKS

Compressor Oil Charge

Proper oil charge is critical for reliable operation of reciprocating compressors. Both undercharging and overcharging will result in compressor damage.

On most applications, the factory oil charge is correct and no addition of oil is required. However, it may be necessary to add oil to systems which have extremely long interconnecting lines.

An oil level sight glass is provided integral to the compressor shell in order to confirm proper oil charge on all 20 through 60-ton units. The following procedure should be followed:

1. Check the oil level **prior to initial refrigerant charging and start-up** of a new system. To be proper, the oil level must be visible in the sight glass. Note the oil level mark for future reference.

2. Approximately one hour after initial start-up and after the oil sump is warm to the touch, check the oil level with the compressor running **fully loaded.** The oil level must be visible in the sight glass. If it is not visible, add oil until the level is halfway up the sight glass.

CAUTION: Do not attempt to check the oil level at part load compressor operation. It is not intended that the oil level be visible in the sight glass under these conditions. Adding oil could result in a compressor oil overcharge and subsequent compressor damage.

3. Allow the compressor to run at full load until the oil sump is warm to the touch. If the oil level increases from Step 2, oil should be removed and the process repeated until the sight glass level remains at the halfway mark.

CAUTION: Checking oil level with a cold sump can incorrectly indicate excess oil in the sump due to refrigerant in the oil.

Crankcase Heater

Normally, it is not necessary to energize the crankcase heater prior to **initial start-up.** However, if more than 30-minutes has elapsed between refrigerant charging and start-up a significant amount of refrigerant could migrate to the compressor. When there is a time lapse between charging and start-up, the crankcase heater should be energized for at least eight hours prior to starting the unit.

CAUTION: Failure to energize the crankcase heater and wait eight hours before starting the compressor may result in excessive oil foaming at start-up and possible damage to the compressor bearings.

COMPRESSOR MOTOR

With the compressor operating, check the amp draw. The amperage should not exceed the "Maximum Allowable Amps" listed in Table 6. The amp draw may be less than the value listed in the table.

Voltage at the compressor terminals must be within the "Allowable Voltage Range" listed in Table 4. If not, check the voltage at the unit terminal block and at the disconnect switch to determine if voltage problems are being caused by feeder line, loose terminals, or defective unit wiring.

VOLTAGE IMBALANCE

Voltage imbalance on three phase systems can cause motor overheating and eventual failure. Maximum allowable imbalance is two percent, which must be measured at the compressor terminals. Voltage imbalance is defined as 100 times the maximum de-

TABLE 6 - Maximum Allowable Amp Draw

CONDENSING UNIT	ELECTRICAL CHARACTERISTICS	ALLOWABLE VOLTAGE RANGE	MAX. ALLOWABLE AMPS	
			MATCHED EVAP.	OVERSIZED EVAP.
RAUB-C206	200/60/3	180-220	97	100
RAUB-C203	230/60/3	207-253	84	87
RAUB-C204	460/60/3	414-506	42	43
RAUB-C202	575/60/3	517-633	34	35
RAUB-C256	200/60/3	180-220	118	121
RAUB-C253	230/60/3	207-253	103	106
RAUB-C254	460/60/3	414-506	51	53
RAUB-C202	575/60/3	517-633	41	42
RAUB-C306	200/60/3	180-220	143	149
RAUB-C303	230/60/3	207-253	124	130
RAUB-C304	460/60/3	414-506	62	65
RAUB-C302	575/60/3	517-633	50	52
RAUB-C406	200/60/3	180-220	97	100
RAUB-C403	230/60/3	207-253	84	87
RAUB-C404	460/60/3	414-506	42	43
RAUB-C402	575/60/3	517-633	34	35
RAUB-C506	200/60/3	180-220	119	122
RAUB-C503	230/60/3	207-253	103	106
RAUB-C504	460/60/3	414-506	52	53
RAUB-C502	575/60/3	517-633	41	43
RAUB-C606	200/60/3	180-220	143	150
RAUB-C603	230/60/3	207-253	125	130
RAUB-C604	460/60/3	414-506	62	65
RAUB-C602	575/60/3	517-633	50	52

TABLE 7 - RAUB 20-60 Operating Modes

CONDENSING UNIT	SYSTEM LOADING (SEE NOTE 1)	COMPRESSOR LOADING: COMPRESSOR NO. 1 33%	50%	66%	100%	COMPRESSOR NO. 2 33%	50%	66%	100%	REC. EVAP. COIL LOADING	CONDENSER FAN OPERATION #1	#2	#3	#4	#5	#6
RAUB-C20	50%		X							½	P	X				
	100%				X					FULL	P	X				
RAUB-C25	33%	X								½	P	X				
	66%			X						FULL	P	X	X			
	100%				X					FULL	P	X	X			
RAUB-C30	33%	X								½	P	X				
	66%			X						FULL	P	X	X			
	100%				X					FULL	P	X	X			
RAUB-C40	25%		X							½	P	X				
	50%				X					½	P	X				
	75%		X						X	FULL	P	X		P	X	
	100%				X				X	FULL	P	X		P	X	
RAUB-C50	33%			X						½	P	X	X			
	50%				X					½	P	X	X			
	83%			X					X	FULL	P	X	X	P	X	X
	100%				X				X	FULL	P	X	X	P	X	X
RAUB-C60	33%			X						½	P	X	X			
	50%				X					½	P	X	X			
	83%			X					X	FULL	P	X	X	P	X	X
	100%				X				X	FULL	P	X	X	P	X	X

NOTES:
1. Assumes use of 2-step controller on 20 ton unit, 3-step controller on 25 and 30 ton units, and 4-step controller on 40, 50 and 60 ton units. This table does not apply to Multi-Step control (Option "B"). Unloading modes determined by the type of capacity controls.
2. Legend:
   X — In operation with compressor.
   P — In operation in response to fan pressure switch.

viation of the three voltages from the average, without regard to sign, divided by the average voltage. For example, if the three measured voltages are 221, 230 and 227, the average voltage would be:

$$\frac{221 + 230 + 227}{3} = 226 \text{ volts}$$

and the percent voltage imbalance would be:

$$\frac{100 \times (226\text{-}221)}{226} = 2.2\%$$

In this example, 2.2 percent imbalance is not acceptable and could result in as much as 20 percent current imbalance. This will increase the motor winding temperature, and thus decrease the life of the motor.

If more than 2.0 percent imbalance exists, check the voltage readings at the disconnect switch to determine if the imbalance is present in the incoming power lines. If so, the power company should be notified to correct it. If the imbalance is due to problems within the unit, check the unit electrical wiring connections.

OPERATING PRESSURES

Install pressure gauges on the discharge and suction line access valves next to the compressor. When the unit reaches stabilized operation, suction and discharge pressures can be read. Refer to "Operating Pressures" in the MAINTENANCE PROCEDURES section of this manual to compare the measured pressures with the normal system operating pressures.

EXPANSION VALVE SUPERHEAT

After checking operating pressures, check the expansion valve superheat as detailed in the MAINTENANCE section of this manual. The valve should be controlling smoothly without continuing superheat "hunting".

UNLOADING SEQUENCE

After checking to see that the pressures, oil level, superheat setting and refrigerant charge are correct, raise and lower the thermostat setting to confirm that the system loading and unloading sequence is correct. See Table 7.

START-UP LOG

DATE ________________

I. NAMEPLATE INFORMATION

Model No. ________________ Serial No. ________________

Voltage ________________ RLA ________________

II. COMPRESSOR(S)

A. VOLTAGE AT COMPRESSOR TERMINALS

Comp. No. 1: T1 ________ T2 ________ T3 ________

Comp. No. 2: T1 ________ T2 ________ T3 ________

Voltage Imbalance: Comp. No. 1 ________ Comp. No. 2 ________

B. AMP DRAW

Comp. No. 1: L1 ________ L2 ________ L3 ________

Comp. No. 2: L1 ________ L2 ________ L3 ________

III. OPERATING CONDITIONS

A. COMPRESSOR NO. 1

Discharge Pressure ________ Suction Pressure ________

Liquid Line Pressure ________ Suction Line Temp. ________

Liquid Line Temp. ________ Superheat ________

Subcooling ________ Evap. Entering Air Temp. (DB/WB) ________

Ambient Temp. ________ Evap. Discharge Air Temp. (DB/WB) ________

B. COMPRESSOR NO. 2

Discharge Pressure ________ Suction Pressure ________

Liquid Line Pressure ________ Suction Line Temp. ________

Liquid Line Temp. ________ Superheat ________

Subcooling ________ Evap. Entering Air Temp. (DB/WB) ________

Ambient Temp. ________ Evap. Discharge Air Temp. (DB/WB) ________

IV. CONTROLS

Fans Operating (Yes or No): Fan No. 1 ________ No. 2 ________ No. 3 ________

Crankcase Heater Operating (Yes or No): Comp. No. 1 ________ Comp. No. 2 ________

V. REFRIGERANT PIPING

Evacuation Level ________ System Charge ________

OPERATION

SYSTEM CONTROL

Four different types of system control are available with the Model RAUB Split System Condensing Unit. They include two-stage electro-mechanical (shipped less thermostat and toggle switch), electronic with room thermostat, electronic with supply air sensor (RAUB/VAV systems) and four-stage electronic Honeywell (RAUB/EVPA systems).

Units With Two-Step Control

The recommended controls (to be supplied by others) for units with two-step controls are a Penn T25A two-stage electro-mechanical thermostat and a Cutler-Hammer 7562K53 2PDT toggle switch or equivalent. With the control circuit switch closed, the evaporator fan can be operated independently by placing the "Fan-Off-Cool" switch in the "Fan" position. Moving the switch to the "Cool" position will allow the system to operate in the cooling cycle according to thermostat demand.

NOTE: *A detailed sequence of operation is contained in RAUB-W-35.*

Units Shipped With Electronic Thermostat Controls

Refer to Figure 36.

RAUB units shipped with electronic thermostat controls are controlled by a Honeywell T7067A electronic thermostat coupled with a W973 logic panel (MEC). With the control circuit switch (1S1) in the closed position, the evaporator fan may be operated independently by moving the fan switch located on the thermostat subbase to the "On" position. With the fan in either the "On" or "Auto" position and the thermostat switch in either the "Auto" or "Cool" position, the unit will operate according to thermostat demand.

NOTE: *A detailed sequence of operation is contained in RAUB-W-36.*

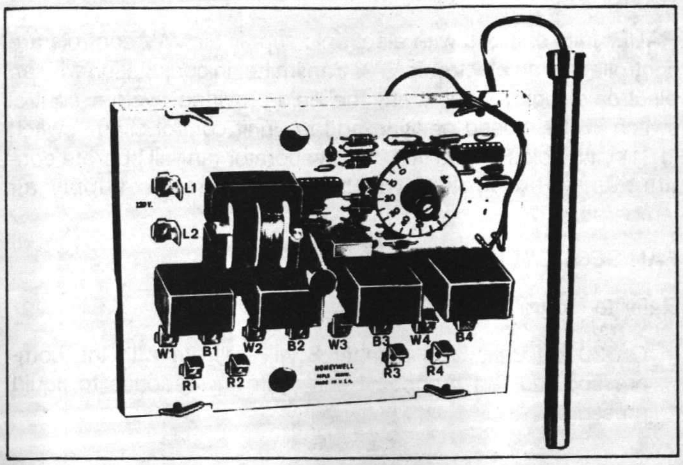


FIGURE 37 - Honeywell CR71A 4-Step Controller

RAUB/EVPA Systems

Refer to Figure 37.

RAUB units equipped with EVPA control panels are controlled by an electronic Honeywell CR71A four-stage controller. To operate the system, start the chilled water pump and close the control circuit switch. The controller will operate the unit according to the return chilled water temperature.

NOTE: *A detailed sequence of operation is contained in RAUB-W-37.*

Multi-Step Control

RAUB units shipped with multi-step controls are designed for use with field-provided controls where maximum unloading is desired.

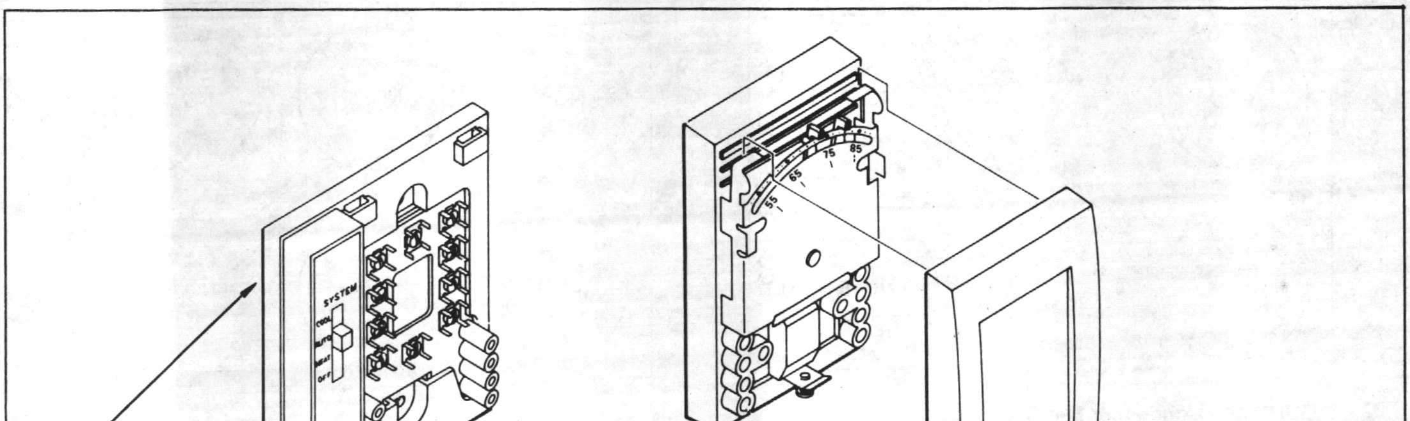


FIGURE 36 - Honeywell Electronic Thermostat With Switching Sub-base

NOTE: *A detailed sequence of operation is contained in RAUB-W-39.*

Electronic Supply Air VAV

RAUB units shipped with electronic supply air VAV controls are controlled by an electronic VAV transmitter in conjunction with an electronic logic panel. With the field-provided system control switch in the closed position and the unit control circuit switch (1S1) in the closed position, the evaporator fan will operate continuously and cooling will be in response to supply air temperature.

FAN SEQUENCING

Refer to Figure 38 and Table 8.

- On 20-ton units, fan number 2 will operate with the compressor and fan number 1 will cycle in response to liquid pressure.
- On 25 and 30-ton units, fan number 2 will operate with the compressor, fan number 1 will cycle in response to liquid pressure and fan number 3 will operate with compressor unloading.
- On 40-ton units, fans 2 and 5 will operate with the compressors and fans 1 and 4 will cycle in response to liquid pressure.
- On 50 and 60-ton units, fans 2, 5, 3 and 6 will operate with the compressors and fans 1 and 4 will cycle in response to liquid pressure.

THERMOSTATS

In operation, the zone thermostat measures continuously the temperature of the air being supplied to the zone. If controlled by the electro-mechanical thermostat, temperature sensitive elements merely make and break switches, enabling various stages of cooling to come on.

If controlled by the electronic thermostat, a 20-volt DC regulated power supply is provided to the thermostat. A continuous signal of 1 to 16 volts DC is returned to the Honeywell master energy controller by the thermostat. This signal is monitored by the controller to determine actual zone cooling requirements. The controller will then, according to the voltage value received, operate the necessary mechanical components through relay stages which are sensitive to the zone signal.

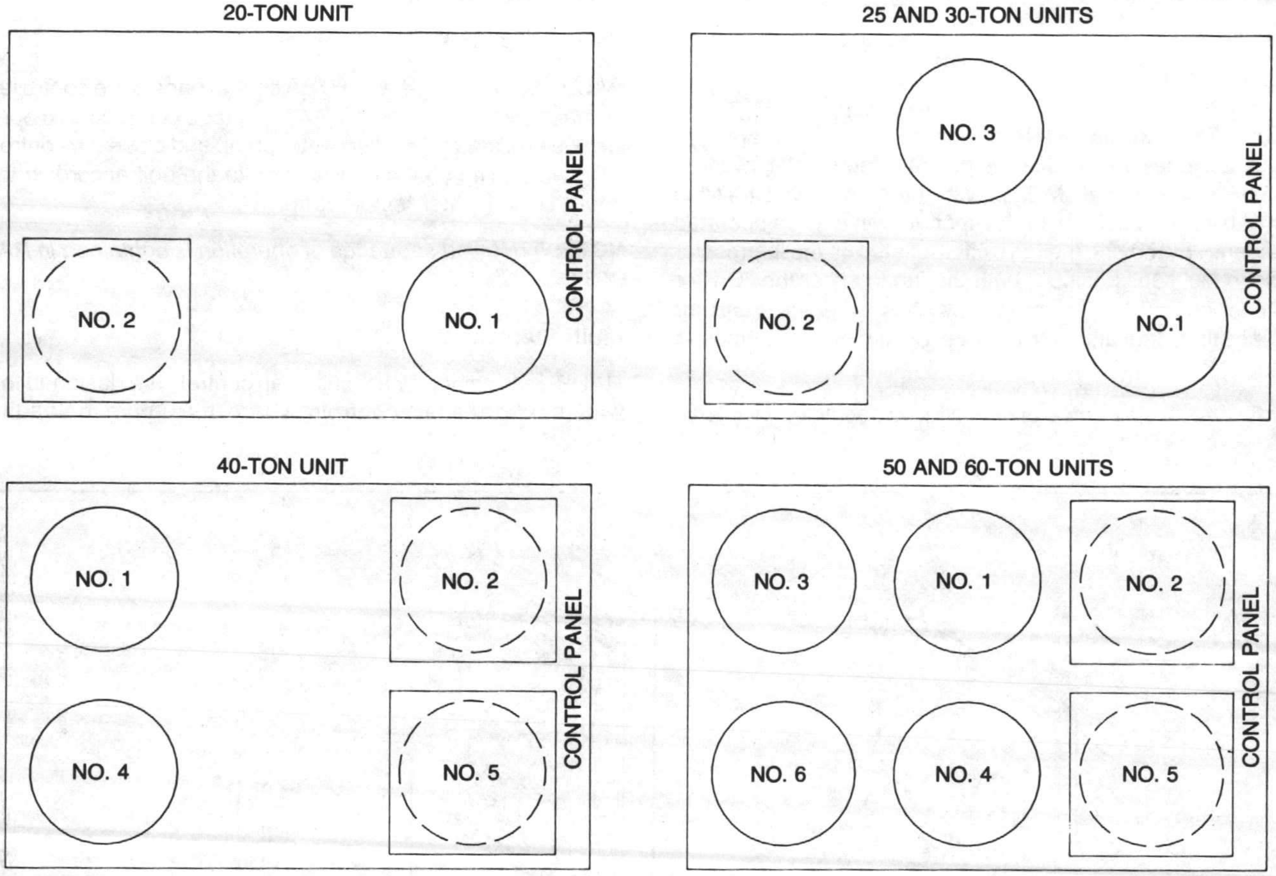


FIGURE 38 - Condenser Fan Sequence

TABLE 8 - Fan Sequencing

MODEL	FAN OPERATES WITH COMPRESSOR(S)	FAN CONTROLLED BY FAN PRESSURE SWITCH	FAN OPERATES WITH COMPRESSOR UNLOADING
	FAN NUMBER	FAN NUMBER	FAN NUMBER
RAUB 20	2	1	—
RAUB 25	2	1	3[1]
RAUB 30	2	1	3[1]
RAUB 40	2 and 5	1 and 4	—
RAUB 50	2, 5, 3, 6	1 and 4	—
RAUB 60	2, 5, 3, 6	1 and 4	—

NOTE:
1. Fan #3 operates with cooling stages 2 and 3.
2. Fans 3 and 6 operate with compressor unloading on multi-step controls.

Electrical Sequence of Operation, 2-Step Controls

See Figure 39.

Although the controls used with these units are optional, a Penn T25A thermostat and Cutler-Hammer 7562K53 2PDT toggle switch are the recommended equipment. The following discussion assumes the use of the recommended controls.

The system's operation is controlled by a system control switch and a two-stage thermostat. Closing the unit disconnect switch supplies power to the system control switch (1S1), control power transformer and compressor crankcase heater (2B7HR1).

The evaporator fan can be operated independently by placing the Fan-Off-Cool switch in the "Fan" position. This energizes the evaporator fan contactors, starting the fan. Moving the Fan-Off-Cool switch to the "Cool" position, energizes the evaporator fan contactors and closes the evaporator fan interlock contacts, supplying power to the thermostat and the normally open contacts (1K13) of the low ambient relay.

20 To 30-Ton Units

Sensing a need for cooling, the first-stage contacts of the two-stage thermostat will close, supplying power to the compressor fixed "on" timer (1U3). The fixed "on" timer times to close upon de-energization or when the compressor stops. If the compressor has been off for five minutes and the timer has timed out, power will be supplied through the 1U3's closed contacts to the first-stage cooling relay (1K1), the low ambient timer (1U5) and the compressor unloader solenoid (2B7L3). Compressor unloader solenoid 2B7L4 is also energized on 25 and 30-ton units.

Energizing 1K1 closes its two normally open sets of contacts. One set energizes the first-stage liquid line solenoid valve (2L1) and the second set supplies power to the compressor control circuit.

Supplying power to the low ambient timer (1U5) will energize the low ambient relays (1K13 and 1K14) through its normally closed time-to-open contacts for approximately three minutes. Energizing 1K13 will close its two normally open sets of contacts. The first set bypasses the thermostat and the second set bypasses the low pressure cut-out switch (2B7S4), supplying power to the condenser fan contactor (1K8), condenser fan pressure control (1S10) and compressor contactor (1K3). Energizing 1K3 will close its axuiliary compressor contacts.

NOTE: Units equipped with part-winding starter, *supply power to the part-winding time delay (1DL1) and compressor contactor 1K5's auxiliary contacts in addition to 1K8, 1S10 and 1K3. After 0.5 second timing, 1DL1 will close, energizing 1K5. This will close the auxiliary contacts of 1K5 and also supply power to the second set of compressor motor windings.*

Energizing 1K14 will open its two normally closed set of contacts, de-energizing two optional hot gas bypass valves for a three-minute period. This allows sufficient head pressure to build up before hot gas is allowed to pass. **After approximately three minutes, the 1U5 contacts will open de-energizing the 1K13 and 1K14 low ambient relays.** At this point, the control circuit will once again operate according to thermostat demand and the compressor and the condenser fans will operate through the low pressure control. ***NOTE: On units equipped with hot gas bypass,*** *the hot gas solenoid valve will energize, allowing the hot gas valve to operate according to suction pressure.*

As the cooling load increases, the second-stage contacts of the thermostat will close, energizing the second-stage cooling relay (1K2). The normally closed set of 1K2 contacts will open, de-energizing the compressor unloader solenoid (2B7L3), which will fully load the compresor. ***NOTE: On 25 and 30-ton units,*** *compressor unloader solenoid 2B7L4 is de-energized in addition to the 2B7L3 solenoid to provide 100 percent compressor operation. The normally open set of 1K2 contacts will close, energizing the second circuit's liquid line solenoid valve.* ***NOTE: On units with hot gas bypass,*** *the second circuit hot gas bypass solenoid valve will also be energized by way of the closed set of 1K14 contacts. The unit is now operating at 100 percent capacity.*

As the cooling load subsides, the second-stage thermostat contacts will open, de-energizing 1K2 and returning the unit to first-stage operation. As the cooling load is further reduced and finally satisfied, the first-stage thermostat contacts will open, de-energizing the first control relay (1K1). De-energizing 1K1 will open its two sets of contacts. The first set will de-energize (close) the liquid line solenoid valve, shutting off refrigerant flow to the evaporator. Opening the second set will leave only the compressor auxiliary contacts (1K3 Aux.) to supply power to the compressor control circuit.

The compressor will continue to operate, removing the remaining refrigerant from the evaporator and lowering the suction pressure. When the suction pressure is reduced to approximately 7 psig, the low pressure control will open, de-energizing the compressor and condenser fan contactor relays. De-energizing 1K3 will open its auxiliary contacts, locking out the control circuit.

The unit will restart after a call for cooling is established and the compressor fixed "off" timer times out.

40 To 60-Ton Units

Sensing a need for cooling, the first-stage contacts of the thermostat will close, supplying power to the first circuit's fixed "off" timer (1U3). 1U3's contacts time to close upon de-energization and will be closed provided the unit has not operated for five minutes. Current passing through 1U3's closed contacts will supply power to the cooling relay (1K1), low ambient timer (1U5) and time delay between compressors timer (1DL3).

Energizing 1K1 will close its two sets of contacts. One set will energize the liquid line solenoid valve (2L1) and the second set will supply power to the first compressor's control circuit (the reset relay circuit).

Supplying power to the low ambient timer (1U5) will energize relay 1K13 for a three-minute period and close its two sets of contacts. One set will bypass the thermostat's first-stage contacts which will insure a three-minute compressor operation despite the thermostat's demand. The second set will bypass the low pressure cut-out, providing power to the compressor contactor (1K3), condenser fan contactor (1K8) and condenser fan pressure control (1S10). ***NOTE: On part-winding starter units,*** *power is also supplied to part-winding start time delay 1DL1 which will close 0.5 seconds after energization, supplying power to compressor contactor 1K5.* ***NOTE: On units equipped with hot gas bypass,*** *an additional set of normally closed 1K13 contacts will open, de-energizing the first circuit's hot gas bypass solenoid for a three-minute period.*

NOTES:

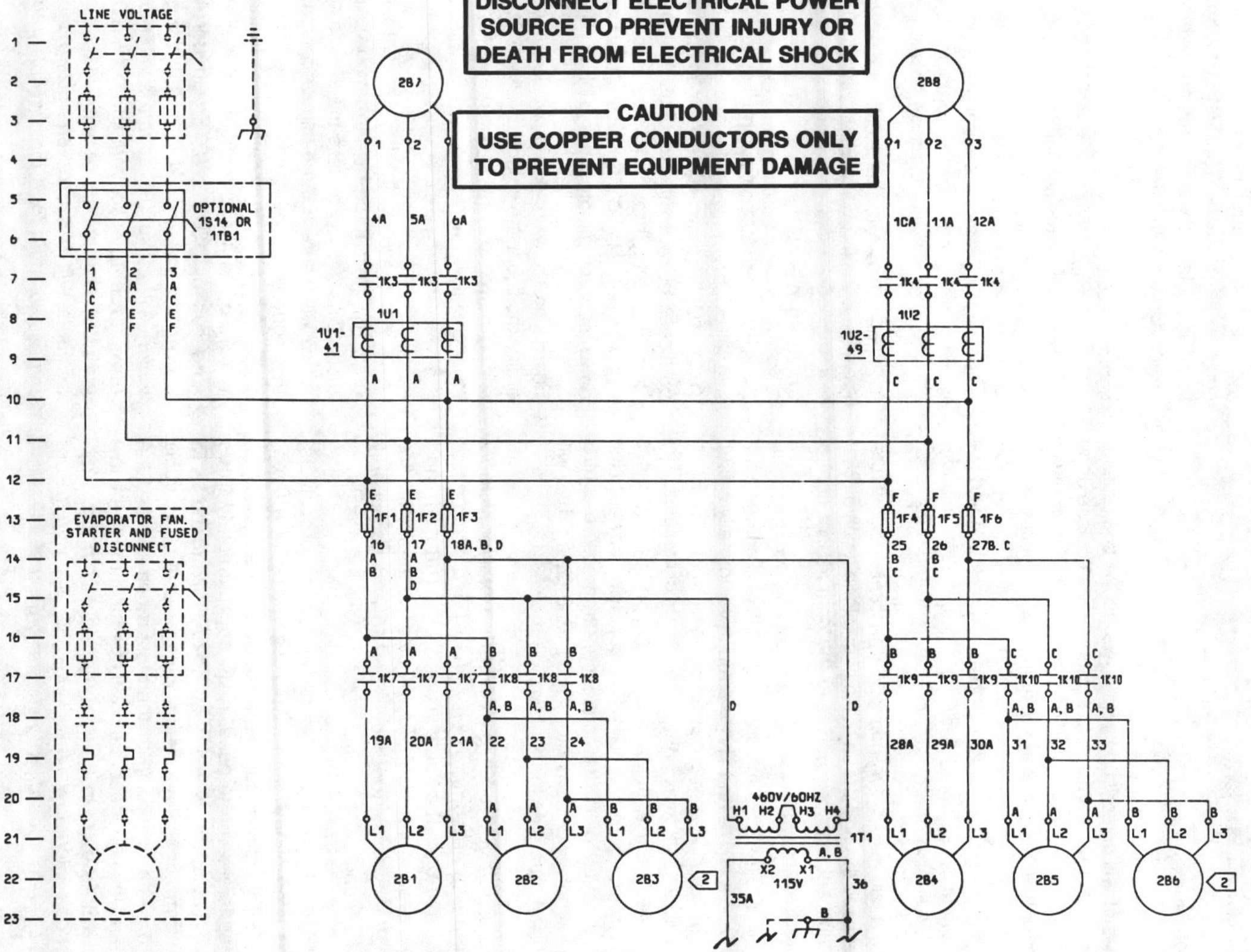
1. UNLESS OTHERWISE NOTED ALL SWITCHES ARE SHOWN AT 25°C(77°F), AT ATMOSPHERIC PRESSURE, AT 50% RELATIVE HUMIDITY, WITH ALL UTILITIES TURNED OFF, AND AFTER A NORMAL SHUTDOWN HAS OCCURED.
DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. DASHED LINE ENCLOSURES AND/OR DASHED DEVICE OUTLINES INDICATE COMPONENTS PROVIDED BY THE FIELD. PHANTOM LINE ENCLOSURES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTIONS.
NUMBERS ALONG THE RIGHT SIDE OF THE SCHEMATIC DESIGNATE THE LOCATION OF THE CONTACTS BY LINE NUMBER. AN UNDERLINED NUMBER INDICATES A NORMALLY CLOSED CONTACT.
AN OPEN ARROWHEAD BELOW THE LINE NUMBER POINTING UPWARD INDICATES A TIMED CONTACT WHICH BEGINS TIMING WHEN ENERGIZED.

2. 2B3, 2B6, AND ASSOCIATED WIRING ARE USED ONLY ON 50 AND 60 TON UNITS.

3. SUGGESTED PARTS ARE A PENN T25A THERMOSTAT AND A CUTLER-HAMMER 7562K53 2PDT TOGGLE SWITCH OR EQUIVALENT

WARNING
DISCONNECT ELECTRICAL POWER SOURCE TO PREVENT INJURY OR DEATH FROM ELECTRICAL SHOCK

CAUTION
USE COPPER CONDUCTORS ONLY TO PREVENT EQUIPMENT DAMAGE



LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
1DL3	DELAY BETWEEN COMPRESSORS	30
1F1--1F6	CONDENSER FAN FUSE	13
1F7	CONTROL CIRCUIT FUSE	24
1F44, 1F45	COMPR PROTECTOR FUSE	41, 49
1K1, 1K2	COOLING RELAY	27, 32
1K3	COMPRESSOR CONTACTOR	43
1K4	COMPRESSOR CONTACTOR	52
1K7, 1K8	CONDENSER FAN CONTACTOR	40, 44
1K9, 1K10	CONDENSER FAN CONTACTOR	49, 53
1K11, 1K12	RESET RELAY	40, 48
1K13, 1K14	LOW AMBIENT RELAY	28, 33
1S1	CONTROL CIRCUIT SWITCH	28
1S10, 1S11	FAN PRESSURE CONTROL	40, 49
1S14	MANUAL DISCONNECT SWITCH	5
1T1	CONTROL POWER TRANSFORMER	21
1TB1	POWER TERMINAL BLOCK	5
1TB4, 5, 6, 7	CONTROL TERMINAL BLOCK	
1U1, 1U2	COMPR CURRENT OVERLOAD	8
1U3, 1U4	COMPR FIXED OFF TIMER	28, 33
1U5, 1U6	LOW AMBIENT TIMER	29, 34
2B1--2B6	CONDENSER FAN MOTOR	22
2B7, 2B8	COMPRESSOR	2
2B7HR1	CRANKCASE HEATER	25
2B8HR2	CRANKCASE HEATER	26
2B7S2, 2B8S3	HIGH PRESSURE CUTOUT	41, 49
2B7S4, 2B8S5	LOW PRESSURE CUTOUT	41, 49
2B7S6	COMPR WINDING THERMOSTAT	41
2B8S7	COMPR WINDING THERMOSTAT	49
2L1, 2L2	LIQUID LINE SOLENOID	39, 48
2L5, 2L6	HOT GAS BYPASS SOLENOID	37, 46

DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	INSIDE UNIT CONTROL PANEL
2	OUTSIDE UNIT CONTROL PANEL

(CONTINUED ON NEXT PAGE)

(CONTINUED FROM PREVIOUS PAGE)

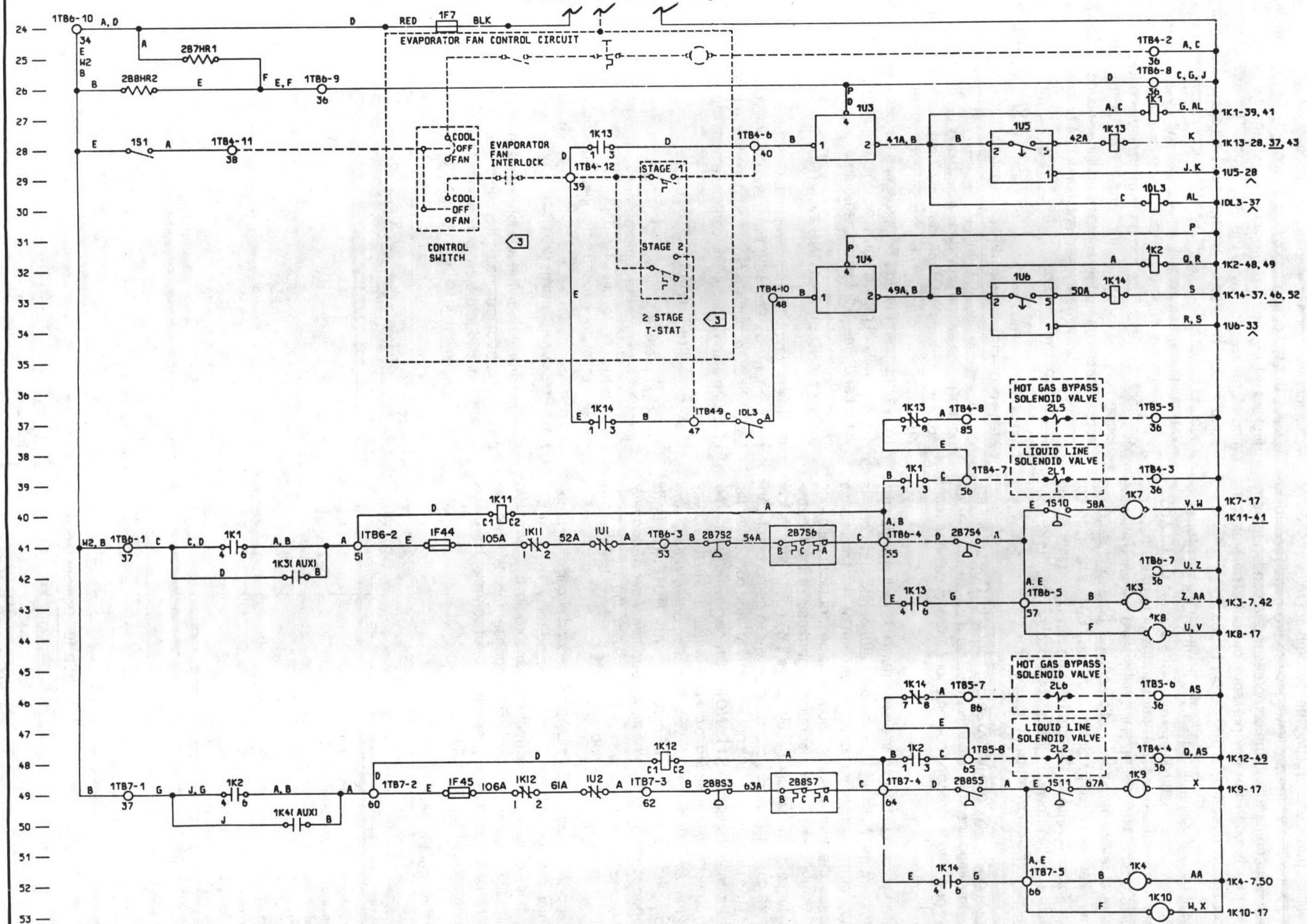


FIGURE 39 - System Wiring Diagram, 40, 50 and 60-Ton Units, Across-the-Line Start, 460/60/3, 2-Step Control

2304-0840A

After approximately three minutes, the low ambient timer contacts will reopen, de-energizing the low ambient relay (1K13). At this point, the first control circuit will once again operate according to thermostat demand and the compressor and condenser fans will operate through the low pressure cut-out. The first compressor is now operating at 100 percent capacity.

As the need for cooling increases, the thermostat's second stage contacts will close, supplying power to the second circuit's compressor fixed "off" timer (1U4) through the time delay between compressor contacts (1DL3). 1DL3 will close 0.5 second after the first control relay energizes. 1U4's contacts time to close upon de-energization and will be closed provided 1U4 has been de-energized for five minutes. Current passing through 1U4's closed contacts supplies power to the second cooling relay (1K2) and the second circuit low ambient timer (1U6).

Energizing 1K2 will close its two sets of contacts. One set will energize the liquid line solenoid valve (2L2) and the second set will supply power to the second compressor control circuit (the reset relay circuit).

Supplying power to the low ambient timer (1U6) will energize the low ambient relay (1K14) for a three-minute period and close its two sets of normally open contacts. One set of 1K14's contacts bypasses the thermostat's second-stage contacts, allowing three-minute compressor operation regardless of the thermostat's demand. The second set bypasses the second circuit's low pressure cut-out (2B8S5), providing power to compressor contactor (1K4), condenser fan contactor (1K10) and condenser fan pressure control switch (1S11). ***NOTE: On part-winding starter units,*** *power is also supplied to the part-winding start time delay (1DL2) which will close 0.5 seconds after energization, supplying power to compressor contactor 1K5.* ***NOTE: On units equipped with hot gas bypass,*** *an additional set of normally closed 1K14 contacts will open, de-energizing the hot gas solenoid for a three-minute period.*

After approximately three minutes, the second circuit's low ambient timer contacts will open, de-energizing relay 1K14. At this point, both circuits will be operating according to thermostat demand and the compressors and condenser fans will operate through their respective low pressure cut-out controls. The unit is now operating at full capacity.

As the cooling load diminishes, the thermostat's second stage contacts will open, de-energizing cooling relay 1K2. De-energizing 1K2 will open its two sets of normally open contacts. The first set will de-energize the liquid line solenoid valve (2L2), shutting off refrigerant flow to the evaporator. The second set which supplies the compressor control circuit will open, leaving only the second compressor's auxiliary contacts to supply control power. The suction pressure will reduce until the second circuit's low pressure cut-out opens, de-energizing the compressor and condenser fan relays. The compressor auxiliary contacts will open, locking out the second control circuit. It should be noted that the second circuit cannot re-energize until the second stage thermostat contacts have reclosed and timer 1U4 has remained de-energized for five minutes.

When the cooling load has been satisfied, the thermostat's first-stage contacts will open, de-energizing cooling relay 1K1. Just as on the second circuit, the liquid line solenoid valve will shut and control power will be provided through only the first compressor's auxiliary contacts. At approximately 7 psi, the low pressure cut-out will open, de-energizing the compressor and condenser fan relays and also the first compressor's auxiliary set of contacts. The unit will not restart until a call for cooling has been re-established and timer 1U3 has timed out.

SAFETY AND OPERATING CONTROLS

The operation of the High Pressure Cut-out, Low Pressure Control, Compressor Fixed Off Timer and the Low Ambient Timer has been checked at the factory and does not require extensive rechecking at the jobsite. The control settings are listed in Table 9.

High Pressure Cut-out (2B7S2)

The high pressure cut-out, sensing the compressor discharge pressure, prevents the compressor motor from being overloaded. It opens the control circuit, stopping the compressor should condensing pressure exceed safe operating limits (405 ± 10 psig).

Low Pressure Control (2B7S4)

Sensing pressure on the suction side of the compressor, the low pressure control terminates the pumpdown cycle when the pressure is reduced to the cut-out setting of the control (7 ± 3 psig). When the system is to be restarted, the build-up of suction pres-

TABLE 9 - Control Settings

CONTROL	FAN NO.	SETTINGS	
		CUT-IN	CUT-OUT
High Pressure (2B7S2 & 2B8S3*)	—	300 ± 20 PSIG	405 ± 10 PSIG
Low Pressure (2B7S4 & 2B8S5*)	—	22 ± 3 PSIG	7 ± 3 PSIG
Discharge Temperature Limit	—	Manual**	280 ± 7.5 F
Fan Pressure			
20-Ton (1S10)	1	300 ± 10 PSIG	155 ± 10 PSIG
25-Ton (1S10)	1	300 ± 10 PSIG	155 ± 10 PSIG
30-Ton (1S10)	1	300 ± 10 PSIG	155 ± 10 PSIG
40-Ton (1S10 & 1S11)*	1 & 4	300 ± 10 PSIG	155 ± 10 PSIG
50-Ton (1S10 & 1S11)*	1 & 4	300 ± 10 PSIG	155 ± 10 PSIG
60-Ton (1S10 & 1S11)	1 & 4	300 ± 10 PSIG	155 ± 10 PSIG
Compressor Fixed Off Timer (1U3 & 1U4*)		5-Minutes	
Low Ambient Timer (1U5 & 1U6*)		3-Minutes	

* Used on 40 thru 60-ton units only.

** Cannot be reset until discharge gas temperature drops below 180 F.

TABLE 10 - Damper Operation

FULLY CLOSED	FULLY OPEN
170 PSI	250 PSI

sure, resulting from the opening of the first liquid solenoid valve, will close the control contacts at 22 ± 3 psig.

Condenser Fan Pressure Control (1S10 and 1S11)

The last condenser fan energized by each compressor circuit operates in response to liquid line pressure. See Figure 40 for fan numbering sequence. At 300 ± 10 psig the condenser fan contactor is energized. When condenser pressure falls to 155 ± 10 psig the contactor is de-energized.

Compressor Fixed Off Timer(s) (1U3 and 1U4)

Units equipped with compressor fixed off timers provide a 5-minute compressor fixed off period which will prevent rapid compressor cycling. The timers begin timing upon de-energization.

Low Ambient Timers (1U5 and 1U6)

Low ambient timers are standard equipment on units shipped without controls (ninth model number digit is A, B or F) and are optional equipment on all other units.

The timers are called fixed on timers on units shipped without controls and serve a dual function. Low ambient timers act as anti-recycle timers by incurring a three minute compressor fixed on period and also provide low ambient compressor start-up by bypassing the low pressure switch for three minutes.

On all other units, the timers are provided only for low ambient start-up.

Low Ambient Dampers

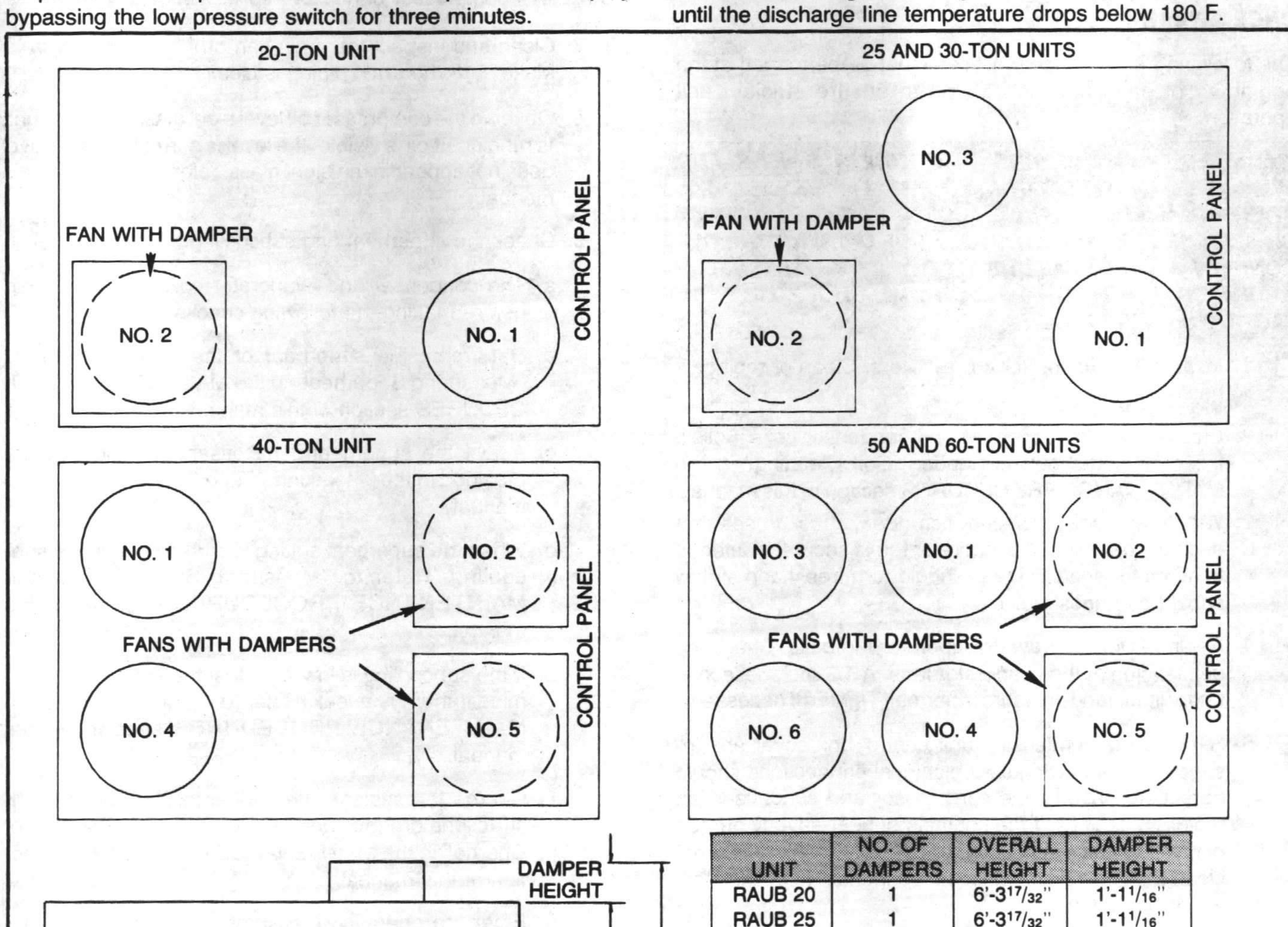
Refer to Figure 40.

Low ambient dampers on 20 through 60-ton units are factory installed optional items. They control the flow of air across the coils. During start-up, the blades must be inspected for proper alignment, obstructions and free operation.

To check damper operation, the damper must be fully open when the discharge pressure reaches 250 psig. On dual compressor units, check damper operation for each circuit separately in the same manner as single compressor units. Damper operation will occur between the liquid line pressures given in Table 10.

Discharge Temperature Limit

The discharge temperature limit control senses compressor discharge gas temperature and shuts the system off by opening the control circuit when discharge temperature exceeds 280 ±7.5 F. This manual reset control protects the compressor from excessive oil and/or refrigerant temperatures, which commonly occur due to loss of refrigerant charge. Reset cannot be accomplished until the discharge line temperature drops below 180 F.



UNIT	NO. OF DAMPERS	OVERALL HEIGHT	DAMPER HEIGHT
RAUB 20	1	6'-3 17/32"	1'-1 1/16"
RAUB 25	1	6'-3 17/32"	1'-1 1/16"
RAUB 30	1	6'-9 1/32"	1'-1 1/16"
RAUB 40	2	7'-2 1/32"	1'-1 1/16"
RAUB 50	2	7'-2 1/32"	1'-1 1/16"
RAUB 60	2	7'-2 1/32"	1'-1 1/16"

FIGURE 40 - Low Ambient Dampers

MAINTENANCE

PERIODIC MAINTENANCE

Perform all of the indicated maintenance procedures at the intervals scheduled. This will prolong the life of the unit and reduce the possibility of costly equipment failure. A MAINTENANCE LOG is provided on page 51 of this manual for recording operating data on a regular basis.

ONCE A MONTH

Conduct the maintenance inspections outlined below on a monthly basis during the cooling season.

☐ 1. Inspect the evaporator coil air filters. Clean or replace if necessary.

☐ 2. Inspect the evaporator and condenser coils for dirt and foreign debris. If the coils appear dirty, clean them according to the instructions provided under "Coil Cleaning" in the MAINTENANCE PROCEDURES section of this manual.

☐ 3. Check compressor oil level.

ONCE A YEAR

The following maintenance practices must be performed at the beginning of each cooling season to ensure efficient unit operation.

WARNING: OPEN THE UNIT DISCONNECT SWITCH AND LOCK IT IN THAT POSITION TO PREVENT ACCIDENTAL START-UP. NEVER OPEN AN ACCESS PANEL TO INSPECT OR SERVICE THE UNIT WITHOUT FIRST OPENING THE DISCONNECT SWITCH. FAILURE TO DO SO MAY RESULT IN INJURY OR DEATH FROM ELECTRICAL SHOCK OR CONTACT WITH MOVING PARTS.

☐ 1. Inspect the evaporator coil air filters. Clean or replace if necessary.

☐ 2. Clean both the evaporator and condenser coils. Follow the procedures outlined under "Coil Cleaning" in the MAINTENANCE PROCEDURES section of this manual.

☐ 3. With the unit disconnect switch open, check to see that each condenser and evaporator fan is securely fastened to its motor shaft. All fans should turn freely and airflow should be unobstructed.

☐ 4. Replace worn or frayed evaporator fan belts. Check the belt tension of the evaporator fans. A 1/2-inch deflection under light hand pressure is normal. Tighten if necessary.

☐ 5. Remove the condensing unit control box cover and inspect the panel wiring. All electrical connections should be secure. Inspect the compressor and condenser fan motor contactors. If the contacts appear severly burned or pitted, replace the contactor (refer to Figure 41). Do not clean the contacts. Inspect the condenser fan capacitors for visible damage.

☐ 6. Remove any accumulation of dust and dirt from the condensing unit.

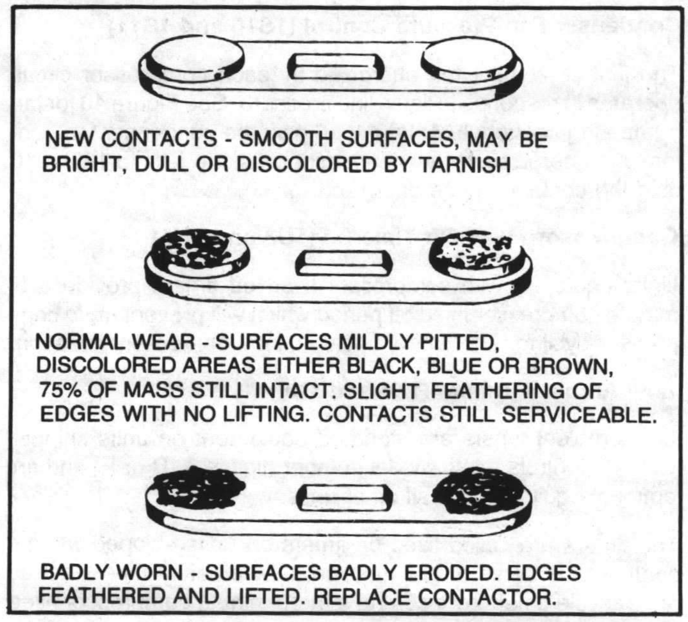


FIGURE 41 - Compressor Contactor Replacement Guide

☐ 7. Clean and inspect the drain pan of the evaporator unit. Make sure the drain piping is clear.

☐ 8. Observe the compressor oil level sight glass while the unit is running. If oil is visible, the level is normal. If an oil level does not appear in the sight glass, refer to page 40 of this manual.

☐ 9. Check the superheat and subcooling.

a. The condenser and evaporator coils must be clean before making the following checks.

b. Determine the superheat of the system. Refer to "Measuring Superheat" in the MAINTENANCE PROCEDURES section of this manual.

c. Adjust the superheat if necessary (instructions are provided in the "Measuring Superheat" section of this manual).

d. When the superheat setting is correct, check the subcooling. Refer to "Measuring Subcooling" in the MAINTENANCE PROCEDURES section of this manual.

e. If the subcooling is low, leak test the system to determine if there is a leak. Refer to "Leak Testing" in the MAINTENANCE PROCEDURES section of this manual.

f. Charge the system with refrigerant if necessary. Instructions are provided under "Checking Refrigerant Charge" in the MAINTENANCE PROCEDURES section of this manual.

g. Enter the operating pressures, superheat, and subcooling in the MAINTENANCE LOG provided on the following page.

MAINTENANCE LOG

DATE	AMBIENT TEMP. (F)	EVAPORATOR ENTERING AIR		COMPRESSOR NO. 1		COMPRESSOR NO. 2*		SUPERHEAT		SUBCOOLING	
		DRY BULB	WET BULB	SUCTION PRESSURE	DISCHARGE PRESSURE	SUCTION PRESSURE	DISCHARGE PRESSURE	CIRCUIT NO. 1 (F)	CIRCUIT NO. 2 (F)*	CIRCUIT NO. 1 (F)	CIRCUIT NO. 2 (F)*

* RAUB 40, 50 and 60 Ton Units Only

SHUTDOWN AND START-UP

Shutdown: Short Duration

The system can be shutdown for short periods of time, such as over the weekend by placing the control circuit switch or the system control switch in the OFF position.

NOTE: *The unit disconnect switch must remain closed. This will permit the crankcase heater to continue to function, preventing refrigerant from condensing in the compressor oil sump.*

Start-up: Short Duration

The system is returned to operation after a shutdown of short duration, such as over a weekend, by adjusting the thermostat setting to the desired temperature, placing the control circuit switch in the ON position, and setting the system control switch in the COOL position.

Shutdown: Seasonal

For seasonal shutdown, open the unit electrical disconnect switch to prevent the unit from starting accidentally.

Start-up: Seasonal

To start the unit after an extended shutdown period, complete the following procedures.

1. Perform all of the "Once a Year" checks listed in the PERIODIC MAINTENANCE section of this manual.
2. Move the control circuit and/or system control switch to OFF.
3. Close the condensing unit electrical disconnect switch. This will energize the compressor crankcase heater. If operating properly, the crankcase should be hot to the touch. Wait a minimum of eight hours before turning the system control switch to the COOL position.

CAUTION: Failure to wait eight hours before turning the system control switch to COOL may result in damage to the compressor bearings.

4. Start the system by adjusting the thermostat setting to the desired temperature, placing the system control switch in the COOL position, and placing control circuit switch in the ON position.
5. Place a clamp-on ammeter on each compressor lead and check the motor amperage. The amperage draw should not be greater than that given in Table 6, "Maximum Allowable Amp Draw".
6. Place the clamp-on ammeter around one of the three leads from the outdoor fan motor. The amp draw should be no greater than the nameplate rating for the condenser fan motors.

MAINTENANCE PROCEDURES

This section of the manual describes specific maintenance procedures which must be performed as a part of the unit's maintenance program. Before performing any of these operations, however, be sure that power to the unit is disconnected unless otherwise instructed.

WARNING: WHEN MAINTENANCE CHECKS AND PROCEDURES MUST BE COMPLETED WITH THE ELECTRICAL POWER ON, CARE MUST BE TAKEN TO AVOID CONTACT WITH ENERGIZED COMPONENTS OR MOVING PARTS. FAILURE TO EXERCISE CAUTION WHEN WORKING WITH ELECTRICALLY-POWERED EQUIPMENT MAY RESULT IN SERIOUS INJURY OR DEATH.

COIL CLEANING

Refrigerant coils must be cleaned at least once a year, or more frequently if the unit is located in a dirty environment. This will help maintain unit operating efficiency and reliability. The relationship between regular coil maintenance and efficient/reliable unit operation is outlined below.

1. Clean condenser coils minimize compressor head pressure and amperage draw, and promote system efficiency.
2. Clean evaporator coils minimize water carry-over and help eliminate frosting and/or compressor flood back problems.
3. Clean coils minimize required fan brake horsepower and maximize efficiency by keeping coil static pressure loss at a minimum.
4. Clean coils keep motor temperature and system pressure within safe operating limits for good reliability.

Specific instructions for cleaning condenser coils are provided in the following paragraphs. Follow these instructions as closely as possible to avoid potential damage to the coils.

To clean condenser coils, the following equipment is required: a soft brush and either a garden pump-up sprayer or a high pressure sprayer. In addition, a high quality detergent must be used: suggested brands include SPREX A.C., OAKITE 161, OAKITE 166, and COILOX. Follow the manufacturer's recommendations for mixing to make sure the detergent is alkaline with a pH value less than 8.5.

1. Disconnect power to the unit.

WARNING: OPEN UNIT DISCONNECT SWITCH. FAILURE TO DISCONNECT UNIT FROM ELECTRICAL POWER SOURCE MAY RESULT IN SEVERE ELECTRICAL SHOCK, AND POSSIBLE INJURY OR DEATH.

2. Remove enough panels from the unit to gain access to the coil.
3. Protect all electrical devices such as motors and controllers from dust and spray.
4. Straighten coil fins with a fin rake, if necessary.
5. Use a soft brush to remove loose dirt and debris from both sides of the coil.
6. Mix the detergent with water according to the manufacturer's instructions. The detergent-and-water solution may be heated to a maximum of 150 F to improve its cleansing ability.

WARNING: DO NOT HEAT THE DETERGENT-AND-WATER SOLUTION TO TEMPERATURES IN EXCESS OF 150 F. HIGH-TEMPERATURE LIQUIDS SPRAYED ON THE COIL EXTERIOR WILL RAISE THE PRESSURE WITHIN THE COIL AND MAY CAUSE IT TO BURST, RESULTING IN POSSIBLE INJURY TO SERVICE PERSONNEL AND EQUIPMENT DAMAGE.

7. Place the detergent-and-water solution in the sprayer. If a high-pressure sprayer is used, be sure to follow these guidelines:
   - Minimum nozzle spray angle is 15 degrees.
   - Spray the solution perpendicular (at a 90 degree angle) to the coil face.
   - Keep the sprayer nozzle at least six inches from the coil.
   - Sprayer pressure must not exceed 600 psi.

CAUTION: Do not spray motors or other electrical components. Moisture can cause component failure.

8. Spray the leaving air side of the coil first, then spray the entering air side of the coil. Allow the detergent-and-water solution to stand on the coil for five minutes.
9. Rinse both sides of the coil with cool, clean water.
10. Inspect the coil. If it still appears to be dirty, repeat Steps 8 and 9.
11. Replace all unit panels and parts, and restore electrical power to the unit.
12. Remove protective covers installed in Step 3.

CONTROL TESTING

The following procedures can be used to check the operation of the high and low pressure controls. To determine operating pressures, attach gauges to the compressor suction and discharge access ports.

High Pressure Control

WARNING: BEFORE DISCONNECTING ANY WIRING, OPEN THE UNIT DISCONNECT SWITCH. FAILURE TO DO SO MAY RESULT IN SERIOUS PERSONAL INJURY OR DEATH CAUSED BY ACCIDENTAL ELECTRIC SHOCK.

1. Open the unit electrical disconnect switch.
2. Disconnect the condenser fan motor leads at the condenser fan relays. This will de-energize the condenser fans.
3. Remove the reset relay controlling compressor number two from its socket to prevent compressor number two from starting while checking the high pressure control for compressor number one.
4. Close the unit disconnect switch and start the unit.

CAUTION: Be prepared to open the unit disconnect switch immediately if the compressor continues to run after the discharge pressure exceeds the high pressure control cut-out range. Failure to do so could damage the system.

5. Observe the rising discharge pressure. When the pressure reaches 405 ± 10 psig, as shown in Table 9, the compressor should shut-off. If the pressure reaches 415 psig without the high pressure control contacts opening, immediately open the unit disconnect switch. Check to make sure that the high pressure control attached to liquid line number one is wired to low voltage circuit number one. If this is not a problem, replace the faulty high pressure control.
6. On RAUB 40, 50 and 60-ton units, repeat steps 1 through 5 to test the high pressure control in the second compressor circuit. Replace the reset relay for compressor number two and then remove the reset relay controlling compressor number one. This will prevent compressor number one from operating while checking the operation of the high pressure control for compressor number two.
7. Open the unit disconnect switch.
8. Reconnect the wires removed in Step 2.
9. Allow the discharge pressure(s) to drop below the cut-in setting in Table 9 and then close the unit disconnect switch. This will close the reset relay that locked out the compressor contactor when the high pressure control tripped.
10. The unit should start. If not, allow the discharge pressure to decrease further and repeat Step 9.

Low Pressure Control

To check the operation of the control, simply observe the control cut-out pressure during a normal pump-down sequence. If the control fails to function at the cut-out pressure, replace the control with a new control.

EVACUATION PROCEDURES

For field evacuation, use a rotary-style vacuum pump capable of pulling a vacuum of 100 microns or less.

When hooking the vacuum pump to a refrigeration system, it is important to manifold the pump to both the high and low side of the system (liquid line access valve and compressor suction access valve). Follow the pump manufacturer's directions as to the proper methods of using the vacuum pump.

CAUTION: Do not, under any circumstances, use a megohm meter or apply power to the windings of a compressor while it is under a deep vacuum. In the rarified atmosphere of a vacuum, the motor windings can be damaged.

The lines used to connect the pump to the system should be copper and of the largest diameter that can practically be used. Using larger line sizes with minimum flow resistance can significantly reduce evacuation time. Rubber or synthetic hoses are not recommended for unit evacuation because they have moisture absorbing characteristics which result in excessive rates of outgassing and pressure rise during the standing vacuum test. This makes it impossible to determine if the unit has a leak, excessive residual moisture, or a continual or high rate of pressure increase due to the hoses.

An electronic micron vacuum gauge should be installed in the common line ahead of the vacuum pump shutoff valve, as shown in Figure 42. Close Valves B and C, and open Valve A. After several minutes, the gauge reading will indicate the minimum blank-off pressure the pump is capable of pulling. Rotary pumps should produce vacuums of less than 100 microns.

Open Valves B and C. Evacuate the system to a pressure of 500 microns or less. Once 500 microns or less is obtained, with Valve A closed, a time versus pressure rise should be performed. The maximum allowable rise over a 15 minute period is 200 microns. If the pressure rise is greater than 200 microns but levels off to a constant value, excessive moisture is present. If the pressure steadily continues to rise, a leak is indicated. Figure 43 illustrates three possible results of the time versus temperature rise check.

LEAK TESTING

When leak testing the unit, the following safety precautions must be observed:

WARNING: DO NOT WORK IN A CLOSED AREA WHERE REFRIGERANT OR NITROGEN MAY BE LEAKING. A SUFFICIENT QUANTITY OF VAPORS MAY BE PRESENT TO CAUSE PERSONAL INJURY. PROVIDE ADEQUATE VENTILATION.

WARNING: DO NOT USE OXYGEN, ACETYLENE, OR AIR IN PLACE OF REFRIGERANT AND DRY NITROGEN FOR LEAK TESTING. A VIOLENT EXPLOSION WILL RESULT WHICH COULD CAUSE SERIOUS INJURY OR DEATH.

WARNING: ALWAYS USE A PRESSURE REGULATOR, VALVES, AND GAUGES TO CONTROL DRUM AND LINE PRESSURES WHEN PRESSURE TESTING THE SYSTEM. EXCESSIVE PRESSURES MAY CAUSE LINE RUPTURES, EQUIPMENT DAMAGE, OR AN EXPLOSION WHICH COULD RESULT IN PERSONAL INJURY OR DEATH.

Leak test the liquid line, evaporator, and suction line at pressures dictated by local codes.

CAUTION: Do not exceed 200 psig when leak testing the system.

1. Charge enough refrigerant into the system to raise the pressure to 100 psig.
2. Use a halogen leak detector or halide torch to check for leaks. Be thorough in this test, checking the interconnecting piping joints, the evaporator unit, and the condensing unit.
3. If a leak is found during the testing, release the test pressure, break the connection, and remake it as a new joint. Refer to the "Brazing Procedures" in this section of the manual for proper brazing techniques.

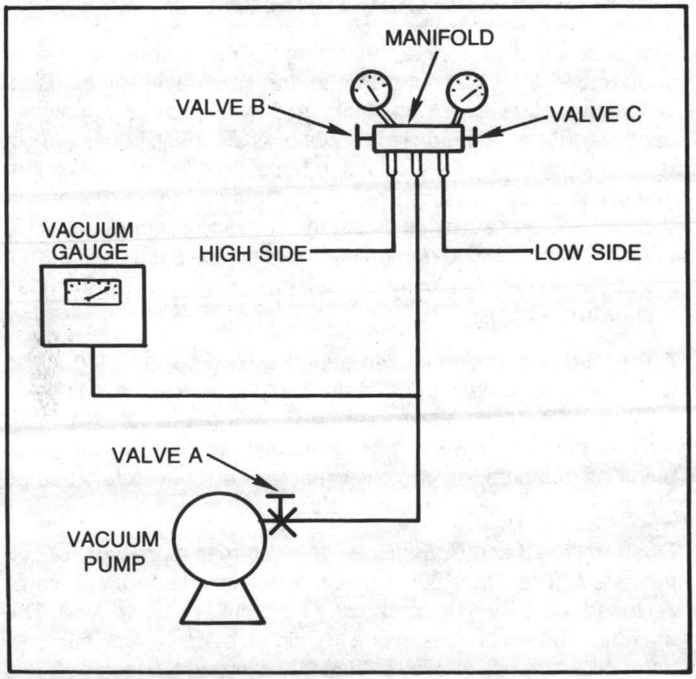


FIGURE 42 - Vacuum Pump Hook-up

4. If no leak is found, use nitrogen to increase the test pressure to 150 psig, and repeat the leak test. Soap bubbles should be used to check for leaks when nitrogen is added. If a leak is found after increasing the pressure to 150 psig using nitrogen, release the pressure and repair the leak.
5. Retest the system to make sure the new connection is solid.
6. If a leak is suspected after the system has been fully charged with refrigerant, use a halogen leak detector, halide torch, or soap bubbles to check for leaks.

BRAZING PROCEDURES

Proper brazing techniques are essential when installing refrigerant piping. The following factors should be kept in mind when forming sweat connections.

1. When copper is heated in the presence of air, copper oxide forms. To prevent copper oxide from forming inside the tubing during brazing, sweep an inert gas, such as dry nitrogen, through the tubing. Nitrogen displaces air in the tubing and prevents oxidation of the interior surfaces. A nitrogen flow of one to three cubic feet per minute is sufficient to displace the air. Use a pressure regulating valve or flow meter to control the flow.
2. Ensure that the tubing surfaces to be brazed are clean, and that the ends of the tubes have been carefully reamed to remove any burrs.
3. Make sure the inner and outer tubes of the joint are symmetrical and have a close clearance, providing an easy slip fit. If the joint is too loose, the tensile strength of the connection will be significantly reduced. The overlap distance should be equal to the diameter of the inner tube.
4. Wrap the body of each refrigerant line component with a wet cloth to keep it cool during brazing. Also move line insulation and tube grommets away from the joints. Excessive heat can damage these components.
5. If flux is used, apply it sparingly to the joint. Excess flux will contaminate the refrigerant system.
6. Apply heat evenly over the length and circumference of the joint. The entire joint should become hot enough to melt the brazing material.
7. Begin brazing when the joint is hot enough to melt the brazing rod. The hot copper tubing, not the flame, should melt the rod.
8. Continue to apply heat around the circumference of the joint until the brazing material is drawn into the joint by capillary action, making a mechanically sound and gas-tight connection. Remove the brazing rod as soon as a complete fillet is formed to avoid possible restriction in the line.
9. Visually inspect the connection after brazing to locate any pin holes or crevices in the joint. The use of a mirror may be required, depending on joint location.

REFRIGERANT CHARGING

Once the system is properly installed, leak tested and evacuated, refrigerant charging should begin. Liquid refrigerant is charged into the system through the liquid line access valve.

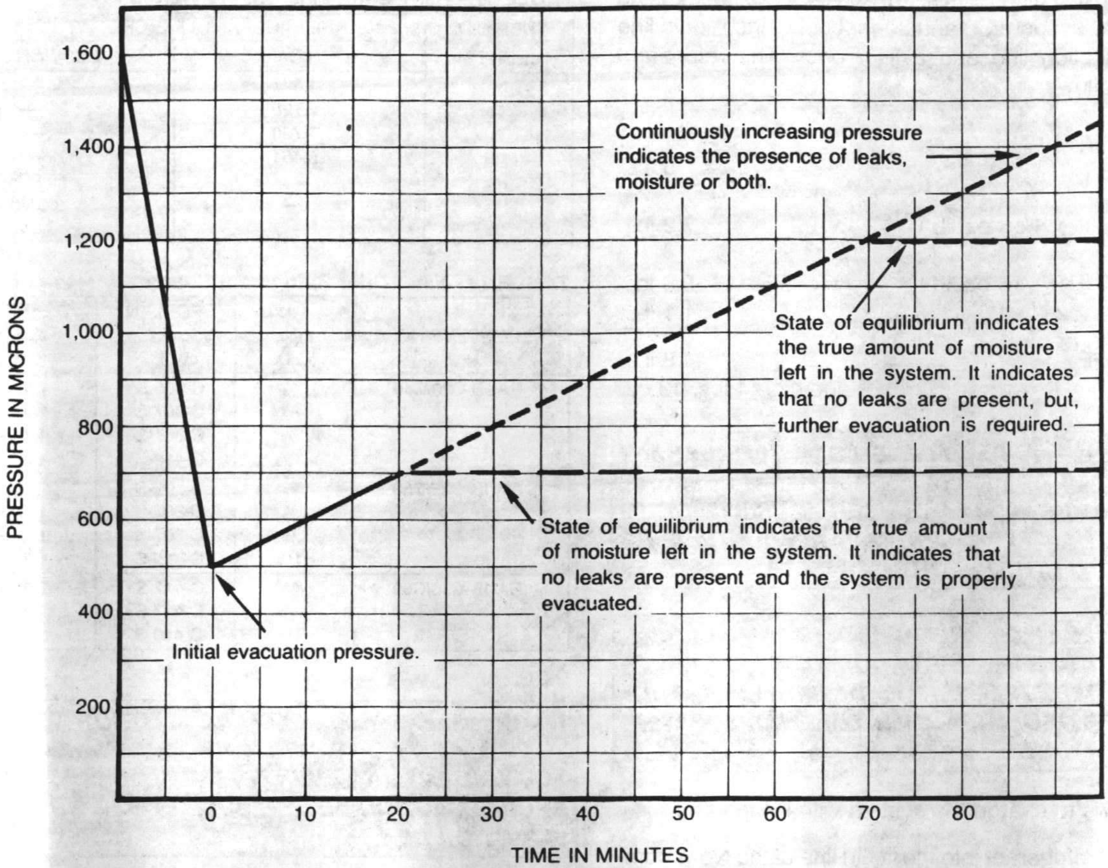


FIGURE 43 - Time Vs. Pressure Rise After Evacuation

Refrigerant should be charged into the system by weight. Use an accurate scale or a charging cylinder to determine the exact weight of the refrigerant entering the system. Failure to use either a scale or charging cylinder can lead to under-charging or over-charging, resulting in unreliable operation.

The weights of refrigerant required for the evaporator unit and the condensing unit are given in Table 11. The weight of refrigerant required for the system piping can be determined by measuring the refrigerant lines and using the data in Tables 12 and 13. The total system operating charge is calculated by adding the charge weight requirements of each part of the system. Refer to the following example.

TABLE 11 - Operating Unit Refrigerant Charge Weight

CONDENSING UNIT			EVAPORATOR		
MODEL NUMBER	R-22 CHARGE LBS./CIRC.	R-22 CHARGE TOTAL, LBS.	MODEL NUMBER	R-22 CHARGE LBS./CIRC.	R-22 CHARGE TOTAL, LBS.
RAUB-C20	28 lbs.	28 lbs.	BRCB-C20	4 lbs.	4 lbs.
			BRCB-C25	5 lbs.	5 lbs.
RAUB-C25	31 lbs.	31 lbs.	BRCB-C25	5 lbs.	5 lbs.
			BRCB-C30	6 lbs.	6 lbs.
RAUB-C30	40 lbs.	40 lbs.	BRCB-C30	6 lbs.	6 lbs.
			BRCB-C40*	8 lbs.	6 lbs.
RAUB-C40	29 lbs.	58 lbs.	BRCB-C40	4 lbs.	8 lbs.
			BRCB-C50	5 lbs.	10 lbs.
			(2) BRCB-C20	4 lbs.	8 lbs.
			(2) BRCB-C25	5 lbs.	10 lbs.
RAUB-C50	31 lbs.	62 lbs.	BRCB-C50	5 lbs.	10 lbs.
			(2) BRCB-C25	5 lbs.	10 lbs.
			(2) BRCB-C30	6 lbs.	12 lbs.
RAUB-C60	40 lbs.	80 lbs.	(2) BRCB-C30	6 lbs.	12 lbs.
			(2) BRCB-C40	8 lbs.	16 lbs.

* Tee together as one circuit.

EXAMPLE: The installation consists of an RAUB 25 condensing unit, a BRCB 2500 evaporator, and 30-feet of 7/8-inch liquid line and 1-5/8-inch suction line and a filter drier. The refrigerant charges are as follows:

RAUB 25	= 31 lbs.
BRCB 2500	= 5 lbs.
Liquid line (3.79 oz./ft. x 30 ft. x 1/16 oz./lb.)	= 7.2 lbs.
Suction Line (.288 oz./ft. x 30 ft. x 1/16 oz./lb.)	= 0.5 lbs.
Filter Drier	= 1.1 lbs.
TOTAL CHARGE	44.8 lbs. or approx. 44 lbs.-13 oz.

WARNING: DO NOT APPLY FLAME TO A REFRIGERANT DRUM IN AN ATTEMPT TO INCREASE THE DRUM PRESSURE. UNCONTROLLED HEAT MAY CAUSE EXCESSIVE DRUM PRESSURES AND AN EXPLOSION MAY RESULT CAUSING SERIOUS PERSONAL INJURY OR DEATH.

WARNING: SHOULD LIQUID REFRIGERANT COME IN CONTACT WITH THE SKIN, THE INJURY SHOULD BE TREATED AS IF THE SKIN HAS BEEN FROSTBITTEN OR FROZEN. SLOWLY WARM THE AFFECTED AREA WITH LUKEWARM WATER. SEEK MEDICAL ATTENTION.

Proceed as follows to charge the system with refrigerant.

1. Charge liquid refrigerant into the liquid line of the No. 1 compressor circuit, using the liquid line access valve. The vacuum within the system will draw most of the required refrigerant into the system. If the pressure within the system equalizes with the pressure in the charging cylinder before the required charge has been drawn in, proceed to Step 2.

NOTE: *On 40, 50 and 60-ton units, this charging process must be repeated for compressor circuit Number 2.*

2. If the system cannot be completely charged by liquid refrigerant entering the system liquid line as outlined in Step 1, complete the process by charging gaseous refrigerant into the suction line. Proceed as follows:

   a. Close the liquid line valve on the manifold gauge set.

   b. Connect the manifold gauge set to the suction and discharge access valves (shown in Figure 44). The manifold valves should be closed.

   c. Start the unit by following the procedures outlined in the SYSTEM START-UP section of this manual.

   d. With the condensing unit operating, slowly open the suction line valve on the manifold gauge set. The remainder of the refrigerant will be drawn into the system.

CAUTION: Do not allow liquid refrigerant to enter the suction line. Excessive liquid will damage the compressor.

CHECKING REFRIGERANT CHARGE

Before taking measurements to determine if the system is correctly charged with refrigerant, verify that all other aspects of the system operation are proper. The following conditions must be checked and satisfied.

TABLE 12 - Refrigerant Line Charge Weight

TUBE O.D. (INCHES)	REFRIGERANT LINE CHG. WT. (Oz/Ft) LIQUID LINE	SUCTION LINE
⅝	1.827	—
¾	2.728	—
⅞	3.790	—
1⅛	6.461	—
1⅜	—	0.203
1⅝	—	0.288
2⅛	—	0.500

TABLE 13 - Filter Drier Refrigerant Charge

CONDENSING UNIT	LIQUID LINE O.D.	SPORLAN PART NO.	REFRIGERANT CHARGE OUNCES
RAUB-C20/C40	⅝	C-305-S	1 lb. - 1 oz.
	¾	C-307-S	1 lb. - 1 oz.
	⅞	C-307-S	1 lb. - 1 oz.
	1⅛	C-419-S	1 lb. - 8 oz.
RAUB-C25/C50	⅝	C-305-S	1 lb. - 1 oz.
	¾	C-307-S	1 lb. - 1 oz.
	⅞	C-307-S	1 lb. - 1 oz.
	1⅛	C-419-S	1 lb. - 8 oz.
RAUB-C30/C60	¾	C-417-S	1 lb. - 8 oz.
	⅞	C-417-S	1 lb. - 8 oz.
	1⅛	C-419-S	1 lb. - 8 oz.

WARNING: EXERCISE EXTREME CAUTION WHEN CHECKING ROTATION OF CONDENSER AND EVAPORATOR FANS TO AVOID ENTANGLEMENT IN FAN BLADES. FAILURE TO EXERCISE CAUTION MAY RESULT IN SERIOUS PERSONAL INJURY OR DEATH.

1. Check the evaporator and condenser fans to ensure that they are rotating in the proper direction, that the fan blades do not have dirt buildup, and that each fan is turning at the proper RPM. Make sure that the evaporator fan RPM is correct for the airflow desired and for the external static pressure being imposed by the duct system.

2. Make sure the evaporator air filters are clean.

3. Check the evaporator and condenser coils to ensure that they are clean, that the fins are straight, and that there are no obstructions to airflow.

4. Measure the suction line superheat and adjust the expansion valve, if necessary. (Refer to "Measuring Superheat" in the MAINTENANCE PROCEDURES section of this manual.) The expansion valve superheat setting must be between 12 and 16 F.

Visually inspect the liquid line sight glass to see if clear liquid is present. Bubbles in the liquid line sight glass indicate either low refrigerant charge, excess liquid line pressure drop, or excess liquid line heat gain.

CAUTION: A clear sight glass does NOT necessarily mean the system has sufficient refrigerant.

After verifying that the system is operating properly, determine if the refrigerant charge is correct. This is accomplished by checking both system operating pressures **and** subcooling leaving the condensing unit.

CAUTION: It is not sufficient to check only operating pressures or only subcooling. Both must be in the acceptable range in order to establish correct system charge.

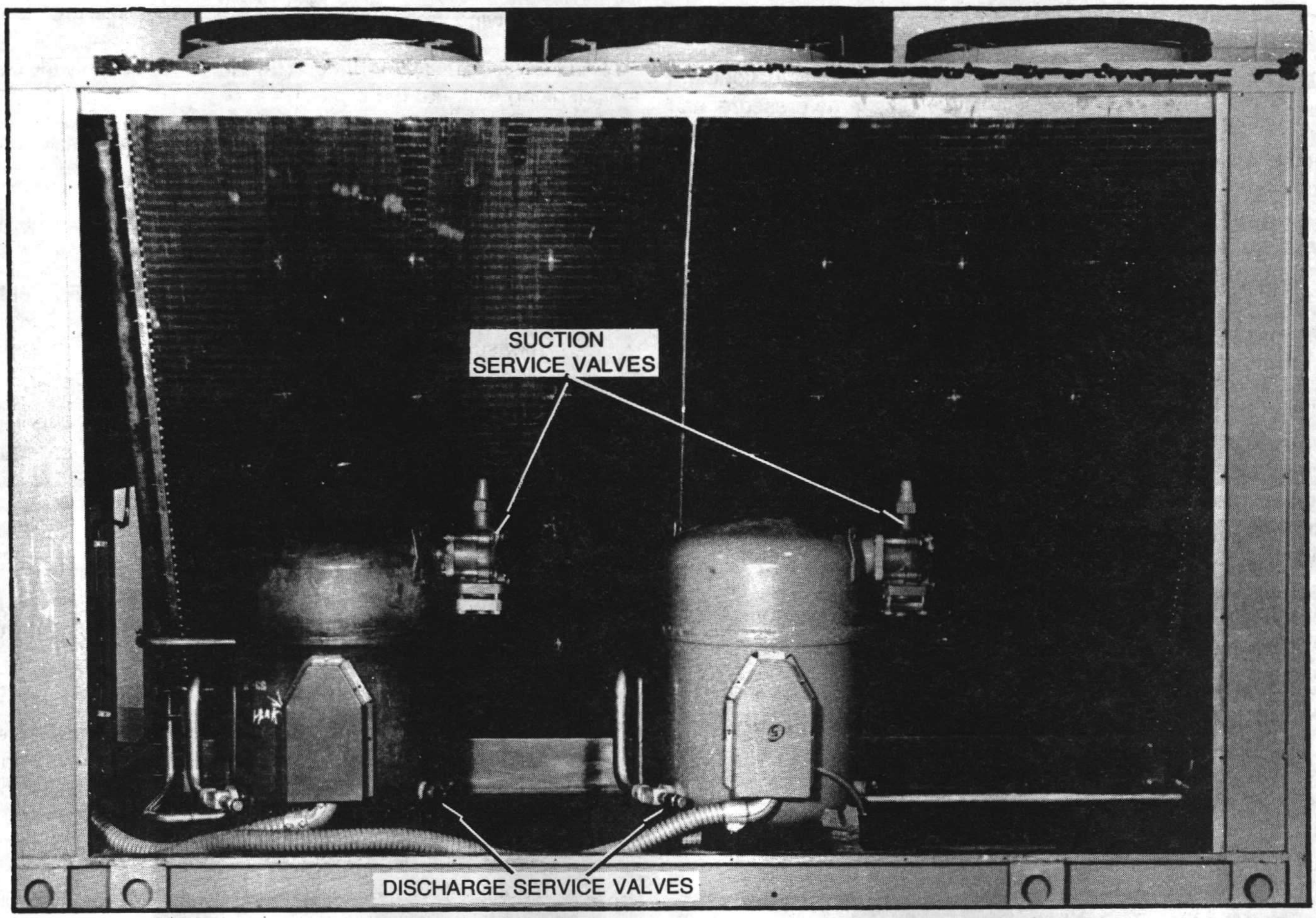


FIGURE 44 - Compressor Access Valves

Operating Pressures:

Measure the suction and discharge line pressures and compare these readings with the normal operating pressures listed in Figures 45 through 50 and Tables 14, 15 and 16. Refer to "Operating Pressures" in the MAINTENANCE PROCEDURES section of this manual. Figure 44 illustrates suction and discharge service valves.

Subcooling:

Determine the system subcooling. (Refer to "Measuring Subcooling" in the MAINTENANCE PROCEDURES section of this manual.) If the system is properly charged, subcooling at the liquid line access valve should be 14 to 19 F.

The system is low on refrigerant if: 1) the suction and discharge pressures are lower than the normal operating pressures as determined from Figures 45 through 50 and Tables 14, 15, and 16, 2) liquid subcooling is low (less than 14-19 F).

The system is overcharged with refrigerant if: 1) the suction and discharge pressures are higher than normal operating pressures, **and** 2) liquid subcooling is high (greater than 14-19 F).

CAUTION: If both the suction and discharge pressures are low but subcooling is in the acceptable range, the system has a problem other than a shortage of refrigerant. Do not add refrigerant. Refer to the TROUBLESHOOTING section of this manual.

Adding Refrigerant:

Use the suction line access valve to add refrigerant to a system with a low charge, making sure that only refrigerant vapor enters the suction line. Continue to add refrigerant until the subcooling is between 14 and 19 F. At this point, the operating pressures should be within the limits defined by Figures 45 through 50 and Tables 14 through 16.

Removing Refrigerant:

If the system is overcharged, some refrigerant must be removed to lower the subcooling to the 14-19 F range. Refrigerant should be discharged from the system slowly to keep oil loss at a minimum. The liquid line access valve can be depressed to remove refrigerant. However, refrigerant should not be discharged into the atmosphere.

CAUTION: Do not allow refrigerant to come in contact with the skin. If this occurs, the injury should be treated as if the skin has been frostbitten or frozen. Slowly warm the affected area with lukewarm water.

OPERATING PRESSURES

Operating pressure data can be used to determine if the system is operating properly. System malfunctions — such as low airflow, line restrictions, incorrect refrigerant charge, malfunctioning expansion valve, damaged compressor, and so on — will result in pressure variations which are outside the normal range. If the condensing unit and evaporator are checked individually, as described below, the operating pressures can be used to determine which side of the system (high side or low side) is malfunctioning. In addition, the relationship of suction vs. discharge pressure, as well as whether these pressures are higher or lower than expected, will provide valuable clues for determining the specific problem(s).

CAUTION: Operating pressure data, by itself, cannot be used to accurately charge system. Charging by weight is preferred. If this is not feasible, a combination of operating pressures and subcooling measurement is necessary to properly charge the system. Refer to "Checking Refrigerant Charge" in the MAINTENANCE section of this manual.

Unfortunately, many application variables exist which affect operating pressures. These include indoor dry bulb and wet bulb temperature, outside dry bulb temperature, suction line pressure drop, and evaporator airflow. Since these variables can give misleading results, it is not recommended that operating pressures be used as the sole check of system operation. Further, the following conditions must be satisfied before checking system operating pressures.

1. The outdoor ambient temperature must be between 65 and 105 F. At ambient temperatures outside of this range, meaningful operating pressures cannot be measured.
2. The relative humidity of the air entering the evaporator must be above 40 percent. If it is less than 40 percent, meaningful operating pressures cannot be measured.
3. All compressors must be operating fully loaded. Set the thermostat as necessary to accomplish this.
4. **All** condenser fans must be operating. If necessary, jumper the fan pressure switches. Be sure to remove the jumpers when measurements are completed.
5. Do not take measurements with the low ambient dampers and/or hot gas bypass operating. Disconnect the low ambient dampers and de-energize the hot gas bypass before taking measurements. Be sure to reconnect low ambient dampers/hot gas bypass after taking measurements.

Use the following steps to check operating pressures.

1. Condensing unit performance (this is a check of only the condensing unit, not the system).
   a. Measure pressures (psig) at the suction and discharge line access valves next to the compressor.
   b. Measure the dry bulb air temperature (F) entering the condenser coil.
   c. If the outside ambient is between 65 and 105 F, enter the appropriate graph in Figures 45 through 50 at the measured suction pressure and condenser ambient. Read the corresponding discharge pressure.
   d. The measured discharge pressure should be within ±7 psig of the graph pressure. If the difference is greater than ±7 psig, refer to the TROUBLESHOOTING section of this manual.
2. Evaporator Performance:
   a. Measure the actual wet bulb temperature (F) of the air entering the evaporator. Be sure to measure the mixed air condition if outside air is being ducted in.
   b. Find the correct combination of condensing unit and evaporator from Table 14. Match the condenser entering air temperature (measured in Step 1) with the evaporator wet bulb temperature (measured in Step 2) to determine the correct suction pressure.
   c. Use Table 15 to correct the suction pressure (from Table 14) for the line sizes used in your installation.
   d. Use Table 16 to correct the suction pressure (from Step 2) for the airflow of your evaporator.
   e. The measured suction pressure at the compressor should be within ±2 psi of the corrected pressure from Tables 14 through 16. If not, improper **system** operation is indicated. Refer to the TROUBLESHOOTING section of this manual.

CAUTION: Table 14 is not accurate if the relative humidity of the entering evaporator air is less than 40%, or if an evaporator/condensing unit other than those listed is used.

TABLE 14 - Compressor Suction Pressures (PSIG)

CONDENSING UNIT	EVAPORATOR	EVAP. AIRFLOW (SCFM)	CONDENSER AMBIENT, F: 65 WET BULB, F: 55			75 WET BULB, F: 55			85 WET BULB, F: 55			95 WET BULB, F: 55			105 WET BULB, F: 55		
			55	60	65	55	64	72	55	65	75	55	65	75	55	65	75
			COMPRESSOR SUCTION PRESSURES, PSIG														
RAUB-C20	BRCB-C20	8,000	48.1	53.3	58.9	50.2	60.1	70.0	52.2	63.6	76.7	54.1	65.8	79.3	56.0	68.0	81.8
	BRCB-C25	10,000	51.6	57.4	63.7	53.5	64.5	75.6	55.4	67.9	82.5	57.2	70.0	84.8	58.9	72.0	87.1
RAUB-C25	BRCB-C25	10,000	50.2	55.6	61.4	51.7	61.9	72.1	53.4	65.1	78.4	55.3	67.2	80.8	57.4	69.6	83.5
	BRCB-C30	12,000	53.9	59.6	65.7	55.3	66.1	76.8	56.9	69.2	83.2	58.7	71.2	85.5	60.6	73.4	87.9
RAUB-C30	BRCB-C30	12,000	50.3	55.7	61.5	51.9	62.1	72.4	53.6	65.3	78.7	55.4	67.3	81.0	57.2	69.4	83.4
	BRCB-C40	16,000	55.2	61.4	67.7	56.6	68.1	79.4	58.2	71.2	86.0	59.8	73.0	88.0	61.4	74.9	90.1
RAUB-C40	BRCB-C40	16,000	48.5	53.7	59.3	50.5	60.5	70.5	52.5	64.0	77.2	54.5	66.2	79.7	56.3	68.4	82.3
	BRCB-C50	20,000	52.4	58.1	64.2	54.4	65.1	75.9	56.3	68.5	82.7	58.1	70.7	85.1	59.8	72.7	87.4
	BRCB-C20(2)	16,000	48.0	53.2	58.8	50.1	60.0	69.9	52.1	63.5	76.5	54.1	65.7	79.1	55.9	67.9	81.7
	BRCB-C25(2)	20,000	51.5	57.3	63.5	53.4	64.4	75.4	55.3	67.8	82.3	57.1	69.9	84.7	58.9	71.9	87.0
RAUB-C50	BRCB-C50	20,000	50.7	55.9	61.5	52.2	62.1	72.0	53.9	65.2	78.2	55.9	67.4	80.7	58.1	69.9	83.4
	BRCB-C25(2)	20,000	50.3	55.7	61.5	51.8	62.0	72.3	53.5	65.2	78.6	55.4	67.4	81.0	57.5	69.8	83.7
	BRCB-C30(2)	24,000	54.0	59.7	65.8	55.4	66.2	77.0	57.0	69.3	83.4	58.8	71.4	85.7	60.8	73.6	88.2
RAUB-C60	BRCB-C30(2)	24,000	50.3	55.7	61.6	52.0	62.2	72.5	53.7	65.4	78.9	55.5	67.5	81.2	57.3	69.6	83.6
	BRCB-C40(2)	32,000	55.2	61.3	67.8	56.7	68.2	79.6	58.3	71.3	86.1	59.9	73.2	88.2	61.5	75.1	90.3

NOTES:
1. Table only good for relative humidity of air entering evaporator greater than 40%.
2. Interpolation between wet bulb temperatures is allowable. Do not extrapolate outside range given.

TABLE 15 - Suction Pressure Correction for Line Size (PSI)

CONDENSING UNIT	1⅜" O.D. SUCTION LINE LENGTH, FEET								
	0*	25	50	75	100	125	150	175	200
RAUB-C20	-1.1	-2.5	-3.7	-4.9	-6.0	-7.0	-7.9	-8.8	-9.7
RAUB-C40	-1.1	-2.5	-3.8	-4.9	-6.0	-7.0	-8.0	-8.9	-9.7
CONDENSING UNIT	**1⅝" O.D. SUCTION LINE LENGTH, FEET**								
	0	25	50	75	100	125	150	175	200
RAUB-C20	+0.7	0	-0.6	-1.3	-1.8	-2.4	-3.0	-3.5	-4.0
RAUB-C25	-1.3	-2.3	-3.2	-4.1	-4.9	-5.7	-6.4	-7.1	-7.8
RAUB-C30	-1.7	-3.0	-4.2	-5.3	-6.3	-7.3	-8.2	-9.0	-9.9
RAUB-C40	+0.7	0	-0.6	-1.2	-1.8	-2.4	-3.0	-3.5	-4.0
RAUB-C50	-1.3	-2.2	-3.1	-3.9	-4.7	-5.4	-6.1	-6.8	-7.4
RAUB-C60	-1.8	-3.1	-4.2	-5.4	-6.4	-7.3	-8.2	-9.1	-9.9
CONDENSING UNIT	**2⅛" O.D. SUCTION LINE LENGTH, FEET**								
	0	25	50	75	100	125	150	175	200
RAUB-C20	+1.8	+1.6	+1.4	+1.2	+1.0	+0.8	+0.7	+0.5	+0.3
RAUB-C25	+0.3	0	-0.2	-0.5	-0.8	-1.1	-1.3	-1.6	-1.8
RAUB-C30	+0.4	0	-0.3	-0.7	-1.1	-1.4	-1.8	-2.1	-2.4
RAUB-C40	+1.8	+1.6	+1.4	+1.2	+1.0	+0.9	+0.7	+0.5	+0.3
RAUB-C50	+0.2	0	-0.3	-0.6	-0.8	-1.1	-1.3	-1.6	-1.8
RAUB-C60	+0.4	0	-0.4	-0.7	-1.1	-1.5	-1.8	-2.2	-2.5

* 0 feet provided for interpolation purposes only.

TABLE 16 - Suction Pressure Correction for Airflow (PSI)

	PERCENT OF RATED EVAPORATOR AIRFLOW								
CONDENSING UNITS	-20%	-15%	-10%	-5%	0%	+5%	+10%	+15%	+20%
RAUB-C20-60	-2.6	-1.9	-1.2	-0.6	0	+0.5	+1.0	+1.4	+1.9

NOTE: PRESSURES GIVEN WITH ALL CONDENSER FANS OPERATING

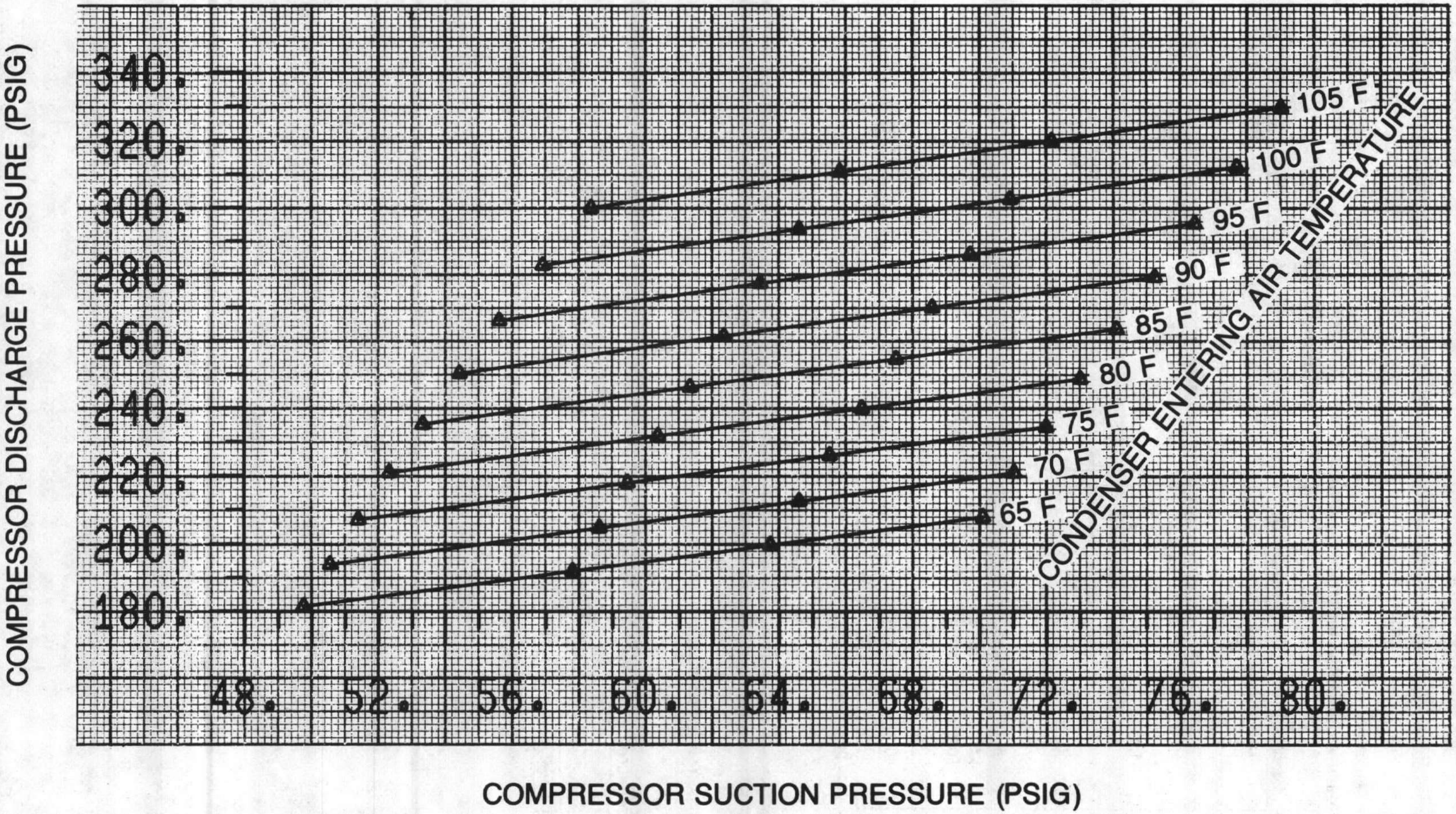


FIGURE 45 - RAUB-C20 Operating Pressures

NOTE: PRESSURES GIVEN WITH ALL CONDENSER FANS OPERATING

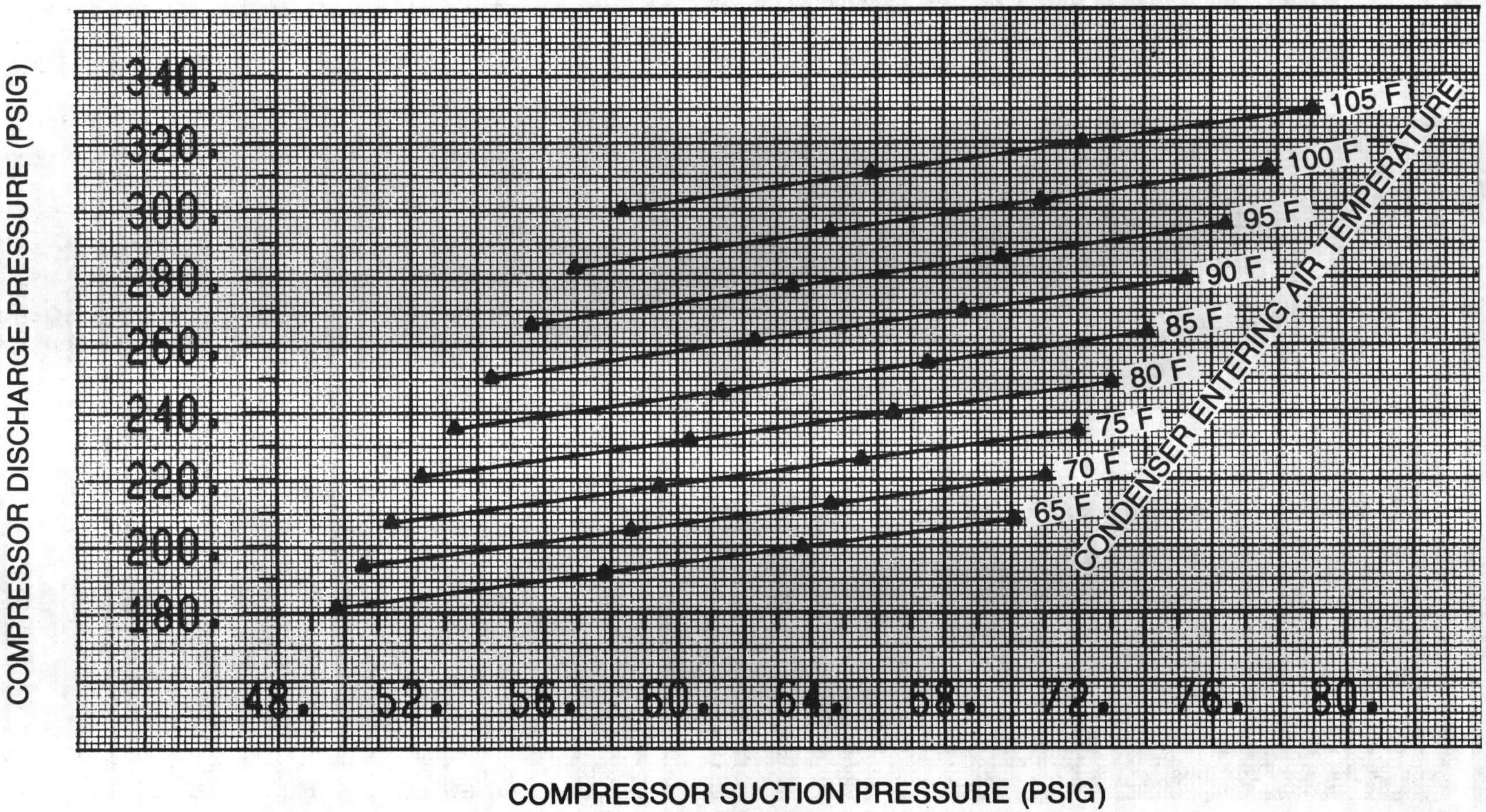


FIGURE 46 - RAUB-C25 Operating Pressures

NOTE: PRESSURES GIVEN WITH ALL CONDENSER FANS OPERATING

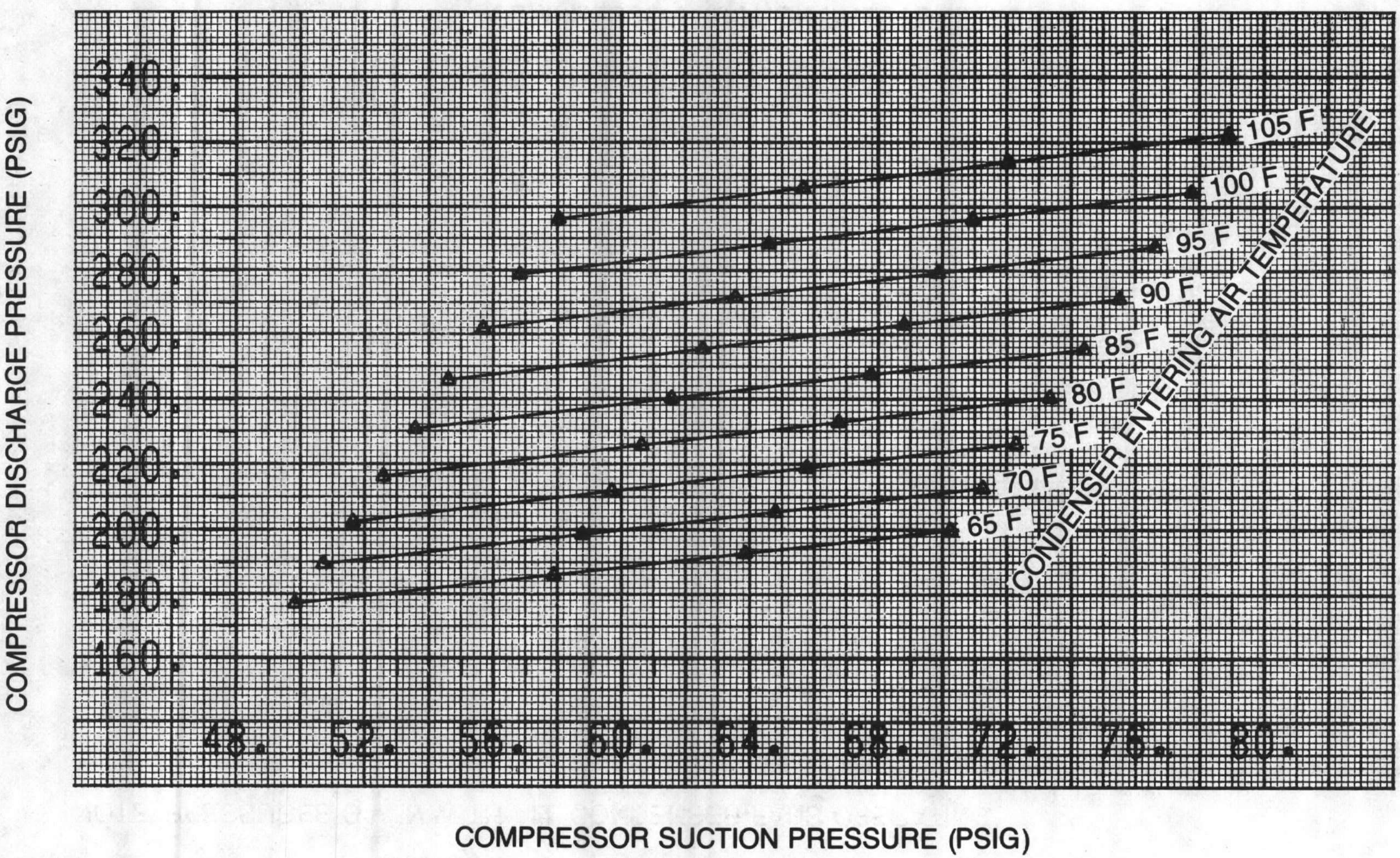


FIGURE 47 - RAUB-C30 Operating Pressures

NOTE: PRESSURES GIVEN WITH ALL CONDENSER FANS OPERATING

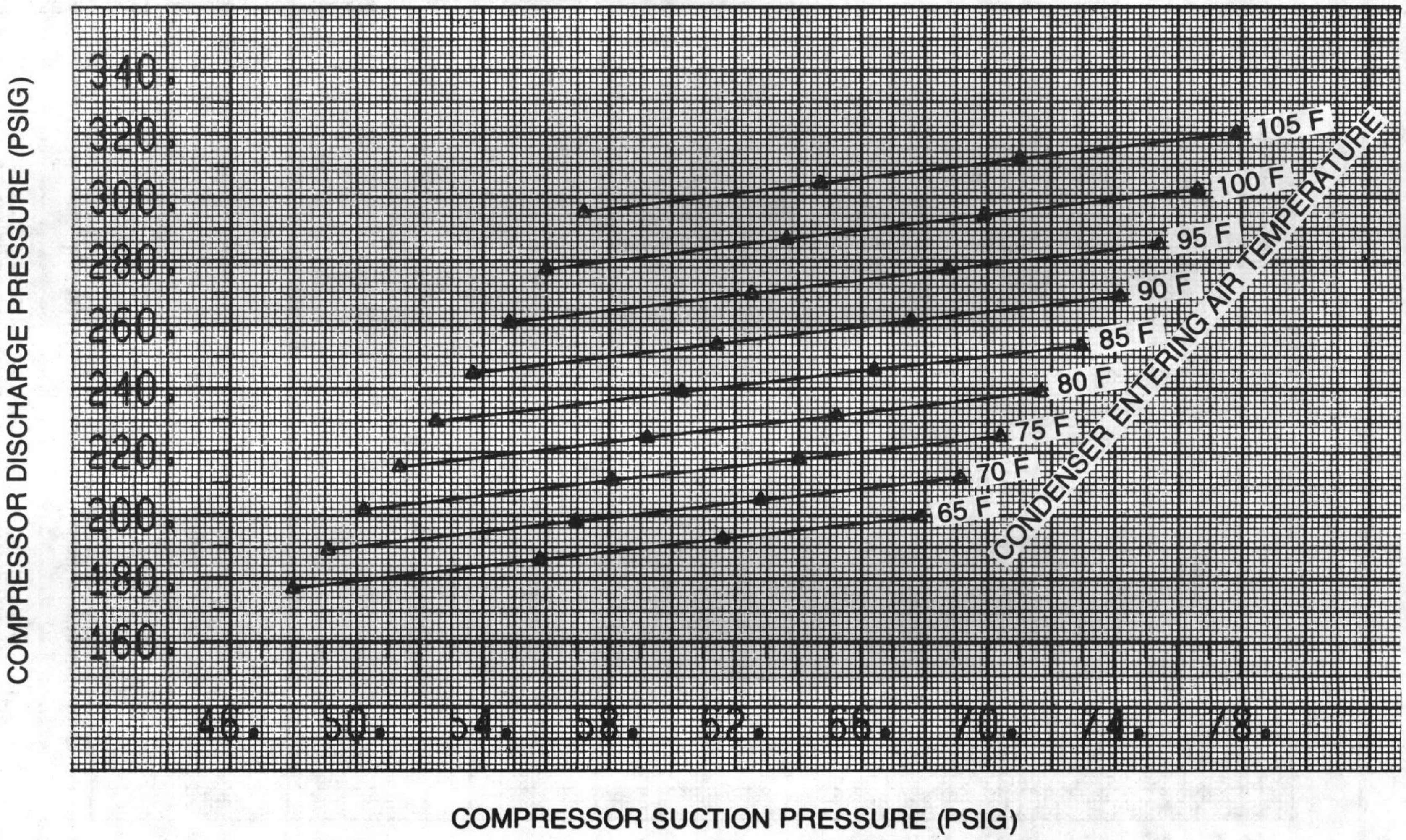


FIGURE 48 - RAUB-C40 Operating Pressures

NOTE: PRESSURES GIVEN WITH ALL CONDENSER FANS OPERATING

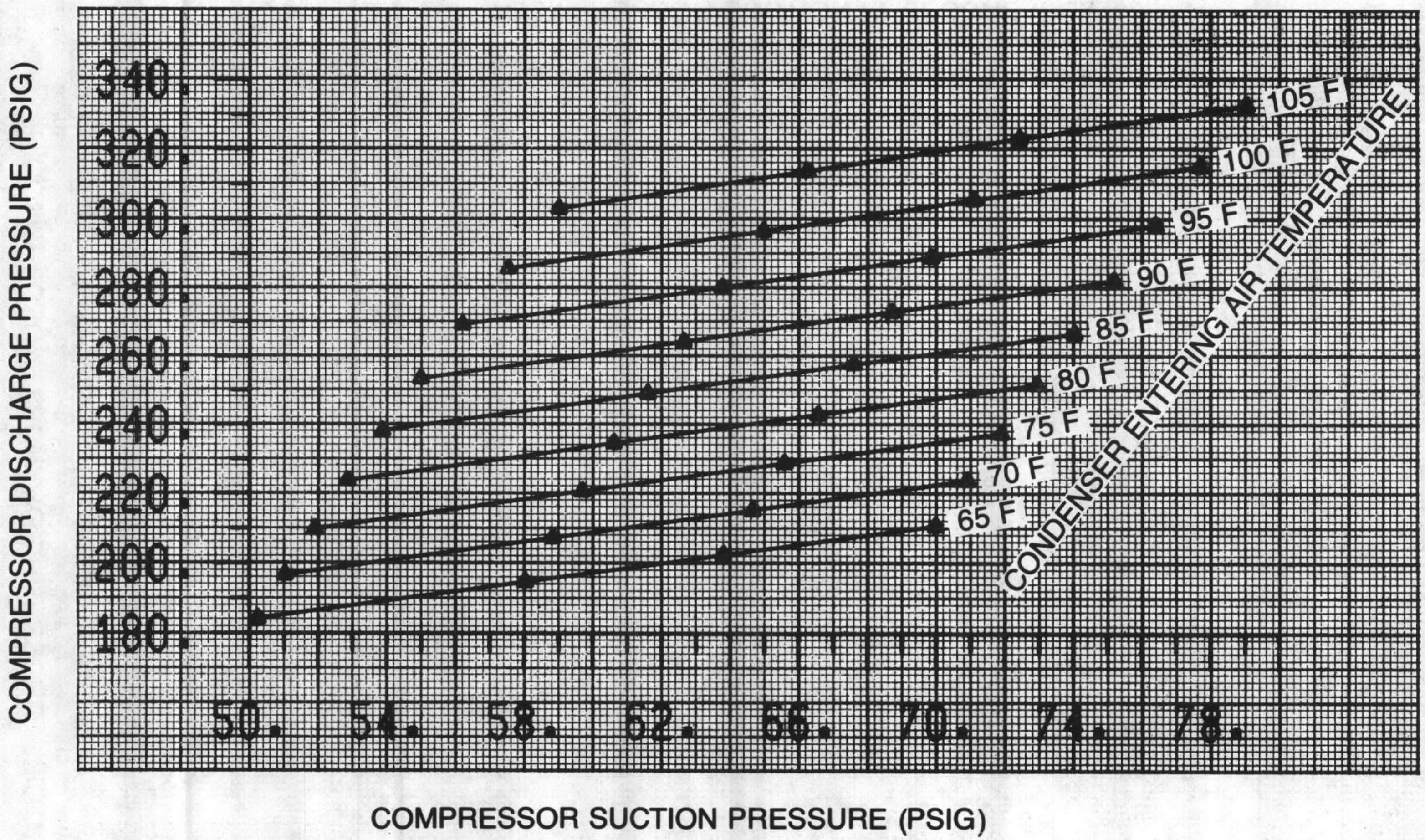


FIGURE 49 - RAUB-C50 Operating Pressures

NOTE: PRESSURES GIVEN WITH ALL CONDENSER FANS OPERATING

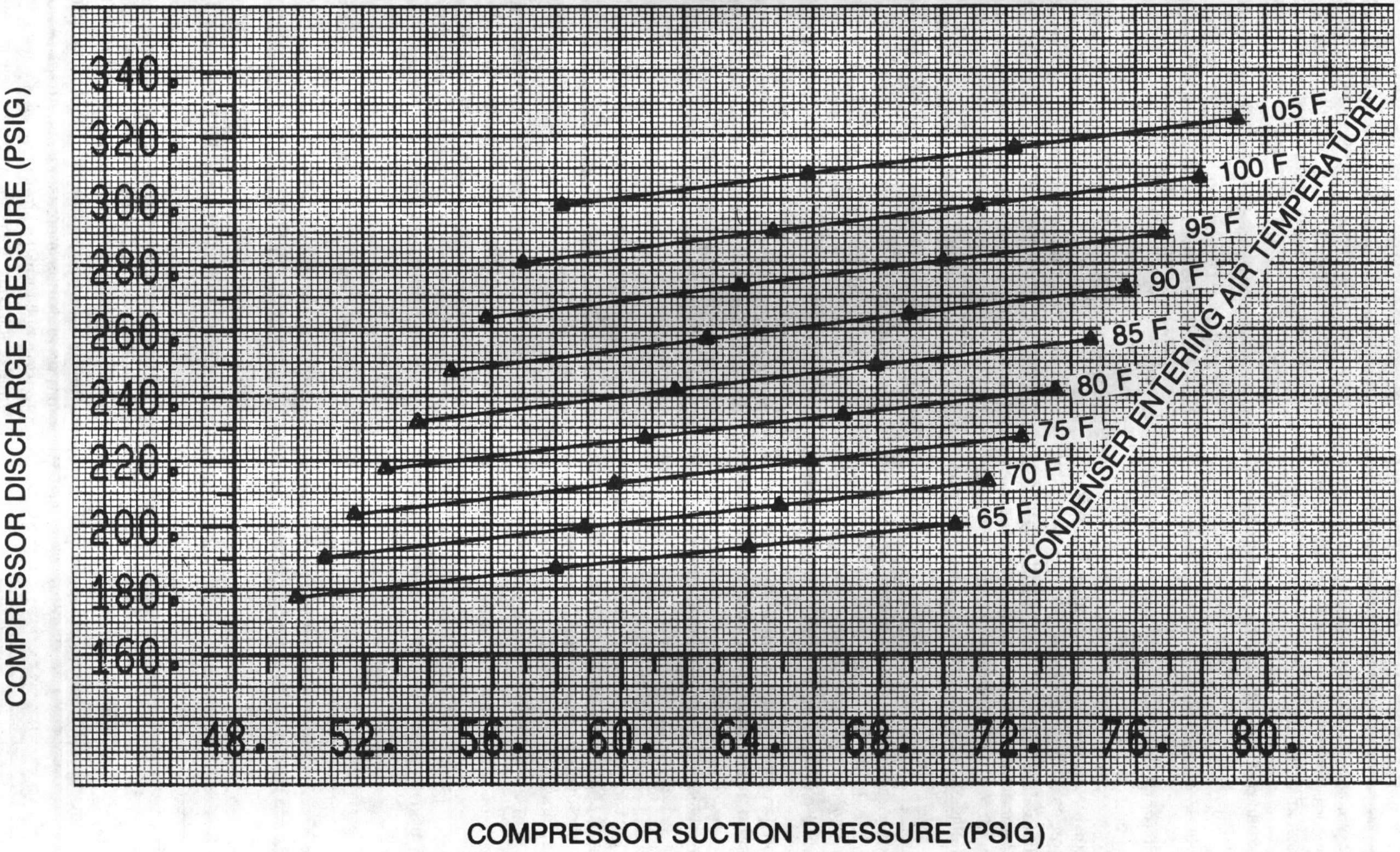


FIGURE 50 - RAUB-C60 Operating Pressures

THERMOSTATIC EXPANSION VALVE ADJUSTMENT AND SUPERHEAT MEASUREMENT

Since the reliability and performance of the refrigeration system is heavily dependent on proper expansion valve adjustment, the importance of proper suction gas superheat cannot be overemphasized. The accurate measurement of suction superheat will provide the following information:

1. How well the expansion valve is controlling the refrigerant flow.
2. The efficiency of the evaporator coil.
3. The amount of protection the compressor is receiving against flooding or overheating.

The safe setting range for suction gas superheat on Trane equipment is 12 to 16 degrees at the evaporator. Settings within this range will allow for measurement error. Superheat of less than 12 degrees can cause refrigerant floodback which could cause serious compressor damage. Superheat greater than 16 degrees can reduce system efficiency by reducing the effective evaporator surface.

CAUTION: When checking the superheat setting, the outdoor ambient must be between 65 and 105 F. Entering evaporator air should be above 40 percent relative humidity and all condenser fans and compressors must be operating fully loaded.

To determine suction gas superheat, the pressure at the outlet of the evaporator must be measured and then converted to saturated vapor temperature by using a Refrigerant-22 pressure/temperature chart. The saturated vapor temperature can then be subtracted from the actual suction temperature which is measured on the suction line close to the expansion valve bulb. The difference between the two temperatures is known as suction gas superheat. On many Trane fan/coil units an access valve is provided close to the expansion valve bulb. This valve must be added on Climate Changers and other evaporators which are not so equipped. To obtain an accurate reading, an access valve close to the expansion valve bulb must be utilized when determining suction gas superheat.

TABLE 17 - Pressure/Temperature Conversions for Calculating Suction Line Superheat

SATURATED TEMPERATURE	PRESSURE USING REFRIGERANT-22
30	54.9
31	56.2
32	57.5
33	58.8
34	60.1
35	61.5
36	62.8
37	64.2
38	65.6
39	67.1
40	68.5
41	70.0
42	71.4
43	73.0
44	74.5
45	76.0
46	77.6
47	79.2
48	80.8
49	82.4
50	84.0

Instruments to Use

1. The gauge used to measure suction pressure should be of the best quality available. Gauges permanently installed on the equipment should not be used. A good quality gauge on a standard refrigerant manifold set is recommended.
2. To measure suction temperature, an electronic temperature tester will be sufficient. Testers manufactured by Robinnaire, Annie, and Thermal are among those available. Glass thermometers do not have sufficient contact area to give accurate readings.

Procedure

1. Cut the suction line insulation to gain access to the suction line. If armaflex is used, it is best to cut around the circumference of the tubing.
2. Clean the line carefully and attach the electronic temperature sensor. Black electrical tape works well when securing the sensor of the temperature tester to the suction line. (Make sure the sensor is making good contact with the tube.)
3. Rejoin the armaflex and seal with plastic tape to prevent sensor contact with ambient air.

NOTE: *For measurement accuracy the temperature sensor* ***must*** *be installed and insulated properly. Make sure the armaflex extends at least six inches on both sides of the sensor location. Seal both ends of the armaflex to keep ambient air from getting under the insulation and affecting the temperature readings.*

4. Install a pressure gauge to monitor suction pressure.
5. Operate the system for approximately 10 to 15 minutes to be sure that the expansion valve has time to stabilize.
6. To measure superheat, compare the saturated vapor temperature of the refrigerant converted from the suction pressure reading (see Table 17) to the actual temperature measured at the line by the electronic tester. Proper suction superheat is 12 to 16 degrees.

EXAMPLE:

Suction Pressure = 66.0 psig
Suction Temperature = 52 F
Suction Pressure converted to Saturated Vapor Temperature (from Table 17) = 38 F
Suction Superheat
= (Actual Line Temp.) - (Saturated Vapor Temp.)
= (52 F) - (38 F)
= 14 F

If initial suction superheat readings fall below 12 degrees, the adjusting stem on the expansion valve should be adjusted clockwise to close the valve, limiting the flow of refrigerant to the evaporator and thus increasing superheat. Adjustment should be made a half turn at a time. Conversely, if the initial suction superheat reading is greater than 16 degrees, the adjusting stem on the expansion valve should be adjusted counterclockwise to open the valve, increasing the flow of refrigerant to the evaporator and thus decreasing superheat. Adjustments should be made until an acceptable reading is obtained. The system should be allowed to restabilize for 10 minutes after each adjustment.

MEASURING SUBCOOLING

1. The outdoor ambient temperature must be between 65 and 105 F. At ambient temperatures outside of this range, meaningful operating pressures cannot be measured.
2. The relative humidity of the air entering the evaporator must be above 40 percent. If it is less than 40%, meaningful operating pressures cannot be measured.
3. All compressors must be operating fully loaded. Set the thermostat as necessary to accomplish this.
4. **All** condenser fans must be operating. If necessary, jumper the fan pressure switches. Be sure to remove the jumpers when measurements are completed.
5. Do not take measurements with the low ambient dampers and/or hot gas bypass operating. Disconnect the low ambient dampers and de-energize the hot gas bypass before taking measurements. Be sure to reconnect low ambient dampers/hot gas bypass after taking measurements.

The proper setting range for liquid subcooling is 14 to 19 F. The compressor must be fully loaded and both compressors must be operating if so equipped. Use these steps to measure subcooling:

1. Measure the liquid line pressure at the liquid line access valve installed inside the condensing unit. Convert this pressure reading to saturated temperature by using a Refrigerant-22 pressure/temperature chart (refer to Table 18).
2. Measure the actual liquid line temperature on the liquid line close to the access valve. To ensure an accurate reading, clean the line thoroughly where the electronic temperature sensor will be attached. Glass thermometers do not have sufficient contact area to give accurate readings. After securing the sensor to the line, wrap the sensor and line with insulation to prevent contact with ambient air.
3. Determine the system subcooling by subtracting the actual liquid line temperature (measured in Step 2) from the saturated liquid temperature (calculated in Step 1).
4. If the system is properly charged, subcooling at the liquid line access valve should be 14-19 F.

COMPRESSOR OIL CHARGE

Proper oil charge is critical for reliable operation of reciprocating compressors. Both undercharging and overcharging will result in compressor damage.

On most applications, the factory oil charge is correct and no addition of oil is required. However, it may be necessary to add oil to systems which have extremely long interconnecting lines.

An oil level sight glass is integral to the compressor shell in order to confirm proper oil charge on all 20 through 60-ton units. The following procedure should be followed:

1. Check the oil level **prior to initial refrigerant charging and start-up** of a new system. To be proper, the oil level must be visible in the sight glass. Note the oil level mark for future reference.
2. Approximately one hour after initial start-up, and after the oil sump is warm to the touch check the oil level with the compressor running **fully loaded.** The oil level must be visible in the sight glass. If it is not visible, add oil until the level is halfway up the sight glass.

TABLE 18 - Pressure/Temperature Conversion for Calculating Liquid Line Subcooling

SATURATED TEMPERATURE	PRESSURE USING REFRIGERANT-22
70	121.4
75	132.2
80	143.6
85	155.7
90	168.4
95	181.8
100	195.9
105	210.8
110	226.4
115	242.7
120	259.9
125	277.9
130	296.8
135	316.6
140	337.2
145	358.9
150	381.5

CAUTION: Do not attempt to check the oil level at part load compressor operation. It is not intended that the oil level be visible in the sight glass under these conditions. Adding oil could result in a compressor overcharge and subsequent compressor damage.

3. Allow the compressor to run at full load until the compressor sump is warm to the touch. If the oil level increases from Step 2, oil should be removed and the process repeated until the sight glass level is maintained at the halfway mark.

CAUTION: Checking oil level with a cold sump can incorrectly indicate excessive oil charge due to refrigerant in the oil.

TROUBLESHOOTING

The Troubleshooting Chart on the following pages is provided to serve as an aid for identifying the cause of any system malfunctions that may occur. The chart is divided into three columns:

- the "SYMPTOM" column describes the behavior the unit is exhibiting;
- the "PROBABLE CAUSE" column identifies possible sources of malfunction;
- the "RECOMMENDED ACTION" column indicates the procedures required to correct the malfunction.

If operating difficulties are encountered, make the following preliminary checks before referring to the Troubleshooting Chart:

- ☐ Check the thermostat to ensure that it is properly set, receiving control power, and "making/breaking" on a call for heating or cooling.
- ☐ Verify that the unit is receiving electrical supply power, and that the fuses are intact.
- ☐ Check the filters to make sure they are positioned properly, and free of dirt and debris.

After completing the checks listed above, inspect the system for other obvious causes of trouble such as broken fan belts, a clogged condenser coil, or restricted air ducts. If everything appears to be in order, but the unit still fails to operate properly, refer to the appropriate section of the Troubleshooting Chart.

NOTE: *The Troubleshooting Chart which follows is provided solely as a guide for determining the cause of mechanical failure or malfunction. When mechanical problems do occur, Trane recommends that trained service personnel be contacted to help ensure proper diagnosis and repair of the unit.*

WARNING: OPEN THE UNIT DISCONNECT SWITCH AND LOCK IT IN THAT POSITION TO PREVENT ACCIDENTAL START-UP. NEVER OPEN AN ACCESS PANEL TO INSPECT OR SERVICE THE UNIT WITHOUT FIRST OPENING THE DISCONNECT SWITCH. FAILURE TO DO SO MAY RESULT IN INJURY OR DEATH FROM ELECTRICAL SHOCK OR CONTACT WITH MOVING PARTS.

TROUBLESHOOTING CHART

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
A. Compressor does not start, and does not hum.	1. No power to unit.	1. Check for the following: a. Disconnect switch open. b. Fuses blown.
	2. No call for cooling.	2. Check for the following: a. Defective thermostat. b. Broken or improper control wiring. c. Blown control power fuse.
	3. Anti-recycle timer has not timed out (if installed).	3. Wait at least five minutes for the anti-recycle timer to time out.
	4. Unit locked out by reset relay.	4. Check for the following: a. Excessive discharge pressure. Refer to Symptom L, "Discharge pressure too high". b. Defective high pressure control. c. Compressor winding stat open. Refer to Low Suction Pressure. d. Defective comp. protector or fuse-check for winding stats shorted to motor windings. e. Defective reset relay contact. f. Comp. current overload open. Refer to Symptom F.
	5. Compressor contactor will not close.	5. Check for the following: a. Defective comp. contactor. b. Improper wiring. c. Reset relay open. d. Low pressure control open. e. Cooling relay not energized. Defective relay-check thermostat circuit. See Symptom A, Cause 2.
	6. Compressor winding stat open.	6. Refer to Symptom F. a. Check compressor amp draw. b. Defective low pressure control - replace.

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
B. Compressor hums, but will not start.	1. Low voltage at the compressor.	1. Check for the following: a. A single blown fuse. b. Low line voltage. c. Defective compressor contactor. d. Loose wiring connections. e. Defective part winding start time delay.
	2. Defective compressor.	2. Check for the following: a. Open motor winding. b. Excessive amp draw on all phases.
C. Second stage compressor fails to start.	1. Time delay contacts fail to close.	1. Replace time delay relay.
	2. No call for cooling.	2. Check for the following: a. Defective thermostat. b. Broken or improper control wiring.
	3. Unit locked out by reset relay.	3. Same as A-4.
	4. Compressor contactor will not close.	4. Same as A-5.
D. Compressor short cycles.	1. Intermittent contact in control circuit.	1. Check for the following: a. Defective relay contacts. b. Loose wiring connections.
	2. Poor thermostat placement.	2. Refer to "Thermostat Installation" in the ELECTRICAL WIRING section of this manual.
	3. Defective anti-recycle timer.	3. Replace.
	4. Defective liquid line solenoid valve.	4. Replace.
	5. Low refrigerant charge.	5. Check for leak, add refrigerant.
	6. Plugged liquid line filter-driers.	6. Replace.
	7. Defective low pressure control.	7. Replace.
	8. Defective low ambient time delay relay.	8. Replace.
E. Compressor runs continuously.	1. Unit undersized for load (cannot maintain space temperature).	1. Check for cause of excessive load.
	2. Thermostat setpoint too low.	2. Readjust thermostat.
	3. Defective thermostat or control wiring (conditioned space too cold).	3. Replace thermostat. Replace or repair control wiring.
	4. Welded contacts on compressor contactor.	4. Repair or replace contactor.

(CONTINUED ON NEXT PAGE)

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
	5. Leaky valves in compressor (indicated by operation at abnormally low discharge and high suction pressures).	5. Replace compressor.
	6. Shortage of refrigerant (indicated by reduced capacity coupled with high superheat, low subcooling, and low suction pressure).	6. Find and repair refrigerant leak. Recharge system.
	7. Liquid line solenoid valve stuck open.	7. Repair/replace.
	8. Defective low pressure control.	8. Replace.
F. Compressor motor winding stat open.	1. Excessive load on evaporator (indicated by high supply air temperature).	1. Check for the following: a. Excessive airflow. b. High return air temperature.
	2. Lack of motor cooling (indicated by excessive superheat).	2. Check for the following: a. Improper expansion valve setting. b. Faulty expansion valve. c. Restriction in liquid line.
	3. Improper voltage at compressor.	3. Check for the following: a. Low or imbalanced line voltage. b. Loose power wiring. c. Defective compressor contactor.
	4. Internal parts of compressor damaged.	4. Replace compressor.
G. Compressor is noisy.	1. Internal parts of compressor damaged or broken (compressor knocks).	1. Replace compressor.
	2. Liquid floodback (indicated by abnormally cold suction line and low superheat).	2. Check and adjust superheat.
	3. Liquid refrigerant in the compressor at start-up. (Indicated by abnormally cold compressor shell.)	3. Replace crankcase heater.
H. System short of capacity.	1. Low refrigerant charge (indicated by low subcooling and high superheat).	1. Add refrigerant.
	2. Clogged filter drier (indicated by temperature change in refrigerant line through drier).	2. Replace filter drier or core of drier.
	3. Incorrect thermostatic expansion valve setting.	3. Readjust expansion valve.

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
	4. Expansion valve stuck or obstructed (indicated by high superheat and high space temperature).	4. Repair or replace expansion valve.
	5. Low evaporator airflow.	5. Check filters. Adjust airflow.
	6. Noncondensibles in system.	6. Evacuate and recharge system.
	7. Leaky valves in compressor (indicated by operation at abnormally low discharge and high suction pressures).	7. Replace compressor.
I. Suction pressure too low.	1. Shortage of refrigerant (indicated by high superheat and low subcooling).	1. Find and repair refrigerant leak. Recharge system.
	2. Thermostat set too low (indicated by low discharge pressure and low space temperature).	2. Re-adjust thermostat.
	3. Low airflow.	3. Check for clogged filters, incorrect fan speed, or high duct static pressure.
	4. Clogged filter drier.	4. Check for frosting on filter drier. Replace if necessary.
	5. Expansion valve power assembly has lost charge.	5. Repair or replace expansion valve power head assembly.
	6. Obstructed expansion valve (indicated by high superheat).	6. Clean or replace valve.
J. Suction pressure too high.	1. Excessive cooling load (indicated by high supply air temperatures).	1. See Symptom E, "Compressor runs continuously".
	2. Overfeeding of expansion valve (indicated by abnormally low superheat and liquid flooding to compressor).	2. Adjust superheat setting and check to see that remote bulb is properly attached to suction line.
	3. Suction valves broken (indicated by noisy compressor).	3. Replace compressor.
K. Discharge pressure too low.	1. Shortage of refrigerant (indicated by low subcooling and high superheat plus bubbles in sight glass).	1. Repair leak and recharge system.
	2. Broken or leaky compressor discharge valves (indicated by suction and discharge pressures that equalize rapidly after shutdown).	2. Replace compressor.
	3. Condenser fan control stuck in closed position (contacts closed when pressure is below 155 psig.)	3. Replace defective control.
	4. Unit running below minimum operating ambient.	4. Provide adequate heat pressure controls or a unit ambient lockout switch.
	5. Low ambient damper stuck open (indicated by low discharge pressure).	5. Repair or replace damper operator.

(CONTINUED ON NEXT PAGE)

(CONTINUED FROM PREVIOUS PAGE)

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
L. Discharge pressure too high.	1. Too little or too warm condenser air; restricted air flow.	1. Clean coil. Check fan and motors for proper operation.
	2. Air or noncondensible gas in system (indicated by exceptionally hot condenser and excessive discharge pressure).	2. Evacuate and recharge system.
	3. Overcharge of refrigerant (indicated by high subcooling, low superheat, and high suction pressure).	3. Remove excess refrigerant.
	4. Excessive system load.	4. Reduce load.
	5. Defective condenser fan or fan pressure control (indicated by one fan off and high condenser pressure).	5. Repair or replace switch.
	6. Defective or inoperative low ambient dampers.	6. Repair or replace defective parts.

IMPORTANT: Fill out the following form when contacting your Trane Service Company for parts or information.

UNIT MODEL NUMBER ________________

UNIT TYPE NUMBER ________________

DATE OF INSTALLATION ________________

INSTALLED BY ________________

TRANE SERVICE COMPANY ________________

ADDRESS ________________

PHONE ________________

PRINTED BY PRODUCTION SERVICES — LA CROSSE FWB/DJL

BLDG # AS-3502

Installation Operation Maintenance

RAUB-IOM-4

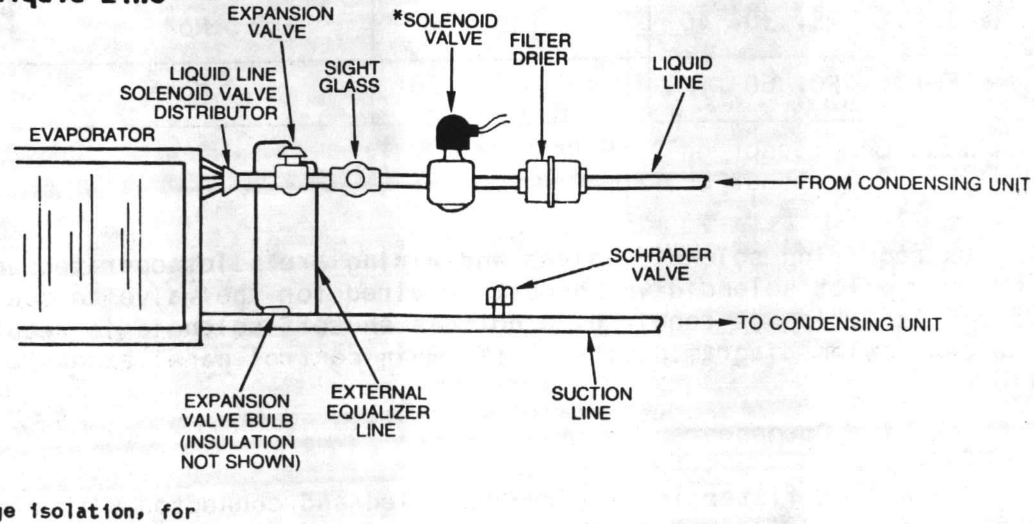
Library	Service Literature
Product Section	Unitary
Product	Split System, 20-60 Tons
Model	RAUB
Literature Type	Inst.-Oper.-Main.
Sequence	4
Date	March 1985
File No.	SV-UN-S/S-RAUB-IOM-4-385
Supersedes	

Supplement to RAUB-IOM-3 for D and E Design Sequence Units

Liquid Line Components

A properly sized liquid line filter drier must be installed upstream from the expansion valve. In addition, a moisture indicator/sight glass should be installed between the expansion valve and filter drier. Both of these components should be installed at the evaporator close to the expansion valve, as shown in Figure 1.

Figure 1 - Diagram of Refrigerant Piping Components in Liquid Line



* Required for charge isolation, for evaporator unloading, or when used with control option F (Remote EVPA).

Note: Install the expansion valve, sight glass, solenoid valve, and filter drier as close to the evaporator as possible.

The number of other valves, reducers and tube bends should be minimized as these items tend to increase the pressure drop and reduce subcooling at the expansion valve.

Liquid line solenoid valves are required for only three reasons: 1) evaporator coil unloading, 2) refrigerant charge isolation, and 3) EVPA control. Refer to the connection diagram pasted on the main control panel access door for proper field wiring.

Evaporator Coil Unloading -- A solenoid valve may be used to unload part of the evaporator coil when the compressor is unloaded. When unloading the evaporator coil, make sure that the percentage of coil surface active is always greater than or equal to the percentage of compressor capacity.

Refrigerant Charge Isolation -- For charge isolation, liquid line solenoid valves can be installed to entirely shut off refrigerant flow. This reduces the refrigerant migrating from the condenser to the evaporator during the off cycle and in some situations reduces the amount of liquid refrigerant entering the compressor. This measure is not necessary; charge isolation is most effective when refrigerant line lengths are greater than 100 feet.

EVPA Control -- A liquid line solenoid for each refrigerant circuit is always required on units applied with remote EVPA.

Hot Gas Bypass Solenoid Valve

The removal of pumpdown does not affect the application of hot gas bypass. However, some hot gas bypass systems will no longer require the hot gas shutoff solenoid valve that is now used with hot gas bypass valves. This will save jobsite installation costs. Use the following table to determine if hot gas solenoid valves are required.

Unit Size	Control Option	Hot Gas Solenoid Valve and Wiring Required?
RAUB-C20 - 60	A, B, C, D, F	Yes
RAUB-C20, 25, 30, 40	E	No*
RAUB-C40, 50, 60	E	No**

* No. 1 Compressor only on RAUB-C40.
** No. 2 Compressor on RAUB-C40.

Valves requiring solenoid valves and wiring are pilot operated and have an integral pilot solenoid which must be wired for the valve to operate. When charge isolation is required, a hot gas shutoff solenoid is required. Refer to the connection diagram pasted on the main control panel access door for proper field wiring.

Suction Line Components

A suction line filter is factory-installed and connected with a short stub to the suction service valve. This suction line filter increases the reliability of the compressor by improving the cleanliness of the system.

PRINTED BY PRODUCTION SERVICES — LA CROSSE
CJ/DL

TAB PLACEMENT HERE

DESCRIPTION:

BurnHam

sTeel Boiler

☐ Tab page did not contain hand written information

☑ Tab page contained hand written information
*Scanned as next image

Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

BLDG. AS-3504

OPERATION AND MAINTENANCE MANUAL

for

STEEL BOILERS

(Including Water Treatment)

BURNHAM CORPORATION
HYDRONICS DIVISION
Lancaster, PA 17604

BURNHAM
STEEL BOILER

THE HYDRONICS INSTITUTE

35 Russo Pl. Berkeley Heights, N.J. 07922

April 1985

PREFACE

The useful service life of a steel boiler depends almost entirely on the diligence of those who are charged with the responsibility of boiler maintenance.

This manual contains recommendations covering boiler maintenance, operation and other details useful to the owner, the maintenance crew, and the operators. It is based on actual experience of many boiler manufacturers, and upon test work done in laboratories, and in the field. It is not intended that this manual should take precedence over the manufacturer's maintenance and operating instructions, if any are supplied, but rather to complement them. In every instance, the manufacturer's recommendations for maintenance and operation of the particular boiler that has been installed should be followed.

This booklet is intended to cover steel boilers which are constructed in accordance with Section IV of the ASME Boiler and Pressure Vessel Code. "Suggested Rules for the Care of Power Boilers", as stated in the ASME Boiler and Pressure Vessel Code Section VII, are recommended as instructions covering the operation and maintenance of high pressure boilers.

A section on Water Treatment is included because of the importance of proper water treatment on the life expectancy of a boiler. It is recommended that a water treatment consultant be engaged to develop the proper program for a boiler as related to local water conditions.

Be sure to check local codes and ordinances before completing plans for any new or replacement boiler installation. It is also advisable to consult a qualified engineer.

Every effort has been made to assure the accuracy of this manual and other publications of the Hydronics Institute, formerly the Institute of Boiler and Radiator Manufacturers. However, neither The Institute nor those responsible for the preparation of I=B=R publications make any representation, or guaranty, or assume, or accept any responsibility or liability with respect thereto.

BOILER ROOM

The boiler room should be well lighted and should have an emergency light source for use in case of power failure. If a flashlight is used for this purpose, it should be maintained in good condition and should be protected against removal from the boiler room.

Proper and convenient water fill connections should be installed and provision should be made to prevent boiler water from back feeding into the service water supply. Provision should also be made in every boiler room for a convenient water supply which can be used to flush out the boiler or to clean the boiler room floor.

Proper and convenient sewer connections should be provided for draining boilers. Unobstructed floor drains, properly located in the boiler room, will facilitate proper cleaning of the boiler room.

The boiler room must have an adequate air supply to permit clean, safe combustion and to minimize soot formation. An unobstructed air opening should be provided. It may be sized on the basis of one square inch per 2000 Btuh maximum fuel input of the combined burners located in the boiler room, or as specified in The National Fire Protection Association, or American Insurance Association standards for oil installations and for gas installations for the particular job conditions. The boiler room air supply opening must be kept clear at all times.

CLEANING AND FILLING A NEW BOILER

Steam Boiler

Before putting water into a new boiler, make certain that the firing equipment is in operating condition to the extent that this is possible without actually lighting a fire in the empty boiler. This is necessary because raw water must be boiled (or heated to at least 180° F) *immediately* after it is introduced into the boiler, in order to drive off the dissolved gases, which might otherwise corrode the boiler.

Fill the boiler to the proper water line and operate the boiler with steam in the entire system for a few days to bring the oil and dirt back from the system to the boiler. This is not necessary if the condensate is to be temporarily wasted to the sewer, in which case the system should be operated until the condensate runs clear.

The oil and greases which accumulate in a new steam boiler can usually be washed out by boiling as follows:

(a) Fill the boiler to the normal waterline.

(b) Remove the safety valve.

(c) Provide a boil-out compound of caustic soda and trisodium phosphate in the proportions of 2½ lbs. of each chemical per 120 gallons of boiler water. *Caution:* Use care in handling these chemicals. The caustic soda is extremely corrosive to skin and clothing. DO NOT PERMIT EITHER THE DRY MATERIAL OR THE CONCENTRATED SOLUTION TO COME INTO CONTACT WITH SKIN OR CLOTHING.

(d) Mix the chemicals with water and pour into the boiler through the safety valve opening.

(e) Replace the safety valve.

(f) Start the firing equipment.

(g) Boil the water for at least 5 hours.

(h) Stop the firing equipment.

(i) Drain the boiler in a manner and to a location that hot water can be discharged with safety.

(j) Wash the boiler thoroughly, using a hose with sufficient pressure.

(k) Fill the boiler to the normal waterline.

(l) Add a charge of boiler water treatment compound.

(m) Boil, or bring water temperature to at least 180° F *immediately.*

(n) The boiler is now ready to be put into service or on stand-by.

In stubborn cases this simple boil-out may not remove all the oil and grease, and another boil-out with surface blow-off may be necessary. For this type of cleaning proceed as follows:

(1) Prepare the boiler for cleaning by running a temporary pipe line from the surface blow-off connection to an open drain or some other location where hot water may be discharged with safety. If no such tapping is available, use the safety valve tapping but run the pipe full size and as short a length as possible. Do not install a valve or any other obstruction in this line.

(2) Fill the boiler until water reaches the top of the water gauge glass.

(3) Add caustic soda and trisodium phosphate in the proportions of 2½ lbs. of each chemical per 120 gallons of boiler water. *Caution:* Use care in handling these chemicals. The caustic soda is extremely corrosive to skin and clothing. DO NOT PERMIT EITHER THE DRY MATERIAL OR THE CONCENTRATED SOLUTION TO COME INTO CONTACT WITH SKIN OR CLOTHING.

(4) Start the firing equipment and operate sufficiently to boil the water without producing steam pressure.

(5) Boil for about five hours.

(6) Open boiler feed valve sufficiently to permit a steady trickle of water to run out the overflow pipe.

(7) Continue this slow boiling and trickle of water for several hours until the water coming from the overflow pipe is clear.

(8) Stop the firing equipment.

(9) Drain the boiler in a manner and to a location that hot water can be discharged with safety.

(10) Remove covers and plugs from all washout openings and wash the water side of the boiler thoroughly, using a hose with sufficient pressure.

(11) Refill boiler to 1″ of water in the water gauge glass.

Note: If water in water gauge glass does not appear to be clear, repeat steps 2 to 11 and boil out the boiler for a longer time.

(12) Remove temporary piping.

(13) Close boiler.

(14) Replace safety valve.

(15) Add a charge of boiler water treatment compound.

(16) Boil, or bring water temperature to at least 180° F *immediately*.

(17) The boiler is now ready to be put into service or on stand-by.

Hot Water Boiler

Before putting water into a new boiler, make certain that the firing equipment is in operating condition to the extent that this is possible without actually lighting a fire in an empty boiler. This is necessary because raw water must be heated to at least 180° F *immediately* after it is introduced into the boiler, in order to drive off the dissolved gases which might otherwise corrode the boiler.

The oil and grease which accumulate in a new hot water boiler can be washed out in the following manner:

(a) Add caustic soda or trisodium phosphate to the boiler water at the rate of 1 lb. of *either* chemical per 50 gallons of total water in the system. *Caution:* Use care in handling these chemicals. The caustic soda is extremely corrosive to skin and clothing. DO NOT PERMIT EITHER THE DRY MATERIAL OR THE CONCENTRATED SOLUTION TO COME INTO CONTACT WITH SKIN OR CLOTHING.

(b) Fill the entire system with water.

(c) Start the firing equipment.

(d) Circulate the water through the entire system.

(e) Vent the system, including the radiation.

(f) Allow boiler water to reach operating temperature if possible.

(g) Continue to circulate the water for a few hours.

(h) Stop the firing equipment.

(i) Drain the system in a manner and to a location that hot water can be discharged with safety.

(j) Wash the water side of the boiler thoroughly, using a hose with sufficient pressure.

(k) Refill the system with fresh water.

(l) Bring water temperature to at least 180° F *immediately.*

(m) Tighten hand holes, manholes and plugs while boiler is hot.

(n) The boiler is now ready to put into service or on stand-by.

Deaeration

It is strongly recommended that the water in a boiler be deaerated and be treated with a suitable boiler water treatment compound whenever the boiler is filled with water. This is applicable whether the boiler is in operation or on stand-by, and is particularly necessary immediately upon refilling the boiler after washing, inspection or repair. (See section on Water Treatment.)

Feeding Water Treatment Compound into the System

A feeder for introducing boiler water treatment compound into a boiler is convenient. The feeder may be made of pipe fittings and placed in the return line.

In a system equipped with a pump-assisted return or with a boiler feed pump, the feeder should be placed in the piping on the discharge side of the pump.

Do not introduce water treatment by placing it in a condensate receiver, hot well, or make-up tank.

Local Water Conditions

Local water conditions may necessitate analysis by a suitable water treatment consultant.

START UP

When initially firing the boiler observe the following:

(a) Never operate a boiler without being sure it is filled with water. This should be obvious but it is repeated here because insurance company records show that many boilers are damaged because a fire was started in an empty boiler.

(b) When starting the firing equipment, follow the firing equipment manufacturer's instructions, which should be posted in the boiler room.

(c) Do not light the pilot light until the combustion chamber has been vented.

(d) Do not turn on the fuel supply at any time unless you know the combustion chamber has been properly vented and unless you know the pilot light is in proper operation.

(e) In case of "flash-back", shut off the fuel supply at once and do not turn it on again until the boiler has been thoroughly vented.

(f) Bring the temperature up slowly.

Following a cold start, condensation may occur in a gas fired boiler to such an extent that it appears that the boiler is leaking. This condensation can be expected to stop after the boiler is hot.

CUTTING-IN

When placing a boiler on the line with other boilers which are already in service, keep its stop valve at the boiler outlet and return stop valve closed until the pressure within the boiler is exactly the same as the pressure in the steam main. See that the line between the stop valve at the boiler outlet and the steam main is drained, then open the stop valve very slightly. If there is no unusual disturbance, such as noise, vibration etc., continue to slowly open the valve to a "full open" position, then open the valve in the return line.

Caution: When the stop valve at the boiler outlet is closed, the stop valve in the return line of that boiler must also be closed.

OPERATION

Steam Boilers

Whenever going on duty, check the water level in all steam boilers at once.

The maximum operating pressure of a steam boiler should be 3 or 4 psi lower than the "set" pressure of the safety valve. This pressure differential is required to permit the valve to close tightly after it has popped under pressure.

Where low pressure steam boilers are used solely for heating and where practically all of the condensate is returned to the boiler, do not "blowdown" the boiler. High pressure boilers and low pressure process boilers should be "blowndown" as required to maintain chemical concentrates at the desired level and to remove precipitated sediments. Boilers which are equipped with a slow opening blowoff valve and a quick opening blowoff cock, should have the lever valve or cock opened first, followed by gradual opening and closing of the slow opening valve. When the slow opening valve has been shut tight, then close the lever valve or cock.

Caution: Do not open the slow opening valve first and pump the lever action valve open and closed, as the water hammer is apt to break the valve bodies or pipe fittings.

If rust appears in the water gauge glass, this is an indication of corrosion that must not be ignored. Check the boiler water to be sure that the water treatment compound is at proper strength and make sure the boiler is not requiring considerable quantities of make-up water. Check the return line and other parts of the system for evidence of corrosion.

A wide fluctuation of water line may indicate that the boiler is foaming or priming. This may be due to the water line being carried too high, or especially in low pressure boilers, a very high rate of steaming. Foaming may also be caused by dirt or oil in the boiler water. Foaming can sometimes be cured by blowing the boiler down, draining two or three inches, then refilling a few times. In persistent cases, it may be necessary to take the boiler out of service, drain and wash out thoroughly as described for a new steam boiler installation and then refill and put back into service.

If the water disappears from the water gauge glass, stop the boiler immediately, and in the case of a coal fired boiler, close the ashpit door and open the fire doors and cover the fire with ash, fresh fine coal or earth. *Do Not* turn on the the water feed line. *Do Not* open safety valve. Let the boiler cool until the crown sheet is at hand touch temperature. Then add water to 1″ in the water gauge glass. *Do Not* put the boiler back into service until you have located and corrected the condition responsible for low water.

Low Water Cutoff, Pump Control and Waterfeeder

Check the operation of the low water cutoff, pump control, and the water feeder if one is installed. Follow the instructions on the tag or plate, attached to each control, to "blowdown" the control regularly as recommended by the manufacturer.

Due to mud accumulations, despite "blowdowns", some manufacturers recommend that the float chamber be opened once a year and cleaned out. It is advisable to test the low water cutoff under actual operating conditions. With the burner operating and the boiler steaming at proper water level, close all the valves in the feedwater and condensate return lines so that the boiler will not receive any replacement water. Then carefully observe the waterline to determine where the cutoff switch stops the burner in relation to the lowest permissible waterline established by the boiler manufacturer.

If the burner cutoff level is not at, or slightly above, the lowest permissible waterline, in a new installation the low water cutoff should be moved to the proper elevation, or in an existing installation should be serviced, repaired, or replaced if necessary.

Hot Water Boilers

Whenever going on duty, check the pressure and temperature in all water boilers.

When the boiler is cold the stationary and movable hands of the combination altitude pressure gauge should be together; when the boiler is hot, the movable hand should be above the stationary hand.

> The stationary hand should be aligned with the movable hand at the time the system is initially filled, or it may be set to indicate the minimum pressure under which the system can operate and still maintain a positive pressure at the highest point in the system.

The maximum operating pressure of a hot water boiler should be 3 or 4 psi lower than the relieving pressure of the relief valve. This pressure differential is required to permit the valve to close tightly after it has opened under pressure.

General

Where water losses from a steam boiler or a hot water boiler become abnormal, as indicated by the requirements of large amounts of make-up water, an investigation should be made immediately to determine the cause. Proper repair or replacement of parts should be made at once rather than to increase the water treatment to protect the system due to excessive raw water make-up. If the operator cannot determine the cause of the water loss, a competent contractor or consulting engineer should be contacted.

When make-up water is needed and the boiler or condensate tank is not equipped with an automatic water feeder, manually add feed water to a steam boiler, preferably when the boiler is not steaming, or to a water boiler when it is not at its maximum operating water temperature.

(a) Use every practical means for excluding oxygen from the boiler water. Oxygen will be brought in with the make-up water; therefore, hold make-up to a minimum. If the boiler loses more than

3" of water per month, this is an indication of a probable leak in some part of the system. The leak should be discovered and corrected.

(b) If the system includes a pump for returning condensate or adding feed water, be certain that the air vent at the receiver is operating properly.

If large quantities of feed water are required, deaerating equipment is highly desirable to remove dissolved gases, thereby minimizing oxygen corrosion.

MAINTENANCE

General

Clean the boiler tubes and other heating surfaces whenever required. The frequency of the cleaning must be determined by trial. It cannot be predicted. Clean the smoke boxes when required.

Draining and Washing Steam or Water Boilers

A clean, properly maintained, steam heating boiler or hot water system should not be drained unless there is a possibility of freezing, unless the boiler has accumulated a considerable amount of sludge or dirt on the water side, or unless draining is necessary to permit repairs.

Very little sludge should accumulate in a boiler where little make-up water is added and where an appropriate boiler water treatment is maintained at proper strength.

Anti-Freeze Solutions

Anti-Freeze solutions, when used in a heating system, should be tested from year to year as recommended by the manufacturer of the anti-freeze which is used. Anti-freeze solutions must not be circulated through

Water Heaters

Any water heater installed in, or connected to a boiler, should be back-washed periodically, using valves to reverse the direction of flow through the heater. The purpose of this back-washing is to reduce the amount of scale which will accumulate at the outlet side of the heater. Continue the back-washing until the water runs clear. The back-washing may be done frequently and the maximum interval should be determined by trial.

Fireside Corrosion

In this manual some of the causes of water side corrosion have been outlined and procedures recommended which, if followed, may be expected to minimize trouble from this source. Boilers can, however, also corrode on the fireside. This results from corrosive substances in the fuel and it may be difficult to control. Some fuel oils contain substances which cause fireside corrosion. Sulphur, vanadium and sodium are among the materials that may contribute to this problem. Fuel oils in use today are commonly specified according to United States Department of Commerce Commercial Standard CS12-48 and this Standard does not place any quantity limits on sulphur for No. 4 and heavier oils and does not mention vanadium nor sodium.

In the distillation of oils, the vanadium, sodium and much of the sulphur remain in the residuals. Therefore, the probability of this type of corrosion is greater when the fuel oil is a residual (No. 6) or is a No. 4 or No. 5 mixture containing residual.

Deposits of sulphur compounds may cause fireside corrosion. The probability of trouble from this source depends to a large degree on the amount of sulphur in the fuel and on the care used in cleaning the fireside heating surfaces. This is particularly true when preparing a boiler for a period of idleness. Preventing this trouble depends also on keeping the boiler heating surfaces dry when a boiler is out of service.

Deposits of vanadium, or vanadium and sodium compounds also may cause fireside corrosion and these compounds may be corrosive during the season when boilers are in service.

The man responsible for boiler maintenance should be certain that the fireside surfaces of the boilers in his care are thoroughly cleaned at the end of the firing season. He should also observe the fireside surfaces during the firing season and if signs of corrosion are discovered, a reputable consultant should be engaged.

Steam Boilers

If rust appears in the water gauge glass, this is an indication of corrosion that must not be ignored. Check the boiler water to be sure that the treatment is at proper strength and make sure that the boiler is not requiring considerable quantities of make-up water. Check the return line and other parts of the system for evidence of corrosion.

Check the water gauge glass regularly. The required frequency must be determined by trial. The check should be made when there is steam pressure on the boiler. Close the lower gauge glass valve, then open the drain cock which is on the bottom of this valve, and blow the glass clear. Close the drain cock and open the lower gauge glass valve. Water should return to the gauge glass immediately. If water return is sluggish, leave the lower gauge glass valve open and close the upper gauge glass valve. Then open the drain cock and allow water to flow until it runs clear. Then close the drain valve and repeat the first described test, with the lower gauge glass valve closed.

If leaks appear around the water gauge glass or fittings, correct the leaks at once. Steam leaks may result in a false water line reading and may damage the fittings.

In a clean boiler room, safety valves on steam boilers should be checked for proper operation at the beginning of the regular heating season and about every six months. If the presence of chemical fumes or dirt might tend to affect proper operation, the safety valves should be checked about every month. It is preferred that the safety valves be tested by raising the steam pressure until the valve pops. If this is not practical, the valves may be tested by operating the hand lever, but the steam pressure should be as high as practical so that the seat and valve passages will be blown clear of any foreign matter.

Caution: Take necessary precautions to prevent the possibility of scalding the operator, or others, during this test.

(a) If the popping pressure remains constant, no attention is required. If a valve fails to seal tight, blow it at the set pressure. If it still leaks, or if popping pressure is higher than that marked on the valve, replace it. Do not dismantle the safety valve or attempt to adjust it except under supervision of an authorized boiler inspector.

(b) ASME rated safety valves were supplied as part of the original equipment with the boiler. When replacement is necessary, use only ASME rated valves.

Water Boilers

Relief valves on water boilers need to be tested only once a year at the beginning of the heating season, unless the presence of chemical fumes or other injurious materials make more frequent testing necessary.

These valves should be tested by operating the hand lever. Observe valves closely after the test to be sure they are closed tightly and do not drip. Continued dripping may indicate the presence of dirt on the valve seat, and the valve should be reflushed. If dripping continues, the valve should be replaced.

ASME rated relief valves were supplied as a part of the original equipment with the boiler. When replacement is necessary, use only ASME rated valves.

REMOVAL OF BOILER FROM SERVICE

Steam Heating Boiler

When a steam heating boiler is to be taken out of service at the end of the heating season, or for repairs, proceed as follows: While maintaining boiler temperature (from 180°F to 200°F), drain off the boiler water until it runs clear. Then refill to the top of the water gauge glass, and add sufficient water treatment compound to bring the treatment up to strength. When all the gases are dissolved, the firing equipment may be shut down.

High Pressure Boiler

For high pressure units, a different approach is used. At least 15 minutes before going off the line, the proper amount of chemical to protect the boiler during standby should be added. After going off the line, fill the boiler to the top. Shut off the steam valve and seal the boiler when it is cool to prevent any ingress of air into the boiler. Test the boiler water for proper chemical content at least once a month. The company supplying the water treatment compound for the boiler will give the proper chemical treatment for boilers in standby condition.

Water Boiler

For a water boiler, the procedure is to drain from the bottom of the boiler while it is still hot (180°F to 200°F) until the water runs clean, then to refill to the normal water fill pressure. This should be a yearly procedure. If water treatment is used in the system, sufficient treatment compound should be added to condition the added water.

General

When the boiler (any of those referred to above) is cool, clean the tubes and other heating surfaces thoroughly, and scrape the surfaces down to clean metal. Clean the smoke boxes and other areas where soot or scale may accumulate.

Soot is not corrosive when it is perfectly dry, but can be very corrosive when it is damp. For this reason it is necessary to remove all the soot from a boiler at the beginning of the non-operating season, or any extended non-firing period.

Swab the heating surfaces with neutral mineral oil to protect against rust. If the boiler room is damp, place a tray of calcium chloride or slaked lime in the combustion chamber and replace the chemical when it becomes mushy.

Drain a steam boiler back to normal water level before putting the boiler back in service.

Check the boiler occasionally during the idle period and make certain it is not rusting.

This is an opportune time to repaint the exposed metal parts of the boiler and to inspect and service the firing equipment and combustion chamber.

BOILER REPAIRS

Do not permit repairs to the boiler while it is in service, or under pressure, except with the approval and under the supervision of an authorized boiler inspector or responsible engineer.

When repair work is required, notify the representative of the company who insures the boiler and be guided by his instructions.

All repair work should be done by experienced boiler mechanics. Welding should be done by ASME Code Certified Welders.

Take every precaution necessary to insure against injury to men who are working in the boiler room and particularly to those working inside the steam space or in the combustion chamber of the boiler. Pull the main burner switch and lock it out or tag it, swing the burner out of place, if possible, close and lock valves, etc., and always have one man standing by outside when a man is working inside a boiler.

When practical, use a flashlight in preference to an extension light for internal inspection purposes. If an extension cord is taken into a boiler, be certain that the cord is rugged and in good condition and that it is properly grounded.

If one tube in a boiler should develop a leak due to corrosion, it is likely that other tubes are corroded also. Have the boiler examined by a capable and experienced inspector before ordering the replacement of one or a few tubes. If all tubes will need replacement soon, it is preferable and less expensive to have the work done at one time.

When a sealer is used to eliminate system leaks and similar problems, or if the sealer is used in conjunction with other compounds, the system should be completely flushed and drained after the sealers have performed their function. A maximum interval of five days with a sealer in the system is recommended. Sealers have a detrimental effect on boilers, pumps and relief valves and should be flushed out as quickly as possible.

BOILER WATER TREATMENT

Use every practical means for protecting the boiler water against contamination by free oxygen or carbon dioxide gases.

Determine the water containing capacity of your boiler so you can instruct your maintenance crew regarding the required amount of boiler water treatment compound. If this information is not given on the boiler, in the boiler catalog, or other publications, then meter the water at the time of the initial filling and record the information.

Whenever a boiler is refilled with water, boil the water or heat it to at least 180°F *immediately* to drive off the dissolved gases, and add a charge of boiler water treatment compound to control corrosion. If a chromate water treatment compound is used, follow the instructions listed below to determine the amount required. Draw a color comparison sample as described below. Use other boiler water treatment compounds in the amounts specified by the supplier. The material may be introduced through an opening such as the safety valve or manhole opening, or through a feeder if one is available. In high pressure units a reliable water treatment firm should be consulted and their recommendations put into effect.

A chromate boiler water treatment compound is effective for use as a boiler water conditioner in all regular low pressure steam boilers where all, or practically all, of the condensate is returned to the boiler. This material is effective in controlling corrosion and pitting. When maintained at the recommended concentration in a clean boiler, it will prevent or arrest oxygen and CO_2 corrosion. This compound is intended solely for controlling corrosion and is not a cleaner, nor does it control for formation of scale.

The use of chromate boiler water treatment compound in a water boiler involves different considerations. Too high a concentration must be avoided as it may damage pump seals. Therefore, with a lower level of protection, it is necessary to take even greater precautions to keep free oxygen out of the system. Free oxygen can enter from system leaks, faulty vents, or vents improperly located with regard to pumps, and from makeup water.

If a chromate boiler water treatment compound is used, draw a *color test sample* of water into a clear glass bottle. Mark and retain this sample for use in making periodic tests as described below. Draw a new sample whenever a new charge of boiler water treatment compound is added. The sample should be drawn after the compound is completely dissolved and thoroughly mixed in the boiler water, and should be stored in an air tight bottle.

A chromate boiler water treatment compound, consisting of 95% sodium chromate and 5% sodium borate has been tested extensively over a five-year period in the laboratories of a reliable and well known boiler tube manufacturer. These tests have shown that the material, when used and maintained at the concentrations listed below, is effective in controlling or arresting corrosion. These chemicals may be purchased from any reliable chemical company. **Caution:** Chromate is still recognized as one of the best inhibitors for protection of metal, although it is now prohibited by many states or cities for use as water treatment, due to the toxic effect of the chromate when dumped in rivers, streams, and sanitary sewage systems.

a. *Water Treatment for Low Pressure Steam Boilers*

   Low pressure steam boilers should be maintained with a chromate concentration of 2 lbs. per 100 gallons of boiler water (2200 PPM). This concentration will be effective where all or practically all of the condensate is returned to the boilers. After boiler and system have been cleaned and refilled as previously described, test the pH of the water in the system as described below. The pH should be higher than 7, but lower than 11. Add some of the washout chemical if necessary, to bring the pH within the specified range. Under service conditions where a considerable amount of make-up is required, the owner should employ a professional water treatment company to provide and supervise the use of the required water treatment.

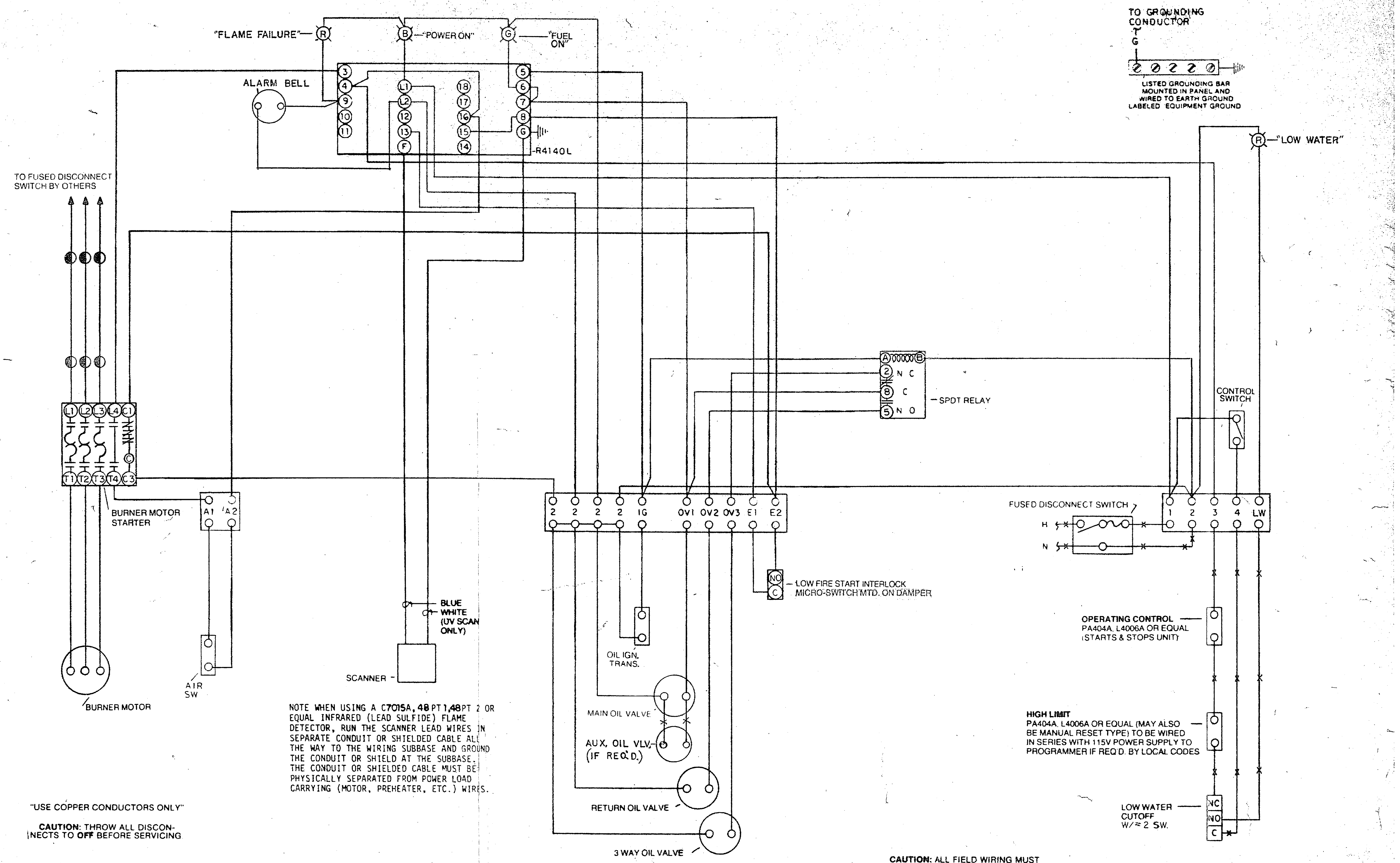
b. *Water Treatment for High Pressure Boilers*

   In high pressure boilers the water treatment should be prescribed by a reputable water treatment company. Water conditions vary from time to time, and from place to place, and in these boilers, to have good service results, the water treatment should be tailored to fit the boiler and the water conditions.

c. *Water Treatment for Low Pressure Water Boilers*

   Low pressure water boilers should be maintained with a chromate concentration of 1 lb. per 400 gallons of boiler water (300 PPM). Test the pH of the water in the system. The pH should be higher than 7, but lower than 9. Add some of the washout chemical, if necessary, to bring the pH within the specified range. As previously noted, with this lower level of protection, care must be exercised to eliminate all of the free oxygen in the system.

Making a pH or Alkalinity Test — The condition of the boiler water can be quickly tested with hydrion paper which is used in the same manner as litmus paper, except it gives specific readings. A color chart on the side of the small hydrion dispenser gives the reading in pH. Hydrion paper is inexpensive and obtainable from any chemical supply house or through your local druggist.



NOTE WHEN USING A C7015A, 48PT1,48PT2 OR EQUAL INFRARED (LEAD SULFIDE) FLAME DETECTOR, RUN THE SCANNER LEAD WIRES IN SEPARATE CONDUIT OR SHIELDED CABLE ALL THE WAY TO THE WIRING SUBBASE AND GROUND THE CONDUIT OR SHIELD AT THE SUBBASE. THE CONDUIT OR SHIELDED CABLE MUST BE PHYSICALLY SEPARATED FROM POWER LOAD CARRYING (MOTOR, PREHEATER, ETC.) WIRES.

"USE COPPER CONDUCTORS ONLY"

CAUTION: THROW ALL DISCONNECTS TO **OFF** BEFORE SERVICING

FACTORY WIRING
24V / 115V / 200-575V — FIELD WIRING "SEE SPEC SHEET FOR VOLTAGE"

— G — EQUIPMENT GROUNDING CONDUCTOR

EQUIPMENT SHOWN ON DIAGRAM IS ONLY PROVIDED AND MOUNTED BY POWER FLAME IF SPECIFICALLY CALLED FOR ON BURNER SPEC SHEET

CAUTION: ALL FIELD WIRING MUST BE WIRED AS SHOWN ON **WIRING DIAGRAM**.

PCXO-R4140L1105/U-HOL-XS-XD-TX-XX-BX-DD-X-CO-AA-XXX-XX-XXX-XXX

REVISION	REV'D	DATE
2 ADDED AUX. OIL VALVE &	LH NF	4-8-88
2 ADDED ALARM BELL	"	" " "
1 REV'D. LIGHTS	DK	4-1-88

Power Flame Incorporated
2001 S. 21st • PARSONS, KANSAS 67357 • PHONE (316) 421-0480

DWN. BY KIDD	CHKD. BY	APVD BY NF	SCALE 2249	DATE 1-26-88
JOB NAME			FILE LOC.	
TITLE OIL BURNER WITH R4140L, LO-HI-OFF, 3 Ø MOTOR, 4 — LIGHTS & SCANNER			PLATE NO. OF PLATES	
			DWG. NO. WO- 2500L -2	

BLDG. AS-3504

TAB PLACEMENT HERE

DESCRIPTION:

N/A

☐ Tab page did not contain hand written information

☑ Tab page contained hand written information
*Scanned as next image

Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

Chet Adams Company

Sales Engineers

HEATING AIR CONDITIONING EQUIPMENT VENTILATING

AIR POLLUTION SYSTEMS ENERGY CONSERVATION

February 16, 1988

MAINTENANCE AND OPERATING INSTRUCTIONS

Project:	Replace Air Conditioning Units Marine Corps Air Station, New River Jacksonville, NC
Contractor:	Humphrey Heating & Roofing, Inc. Jacksonville, NC
P.O.#	103-284
Sales Rep:	Chet Adams Company Cary, NC
Manufacturer:	Ilg Industries

EXHAUST FANS

3 - PV 83 Direct drive propeller wall exhaust fans, 230 CFM @1/8"SP, 1/40 HP, 115/1/60, with rear guard and backdraft damper.

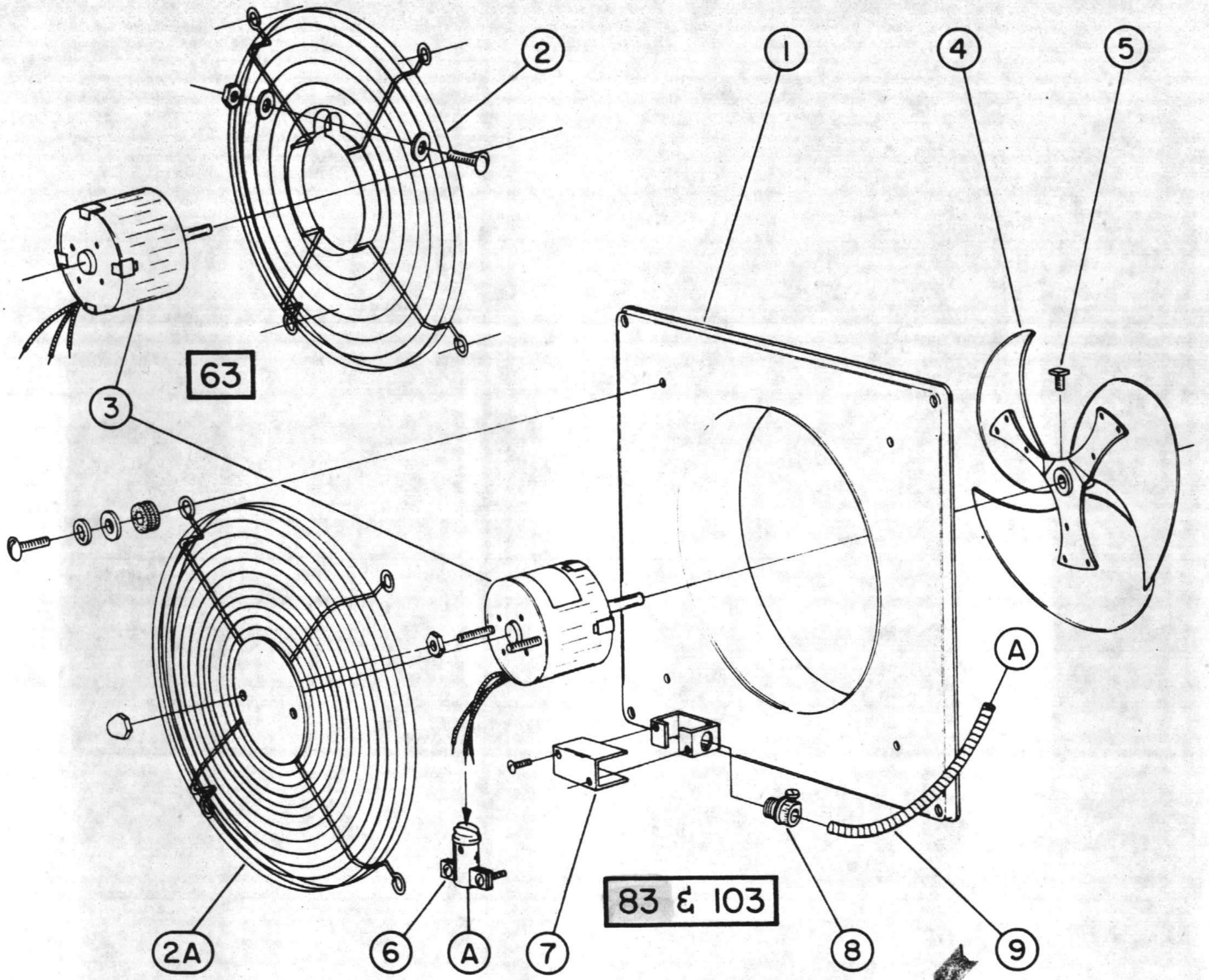
CARY, N.C. 27511 Box 5218 919/851-6331
GREENSBORO, N.C. 27402 Box 3073 919/273-0566
CHARLOTTE, N.C. 28299 Box 9158 704/375-4483
COLUMBIA, S.C. 29210 16 Nob Hill Road 803/798-0602
CHARLESTON, S.C. 29412 1058 Fort Sumter Dr. 803/762-1045

AN 14161-3

PV 63, 83 & 103 PROP. FANS

ILG

DRAWN BY: AL. LUTZ
DATE: DEC. 1985
APPROVED BY: G.R.I.



			63	83	103
NO.	NAME OF PART		PART NO.		
1	PANEL ASSY.	BN 15370	1006-9003B	1008-9002B	1010-9003B
2	GUARD MOTOR SUPPORT		B1006-1100A	————	————
2A			————	B1008-1101C	B1010-1101D
3	MOTOR		AS SPECIFIED		
4	WHEEL ASSY.		B1006-9001A	A1008-9000A	A1210-9047A
5	SET SCREW, SQ. HD.		10-24 × 1/4	10-24 × 1/2	
6	CONDUIT CLAMP		8500-4213		
7	OUTLET BOX COVER		A9917-1702A		
8	CONNECTOR		8500-4200		
9	FLEXIBLE CONDUIT		8500-4210		

ILG

A CHECK IN THE APPROPRIATE SQUARE INDICATES THE TYPE OF BEARINGS USED IN THE MOTOR POWERING THIS EQUIPMENT

GENERAL INSTRUCTIONS FOR FAN MOTORS

☐ RELUBRICATABLE BALL BEARINGS - An instruction tag from the manufacturer is included with the motor and the recommendations contained therein should be followed.

☐ SEALED BALL BEARINGS - The bearings are factory-packed with a general purpose bearing lubricant and require no further attention. The life of the grease is dependent upon the number of operating hours and temperature. Under normal conditions of operation (8 hours per day, 5 days per week and average ambient temperature of 80 deg. F) the expected grease-life will be approximately seven years. The life may be greater or less depending upon the enclosure of the motor, RPM, type of mounting, variation in ambient temperature and operating duty cycle. In terms of hours of operation, expected life may be stated as approximately 30,000 hours for open motors and 20,000 hours for enclosed motors when working in an average ambient temperature of 80 deg. F.

☐ SEALED SLEEVE BEARINGS - Bearings of this type are provided with a large lubricant reservoir and require no attention. Because of the extremely light loads on motors with this type of bearing, the life will compare favorably with larger motors having sealed ball bearings.

☐ RELUBRICATABLE SLEEVE BEARINGS - The bearing is essentially the same as the sealed sleeve bearing with the exception that it may be relubricated to secure extended life. To obtain maximum life, 5 or 6 drops of SAE20 Motor Oil or Electric Motor Bearing Oil should be added after every 1,000 hours of operation.

NOTE: THE STATEMENTS REGARDING EXPECTED LIFE DO NOT CONSTITUTE A GUARANTEE, EXPRESSED OR IMPLIED - BUT SERVE ONLY AS AN INDICATION OF WHAT MAY BE EXPECTED OF THE EQUIPMENT. (REFER TO STANDARD TERMS AND CONDITIONS OF SALE.)

GENERAL NOTES REGARDING FAN EQUIPMENT

1. OVERLOAD PROTECTION - Some motors are provided with built-in overload protection. This fact is so noted on the Motor Rating Plate. If the motor does not contain built-in overload protection, it is mandatory that this protection be provided by starters in the motor circuit. The starters are to be equipped with overload protection devices of a rating suitable for the current rating of the motor.
2. PERIODIC CLEANING - Periodic cleaning of all fan equipment is strongly recommended. Dirt and grease accumulations on the impeller cause vibration which greatly increases stresses and loads on the motor bearings. A program of preventive maintenance will greatly increase fan and motor life.
3. CHECKING DIRECTION OF ROTATION - Care should be taken to insure the proper direction of rotation. This is particularly true in the case of centrifugal type roof ventilators. This type of equipment will deliver air when running in either direction; however, the load is greatly increased when operation is in the wrong rotation. This is a very common cause of overload tripping in centrifugal type roof ventilators. When this trouble is experienced, try reversing fan rotation before increasing the size of the overload protection.
4. MOTOR OVERLOAD - Forward-curve and radial-bladed fans consume maximum horsepower at 0 in. Static Pressure. Some fans of this type are powered so that operation at 0 in. Static Pressure will overload the motor. Check Catalog Ratings to determine minimum Static Pressure operation if overloading is experienced with this type of equipment.
5. CHECKING RUNNING CLEARANCE - To achieve maximum performance and efficiency, fans are precision-built machines. Upon occasion, parts will shift slightly due to mishandling in shipment. This can cause binding of the rotating assembly. Before placing any fan in operation, the impeller should be turned by hand to ensure that no binding or interference is present.

ILG INDUSTRIES INC. 2850 North Pulaski Road, Chicago, Illinois 606[illegible]

STANDARD TERMS AND CONDITIONS OF SALE

No provision, term or condition of Buyer's order which is inconsistent with, different from or in addition to Seller's terms and conditions shall be binding upon Seller unless expressly agreed to in writing and signed by a duly authorized representative of Seller. Seller shall not be obligated to Buyer in any way until written acceptance of Buyer's order is made by Seller's duly authorized representative at its offices: 2850 North Pulaski Road, Chicago, Illinois. Seller's quotation shall be considered as an invitation to trade and shall not be construed as an offer to contract. The equipment and products described are herein referred to as the "goods."

PRICE

1. Prices are F.O.B. point of shipment.
2. Prices set forth on Seller's quotation are firm for a period of thirty (30) days from the date of the quotation. In the event of any changes in specifications indicated by Buyer's purchase order, Seller may adjust the price to cover such changes.
3. If, at Buyer's request, shipment is extended beyond six (6) months from date of Seller's written quotation, Seller may increase the stated price of the unshipped goods one percent (1%) per month.
4. Prices of goods not manufactured by Seller are at all times subject to revision to reflect price increases by Seller's suppliers.
5. All prices are subject to the addition of any Federal, State or local taxes which may be applicable to the sale, purchase, delivery, storage, use or processing of the goods sold. Any such tax shall be due and payable to Seller at or before the time the tax is payable by Seller to the taxing authority, or in lieu thereof, Buyer may provide Seller with a tax exemption certificate acceptable to the taxing authority.

PAYMENT TERMS

1. Terms of payment are thirty (30) days net from date of invoice, no discounts, unless otherwise specified.
2. Interest at the rate of one and one-half percent (1.5%) per month (18% per annum), or the maximum lawful rate allowable, will be charged, whichever is less, on all past due invoices.
3. No payments made to representatives or agents will be valid. Payments shall be made directly to Seller, at its home office, Chicago, Illinois.
4. Minimum billing for any goods sold by the Seller shall be $25.00 net, exclusive of all transportation.
5. Pro rate retainage fees or back charges will not be accepted by Seller. Collection of such deductions from payments will be enforced at Buyer's expense.
6. Seller shall not be liable for any liquidated damages or penalties whatsoever unless otherwise agreed to in writing.
7. Seller reserves the right to require full payment in advance of shipment, posting of security for payment, or other payment arrangements when in Seller's judgment, open billing terms are not acceptable.

DELIVERY AND ACCEPTANCE

1. Delivery dates are estimated by Seller and are not guaranteed.
2. Shipments shall be made by the method or carrier deemed most feasible by Seller and Seller reserves the right to ship all or part of the goods from any shipping point other than the points specified herein.
3. Risk of loss or damage passes to the Buyer upon delivery of the goods to the carrier at point of shipment.
4. Buyer shall inspect all goods upon receipt. If Buyer rejects all or part of the goods, Buyer shall give Seller written notice of rejection, specifying the reasons therefore within five (5) days after receipt of the goods. In the event Buyer does not so notify Seller, Buyer shall be deemed to have accepted the goods.

WARRANTY AND LIMITATIONS OF LIABILITY

SELLER WARRANTS THAT THE GOODS SHALL BE FREE FROM DEFECTS IN MATERIALS OR WORKMANSHIP FOR A PERIOD OF ONE (1) YEAR FROM THE DATE OF INITIAL INSTALLATION OR FOR A PERIOD OF EIGHTEEN (18) MONTHS FROM DATE OF SHIPMENT, WHICHEVER PERIOD FIRST EXPIRES. NO WARRANTY IS MADE OR OFFERED WITH RESPECT TO ANY PROTECTIVE COATINGS APPLIED TO THE GOODS. SELLER'S WARRANTY OBLIGATIONS WITH RESPECT TO GOODS NOT MANUFACTURED BY SELLER SHALL NOT EXCEED THE OBLIGATIONS UNDERTAKEN BY THE MANUFACTURER THEREOF UNDER EXPRESS WARRANTY TO SELLER.

If, in Buyer's judgment, the goods do not meet the warranties expressed above, and the Buyer notifies Seller of the defect within a reasonable time after discovery of the defect and within the warranty period, Seller agrees to correct the defect by repairing or replacing, F.O.B. point of manufacture, any parts or components of the goods determined by Seller to be defective, or at its option by issuing credit for the defective parts or components. Seller shall not be liable for labor or other charges, costs or expenses related to the removal, shipping, handling, installation or re-installation of any goods or components.

THE EXPRESS WARRANTIES SET FORTH ABOVE ARE GIVEN BY SELLER IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IT IS EXPRESSLY AGREED THAT BUYER'S EXCLUSIVE REMEDY AND SELLER'S LIABILITY SHALL BE LIMITED TO THE REPAIR OR REPLACEMENT OF, OR THE ISSUANCE OF CREDIT FOR, DEFECTIVE PARTS OR COMPONENTS.

SELLER EXPRESSLY DISCLAIMS ANY AND ALL LIABILITY FOR AND SHALL NOT BE LIABLE FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOSSES RESULTING FROM OR ARISING FROM OR OUT OF DEFECTIVE GOODS, SELLER'S NEGLIGENCE, BREACH OF WARRANTY, BREACH OF CONTRACT, ANY TORT, OR CLAIMS BASED UPON STRICT LIABILITY OF THE SELLER. IN NO EVENT SHALL SELLER BE LIABLE FOR CONSEQUENTIAL DAMAGES OR LOSSES COMMERCIAL IN NATURE.

NUCLEAR USE

1. Buyer covenants, represents and warrants that neither Buyer nor any third party shall use, re-sell or otherwise dispose of any goods or part thereof in connection with any activity or process involving nuclear fission or fusion or any use or handling of any source, special nuclear or by-product material, as those materials are defined in the U.S. Atomic Energy Act of 1954 (as amended), without Seller's prior written consent, and until such time as Buyer, or such third party, at no expense to Seller, shall have arranged for insurance coverage, indemnities, and waivers of liability, recourse and subrogation, all acceptable to Seller, and all fully adequate in the opinion of Seller, to protect Seller (and its subcontractors and suppliers) against liability of any kind whether in contract, tort (including negligence), strict liability or otherwise. The aforesaid covenants, representations and warranties shall survive this contract and sale.
2. Seller shall not be obligated to deliver the goods until such insurance, indemnities and waivers have been procured and are legally operative in Seller's favor. Buyer's failure to comply with any provisions of this paragraph entitled "Nuclear Use" shall be cause for Seller to cancel this contract without liability to Seller, and pursue any remedies provided in law or equity by this contract, the Uniform Commercial Code, or otherwise.

EXCUSABLE DELAY

Seller shall not be deemed to be in default on account of delays in the delivery of goods or in the performance of this contract or any other act to be performed by Seller due to any of the following causes: acts of God; acts of Buyer; insurrections or riots; fires; floods; explosions; earthquake or serious accidents; epidemics or quarantine restrictions; any act of government affecting prices, fuels, materials, facilities or completed goods; strikes, labor troubles causing cessation, slow-down or interruption of work; shipment delays; inability to obtain materials, fuel, accessories, manufacturing facilities, transportation, equipment or parts; any other cause to the extent it is beyond Seller's control.

TERMINATION AND RETURNED GOODS

1. Termination of the order by Buyer, or any part thereof, will not be effective unless agreed to in writing by Seller. Accepted terminations will be subject to all charges incurred by Seller for material consumed, work performed and all other expenses incurred to the date of acceptance.
2. Goods accepted for return and credit are subject to a twenty percent (20%) charge for handling and/or reconditioning, unless otherwise agreed by Seller. Transportation charges for returned goods must be prepaid by Buyer. Before returning goods Buyer must obtain Seller's authorization, and attach Seller's "Return Material Tag" to all shipments. Notice of shipment must be given to Seller on the day of shipment and Buyer must furnish a copy of the Bill of Lading, order number and invoice date.
3. Goods manufactured specifically to order or to specifications of Buyer may not be returned for credit. Changes requested by Buyer in non-stock goods after commencement of manufacturer will be subject to a revision in price to reflect additional costs.
4. Use of materials, parts or equipment furnished by Buyer will subject the order to termination without any liability on the part of Seller if the said materials, parts or equipment are defective or will not perform to Seller's requirements. However, Buyer shall be liable to pay Seller's costs and expenses through date of termination.

PATENTS AND TRADEMARKS

Seller shall indemnify the Buyer against liability for infringement of any United States Letters Patent arising out of the manufacture, sale or use of any of Seller's goods furnished, provided that the Buyer shall promptly notify Seller of any such claim and give Seller the opportunity to defend against such claim. The Buyer shall be responsible for all such loss when a particular process or system, or the goods of a particular manufacturer or manufacturers is specified, or when infringement is incurred by employing the furnished Seller's goods in combination with other parts or goods. All drawings and data furnished by Seller shall remain its property and shall be returned to Seller upon request.

DEVELOPMENT CHANGES, DESIGN AND SPECIFICATIONS

1. Changes in design or specifications may be made at Seller's discretion and Seller has no obligation to incorporate such changes in goods manufactured prior to the change.
2. Seller may furnish Buyer with goods which have been subject to changes in design or specifications provided such changes do not adversely affect price, delivery, or any guaranteed performance of the goods or make unusable or obsolete any other item of goods furnished to Buyer under this contract.
3. All drawings, instructions and/or technical and engineering services which Seller may furnish with respect to installation or use of the goods are furnished solely for the review and approval of the Buyer. Seller makes no representation or warranty with respect to the accuracy or sufficiency of any such information and disclaims all liability in connection with their use or application.
4. Seller reserves the right to correct any factory, engineering, clerical or stenographic errors or omissions which may appear upon review and verification of data referred to in Seller's quotation, or Buyer's order

COMPLIANCE WITH LAWS

No representation or claim is made regarding compliance with the Occupational Safety and Health Act of 1970, or its amendments, or any other federal, state or local laws, ordinances, codes, rules or regulations which may apply to the goods or their installation.

GOVERNING LAW AND SEVERABILITY

1. This agreement shall be governed in all respects by the law of Illinois.
2. This contract shall be binding upon and shall inure to the benefit of the parties, their successor and assigns.
3. If any provision or term herein is found to be invalid or unenforceable as a matter of law or by public policy, it shall be considered to be severed from the remainder of the terms and conditions which shall remain in full force and effect.

TAB PLACEMENT HERE

DESCRIPTION:

Air control

System

☐ Tab page did not contain hand written information

☑ Tab page contained hand written information
*Scanned as next image

1-9-01 X:4:4.0621

Taco Submittal Data Information Air Separator

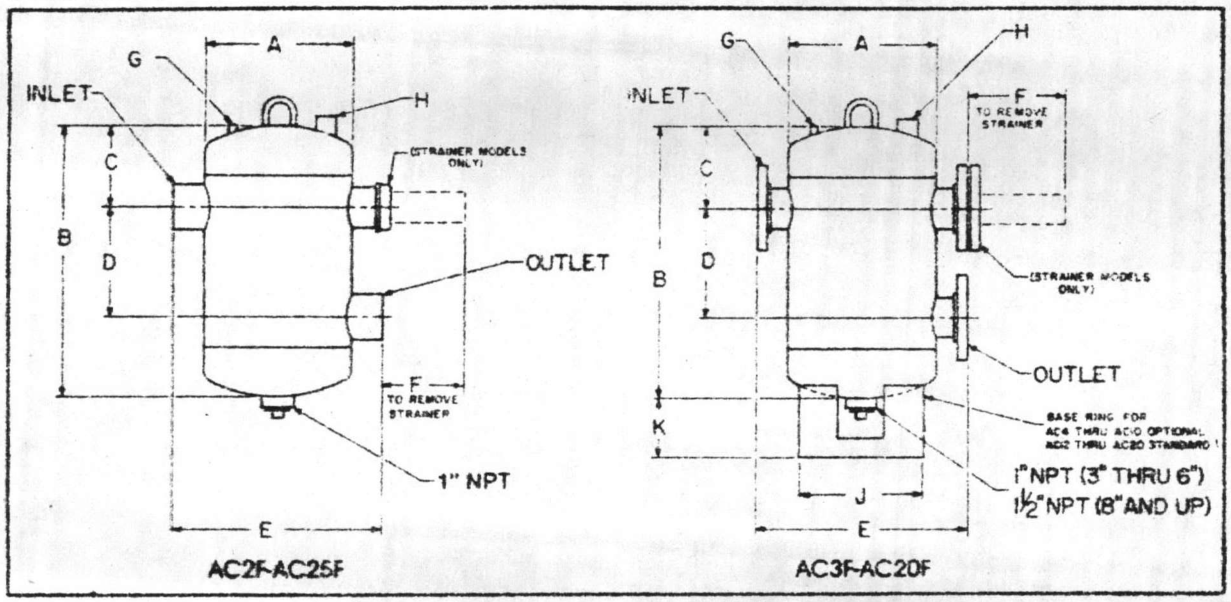
401-001

Supersedes: 401-001 dated 6/1/87 Effective: August 5, 1987

Job: VARIOUS BLDGS. (B55548) NEW RIVER, M.C.A.S.

ITEM	QUANTITY	MODEL NO.	SIZE
BLD AS205	1	AC2F	2"
BLD AS 3504	1	AC2F	2"
BLD AS-236	1	AC25F	2 1/2"

DIMENSIONS



PIPE SIZE inches	PRODUCT NO. less strainer	PRODUCT NO. with strainer	A	B Max	C	D	E	F	G	H	J	K	MAX FLOW (gpm)	STRAINER FREE AREA (sq. in.)	LESS STRAINER C_v FACTOR	WITH STRAINER C_v FACTOR	APPROX. SHIPPING WT. less strainer	APPROX. SHIPPING WT. with strainer
2	~~AC2~~	AC2F	8.625	18.00	6.31	5.38	12.00	13	3/4"NPT	3/4"NPT			80	22	86	72	32	37
2 1/2	~~AC25~~	AC25F	10.750	20.00	7.06	5.88	16.00	16	3/4"NPT	3/4"NPT			130	34	122	102	72	78
3	AC3	AC3F	14	27.25	8.00	11.25	20.75	19	3/4"NPT	1 1/4"NPT			190	51	190	162	92	120
4	AC4	AC4F	16	31.39	9.32	12.75	25.25	19	3/4"NPT	1 1/4"NPT		6 3/4†	330	80	325	272	140	176
5	AC5	AC5F	16	31.39	8.82	13.75	25.25	22	3/4"NPT	1 1/4"NPT		6 3/4†	550	112	510	422	180	228
6	AC6	AC6F	20	34.88	10.06	14.75	29.25	26	3/4"NPT	1 1/4"NPT		6 1/2†	900	180	750	618	240	290
8	AC8	AC8F	20	45.50	14.06	17.38	29.75	28	3/4"NPT	1 1/4"NPT		6 1/2†	1500	246	1260	1060	322	416
10	AC10	AC10F	24	47.50	14.81	17.88	34.75	32	3/4"NPT	1 1/4"NPT		6 3/4†	2600	392	2000	1670	545	670
12	AC12	AC12F	30	56.94	16.85	23.25	42.00	37	3/4"NPT	1 1/2"NPT	22	7 1/2	3400	548	2900	2400	860	1060
14	AC14	AC14F	36	65.00	19.88	25.25	48.75	43	3/4"NPT	1 1/2"NPT	24	7 1/2	4700	732	3500	2850	980	1170
16	AC16	AC16F	36	71.50	21.75	28.00	49.75	44	3/4"NPT	1 1/2"NPT	24	7 1/2	6000	845	4600	3800	1200	1300
18	AC18	AC18F	42	74.81	22.59	29.63	55.75	51	3/4"NPT	1 1/2"NPT	30	7 1/2	8000	1125	5900	4900	1648	1764
20	AC20	AC20F	48	82.81	25.28	32.25	62.25	58	3/4"NPT	1 1/2"NPT	36	7 1/2	10,000	1435	7400	6200	2600	3200

Rated @ 125 PSI @ 375°F Designed and constructed per ASME Section VIII Div. 1 †Optional

TACO, Inc., 1160 Cranston St., Cranston, RI 02920. (401) 942-8000 Telex 92-7627
TACO, (Canada) Ltd., 1310 Aimco Blvd., Mississauga, Ontario L4W 1B2 (416) 625-2160 Telex 06-961179

TAB PLACEMENT HERE

DESCRIPTION:

N/A

☐ Tab page did not contain hand written information

☑ Tab page contained hand written information
*Scanned as next image

Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

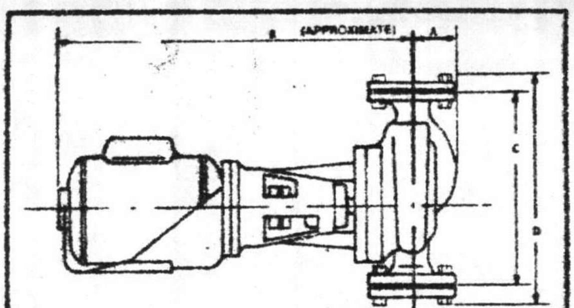
Taco Submittal Data Information 1600 Series Pumps

301-004

MODEL 1619 SUPERSEDES: SD300-1.4

Job: BLDG AS205 (B55548) NEW RIVER, M.C.A.S

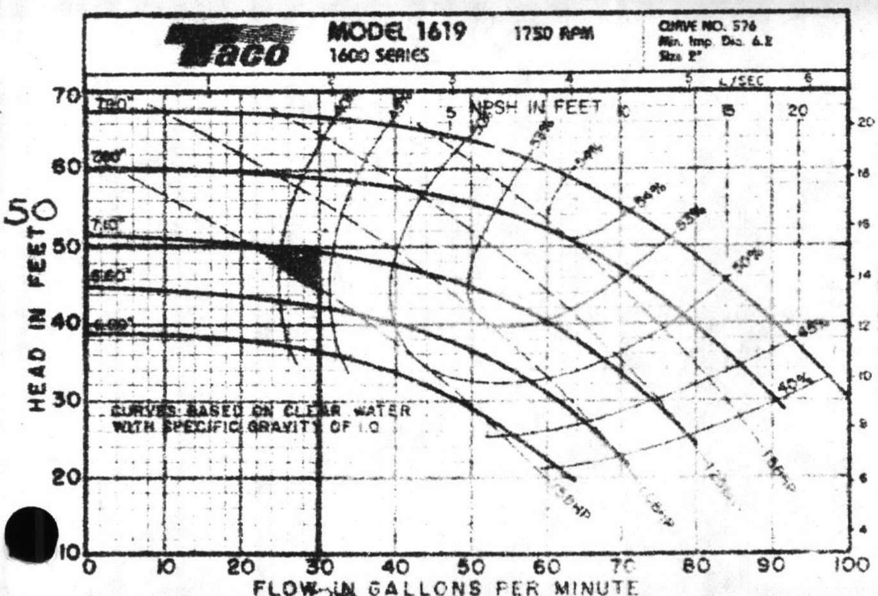
ITEM NO.	MODEL NO.	IMPELLER DIA.	G.P.M.	HEAD IN FT.	H.P.	ELECTRICAL CHARACTERISTICS
H.W.	1619C	7.1	30	50	1½	208/3/60



SIZES & DIMENSIONS:
(APPROXIMATE)

MODEL	Flange Size	H.P. (W)	A	B	C	D
1619	2	¾ (560)* 1 (746)* 1½ (1119)* 2 (1492)*	3 (76)*	18½ (469)* 19 (483)* 21 (533)* 23 (584)*	14½ (368)*	17⅜ (441)*

*Millimeters



SPECIFICATIONS:

MOTORS
1750 RPM, Three Phase 200V or 230/460V 60C Sleeve Bearing Motors.
Also available in Single Phase with overload protection except 3 HP (2238W).

BODY
Cast Iron with flanged in-line connections. Companion flanges are included.

IMPELLER
Cast Bronze, Closed, Dynamically Balanced.

DRIVE COUPLING
Non-Metallic/Vibration Dampening

SHAFT
Alloy Steel with Cupro-Nickel Sleeve.

FRAME
Sleeve Bearing, Disc Type, Oil lubricated. REMOVABLE BEARING CARTRIDGE FITS ALL MODELS. Dip Stick to measure oil level.

MECHANICAL SEAL
2 Piece Standard—250°F (121°C) Operating Temp.
Hi-Temp—Extra Cost—300°F (149°C) Operating Temp.

WORKING PRESSURE
175 PSI (1207kPa) ... in accordance with ASA B16.1
NOTE: Flanges are tapped for gauges

Quality Through Design — COMPARE.

TACO, INC. 1160 Cranston St., Cranston, RI 02920 (401) 942-8000 Telex 92-7624
TACO (Canada) Ltd. 3090 Lenworth Dr., Mississauga, Ontario, Canada Telex 06-961179

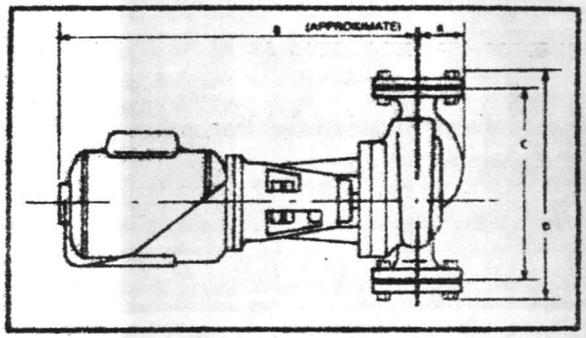
Taco Submittal Data Information 1600 Series Pumps

301-002

MODEL 1611 SUPERSEDES: SD300-1.2

Job: BLDG AS 3504 (B55548) NEW RIVER, M.C.A.S

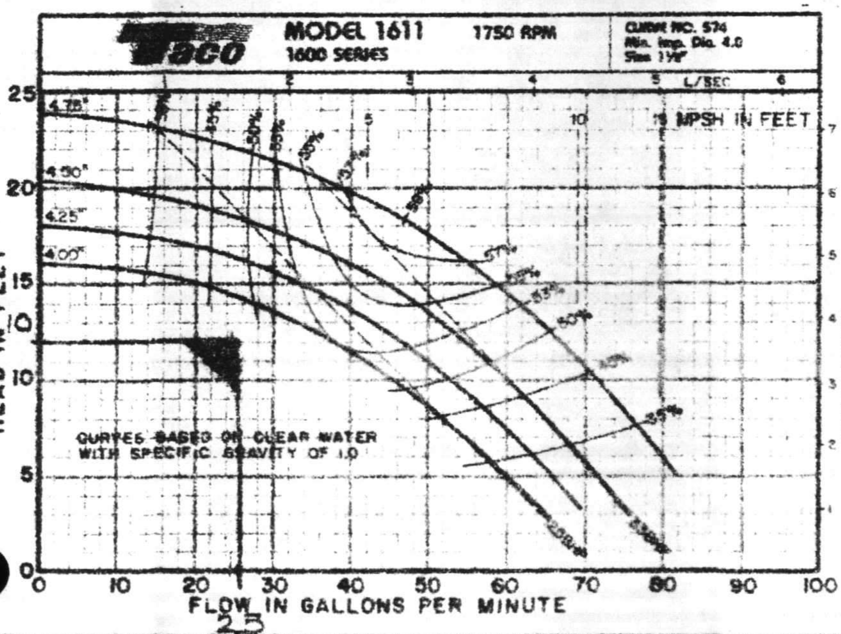
ITEM NO.	MODEL NO.	IMPELLER DIA.	G.P.M.	HEAD IN FT.	H.P.	ELECTRICAL CHARACTERISTICS
H.W.	1611C	4.0	25	12	1/3	115/1/60



SIZES & DIMENSIONS:
(APPROXIMATE)

MODEL	Flange Size	H.P. (W)	A	B	C	D
1611	1½	¼ (187)* 1/3 (249)* ½ (373)*	3 (76)*	16½ (419)* 16½ (419)* 17 (432)*	10¼ (200)*	12⅞ (327)*

*Millimeters



SPECIFICATIONS:

MOTORS
1750 RPM, Three Phase 200V or 230/460V 60C Sleeve Bearing Motors.
Also available in Single Phase with overload protection except 3 HP (2238W).

BODY
Cast Iron with flanged in-line connections. Companion flanges are included.

IMPELLER
Cast Bronze, Closed, Dynamically Balanced.

DRIVE COUPLING
Non-Metallic/Vibration Dampening

SHAFT
Alloy Steel with Cupro-Nickel Sleeve.

FRAME
Sleeve Bearing, Disc Type, Oil lubricated. REMOVABLE BEARING CARTRIDGE FITS ALL MODELS. Dip Stick to measure oil level.

MECHANICAL SEAL
2 Piece Standard—250°F (121°C) Operating Temp.
Hi-Temp—Extra Cost—300°F (149°C) Operating Temp.

WORKING PRESSURE
175 PSI (1207kPa) . . . in accordance with ASA B16.1
NOTE: Flanges are tapped for gauges

Quality Through Design — COMPARE.

TACO, INC. 1160 Cranston St., Cranston, RI 02920 (401) 942-8000 Telex 92-7627
TACO (Canada) Ltd. 3090 Lenworth Drive, Mississauga, Ontario, Canada Telex 06-961179

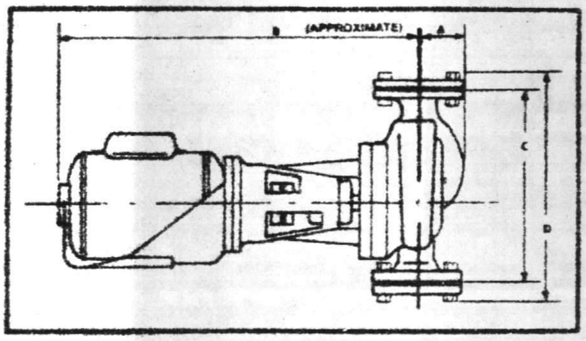
Submittal Data Information
1600 Series Pumps

301-004

MODEL 1619 SUPERSEDES: SD300-1.4

Job: VARIOUS BLDGS (B55548) NEW RIVER, M.C.A.S.

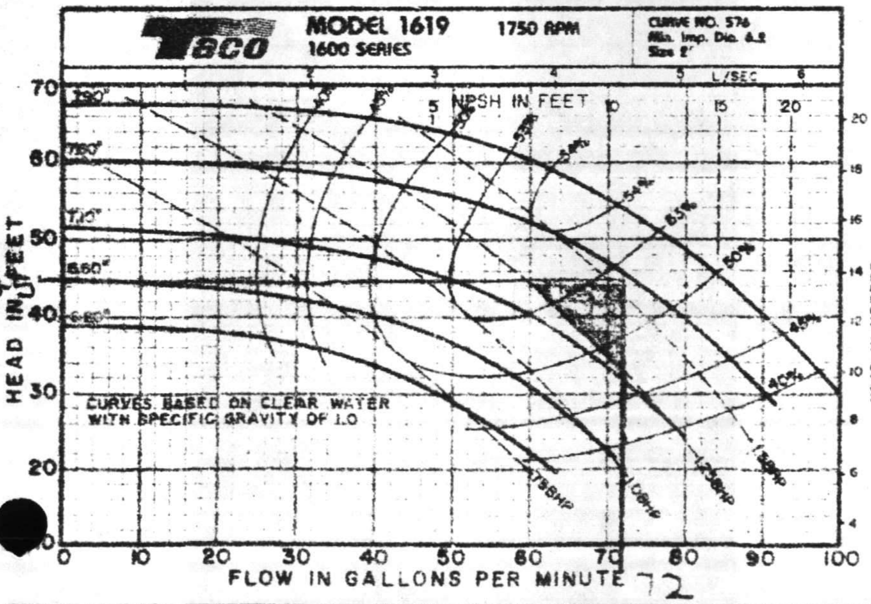
ITEM NO.	MODEL NO.	IMPELLER DIA.	G.P.M.	HEAD IN FT.	H.P.	ELECTRICAL CHARACTERISTICS
H.W	1619C	7.6	72	45	2	208/3/60



SIZES & DIMENSIONS:
(APPROXIMATE)

MODEL	Flange Size	H.P. (W)	A	B	C	D
1619	2	¾ (560)* 1 (746)* 1½ (1119)* 2 (1492)*	3 (76)*	18½ (469)* 19 (483)* 21 (533)* 23 (584)*	14½ (368)*	17⅜ (441)*

*Millimeters



SPECIFICATIONS:

MOTORS
1750 RPM, Three Phase 200V or 230/460V 60C Sleeve Bearing Motors.
Also available in Single Phase with overload protection except 3 HP (2238W).

BODY
Cast Iron with flanged in-line connections. Companion flanges are included.

IMPELLER
Cast Bronze, Closed, Dynamically Balanced.

DRIVE COUPLING
Non-Metallic/Vibration Dampening

SHAFT
Alloy Steel with Cupro-Nickel Sleeve.

FRAME
Sleeve Bearing, Disc Type, Oil lubricated. REMOVABLE BEARING CARTRIDGE FITS ALL MODELS. Dip Stick to measure oil level.

MECHANICAL SEAL
2 Piece Standard—250°F (121°C) Operating Temp.
Hi-Temp—Extra Cost—300°F (149°C) Operating Temp.

WORKING PRESSURE
175 PSI (1207kPa) . . . In accordance with ASA B16.1
NOTE: Flanges are tapped for gauges

Quality Through Design — COMPARE.

TACO, INC. 1160 Cranston St., Cranston, RI 02920 (401) 942-8000 Telex 92-7627
TACO (Canada) Ltd. 3090 Lenworth Drive, Mississauga, Ontario, Canada Telex 06-961179

TAB PLACEMENT HERE

DESCRIPTION:

Heat exchangers

☐ Tab page did not contain hand written information

☒ Tab page contained hand written information
*Scanned as next image

Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

ES01 - 2.2.2.1.4 (65)

Taco Submittal Data Information U Tube Heat Exchangers

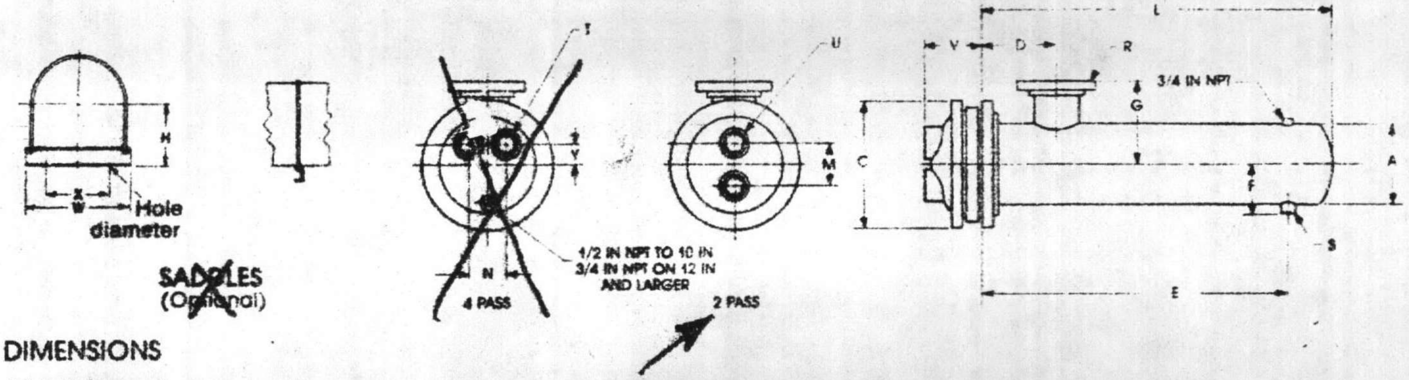
201-007

4" DIAMETER STEAM

SUPERSEDES: SD200-1

Job: BLDG. AS205 NEW RIVER MCAS

Item No.	Model No.	Pass	GPM Tubes	Temp. In	Temp. Out	Steam Pressure Shell	Pressure Drop Tubes	Velocity Tubes
CONV.	G 4206 S	2 PASS	30 GPM	160 °F	180 °F	20 PSIG	1.2 FT.	4.3 ft/sec



DIMENSIONS

4 Inch Diameter

Model Number		Cast Iron Heads						Dimensions (inches)									Heating Surface (sq. ft.)	Shipping Weight (lbs.)
2 Pass	4 Pass	2 Pass		4 Pass				2 and 4 Pass										
		M	U	N	T	Y	V	A	C	D	E	F	G	L	R	S		
G4204S	G4404S	2½	1½T	2⅜	1T	⅞	2⅞	4½	9	5	19½	4	4	24½	1¼T	1T	4.6	65
G4206S	G4406S	2½	1½T	2⅜	1T	⅞	2⅞	4½	9	5	31½	4	4	36½	1¼T	1T	7.0	75
G4208S	G4408S	2½	1½T	2⅜	1T	⅞	2⅞	4½	9	5	43½	4	4	48½	1¼T	1T	9.3	84
G4210S	G4410S	2½	1½T	2⅜	1T	⅞	2⅞	4½	9	5	55½	4	4	60½	1¼T	1T	11.7	94
G4212S	G4412S	2½	1½T	2⅜	1T	⅞	2⅞	4½	9	5	67½	4	3¾	72½	1½T	1T	14.1	104
G4214S	G4414S	2½	1½T	2⅜	1T	⅞	2⅞	4½	9	5	79½	4	3¾	84½	1½T	1T	16.4	114
G4216S	G4416S	2½	1½T	2⅜	1T	⅞	2⅞	4½	9	5	91½	4	3¾	96½	1½T	1T	18.8	124
G4218S	G4418S	2½	1½T	2⅜	1T	⅞	2⅞	4½	9	5	103½	4	3¾	108½	1½T	1T	21.1	134
G4220S	G4420S	2½	1½T	2⅜	1T	⅞	2⅞	4½	9	5	115½	4	3¾	120½	1½T	1T	23.5	144

SADDLE DIMENSIONS: H-5¼; W-6¹⁵⁄₁₆; X-5½; Hole Dia.-½.

MATERIALS OF CONSTRUCTION (Unless otherwise indicated, standard will be furnished.)

	Standard	Optional
Shell	Steel	304ss, 316ss
Head	Cast Iron 4-10" Fabricated Steel 12-30"	Fabricated Steel, Cast Bronze, Fabricated 304ss/316ss Cast Bronze, Fabricated 304ss/316ss
Tubes	3/4 x 20 BWG Copper	3/4 x 18 BWG Copper, Steel, 304ss, 316ss, 90/10 Cu Ni, Admiralty
Tube Sheet	Steel	Bronze, Brass, 304ss, 316ss, 90/10 Cu Ni
Separators	Steel	Bronze, Brass, 304ss, 316ss, 90/10 Cu Ni
Working Pressure	150 PSIG (ASME)	Consult Factory
Max. Temperature	375°F	Consult Factory

Quality Through Design — COMPARE.

TACO, Inc., 1160 Cranston St., Cranston, RI 02920 (401) 942-8000 Telex 92-7627
TACO, (Canada) Ltd., 8450 Simcoe Blvd., Mississauga, Ontario L4W 1B2 (416) 625-2160 Telex 06-961179

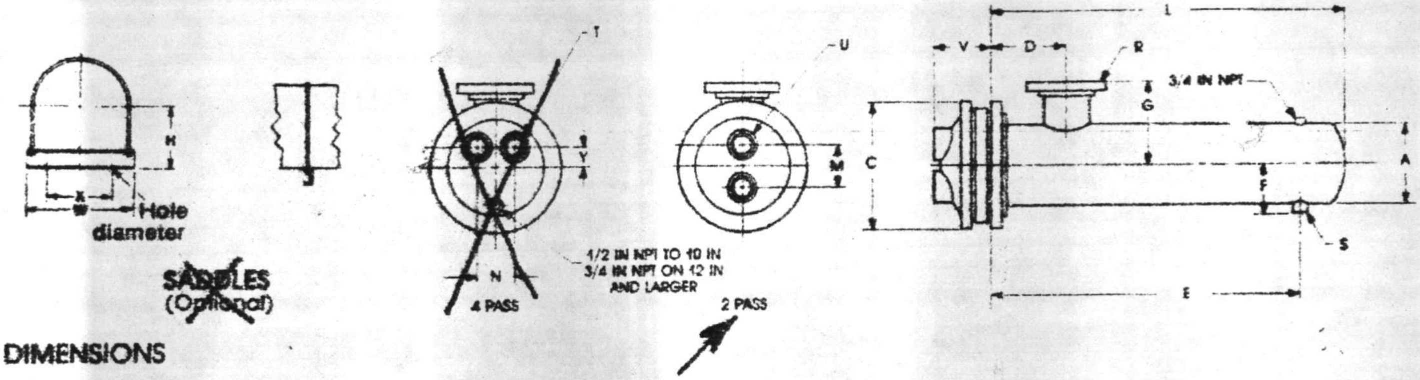
Taco Submittal Data Information U Tube Heat Exchangers

201-008

6" DIAMETER STEAM SUPERSEDES: SD200-1

Job: BLDG AS 236 NEW RIVER M.C.A.S.

Item No.	Model No.	Pass	GPM Tubes	Temp. In	Temp. Out	Steam Pressure Shell	Pressure Drop Tubes	Velocity Tubes
Conv.	G 6206 S	2 PASS	72 GPM	160 °F	180 °F	40 PSIG	1.7 FT	5.1 FT/SEC



DIMENSIONS

6 Inch Diameter

Model Number		Cast Iron Heads						Dimensions (Inches)									Heating Surface (sq.ft.)	Shipping Weight (lbs.)
2 Pass	4 Pass	2 Pass		4 Pass				2 and 4 Pass										
		M	U	N	T	Y	V	A	C	D	E	F	G	L	R	S		
G6204S	G6404S	4	2T	3¾	1½T	1¼	3 7/16	6⅝	11	5	18½	4⅞	4⅞	25	1½T	1T	9.1	120
G6206S	G6406S	4	2T	3¾	1½T	1¼	3 7/16	6⅝	11	5	30½	4⅞	4⅞	37	2T	1T	13.8	148
G6208S	G6408S	4	2T	3¾	1½T	1¼	3 7/16	6⅝	11	5	42½	4⅞	5¾	49	2½	1T	18.5	182
G6210S	G6410S	4	2T	3¾	1½T	1¼	3 7/16	6⅝	11	5	54½	4⅞	5¾	6'	2½	1T	23.2	207
G6212S	G6412S	4	2T	3¾	1½T	1¼	3 7/16	6⅝	11	5	66½	4⅞	5 9/16	3	3T	1T	27.9	235
G6214S	G6414S	4	2T	3¾	1½T	1¼	3 7/16	6⅝	11	5	78½	4⅞	5 9/16	85	3T	1T	32.6	262
G6216S	G6416S	4	2T	3¾	1½T	1¼	3 7/16	6⅝	11	5	90½	4⅞	5 9/16	97	3T	1T	37.3	290
G6218S	G6418S	4	2T	3¾	1½T	1¼	3 7/16	6⅝	11	5	102½	4⅞	5 9/16	109	3T	1T	42.1	318
G6220S	G6420S	4	2T	3¾	1½T	1¼	3 7/16	6⅝	11	5	114½	4⅞	5 9/16	121	3T	1T	46.8	346

SADDLE DIMENSIONS: H-6 5/16; W-9¼; X-7½; Hole Dia.-⅝.

MATERIALS OF CONSTRUCTION (Unless otherwise indicated, standard will be furnished.)

	Standard	Optional
Shell	Steel	304ss, 316ss
Head	Cast Iron 4-10" Fabricated Steel 12-30"	Fabricated Steel, Cast Bronze, Fabricated 304ss/316ss Cast Bronze, Fabricated 304ss/316ss
Tubes	3/4 x 20 BWG Copper	3/4 x 18 BWG Copper, Steel, 304ss, 316ss, 90/10 Cu Ni, Admiralty
Tube Sheet	Steel	Bronze, Brass, 304ss, 316ss, 90/10 Cu Ni
Separators	Steel	Bronze, Brass, 304ss, 316ss, 90/10 Cu Ni
Working Pressure	150 PSIG (ASME)	Consult Factory
Max. Temperature	375°F	Consult Factory

Quality Through Design — COMPARE.

TACO, Inc., 1160 Cranston St., Cranston, RI 02920 (401) 942-8000 Telex 92-7627
TACO, (Canada) Ltd., 1310 Aimco Blvd., Mississauga, Ontario L4W 1B2 (416) 625-2160 Telex 06-961179

TAB PLACEMENT HERE

DESCRIPTION:

N/A

☐ Tab page did not contain hand written information

☑ Tab page contained hand written information
*Scanned as next image

Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

Taco Submittal Data Information "PS" Expansion Tanks

401-007

SUPERSEDES: 401-007 (dated 1/1/85)

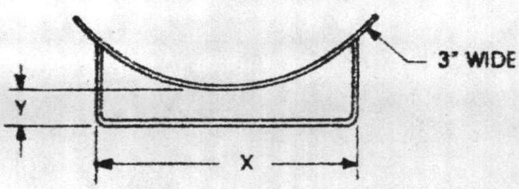
Job: VARIOUS BLDGS. (B5554 8) NEW RIVER, M.C.A.S.

ITEM	LOCATION	MODEL	QUANTITY	GALLONS
BLDG. AS205		PS030	1	30
BLDG. AS210		PS030	1	30
BLDG. AS236		PS030	1	30

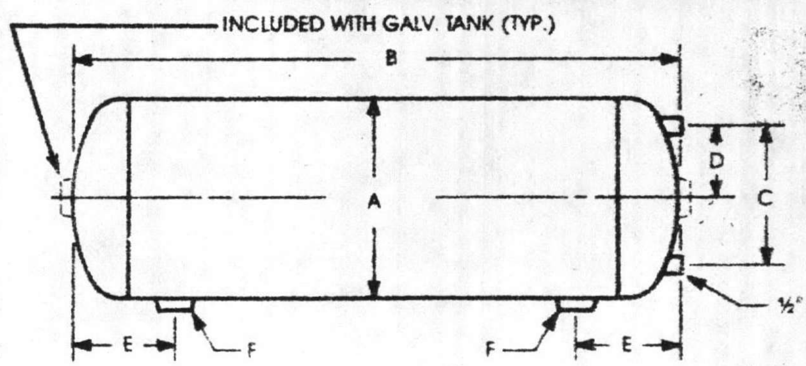
(OPTIONAL) SADDLES

(For Horizontal Installation)

FIG. 1



Tank Dia.	X	Y	Weight In Lbs. Per Pair
14	8	2	8
16	8	2 1/8	8
20	14 5/8	1 1/16	14
24	14 5/8	1 3/4	13
30	14	2 1/2	12 1/2
36	15 1/2	2 7/10	13 1/2



SIZES & DIMENSIONS

Model No.	Capacity Gal	A	B	C	D	E	F	Approx. Wt. Lbs. Painted	Approx. Wt. Lbs. Galv.
PS015	15	14	27	10⅝	5 5/16	7	1½	49	59
PS030	30	14	46½	10⅝	5 5/16	7	1½	88	96
PS040	40	14	65⅞	10⅝	5 5/16	7	1½	114	124
PS060	60	16	75½	12	6	7½	1½	118	132
PS080	80	20	66⅞	15¼	7⅝	9	2	160	175
PS100	100	20	78¾	15¼	7⅝	9	2	196	215
PS120	120	24	67⅛	18¾	9⅜	10	2	213	233
PS135	135	24	75⅞	18¾	9⅜	10	2	235	255
PS180	180	30	64⅞	22	11	12	2	363	286
PS220	220	30	79⅛	22	11	12	2	433	460
PS240	240	30	85¾	22	11	12	2	466	496
PS300	300	36	76½	28	14	13⅜	2	676	706
PS400	400	36	99¾	28	14	13⅜	2	858	899
PS500	500	36	126⅝	28	14	13⅜	2	1069	1120

SPECIFICATIONS
- Manufactured in Accordance with ASME Section VIII.
- Max. Working Pressure — 125 PSIG.
- Max. Operating Temperature — 375°F.

ASME STAMPED

Quality Through Design — COMPARE.

TACO, Inc., 1160 Cranston St., Cranston, RI 02920 (401) 942-8000 Telex: 92-7627
TACO, (Canada) Ltd., 1310 Aimco Blvd., Mississauga, Ontario L4W 1B2 (416) 625-2160 Telex: 06-961179

Taco

SUBMITTAL DATA

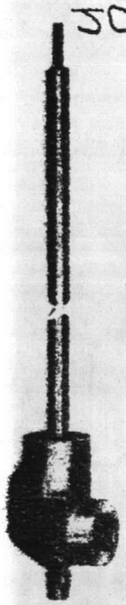
NUMBER
SD 100-2.5

Effective: July 1, 1981
Supersedes: SD 100-2.5
dated 4/81

TACO-TROL TANK FITTINGS

Plant ID 001-311

JOB: VARIOUS BLDGS. (R55548)
NEW RIVER, M.C.A.S.



PURPOSE

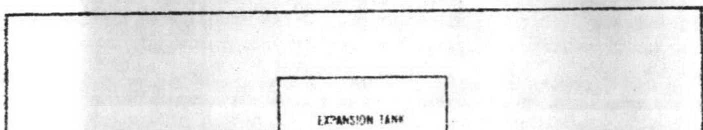
Designed to control the flow of air into the expansion tank while preventing free interchange of water between the expansion tank and the system.

HOW IT WORKS

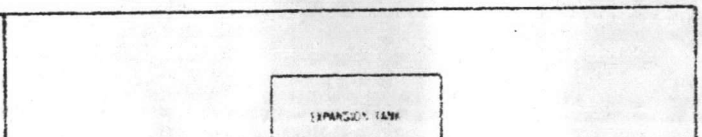
As air enters the fitting, it is directed thru the outer tube to the tank. As the water in the tank cools during an off cycle period of the firing device, water will tend to flow back toward the boiler or system. Because a restriction is built into the fitting, gravity circulation between boiler and tank is virtually eliminated. An inner tube and manual vent are also provided to permit air to escape from the tank during the initial filling and venting of the system.

HOW USED

The Taco-Trol Tank Fitting is screwed directly into the expansion tank and may be piped to an Air-Scoop (air separator or purger) or directly to the boiler if a "dip tube" is used (See Sketch).



INSTALLATION WITH AIR-SCOOP & HI-VENT



INSTALLATION WITH DIP TUBE

Taco Inc. 1160 ... Cranston, Rhode Island 02920 Telephone (401) 942 8000 Telex 92 7627
... Ontario Telephone (416) 625 7160 Telex 06 961179

INSTALLATION AND FILLING PROCEDURE

INSTALLATION

1– Cut tubes to correct length per dimension table below.

2– Insert Tank Fitting into bottom of expansion tank, using close nipple supplied.

3– Connect Fitting to Air-Scoop Tank Connection or Boiler Dip Tube with ½" (15 mm) pipe: If vertical line is some distance from Fitting, pitch horizontal Line up to Fitting approximately 1/8" (5 mm) per foot (305 mm) of pipe length.

FILLING PROCEDURE

A– Open air vent screw on Taco-Trol Tank Fitting. Close all system vents and fill system. As soon as water flows freely from vent screw opening in Tank Fitting, close the screw tightly.

DO NOT RE-OPEN THIS VENT SCREW EXCEPT TO DRAIN TANK

B– Open system vents and vent all high points.

C– Adjust Pressure Reducing Valve (if required) to provide positive pressure at highest point in system.

D– After system is filled, start circulator. Circulate cold water for several minutes to dislodge air bubbles from system.

E– Stop circulator. Fire Boiler to High Limit shut-off temperature. After firing stops, wait a few minutes, then re-start circulator to permit separated air to enter expansion tank or leave system thru Taco Air-Scoop.

F– Stop circulator and re-vent system high points. Reset all controls for automatic operation. System is now ready for normal operation.

If it is necessary to drain expansion tank for any reason, open air vent screw in Taco-Trol Tank Fitting and open Boiler drain to drain tank.

SIZE & SPECIFICATIONS

Prod. No.	Size Connections		Maximum Working Pressure	Approx. Wht. Lbs.
	Boiler or Air-Scoop	Expansion Tank		
→ 439	3/4" (20 mm)	1/2" (15 mm)	125 PSI (862kPa)	1 (.5 kg)
438	1" (25 mm)	1" (25 mm)	125 PSI (862kPa)	2.2 (1 kg)

CUT-OFF TABLE

For expansion tanks smaller than 24" in diameter cut off both tubes as follows:–

	Tank Diameter	Cut Off Both Tubes
→ 439	24" (610 mm)	None
	20" (508 mm)	2-1/8" (54 mm)
	16" (406 mm)	4-1/4" (108 mm)
	14" (356 mm)	5-5/16" (135 mm)
	12" (305 mm)	6-3/8" (162 mm)

For expansion tanks larger than 24" thru 36" in diameter cut off both tubes as follows:–

	Tank Diameter	Cut Off Both Tubes
438	36" (915 mm)	None
	30" (762 mm)	3-3/16" (80 mm)
	24" (610 mm)	6-3/8" (160 mm)

NOTE: Inner tube must always be 1" (25 mm) longer than outer tube

TAB PLACEMENT HERE

DESCRIPTION:

Tank Drainer

☐ Tab page did not contain hand written information

☑ Tab page contained hand written information
*Scanned as next image

Taco	SUBMITTAL DATA SHEET	Customer:
NUMBER SD 100-2.6	Effective: November 15, 1982 Supersedes: SD100-2.6 dated 4/30/81	Job: VARIOUS BLDGS. (B55548) NEW RIVER M.C.A.S

TANK DRAINER

PURPOSE

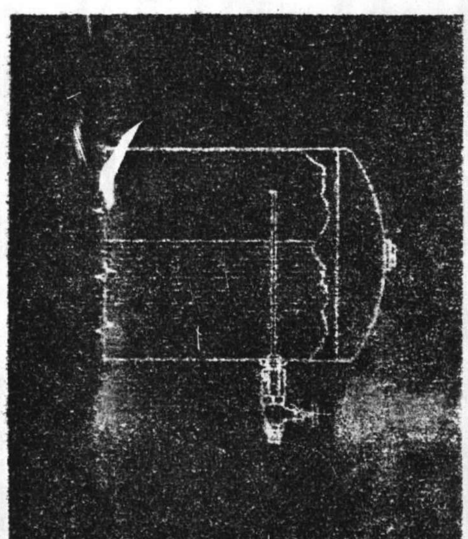
Designed for fast draining of water from water-logged Expansion Tanks.

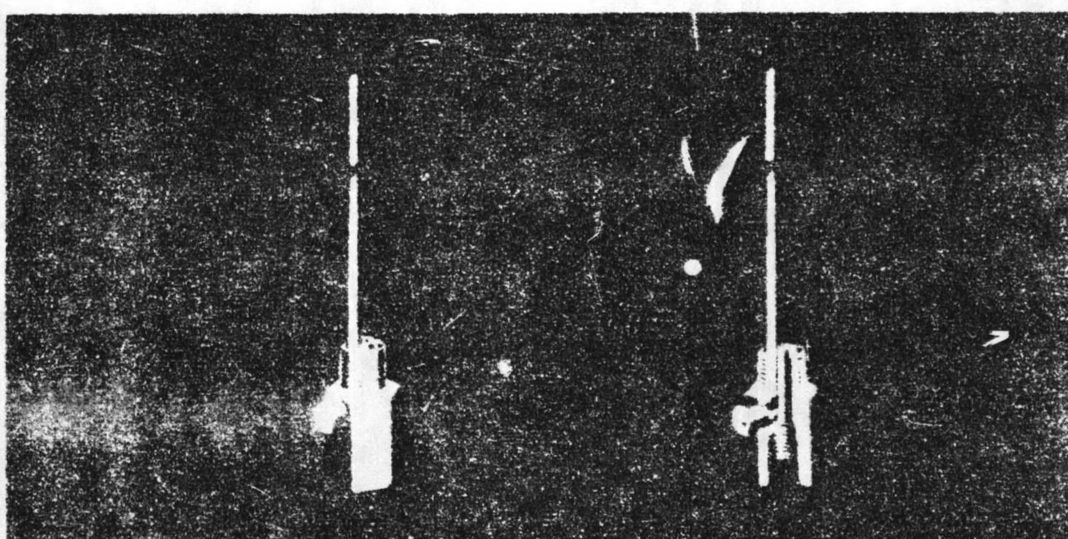
FEATURES

- Low Cost
- Quick Air Charging
- Easily installed
- All brass body
- 11" (280 mm) long copper tube
- Air charging plug on side, preventing water from soaking installer
- Adaptable to any style drain valve
- Individually boxed for full protection

OPERATION

Removing the plug on side of Tank Drainer permits air to enter into top of Expansion Tank, breaking the vacuum for fast and full flow draining of the Expansion Tank and/or the Heating System.





* DIMENSIONS

PRODUCT NO.	CONN. SIZE	APPROX. SHIPPING WEIGHT				DIAMETER		LENGTH	
		EACH		12 PCS.					
		Lb.	Kg.	Lb.	Kg.	In.	mm	In.	mm
440	1/2" N.P.T.	.6	.3	8	3.6	1 1/8	29	13	330

*CHANGE

TAB PLACEMENT HERE

DESCRIPTION:

Electronic

Air cleaner

☐ Tab page did not contain hand written information

☒ Tab page contained hand written information
*Scanned as next image

TRION

MODEL 71 SERIES
CERTIFIED SUBMITTAL DATA

TRION, INC. P.O. BOX 760 SANFORD, N.C. 27330

Project ______ Location ______
Architect/Engineer Cheatham & Assoc. Location Jacksonville, NC
Purchaser Humphrey Heating Location Jacksonville, NC
Trion Representative Environmental Product Sales Location Raleigh, NC
Trion Job Number J3-73-7774 Submittal Prepared By Jerry L. Crotts Date Nov. 9, 1987

SYSTEM NUMBER	DESIGN CAPACITY (CFM)	%EFFICIENCY ( ) ASHRAE DISCOLORATION ( ) DOP	TRION MODEL NUMBER	*HAND LEFT OR RIGHT	DETERGENT TANK-SIZE (GAL)	DISTANCE BETWEEN POWER PACKS & UNIT (Ft.)	EXTERNAL STATIC "H_2O
1	12,000	90	71-206-02	*	16	*	N/A

OFFICE OF THE
OFFICER IN CHARGE OF CONSTRUCTION
CAMP LEJEUNE, NORTH CAROLINA
APPROVED
SUBJECT TO CONTRACT REQUIREMENTS
CONTRACT N62470-86-C-5548
DATE 2-5-88
CHEATHAM AND ASSOCIATES
T. L. HUGUELET
CDR, CEC, USN
Officer in Charge
of Construction

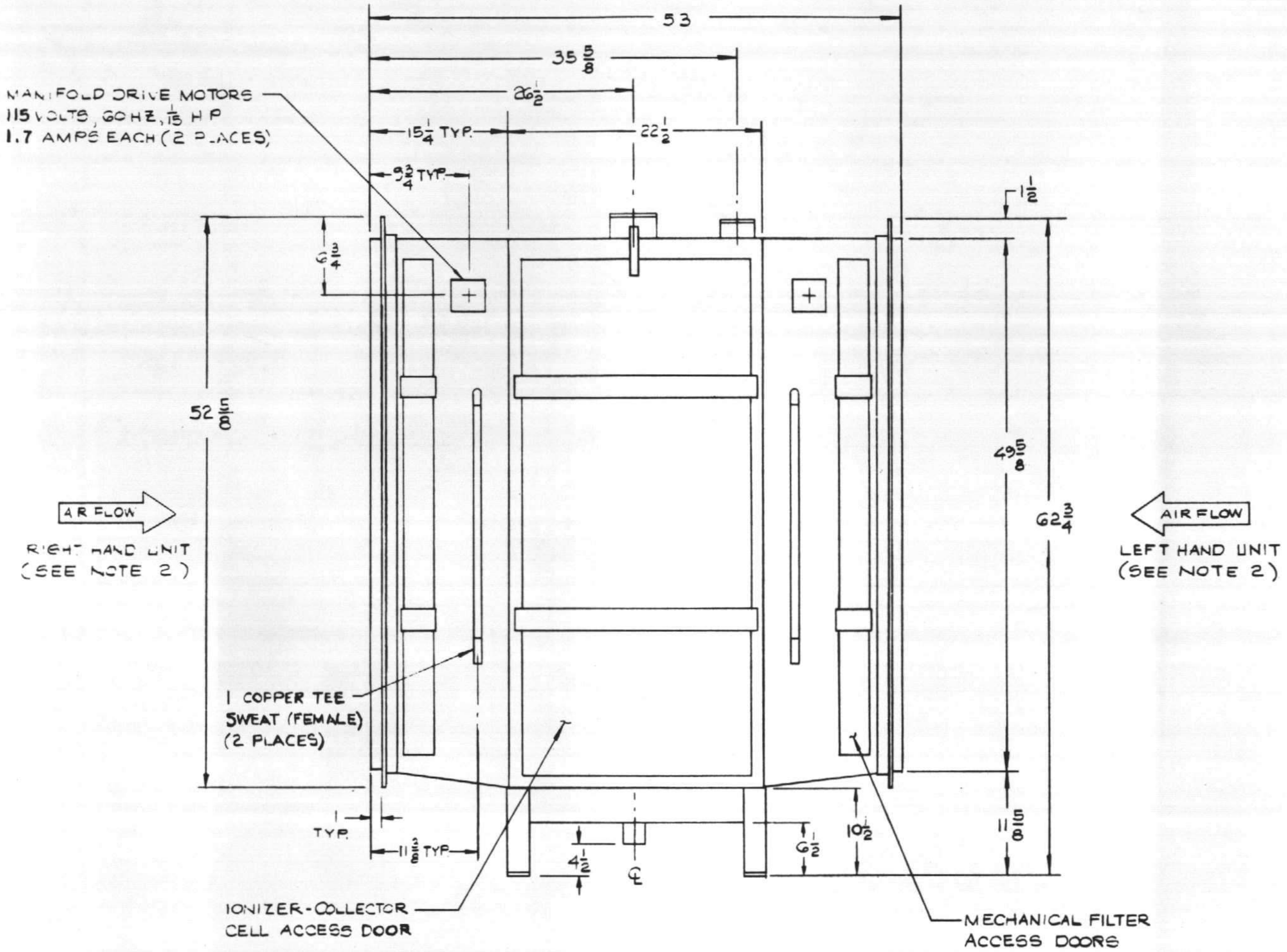
* ACCESS AND/OR ELECTRICAL AND WATER CONNECTIONS. "RIGHT" OR "LEFT" HAND DETERMINED BY FACING INLET WITH AIR STRIKING ONE'S BACK.

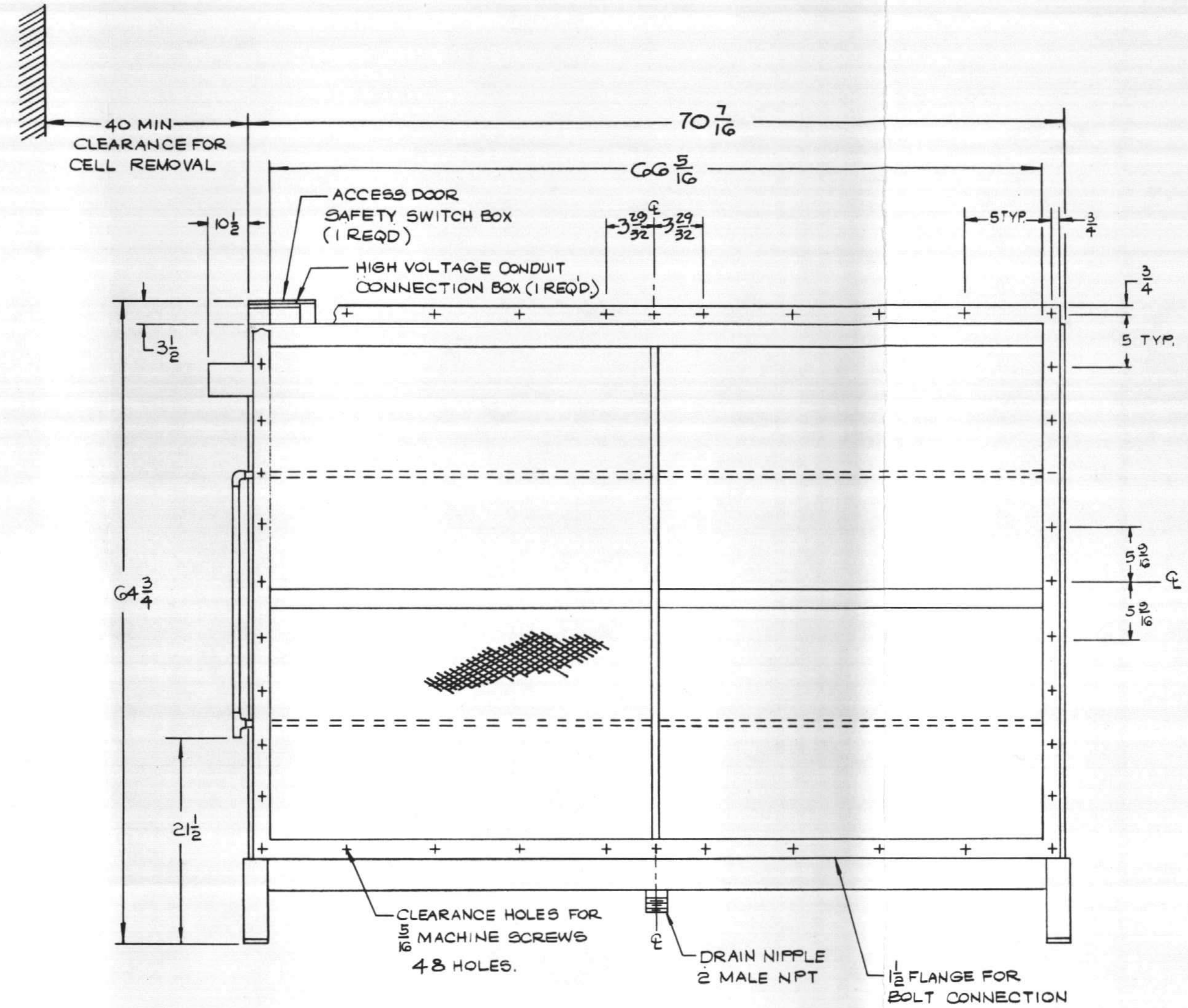
Options, Accessories &/ Or Special Requirements:

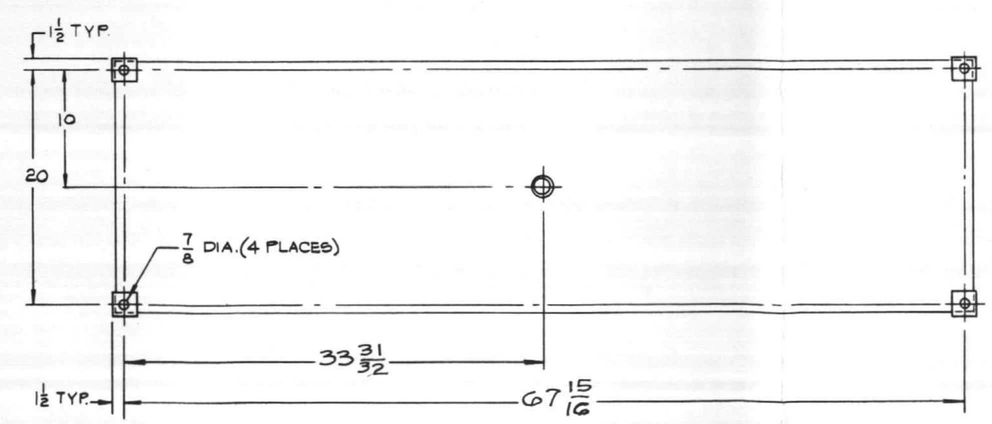
* To be determined

DRAWINGS INCLUDED

System Number(s)	1				
Unit Outline	429360				
Blower Outline	N/A				
Power Pack(s) Outline	427935				
Control Outline	427983				
Detergent System Outline	329445				
Piping Schematic	429488				
Field Wiring Diagram	429434				
Wiring Schematic	429605				







FLOOR MOUNTING LAYOUT

NOTES:

1- PRECIPITATOR NET WEIGHT 1,225 LBS.

2- DIRECTION OF AIR FLOW THROUGH UNIT WILL BE AS SPECIFIED ON ORDER.

We certify that the material and design will be furnished in accordance with this drawing.

REVISIONS

C.O. 2857

NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED USE

SCALE	FRACT. DIM.	DEC. DIM.	ANGLES
N	±1/8	—	—
DR. F.R.	CHKD. GAD	APP. TGW	
DATE 10-26-79	DATE 10-29-79	DATE 10-29-79	

TITLE: UNIT OUTLINE MODEL 71-206-02

TRION, INC. SANFORD, NORTH CAROLINA 27330

DWG 429360

THIS DRAWING PROPERTY OF TRION INC.

REV —

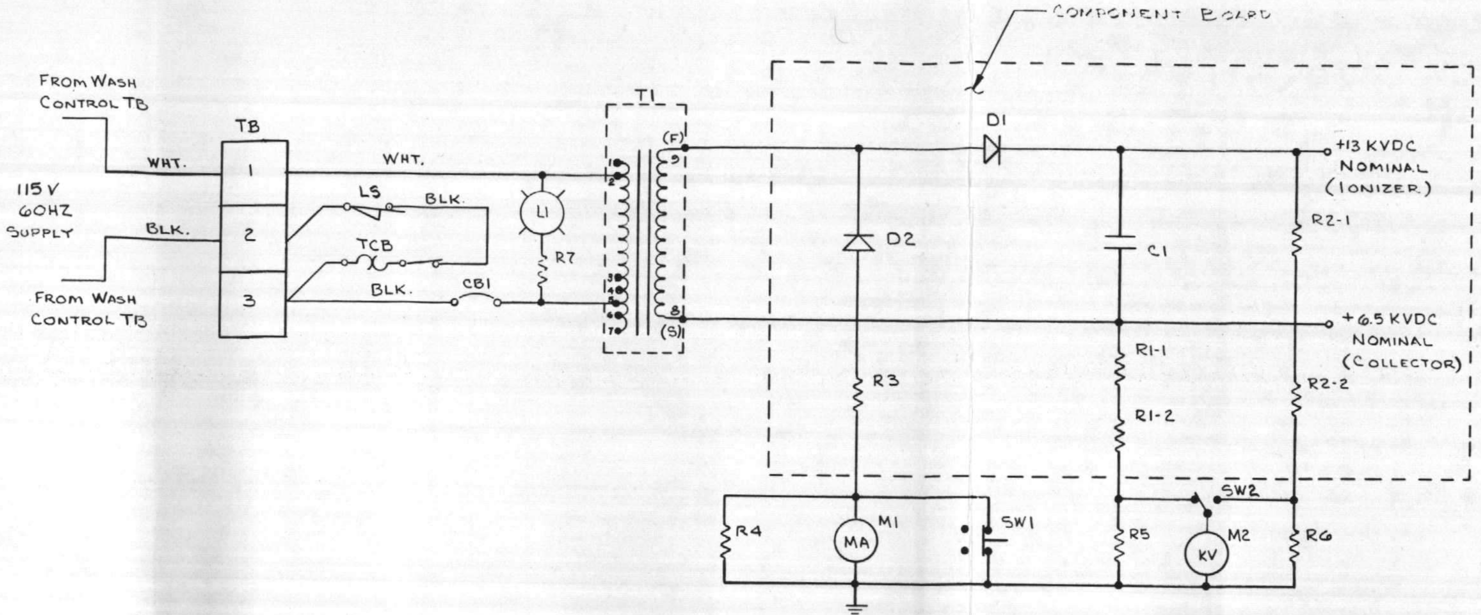
SHT —

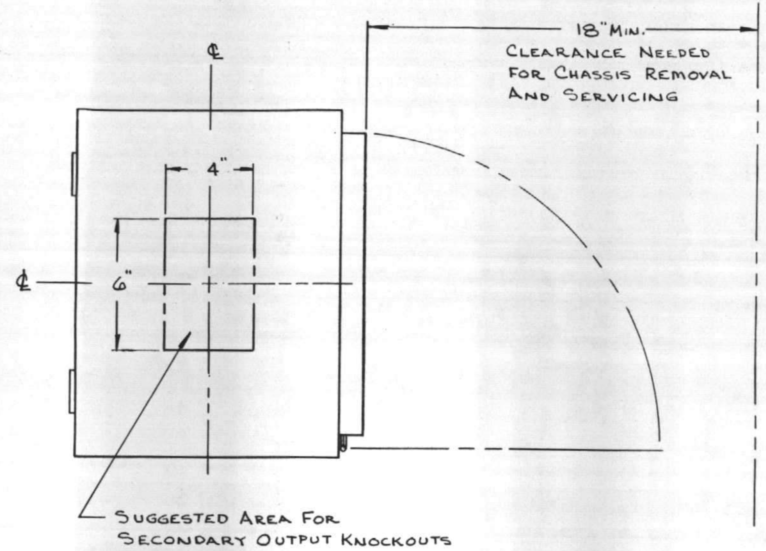
429360

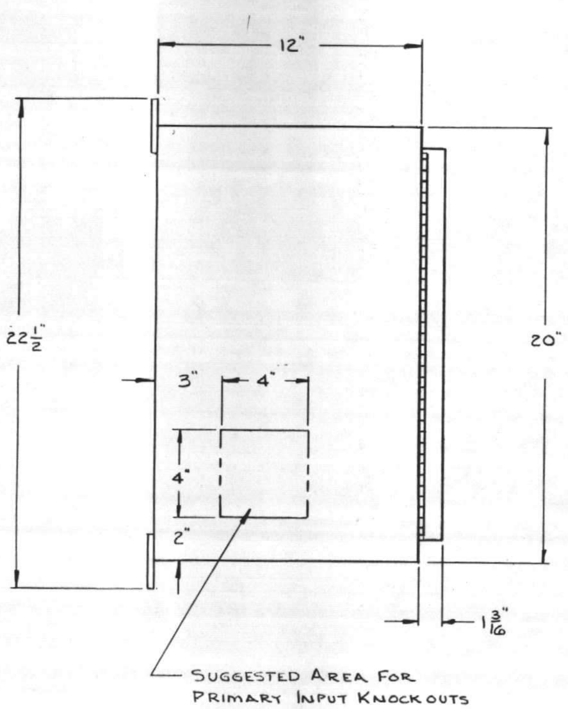
BRUNING 40-534 30341-2

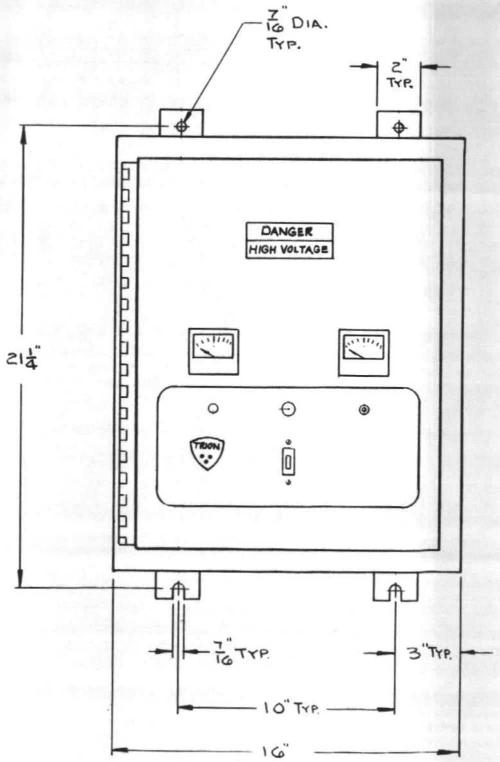
MODEL NO.	POWER PACKS REQD. PER UNIT
60-304-00	1
60-305-00	1
60-306-00	1
60-307-00	2
60-308-00	2
60-309-00	2
60-404-00	1
60-405-00	2
60-406-00	2
60-407-00	2
60-408-00	2
60-409-00	2
60-504-00	2
60-505-00	2
60-506-00	2
60-507-00	2
60-604-00	2
60-605-00	2
60-606-00	2
60-704-00	2
60-705-00	2
60-205-00	1

MODEL NO.	POWER PACKS REQD. PER UNIT
71-102-XX	1
71-103-XX	1
71-104-XX	1
71-105-XX	1
71-106-XX	1
71-107-XX	1
71-108-XX	1
71-109-XX	1
71-203-XX	1
71-204-XX	1
71-205-XX	1
71-206-XX	1
71-207-XX	1
71-208-XX	1
71-209-XX	1
71-303-XX	1
71-304-XX	1
71-305-XX	1
71-306-XX	1
71-307-XX	2
71-308-XX	2
71-309-XX	2









SYMBOL	DESCRIPTION
T1	TRANSFORMER
TB	INPUT TERMINAL BLOCK
LS	LIMIT SWITCH
SW1	PUSH TO READ SWITCH
SW2	METER SELECTOR
TCB	THERMAL CIRCUIT BREAKER
CB1	CIRCUIT BREAKER
R1-1, R1-2, R2-1, R2-2	MULTIPLIER RESISTOR
R3	SURGE RESISTOR
R4	BYPASS RESISTOR
R5, R6	DIVIDER RESISTOR
R7	CURRENT LIMITING RESISTOR
M1	MILLIAMMETER
M2	KILOVOLT METER
C1	CAPACITOR
L1	PILOT LIGHT
D1, D2	RECTIFIER

NOTES:

1. POWER PACKS SHOULD BE MOUNTED AS CLOSE TO EYE LEVEL AS PRACTICAL FOR EASE IN SERVICING AND OBSERVING CONTROLS.
2. WHEN MORE THAN ONE PACK IS EMPLOYED, ESPECIALLY IN MUTI-SECTION INSTALLATION, IT IS ADVISABLE TO ARRANGE THE MOUNTING IN A MEANINGFUL ORDER IN ACCORDANCE WITH THE PRECIPITATOR SECTION ARRANGEMENT.
3. WEIGHT 110 LBS.

We certify that the material and [illegible] be [illegible]nished in accordance with this drawing.

REVISIONS

F JGW 7-15-82 CO-4054 DFS ADDED: MODEL NOs 71-308-XX, 71-309-XX

E GAD 1-3-79 CO2919 CHANGED: LS, SW1, SW2 WAS SW1, SW[illegible] RESP.

D CBE 12-12-79 CO-2857 CHGD: TB WAS TB2, TB INPUT WAS TB2.

C CBE 10-4-79 CO-2802 ADDED: MODEL CHART, & NOTES

B [illegible] CO 27[illegible] [illegible]

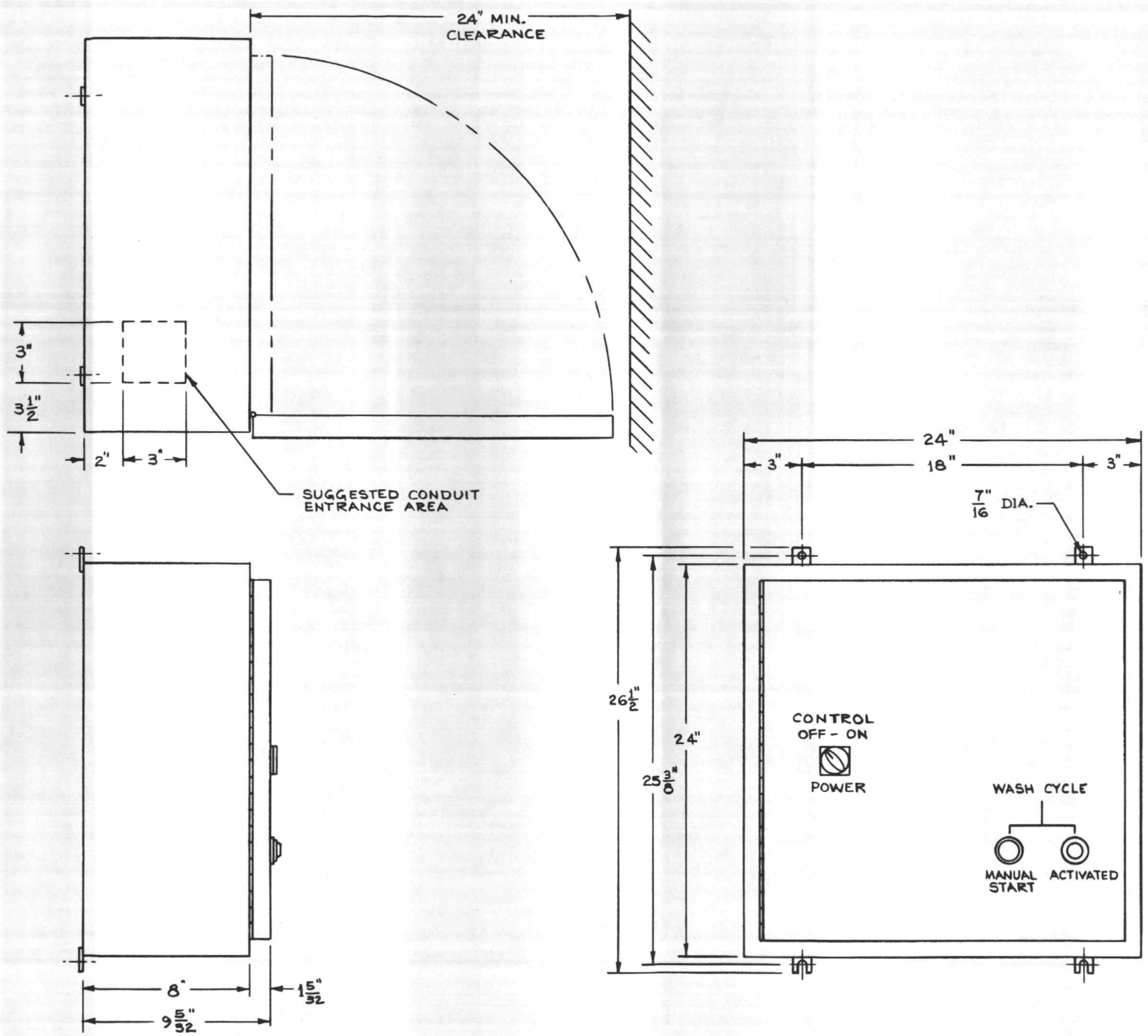
A TV 9-6-79 CO-2760 TB2 REDRAWN ADDED R7 & TCB

		UNLESS OTHERWISE SPECIFIED USE				TITLE	DWG	REV
		SCALE ~	FRACT. DIM. ±1/8	DEC. DIM. —	ANGLES —	POWER PACK OUTLINE NEMA 12 ENCLOSURE		E
NEXT ASSY	USED ON	DR. TV DATE 9-6-79	CHKD. LWS DATE 9-6-79	APP. LWS DATE 9-6-79		TRION, INC. SANFORD, NORTH CAROLINA 27330	427935 THIS DRAWING PROPERTY OF TRION INC	SHT —
APPLICATION								

427935

BRUNING 40-534 30341-2

REVISIONS

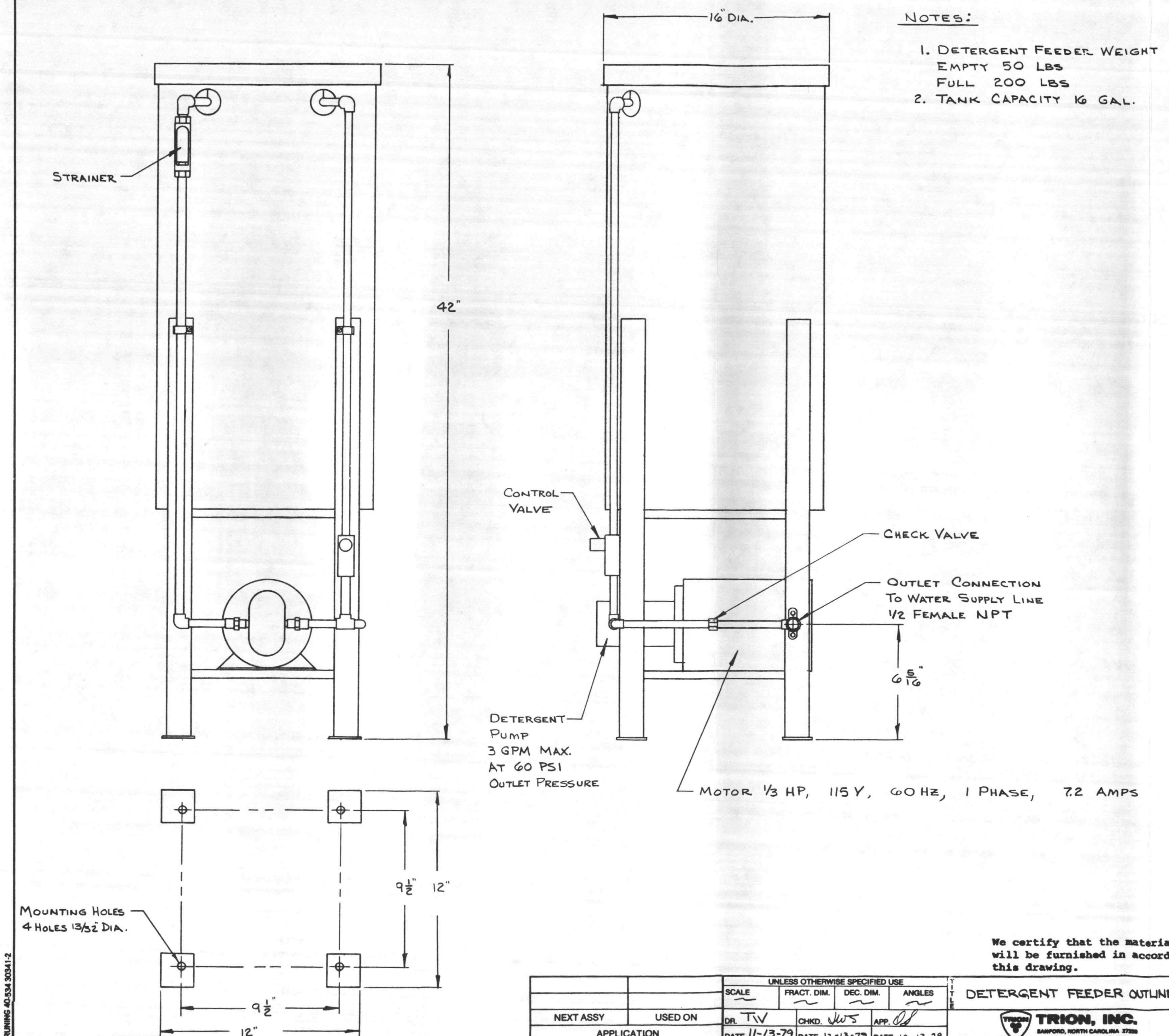


427983

We certify that the material and design will be furnished in accordance with this drawing.

WEIGHT - 90 Lbs.

		UNLESS OTHERWISE SPECIFIED USE				TITLE	REV
	MODEL 71	SCALE ~	FRACT. DIM. ~	DEC. DIM. ~	ANGLES ~	D CONTROL OUT LINE TYPICAL	—
NEXT ASSY	USED ON	DR. GAD	CHKD. MEG	APP. MEG		TRION, INC. SANFORD, NORTH CAROLINA 27330	SHT
APPLICATION		DATE 8-21-78	DATE 8-22-78	DATE 8-22-78		DWG 427983 THIS DRAWING PROPERTY OF TRION INC.	—



NOTES:

1. DETERGENT FEEDER WEIGHT
   EMPTY 50 LBS
   FULL 200 LBS
2. TANK CAPACITY 16 GAL.

REVISIONS

329445

We certify that the material and design will be furnished in accordance with this drawing.

CO - 2857

		UNLESS OTHERWISE SPECIFIED USE				TITLE		REV
		SCALE ~	FRACT. DIM. ~	DEC. DIM. ~	ANGLES ~	DETERGENT FEEDER OUTLINE	16 GAL. TANK	—
NEXT ASSY	USED ON	DR. TW	CHKD. WWS	APP. [illegible]		TRION, INC. SANFORD, NORTH CAROLINA 27330	DWG 329445	SHT —
APPLICATION		DATE 11-13-79	DATE 12-13-79	DATE 12-13-79			THIS DRAWING PROPERTY OF TRION INC.	

BRUNING 40-534 30341-2

REVISIONS

1. HAND SERVICE VALVE, 1 1/4" (BY OTHERS)
2. STRAINER, 1 1/4" (BY TRION)
3. SOLENOID VALVE, 1 1/4" (BY TRION) SEE NOTE 2
4. VACUUM BREAKER, 1 1/4" (BY TRION) SEE NOTE 1
5. 3 1/2" GAUGE, 0 - 100 PSI (BY OTHERS)

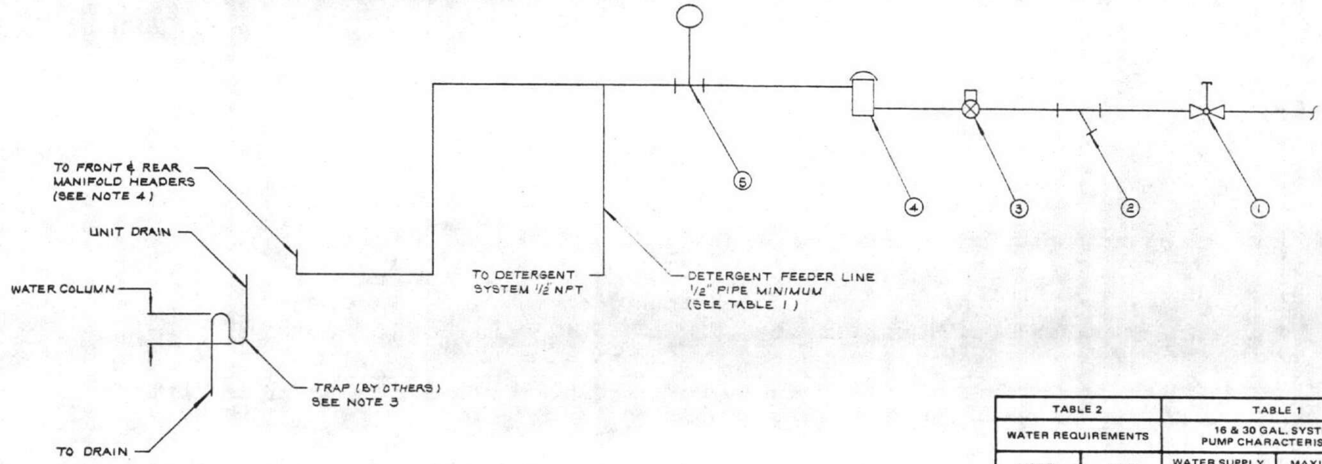


TABLE 2	
WATER REQUIREMENTS	
MODEL	GPM
71-102	5
71-103	7
71-104	10
71-105	12
71-106	14
71-107	17
71-108	19
71-109	22
71-203	14
71-204	19
71-205	24
71-206	29
71-207	34
71-208	38
71-209	43
71-303	22
71-304	29
71-305	36
71-306	43
71-307	50
71-308	58
71-309	65

TABLE 1	
16 & 30 GAL. SYSTEM PUMP CHARACTERISTICS	
WATER SUPPLY LINE PRESS (PSI)	MAXIMUM (FT) VERTICAL HEAD
35	57
40	46
45	34
50	23
PUMP CAPACITY AT MAXIMUM VERTICAL HEAD IS 3.0 GPM	
55 GAL. SYSTEM PUMP CHARACTERISTICS	
WATER SUPPLY LINE PRESS (PSI)	MAXIMUM (FT) VERTICAL HEAD
35	57
40	46
45	34
50	23
PUMP CAPACITY AT MAXIMUM VERTICAL HEAD IS 6.5 GPM	

NOTES:

1. VACUUM BREAKER MUST BE MOUNTED IN VERTICAL POSITION, AT LEAST 6 INCHES ABOVE THE HIGHEST WASH MANIFOLD.
2. SOLENOID VALVE COIL MUST BE MOUNTED UPRIGHT.
3. DRAIN-LINE TRAP MUST PROVIDE SUFFICIENT WATER COLUMN TO OVERCOME THE INTERNAL STATIC PRESSURE OF THE AIR HANDLING SYSTEM IN WHICH THE AIR CLEANER IS INSTALLED.
4. SUPPLY LINE PRESSURE:
35 PSI MINIMUM
50 PSI MAXIMUM

We certify that the material and design will be furnished in accordance with this drawing.

CO - 2857

	MODEL 71	UNLESS OTHERWISE SPECIFIED USE: SCALE ~ FRACT. DIM. ~ DEC. DIM. ~ ANGLES ~	TITLE: PIPING SCHEMATIC OUTLINE		REV —
NEXT ASSY	USED ON	DR CBE / CHKD WWS / APP [illegible]	TRION, INC.	DWG 429488	SHT —
APPLICATION		DATE 12-11-79 / DATE 12-18-79 / DATE 12-18-79		THIS DRAWING PROPERTY OF TRION INC.	

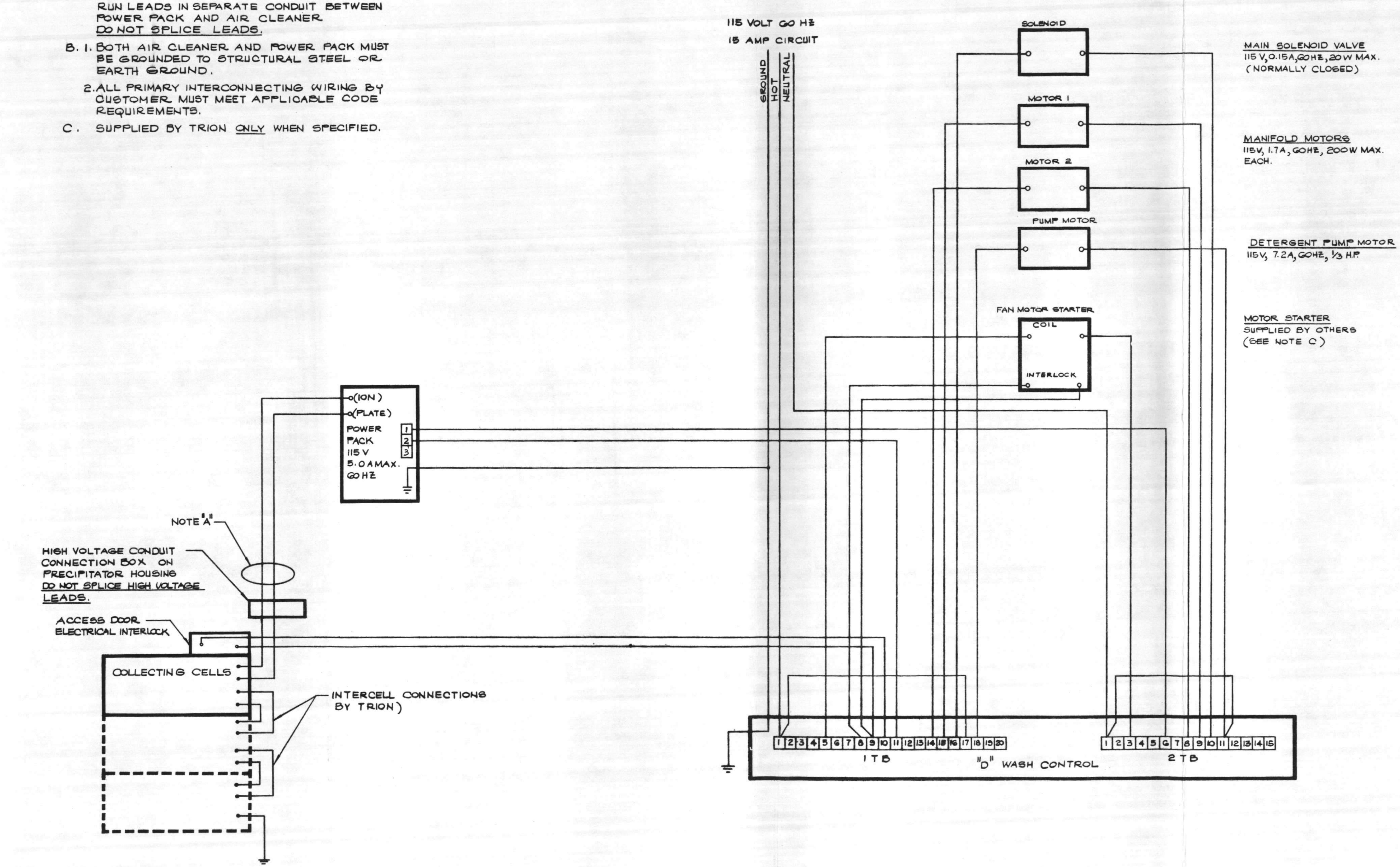
NOTES:

A. HIGH VOLTAGE LEADS BY TRION
STANDARD LENGTH - 25 FT.
IONIZER RED
PLATE BLACK
RUN LEADS IN SEPARATE CONDUIT BETWEEN POWER PACK AND AIR CLEANER
DO NOT SPLICE LEADS.

B. 1. BOTH AIR CLEANER AND POWER PACK MUST BE GROUNDED TO STRUCTURAL STEEL OR EARTH GROUND.

2. ALL PRIMARY INTERCONNECTING WIRING BY CUSTOMER MUST MEET APPLICABLE CODE REQUIREMENTS.

C. SUPPLIED BY TRION ONLY WHEN SPECIFIED.



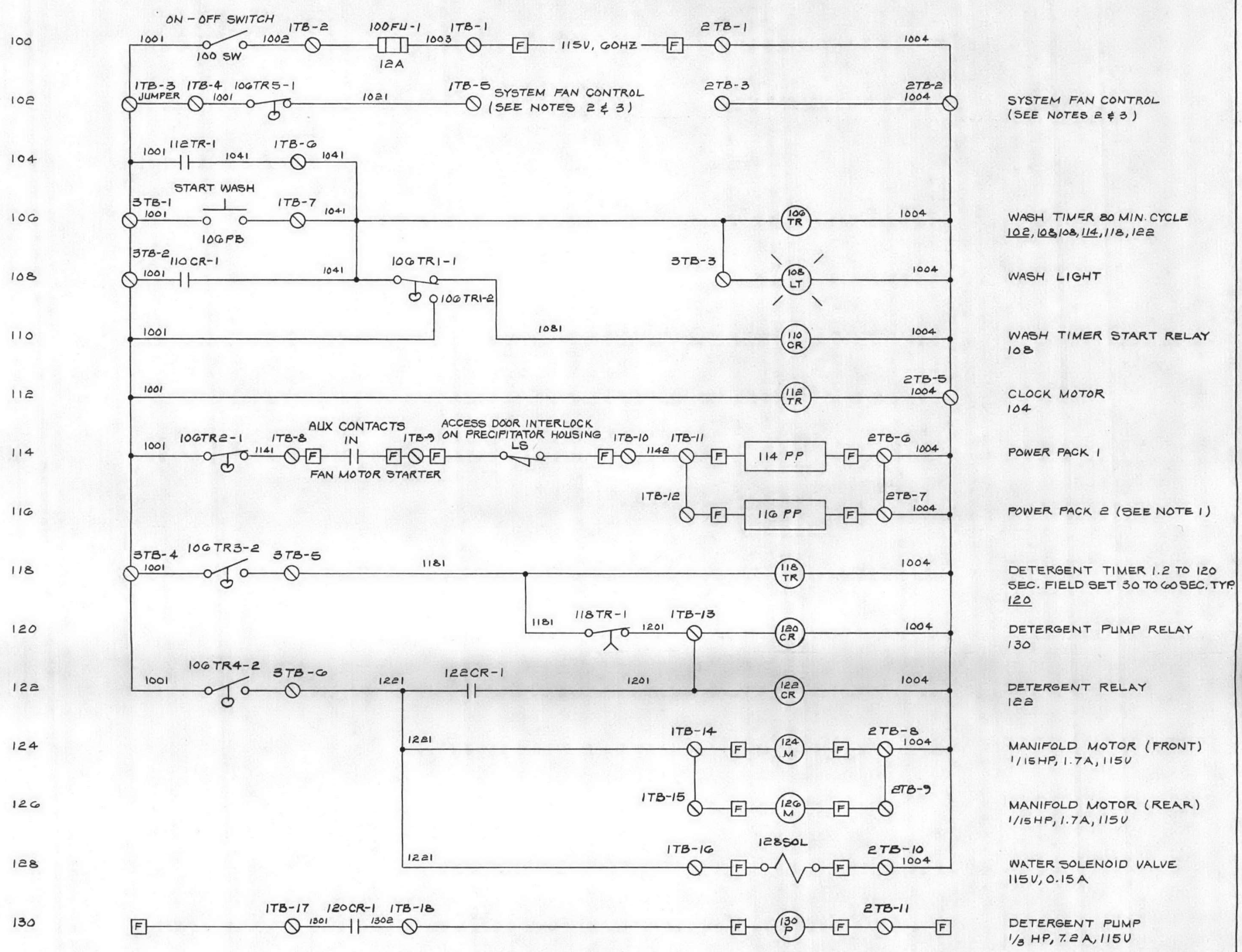
REVISIONS

429434

We certify that the material and design will be furnished in accordance with this drawing.

C.O. 2857

	MODEL 71	UNLESS OTHERWISE SPECIFIED USE				FIELD WIRING DIAGRAM	ONE POWER PACK WASH CONTROL 16/30 GAL. DETERGENT SYSTEM	REV —
NEXT ASSY	USED ON	SCALE ~	FRACT. DIM. ~	DEC. DIM. ~	ANGLES ~	TRION, INC. SANFORD, NORTH CAROLINA	DWG 429434	SHT —
APPLICATION		DR. F.R. DATE 11-19-79	CHKD. WS DATE 12-18-79	APP. DB DATE 12-18-79			THIS DRAWING PROPERTY OF TRION INC.	



LEGEND

- ⊘ TERMINAL IN CONTROL
- [F] FIELD WIRING
- CAM OPERATED SWITCH

NOTE

1) EXTRA TERMINALS PROVIDED FOR FIELD WIRING IF SECOND POWER PACK IS USED
2) 106TR5-1 CONTACT PROVIDES FOR FAN OPERATION AS FOLLOWS:
   A. CONTACT OPENS DURING WASH CYCLE TO STOP FAN (FACTORY WIRED TO 115V/60HZ SUPPLY)
   B. CONTACT CLOSES FOR FORCED DRYING & CONTINUES CLOSED FOR NORMAL AIR CLEANING OPERATION. (FACTORY WIRED TO 115V/60HZ SUPPLY)
3) SYSTEM FAN CONTROL MAY BE OPERATED FROM OTHER THAN 115V/60HZ BY DISCONNECTING JUMPER WIRE BETWEEN 1TB-3 & 1TB-4. THIS ISOLATES 106TR5-1. 106TR5-1 CAN NOW BE WIRED TO PROVIDE INDEPENDENT CONTROL IN FAN CIRCUIT.

We certify that the material and desi... will be furnished in accordance with this drawing.

REVISIONS

A CBE 4-17-80 CO-3102

CO - 3006

NEXT ASSY	USED ON	UNLESS OTHERWISE SPECIFIED USE			
	"D" CONTROL	SCALE ~	FRACT. DIM. ~	DEC. DIM. ~	ANGLES ~
APPLICATION		DR. CBE DATE 1-31-80	CHKD. EFC DATE 2-7-80	APP. VWS DATE 2-13-80	

SCHEMATIC "D" CONTROL

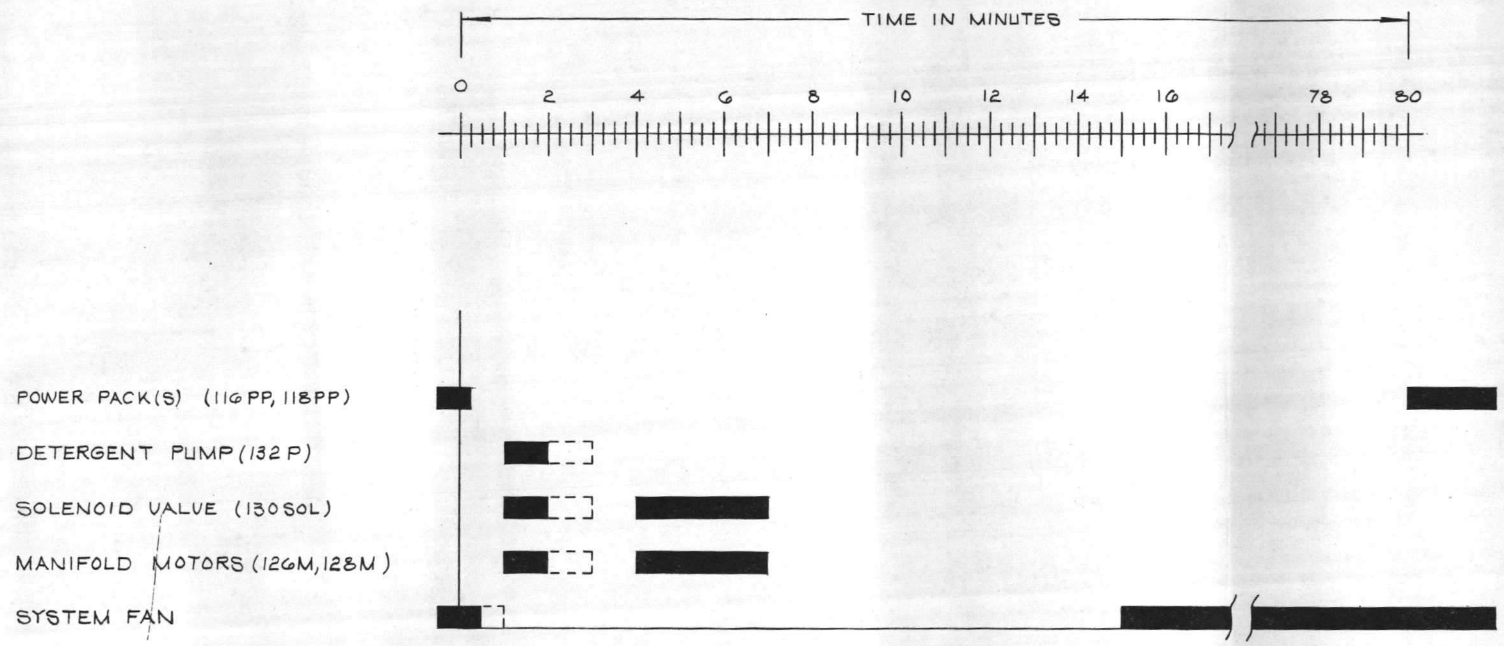
INTERNAL CLOCK 10/60 GAL. DETERGENT SYSTEM

TRION, INC. SANFORD, NORTH CAROLINA 27330

DWG 429605 REV A SHT 1/2

THIS DRAWING PROPERTY OF TRION INC.

429605



0 - 1 SYSTEM COAST TIME - ALLOW FAN TO STOP

1 - 3 WASH TIME - CAM 3 ON 108TR FACTORY SET TO 2 MINUTES
ADJUST 120TR FOR OPTIMUM DETERGENT USAGE

3 - 5 SOAK TIME - ADJUSTABLE BY VARYING START OF DETENT OF
CAM 4 ON 108TR

5 - 8 RINSE TIME - FACTORY SET FOR 3 MINUTES. ADJUST BY VARYING
DETENT OF CAM 4 ON 108TR

8 - 15 DRIP DRY TIME - ADJUSTABLE BY VARYING DETENT END OF CAM
5 ON 108 TR

15 - 80 FAN DRY TIME

SEQUENCE OF OPERATION

The wash cycle can be initiated either manually or automatically and requires 80 minutes for completion. Manual operation is initiated by depressing the Manual Start push-button switch 108PB. Automatic operation is initiated through the closing of the 7 day timer normally open switch 114TR and the one second time delay relay 104TR.

Once the wash sequence is initiated cam 1 (108TR1-2) closes turning on the wash light 110LT, cam 2 (108TR2-1) opens deenergizing the power pack(s) and cam 5 (108TR5-1) opens to shut down the fan. After approximately one minute of fan coast time, cam 3 (108TR3-2) closes energizing the variable time delay relay 120TR.

120TR energizes the detergent pump relay 122CR, control relay 124CR, solenoid valve 130SOL and the manifold motors 126M and 128M. These remain energized for the amount of time set on 120TR (1.2-120 seconds). Typical field setting will be 30 to 60 seconds. After a soak time of up to two minutes, cam 4 (108TR4-2) closes energizing the solenoid valve 130SOL and the manifold motors 126M and 128M for 3 minutes.

After this rinse period, the unit will drip dry for approximately 6 minutes before cam 5 (108TR5-1) closes turning the system fan back on. The system will force dry for approximately 60 minutes after which 108TR will complete its cycle, and return the system to its normal operating state.

429605

						CO - 3006
						REVISIONS
		UNLESS OTHERWISE SPECIFIED USE				
	"D" CONTROL	SCALE ~	FRACT. DIM. ~	DEC. DIM. ~	ANGLES ~	TITLE SCHEMATIC "D" CONTROL SEQUENCE OF OPERATION — REV —
NEXT ASS'Y.	USED ON	DR. CBE	CHKD. EFC	APP. JWS		TRION, INC. SANFORD, NORTH CAROLINA 27330 — DWG 429605 — SHT 2/2
APPLICATION		DATE 1-31-80	DATE 2-7-80	DATE 2-19-80		THIS DRAWING PROPERTY OF TRION INC — DR-5

TRION

ELECTRONIC AIR CLEANERS

CUSTOM PACKAGED EQUIPMENT

MODEL
71
SERIES

Mark V "Scavenger"

Designed for heavy Commercial and Industrial Applications

Trion, Inc. the leader in the design, manufacture and distribution of Electronic Air Cleaners.

The Advantages of Trionized Air

Contaminated air is an undesirable by-product of progress. Contaminated air can be caused by the most simple movement as well as complex operations. In the relatively clean atmosphere of a modern office building, dust is created by foot steps on a carpet. In machine shops, oil mist is created when metals are shaped and formed. Welding shops create fume. The extrusion of plastics, the processing of tobacco, the operations in spinning and weaving mills, all create contamination. It becomes apparent that almost every move man makes fouls the air he breathes. In that these contaminates cannot be prevented from developing, they must be removed, both efficiently and economically. Trion Electronic Air Cleaners are designed to meet these two very basic requirements.

As we communicate in todays world, we use a select group of words. Energy conservation, recycle, low cost, governmental pressures . . . these terms of speech are synonymous with the Trion method of cleaning air.

ENERGY CONSERVATION:

The low pressure drop existing in Trion equipment means reduction in fan motor horsepower. By comparison to other means of filtration, the pressure drop created by Trion Electronic Air Cleaners is low. It is low initially when first installed and remains low in operation.

RECLAMATION:

Many substances, such as expensive lubricating oils, are useless and a menace in an airborne state. When collected, they coalesce, and are suitable for reuse. In addition to the benefit of the salvage, the nuisance has been eliminated.

SPECIFIC INTEREST:

Acceptable pollution levels by governmental and associated pressures have become a way of life. To continue to progress, pollution problems must be addressed or prevented. Trion Electronic Air Cleaners are recognized and accepted as an efficient practical solution.

GENERAL EXPENSES:

Dirty conditioning coils reduce efficiency and are costly to clean. Soiled finish on walls and furnishings are expensive to clean or replace. Material in process or finished stock that is rejected due to soilage or contamination can be disastrous to profits. Trion Electronic Air Cleaners are a practical method to reduce operating costs as well as the enhancement of the general well being of those using ventilation air.

NEW INTEREST:

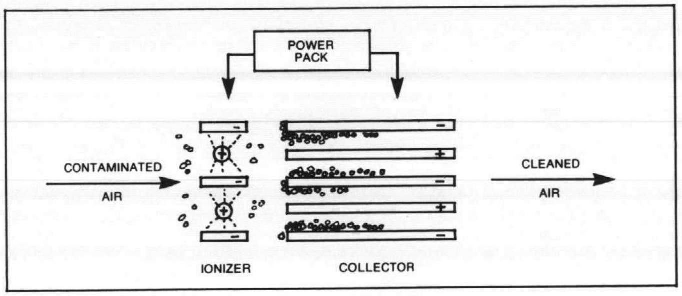
The new avenues stemming from today's research and technical development multiply rapidly. From this progress, situations are created that are untried and our industry is called upon daily to collect airborne contaminates to which there is no past reference. Tempered with application potential, this challenge is of interest and Trion invites the opportunity to investigate.

The Principle of Operation

As contaminated air enters the electronic air cleaner, it must pass by fine diameter tungsten wires suspended between flat grounded electrodes. The DC voltage supplied to the wires creates a high intensity field wherein the particulate matter in the air becomes electrically charged. The charged particles then pass into a collector plate section made up of a series of equally spaced parallel plates. Each alternate plate is charged with the same polarity as the particles, which repel, while the interleaving plates are grounded, which attract and collect.

Liquid contaminates, coalesce into droplets when collected and run off the collector plates in a self-cleaning action.

Solid contaminates, or more viscous substances, accumulate and are periodically washed away.



The Model 71 Packaged Line

Todays' industry demands a packaged precipitator capable of cleaning heavy commercial and industrial environments. To meet this need the Trion Model 71 was designed to provide twenty sizes ranging from 2000 to 27,000 CFM in capacity.

Stationary pre/after filtration and washing/detergent systems are available and may be added to the base unit to meet specific job requirements.

Most sizes are available with blower sections.

Access to the collecting elements (ionizing-collecting cells) and the pre/after filters is located on one end of the unit, perpendicular to the direction of air flow and may be specified on either side of the unit.

Two standard size ionizing-collecting cells are employed in the make-up of any given unit. The height and depth dimensions are identical; 24″ high x 18″ deep. Cell width dimensions vary: nominal 24″ and 36″. This provides increments of 1 foot widths and 2 foot heights.

The power pack is designed for remote mounting up to 250 feet away from the base unit.

When a washer/detergent system is required a control is furnished to actuate the washing cycle. It may be furnished either semi-automatic (push button initiated) or completely automatic (time clock initiated). An optional step-down transformer—is also available.

The control for the blower package includes a motor starter with fused disconnect switch and a step-down transformer for single power supply hook-up.

When control accessories are specified they are factory mounted and wired inside the control.

Model Number Designation

71 — X XX — XX

- Equipment Type (Custom Packaged Line) — 71
- Number of Cells in Height — X
- Nominal Cell Width in Feet — XX
- Specific Features — XX

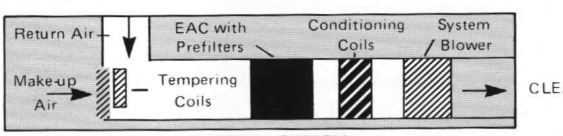
Specific Feature Designation

MODEL 71-XXX-	BASE UNIT	FRONT & REAR COLLARS	*STATIONARY FILTERS AND PERFORATED PLATE	WASHER W/DETERGENT SYSTEM	FAN SECTION
—00	YES	NO	NO	NO	NO
—01	YES	YES	YES	NO	NO
—02	YES	YES	YES	YES	NO
—03	YES	YES	YES	NO	YES
—04	YES	YES	YES	YES	YES

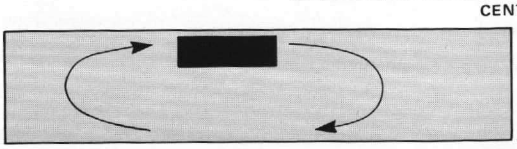
*Stationary Filters—1″ heavy duty metal mesh.
Perforated Plate—5/16″ holes on 1/2″ staggered centers.
Stationary filters shipped as standard.
If perforated plate is desired front and/or rear it must be specified.
Refer to feature Designation Table to make selection.
Refer to Efficiency Resistance Graph for pressure drop.

Typical System Arrangements

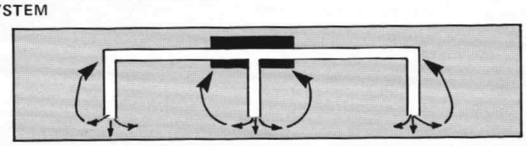
The Model 71 readily adapts to the various air distribution systems utilized to deliver contaminate for collection. Air inlet and outlet collars on the unit contain predrilled flanges, as well as straight edges, for adjoining duct connections. Cabinetry legs employ wide, predrilled pads for mounting securement.



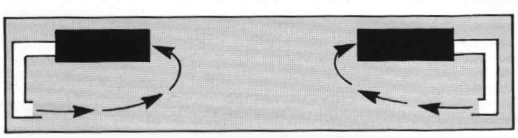
CENTRAL SYSTEM



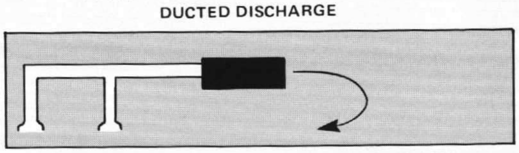
FUGITIVE CONTAMINATE - FREE STANDING UNIT



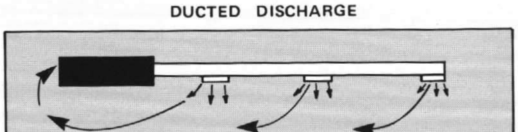
FUGITIVE CONTAMINATE - LOW COLUMN DUCTED DISCHARGE



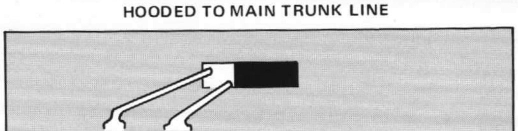
FUGITIVE CONTAMINATE - LOW SIDE WALL DUCTED DISCHARGE



MULTIPLE SOURCE CAPTURED CONTAMINATE - HOODED TO MAIN TRUNK LINE

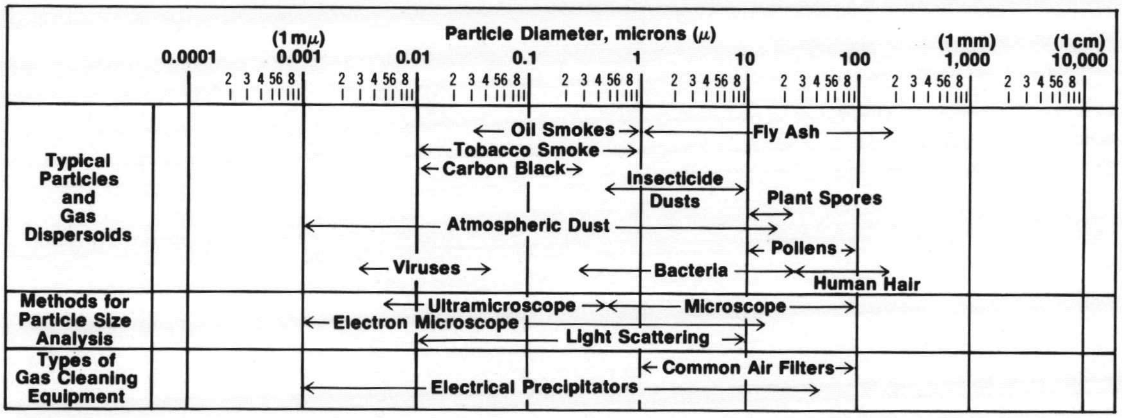


FUGITIVE CONTAMINATE - MULTIPLE OVERHEAD DISCHARGE THROUGH CENTRAL TRUNK LINE

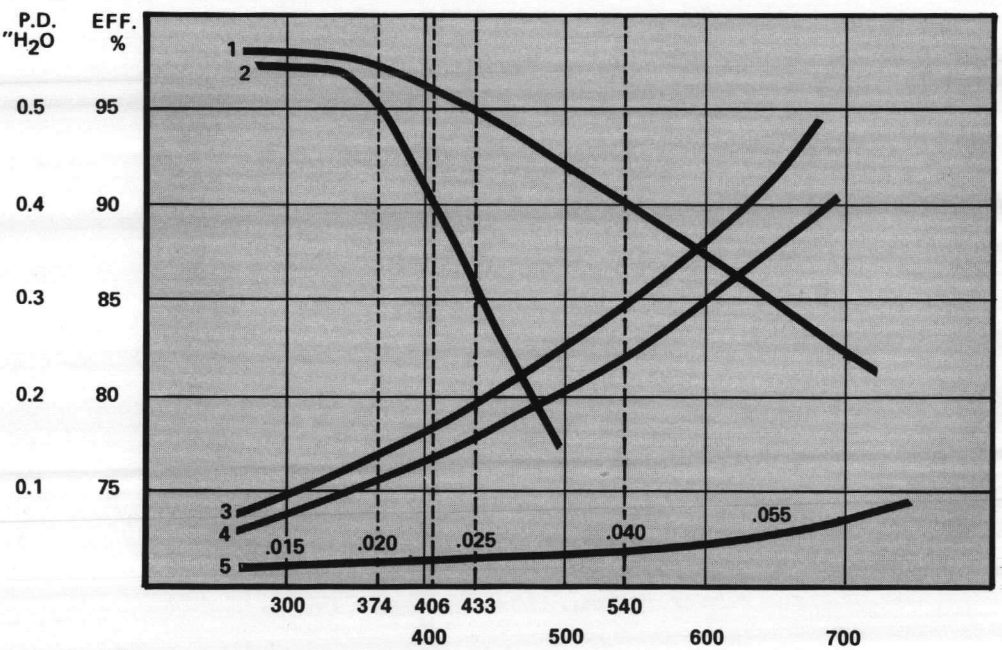


MULTIPLE SOURCE CAPTURED CONTAMINATE - HOODED TO COMMON MIXING PLENUM

Characteristics of Particles and Particle Dispersoids



Efficiency Resistance



AIR VELOCITY FEET PER MINUTE
(VOLUME OF AIR FLOW CFM PER SQ. FT. OF FACE AREA)

EFFICIENCY—CURVES 1 AND 2

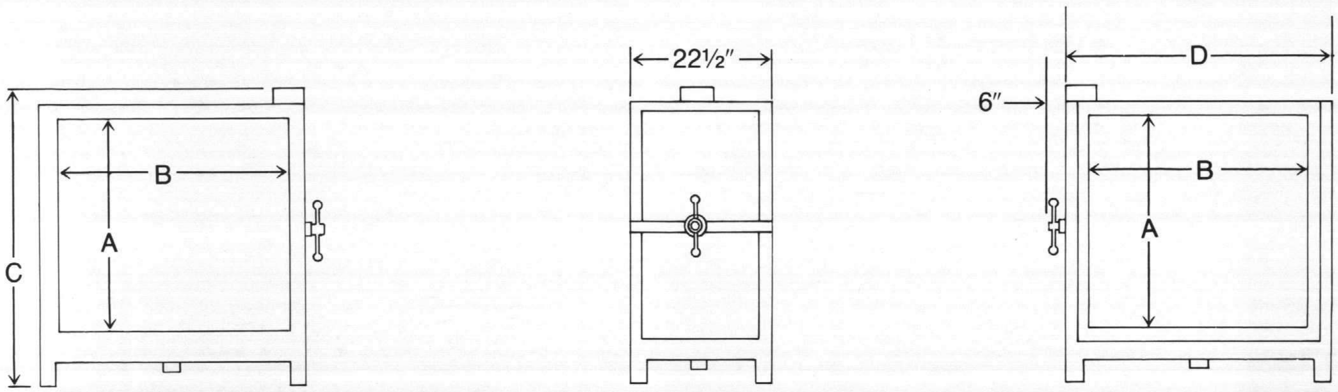
1. ASHRAE Standard 52-76 Dust Spot Test Method Atmospheric Air.
2. DOP Dioctylphthalate Aerosol Using Penetration Meter.

PRESSURE DROP ACROSS UNIT—CURVES 3 AND 4

3. Cell with 40% open perforated plate front and rear.
4. Cell with 1" metal mesh filter front and rear.
5. Cell only.

Base Unit without Collars without Wash

Model Designation ends in -00



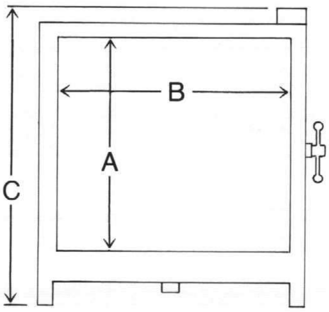
Size Capacity Data Chart

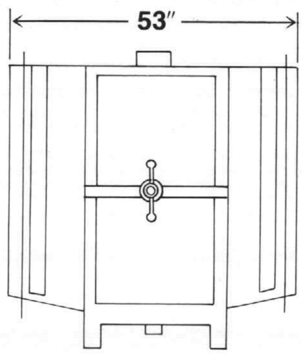
MODEL DESIGNATION NUMBER	CFM CAPACITIES EFFICIENCIES (1)		CFM CAPACITIES EFFICIENCIES (2)		SQ. FT. CELL FACE AREA (3)	POWER PACK TYPE	71-XXX-00 NOT AVAILABLE WITH A BLOWER SECTION				
							OPENING DIMENSIONS		OVERALL DIMENSIONS		WT. LBS. (4)
	95%	90%	95%	90%			HEIGHT A	WIDTH B	HEIGHT C	WIDTH D	
71-102-00	1,600	2,000	1,375	1,500	3.68	E	25"	21⅞"	40½"	26"	360
71-103-00	2,400	3,000	2,070	2,250	5.54	E	25"	33	40½"	37⅛"	410
71-104-00	3,200	4,000	2,750	3,000	7.36	E	25"	44	40½"	48⅛"	460
71-105-00	4,000	5,000	3,350	3,750	9.22	E	25"	55⅛"	40½"	59¼"	530
71-106-00	4,800	6,000	4,125	4,500	11.08	E	25"	66⅜"	40½"	70½"	655
71-107-00	5,600	7,000	4,850	5,250	12.90	E	25"	77¼"	40½"	81⅜"	705
71-108-00	6,400	8,000	5,500	6,000	14.76	E	25"	88½"	40½"	92⅝"	750
71-109-00	7,200	9,000	6,200	6,750	16.62	E	25"	99¾"	40½"	103⅞"	800
71-203-00	4,800	6,000	4,125	4,500	11.08	E	49¼"	33	64¾"	37⅛"	655
71-204-00	6,400	8,000	5,500	6,000	14.72	E	49¼"	44	64¾"	48⅛"	750
71-205-00	8,000	10,000	6,890	7,500	18.44	F	49¼"	55⅛"	64¾'	59¼"	805
71-206-00	9,600	12,000	8,250	9,000	22.16	F	49¼"	66⅜"	64¾"	70½"	900
71-207-00	11,200	14,000	9,700	10,500	25.80	F	49¼"	77¼"	64¾"	81⅜"	1,100
71-208-00	12,800	16,000	11,000	12,000	29.52	F	49¼"	88½"	64¾"	92⅝"	1,200
71-209-00	14,400	18,000	12,400	13,500	33.24	F	49¼"	99¾"	64¾"	103⅞"	1,300
71-303-00	7,200	9,000	6,200	6,750	16.62	E	73⅞"	33	89⅜"	37⅛"	750
71-304-00	9,600	12,000	8,250	9,000	22.08	F	73⅞"	44	89⅜"	48⅛"	900
71-305-00	12,000	15,000	10,300	11,200	27.66	F	73⅞"	55⅛"	89⅜"	59¼"	1,050
71-306-00	14,400	18,000	12,400	13,500	33.24	F	73⅞'	66⅜"	89⅜"	70½"	1,200
71-307-00	16,800	21,000	14,400	15,700	38.70	Fx2	73⅞"	77¼"	89⅜"	81⅜"	1,350
71-308-00	19,200	24,000	16,500	18,000	44.28	Fx2	73⅞"	88½"	89⅜"	92⅝"	1,500
71-309-00	21,600	27,000	18,600	20,200	49.86	Fx2	73⅞"	99¾"	89⅜"	103⅞"	1,650

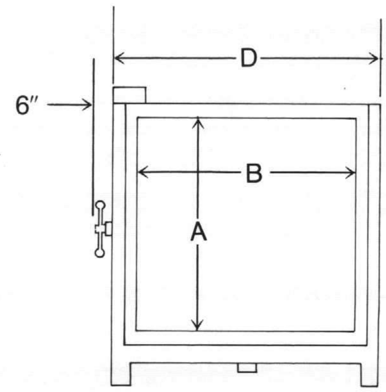
(1) ASHRAE Standard 52-76 Dust Spot Test method.
(2) DOP efficiency based on use of Dioctylphthalate Aerosol.
(3) Total gross face area of ionizing-collecting cells in accordance with ASHRAE Standard 52-76.
(4) Total weight of unit with power pack(s).

Base Unit with Collars without Wash

Model Designation Ends in -01





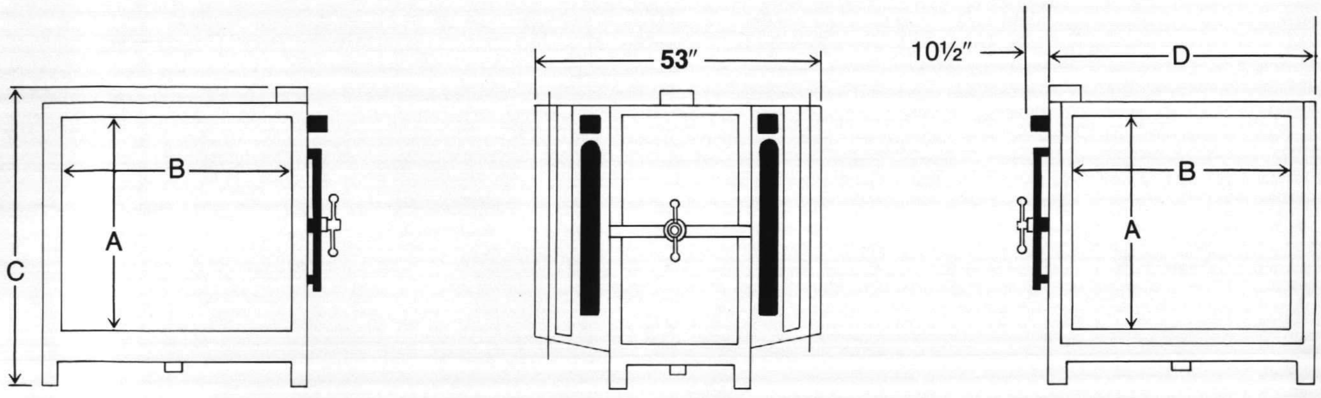


Size Capacity Data Chart

MODEL DESIGNATION NUMBER	CFM CAPACITIES EFFICIENCIES (1)		CFM CAPACITIES EFFICIENCIES (2)		SQ. FT. CELL FACE AREA (3)	POWER PACK TYPE	71-XXX-01 W/O WASH					
							COLLAR DIMENSIONS		OVERALL DIMENSIONS		WT.LBS. (4)	AVAILABLE WITH FAN SECTION
	95%	90%	95%	90%			HEIGHT A	WIDTH B	HEIGHT C	WIDTH D		
71-102-01	1,600	2,000	1,375	1,500	3.68	E	25″	21¾″	40½″	26″	410	YES
71-103-01	2,400	3,000	2,070	2,250	5.54	E	25″	33″	40½″	37⅛″	460	YES
71-104-01	3,200	4,000	2,750	3,000	7.36	E	25″	44″	40½″	48⅛″	510	YES
71-105-01	4,000	5,000	3,350	3,750	9.22	E	25″	55⅛″	40½″	59¼″	580	YES
71-106-01	4,800	6,000	4,125	4,500	11.08	E	25″	66¼″	40½″	70½″	705	YES
71-107-01	5,600	7,000	4,850	5,250	12.90	E	25″	77¼″	40½″	81⅜″	755	YES
71-108-01	6,400	8,000	5,500	6,000	14.76	E	25″	88½″	40½″	92⅝″	800	YES
71-109-01	7,200	9,000	6,200	6,750	16.62	E	25″	99¾″	40½″	103⅞″	850	YES
71-203-01	4,800	6,000	4,125	4,500	11.08	E	49⅝″	33″	64¾″	37⅛″	705	YES
71-204-01	6,400	8,000	5,500	6,000	14.72	E	49⅝″	44″	64¾″	48⅛″	800	YES
71-205-01	8,000	10,000	6,890	7,500	18.44	F	49⅝″	55⅛″	64¾″	59¼″	855	YES
71-206-01	9,600	12,000	8,250	9,000	22.16	F	49⅝″	66¼″	64¾″	70½″	950	YES
71-207-01	11,200	14,000	9,700	10,500	25.80	F	49⅝″	77¼″	64¾″	81⅜″	1,150	YES
71-208-01	12,800	16,000	11,000	12,000	29.52	F	49⅝″	88½″	64¾″	92⅝″	1,250	YES
71-209-01	14,400	18,000	12,400	13,500	33.24	F	49⅝″	99¾″	64⅜″	103⅞″	1,350	YES
71-303-01	7,200	9,000	6,200	6,750	16.62	E	74¼″	33″	89⅜″	37⅛″	800	YES
71-304-01	9,600	12,000	8,250	9,000	22.08	F	74¼″	44″	89⅜″	48⅛″	950	YES
71-305-01	12,000	15,000	10,300	11,200	27.66	F	74¼″	55⅛″	89⅜″	59¼″	1,100	YES
71-306-01	14,400	18,000	12,400	13,500	33.24	F	74¼″	66¼″	89⅜″	70½″	1,250	YES
71-307-01	16,800	21,000	14,400	15,700	38.70	Fx2	74¼″	77¼″	89⅜″	81⅜″	1,400	YES
71-308-01	19,200	24,000	16,500	18,000	44.28	Fx2	74¼″	88½″	89⅜″	92⅝″	1,550	YES
71-309-01	21,600	27,000	18,600	20,200	49.86	Fx2	74¼″	99¾″	89⅜″	103⅞″	1,700	YES

(1) ASHRAE Standard 52-76 Dust Spot Test method.
(2) DOP efficiency based on use of Dioctylphthalate Aerosol.
(3) Total gross face area of ionizing-collecting cells in accordance with ASHRAE Standard 52-76.
(4) Total weight of unit with power pack(s).

Base Unit with Collars with Wash
Model Designation Ends in -02



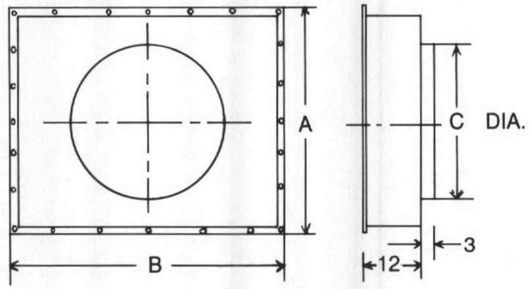
Size Capacity Data Chart

MODEL DESIGNATION NUMBER	CFM CAPACITIES EFFICIENCIES (1)		CFM CAPACITIES EFFICIENCIES (2)		SQ. FT. CELL FACE AREA (3)	POWER PACK TYPE	71-XXX-02 W/WASH								
							COLLAR DIMENSIONS		OVERALL DIMENSIONS		WT. LBS. (4)	AVERAGE H_2O REQ. GPM (5)	DET. AV. GAL. PER WASH	AVAILABLE WITH FAN SECTION
	95%	90%	95%	90%			HEIGHT A	WIDTH B	HEIGHT C	WIDTH D				
71-102-02	1,600	2,000	1,375	1,500	3.68	E	25″	21¾″	40½″	26″	490	5	.25	YES
71-103-02	2,400	3,000	2,070	2,250	5.54	E	25″	33″	40½″	37⅛″	560	7	.35	YES
71-104-02	3,200	4,000	2,750	3,000	7.36	E	25″	44″	40½″	48⅛″	630	10	.50	YES
71-105-02	4,000	5,000	3,350	3,750	9.22	E	25″	55⅛″	40½″	59¼″	720	12	.60	YES
71-106-02	4,800	6,000	4,125	4,500	11.08	E	25″	66¼″	40½″	70½″	865	14	.70	YES
71-107-02	5,600	7,000	4,850	5,250	12.90	E	25″	77¼″	40½″	81⅜″	910	17	.85	YES
71-108-02	6,400	8,000	5,500	6,000	14.76	E	25″	88½″	40½″	92⅝″	950	19	.95	YES
71-109-02	7,200	9,000	6,200	6,750	16.62	E	25″	99¾″	40½″	103⅞″	1,020	22	1.10	YES
71-203-02	4,800	6,000	4,125	4,500	11.08	E	49⅝″	33″	64¾″	37⅛″	780	14	.70	YES
71-204-02	6,400	8,000	5,500	6,000	14.72	E	49⅝″	44″	64¾″	48⅛″	895	19	.95	YES
71-205-02	8,000	10,000	6,890	7,500	18.44	F	49⅝″	55⅛″	64¾″	59¼″	1,025	24	1.20	YES
71-206-02	9,600	12,000	8,250	9,000	22.16	F	49⅝″	66¼″	64¾″	70½″	1,225	29	1.45	YES
71-207-02	11,200	14,000	9,700	10,500	25.80	F	49⅝″	77¼″	64¾″	81⅜″	1,370	34	1.70	YES
71-208-02	12,800	16,000	11,000	12,000	29.52	F	49⅝″	88½″	64¾″	92⅝″	1,465	38	1.90	YES
71-209-02	14,400	18,000	12,400	13,500	33.24	F	49⅝″	99¾″	64¾″	103⅞″	1,595	43	2.15	YES
71-303-02	7,200	9,000	6,200	6,750	16.62	E	74¼″	33″	89⅜″	37⅛″	945	22	1.10	YES
71-304-02	9,600	12,000	8,250	9,000	22.08	F	74¼″	44″	89⅜″	48⅛″	1,215	29	1.45	YES
71-305-02	12,000	15,000	10,300	11,200	27.66	F	74¼″	55⅛″	89⅜″	59¼″	1,300	36	1.80	YES
71-306-02	14,400	18,000	12,400	13,500	33.24	F	74¼″	66¼″	89⅜″	70½″	1,450	43	2.15	YES
71-307-02	16,800	21,000	14,400	15,700	38.70	Fx2	74¼″	77¼″	89⅜″	81⅜″	1,650	50	2.50	YES
71-308-02	19,200	24,000	16,500	18,000	44.28	Fx2	74¼″	88½″	89⅜″	92⅝″	1,850	58	2.90	YES
71-309-02	21,600	27,000	18,600	20,200	49.86	Fx2	74¼″	99¾″	89⅜″	103⅞″	2,050	65	3.25	YES

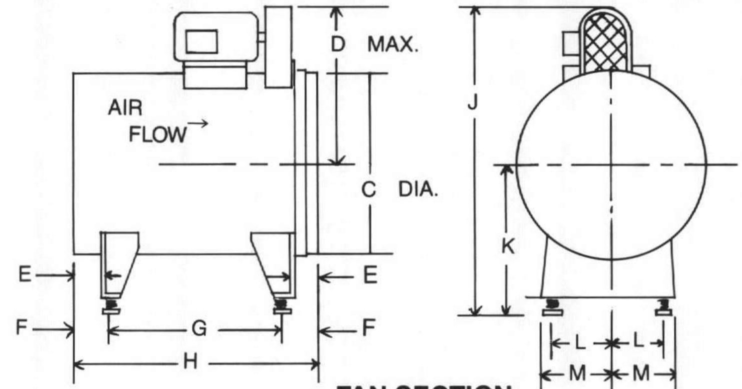
(1) ASHRAE Standard 52-76 Dust Spot Test method.
(2) DOP efficiency based on use of Dioctylphthalate Aerosol.
(3) Total gross face area of ionizing-collecting cells in accordance with ASHRAE Standard 52-76.
(4) Total weight of unit with power pack(s), control, wash and 16 gal. detergent system without liquid detergent. Detergent wt. 9.25 lb./gallon.
(5) Average wash cycle is 4 minutes. Multiply GPM × 4 for average maximum water volume.

Fan Transition Dimensional Data (inches):

Model Designation Ends In -03 or -04



TRANSITION
(Connected to air cleaner discharge at factory)



FAN SECTION

FAN SIZE(1)	A & B	C	D	E	F	G	H	J	K	L	M
SL122-1		17	24	2 1/2	3 3/8	21 1/4	28	48 1/2	24 1/2	8 1/2	9 3/4
SL135-1		18 3/4	25	2 1/2	3 3/8	23 1/2	30 1/4	49 1/2	24 1/2	9 3/8	10 5/8
SL150-1		20 3/4	26 1/4	2 1/2	3 3/8	26 1/2	33 1/4	50 3/4	24 1/2	10 3/8	11 5/8
SL165-1		22 7/8	27 3/4	2 1/2	3 3/8	29 1/4	36	52 1/4	24 1/2	11 1/2	12 3/4
SL182-1		25 1/4	34 1/2	2 1/2	3 3/8	34 1/2	39 1/4	59	24 1/2	12 5/8	13 7/8
SL182-2	SAME AS	25 1/4	34 1/2	2 1/2	3 3/8	32 1/2	39 1/4	59	36 7/16	12 5/8	13 7/8
SL200-1	AIR CLEANER	27 5/8	36	2 1/2	3 3/8	35 5/8	42 3/8	60 1/2	24 1/2	13 7/8	15 1/8
SL200-2	OUTLET	27 5/8	36	2 1/2	3 3/8	35 5/8	42 3/8	72 7/16	36 7/16	13 7/8	15 1/8
SL222-1		30 7/8	38 3/4	3 1/2	4 7/8	38 1/4	48	63 1/4	24 1/2	15 1/2	16 3/4
SL222-2	REFER TO	30 7/8	38 3/4	3 1/2	4 7/8	38 1/4	48	75 3/16	36 7/16	15 1/2	16 3/4
SL222-3	MODEL	30 7/8	38 3/4	3 1/2	4 7/8	38 1/4	48	87 1/2	48 3/4	15 1/2	16 3/4
SL245-1	71-XXX-01	34	41 1/2	3 1/2	4 7/8	43	52 3/4	66	24 1/2	17	18 1/4
SL245-2	OR	34	41 1/2	3 1/2	4 7/8	43	52 3/4	77 15/16	36 7/16	17	18 1/4
SL245-3	71-XXX-02	34	41 1/2	3 1/2	4 7/8	43	52 3/4	90 1/4	48 3/4	17	18 1/4
SL270-1	PAGE 5 & 6	37 1/2	43 3/4	3 1/2	4 7/8	48 1/4	58	68 1/4	24 1/2	18 3/4	20
SL270-2		37 1/2	43 3/4	3 1/2	4 7/8	48 1/4	58	80 9/16	36 7/16	18 3/4	20
SL270-3		37 1/2	43 3/4	3 1/2	4 7/8	48 1/4	58	92 1/8	48 3/4	18 3/4	20
SL300-2		41 5/8	45 3/4	3 1/2	4 7/8	53 3/4	63 1/2	82 3/16	36 7/16	20 7/8	22 1/8
SL300-3		41 5/8	45 3/4	3 1/2	4 7/8	53 3/4	63 1/2	94 1/2	48 3/4	20 7/8	22 1/8
SL330-2		45 3/4	51 1/2	3 1/2	4 7/8	59 1/2	69 1/4	87 15/16	36 7/16	22 7/8	24 1/8
SL330-3		45 3/4	51 1/2	3 1/2	4 7/8	59 1/2	69 1/4	100 1/4	48 3/4	22 7/8	24 1/8
SL365-2		50 1/2	53 3/4	3 1/2	4 7/8	62 1/4	72	90 3/16	36 7/16	25 1/4	27 1/4
SL365-3		50 1/2	53 3/4	3 1/2	4 7/8	62 1/4	72	102 1/2	48 3/4	25 1/4	27 1/4
SL402-3		55 5/8	57 1/4	5	6 3/4	69 3/4	83 1/4	106	48 3/4	20 7/8	29 7/8
SL445-3		61 1/2	60 1/4	5	6 3/4	77 1/4	90 3/4	109	48 3/4	30 3/4	32 3/4

(1) Refer to Fan Data Chart below for fan size.
(2) 71-XXX-03 is the designation for a Model 71-XXX-01 Air Cleaner (less washer) coupled with a blower section.
(3) 71-XXX-04 is the designation for a Model 71-XXX-02 Air Cleaner (with washer) coupled with a blower section.
(4) Refer to 71-XXX-01 or 71-XXX-02 data for Air Cleaner dimensions.
(5) Dimensions listed are nominal.
(6) For total assembly weight, add Air Cleaner weight, pages 5 or 6, to Fan Transition weight listed below.

Fan Data

CFM	MODEL 71-XXX-03 OR 71-XXX-04	FANS & TRANSITION WT (LBS.) W/MAX. HP MOTOR	FAN SIZE	OUTLET VELOCITY FPM	EXTERNAL STATIC PRESSURE 0″ SP RPM	HP	½″ SP RPM	HP	1″ SP RPM	HP	1½″ SP RPM	HP	2″ SP RPM	HP	(H.P. BELOW IS ACTUAL MOTOR H.P.) 2½″ SP RPM	HP	3″ SP RPM	HP	3½″ SP RPM	HP	4″ SP RPM	HP
1375	71-102-XX	224	SL122-1	887	1608	½	1809	¾	1978	¾	2148	1	2236	1	2477	1½	2644	2	2864	2	—	
1500	71-102-XX	240	SL122-1	968	1734	½	1923	¾	2097	1	2256	1	2419	1½	2551	1½	2702	2	2873	2	3030	3
1600	71-102-XX	240	SL122-1	1032	1839	¾	2023	1	2177	1	2335	1½	2481	1½	2623	1½	2816	2	2909	3	3048	3
2000	71-102-XX	261	SL135-1	1058	1667	¾	1878	1	2035	1½	2174	1½	2299	2	2424	2	2548	3	2677	3	2797	3
2070	71-103-XX	273	SL135-1	1095	1714	1	1926	1	2080	1½	2214	1½	2339	2	2464	3	2588	3	2706	3	2836	3
2250	71-103-XX	288	SL135-1	1190	1844	1	2045	1½	2199	1½	2332	2	2446	2	2571	3	2679	3	2788	3	2890	5
2400	71-103-XX	328	SL150-1	1030	1396	¾	1517	1	1645	1	1784	1½	1935	2	2089	3	2226	3	2359	3	2469	5
2750	71-104-XX	340	SL150-1	1180	1585	1	1687	1½	1792	1½	1909	2	2037	2	2165	3	2301	3	2423	5	2551	5
3000	71-103-XX	371	SL165-1	1064	1304	1	1415	1½	1538	1½	1667	2	1786	3	1910	3	2034	3	2158	5	2247	5
3000	71-104-XX	383	SL165-1	1064	1304	1	1415	1½	1538	1½	1667	2	1786	3	1910	3	2034	3	2158	5	2247	5
3200	71-104-XX	383	SL165-1	1135	1379	1	1488	1½	1600	1½	1749	2	1830	3	1951	3	2071	5	2184	5	2302	5
3350	71-105-XX	420	SL182-1	971	1089	1	1209	1½	1319	1½	1450	2	1573	3	1692	3	—		—		—	
3350	71-105-XX	395	SL165-1	1188	—		—		—		—		—		—		2107	5	2211	5	2320	5
3750	71-105-XX	510	SL200-1	906	909	1	997	1	1119	1½	1261	2	1389	3	1506	5	—		—		—	
3750	71-105-XX	474	SL182-1	1087	—		—		—		—		—		—		1847	5	1948	5	2060	7½
4000	71-104-XX	462	SL182-1	1159	1284	1½	1370	2	1465	2	1575	3	1688	3	1786	5	1887	5	1980	5	2072	7½
4000	71-105-XX	474	SL182-1	1159	1284	1½	1370	2	1465	2	1575	3	1688	3	1786	5	1887	5	1980	5	2072	7½
4125	71-106-XX	485	SL182-1	1196	1320	1½	1403	2	1495	3	1605	3	1705	3	1809	5	1901	5	2002	5	2094	7½
4125	71-203-XX	481	SL182-2	1196	1320	1½	1403	2	1495	3	1605	3	1705	3	1809	5	1901	5	2002	5	2094	7½
4500	71-106-XX	560	SL200-1	1087	1079	1½	1139	1½	1226	2	1331	3	1442	3	1568	5	1667	5	1768	7½	1852	7½
4500	71-203-XX	556	SL200-2	1087	1079	1½	1139	1½	1226	2	1331	3	1442	3	1568	5	1667	5	1768	7½	1852	7½
4800	71-106-XX	560	SL200-1	1159	1146	1½	1206	2	1280	3	1367	3	1472	5	1586	5	1690	5	1791	7½	1882	7½
4800	71-203-XX	556	SL200-2	1159	1146	1½	1206	2	1280	3	1367	3	1472	5	1586	5	1690	5	1791	7½	1882	7½
4850	71-107-XX	572	SL200-1	1171	1158	2	1214	2	1286	3	1374	3	1479	5	1590	5	1702	5	1796	7¼	1887	7½
5000	71-105-XX	549	SL200-1	1208	1192	2	1245	2	1316	3	1397	3	1493	5	1600	5	1712	5	1812	7½	1901	7½
5250	71-107-XX	572	SL200-1	1268	1235	2	1306	3	1364	3	1442	3	1526	5	1623	5	1721	5	1823	7½	1916	7½
5500	71-108-XX	682	SL222-1	1074	965	1½	1013	2	1080	3	1193	3	1294	5	1399	5	1495	7½	1585	7½	1662	10
5500	71-204-XX	671	SL222-2	1074	965	1½	1013	2	1080	3	1193	3	1294	5	1399	5	1495	7½	1585	7½	1662	10
5600	71-107-XX	670	SL222-1	1094	981	2	1031	2	1098	3	1199	3	1302	5	1409	5	1501	7½	1593	7½	1689	10
6000	71-106-XX	658	SL222-1	1172	1047	2	1093	3	1134	3	1232	5	1333	5	1429	5	1527	7½	1611	7½	1724	10
6000	71-203-XX	654	SL222-2	1172	1047	2	1093	3	1134	3	1232	5	1333	5	1429	5	1527	7½	1611	7½	1724	10
6000	71-204-XX	671	SL222-2	1172	1047	2	1093	3	1134	3	1232	5	1333	5	1429	5	1527	7½	1611	7½	1724	10
6000	71-108-XX	682	SL222-1	1172	1047	2	1093	3	1134	3	1232	5	1333	5	1429	5	1527	7½	1611	7½	1724	10
6200	71-109-XX	694	SL222-1	1210	1080	3	1123	3	1174	3	1250	5	1348	5	1442	5	1535	7½	1623	7½	1708	10
6200	71-303-XX	684	SL222-3	1210	1080	3	1123	3	1174	3	1250	5	1348	5	1442	5	1535	7½	1623	7½	1708	10
6400	71-108-XX	793	SL245-1	1031	839	2	893	2	970	3	1063	5	1168	5	1257	7½	1339	7½	1413	10	1488	10
6400	71-204-XX	782	SL245-2	1031	839	2	893	2	970	3	1063	5	1168	5	1257	7½	1339	7½	1413	10	1488	10
6750	71-109-XX	805	SL245-1	1087	879	2	935	3	996	3	1083	5	1182	5	1274	5	1352	7½	1436	10	1503	10
6750	71-303-XX	795	SL245-3	1087	879	2	935	3	996	3	1083	5	1182	5	1274	5	1352	7½	1436	10	1503	10
6890	71-205-XX	800	SL245-2	1110	894	2	947	3	1013	3	1095	5	1188	5	1283	7½	1367	7½	1441	10	1507	10
7000	71-107-XX	781	SL245-1	1127	911	3	961	3	1020	3	1102	5	1190	7½	1289	7½	1370	7½	1452	10	1518	10
7200	71-109-XX	805	SL245-1	1159	936	2	986	3	1042	3	1162	5	1202	5	1297	5	1379	7½	1457	10	1532	10
7200	71-303-XX	795	SL245-3	1159	936	2	986	3	1042	3	1162	5	1201	5	1297	5	1379	7½	1457	10	1532	10
7500	71-205-XX	800	SL245-2	1208	974	3	1016	3	1071	5	1143	5	1225	5	1307	7½	1394	7½	1470	10	1546	10
8000	71-108-XX	925	SL270-1	1061	758	2	829	3	922	3	991	5	1062	5	1130	7½	1199	7½	1270	10	1329	10
8000	71-204-XX	914	SL270-2	1061	758	2	829	3	922	3	991	5	1062	5	1130	7½	1199	7½	1270	10	1329	10
8000	71-205-XX	932	SL270-2	1061	758	2	829	3	922	3	991	5	1062	5	1130	7½	1199	7½	1270	10	1329	10
8250	71-206-XX	950	SL270-2	1094	775	2	847	3	927	3	1004	5	1076	5	1146	7½	1215	7½	1275	10	1341	10
8250	71-304-XX	951	SL270-3	1094	775	2	847	3	927	3	1004	5	1076	5	1146	7½	1215	7½	1275	10	1341	10
9000	71-109-XX	937	SL270-1	1194	846	3	901	3	976	5	1049	5	1122	7½	1184	7½	1248	7½	1308	10	1368	10
9000	71-206-XX	950	SL270-2	1194	846	3	901	3	976	5	1049	5	1122	7½	1184	7½	1248	7½	1308	10	1368	10
9000	71-303-XX	927	SL270-3	1194	846	3	901	3	976	5	1049	5	1122	7½	1184	7½	1248	7½	1308	10	1368	10
9000	71-304-XX	951	SL270-3	1194	846	3	901	3	976	5	1049	5	1122	7½	1184	7½	1248	7½	1308	10	1368	10
9600	71-206-XX	950	SL270-2	1273	905	3	950	5	1016	5	1085	5	1154	7½	1217	7½	1276	10	1333	10	1393	10
9600	71-304-XX	951	SL270-3	1273	905	3	950	5	1016	5	1085	5	1154	7½	1217	7½	1276	10	1333	10	1393	10
9700	71-207-XX	967	SL270-2	1286	911	3	958	5	1023	5	1091	5	1162	7½	1225	7½	1281	10	1340	10	1398	10
10000	71-205-XX	1075	SL300-2	1074	690	3	751	3	822	5	897	5	960	7½	1020	7½	—		—		—	
10000	71-205-XX	1060	SL270-2	1326	—		—		—		—		—		—		1299	10	1355	10	1410	15
10300	71-305-XX	1272	SL300-3	1106	708	3	770	3	837	5	908	5	973	7½	1030	7½	1086	10	1144	10	1201	15
10500	71-207-XX	1265	SL300-2	1128	721	3	778	3	845	5	917	5	979	7½	1040	7½	1095	10	1154	10	1207	15
11000	71-208-XX	1274	SL300-2	1182	754	3	806	5	870	5	936	7½	1000	7½	1058	7½	1112	10	1168	10	1222	15
11200	71-207-XX	1265	SL300-2	1203	766	3	818	5	882	5	945	7½	1009	7½	1067	10	1120	10	1175	15	1227	15
11200	71-305-XX	1272	SL300-3	1203	766	3	818	5	882	5	945	7½	1009	7½	1067	10	1120	10	1175	15	1227	15
12000	71-206-XX	1248	SL300-2	1288	820	5	865	5	919	5	980	7½	1043	7½	1098	10	1154	10	1201	15	1250	15
12000	71-208-XX	1274	SL300-2	1288	820	5	865	5	919	5	980	7½	1043	7½	1098	10	1154	10	1201	15	1250	15
12000	71-304-XX	1249	SL300-3	1288	820	5	865	5	919	5	980	7½	1043	7½	1098	10	1154	10	1201	15	1250	15
12000	71-305-XX	1272	SL300-3	1288	820	5	865	5	919	5	980	7½	1043	7½	1098	10	1154	10	1201	15	1250	15
12400	71-209-XX	1301	SL300-2	1332	842	5	887	5	941	7½	998	7½	1062	10	1118	10	1168	10	1218	15	1265	15
12400	71-306-XX	1296	SL300-3	1332	842	5	887	5	941	7½	998	7½	1062	10	1118	10	1168	10	1218	15	1265	15
12800	71-208-XX	1274	SL300-2	1375	870	5	911	5	962	7½	1019	7½	1076	10	1134	10	1186	15	1233	15	1281	15
13500	71-209-XX	1437	SL330-2	1198	698	5	754	5	794	7½	860	7½	922	10	975	10	1024	15	1072	15	1120	15
13500	71-306-XX	1432	SL330-3	1198	698	5	754	5	794	7½	860	7½	922	10	975	10	1024	15	1072	15	1120	15
14000	71-207-XX	1411	SL365-2	1015	541	3	579	5	642	5	710	7½	770	7½	—		—		—		—	
14000	71-207-XX	1401	SL330-2	1242	—		—		—		—		—		989	10	1041	15	1085	15	1134	15
14400	71-209-XX	1474	SL365-2	1044	555	3	593	5	652	5	718	7½	778	10	—		—		—		—	
14400	71-209-XX	1437	SL330-2	1278	—		—		—		—		—		1003	15	1051	15	1099	15	1143	15
14400	71-306-XX	1469	SL365-3	1044	555	3	593	5	652	5	718	7½	778	10	—		—		—		—	
14400	71-306-XX	1432	SL330-3	1278	—		—		—		—		—		1003	15	1051	15	1099	15	1143	15
14400	71-307-XX	1492	SL365-3	1044	555	3	593	5	652	7½	718	7½	778	10	—		—		—		—	
14400	71-307-XX	1455	SL330-3	1278	—		—		—		—		—		1003	15	1051	15	1099	15	1143	15
15000	71-305-XX	1418	SL365-3	1088	578	5	610	5	664	5	730	7½	—		—		—		—		—	
15000	71-305-XX	1432	SL330-3	1331	—		—		—		—		968	10	1020	15	1071	15	1115	15	1158	20
15700	71-307-XX	1465	SL365-3	1139	604	5	663	5	681	7½	742	7½	—		—		—		—		—	
15700	71-307-XX	1479	SL330-3	1393	—		—		—		—		989	10	1043	15	1090	15	1138	15	1180	20
16000	71-208-XX	1575	SL365-2	1160	614	5	644	5	690	7½	749	7½	808	10	862	15	914	15	—		—	
16000	71-208-XX	1434	SL330-2	1420	—		—		—		—		—		—		—		1146	20	1190	20
16500	71-308-XX	1668	SL365-3	1197	633	5	665	5	702	7½	757	7½	817	10	871	15	922	15	967	15	1012	20
16800	71-307-XX	1644	SL365-3	1218	644	5	672	5	710	7½	764	7½	824	10	880	15	926	15	971	15	1018	20
18000	71-209-XX	1626	SL365-2	1305	688	7½	713	7½	745	7½	793	10	843	10	900	15	949	15	994	20	1037	20
18000	71-306-XX	1621	SL365-3	1305	688	7½	713	7½	745	7½	793	10	843	10	900	15	949	15	994	20	1037	20
18600	71-309-XX	1692	SL365-3	1349	709	7½	734	7½	764	7½	807	10	855	15	912	15	961	15	1004	20	1048	20
19200	71-308-XX	1668	SL365-3	1392	731	7½	754	7½	782	10	822	10	871	15	923	15	972	15	1016	20	1061	20
20200	71-309-XX	2408	SL402-3	1205	577	7½	602	7½	640	7½	693	10	741	15	789	15	835	20	876	20	918	25
21000	71-307-XX	2360	SL402-3	1252	599	7½	623	7½	654	7½	707	10	753	15	802	15	845	20	884	20	929	25
21600	71-309-XX	2408	SL402-3	1288	615	7½	638	7½	668	10	715	10	762	15	809	15	850	20	893	20	935	25
24000	71-308-XX	2384	SL402-3	1431	681	10	703	10	726	15	761	15	803	15	847	20	887	20	925	25	966	25
27000	71-309-XX	3013	SL445-3	1318	568	10	591	10	617	15	653	15	699	15	740	20	785	25	813	25	851	30

Engineering Specifications

THE FOLLOWING GUIDE COVERS FIVE MODEL VARIATIONS. SELECT THE SPECIFIC MODEL, THEN THE SPECIFICATION SECTION AS NOTED (A, B, ETC.) AND THE WORDING OPTIONS WITHIN THE SECTION THAT ARE APPLICABLE.

MODEL	COPY SECTION							
	A	B	B-1	C	D	E	F	G
71-XXX-00	*	*		*	*			
71-XXX-01	*	*	*	*	*			
71-XXX-02	*	*	*	*	*	*	*	
71-XXX-03	*	*	*	*	*			*
71-XXX-04	*	*	*	*	*	*	*	*

SECTION A—GENERAL

The electrostatic precipitator(s) shall be the two stage dual voltage plate type Electronic Air Cleaner(s) Model 71 packaged unit(s) utilizing industrial grade components and construction quality as manufactured by Trion, Inc. Furnish such equipment where shown on plans to clean the specified air volume at an air cleaning efficiency not less than % (determine % efficiency from the size-capacity-data chart) as determined by (select one) the ASHRAE Standard 52-76 Dust Spot Test Method using atmospheric air (or) the DOP Test Methods.

SECTION B—AIR CLEANER HOUSING

The housing shall be of steel construction protected against rust and corrosion with hinged access doors for component removal. All doors shall be gasketed to prevent air and water leakage and doors to charged high voltage components shall be equipped with electrical interlocks for interconnection into the primary power supply to prevent access to charged components. The housing shall be furnished with predrilled, wide bearing mounting pads for mounting securement and the bottom pan pitched toward a threaded drain nipple. Finish shall be industrial gray, 3 mil minimal thickness textured epoxy ester.

SECTION B.1—AIR INLET AND OUTLET COLLARS

Air inlet and outlet collars shall contain (select one) nominal 1″ thick metal mesh filters (or) 40% open perforated plate, accessible from outside of cabinet through hinged access doors. Doors shall be gasketed to prevent air and water leakage from cabinet. Collars shall be equipped with provision for slip joint and flange type connections for adjoining ducting.

SECTION C—IONIZING-COLLECTING CELLS

Ionizing-collecting cell(s) shall be of single unit construction with an 18 inch minimum depth in direction of air flow. All support framing, end plates and ionizer ground electrodes shall be 0.090 inch minimum thick aluminum. Both repelling and collector plates shall be 0.032 inch minimum thick aluminum and rigidly retained in place with tubular spacers and cadmium plated steel tie rods. Spacing between plates shall be no less than 0.318 inch. Each plate shall be 12⅞ inch minimum depth in direction of air flow. Ionizer ground electrodes shall be 0.090 inch minimum thickness and not less than 3⅞ inch minimum depth in direction of air flow. Ionizing wire to ground spacing shall be 1¹/₁₆ inch. Ionizing wires shall be spiraled self-tensioning 0.010 inch minimum diameter tungsten and rigidly supported both in a vertical and lateral plane with stainless steel supports. Total grounded collector surface shall not be less than 28 square feet per square foot of cell face area. High voltage support insulators shall be glass reinforced polyester and designed electrical creep distance surface shall be free from serrations to enhance cleaning. All high voltage electrical connections within each tier of cells shall be between cells and automatically made when cells are installed. High voltage connections between cell tiers and between power pack and cells shall be located on the access door end of the cabinet and manually connected for ease in service.

SECTION D—POWER PACKS

Power packs shall be 100% solid state providing a dual high voltage of 14,000 VDC for the ionizer and 7,000 VDC for the collector. The power pack(s) shall be housed in NEMA 12 type enclosures, operate on 115 VAC, 60 HZ, 1 PH supply and furnished with integrally mounted electrical interlock to prevent access to high voltage components without interrupting the primary power supply. The face panel of the power pack(s) shall contain an indicating light, milliammeter operated with a push-to-read switch to monitor total secondary current and a kilovoltmeter with a selector switch to monitor both ionizer and collector voltages. The circuit shall contain circuit breakers to protect the circuit and prevent nuisance trippage. The high voltage transformer will be equipped with a variable primary input to adjust for a supply voltage ranging from a constant 110 to 125 VDC. All high voltage secondary components shall be board mounted and both readily removable for ease in service. The high voltage capacitor shall be protected from rapid voltage change with a surge resistor. Bleed resistors shall be provided in both the ionizer and collector circuits.

SECTION E—WATER WASH/DETERGENT SYSTEM

Detergent wash and rinse water shall be applied by manifolds located on both the air entering and air leaving sides of each ionizing/collecting cell tier through spray nozzles delivering a positive fan shaped pattern. The manifolds shall contain clean out plugs and oscillate in a vertical plane through motor driven linkage. Drive motors shall be high torque, gear reduced, fan cooled permanently lubricated, 1/15 HP and located outside of the collars for ease in access. The detergent reservoir, pump, motor and by-pass valving, shall be provided as a pre-packaged assembly with an adjustable volume setting. The detergent pump shall be positive displacement self priming and delivery not less than 3.5 GPM to 40 PSIG outlet pressure. Pump motor shall be PSC with built-in overload protection. Main water line strainer, solenoid valve, and vacuum breaker shall be included with the system.

SECTION F—WASH CONTROL

(For Units with Washer and Without Blower Section)
The wash control shall be housed in a NEMA 12 type enclosure. Terminals shall be provided to interconnect the system fan and shall sequence the wash water, detergent, soak time, rinse time, dry time and return to operation cycles. All times shall be field adjustable. Control initiation shall be (select one) semi-automatic pushbutton initiated (or) completely automatic time clock initiated including semi-automatic manual pushbutton override.

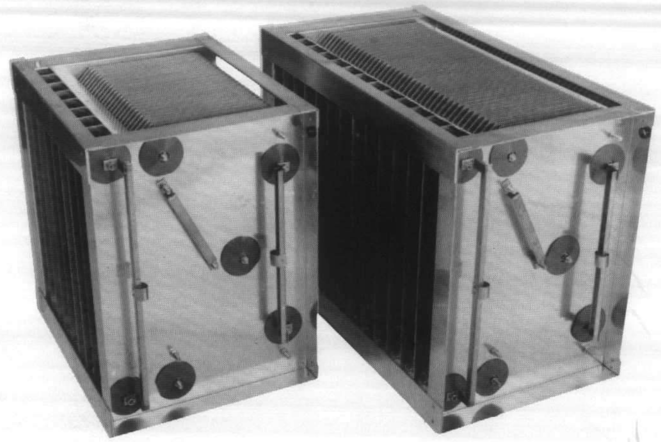
(For Units without Washer and with Blower Section)
The wash control shall be housed in a NEMA 12 type enclosures. Terminals shall be provided to interconnect the system fan and shall incorporate a prewired stepdown transformer, motor starter and fused disconnect switch.

(For Units with Washer and Blower Section)
The wash control shall be housed in a NEMA 12 type enclosure. Terminals shall be provided to interconnect the system fan and shall sequence the wash water, detergent, soak time, rinse time, dry time and return to operation cycles. All times shall be field adjustable. Control initiation shall be (select one) semi-automatic pushbutton initiated (or) completely automatic time clock initiated including semi-automatic manual pushbutton override. The control shall incorporate a prewired stepdown transformer, motor starter and fused disconnect switch.

SECTION G—FAN SECTION

The fan/transition section shall mate with the air cleaner and provide for even distribution of air through the ionizing-collecting cells. The fan shall be in-line Tubular Centrifugal type with non-overloading horsepower characteristics designed to deliver _____ CFM at _____ inches external static pressure. Wheels shall be of all-welded construction with backwardly inclined blades. Wheels 27 inches in diameter and larger shall have double thickness air foil blades; smaller wheels shall have single thickness blades. All wheels shall be statically and dynamically balanced to commercial tolerances. Housings shall be of Tubular design, welded steel construction and shall incorporate curved die-formed conversion vanes and a tapered inner tube at the discharge side of the wheel to provide maximum static pressure regain and minimum noise levels. Finish shall be Industrial gray, textured epoxy ester at a minimum three mil thickness. Shafts shall be designed so that fans operate at speeds well below first critical speed. Bearings shall be heavy duty self-aligning grease lubricated and furnished with external lubrication fittings. The fan performance shall be based on tests conducted according to AMCA Bulletin 210.

Model 71 Major Components

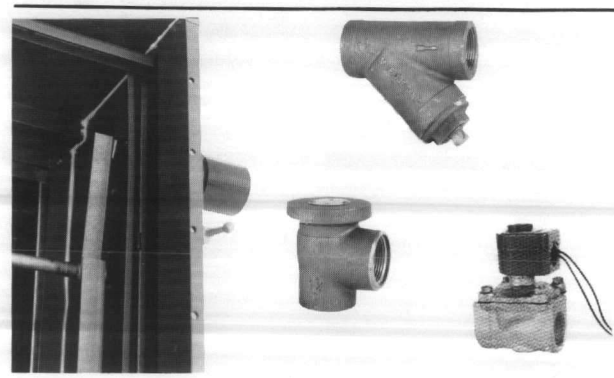


IONIZING-COLLECTING CELL

Type	2 Ft.	3 Ft.
Height	24″	24″
Width	22⅛″	33¼″
Depth	18″	18″
Weight	75 Lbs.	115 Lbs.
Gross Face Area	3.68 Ft.^{2}	5.54 Ft.^{2}
Plate Spacing	.318″	.318″
Plate Depth	12⅞″	12⅞″
Plate Thickness	.032	.032
Wire to Gnd Spacing	1¹/₁₆″	1¹/₁₆″
Ionizer Depth	4″	4″
Ionizer Wire Diameter	.010″	.010″
Wire Mtg. Arrangement	Rigid	Rigid
Ion-Gnd Electrode Thickness	.090	.090
Insulator Diameter Min	2⁹/₁₆″	2⁹/₁₆″
Ft^2 Collector Surface	96	159
Operating Current Min	2.1MA	3.2MA
Operating Current Max	2.5MA	4.0MA
Operating Voltage		
Ionizer Nom. DC	14 KV	14 KV
Collector Nom. DC	7 KV	7 KV

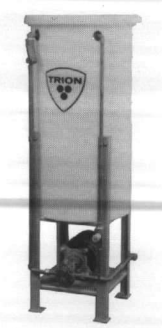
POWER PACK (NEMA 12 ENCLOSURE)

Type	08E	08F
Height	20″	20″
Width	16″	16″
Depth	13¼″	13¼″
⁷/₁₆″ MTG Hole to	10″ x 21¼″	10″ x 21¼″
Min. Service Clearance	18″	18″
Weight	80 Lbs.	110 Lbs.
Input:	115V, 60 Hz, 1 Phase	115V, 60 Hz, 1 Phase
Output DC:		
Max Operating Current	12 MA	25 MA
Ionizer Voltage	14 KV	14 KV
Collector Voltage	7 KV	7 KV
Circuit Breaker Max	3.5 AMP	7.5 AMP
Max Input Power	290 W	400W



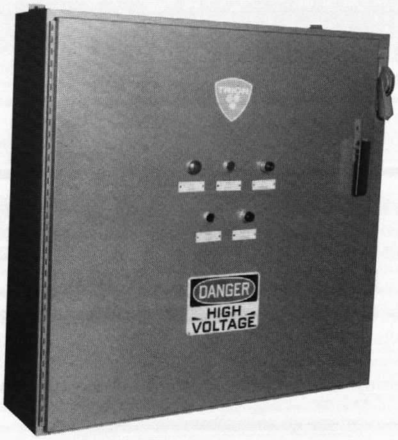
DUAL OSCILLATING WASHERS WITH CYCLOMATIC ACTION

Water Pressure	Line—35 PSI Min. at full flow See size chart for volume req.
Drive	Rigid Linkage
Drive Motor:	
Input:	115V, 60 Hz, 1 Phase
Qty	2
Type	Split Phase Reversible TEFC
H.P.	1/15
Max Input Current	2.6 AMP
Strainer Size	1¼″
Solenoid Valve Size	1¼″
Vacuum Breaker Size	1¼″



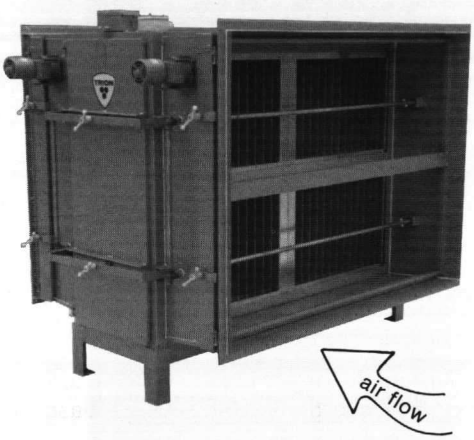
DETERGENT SYSTEM

TYPE	16 Gal	30 Gal	55 Gal
Height	42″	46″	52″
Width	17″	25″	27″
Depth	17″	25″	27″
13/32 MTG. Hole C to C	9½″ x 1	12¾″ x 15¼″	15½″ x 18″
Weight Empty	50 lb.	50 lb.	115 lb.
Weight Full	200 lb.	275 lb.	585 lb.
Pump:			
Output @ max. head	3GPM	3GPM	6.5GPM
Max. Vert. Head @ 40 PSI wash water	46′	46′	46′
Motor:			
Input	115V 60 Hz 1 phase	115V 60 Hz 1 phase	115V 60 HZ 1 phase
Overload Protection	thermal	thermal	thermal
HP	⅓	⅓	¾
Max Input Current	7.2 AMP	7.2 AMP	13.8 AMP



CONTROLS

Control For	Air Cleaner With Washer Without Blower	Air Cleaner With Washer With Blower	Air Cleaner Without Washer With Blower
Type	D	D1	D2
Comes Standard With:			
Step-Down Transformer	No	Yes	Yes
Motor Starter	No	Yes	Yes
Disconnect Switch	No	Yes	Yes
Options Available:			
Step-Down Transformer	Yes	Standard	Standard
Automatic Time Clock	Yes	Yes	No
Height	24″	46¾″	32″
Width	24″	46¾″	30¾″
Depth	10″	12″	12″
7/16″ MTG Hole C to C	18 ″ x 25¼″	40¾ x 49¼″	26″ x 33¼″
Min. Service Clearance	24″	44″	30″
Weight	60 Lbs.	120 Lbs.	90 Lbs.



UNIT CABINET

Hand - The unit hand identifies location of access doors, manifold drive motors, and wash water headers. Hand is optional—left or right—and must be specified. It is determined by standing in air stream facing unit with air flow striking back. Unit shown is left hand.

Dimensions—Refer to size—capacity—date chart
Weight—Refer to size—capacity—data chart
Door Hinges—Located on left facing door
Door Swing—22 inches.
Service Access Required for Cell Removal—40 inches.
Cabinet Metal Thickness—18/16 Ga.
Collar Metal Thickness—16 Ga.
Flange Stock—1½ x 1½ x ⅛
Finish—Industrial gray, textured epoxy ester, 3 mil thickness

FAN SECTION

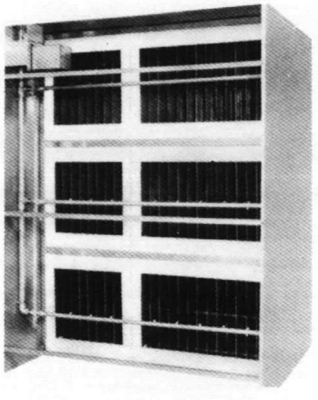
External Static Pressure—as specified
Dimensions—Refer to size—capacity—data chart
Weight—Refer to size—capacity—data chart
Motor:
  H.P.: Refer to size—capacity—data chart
Input:
  460 Volts
  60 Hz, 3 Phase
  Type: TEFC
Blower:
  Backward Inclined
  Heavy Duty
  All Welded Construction
  Extended Inlet Collars
  Statically & Dynamically Balanced
  External Lubrication Fittings
  Finish—Industrial gray, textured epoxy ester, 3 mil thickness

TRI-DEX DETERGENT

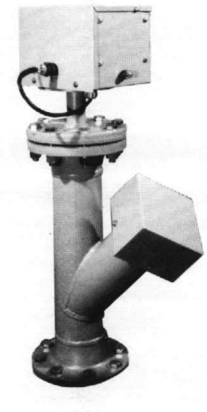
TRI-DEX is a heavy duty alkaline liquid detergent formulation developed specifically for removal of stubborn airborne deposits which coat exposed ionizing-collecting elements of electronic air cleaners.

Deposits to be removed include tars from tobacco smoking, dirt, grease, dust and other tenacious particulate matter which ordinarily is difficult to penetrate and make soluble with other common commercial detergents.

An initial supply of TRI-DEX is supplied with each unit and is available in 6, 30, and 55 gallon containers.

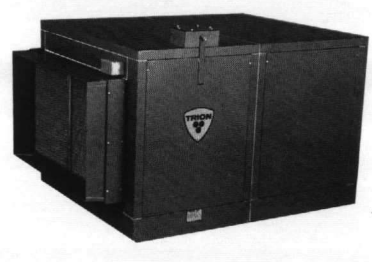


MODEL 60 - FIELD ASSEMBLED PRECIPITATORS

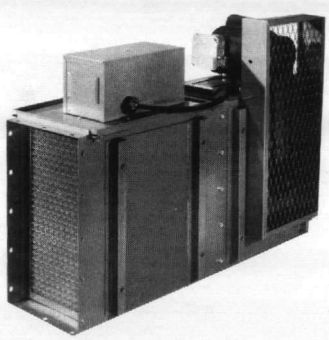


MODEL 24 - VENT FOG PRECIPITATORS

MODEL 38 - INDUSTRIAL MIST PRECIPITATORS



MODEL 18 - OIL MIST PRECIPITATORS



MODEL 22 - OIL MIST PRECIPITATORS

AS A MATTER OF POLICY, TRION, INC. IS CONTINUALLY STRIVING TOWARD CONSTANT PRODUCT IMPROVEMENT. THEREFORE, ALL MODELS AND SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE OR OBLIGATION.

TRION ®

TRION, INC.

101 McNEILL ROAD • BOX 760
SANFORD, NORTH CAROLINA 27331-0760
AREA (919) 775-2201 TWX 510-920-0675

REPRESENTED IN YOUR AREA BY:

Form No. 02-0170

Printed in U.S.A.

TRION

TRION® Model Series 60 and 71 Features, Facts and Benefits

Like most devices, an Electronic Air Cleaner is formed into an air cleaning system by blending together major assemblies. Each assembly performs a separate function to achieve a total end result. The ultimate end result would be a unit with a collection efficiency of 100%, unlimited capacity, require no space, never need cleaning, consume no energy, never malfunction and cost nothing. We do not have a unit like this.

We do, however, keep the ultimate in mind in our design. We review each major assembly for its individual function. Then, and most important, each major assembly is reviewed for its working relationship with the other assemblies. By doing this, a blend is achieved that provides the very best a total electronic air cleaning system can offer.

Our product, like any product, has design features that are obviously clear as to the reason behind them, while other features are hidden and are sometimes questioned. If your position is to specify, or to purchase, or just of general interest, we take this opportunity to review some of our product features, their benefits and the reasoning behind the design.

IONIZING-COLLECTING CELLS

ELECTRICAL CONNECTIONS

POWER PACKS

CLEANING SYSTEM

CONTROLS

CABINETRY

IONIZING-COLLECTING CELLS

Face Area -

Trion uses the total gross face area of the cells to determine the face area of a unit. This excludes any framework that may support the cells. Neither is it to be confused with the net free effective area; the actual open space through the cell. Our reason for choice is based on the ASHRAE Standard 52-76 definition of face area.

Depth in Direction of Air Flow -

Some manufacturers point to shallow cell depth as a selling feature. Trion cells are 18 inches deep. When a particle of contaminate passes through a cell, the time the particle remains in the ionizer and collection sections is one of the functions of efficiency. We have purposely chosen a "relatively" deep cell in order to maintain efficiency at a high velocity and a reduced face area. Square feet of face area is normally much more critical than inches in direction of air flow.

Contaminated Air By-Pass -

Contaminants in the air stream that are not ionized (or electrically charged in the ionizer section) are not precipitated and pass through the collector section of the cell. Ionization is dependent upon the corona discharge created on the ionizing wires. The corona discharge diminishes at the ends of each wire near their points of attachment and at their supports.

To force the contaminated air through the effective ionizing area, Trion blocks off the air flow in the ineffective areas at the top and bottom of each cell with wide horizontal air baffles.

In addition to the primary function of directing air flow, the angular shape of the baffles are designed to provide additional strength and protection without interfering in any way with ionizing wire replacement.

Weight -

Our cell Frame Bracing, End Plates and Ionizer Ground Electrodes are constructed from 0.090" aluminum. Both the Charged Plates and the Grounded Collector Plates are 0.032" aluminum. This thickness eliminates vibration and warpage often found when lighter material is used. The cells are designed for service in atmospheres found in industrial and heavy commercial application. They resist torque, shipping damage and the handling expected in the environment they serve.

Collector Plate Core Support -

It is rigid and it is positive. Our experience with Mil-Spec Design, led us to choose individual spacer and tie rods for support. The cell core is one of the vital components of any precipitator. This is where the task the precipitator is intended to perform takes place. Other methods such as slotted tube/plate tab fold over, keyed twist cam, expanded tube and others were reviewed, experienced and rejected in lieu of the spacer and tie rod method. The close tolerance tubular spacers are used to provide positive spacing and plate alignment. The 3/8" steel tie rods provide support and positive securement.

Collector Plate Spacing -

Our plate spacing is 0.318" (over 5/16"); one of the widest in the industry. Proper plate spacing is determined by blending several considerations. Voltage gradient, contaminate loading depth, collection surface area, washability, and method of support are the main considerations. With proper design, very little, or none of the considerations need to be sacrificed.

High Voltage Insulators -

High voltage insulators in the cell not only separate the high voltage components from ground but must support the weight of the charged components. They must be "strong" electrically and physically. Trion is aware of "insulator strength". The "cookie" shaped insulator is also used in cells supplied to the U.S. Navy. In addition to the above, and just as important, the configuration of the insulator must lend itself readily to cleanability. Our insulators have smooth flat surfaces which are easy to clean. We incorporate no cost saving short cuts by adding serrations or tricky configurations to gain electrical creep distance. These features do provide creep distance but they also provide dirt traps.

Insulator Location -

The ideal location for insulators within a cell has been banted back and forth within the industry for years. To place them inside or outside of the airstream has been the question. We have chosen the best of two worlds and placed them in the end plate. The outboard portion is completely out of the airstream to minimize dirt accumulation. Our end plate area is vertically sealed as it contains no holes to provide electrical clearance. The electrically charged components go through a hole in the center of the insulator. The inboard portion is flush with the end plate, parallel with the airstream and exposed to the wash water stream. All surfaces are flat and smooth and designed to readily clean.

Ionizing Wires -

A vital component. Trion Ionizing Wires are made of 0.010" diameter tungsten. Thickness within the industry varies slightly but a mil or two in diameter is an important factor in strength. A wire of 0.010" diameter has 56% more cross sectional area than a wire 0.008" diameter. In addition to strength, wire location with respect to adjacent components is important (wire to ground spacing). Our wires are positively located on fixed rigid, stainless steel supports which totally eliminate misalignment, either horizontally or vertically, which is often a problem with support pins, springs and external tensioning means. We supply tension within the wire itself by the unique coil design.

ELECTRICAL CONNECTIONS MODEL 71

Packaged Equipment -

Cells load from the cabinet end perpendicular to air flow. All electrical high voltage electrical connections between cells are automatically made when the cells slide into the cabinet. A broad, stainless steel, spring brush connector is secured to the ionizer and collector tie rod ends of each cell to mate with the adjoining cell. The high voltage leads from the power pack and the jumpers between cell tiers on units more than one tier high are connected on the access panel side for ease in service.

ELECTRICAL CONNECTIONS MODEL 60

Field Assembled Equipment -

Cells load from inside duct parallel with air flow. Cells are interconnected with rigid bus bars located on the clean air side of the cells. The bus bars are secured to both the ionizing and collecting section of each cell with threaded, insulated rods to insure positive connection. This arrangement also lends its self well in trouble shooting the large multi-section field assembled installations.

POWER SUPPLY

Trion Designed - Trion Built -

Most precipitator manufacturers purchase power supplies from outside sources. We insist on building our own supply, to our design specifications and our own quality assurance standards. After years of experience we are confident; through proof, that our expertise in this area is second to none. We have to be, it's our bread and butter. The 08E power pack is rated at 12 MA and the 08F pack is rated at 25 MA. The voltage output on both is a nominal 14,000 VDC to the ionizer and 7,000 VDC to the collector. Each component is source inspected for quality, and is selected on the basis of reliability testing in our laboratory under extremely harsh operating conditions. Coil winding and insulation is monitored every step of the way. Final testing and batch life testing is on a continuous basis.

Tapped Primary Transformer -

The heart of any power supply is its high voltage transformer. We have selected the tapped primary design, in order to maximize both flexibility and reliability. Voltage adjustment is available in 5% increments (to a maximum of 45%) by moving the input leads to various positions to meet the normal supply line variations normally encountered in the field, as well as to adjust for specific unit loading.

High Voltage Component Board -

All high voltage components are mounted conveniently on a single, easily removable, component board for ease in servicing the power supply. A spare board in stock minimizes system down-time and allows actual repair to be accomplished at a more convenient time and location. Factory mounted components include two 30 KV, 350 MA silicon high voltage rectifiers, arc tested capacitor, bleed resistors, surge resistor, and high voltage lead connecting posts.

Enclosure -

The power supply is housed in a NEMA-12 cabinet with hinged access door, that provides the maximum protection against contaminant buildup on power supply components.

Circuit Protection -

During the normal course of operation, periodic electrical arc-over is an inherent characteristic in electrostatic precipitators. Arc-over usually stems from a very large piece of particulate matter in the air stream and may become more prevalent when changes occur in humidity and/or fluxuation in supply line voltage.

In form, the arc-over may be momentary or prolonged and of a magnitude that is light or heavy with respect to current draw on the electrical circuit. In the case of a malfunction, such as a broken ionizing wire coming in contact with a grounded component, a dead short takes place. Good circuitry design takes all of these conditions into consideration and provides for maximum component protection with a minimum amount of attention.

In addition to a surge resistor to protect the high voltage DC capacitor from the detrimental effect of rapid changes in secondary voltage, two circuit breakers are employed in the power pack primary. The main breaker is a manual reset, hydraulically damped, magnetic breaker and operates under dead shorts or prolonged arc-over. To prevent nuisance trip out of this main breaker which requires manual reset, an automatic reset, thermal breaker is wired in series with it to protect the circuit under arc-over of a smaller magnitude.

Milliammeter -

A milliammeter is provided on each power supply to indicate total operating current. A "Press to Read" pushbutton is provided. This feature is an extra that saves the meter by removing it from the circuit until it is actually needed.

Power Indicator -

A red indicating light is mounted on the front of the enclosure to show at a glance that line voltage is being applied to the unit.

Kilovoltmeter -

A kilovoltmeter is provided with constant indication. A selector switch is used for reading either the ionizer or the collector voltage. The kilovoltmeter coupled with the milliammeter provides complete operation and service instrumentation.

Safety Switch -

A time delay screw and switch make-up the electrical interlock that interrupts the primary input when the enclosure is opened for inspection or service. The time delay, is accomplished by the screw which allows any residual capacitive charge to drain to ground through the bleeder resistors.

CLEANING SYSTEM

The Trion Electronic Air Cleaner is a high efficiency dirt collector. The collecting elements, the largest in the industry, enable it to efficiently compile and retain large quantities of particulate with a prolonged cleaning frequency. This is its given task. Once collected, however, the particulate has to be effectively removed or the efficiency of the collector will be lowered. Therefore, the cleaning system becomes just as important as the collector.

Cleaning is accomplished with an oscillating wash manifold located in the front and in the rear of each tier of cells. As highest impact and wash water efficiency is produced by nozzles with solid stream or unbroken spray, our manifolds are fitted with nozzles producing a flat solid spray pattern. This simultaneous flooding, from the front and rear, requires a higher initial volume of water than that required by our single manifold residential and light commercial units, but it shortens the wash time, enabling fast return of the unit to cleaning air - - its primary function. All things being equal, it takes a given amount of water to remove a given amount of dirt.

The movement causing the manifolds to oscillate is direct, smooth and uncomplicated. The manifolds are connected to a single drive bar, which in turn is connected to a motor. Chains, cables, sprockets, slide mechanisms limit switches and the adjustments they require are not necessary.

Detergent System -

To augment the wash water, detergent is injected into the water supply prior to entering the manifold headers. The volume (Detergent Water Ratio) is adjustable so that it can be "tailored" in the field for the specific application.

The system consists of a detergent reservoir with gravity feed, a positive displacement pump, by-pass piping with adjustment and a flow check valve. The Detergent Feeder is completely preassembled and is furnished with a 16, 30 or 55 gallon storage tank. Standard accessories include a main water solenoid valve, strainer and vacuum breaker.

Tri-Dex MSP-21 -

The choice of detergent for washing a precipitator is important. Since no commercially available product was satisfactory in all respects, Trion developed Tri-Dex MSP-21. In addition to its excellent affinity for grease and dirt, it is low foaming, freeze-thaw stable, biodegradable, and contains various surface active agents and aluminum corrosion inhibitors. It's specifically designed for cleaning electrostatic precipitators.

WASH CONTROLS

The efficient removal of the precipitated contaminant from the ionizing-collecting cells is as important to the total performance of the equipment as the collecting efficiency. The close control of wash water, especially if it is heated, and the close control of detergent are important considerations. The many types of contaminants and the various loading conditions call for a control that is adjustable to the specific conditions encountered on each specific job. Proper detergent concentration and cycle timing are prerequisite for effective washing from the standpoints of cost and cleaning efficiency. All cycle times are readily adjustable in the field in Trion Controls. On large multi-section controls all times are simply dialed in, right down to the second. The controls sequence the system fan, including coast down, power packs, manifold drive motors, water valves, detergent pump motor and drying cycles.

CABINETRY – MODEL 71

Packaged Equipment -

The Model 71 is packaged up to a nominal volume including 27,000 CFM. Hinged doors, gasketed against air and water leakage, with vault type latching are provided for all component access. The main door to high voltage components is electrically interlocked to prevent entry without first de-energizing the electrical circuit. The collars for the connection of adjoining equipment or duct work employ a standard design to provide for several methods of attachment. A straight single edge is provided as well as a predrilled flange. Mounting legs are sturdy three inch angles with wide bearing pads. Each pad is predrilled so that the cabinet may be either bolted or welded into place. The manifold drive motors are outboard and located on the access side for accessibility. The bottom of adjoining collars and the drain pan are pitched toward a common center drain and all metal is finished and protected against rust and corrosion. The cabinetry is rugged and uncomplicated.

CABINETRY – MODEL 60 -

Field Assembled Equipment -

The Model 60 is designed for and readily adaptable to handle large volumes of air, up to a nominal 180,000 CFM in a single system in standard equipment. Larger systems are readily available when required. It will also handle the small job too, 12,000 CFM.

Sectional Design -

The sectional design allows maximum flexibility. Each section is independent in terms of power supplies and washing systems, but all sections utilize the same detergent system and automatic wash controls. Up to and including five sections may be operated through a single control.

Internal Framing -

Top frame, base and intermediate cell support framework is of welded, galvanized, "Uni-Strut" construction, and is attached to the end support structure with heavy steel angle and bolts. The individual cell support rails allow removal of the ionizing-collecting cells from either the front or rear of the unit. All cabinetry components are match-marked at the factory for ease in assembly. Baffle strips are provided to seal off air by-pass and all metal finish is protected against rust and corrosion.

TRION®

TRION, INC.

101 McNEILL ROAD · P.O. BOX 760
SANFORD, NORTH CAROLINA 27331-0760
AREA (919) 775-2201 · TWX 510-920-0675

Form No. - 04-0033
Supersedes Form No. - 04-0026
4/86

TAB PLACEMENT HERE

DESCRIPTION:

Air Handling

Equipment

☐ Tab page did not contain hand written information

☒ Tab page contained hand written information
*Scanned as next image

Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

Chet Adams Company

Sales Engineers

HEATING AIR CONDITIONING EQUIPMENT VENTILATING

AIR POLLUTION SYSTEMS ENERGY CONSERVATION

February 16, 1988

MAINTENANCE AND OPERATING INSTRUCTIONS

Project:	A/C Building AS-205 Camp Lejeune, NC
Contractor:	Humphrey Htg. & Roofing, Inc. Jacksonville, NC
P.O.#	107-284
Engineer:	Cheatham and Associates
Sales Rep:	Chet Adams Company Cary, NC
Manufacturer:	Governair Corporation

AIR HANDLER

1 - Model RSA-02 custom built exterior air handler as per attached data.

AIR COOLED CONDENSING UNIT

1 - Model ACU-302 air cooled condensing unit as per attached data.

GOVERNAIR CORPORATION
A Nortek Company

25997

SUBMITTAL DATA

PROJECT: A/C BUILDING AS-205
CAMP LEJEUNE, NC

SOLD TO: HUMPHREY HEATING
& ROOFING, INC.
P.O. BOX 1268
JACKSONVILLE, NC 28540

DATE: 12/11/87

SERIAL NO.: 25997

REF. DWG.: 32636

TAG: AC-1

MODEL NO.: ACU-302

NO. UNITS: 1

AIR COOLED CONDENSERS

UNIT CAPACITY:

CAPACITY BALANCED WITH RSA-01 REFERENCE DRAWING NUMBER 32637

27,900 CFM THRU CONDENSER

CONSTRUCTION:

BASE FRAME	- Structural formed steel base,
CABINET - FLOOR	- 14 gauge galvanized steel single wall,
WALLS	- 20 gauge galvanized steel single wall
ROOF	- 20 gauge galvanized steel single wall,
PAINT	- "Landmark Beige" enamel finish inside & out,
ACCESS DOORS	- Single wall construction with hinges,
DOOR LATCHES	- Ventlok 333,

COMPRESSOR SECTION:

COMPRESSOR (1 REQ'D)	- Semi-hermetic model 3DB1-1000, Spring isolated, Suction and discharge line vibrasorbers, 1/2" armaflex suction line insulation,
COMPRESSOR (1 REQ'D)	- Semi-hermetic model 3D51-1500, Spring isolated, Suction and discharge line vibrasorbers, 1/2" armaflex suction line insulation,

CONDENSER SECTION:

CONDENSER COIL:	- 3 row, 1/2" copper tubes, 10 aluminum fins per inch, 35" fin width, 84" fin length, 12 pass with sub-cool circuit, 1 req'd,
CONDENSER COIL	- 3 row, 1/2" copper tubes, 10 aluminum fins per inch, 30" fin width, 66" fin length, 12 pass with sub-cool circuit,
PROP FANS	- 27 1/4" dia,(3 req'd), direct drive, setup 27/2,
MOTORS	- 2 horsepower, 208/3/60 TEFC, 1140 RPM, 56 frame,
LOW AMBIENT OPERATION	- Adjustable to 0 F degrees with flooded condenser head pressure control valves,

REFRIGERANT CIRCUIT (EACH COMPRESSOR):

RECEIVER	- ASME full charge with relief, Inlet and outlet valves,
FILTER DRIER	- Sealed,
SIGHT GLASS	- One per circuit,
SOLENOID VALVE	- Liquid line,

ELECTRICAL REQUIREMENTS:

208/3/60 power with 120 volt control,
120 volt transformer furnished and installed,

ELECTRICAL CONTROLS:

See Wiring Diagram WD-32636

*4841 N. Sewell*OKC,OK 73118*(405)525-6546*

GOVERNAIR CORPORATION
A Nortek Company

25998

SUBMITTAL DATA
ISSUE A

PROJECT: A/C BUILDING AS-205
CAMP LEJUENE, NC

DATE: 12/11/87
12/30/87
SERIAL NO.: 25998

SOLD TO: HUMPHREY HEATING
& ROOFING, INC.
P.O. BOX 1268
JACKSONVILLE, NC 28540

REF. DWG.: 32637-A

TAG: AH-1

MODEL NO.: RSA-02

NOTE: ONE SET OF APPROVED DRAWINGS MUST BE RETURNED PRIOR TO FABRICATION.

NO. UNITS: 1

ETL LABEL

AIR FLOW DATA:

SUPPLY AIR: 9,000 CFM at

.10"	Electronic Air Cleaner-Future
.15"	Damper/Hood
.25"	Filters
.88"	Coil - DX
.07"	Coil - HW
.25"	Unit
.50"	External Static - Available

2.20"	Total Static Design

COOLING CAPACITY - R-22
BTU/HR TOTAL - 358,500
BTU/HR SENSIBLE - 125,969
ENTERING AIR - 79.1 deg. DB, 66.2 deg. WB,
LEAVING AIR - 60 deg. DB, 57.0 deg. WB,
SUCTION TEMP. - 45.5 deg.
AMBIENT TEMP. - 90 deg.
A.P.D. - 0.88

HEATING CAPACITY - Water
BTU/HR TOTAL - 388,124
ENTERING AIR - 20 deg. DB,
LEAVING AIR - 59.8 deg. DB,
ENT./LVG. WATER - 180.0 deg./160 deg.
GPM - 40
FEET P.D. - 1.6
A.P.D. - 0.07

*4841 N. Sewell*OKC,OK 73118*(405)525-6546*

CONSTRUCTION:

BASE FRAME - Structural steel tube electrically welded,
LUGS, LIFTING - Fixed,
CABINET - FLOOR - 18 gauge galvanized steel single wall,
WALLS - 18 gauge galvanized steel single wall
ROOF - 18 gauge galvanized steel single wall,
PAINT - "Landmark Beige" enamel finish inside & out,
INSULATION - 1" fiberglass, 1 1/2 lb. density,
ACCESS DOORS - Double wall construction with standard galvanized steel hinges,
DOOR LATCHES - Ventlok 333,

CONDITIONER SECTION:

COOLING COIL - DX 5 row, 5/8" copper tubes, 12 aluminum fins per inch, 19.38 sq. ft. total, 45" fin width, 62" fin length, 10 pass, 1 req'd,
EXPANSION VALVE - One per compressor with distributor,
BLOWER ASSEMBLY - One - 20" forward curve, class I, DWDI, 778 RPM, 2118 outlet velocity, 5.32 B.H.P.
Isolators - spring,
Relubrication lines extended to drive side,
Variable pitch sheaves,
MOTOR - 7 1/2 horsepower, 208/3/60 ODP, 1750 R.P.M., 213T frame, pivot base,
DRAIN PAN - Insulated with drain connection, mastic coated, traps furnished and installed "By Others",
FILTER RACK - Angle with 2" throwaway filters,
HEATING COIL RE - 1 row, hot water,
5/8" copper tubes, 8 aluminum fins per inch, 19.38 sq. ft. total, 45" fin width, 62" fin length, 2 pass,
OA-RA DAMPERS - Outside air rainhood,
Opposed blade,
Damper motor and controls furnished and installed "By Others",

ECTRICAL REQUIREMENTS:

208/3/60 power with 24 and 120 volt control,
24 volt transformer furnished and installed,
120 volt transformer furnished and installed,

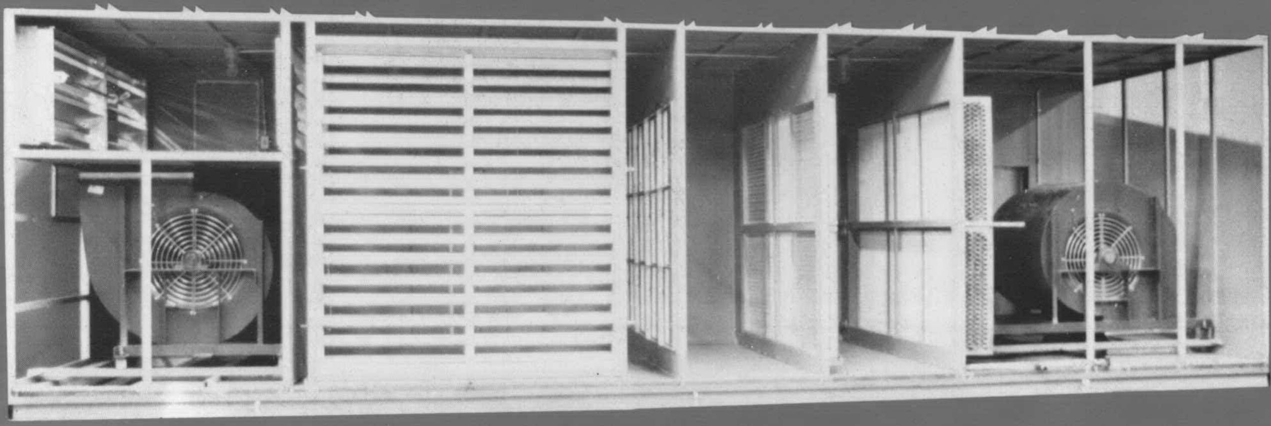
ELECTRICAL CONTROLS:

See Wiring Diagram WD-32637

*4841 N. Sewell*OKC,OK 73118*(405)525-6546*

GOVERNAIR
Oklahoma City, OK

INSTRUCTION MANUAL



Air Handling Units

Installation
Operation
Maintenance

General

This manual has been prepared as a guide when installing, operating and maintaining Governair Air Handling equipment. This is high quality equipment and by following the instructions listed in this manual, years of economical and satisfactory operation will be obtained from your Governair equipment.

It is not possible to cover every item in detail and where an item is listed as typical you should contact your local Governair sales representative or the Governair factory in Oklahoma City for the specific information required.

AH-1
SERIAL # 25998
MODEL # RSA-02

GOVERNAIR
CORPORATION

Table of Contents

General 1
Receiving Instructions 3
Inspection of Equipment 3
Curb Instructions 3-7
Rigging Instructions 7-8
Ship Loose Parts 7
Demounted Units — Assembly 9
Weights 10
Storage 10
Electrical 11
Static Pressure Limits 12
Coils 13
  Direct Expansion 13
  Chilled Water 13
  Hot Water 13
  Steam 13
Piping & Control 13
Coil Freeze Protection of Water & Steam 14
Parts Replacement 14
Pre-Start Up Check 14
Start Up Check Off List 15
Blowers 16-18
Motors 16
Belts 18
Belt Adjustment — See Trouble Shooting 32
Pulleys & Drives 18-21
Lubrication — Motor Bearings 22
Lubrication — Bearings Blowers 22-27
Filters 27
Door Latches 28
Door Gaskets 28
Caulking 28
Paint 28
Drain Traps for Condensate 29
Dampers — Multizone 29
Dampers — Fresh Air — Exhaust Air — Return Air 30
Minimum Position Potentiometer 30
Enthalpy Control or Economizer Change over Thermostat 30
Electrical Heat 31
Troubleshooting 32-39

Receiving

Inspect the complete unit for shipping damage. If damage is present, you have the right to either accept or reject the shipment. If the receiving contractor or the receiving agent for the contractor elects to receive the equipment in a damaged condition, it then becomes the contractor's responsibility to note the extent of the damage on the delivering freight bill of lading in the presence of the delivering agent (driver) of the delivering freight carrier. It then becomes the contractor's responsibility to file a freight claim with the delivering freight carrier in accordance with the ICC regulations. It also then becomes the responsibility of the receiving contractor to work with the delivering carrier to have the equipment repaired to the satisfaction of Governair Corporation so the warranty may remain valid. **Governair must also be notified of shipping damage.**

Note: Governair reserves the right to cancel the warranty on any equipment that is not repaired to Governair's satisfaction.

See section Ship Loose Parts.

Inspection of Equipment — Visual

The equipment type and arrangement should be verified as ordered at once when it arrives at the jobsite. When a discrepancy is found, the local Governair Sales Representative must be notified immediately so that corrective action may be instigated, also verify electrical conformance to specifications. Unauthorized alterations and unauthorized backcharges will not be recognized by Governair Corporation.

Curb Installation

Note: If the unit is to be installed on grillage, this section will not apply.

The curb will be shipped unassembled. It is necessary to assemble it on the jobsite. Each part of the curb is identified with the proper tags and/or markings. Complete assembly instructions are shipped with and attached to each curb package. Where more than one curb is shipped to one location, there will be assembly instructions with and attached to each curb package. It is important the curb be installed level and square.

Note: See section under receiving instructions when receiving curbs and inspecting for freight damage and filing of freight damage claims. Any freight damage is the responsibility of the receiving contractor and/or his authorized receiving agent and the delivering carrier.

See pages 5 & 6 for typical curb installation and parts list. When installing curb, obtain a copy of the approved submittal, as each unit and actual curb installation may not be identical. Do not use this typical curb to install your curb.

Note: Should there be any questions as to the number of pieces of curb parts or assembling of the curb, notify Governair Corporation at once.

CURB PARTS LIST

ITEM	QTY.	DESCRIPTION
		Typical actual parts list will be supplied with your curb

Curb Assembly/Installation Instructions.

1. Match parts received to parts list above and notify factory immediately regarding any discrepancy.
2. Each curb section bears a part number as shown on attached assembly drawing.
3. Referring to the attached submittal and assembly drawings, assemble curb sections using hardware furnished. Curb must be installed square and level with maximum of 48″ between supports and 18″ overhang at ends.
4. Curb may now be insulated and roofed in as required.

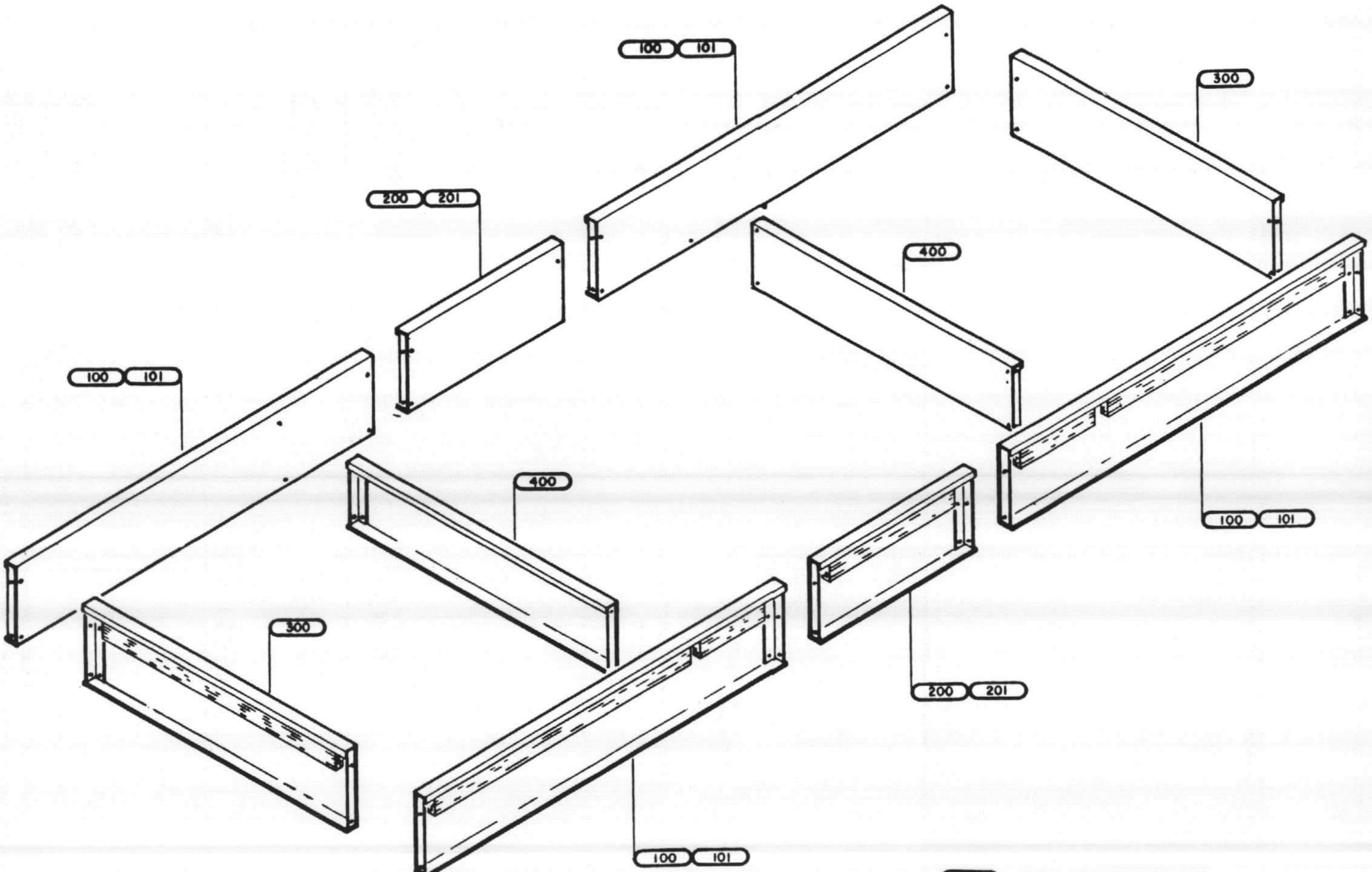
   NOTE: ½″ x 1½″ curb gasket shipped with unit.

GOVERNAIR CORPORATION

GOVERNAIR
CORPORATION

CAUTION

CURB MUST BE INSTALLED SQUARE AND LEVEL WITH MAXIMUM OF 48" BETWEEN SUPPORTS AND 18" OVERHANG AT ENDS.



100	CURB SIDE MAIN SECTION.
101	CURB SIDE MAIN SECTION WITH CROSS BRACE ATTACHMENT HOLES.
200	CURB SIDE SHORT SECTION.
201	CURB SIDE SHORT SECTION WITH CROSS BRACE ATTACHMENT HOLES.
300	CURB END SECTION.
400	CURB CROSS BRACE.

NOTES:

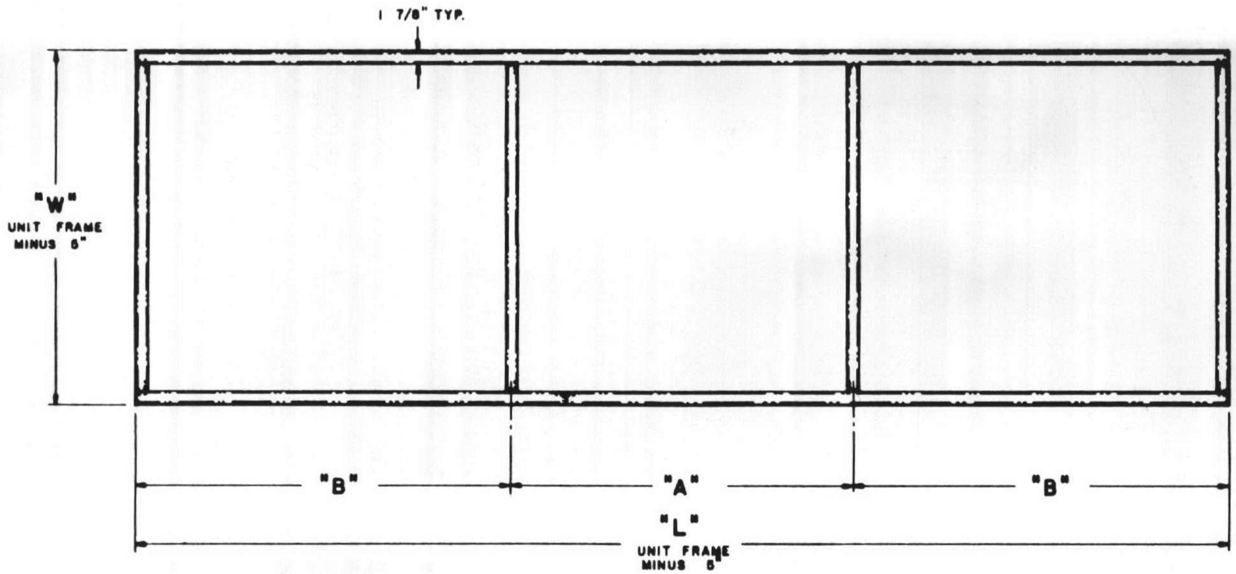
(1) SEE ATTACHED PARTS LIST AND ASSEMBLY/INSTALLATION INSTRUCTIONS, AND CURB DIMENSIONAL DRAWING.

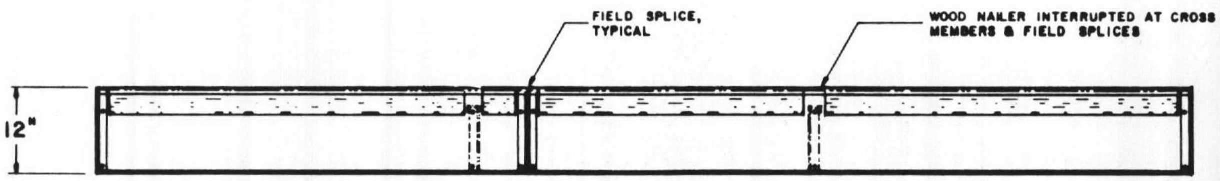
(2) NOT ALL CURB & CROSS BRACE SECTIONS SHOWN ON THIS DRAWING.

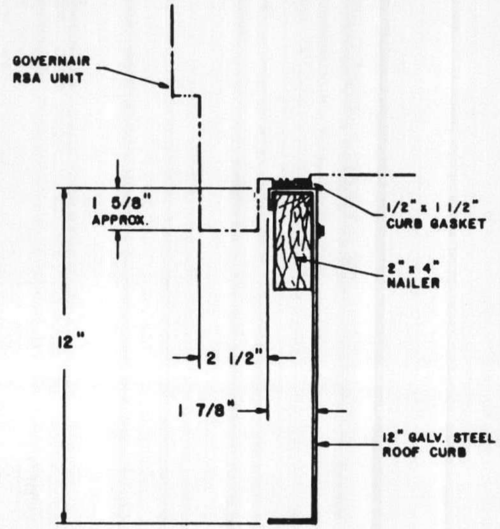
(3) CURB MAY BE SHIPPED PARTIALLY ASSEMBLED.

CAUTION

CURB MUST BE INSTALLED SQUARE AND LEVEL WITH MAXIMUM OF 48" BETWEEN SUPPORTS AND 18" OVERHANG AT ENDS.

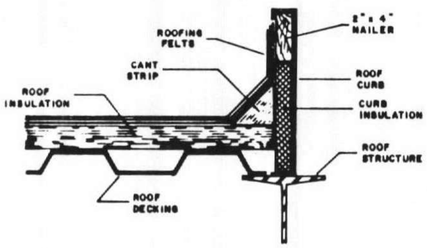




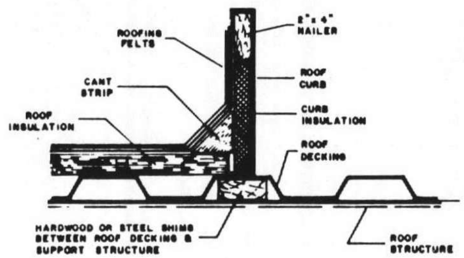


SECTION VIEW

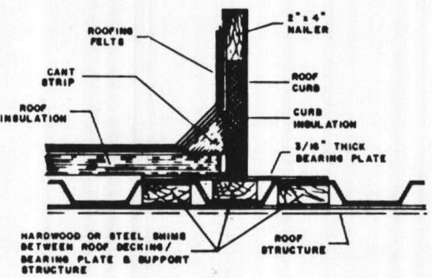
NOTE: Curb, nailer, & gasket furnished by Governair, all parts not shown are furnished & installed in field "BY OTHERS".



TYPE 'A'



TYPE 'B'



TYPE 'C'

SUGGESTED INSTALLATION METHODS

MODEL	SERIAL NO.	A	B	L	W	MAT'L.	UNIT WGT

PROJECT:

9-16-82

GOVERNAIR
4841 N. Sewell • Oklahoma City, OK 73118
(405) 525-6546 • Telex 796-268

MODEL-	TAG-
SERIAL NO-	DRAWING NO-

The curb installation shows a curb gasket that is mounted between the curb and the unit. When this gasket is supplied by Governair Corporation it is not shipped with the curb, but is shipped with the completed unit "ship loose parts" and is so noted on unit packing list. It is necessary to check the unit packing list for location of the section of the unit in which the curb gasket is located. It is necessary to install the curb gasket before setting the unit on the curb. This is necessary for an air seal between the unit and the curb and also serves as a dampener, preventing metal to metal contact between the unit and curb. **However, this should not be used as a vibration isolator where the prevention of noise and vibration transmission into the building is critical.**

Rigging Instructions

Proper handling of the equipment is mandatory during unloading and setting it into position.

NOTE: If equipment is not set in its permanent position and is stored on the ground or other unlevel area, proper provisions must be taken for supporting and protecting the equipment. See section for both short and long-term storage.

It is mandatory that the proper spreader bars and hoisting straps be used when rigging. See page 8 for recommendations. It is also mandatory that an experienced and reliable rigger be selected to handle unloading and final placement of the equipment. Your rigger must be advised that unit contains delicate components and that it be handled in an upright position. Care must be exercised to avoid twisting the structure.

When the equipment has been set in final placement, the following must be done:

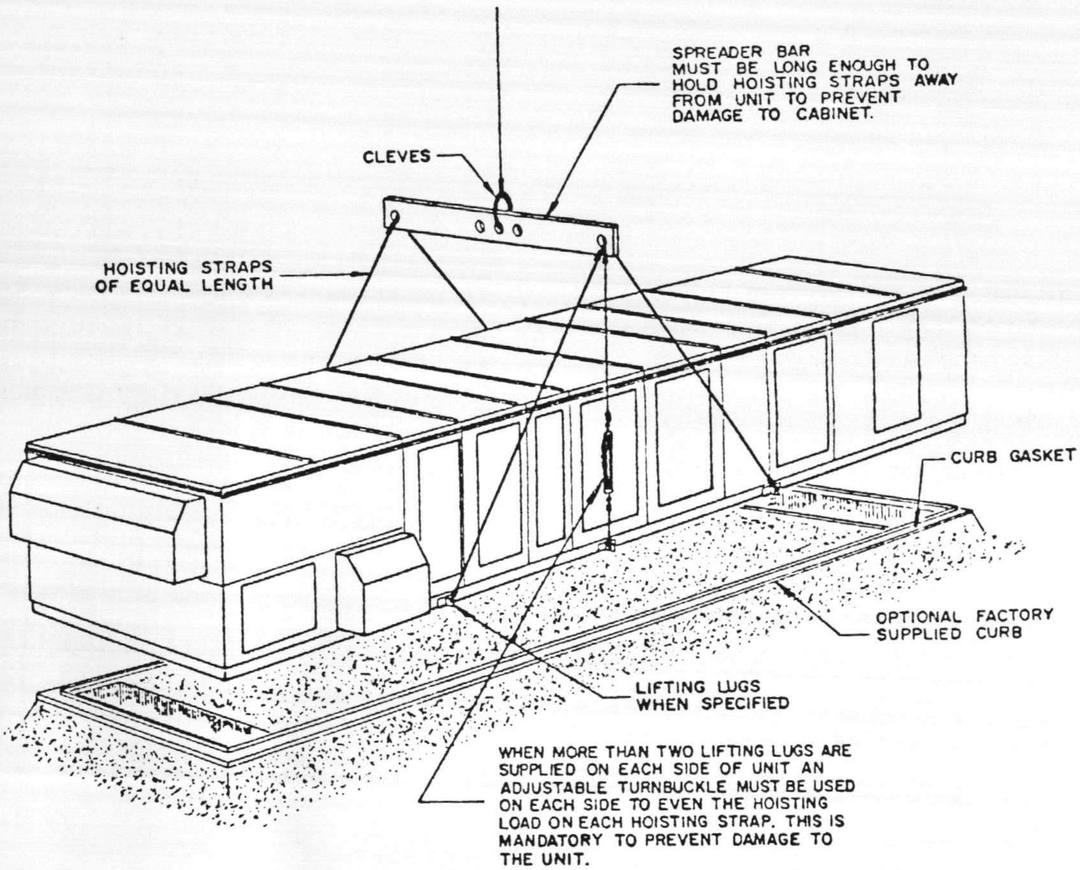
1. Check all caulked seams and air seals. Recaulk if and where caulking has been broken.
2. Check all door latches and readjust if necessary to maintain a good tight seal.

NOTE: Remove shipping screws in body of door handle. These screws are installed prior to shipment to prevent doors from accidentally working open during transit and handling.

Shipped Loose Parts

1. Check the packing list for the list of ship loose parts.
2. Packing list will note how many and type of parts.
3. Packing list will note in what section of the unit each shipped loose part is located.
4. All air filters are shipped as loose parts.
5. Rainhoods are shipped as loose parts. Small rainhoods will be inside the units, and large rainhoods will be outside the unit and so noted on packing list.

Rigging Instructions



Units will have lifting lugs welded and/or bolted to the base when specified.

Avoid damage to the curb and curb gasket when rigging onto a curb. See curb instruction pages 6 and 7.

Spreader bars must be used to prevent damage to the unit casing.

Care must be taken to keep the unit in the upright position during rigging.

Avoid unnecessary jarring or rough handling.

Care must be taken to not damage the water-tight seams in the unit casing.

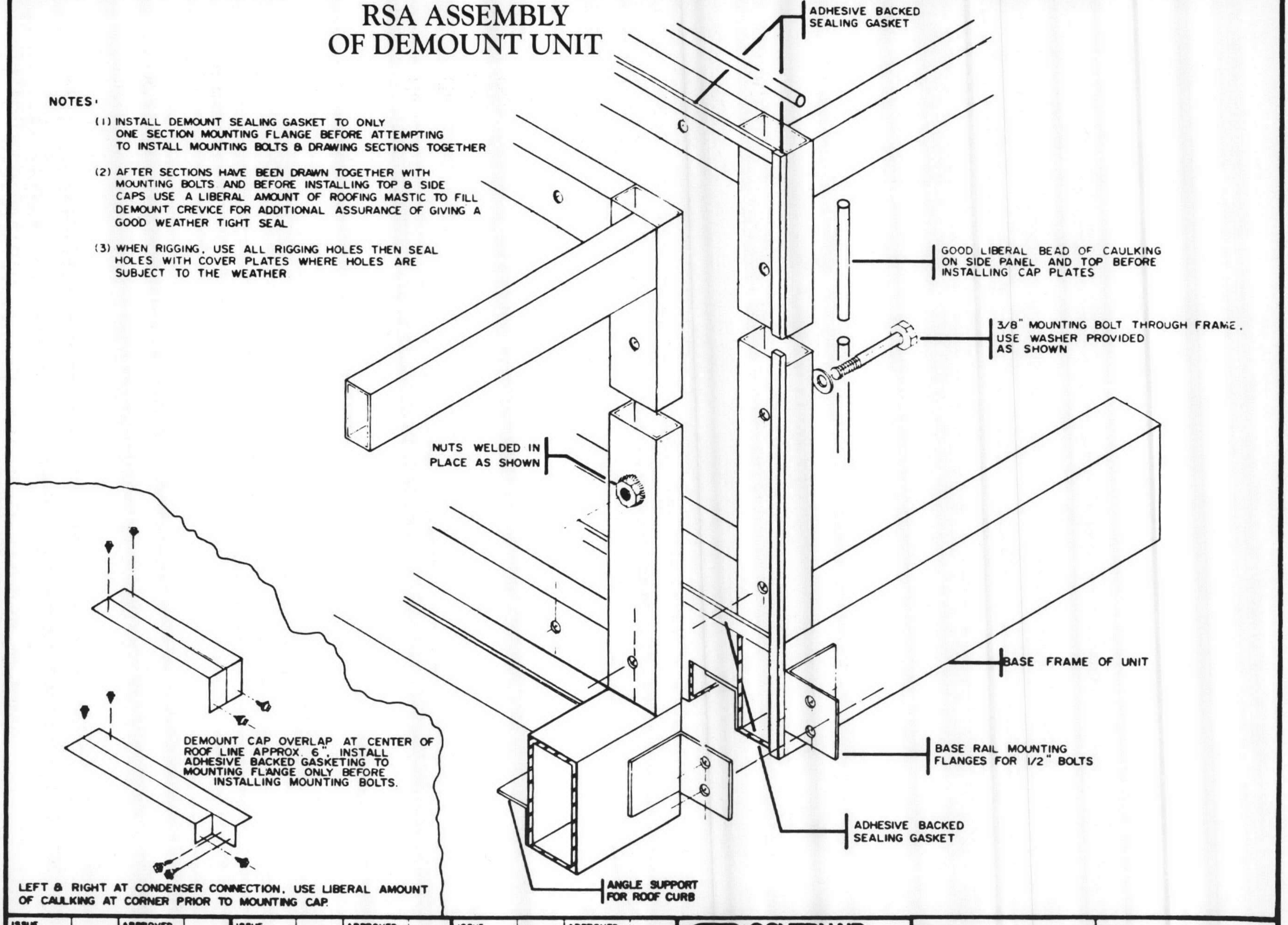
RSA ASSEMBLY OF DEMOUNT UNIT

NOTES:

(1) INSTALL DEMOUNT SEALING GASKET TO ONLY ONE SECTION MOUNTING FLANGE BEFORE ATTEMPTING TO INSTALL MOUNTING BOLTS & DRAWING SECTIONS TOGETHER

(2) AFTER SECTIONS HAVE BEEN DRAWN TOGETHER WITH MOUNTING BOLTS AND BEFORE INSTALLING TOP & SIDE CAPS USE A LIBERAL AMOUNT OF ROOFING MASTIC TO FILL DEMOUNT CREVICE FOR ADDITIONAL ASSURANCE OF GIVING A GOOD WEATHER TIGHT SEAL

(3) WHEN RIGGING, USE ALL RIGGING HOLES THEN SEAL HOLES WITH COVER PLATES WHERE HOLES ARE SUBJECT TO THE WEATHER



ISSUE		APPROVED		ISSUE		APPROVED		ISSUE		APPROVED		GOVERNAIR CORPORATION 4841 N. Sewell • Oklahoma City OK 73118 405 525 6546 • Telex 747 194	MODEL	TAG
PREPARED BY		ELECT. CKD.		PREPARED BY		ELECT. CKD		PREPARED BY		ELECT. CKD				
MECH. CKD		CONST. CKD		MECH CKD		CONST CKD		MECH CKD		CONST. CKD			SERIAL NO	DRAWING NO

GOVERNAIR CORPORATION

Weights of Units

Due to the gross latitude in each unit design, it is not possible to list unit weights in this manual. Unit weights are listed with each unit submittal drawing. These drawings must be referred to when selecting a crane for rigging and figuring roof weight loads.

Contact your Governair Sales Representative should you have any questions.

Storage

Short-Term Storage:

Short-term storage is considered six (6) months or less from date of shipment. Storage maintenance during this time period is usually, but not necessarily, limited to the following:

1. Make sure the equipment is received and unloaded and set in position per guidelines listed under "Rigging".

2. Make sure all access doors are tightly closed and that all access openings into the unit are sealed, such as air supply and air return openings, pipe chase openings, fresh air openings, exhaust air openings, electrical connection openings and other access openings of the unit cabinet that may permit entry of snow, ice, rain water, dust, dirt, mud and other construction debris, or birds and rodents that may enter the interior of the unit.

3. The unit must also be protected when setting on the ground level to prevent damage to the exterior of the cabinet by construction vehicles and personnel.

Long-Term Storage:

Long-term storage is considered to be any period beyond six (6) months from date of shipment. If long-term storage is anticipated, contact the Governair Sales Office at time of order entry for the proper instructions for long-term storage, as it is mandatory that a detailed record be maintained during this long-term storage period, such as, but not limited to, proper sealing of the cabinet, rotation of the blowers and bearings and protection of all motors from moisture. Note: Under certain conditions, it may be necessary to remove the motors from the unit and/or add heat to the motor. This record must be available to Governair should a failure occur during the warranty period. There is a time limit of one year from date of shipment that any unit may be kept in long-term storage. At the end of the one year period, the unit must be in operation.

NOTE: Failure to perform the long-term storage requirements and properly log these required procedures will void the warranty.

Electrical Information

NOTE: All wiring must conform to the National Electrical Code (NEC) and possibly local codes that may be in addition to the NEC.

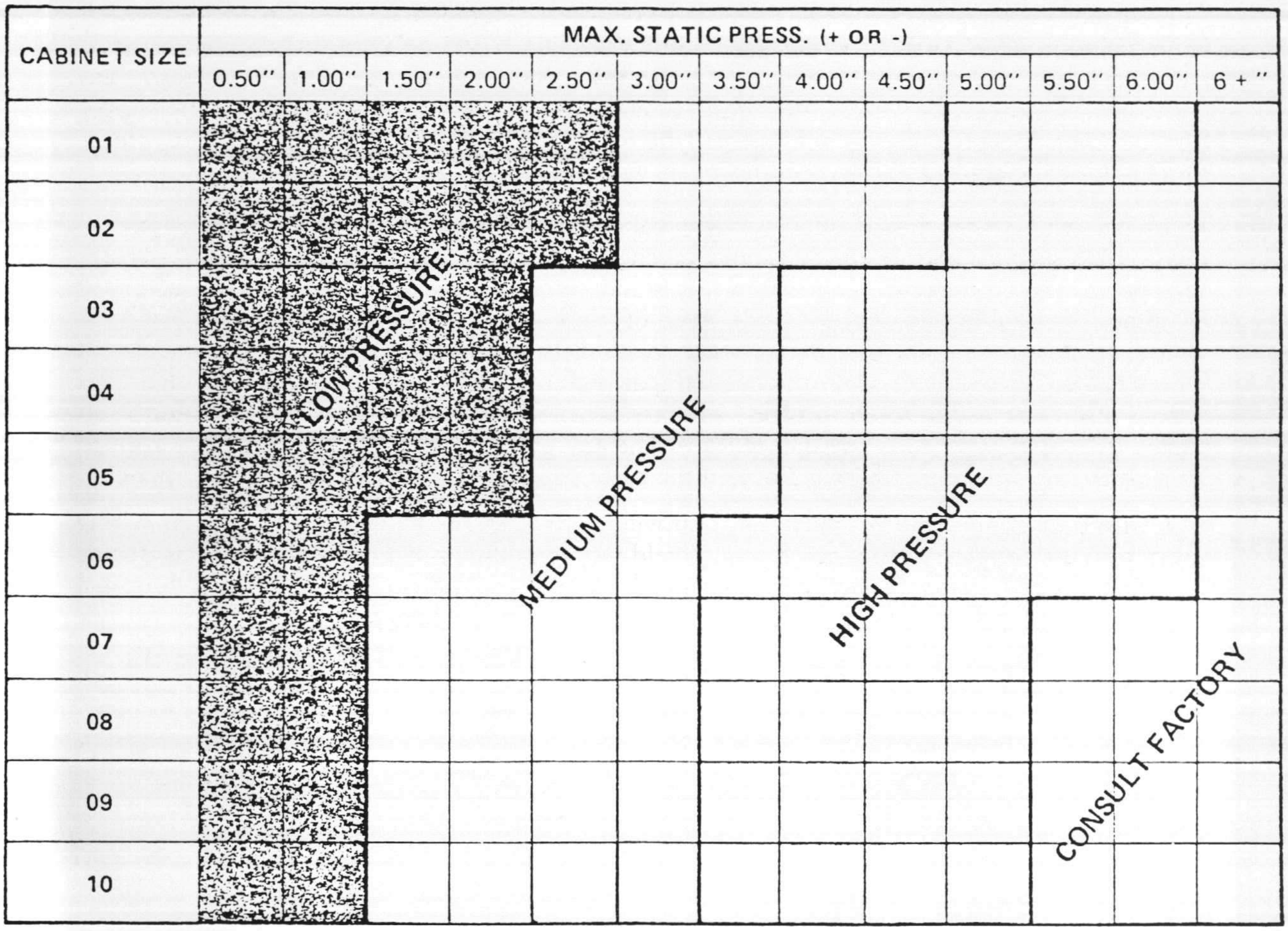
The current characteristics, phase, cycle and voltage are stamped on the nameplate of each Governair unit. The "As Built" wiring and control schematic contained in the instruction envelope enclosed in the control panel box also calls out these requirements. Before attempting to energize any portion of the system, be certain to check the electrical characteristics of the supply current. Even though you may not energize the major components, the voltage reducing transformer, normally applied to the control circuits, will be subjected to the line voltage.

Good practice dictates that all exposed electrical connections in the area of starters, contactors, relays, buss sections and terminals should be checked for tightness prior to the actual startup. Many of the connections contain several wires and while they were tightened at the factory at the time of assembly, and checked at the time of run-in, they may have developed a "set" and will concede to retightening. The danger of a poor connection causing overheating and component failure through inadequate current handling capacity cannot be over emphasized. Cartridge fuses should always be of the fusetron type. Ordinary cartridge fuses, not designed for limited short period overloads, will cause nuisance failures. The amperage value of the fusetron to be applied on a given unit will be clearly called out on the wiring diagram contained in the control panel.

The wiring diagram supplied with each unit will be the "As Built" factory wiring. This wiring diagram must be referred to when bringing field wiring to the unit. This is necessary, as during manufacturing assembly of each unit a terminal number could change. This possible terminal number change will not alter the original approved design and/or operation of the unit.

Static Pressure Limits of Cabinet

TABLE 4



LOW PRESSURE PACKAGE

A. Cabinet construction:
20 gauge single wall (or double wall 20 gauge exterior with 20 gauge solid or perforated liner.) All joints are sealed with latex caulking.

B. All access doors are double wall 20 ga/24 ga and open to the outside with door latches, standard flat gasket and standard galvanized hinges. **Maximum** door size 66" H x 30" W.

MEDIUM PRESSURE PACKAGE

A. Cabinet construction:
16 Gauge single wall (or double wall 18 gauge exterior with solid 20 gauge liner, or double wall 16 gauge exterior with 20 gauge perforated liner.) All joints sealed with latex caulking.

B. All access doors are double wall 18 ga/24 ga with **maximum** door size 66" H x 30" W. All doors open out with door latches and full height hinges.

HIGH PRESSURE PACKAGE

A. Cabinet construction:
16 gauge single wall (or double wall 16 gauge exterior with solid or perforated 20 gauge liner). All joints are sealed with high pressure sealant or continuously welded.

B. All access doors are double wall 16 ga/24 ga with **maximum** door size 66" H x 30" W. Doors open against pressure with full height hinges, door latches, and seal against bulb-type gasket.

NOTE:

(1) Some units may require special construction considerations. The manufacturer reserves the right to modify construction of any unit as deemed necessary.

Coils

Chilled Water and Direct Expansion Coils:

Chilled water and direct expansion coils must not exceed 600 feet per minute to prevent condensate water from being pulled off the coil and outside the condensate drain pan. Air velocity of 500 feet per minute is more desirable.

The static pressure drop across each coil will change with the number of rows deep and other design conditions. Consult the written submittal for each unit on each job.

NOTE: 1. For condensate drain traps, see Table of Contents under "Drain Traps".

2. For winterizing see Table of Contents, "Winterizing Coils".

Hot Water Coils

The static pressure across hot water coils will change with the number of rows deep and fins per inch. This also is closely related with the temperature rise desired leaving the coil.

The temperature rise of the air leaving the coil is also dependent on the airflow across the coil, the gallons of water flow through the coil and the entering water temperature into the coil. Consult the submittal for each specific job for the above information.

NOTE: When using ethylene glycol or other antifreeze solutions, consult Governair for the required derating of each coil. It will be necessary to give the percentage of ethylene glycol required.

Winterizing – See Table of Contents – "Winterizing Coils"

Steam Coils

The static pressure drop across steam coils will change with the number of rows deep and fins per inch. Consult the submittal issued for each specific unit for above information.

DTH Steam Coils are commonly called non freeze coils. Caution: There is no coil that is absolutely free from freezing.

Winterizing – See Table of Contents "Winterizing Coils".

Piping & Control

Consult the job specification for the specific piping requirements for each unit.

Freeze Protection of Coils

All chilled water, hot water and steam coils can be damaged during freezing weather. Pre-cautionary measures must be taken to prevent freezing such as:

1. Draining each coil and related piping, making sure that all low areas also drain.
2. After draining, flush coils with an antifreeze solution such as ethylene glycol. A solution of 50% ethylene glycol and 50% water will protect from freezing to approximately 35° F. below zero at sea level.
3. In case of unit shutdown during winter operation, such as power failure, night shutdown and weekend shutdown, the controls must be installed so the valves will go to the full heat position, and all fresh air dampers and exhaust dampers go to the full closed position. The water circulation pumps must keep circulating water through the coils and/or auxiliary heat must be maintained within the unit cabinet.

Parts Replacement Ordering

Due to the variation of components supplied with this type of equipment, it is not possible to publish a generalized parts list. When requesting replacement parts, the following information must be given:

1. Complete Governair nameplate data such as model and serial number.
2. Name of part, giving full description, including model and serial number, if available.

Pre-Start Up Check

All Governair units are carefully checked at the factory and are operated by factory test technicians to determine satisfactory operation and verify conformance to the specifications. However the check-test and start up procedure supplied as a part of this manual page 15 must be closely adhered to when putting the unit into operation. A copy of the check-test and start up form must be presented to Governair to verify start up date of the unit.

Start Up Check List

Date________________
Model________________
Serial #________________

Pre-start Check		
Unit received undamaged		
Equipment received as ordered		
Unit located properly for service		
Vibration isolators used		
Spring isolation properly adjusted		
Rubber in shear isolators properly shimmed		
Check electrical supply voltage ________________		
Check electrical connections for tightness		
Check fusetron amperage against schematic		
Remove shipping blocks		
Check fan wheel set screw, drive sheaves		
Check bearings for alignment and locking collars		
Rotate wheels and motors to assure freedom of movement		
Check condensate drain traps		
Check to see that proper air filters are installed		
Operational check		
Momentarily start fan motor and assure correct rotation		
Check belts for tightness		
Check fan motor____________ RPM ____________ AMPS		
Check Return fan motor____________ RPM ____________ AMPS		
Check damper operation		
Check cabinet for air leaks		
Check cabinet for possible water leaks		
Latch/tighten all panels		

GOVERNAIR
CORPORATION

Blowers

All blower wheels should rotate freely and should be rotated by hand and the blower hub set screws retightened prior to actually starting the blower. If the blower wheel has shifted in shipment, it may be corrected by:

1. Loosening the bearing collar set screws and moving the blower and shaft to correct. Then retighten bearing collar set screws.

   CAUTION: This may cause the belts to be misaligned which will require realignment.

2. Loosen the blower hub set screws and move blower wheel to correct.

   CAUTION: Do not operate the blower if there is undue vibration. Such operation can result in bearing failure, sprung shaft, or other serious damage.

Forward curved and backward curved blowers having either spring or rubber-in shear isolation, will have wood shipping blocks between the blower frame and the unit base.

The shipping blocks must be removed and the locking nuts on the spring isolators adjusted so that the assembly rides free and properly absorbs the vibration of the fan assembly.

Bearings may be replaced on either assembly by removing two pillow block bearing bolts, loosening two Allen set screws in the concentric locking collar and sliding the bearing off of the shaft. Bearings are self aligning.

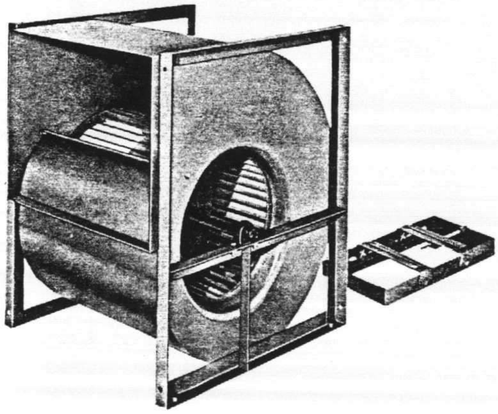
Blower wheels are removed from the forward curved scroll by removing the cutoff in the blower outlet, loosening the bearing and blower wheel set screws to remove the shaft. Remove the wheel through the blower outlet.

Blower wheels are removed from the backward curved blowers through the side of the blower scroll.

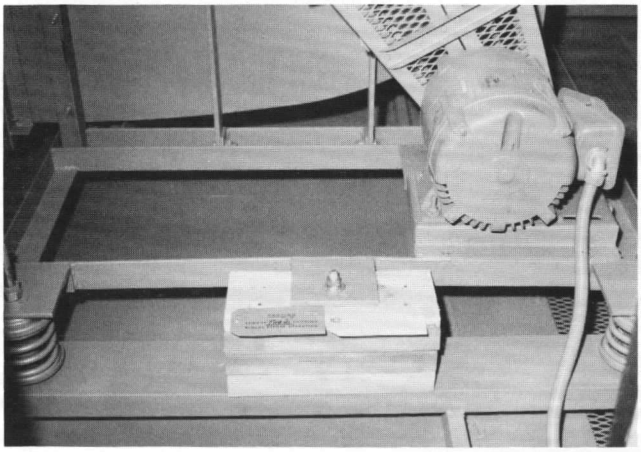
1. Remove the bearing and bearing support.
2. Remove the inlet cone.
3. Remove the wheel through the side of the scroll. See page 17.

Motors

All motors contained in Governair units have been phased at the time of inspection and testing. Should you find the fans or blower wheels operating in a reverse direction, interchange two main supply lines (3 PH.). Do not interchange leads on the motor starters.



Forward Curved Fan Without Spring Isolators



Backward Curved Fan With Belt Guard and Spring Isolators

GOVERNAIR
CORPORATION

BACKWARD INCLINED AND AIRFOIL FANS

INSTRUCTIONS TO DISASSEMBLE AND REASSEMBLE LARGE SIZE FANS:

Step Procedure

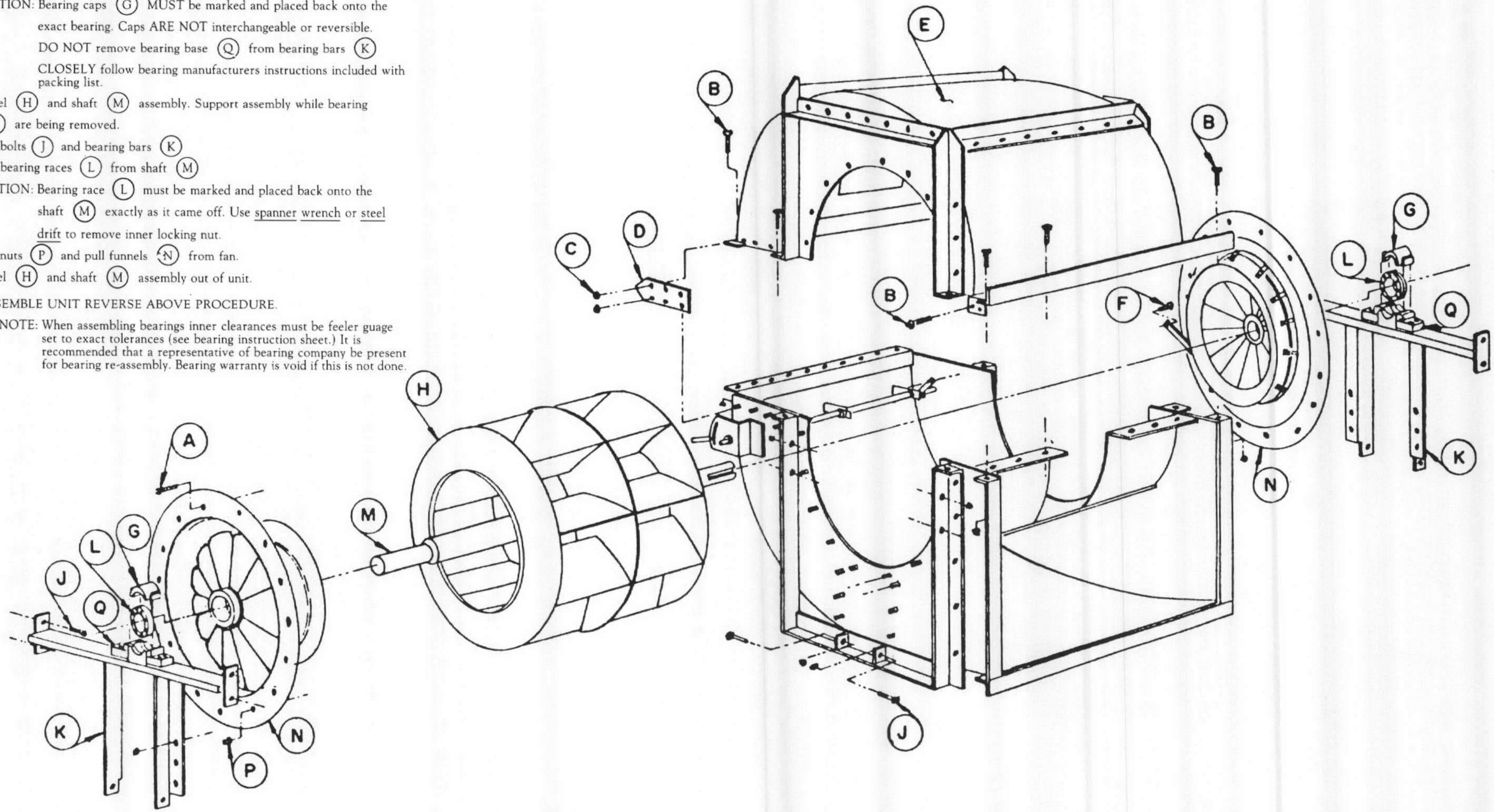
1. Remove funnel bolts (A), split housing bolts (B), nuts (C) and flat stock (D) Covering housing split.
2. Remove top half of housing (E)
3. Remove vane linkage bolts (F)
4. Remove bearing caps (G)

   CAUTION: Bearing caps (G) MUST be marked and placed back onto the exact bearing. Caps ARE NOT interchangeable or reversible.
   DO NOT remove bearing base (Q) from bearing bars (K)
   CLOSELY follow bearing manufacturers instructions included with packing list.
5. Lift wheel (H) and shaft (M) assembly. Support assembly while bearing bars (K) are being removed.
6. Remove bolts (J) and bearing bars (K)
7. Remove bearing races (L) from shaft (M)

   CAUTION: Bearing race (L) must be marked and placed back onto the shaft (M) exactly as it came off. Use spanner wrench or steel drift to remove inner locking nut.
8. Remove nuts (P) and pull funnels (N) from fan.
9. Lift wheel (H) and shaft (M) assembly out of unit.

TO REASSEMBLE UNIT REVERSE ABOVE PROCEDURE.

NOTE: When assembling bearings inner clearances must be feeler guage set to exact tolerances (see bearing instruction sheet.) It is recommended that a representative of bearing company be present for bearing re-assembly. Bearing warranty is void if this is not done.



Backward Inclined and Airfoil Fans

Motor amperage should be checked after the connecting duct work is installed and an air check made on the air distribution system. Only in those cases where the air flow at the outlets is insufficient to meet specifications should the blower speed be changed. The proof of proper motor amperage draw lies not within the motor amp reading, but rather with the effect produced. If the air flow is sufficient at the outlets, do not alter blower speed to bring the motor HP up to nameplate rating. Quite often the motor sizing may fall on the liberal side of the actual requirement and to change speed merely to utilize the HP capacity of the motor may introduce air circulation problems in the conditioned area as well as in the unit. Be certain to check the motor nameplate for the maximum amperage draw.

Belts

Belts should be checked for correct tension at start up and should be checked again after one week of operation. On multiple drive adjustable pulleys, the pitch depth should be checked and equated to insure identical belt travel, power transfer and wear. Adjustable motor bases, either hinged or sliding type, are provided for easy belt adjustment. See section "Belt Adjustment".

Pulley and Drives

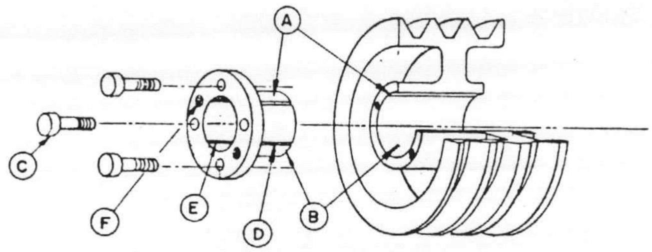
Motor pulleys both adjustable pitch, fixed pitch, and blower shaft pulleys are locked in position with either set screws or split taper lock bushings. It is mandatory that all set screws and/or taper lock bolts be checked for tightness and alignment before putting equipment into operation.

All drive belts must also be checked for proper tension. See section "Belt Adjustment."

NOTE: An incorrectly aligned and tensioned belt can substantially shorten belt life, overload blower and motor bearings shortening their life expectancy and a belt tensioned too tight can overload the motor electrically causing nuisance tripping of the motor overloads and/or motor failure.

For pulley adjustment, removal and installation see page 19, 20 and 21.

Sheaves With
Split Taper Malleable Bushings



A. This key guides bushing into sheave. It provides extra safety and a positive drive.

B. Bushing barrel and bore of sheave are tapered. This assures concentric mounting and a true running sheave.

C. Three cap screws, when tightened, lock bushing in sheave.

D. Bushing is split so that when the locking cap screws force bushing in tapered bore, the bushing grips the shaft with a positive clamping fit. This will withstand vibration and punishing loads without being loosened.

E. Sheave and bushing assembly is keyed to shaft and held in place by compression. This gives added driving strength.

F. Sheave is easily removed from shaft by inserting and tightening two of the cap screws in the tapped holes in the bushing flange. This forces the bushing loose from the sheave and releases the compression so that the entire assembly will slide from the shaft.

WARNING – Do not attempt to pull bushing flange flush with hub end. There should be ⅛″ to ¼″ clearance when tightened.

MVP* Variable Speed Sheaves
Adjustment and Cleaning Instructions

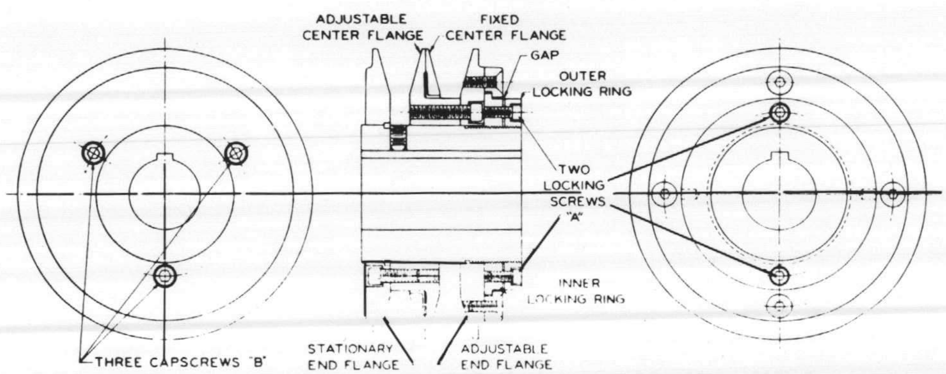


Fig. 1

Pitch Diameter Adjustment Instructions

1. Slack off all Belt Tension by moving motor towards driven shaft until Belts are free of grooves. For easiest adjustment, remove the Belts from the grooves.

2. Loosen both Locking Screws "A" in Outer Locking Ring, but **Do Not Remove Them From The Sheave.**

(There is a gap of approximately 1/32" between Inner and Outer Locking Rings. This gap must be maintained for satisfactory locking of the Sheave. If the Locking Screws "A" are removed by accident and gap is lost, screw the Outer Locking Ring down until it touches the Inner Locking Ring. Then back off the Outer Ring ½ to ¾ turn until the screw holes are lined up in the Inner and Outer Locking Rings. Re-insert Locking Screws "A" but do not tighten them until after adjustment is made.)

3. Adjust Sheave to desired Pitch Diameter by turning Outer Locking Ring.

(Any Pitch Diameter can be obtained within the Sheave range. One complete turn of the Outer Locking Ring will result in .233" change in Pitch Diameter.)

DO NOT OPEN "B" SHEAVES MORE THAN 4¾ TURNS FOR "A" BELTS OR 6 TURNS FOR "B" BELTS. DO NOT OPEN "C" SHEAVES MORE THAN 9½ TURNS. DO NOT OPEN "D" SHEAVES MORE THAN 13 TURNS. DO NOT OPEN "5V" SHEAVES MORE THAN 6 TURNS. DO NOT OPEN "8V" SHEAVES MORE THAN 8½ TURNS.

CAUTION:

SHEAVES SHOULD NOT BE ADJUSTED IN EITHER DIRECTION TO THE POINT WHERE MOVABLE AND STATIONARY FLANGES ARE IN CONTACT.

4. **Tighten BOTH** Locking Screws "A" in the Outer Locking Ring.

5. Replace Belts and move motor away from driven shaft to apply sufficient Belt Tension to prevent slippage. Check speed. If further adjustment is needed, repeat the steps above.

Caution: Do not loosen any screws other than the two LOCKING Screws "A" in the Outer Locking Ring. These screws should be loosened only while the drive is at rest and adjustment is being made. **They must be tightened securely before drive is operated.**

To Strip Sheave for Cleaning

1. If it becomes necessary to clean dirt, lint, etc from the Sheave, it can be disassembled by removing the three Capscrews "B" in the Stationary End Flange of the Sheave (opposite the Locking Rings). After this is done, the Center Flange Assembly can be removed as a unit by loosening Locking Screws "A" and backing off the Locking Rings until they are disengaged from the threaded end of the Barrel.

2. Clean Sheave Barrel and bore of Center Flange Assembly. If it is necessary to use an abrasive, use only fine grit emery cloth. Do not use a file. If Stationary End Flange or Keys are removed from Barrel, be sure they are reassembled as shown below:

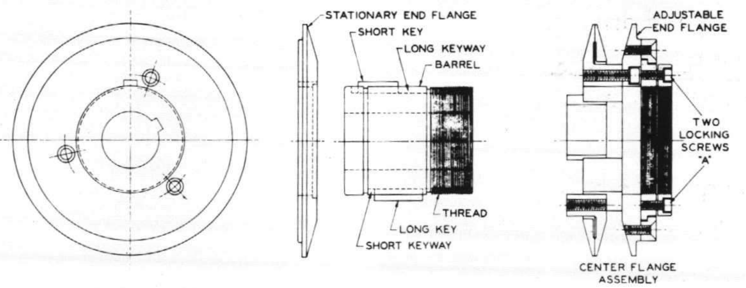


Fig. 2

3. After cleaning, wipe a thin film of high quality rust inhibiting grease, such as TEXACO THREAD-TEX over the Barrel.

4. To reassemble, line up keyways of the Center Flange Assembly so that the keyway extending through the Adjustable End Flange goes over the long key. Place the Center Flange Assembly over the Barrel. It may be necessary to move each flange slightly to line up the keyway with the key in the Barrel.

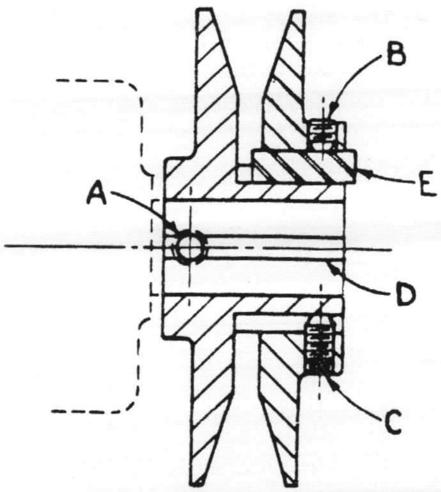
5. When Center Flange Assembly has been placed over Barrel, turn Locking Rings to engage thread on Barrel. Screw Locking Rings onto Barrel thread until Center Flange Assembly is tight against Stationary End flange, then back off ¼ turn.

6. After Sheave is assembled in this position, reinsert Capscrews "B" with lock washers and tighten. Sheave is now ready to readjust for operation.

Caution: Do not remove any screws other than those marked in sketches. This Sheave has been finished grooved and balanced after assembly for true running and quiet operation. Further disassembly offers possibility of Center Flanges being mixed up, which will create unbalance and groove run-out.

Instructions for Mounting and Adjusting

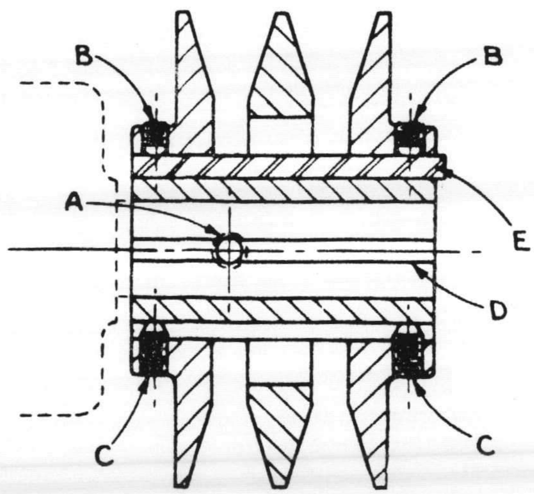
VARIABLE PITCH KEY TYPE SHEAVES



Single Groove

Key "E" projects to provide a grip for removing.

Do not operate sheave with flange projecting beyond the hub end.



Two Groove

Mounting:

1. All sheaves should be mounted on the motor or driving shaft with the end containing the setscrew "A" toward the motor.
2. Be sure both driving and driven sheaves are in alignment and that shafts are parallel.
3. Fit internal key "D" between sheave and shaft, and lock setscrew "A" in place. Wrench Torque 110″ lbs. min. – 130″ lbs. max.

Adjusting:

1. Loosen setscrews "B" and "C" in moving parts of sheave and pull out external key "E". (This key projects a small amount to provide a grip for removing.)
2. Adjust sheave pitch diameter for desired speed by opening moving parts by half or full turns from closed position. DO NOT OPEN MORE THAN FIVE FULL TURNS FOR "A" BELTS OR SIX FULL TURNS FOR "B" BELTS.
3. Replace external key "E" and tighten setscrews "B" over key and setscrews "C" into keyway in fixed half of the sheave. Wrench Torque 110″ lbs. min. – 130″ lbs. max.
4. Put on belts and adjust belt tension (Do not force belts over grooves.)
5. Future adjustments should be made by loosening the belt tension and increasing or decreasing the pitch diameter of the sheave by half or full turns as required. Readjust belt tension before starting drive.
6. Two groove sheaves must have both halves adjusted by the same number of turns from closed position to insure the same pitch diameter.
7. Be sure that ALL keys are in place and that ALL setscrews are torqued properly before starting drive. Check setscrews and belt tension after 24 hours service.
8. Recheck motor running load amps with motor name plate R.L.P.

Lubrication

Motors: check the name plate of each for proper lubricant to use. If no lubrication instructions are on the motor name plate the following lubricating instructions are to be followed.

Motors are equipped with double-shield ballbearings* having sufficient grease to last indefinitely under normal service. Where the motor is used constantly in dirty, wet or corrosive atmospheres, it is advisable to add one quarter ounce of grease per bearing every three months. Use a good quality rust inhibited polyurea based grease, such as Chevron SR1.

When greasing the bearings, keep all dirt out of the area. Wipe the fittings completely clean and use clean equipment. More bearing failures are caused by dirt introduced during greasing than from insufficient grease.

*The blower end bearings of 143T and 145T motors are sealed bearings and need no greasing.

CENTRIFUGAL FAN MAINTENANCE AND LUBRICATION

BEARING LUBRICATION INSTRUCTIONS

Bearing Types

Governair typically furnishes one of three basic bearing types for centrifugal fans — ball bearing, spherical roller bearing, spherical roller bearing with split housing. The bearing type and manufacturer are indicated on each bearing.

Operating Conditions

Bearings should not be located in the airstream or an environment with a heavy concentration of abrasive elements. Governair does NOT recommend grease lubricated bearings for ambient temperatures above 200° F. For information on water, or oil cooled bearings contact the factory.

Grease Selection

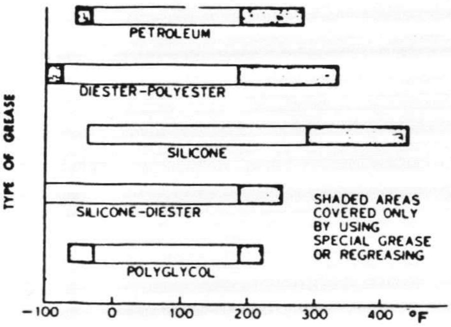
Various types and brands of grease are suggested below and on the following pages. The brands suggested for your specific bearing type and application can be used. In all cases one should avoid mixing different brands of grease.

Initial Greasing

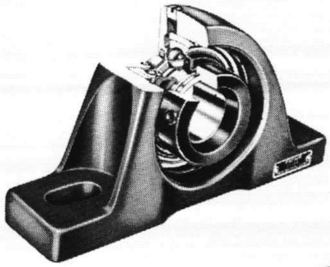
All standard bearings provided by Governair should be purged and relubricated before operation. Using the approved grease or an equivalent, lubricate the bearing and housing reservoir through the pressure lubrication fitting. Complete greasing is assured if grease is worked in on one side of the bearing until grease appears on both sides. If the bearing will be operated at less than 150 RPM, and in dirty conditions, more grease is desirable. The bearing will discharge excess grease through seals after a short period of operation. It is not necessary to replace this initial discharge because leakage will cease when the excess grease is worked out.

Relubrication

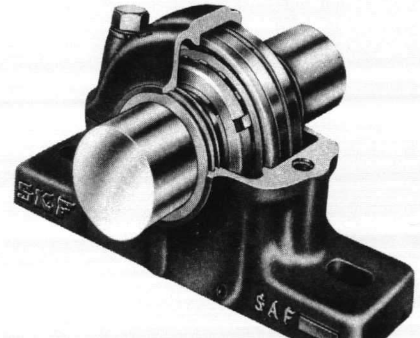
The initial greasing interval can be determined by the conditions or bearing instructions which follow. By carefully observing the condition of the grease expelled from bearings at the time of relubrication, it can be determined whether the maintenance schedule should be altered. When regreasing, avoid mixing different brands of grease.



Temperature Range for Greases



Ball Bearing



Spherical Roller Bearing With Split Housing

Spherical Roller Bearing

GOVERNAIR CORPORATION

Grease Lubrication Chart

Operating condition: Dirt	Operating condition: Moisture	Bearing operating temperature	Greasing interval □	Use grease equivalent to these grades	Remarks
Fairly clean	None	32°F. to 120°F. 120°F. to 160°F. 160°F. to 200°F.	6 to 12 months 1 to 2 months 1 to 4 weeks	Phillips Petroleum Co. Philube L #1 Master Lubricants Co. Lubrike M-3 Spec. Atlantic Refining Co. Atlantic 62 Imperial Oil Ltd. Andok 280	
Moderate to extremely dirty	None	32°F. to 160°F. 160°F. to 200°F.	1 to 4 weeks 1 week		
Fairly clean	Heavy moisture and direct water splash	32°F. to 200°F.	1 week	Standard Oil Co. (Ind.) Amelith #1 Sun Oil Co. Sunoco 844-X New York & New Jersey Lubricant Co. F-925 Mobil Oil Co. Mobilux #1	Customer should provide flinger or place a hood over bearing housing and fasten a disc to shaft just inside of hood shaft opening. Consult Link-Belt.
		32°F. to 200°F.	Determined by frequent inspection of installation.	Shell Oil Co. Alvania EP2 Mobil Oil Co. Sovarex grease L-1	
	None	32°F. to −40°F.	Consult Link-Belt Application Engineering	Mobil Oil Co. Mobilgrease BRB Zero Texas Co. 2324 Uni Temp. Ep	Cold storage room
	None	Over 200°F. or below −40°F.	Consult Link-Belt Application Engineering	Special lubrication may be required. Consult Link-Belt.	A different Link-Belt bearing may be required using oil as a lubricant, etc.

□ Frequency of regreasing will vary, depending on the hours of operation, temperature and surrounding conditions.

Storage

Bearings which are to be stored or idle for an extended period of time should be wrapped in a neutral grease-proof paper, foil or plastic film. Compounds can be recommended by the bearing manufacturer to provide protection for several months to several years. During storage the bearings should be rotated monthly to prevent corrosion. After long-term storage, grease should be purged from the bearings and fresh grease injected prior to start up.

Instructions for Specific Bearings

Below and on the following pages are copies of the lubrication instruction labels similar to those for the standard bearings provided by Governair. If additional information is required for these or other bearings provided by Governair, contact the bearing manufacturer directly.

SEAL MASTER BALL BEARING UNITS

prelubricated . . . ready for immediate use

RELUBRICATE WHILE RUNNING IF POSSIBLE,
IF RELUBRICATING WHILE IDLE, ADD ONLY
4 to 5 SHOTS WITH HAND GUN
USE GREASE, NOT OIL

SUGGESTED INTERVAL

Speed	Temperature	Cleanliness	Greasing Interval
0-100 RPM	TO 140°F.	CLEAN	6-12 MONTHS
101-1500 PRM	TO 140°F.	CLEAN	2-6 MONTHS
ANY SPEED	TO 140°F.	DIRTY	1 WK. - 1 MO.
ANY SPEED	TO 200°F.	DIRTY	DAILY - 2 WK.

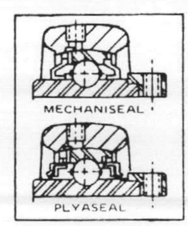
IF ABNORMAL CONDITIONS EXIST CONSULT SEALMASTER ENGINEERS FOR RECOMMENDATIONS.

SEALMASTER BEARING DIVISION
STEPHENS-ADAMSON MFG. CO.
AURORA, ILL. LOS ANGELES, CAL. BELLEVILLE, ONT.

ASSEMBLY AND LUBRICATION INSTRUCTIONS
FOR FAFNIR RELUBRICATABLE MECHANISEAL & PLYASEAL
TRANSMISSION UNITS

INSTALLATION

LOCATE ASSEMBLED UNIT TO POSITION AND LINE-UP SHAFT CAREFULLY. FAFNIR SELF-ALIGNING UNITS WILL AUTOMATICALLY COMPENSATE FOR MISALIGNMENT, BUT SHAFT MUST BE STRAIGHT. BOLT UNIT SECURELY TO SUPPORTING STRUCTURE.



SLIDE COLLAR AGAINST CAM END OF INNER RING. ENGAGE CAMS BY ROTATING COLLAR UNTIL IT SLIDES OVER CAMMED END OF INNER RING. LOCK COLLAR BY TAPPING LIGHTLY IN DIRECTION OF SHAFT ROTATION. TIGHTEN SET SCREW TO DISASSEMBLE. LOOSEN SET SCREW AND TAP COLLAR IN DIRECTION OPPOSITE SHAFT ROTATION.

LUBRICATION

BEARINGS HAVE BEEN FACTORY PRELUBRICATED WITH HIGH QUALITY GREASE AND FOR NORMAL CONDITIONS OF SERVICE REQUIRE NO FURTHER LUBRICATION.

NORMAL SERVICE IS CONSIDERED AS OPERATION IN A CLEAN DRY ATMOSPHERE AT TEMPERATURES BETWEEN -20°F and 180°F AND AT SHAFT SPEEDS UP TO 2100 FT. PER MIN.

WHERE SERVICE IS ABNORMAL WITH RESPECT TO SPEED, TEMPERATURE OR EXPOSURE TO CONTAMINATION, OR EXTREMELY LONG LIFE IS REQUIRED, PERIODIC RELUBRICATION MAY BE ADVISABLE.

LUBRICATION SCHEDULE FOR HORIZONTAL MOUNTED FAN WITH FMC/LINK BELT SERIES 200 BALL BEARING UNITS

LINK-BELT
BEARING DIVISION

CONSULT
MANUFACTURER
FOR SPECIFIC RECOMMENDATIONS

SHAFT SIZE INCHES	OPERATING SPEED (RPM)									
	500	1000	1500	2000	2500	3000	3500	4000	4500	5000
	RELUBRICATION CYCLE (MONTHS)									
1/2 thru 1	6	6	6	6	6	6	4	4	2	2
1-1/16 thru 1-7/16	6	6	6	6	6	6	4	4	2	1
1-1/2 thru 1-3/4	6	6	6	4	4	2	2	2	1	1
7-7/8 thru 2-3/16	6	6	4	4	2	2	1	1	1	
2-1/4 thru 2-7/16	6	4	4	2	2	1	1	1		
2-1/2 thru 3	6	4	4	2	1	1	1			
3-7/16 thru 3-1/2	6	4	2	1	1	1				
3-15/16 thru 4	6	4	2	1	1					

Lubricate with or equivalent to:

Shell – Alvania EP Grease No. 2
Texaco – Molytex Grease No. 2
Mobil – Mobilux EP2
Gulf – Gulfcrown Grease No. 2
American – Amolith Grease No. 2

For operating temperatures below 32°F or above 300°F consult manufacturer.

Condition of temperature, moisture, or dirt will require more frequent lubrication cycle. Use sufficient volume of grease to purge the seals. Rotate bearings during relubrication where good safety practice permits. For corrosion protection, lubricate upon shutdown. Rotate bearings monthly during fan storage.

RECOMMENDED LUBRICATION SCHEDULE FOR FMC/LINK-BELT SERIES 300 BALL BEARINGS USED ON HORIZONTAL MOUNTED FANS

CONSULT
MANUFACTURER
FOR SPECIFIC RECOMMENDATIONS

SHAFT SIZE INCHES	OPERATING SPEED (RPM)									
	500	1000	1500	2000	2500	3000	3500	4000	4500	5000
	LUBRICATION CYCLE (MONTHS)									
5/8 thru 1	6	6	6	6	4	4	4	4	2	2
1-1/8 thru 1-1/2	6	6	6	4	4	4	2	2	2	1
1-5/8 thru 1-15/16	6	6	6	4	4	2	2	1	1	
2 thru 2-1/2	6	6	4	4	2	1	1			
2-11/16 thru 3-3/16	6	4	2	2	1	1	½			
3-7/16 thru 3-15/16	6	4	2	1						

Lubricate with the following greases or their equivalent:

Shell – Alvania EP Grease No. 2
Texaco – Molytex Grease No. 2
Mobil – Mobilux EP2
Gulf – Gulfcrown Grease No. 2
American – Amolith Grease No. 2

If bearings are subjected to temperatures below 32° or above 200°F, consult fan manufacturer for proper lubrication.

Apply sufficient grease when relubricating to cause some purging of grease at seals.

Increase the frequency of relubrication in conditions of abnormal moisture or dirt.

Lubricate for extended shutdown or storage and rotate shaft monthly for corrosion protection.

601-64 272 FMC CORPORATION • LINK-BELT BEARING DIVISION • INDIANAPOLIS, INDIANA

Grease lubrication schedule
Link-Belt® spherical roller bearings — Series B22400 and B22500
For use on horizontal shaft equipment

Shaft sizes		Amount of grease		Operating speed (rpm)									
				500	1000	1500	2000	2200	2700	3000	3500	4000	4500
Inches	MM	IN^3	CM^3	Lubrication cycle (months)									
3/4 - 1	25	0.39	6.4	6	6	6	4	4	4	2	2	1	1
1-1/8 - 1-1/4	30	0.47	7.7	6	6	4	4	2	2	1	1	1	1
1-7/16 - 1-1/2	35	0.56	9.2	6	4	4	2	2	1	1	1	1	½
1-5/8 - 1-3/4	40	0.80	13.1	6	4	2	2	1	1	1	1	½	
1-15/16 - 2	45-50	0.89	14.6	6	4	2	1	1	1	1	½		
2-3/16 - 2-1/4	55	1.09	17.9	6	4	2	1	1	1	½			
2-7/16 - 2-1/2	60	1.30	21.3	4	2	1	1	1	½				
2-11/16 - 3	65-75	2.42	39.7	4	2	1	1	½					
3-3/16 - 3-1/2	80-85	3.92	64.2	4	2	1	½						
3-11/16 - 4	90-100	5.71	93.6	4	1	½							
4-3/16 - 4-1/2	100-115	6.50	106.5	4	1	½							
4-15/16 - 5	125	10.00	163.9	2	1	½							

These guidelines are for usage on applications approved by FMC.

Lubricate with a multi-purpose roller bearing NLGI Grade 1 or 2 grease having rust inhibitors, anti-oxidant additives, and a minimum oil viscosity of 400 SSU at 100°F. For operation requiring a monthly or less cycle the grease should also be suitable for temperatures up to 250°F continuous, dynamically stable and must not churn or whip.

Some greases having the desired properties are:

American — Rykon Grease No. 2 EP, Mobil — Mobilgrease®28, Texaco — Molytex EP2 grease.

If bearings are subjected to temperatures below 32° or above 200°F, consult equipment manufacturer for proper lubrication.

Conditions of vibration exceeding 1 to 2 mils, moisture or dirt will require a more frequent lubrication cycle or special lubricant selection. Rotate bearings during relubrication where good safety practice permits.

Lubricate bearing prior to extended shutdown or storage and rotate shaft monthly to aid corrosion protection.

601-65-084

FMC Corporation • Bearing Division • Indianapolis, Indiana 46206

GOVERNAIR
CORPORATION

SKF SPHERICAL ROLLER BEARINGS

RELUBRICATE ON THIS SCHEDULE UNDER NORMAL OPERATING CONDITIONS

LUBRICATION IN HOURS

SHAFT DIA. (IN.)	SPEED IN R.P.M. 300	500	700	900	1100	1300	1500	1800	2400	2700	3000
2-3/16	6060	3550	2470	1875	1490	1230	1035	825	565	475	410
2-7/16	5520	3220	2220	1670	1320	1070	900	700	465	380	
2-11/16	5090	2930	2010	1495	1170	940	780	600	375		
2-15/16	5090	2930	2010	1495	1170	940	780	600	375		
3-7/16	4560	2590	1745	1280	985	770	625	460			
3-15/16	4270	2400	1600	1155	875	675	535	375			
4-7/16	3580	1940	1240	845	600	425					
4-15/16	3380	1800	1125	750	515						
5-7/16	3050	1570	940	590	370						
5-15/16	2900	1470	850	510							

LUBRICATION NOTES

The upper half of the housing has two tapped holes 30° from the vertical center line. One hole is in the center of the housing; the other is to the side. Lubricate through the center hole for spherical roller bearings with W33 feature (with groove around the outer ring) and lubricate through the side hole for self-aligning ball bearings and spherical roller bearings without W33 feature (without groove around outer ring). *This is important! The lubricant will not get to the bearing if it is applied through the center hole when a bearing without the grooved outer ring is used.*

GREASE LUBRICATION: If grease is used as a lubricant it should be smeared between the rolling elements and worked in. The lower half of the housing should be packed 1/3 to 1/2 full.

BALL BEARINGS: An apparent channeling grease with a ASTM penetration of 190 minimum should be used.

ROLLER BEARINGS: Greases to be used should have an ASTM penetration above 300 and should not channel.

GREASE CLASSIFICATION

CLASS	TYPE OF BASE (1)	OIL VISCOSITY SAYBOLT SECOND (Approx.) SSU @ 100°F.	@ 210°F.	NLGI (2) GRADE
A	Lithium or Equal	200-500	48-55	0
B	" " "	400-600	58-68	1
C	" " "	800-1000	75-82	1
D	Lithium Only	800-1000	75-82	2

TYPE OF GREASE & RELUBE CYCLE RECOMMENDED

Operating Temp. of Brg. (4)	Grease Class Requirement (From Above Chart) for Different Speeds (3) Low (5)	Medium	High	Suggested (8) Relube Cycle
0-70	A or B	A or B		6-12 months
70-120	B or C (6)	B or C		6-12 months
120-160	B or C (6)	C or D	D (7)	2-3 weeks
160-200	C	C or D	D (7)	1-4 weeks

(1) *Calcium Complex Greases Not Recommended For Spherical Roller Bearings.*
(2) National Lubricating Grease Institute Consistency Code.
(3) Definition of speed categories:
Low Up to ¼ of catalog speed limit for static oil lubication.
Medium ¼ to ½ catalog speed limit for static oil lubication.
High ½ to full catalog speed limit for static oil lubrication.
(4) Consult SKF Engineering if temperature is below 0° or above 200°F.
(5) Extremely slow speed, will require special consideration if loads are high.*
(6) Use type "C" where load is heavy, 15,000 hours bating life or less and/or speeds are less than 100 RPM.
(7) Consult SFK Engineering – Grease lube not normally recommended under this combination of operating conditions.
(8) Clean – Dry applications only
For moderate conditions of dirt and /or moisture, use cycle of 1 to 2 months.
For extreme conditions of dirt and/or moisture use cycle of 1 week.
Vertical applications normally require shorter than normal relube cycle.
(9) Never mix greases with unlike bases.
(10) Remove old grease at least once a year.

*Under all conditions, application should be checked using the SKF lubricant film parameter found in the Engineer Date Catalog.

SAF 225/226 SPIT HOUSING PILLOW BLOCKS WITH **SKF** SPHERICAL ROLLER BEARINGS

RELUBRICATE ON THIS SCHEDULE

PILLOW BLOCK NUMBER 225/226	SHAFT DIA.	SPEED (R.P.M.) — RELUBRICATION INTERVAL (HOURS)											GREASE ADDED AT EACH INTERVAL (OUNCES) — PILLOW BLOCK SERIES	
		300	500	700	900	1100	1300	1500	1800	2400	2700	3000	225	226
09	1-7/16	6775	3995	2800	2140	1715	1425	1210	980	690	595	515	0.35	0.52
10	1-11/16	6400	3760	2630	2000	1600	1325	1120	900	625	535	515	0.37	0.79
11	1-15/16	6070	3555	2475	1880	1495	1230	1040	830	565	480	410	0.45	0.93
13	2-3/16	5530	3215	2220	1670	1320	1075	900	705	465	385	320	0.67	1.21
15	2-7/16	5090	2935	2010	1495	1170	945	780	600	375	300		0.72	1.58
16	2-11/16	4900	2810	1915	1420	1105	885	725	550	330	260		0.83	1.77
17	2-15/16	4720	2700	1830	1345	1040	830	670	505	295			0.97	1.94
18	3-3/16	4560	2590	1750	1280	980	775	625	460				1.15	2.19
20	3-7/16	4265	2400	1600	1155	875	675	535	380				1.49	2.82
22	3-15/16	4010	2230	1465	1045	775	585	450	300				1.91	3.45
24	4-3/16	3780	2075	1385	940	680	505	370					2.24	4.02
26	4-7/16	3575	1935	1235	845	595	425	300					2.65	4.68
28	4-15/16	3385	1805	1130	755	515	350						3.06	5.50
30	5-3/16	3210	1685	1035	670	440	280						3.54	6.21
32	5-7/16	3050	1575	940	590	365							4.17	6.97
34	5-15/16	2900	1470	855	515	295							4.79	7.77

Notes:
1. Lubricate with a Grade 2 lithium or non-soap base grease having an oil viscosity of 500-1000 SUS at 100°F.
2. Should bearing operating temperature be below 32°F. or above 200°F. consult fan manufacturer for lubrication recommendations.
3. Clean and repack annually.
4. If fans are to be stored after arrival at job site, bearings should be immediately relubricated and shaft rotated monthly for corrosion protection.

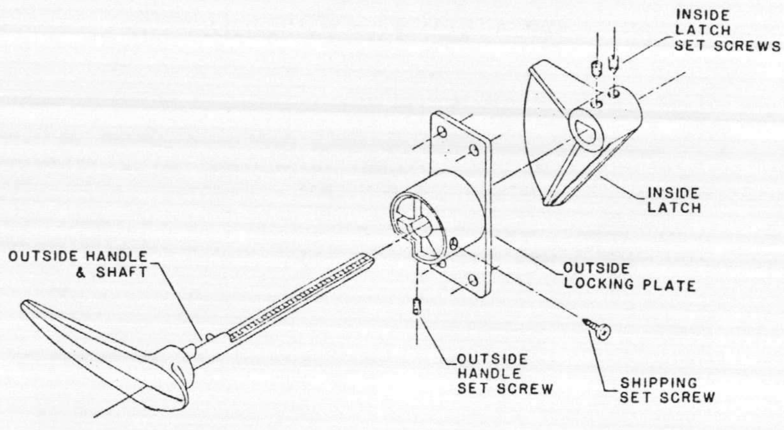
Air Filters

All filters are shipped loose in boxes inside of unit. See packing list received with each unit showing what section of unit filters are shipped in. It is mandatory that filters be installed in the filter frames of each unit before putting the unit into operation to protect the coils and keep them clean.

Upstream access filter frames have a removable section of the frame secured in place with sheet metal screws. It is necessary to remove this section for each horizontal row of filters, install the filters and secure the removable frame section back in place.

Side access slide filters have a side plate to the filter frame secured on with sheet metal fasteners. The opposite side is hinged. Remove the fasteners, swing open side plate, slide filters into filter frame, close side plate and re-install sheet metal fasteners.

Due to the wide variety of bag filters, hepa filters, roll filters and odor removing filters it is not possible to cover all of them in this manual. However, when these filters are supplied installation instructions are shipped with each type.



VENTLOCK # 333 DOOR LATCH

Door Latch

Remove shipping set screw before attempting to open door.

The first quarter turn of the latch handle engages the flange, and during the next quarter turn not only does the bevel on the flange impart compression amounting to 5/32″, but a stud on the latch handle works against a cam in the latch barrel pulling in the striker another 1/8″. In other words, total compression of over 1/4″ is provided by this latch.

The door handle should be checked for proper adjustment so that the door makes a positive seal against the door gasket. To adjust door handle, loosen locking set screws, move flange to desired position on latch shaft, retighten locking set screws.

Door Gaskets

3/16″ x 3/4″ closed cell door gasketing is applied to the door frame opening. At time of startup, the door frame and gasketing should be inspected for possible damage by workmen during the hookup of the equipment.

Caulking

There is always the possibility that external caulked seams may be loosened during the shipping and rigging process. Any seam that appears to be a possible leak source should be recaulked, with acrylic or silicone sealant.

Paint Standard

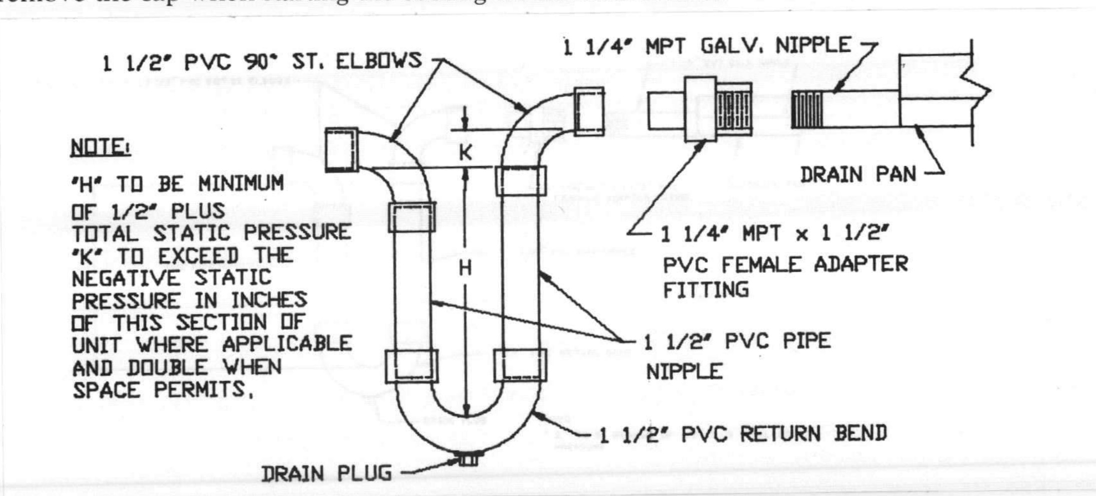
Units are painted with an industrial enamel which will meet or exceed the exposure requirements of TTP 636 Federal Specifications. This finish lends itself to repainting with other enamels; however, it is not recommended that epoxies be used over this paint.

Note: Some units may have special paint. Check each submittal for each unit for special paint.

Condensate Drain

The majority of evaporator coils are located in the units so that the supply air is drawn through them. This results in the condensate being induced to the area of low static pressure. Unless some means of pressure equalization is provided in the condensate drain, the air rushing through the drain pan pipe flange will cause the condensate to pile up in the drain pan. As the unit continues to operate, the accumulated water will be picked up by the in-rushing air and carried with the air over the side of the drain pan causing possible water leaks into the supply duct and/or through the bottom of the unit causing water damage in the building. A minimum trap should be installed to prevent this condensate water buildup. See illustration below. On initial startup, it may be necessary to fill the trap manually or, after the unit has operated sufficiently for a small amount of condensate to collect in the drain pan, turn off the unit, and the trap will automatically fill.

During the winter months when the cooling system is turned off and the unit is exposed to freezing conditions, an antifreeze solution should be poured into the condensate drain trap to prevent freezing and possible damage. The condensate drain trap may also be drained and capped, but be sure to remove the cap when starting the cooling for the next season.



Dampers

CAUTION: Dampers, operators, controls and linkage must be checked prior to applying power to the operators making sure nothing will obstruct the operation of the dampers. Do not over-drive damper operators as this may cause damage to the dampers.

Multizone Dampers

FUNCTION: Position zone dampers in response to zone thermostat. One end switch from each motor should be connected in series to prevent heating source from operating until at least one zone is calling for heat.

LOCATION: Discharge end of unit above or below dampers.

Fresh Air — Return Air and Exhaust Air Damper Motors

FUNCTION: One or more damper motors operate outside air, return air and exhaust air dampers, which function in response to mixed air thermostat or through mixed air lock out to minimum position. Spring return on damper motors close outside air dampers, close exhaust dampers and opens return air dampers when there is no power to the motors.

LOCATION: Mixed air section, return air section and/or exhaust air section.

Minimum Position Potentiometer (If Supplied)

FUNCTION: To maintain minimum outside air setting when energized. Position may be tailored to suit individual job.

LOCATION: Inside of damper motor in mixed air section or in remote control panel.

A good check-out should guarantee that:

1. The motor operates the load properly.
2. The motor responds properly to a controller.
3. The motor returns the damper to the starting position whenever power to the motor is interrupted.
4. There is no binding or stalling of the motor as the motor travels through its entire range.

NOTE: To simplify checkout procedure, it is suggested that an auxiliary potentiometer be substituted for the controller. This may be obtained through your local controls supplier.

Enthalpy Control or Economizer Change Over Thermostat

Function: To drive fresh air dampers and exhaust air dampers to the minimum or closed position and the return air dampers to full open position. When the outside air temperature is below the setting of the control the fresh air dampers, return air dampers and exhaust air dampers are in full economizer cycle operation.

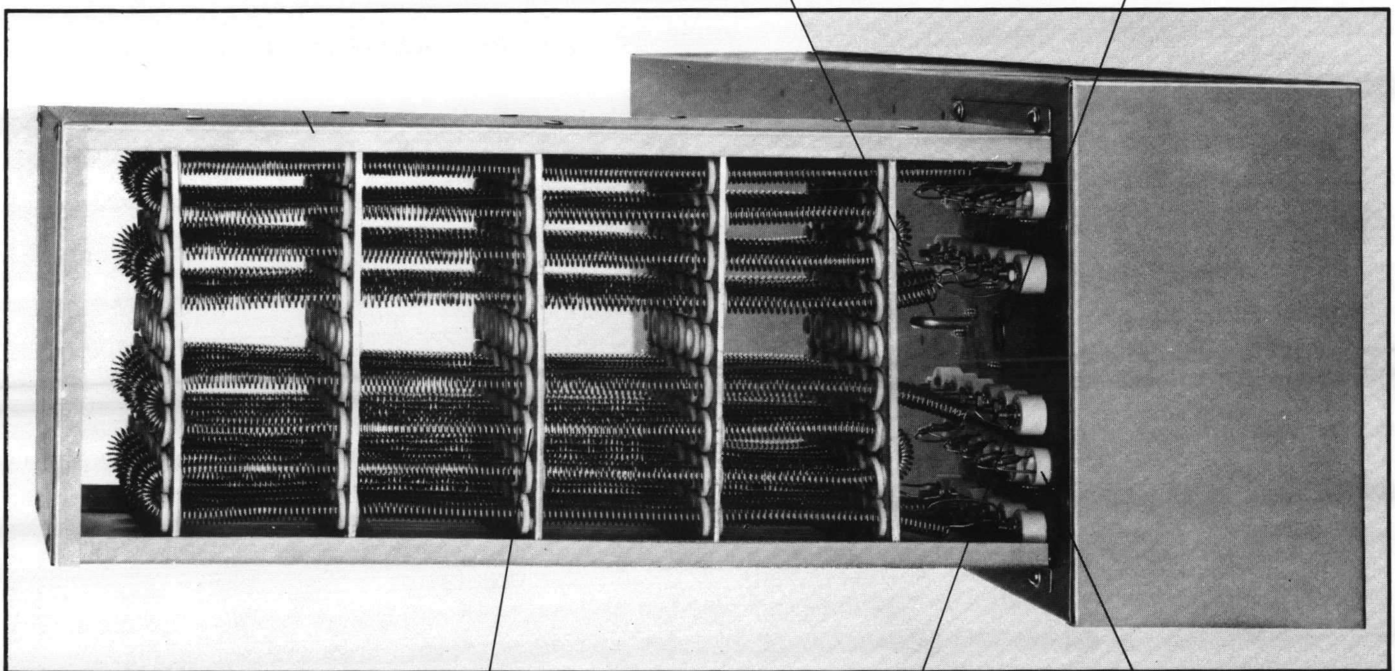
LOCATION: Return air section with the sensing element extending into the fresh air section.

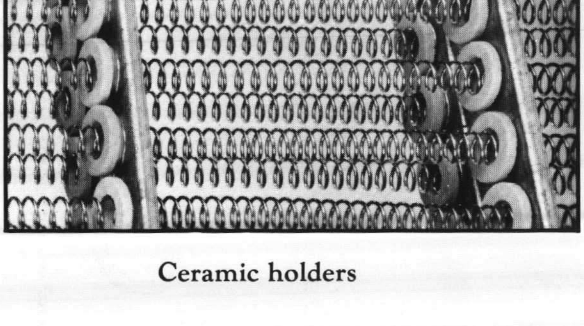
ELECTRIC HEATER
TYPICAL

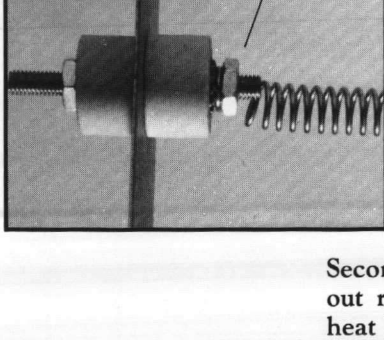
NOTE: When ordering replacement parts give the complete model and serial number of both the electric heater and the Governair unit.

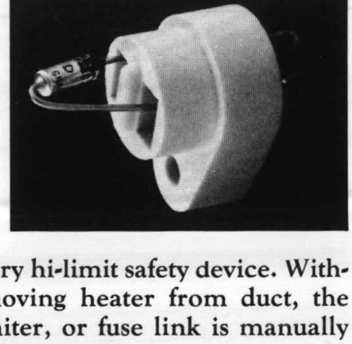
Air Pressure Switch sensing tube removable inside the heater control panel.

Automatic primary hi-limit





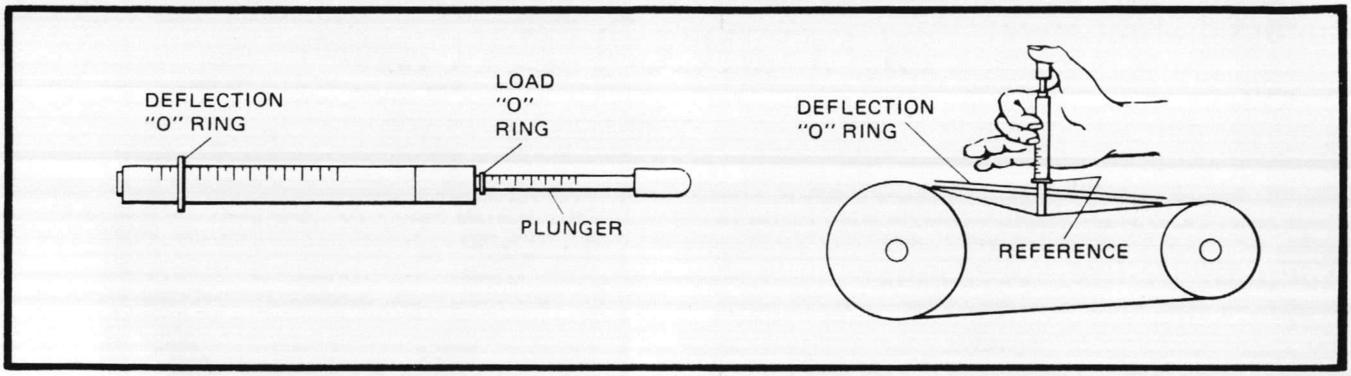




Ceramic holders

Secondary hi-limit safety device. Without removing heater from duct, the heat limiter, or fuse link is manually replaceable in the control panel by removing one screw.

GOVERNAIR
CORPORATION



BELT TENSIONING GAUGE

Troubleshooting

An air moving system consists of the entire air circuitry through which air flows. Included in the system are such components as duct work, fittings, branch ducts, dampers, heat exchangers, filters, coils, elbows, registers, grilles, and other items through which air flows or which offer obstruction to air flow.

While differences in temperature and humidity may cause air movement, it may be considered very slight in comparison to the positive circulation required in an air conditioning system. To accomplish this air movement, a fan has two functions to perform.

1. To produce sufficient pressure or head to accelerate the mass of air from a state of rest to the required velocity, and
2. To produce sufficient pressure to overcome any resistances to the flow of air

The determination of these pressures is a very important part of troubleshooting an air conditioning system. The generally accepted standard instrument for measuring these unit pressures is the Pitot Tube (see Figure 31). The Pitot Tube is used in conjunction with an Inclined Manometer, Magnehelic Gauge, or a Tube Manometer.

When the Pitot Tube is used in conjunction with these instruments, one is able to read velocity pressure (Vp), static pressure (Sp), and total pressure (Tp) within the system.

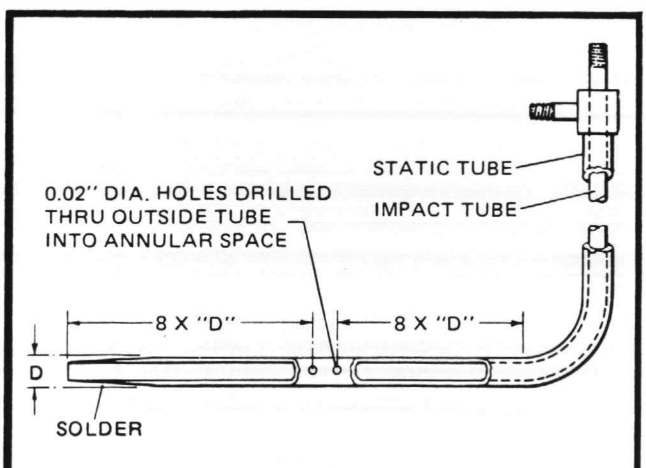


FIG. 31 — CONSTRUCTION OF PITOT TUBE

Pitot Tube

The pitot consists of an impact tube within a larger static tube. When the impact tube is pointed directly into the air stream, the small static pressure holes are perpendicular to the air stream and are not affected by air velocity.

To read velocity pressure, the total pressure tap at the end of the pitot tube is connected to one leg of a manometer and the static pressure tap at the side of the pitot tube is connected to the other leg of the manometer. Refer to Figure 32.

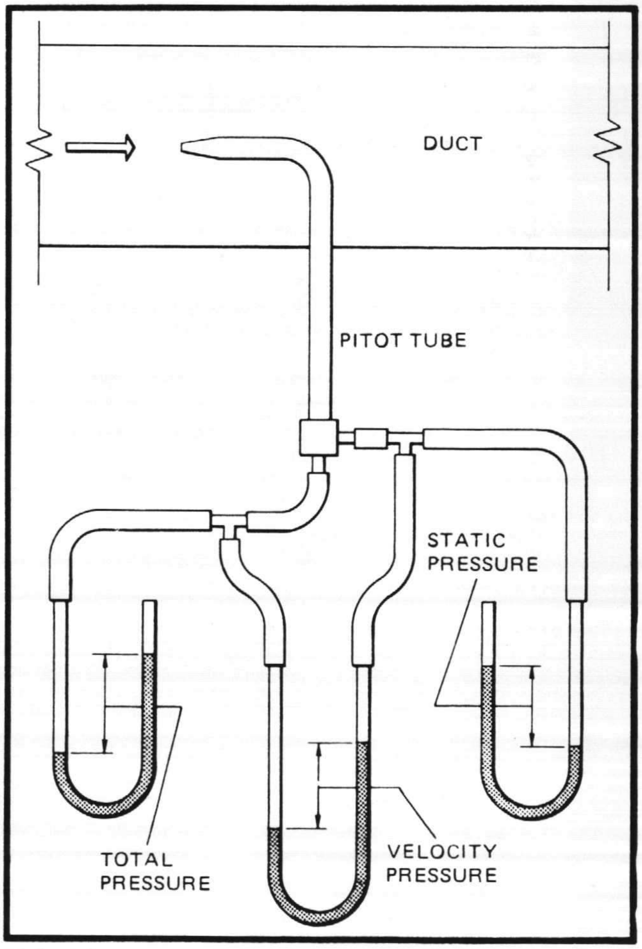


FIG. 32 — PITOT TUBE CONNECTIONS

Inclined Manometer

This instrument, also known as a draft gauge, is a simple, foolproof device, which responds directly to the air pressure exerted against it (transmitted from the Pitot tube), and reads directly in inches of water. Ranges for these instruments vary, and the technician should have one or more instruments to cover the range of 0 to 8 inches of water. Refer to Figure 33.

Magnahelic Pressure Gauge

"Magnahelic" is not a generic term but is registered by Dwyer Instrument Company. The magnahelic gauge is a diaphragm-operated gauge that has several advantages over a liquid manometer; (1) It need not be leveled to 0 and can be used easily on a ladder or unlevel surface. (2) When hooked up to the Pitot tube it need not be purged of air bubbles as the liquid manometer may. (3) There is less chance of parallax error in reading the dial face. (4) It is easily transported without the chance of losing the liquid charge. Unless extreme accuracy is required, this instrument may replace the manometer for average air conditioning work, and like the manometer, is available in a variety of ranges. The dial is only 4 inches in diameter and therefore has a limited scale; several instruments are required to cover the normal ranges encountered in average air conditioning jobs. Refer to Figure 34.

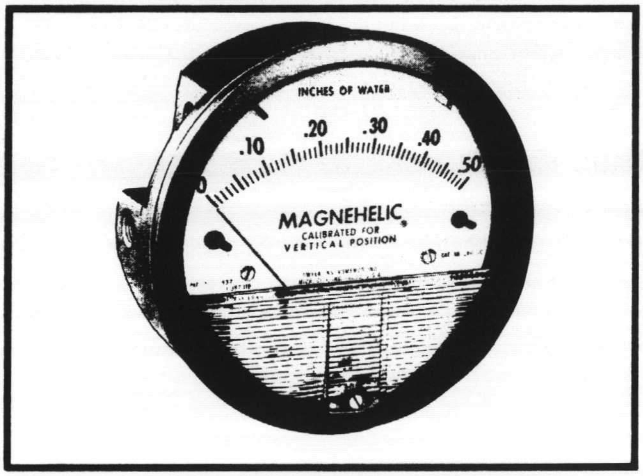


FIG. 34 — MAGNAHELIC PRESSURE GAUGE

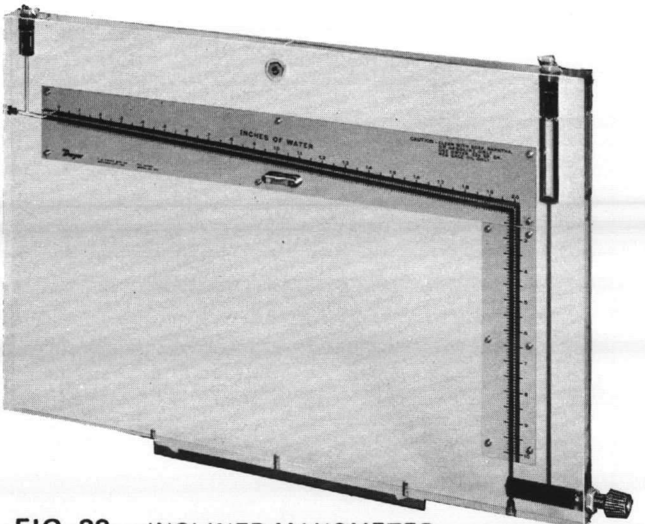


FIG. 33 — INCLINED MANOMETER

"U" Tube Manometer

Pressure is defined as force per unit area — and the best way to measure air pressure is to balance a column of liquid of known weight against the air pressure and measure the height of liquid columns so balanced. The units of measure commonly used are, inches of mercury (in Hg.), using mercury as the fluid and inches of water (in. WG.) using water or oil as the fluid.

Instruments employing this principle are called manometers. The simplest form is the basic well known U-tube manometers (see Figure 35). This device indicates the difference between two pressures or between a single pressure and atmosphere, when one side is open to atmosphere.

If a U-tube is filled to the half way point with water and air pressure exerted on one of the columns, the fluid will be displaced. Thus one leg of water column will rise and the other falls. The difference in height "h" which is the sum of the readings above and below the half way point, indicates the pressure in inches of water column.

The U-tube manometer is a primary standard because the difference in height between the two columns is always a true indication of the pressure regardless of variations in the internal diameter of the tubing.

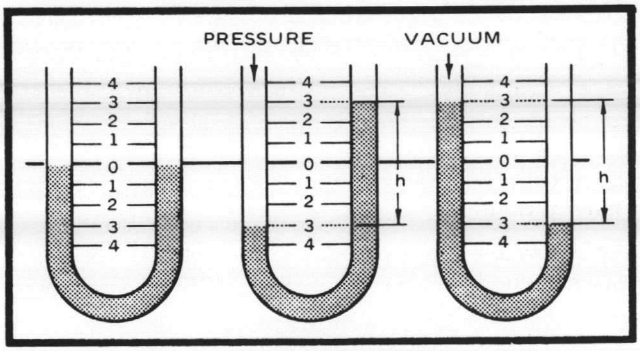


FIG. 35 — "U" TUBE MANOMETERS

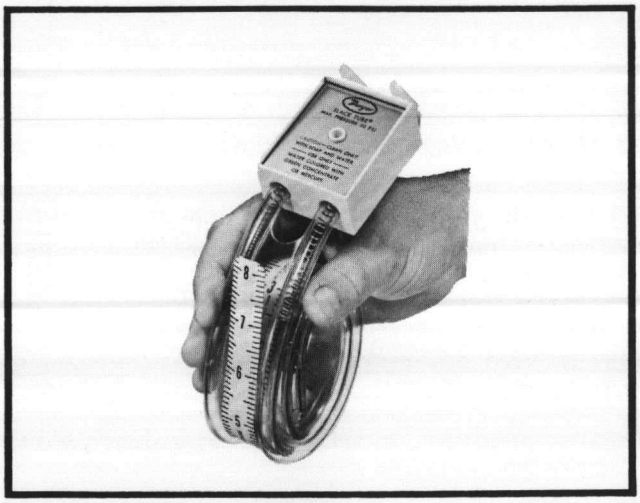


FIG. 36 — TUBE MANOMETER

The Dwyer Slack Tube Manometers are as accurate as the finest laboratory "U" gauges and they are made to roll up compactly for easy carrying and to withstand rough usage. For use on all Governair units the manometers should cover at least a 16 inch range. See Figure 36.

Duct Pressures and How They Work

Velocity — When air moves at a given velocity in a duct it creates a pressure corresponding to the velocity; this is a measure of the kinetic energy in the fluid and it is known as the *velocity pressure* (Vp). Velocity pressure is always exerted in the direction of air flow. The relationship between the velocity and the velocity pressure may be expressed by the following formulas:

$$Vp = \frac{V}{4005}^{\,2}$$

$$V = 4005 \quad Vp$$

It is therefore a simple matter to determine the velocity (fpm) of an airstream if the Vp can be measured. For example, if a Pitot tube manometer hook-up reads 0.250 in. water, we substitute for the above equation:

$$4005 \quad 0.250 \quad = 2002 \text{ fpm}$$

Static Pressure — Independent of its velocity, air, when confined within an enclosure such as a duct or tank, will exert itself perpendicularly to the walls of the enclosure. This is the compressive pressure existing in a fluid, and it is known as the static pressure (Sp). Unlike velocity pressure) which is always positive, static pressure when it is above atmospheric pressure will be positive, but when below atomospheric pressure it will be negative. The discharge side of a fan in a supply system will read a positive pressure, the inlet side of the fan in an exhaust system will read a negative or minus pressure.

Total Pressure — Static pressure is exerted whether air is at rest or in motion. The algebraic sum of static pressure and velocity pressure gives the *total pressure* (Tp). Therefore:

$$Vp = Tp - Sp$$

The manometer does not sense the actual velocity pressure directly but by using the Pitot tube hook-up with the static opening connected to the low pressure side of the gauge, and the total pressure opening connected to the high pressure side of the gauge, the manometer will read the difference between the two, or the *velocity pressure*.

Velocity pressure and static pressure change in the duct work with every change in the duct configuration, but the total pressure, on the other hand, remains constant. Hence, as the velocity pressures decreases, the static pressure increases and vice versa, because the static pressure is always the difference between the total pressure and the velocity pressure. It should be remembered, however, that in an actual duct system, the internal friction will cause a loss of total pressure.

The static pressure in an exhaust system is always below atmospheric pressure, and it is customary among ventilation engineers to omit the minus sign affecting the static (gauge pressure). These men know, of course, that the total pressure is higher than the static pressure by the amount of the velocity pressure.

When the unit is designed for connection to a duct system and the installing contractor assembles ducts, elbows, registers, grilles, etc. to the outlet and/or inlet of the unit, the static pressure drop through this external duct work is called external static pressure. See Figure 37.

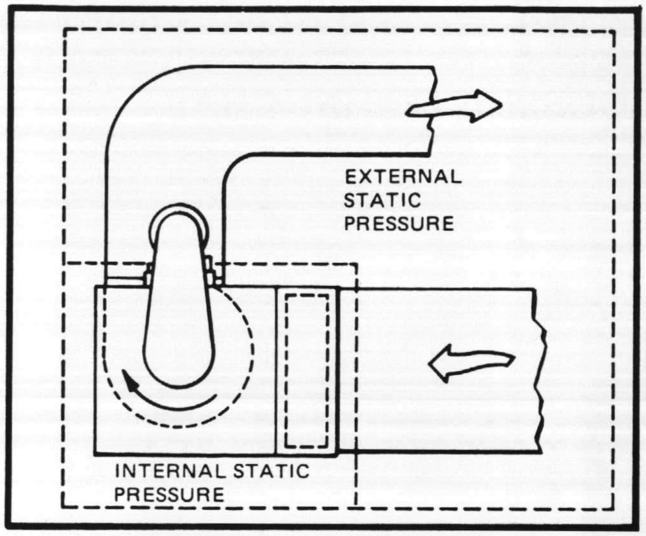


FIG. 37 — AIR MOVING SYSTEM

Fans selected must be capable of moving the desired air flow through the entire air moving system including the unit (internal SP) and also the duct system (external SP).

At a given flow rate the internal static pressure losses plus the external static pressure losses equal the system static pressure or the summation static pressure. These pressures are of great importance when troubleshooting for causes of reduced capacity, vibration, and noise.

Changes in the cross sectional area of duct (contractions or enlargements) cause changes in the velocity of the air flowing through the duct.

When the velocity decreases, the velocity pressure also decreases. Some of the velocity energy is lost as a result of the design of the duct where the area changes. Some of the velocity energy is converted into static pressure energy in the continuing duct work. This conversion of velocity energy to static pressure is called static regain.

When contacting Governair for assistance the following information will be required:

1. Unit Model No.
2. Job Name (Not Contractor)
3. Unit Model No.
4. Customer's Unit Identification
5. Design Data and Actual Data.
   A. Fan RPM
   B. Unit SP (Across Fan)
   C. Unit CFM
   D. Pressure Drop of Water Across Cooling Coil — (PSIG)
   E. Air Pressure Drop Across Coil — (In. of Water)
   F. Temperature Differential Across Cooling Coil (°F)
   G. Voltage
   H. Amperes
6. For Fan or Motor RPM (Use a Tachometer, Stroboscope or Revolution Counter).

7. The Voltage and Amperes can be obtained by using a separate meter or a clamp-on type AMP meter.
8. A sketch of the Duct Configuration would assist us in trying to resolve the problem.
9. The most important item is to provide a detailed explanation of the problem.
10. Most of us recognize that an orifice is the best method of measuring flow in piping. This is also true in an air system and is the reason for reading step 5D.

For further assistance in troubleshooting the air unit refer to the troubleshooting chart which follows:

TROUBLESHOOTING CHART

SYMPTOM	SOURCE		PROBABLE CAUSE
	1.	IMPELLER HITTING INLET RING	Impeller not centered (check shaft clamp.) Inlet ring damaged or not adjusted. Shaft loose in bearing (check locking Collar.) Impeller loose on shaft (check shaft clamp.) Bearing loose in bearing support (check mounting bolts.)
	2.	DRIVE	Sheave not tight on shaft (motor or fan.) Belts hitting belt guard. Belts loose. Adjust after 48 hours operation. Belts too tight. Belts wrong cross section. Belts not "matched" in length on multi-belt drive. Variable pitch sheaves not adjusted so each groove has same pitch diameter (multi-belt drives.) Misaligned sheaves. Belts worn. Motor, motor base or fan not securely anchored. Belts oily or dirty.
	3.	BEARING	Defective bearing. Needs lubrication. Loose on bearing support. Loose on shaft (check locking collar.) Misaligned (check alignment binding.) Foreign material inside bearing. Worn bearing. Fretting corrosion between inner race and shaft.
NOISE	4.	Loose on shaft (check shaft clamp.)	Defective impeller. Do not run fan. Contact manufacturer. Unbalance. Foreign material on fan blades.
	5.	HOUSING	Foreign material in housing. Inlet cones loose or not adjusted.
	6.	ELECTRICAL	Lead-in cable not secure or is too rigid. AC hum in motor or relay. Starting relay chatter. Motor bearings. Single phasing a 3-phase motor.
	7.	SHAFT	Bent. Undersized. May cause noise at impeller, bearings or sheave. Loose internal balance weights. Bearing alignment.
	8.	HIGH AIR VELOCITY	Duct work too small. Fan running too fast. Fan selection too small. Static pressure lower than expected. Registers and grilles too small. Insufficient fade area of heating or cooling coil.
	9.	OBSTRUCTION IN HIGH VELOCITY AIR STREAM MAY CAUSE RATTLE, OR PURE TONE WHISTLE	Dampers. Registers. Loose dampers or splitters. Grilles. Sharp elbows. Sudden expansion of duct work. Sudden contraction of duct work. Turning vanes.

SYMPTOM		SOURCE	PROBABLE CAUSE
NOISE	10.	PULSATION OR SURGE	Oversized duct work. Parallel fan operation. Loose dampers or splitters. System instability. Ducts vibrate at same frequency as fan pulsations. Organ pipe action on long duct.
	11.	HIGH VELOCITY THROUGH CRACKS, HOLES OR PAST OBSTRUCTIONS	Leaks in duct work. Registers or grilles.
	12.	RATTLES AND/OR RUMBLES	Excessive duct velocities. Vibrating ductwork. Flex connector too tight or touching. Vibrating parts not isolated from building.
CFM — LOW	13.	FAN	Forward curve impeller installed backwards. Fan running backwards. Impeller not centered with inlet cones. Fan speed too slow.
	14.	DUCT SYSTEM	Actual system is more restrictive (more resistance to flow) than expected. Dampers closed. Splitter rod disconnected. Registers closed. Leaks in supply ducts. Open duct seams. Insulating duct liner loose. Fire dampers closed.
	15.	FILTERS	Dirty or clogged (dirt, lint, snow, grass.)
	16.	COILS	Dirty or clogged (construction trash.)
	17.	RECIRCULATION	Internal cabinet leaks in bulkhead separating fan outlet (pressure zone) from fan inlets (suction zone.) Leaks around fan outlet at connection through cabinet bulkhead.
	18.	OBSTRUCTED FAN INLETS	Elbows, cabinet walls or other obstructions restrict air flow. Inlet obstructions cause restrictive systems but do not cause increased negative pressure readings near the fan inlet(s). Fan speed may be increased to counteract the effect of restricted fan inlet(s). (Observe fan RPM limits).
	19.	NO STRAIGHT DUCT AT FAN OUTLET	Fans which are normally used in duct systems are tested with a length of straight duct at the fan outlet. If there is no straight duct at the fan outlet, decreased performance will result. If it is not practical to install a straight section of duct at the fan outlet the fan speed may be increased to overcome this pressure loss. Observe fan RPM limits.
	20.	OBSTRUCTIONS IN HIGH VELOCITY AIR STREAM	Obstruction near fan outlet. Sharp elbows near fan outlet. Improperty designed or no turning vanes.
CFM — HIGH	21.	SYSTEM	Oversized duct work. Access door open. System not balanced. Resistance less than specified. Registers or grilles not installed. Dampers set to by-pass coils. Filter(s) not in place.
	22.	FAN	Backward inclined impeller installed backwards (HP will be high.) Variable motor sheave not adjusted. Fanspeed too fast.
STATIC PRESSURE INCORRECT	23.	SYSTEM FAN OR INTERPRETATION OF MEASUREMENTS	GENERAL DISCUSSION The velocity at any point of measurement is a function of the velocity of the air and its density. The static pressure at a point of measurement in the system is a function of system design (resistance to flow), air density and the amount of air flowing through the system. The static pressure measured in a "loose" or oversized system will be less than the static pressure in a "tight" or undersized system for the same airflow rate. In most systems, pressure measurements are indicators of how the installation is operating. These measurements are the result of air flow and as such are useful indicators in defining system characteristics.

REFER TO THE TROUBLESHOOTING SECTION FOR THE PROPER METHODS OF OBTAINING CORRECT READINGS

SYMPTOM	SOURCE		PROBABLE CAUSE
STATIC PRESSURE LOW CFM HIGH	24.	SYSTEM	System has less resistance to flow than expected. This is a common occurrence. Fan speed may be reduced to obtain desired flow rate. This will reduce HP, conserve energy, and save operating costs.
	25.	AIR DENSITY	Pressures will be less with high temperature air or at high altitudes.
	26.	FAN	Backward inclined impeller installed backwards, HP will be high. System resistance less than specified. Fan speed too high.
STATIC PRESSURE LOW, CFM LOW	27.	SYSTEM	Fan inlet and/or outlet conditions not same as tested. See general discussion (23). Also see 13 thru 20.
STATIC PRESSURE HIGH, CFM LOW	28.	SYSTEM	Obstruction in system. Dirty Filters. Dirty coil. Closed fire damper. System too restricted. Also see 13 through 20.

SYMPTOM	SOURCE	PROBABLE CAUSE

SYMPTOM	SOURCE	PROBABLE CAUSE

Motor Trouble Shooting Guide

Apparent Trouble	Possible Causes	Correction
High Current Draw	First check accuracy of ammeter reading on all three phases	
Running Idle	High Line Voltage 5 to 10% over nameplate. Smaller motors (140-213 frames) may increase current at a faster rate.	Consult power company — possibly reduce by using lower transformer tap.
Running Under Load	Motor Overloaded	Reduce load or use larger motor
	High Line Voltage 5 to 10% over motor nameplate voltage on small motors (140-213 frames only)	Consult power company — possibly reduce by using lower transformer tap.
	200 volt motor on 230 or 240 volt system	Change to 230 volt motor.
	Low Line Voltage 5 to 10% lower than nameplate voltage on any size	Consult power company — possibly increase by using high transformer tap.
	230 volt motor on 208 volt system	Change to 200 volt motor.
Unbalanced Current Draw (5% or more of the average current draw)	Unbalanced Line Voltage due to: a. Power Supply	Carefully check voltage across each phase **at the motor terminals** with a good, properly calibrated voltmeter.
	b. Unbalanced System Loading c. High Resistance Connection	If the voltage per phase is more than 1% out of balance, the current will be out of balance by an even greater percentage.
	d. Undersized Supply Lines	If there is doubt as to whether the trouble lies with the power supply or the motor, check per the following:

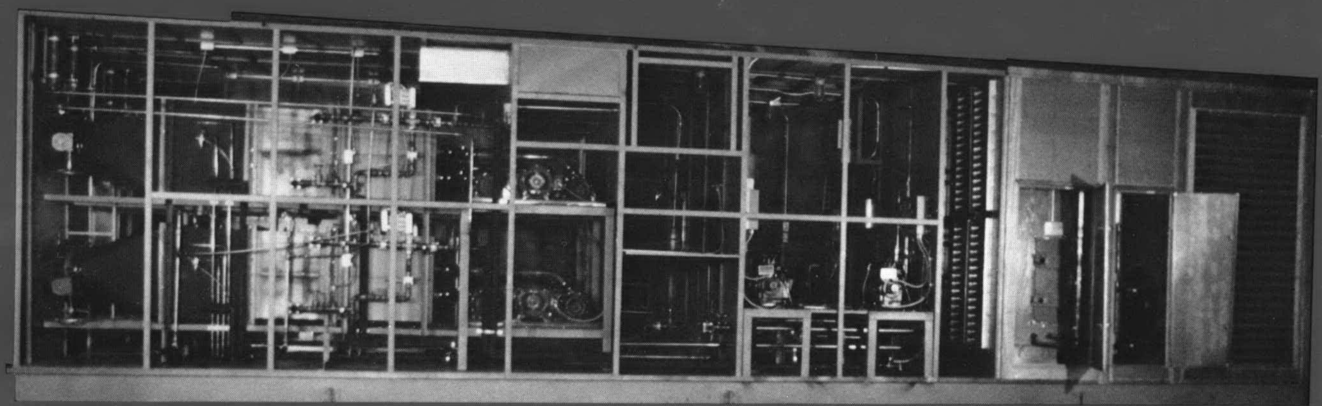
APPARENT TROUBLE	POSSIBLE CAUSE	CORRECTION
	Defective Motor	Rotate **all three input power lines** to the motor by one position — i.e., move line #1 to #2 motor lead, line #2 to #3 motor lead and line #3 to #1 motor lead. a. If the unbalanced current draw pattern follows the **input power lines,** the problem is in the power supply. b. If the unbalanced current draw pattern follows the **motor leads,** the problem is in the motor. Correct the voltage balance of the power supply or replace the motor, depending on answer to a. & b. above.
Excessive Voltage Drop (more than 2 or 3% of nominal supply voltage)	Excessive Starting or Running Load	Reduce load or install larger motor.
	Inadequate Power Supply	Consult power company
	Undersized Supply Lines	Increase Line sizes
	High Resistance Connections	Check motor leads and eliminate poor connections
Overload Relays Tripping		
Upon Starting	Slow Starting (10 - 15 seconds or more) due to High Inertia Load	Reduce starting load. Increase motor size if necessary.
	Low voltage at motor terminals	Improve power supply and/or increase line size.
Under Load	Overload	Reduce load or increase motor size.
	Unbalanced Current Draw	Balance supply voltage.
	Single Phasing	Eliminate.
	Excessive Voltage Drop	Eliminate.
	Too frequent starting or intermittent overloading	Reduce frequency of starts and overloading or increase motor size.
	High Ambient Starter Temperatures	Reduce.
	Wrong Size Relays	Correct size per nameplate amperes of motor. Relays have built in allowance for service factor ampere draw.
Motor Runs Excessively Hot	Overloaded	Reduce load or load peaks and number of starts in cycle or increase motor size.
	Blocked Ventilation a. TEFC's	Clean External ventilation system — check fan.
	b. O.D.P.'s	Blow out internal ventilation passages. Eliminate external interference to motor ventilation.
	High Ambient Temperature over 40° or 105° F	Reduce ambient temperature or provide outside source of cooler air.
	Unbalanced Current Draw	Balance supply voltage. Check motor leads for tightness.
	Single Phased	Eliminate.
Won't Start (just hums and heats up)	Single Phased	Shut power off. Eliminate single phasing. Check motor leads for tightness.
	Rotor or bearings locked	Shut power off. Check shaft for freeness of rotation. Be sure proper sized overload relays are in **each of the 3 phases** of starter
Runs Noisy Under Load (excessive electrical noise or chatter under load)	Single Phased	Shut power off. If motor cannot be restarted, it is single phased. Eliminate single phasing. Be sure proper sized overload relays are in **each of the 3 phases** of the starter.

APPARENT TROUBLE	POSSIBLE CAUSE	CORRECTION
Slow Starting (10 or more seconds on small motors - 15 or more seconds on large motors)		
Across the Line Start	Excessive Voltage Drop (5 - 10% voltage drop causes 10 - 20% or more drop in starting torque)	Consult power company — Check system. Eliminate voltage drop.
	High Inertia Load	Reduce starting load or increase motor size.
Reduced Voltage Start	Excessive Voltage Drop. Loss of Starting Torque.	Check and eliminate per above.
Y-Delta	Starting Torque Reduced to 1/3	Reduce starting load or increase motor size, or
PWS	Starting Torque Reduced to 1/2	Choose type of starter with higher starting torque, or
Auto. Transformer	Starting Torque Reduced to 1/4 to 5/8	Reduce time delay between 1st and 2nd step of starter — get motor across the line sooner.
Load Speed Appreciably Below Nameplate Speed	Overload	Reduce load or increase voltage.
	Excessively Low Voltage	NOTE: A reasonable overload or voltage drop of 10 - 15% will reduce speed only 1-2% A report of any greater drop would be questionable.
	Wrong Nameplate	If speed is off appreciably, i.e., from 1800 to 1200 RPM, check Lincoln code stamp on stator with nameplate. If codes do not agree, replace with motor of proper speed.
	Inaccurate method of measuring RPM.	Check meter using another device or method.
Excessive Vibration (mechanical)	Out of Balance a. Motor Mounting	Be sure motor mounting is tight and solid.
	b. Load	Disconnect belt or coupling — restart motor — if vibration stops, the unbalance was in load.
	c. Sheaves or Coupling	Remove sheave or coupling — tape 1/2 key in shaft keyway and restart motor — if vibration stops, the unbalance was in the sheave or coupling.
	d. Motor	If the vibration does not stop after checking a, b and c above, the unbalance is in the motor — replace the motor.
	e. Misalignment on Close Coupled Application	Check and realign motor to the driven machine.
Noisy Bearings (listen to bearings)		
Smooth Mid Range Hum	Normal fit	Bearing OK
High Whine	Internal fit of bearing too tight	Replace bearing - check fits
Low Runble	Internal fit of bearings too loose	Replace bearing - check fits
Rough Clatter	Bearing Destroyed	Replace bearing — Avoid: a. Mechanical Damage b. Excess Greasing c. Wrong Grease d. Solid Contaminants e. Water running into motor f. Misalignment on close coupled application
Mechanical Noise	Driven Machine or Motor Noise?	Isolate motor from driven machine — check difference in noise level.
	Motor Noise Amplified by resonant mounting	Cushion motor mounting or dampen source of resonance.
	Driven Machine Noise transmitted to motor through drive	Reduce noise of driven machine or dampen transmission to motor.
	Misalignment on close coupled application	Improve alignment.

GOVERNAIR

Oklahoma City, OK

INSTRUCTION MANUAL



SELF CONTAINED and SPLIT SYSTEM AIR CONDITIONING UNITS

Installation
Operation
Maintenance

General

This manual has been prepared as a guide for installing, operating and maintaining Governair heating and cooling equipment. This is high quality equipment and by following the instructions listed in this manual, years of economical and satisfactory operation will be obtained.

It is not possible to cover every item in detail and where an item is listed as typical you should contact your local Governair sales representative or the Governair factory in Oklahoma City for the specific information required.

AC-1
SERIAL # 25997
MODEL # ACU-302

GOVERNAIR
CORPORATION

Table of Contents

	Page
Receiving	2
Inspection of Equipment	2
Shipped Loose Parts	2
Caulking	2
Paint Standard	2
Weights of Units	2
Curb Installation	3-6
Storage	3
Rigging	7-8
Demount Assembly Instructions	9
Condensate Drain	10
Electrical Information	10-11
Pre-Startup Check — Cooling	11
Static Pressure Limits of Cabinet	12
Check Test and Startup Form	13
Superheat	14
Thermostats	15
Head Pressure Control	16
Capacity Control	17-18
Pressure Control Settings	18-19
Compressor — Oil Safety	19
Overload Protection (Solid State)	20
Condenser Fans	21
Blowers	22-23
Belts	24
Pulleys and Drives	24-27
Lubrication	28-33
Filters	33
Door Latch	34
Door Gaskets	34
Dampers	34
Damper Motors	34
Enthalpy Control	35
Parts — Replacement Ordering	35
Coils	35-36
Electric Heat	37
Gas Heat	38-42
Preventative Maintenance	43
Trouble Shooting — Air Side	44-49
Trouble Shooting Guide	49-56
Motors	49-51
Cooling Cycle	52-54
Heating Cycle	54-55
Dampers & Damper Actuators	56

Receiving

Inspect the complete unit for shipping damage. If damage is present, you have the right to either accept or reject the shipment. If the receiving contractor or the receiving agent for the contractor elects to receive the equipment in a damaged condition, it then becomes the contractor's responsibility to note the extent of the damage on the delivering freight bill of lading in the presence of the delivering agent (driver) of the delivering freight carrier. It then becomes the contractor's responsibility to file a freight claim with the delivering freight carrier in accordance with the ICC regulations. It also then becomes the responsibility of the receiving contractor to work with the delivering carrier to have the equipment repaired to the satisfaction of Governair Corporation so the warranty may remain valid. **Governair must also be notified of shipping damage.**

Note: Governair reserves the right to cancel the warranty on any equipment that is not repaired to Governair's satisfaction.

See section Shipped Loose Parts

Inspection of Equipment — Visual

The equipment type and arrangement should be verified as ordered at once when it arrives at the jobsite. When a discrepancy is found, the local Governair Sales Representative, or the Governair factory, must be notified immediately so that corrective action may be initiated, also verify electrical conformance to specifications. Unauthorized alterations and unauthorized backcharges will not be recognized by Governair Corporation.

Shipped Loose Parts

1. Check the packing list for the list of shipped loose parts.
2. Packing list will note how many and type of parts.
3. Packing list will note in what section of the unit each shipped loose part is located.
4. All air filters are shipped as loose parts.
5. Rainhoods are shipped as loose parts. Small rainhoods will be inside the units, and large rainhoods will be outside the unit and so noted on packing list.

Caulking

There is always the possibility that external caulked seams may be loosened during the shipping and rigging process. Any seam that appears to be a possible leak source should be recaulked with acrylic or silicone sealant.

Paint Standard

Units are painted with an industrial enamel which will meet or exceed the exposure requirements of TTP 636 Federal Specifications. This finish lends itself to repainting with other enamels; however, it is not recommended that epoxies be used over this paint.

Note: Some units may have special paint. Check the submittal of each unit for special paint.

Weights of Units

Due to the gross latitude in each unit design, it is not possible to list unit weights in this manual. Unit weights are listed with each unit submittal drawing. These drawings must be referred to when selecting a crane for rigging and figuring roof weight loads.

Contact your Governair Sales Representative should you have any questions.

Curb Installation

Note: If the unit is to be installed on grillage, this section will not apply.

The curb will be shipped unassembled. It is necessary to assemble it on the jobsite. Each part of the curb is identified with the proper tags and/or markings. Complete assembly instructions are shipped with and attached to each curb package. Where more than one curb is shipped to one location, there will be assembly instructions with and attached to each curb package. It is important the curb be installed level and square. Each curb is marked with matching serial numbers for each unit.

The curb installation shows a curb gasket that is mounted between the curb and the unit. When this gasket is supplied by Governair Corporation it is not shipped with the curb, but is shipped with the completed unit "shipped loose parts" and is so noted on unit packing list. It is necessary to check the unit packing list for location of the section of the unit in which the curb gasket is located. It is necessary to install the curb gasket before setting the unit on the curb. This is necessary for an air seal between the unit and the curb and also serves as a dampener, preventing metal to metal contact between the unit and curb. **However, this should not be used as a vibration isolator where the prevention of noise and vibration transmission into the building is critical.**

Note: See section under receiving instructions when receiving curbs and inspecting for freight damage and filing of freight damage claims. Any freight damage is the responsibility of the receiving contractor and/or his authorized receiving agent and the delivering carrier.

See pages 4, 5 and 6 for typical curb drawings. When installing curb, obtain a copy of the approved submittal, as each unit and actual curb installation may not be identical. Do not use this typical curb to install your curb.

Note: Should there by any questions as to the number of pieces of curb parts or assembling of the curb, notify Governair Corporation at once.

Storage

Short-Term Storage:

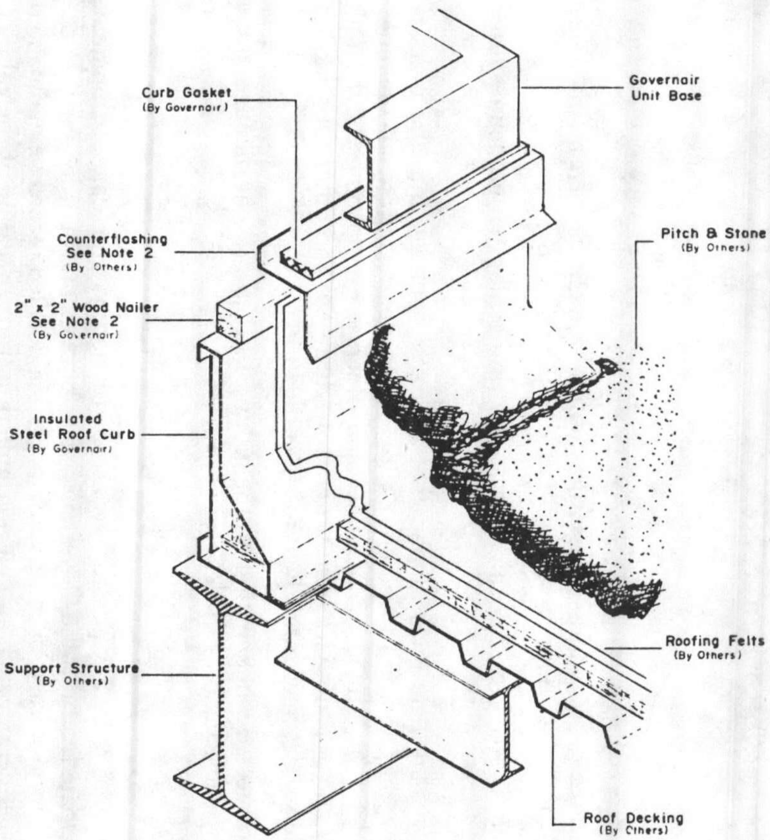
Short-term storage is considered six (6) months or less from date of shipment. Storage maintenance during this time period is usually, but not necessarily, limited to the following:

1. Make sure the equipment is received and unloaded and set in position per guidelines listed under "Rigging."
2. Make sure all access doors are tightly closed and that all access openings into the unit are sealed, such as air supply and air return openings, pipe chase openings, fresh air openings, exhaust air openings, electrical connection openings and other access openings of the unit cabinet that may permit entry of snow, ice, rain water, dust, dirt, mud and other construction debris, or birds and rodents that may enter the interior of the unit.
3. The unit must also be protected when setting on the ground level to prevent damage to the exterior of the cabinet by construction vehicles and personnel.

Long-Term Storage:

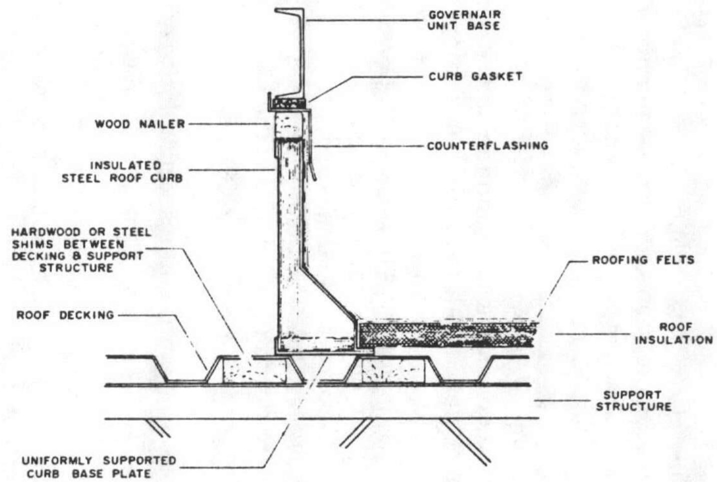
Long-term storage is considered to be any period beyond six (6) months from date of shipment. If long-term storage is anticipated, contact the Governair Sales Office at time of order entry for the proper instructions for long-term storage, as it is mandatory that a detailed record be maintained during this long-term storage period, such as, but not limited to, proper sealing of the cabinet, rotation of the blowers and bearings and protection of all motors from moisture. Note: Under certain conditions, it may be necessary to remove the motors from the unit and/or add heat to the motor. This record must be available to Governair should a failure occur during the warranty

SUGGESTED ROOF CURB INSTALLATIONS



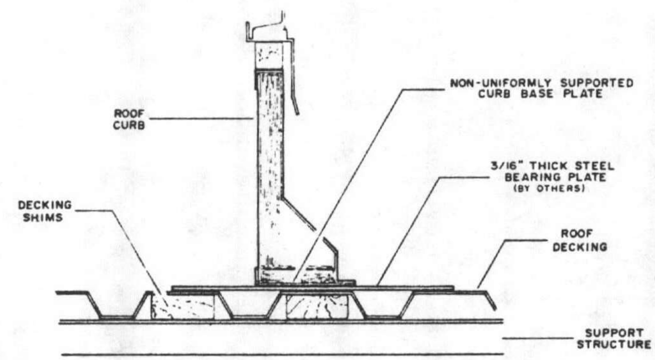
METHOD NO. 1

UNIFORMLY SUPPORTED OVER
STRUCTURAL STEEL



METHOD NO. 2a

UNIFORMLY SUPPORTED OVER
SHIMMED ROOF DECKING



METHOD NO. 2b

NON-UNIFORMLY SUPPORTED OVER
SHIMMED ROOF DECKING

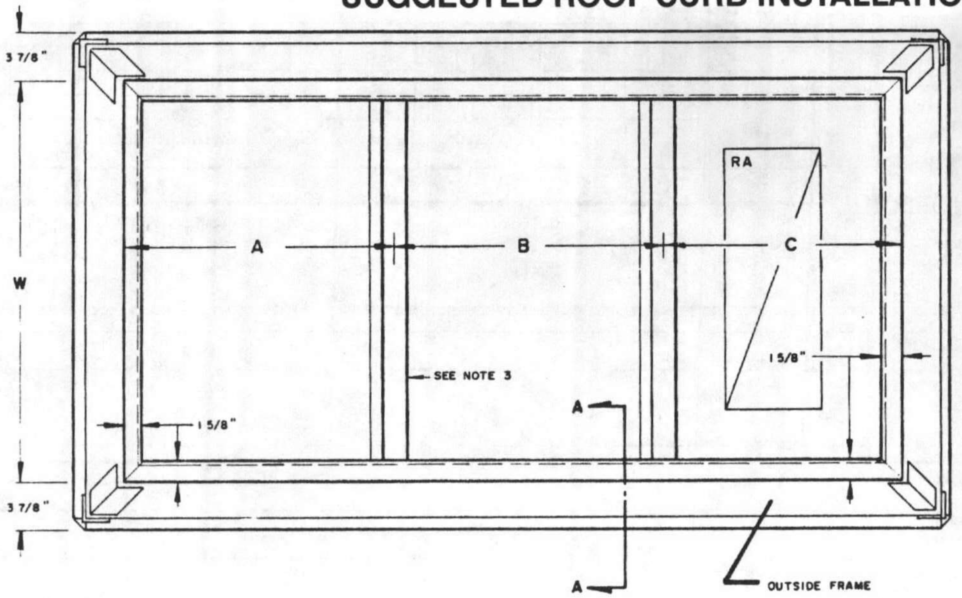
NOTES:

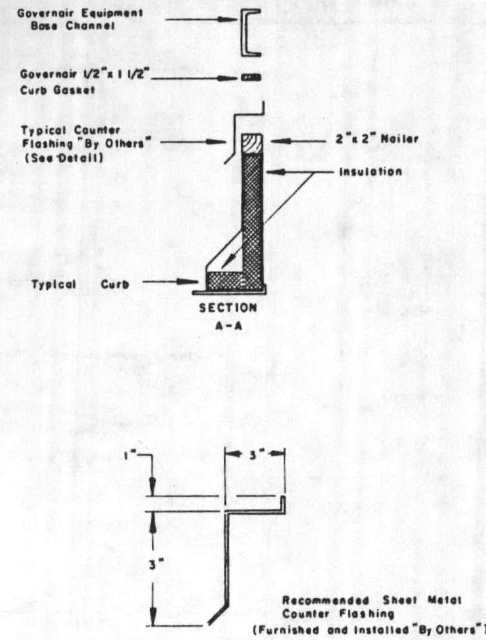
(1) It is recommended that the entire curb be supported across the full width of the curb base plate.

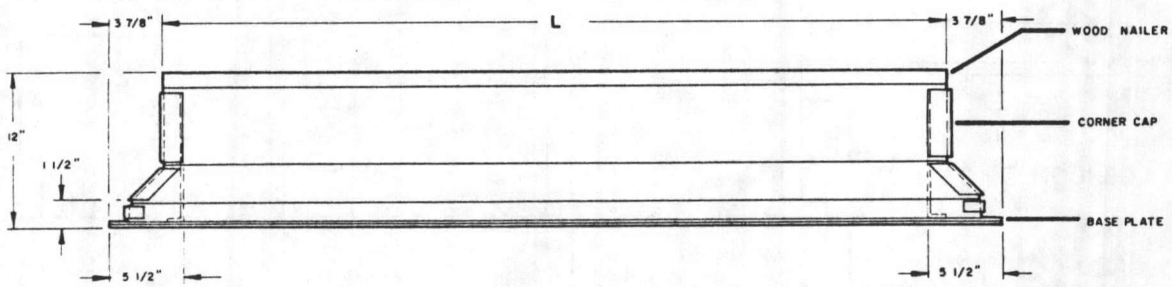
(2) The upper surface of the wood nailer and the counterflashing must be kept smooth and free of nail and screw heads to insure uniform curb loading and a proper unit-to-curb seal.

Governair CORPORATION 4840 N. SEWELL PHONE 405/525-6546 OKLAHOMA CITY, OKLAHOMA 73118	MODEL	DATE	PAGE OF
	SERIAL NO	DRAWING NO	

SUGGESTED ROOF CURB INSTALLATIONS







NOTES:
1) CURB MANUFACTURER TO SUPPLY FINAL CURB DRAWINGS FOR APPROVAL PRIOR TO CONSTRUCTION.
2) CURB MANUFACTURER IS RESPONSIBLE FOR CURB DESIGN AND STRUCTURAL INTEGRITY.
3) WOOD NAILER REQUIRED FOR ALL INTERNAL SUPPORTS.

MODEL	SERIAL NO.	TAG	A	B	C	L	W	WEIGHT

PROJECT :

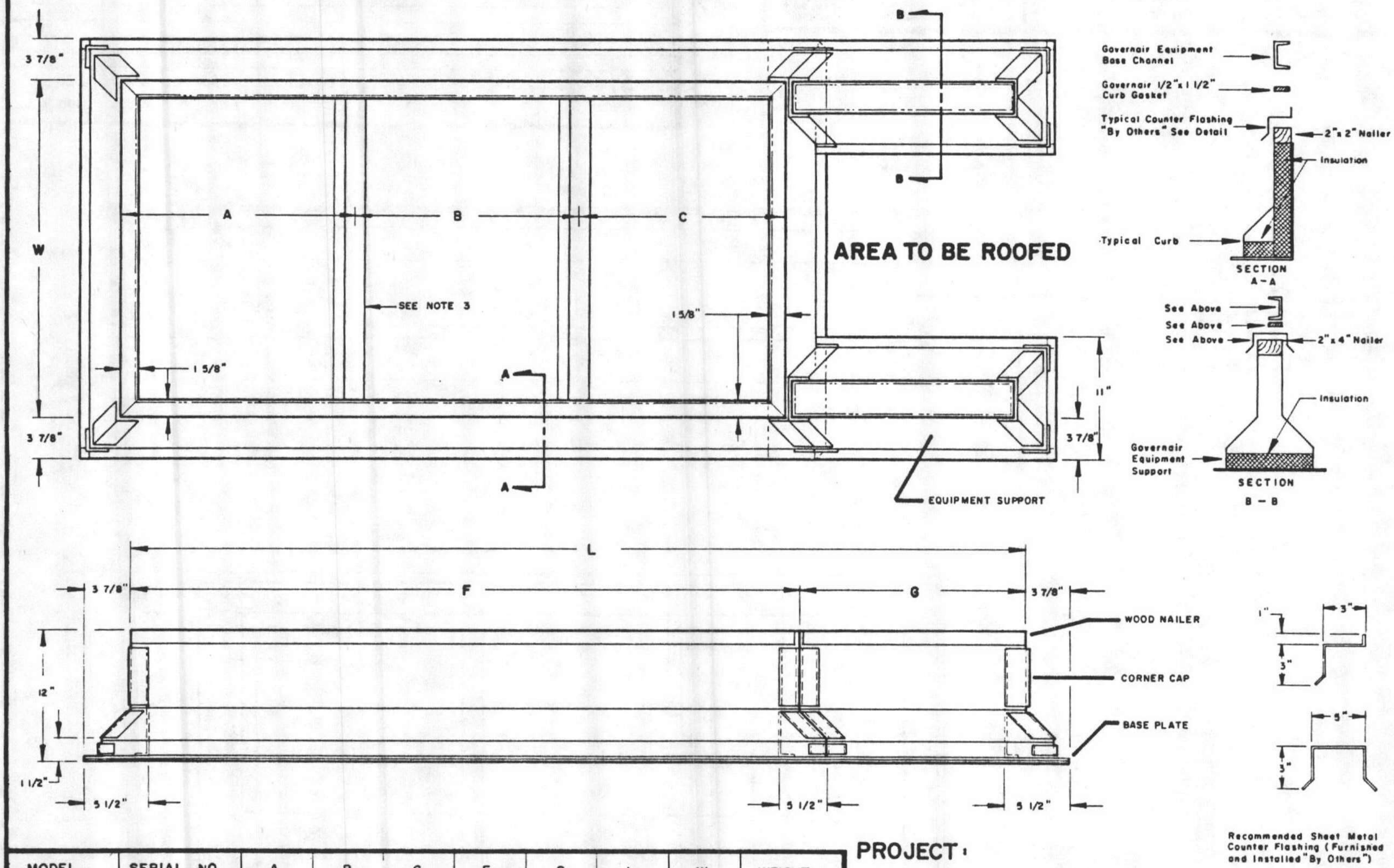
GOVERNAIR CORPORATION
4840 N. Sewell • Oklahoma City, OK 73118
(405) 525-6546 • Telex 747-194

MODEL:	DATE:	PAGE OF
SERIAL NO.	DRAWING NO.	

GOVERNAIR CORPORATION

GOVERNAIR
CORPORATION

SUGGESTED ROOF CURB INSTALLATIONS



MODEL	SERIAL NO.	A	B	C	F	G	L	W	WEIGHT

PROJECT:

NOTES:
1) Curb Manufacturer to Supply Final Curb Drawings for Approval Prior to Construction
2) Curb Manufacturer is Responsible for Curb Design and Structural Integrity
3) Wood Nailer Required for All Internal Supports

GOVERNAIR CORPORATION
4840 N. Sewell • Oklahoma City, OK 73118
(405) 525-6546 • Telex 747-194

period. There is a time limit of one year from date of shipment that any unit may be kept in long-term storage. At the end of the one year period, the unit must be in operation.

Note: Failure to perform the long-term storage requirements and properly log these required procedures will void the warranty.

Rigging

Proper handling of the equipment is mandatory during unloading and setting it into position. See Rigging Instructions page 8.

Note: If equipment is not set in its permanent position and is stored on the ground or other unlevel area, proper provisions must be taken for supporting and protecting the equipment. See section for both Short- and Long-Term storage.

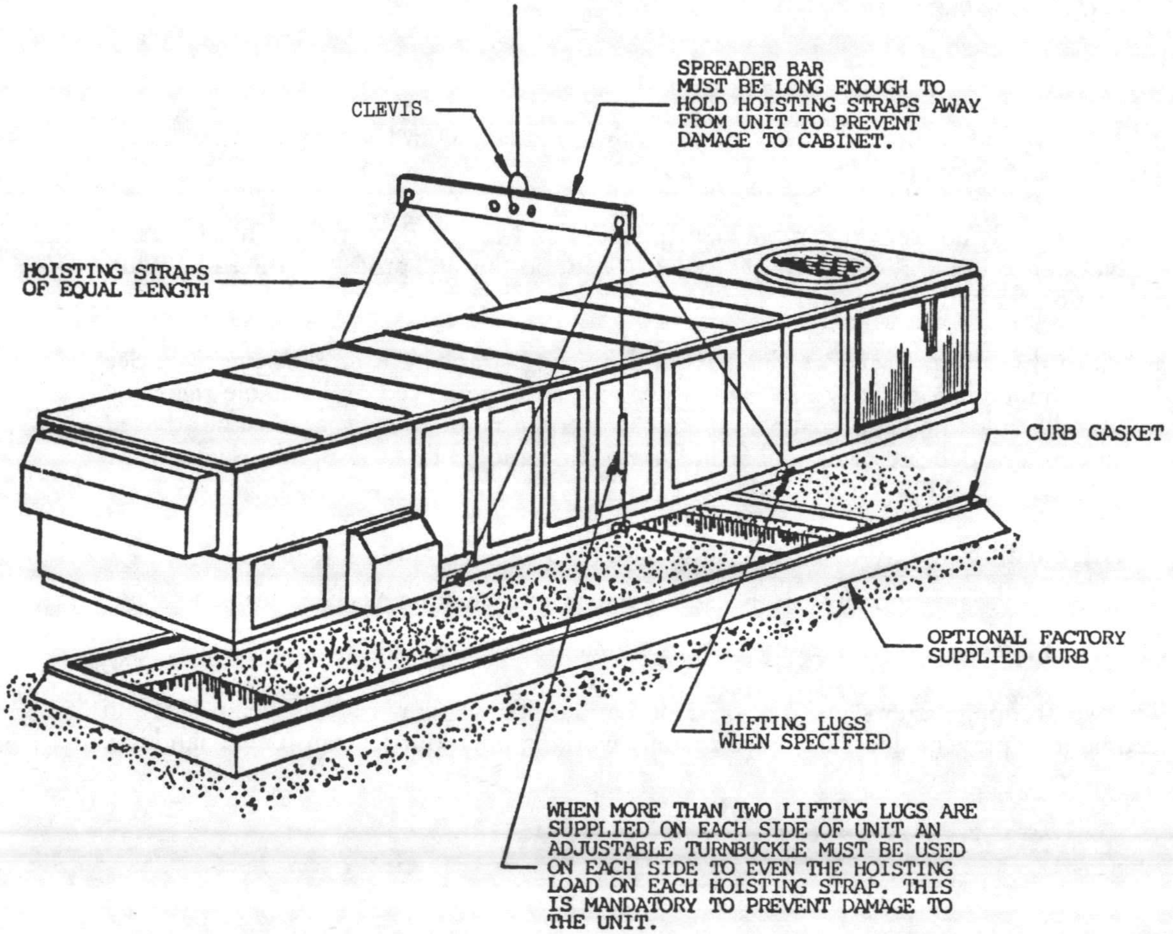
It is mandatory that the proper spreader bars and hoisting straps be used when rigging. See page 8 for recommendations. It is also mandatory that an experienced and reliable rigger be selected to handle unloading and final placement of the equipment. Your rigger must be advised that the unit contains delicate components and that it be handled in an upright position. Care must be exercised to avoid twisting the structure.

When the equipment has been set in final placement, the following must be done:

1. Check all caulked seams and air seals. Recaulk if and where caulking has been broken.
2. Check all door latches and readjust if necessary to maintain a good tight seal.

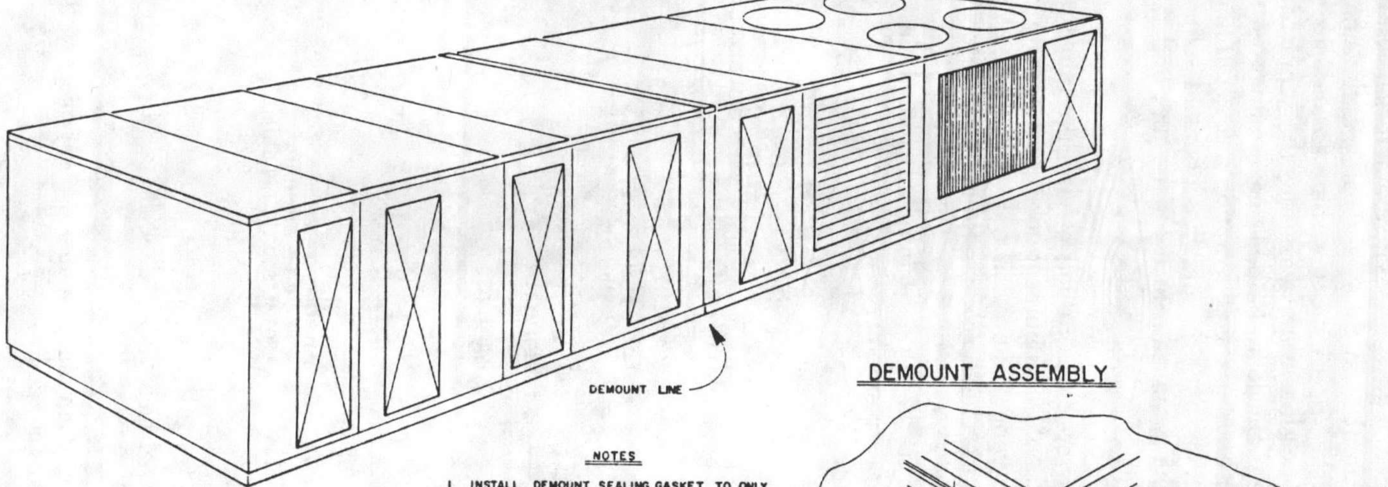
Note: Remove shipping screws in body of door handle. These screws are installed prior to shipment to prevent doors from accidentally working open during transit and handling.

Rigging Instructions



1. Units will have lifting lugs welded and/or bolted to the base when specified.
2. Avoid damage to the curb and curb gasket when rigging onto a curb. See Curb Instruction pages 4, 5 and 6.
3. Spreader bars must be used to prevent damage to the unit casing.
4. Care must be taken to keep the unit in the upright position during rigging.
5. Avoid unnecessary jarring or rough handling.
6. Care must be taken to not damage the water-tight seams in the unit casing.

Demount Assembly Instructions



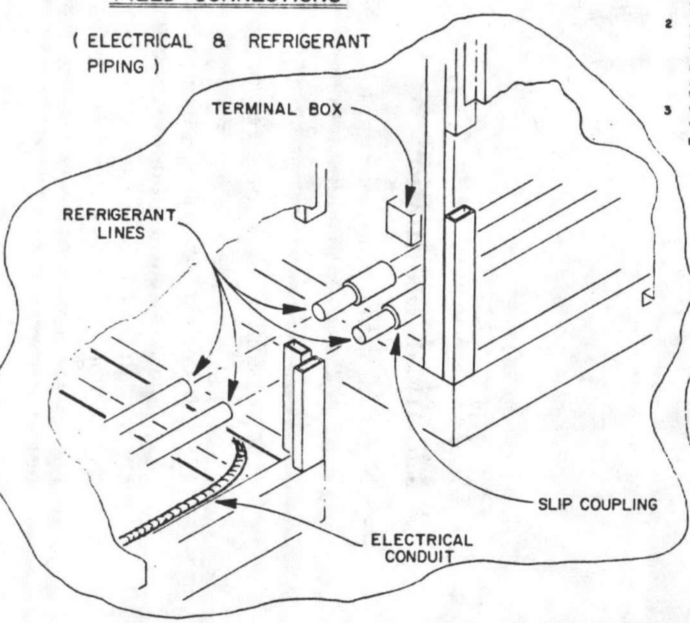
DEMOUNT ASSEMBLY

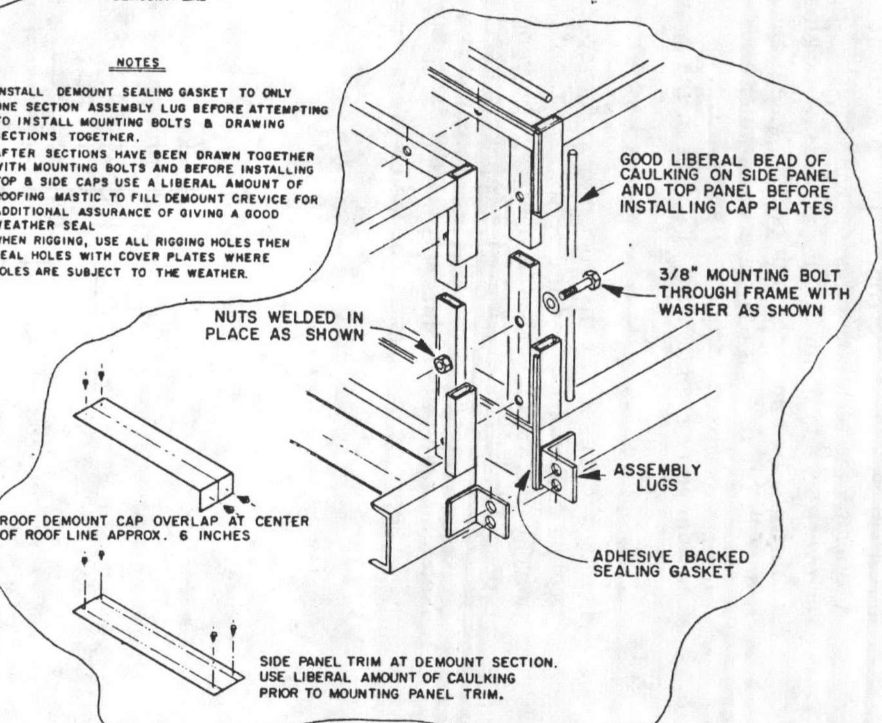
NOTES

1. INSTALL DEMOUNT SEALING GASKET TO ONLY ONE SECTION ASSEMBLY LUG BEFORE ATTEMPTING TO INSTALL MOUNTING BOLTS & DRAWING SECTIONS TOGETHER.
2. AFTER SECTIONS HAVE BEEN DRAWN TOGETHER WITH MOUNTING BOLTS AND BEFORE INSTALLING TOP & SIDE CAPS USE A LIBERAL AMOUNT OF ROOFING MASTIC TO FILL DEMOUNT CREVICE FOR ADDITIONAL ASSURANCE OF GIVING A GOOD WEATHER SEAL
3. WHEN RIGGING, USE ALL RIGGING HOLES THEN SEAL HOLES WITH COVER PLATES WHERE HOLES ARE SUBJECT TO THE WEATHER.

FIELD CONNECTIONS

(ELECTRICAL & REFRIGERANT PIPING)





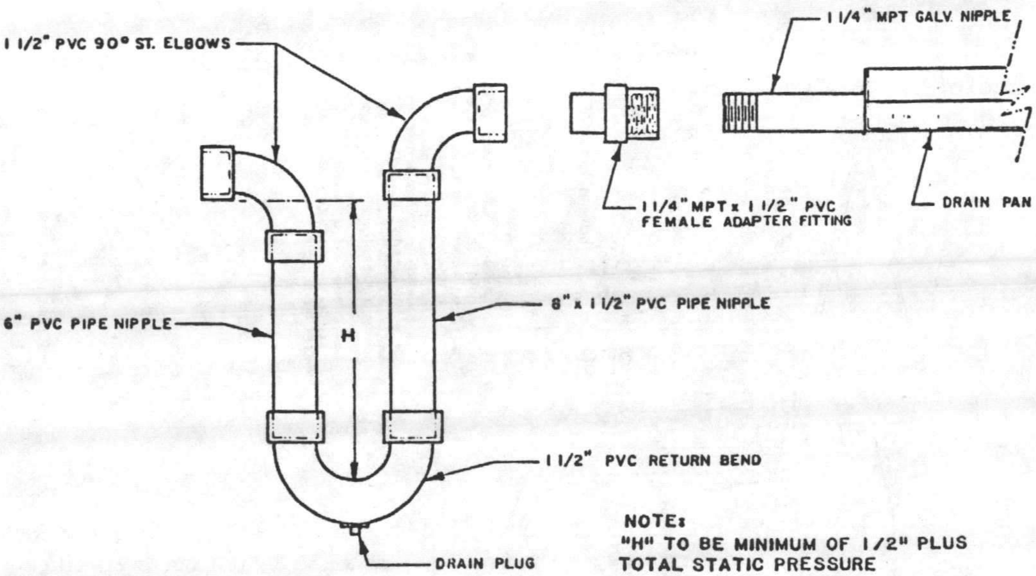
GOVERNAIR CORPORATION

Condensate Drain

The majority of evaporator coils are located in the units so that the supply air is drawn through them. This results in the condensate being induced to the area of low static pressure. Unless some means of pressure equalization is provided in the condensate drain, the air rushing through the drain will cause the condensate to accumulate in the drain pan. As the unit continues to operate, the accumulated water will be picked up by the in-rushing air and carried with the air over the side of the drain pan causing possible water leaks into the supply duct and/or through the bottom of the unit causing water damage in the building. A minimum trap should be installed to prevent this condensate water buildup. See illustration below. On initial startup, it may be necessary to fill the trap manually or, after the unit has operated sufficiently for a small amount of condensate to collect in the drain pan, turn off the unit and the trap will automatically fill.

During the winter months when the cooling system is turned off and the unit is exposed to freezing conditions, an antifreeze solution should be poured into the condensate pan trap to prevent freezing and possible damage. The condensate drain trap may also be drained and capped, but be sure to remove the cap when starting the cooling for the next season.

Note: If lengthy drain lines are used to drain the condensation into roof drains, it may be necessary to use anti-slime tablets in drain pan to prevent clogging.



Electrical Information

Note: All wiring must conform to the National Electrical Code (NEC) and possibly local codes that may be in addition to the NEC.

It is not possible to list all the wiring diagrams that may be supplied with Governair custom manufactured equipment in this manual.

The current characteristics, phase, hertz and voltage are stamped on the nameplate of each Governair unit. The "As Built" wiring and control schematic contained in the instruction envelope enclosed in the control panel box also calls out these requirements. Before attempting to energize any portion of the system, be certain to check the electrical characteristics of the supply current. Even though you may not energize the major components, the voltage reducing transformer normally applied to the control circuits will be subjected to the line voltage.

Good practice dictates that all exposed electrical connections in the area of starters, contactors, relays, buss sections and terminals should be checked for tightness prior to the actual startup.

Many of the connections contain several wires; and while they were tightened at the factory at the time of assembly and checked at the time of run-in, they may have developed a "set" and will concede to retightening. The danger of a poor connection causing overheating and component failure through inadequate current handling capacity cannot be overemphasized. Cartridge fuses should always be of the fusetron type. Ordinary cartridge fuses, not designed for limited short period overloads, will cause nuisance failures. The amperage value of the fusetron to be applied on a given unit will be clearly called out on the wiring diagram contained in the control panel.

The wiring diagram supplied with each unit will be the "As Built" factory wiring. This wiring diagram must be referred to when bringing field wiring to the unit. This is necessary, as during manufacturing assembly of each unit a terminal number could change. This possible terminal number change will not alter the original approved design and/or operation of the unit.

"Caution" & "Note"

All compressors are shipped with the fuses removed from the fuse holders and stored in the control cabinet. These must not be installed until the control circuit power of the control panel has been turned on for twenty-four (24) hours. This is necessary so the compressor crankcase heater may warm the oil in the crankcase of the compressor to drive out any refrigerant that may have migrated to the crankcase of the compressor. The compressor warranty is void if this procedure is not followed.

Note: Starting the compressor with liquid refrigerant in the crankcase will cause damage to the compressor by breaking valve plates, pistons, connecting rods, main bearings and/or the oil pump.

Pre-Start Up Check — Cooling

All Governair units are shipped with all compressor, liquid line receiver and hot gas bypass valves in the closed position. These are to be opened just before startup of the unit and/or before compressor fuses are installed. A leak check should be made at this time.

ALL GOVERNAIR UNITS ARE SHIPPED WITH THE FUSES FOR THE COMPRESSOR REMOVED FROM THE FUSE BLOCKS, TAPED TOGETHER AND STORED IN THE MAIN CONTROL CABINET. THE FUSE BLOCK IS TAGGED **"DO NOT INSTALL FUSES UNTIL THE COMPRESSOR CRANKCASE HEATERS HAVE BEEN TURNED ON FOR A PERIOD OF 24 HOURS TO WARM THE CRANKCASE OIL IN THE COMPRESSOR."**

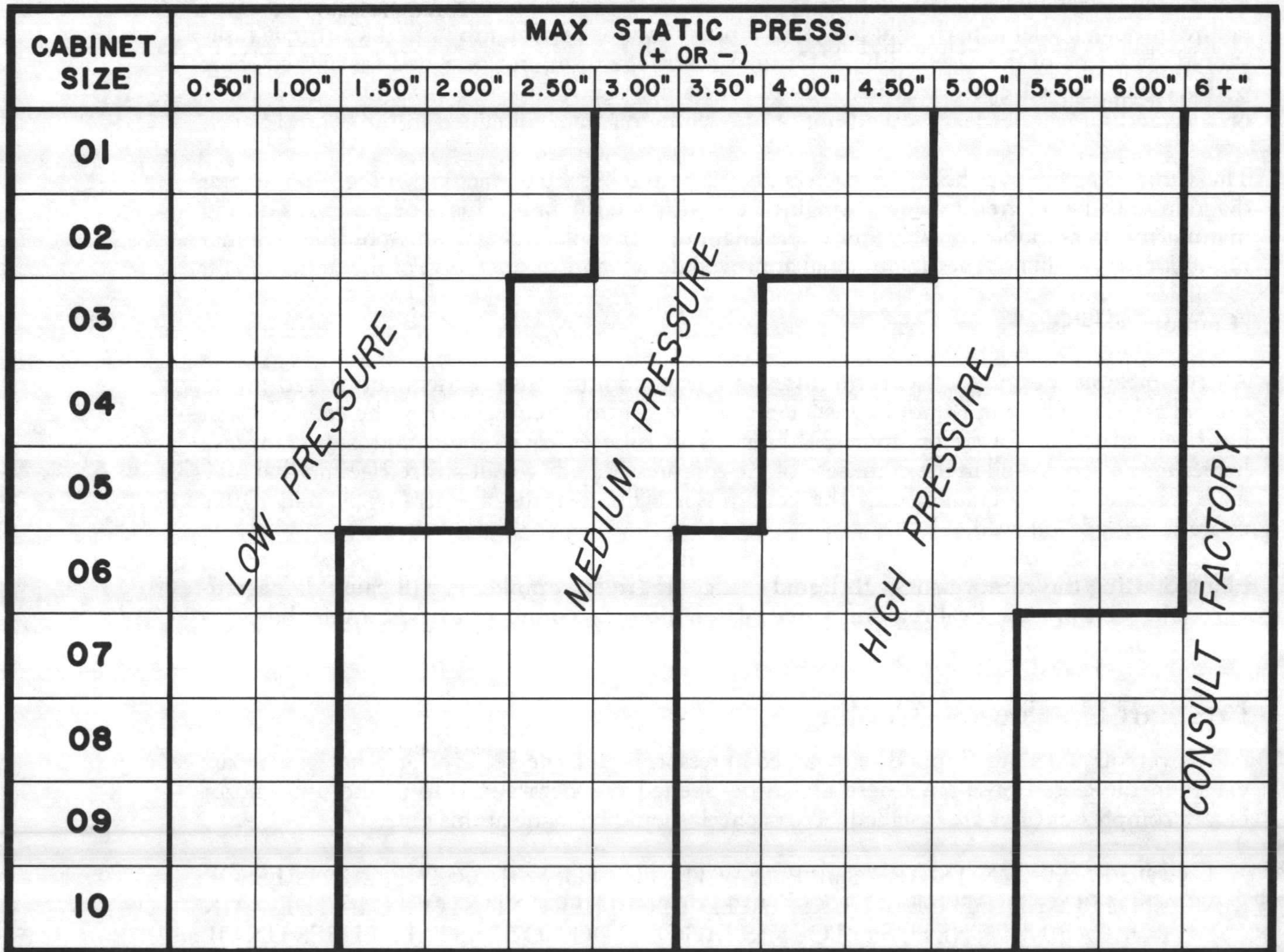
All Governair units are carefully checked and tested at the factory. They are operated by factory test technicians to determine satisfactory operation and verify comformance to specifications. However, the check-test and startup procedure supplied as a part of this manual, on page 13, must be closely followed when putting the unit into operation. A copy of the check-test and startup form must be forwarded to Governair to verify startup date of the unit.

Note: On some split systems (demount) it may not be possible to operate the compressors with a charge of refrigerant prior to shipping from Governair. These units will have a vapor holding charge only and it will be so noted by tagging each circuit (compressor).

Caution: Use Sil-Fos, Easy-Flow or silver solder when connecting the refrigerant piping on split (demount) units. A good high vacuum of 500 microns or less must be pulled on each refrigerant circuit to remove any air and/or moisture that may have entered the system while the tubing was open to the atmosphere during installation.

Caution: BEFORE OPERATING UNIT, BE CERTAIN THAT YOU ARE THOROUGHLY FAMILIAR WITH THE SEQUENCE OF OPERATION.

Static Pressure Limits of Cabinet



LOW PRESSURE PACKAGE:

(A) 20 gauge exterior casing, single or double wall. All joints are sealed with latex caulking.

(B) All access doors are double wall 20 ga./24 ga. with **maximum** door size 66″ H x 30″ W. All doors open to the outside with door latches, standard gasket, and standard hinges.

MEDIUM PRESSURE PACKAGE:

(A) Cabinet construction is 18 gauge exterior on double wall with solid 20 gauge liner and 16 gauge on single wall or double wall with perforated liner. All joints are sealed with latex caulking.

(B) All access doors are double wall 18 ga./24 ga. with **maximum** door size 66″ H x 30″ W. All doors open out with door latches and full height hinges.

HIGH PRESSURE PACKAGE:

(A) Cabinet construction is 16 gauge exterior on double wall with solid 20 gauge liner and 16 gauge on single wall or double wall with perforated liner. All joints are sealed with high pressure sealant or continuously welded.

(B) All access doors are double wall 16 ga./24 ga. with **maximum** door size 66″ H x 30″ W. Doors open against pressure with full height hinges, door latches, and seal against bulb type gasket.

NOTE:

(1) Some units may require special construction considerations. The manufacturer reserves the right to modify construction of any unit as deemed necessary.

FORM NO. 6100A-G401-482

GOVERNAIR
CORPORATION
4840 N. SEWELL PHONE 405/525-6546
OKLAHOMA CITY, OKLAHOMA 73118

START UP PROCEDURE ROOF TOP
CHECK — TEST — START

This must be completed and returned to Governair to validate warranty.

Model No.______ Serial No.______ Date______

Installing Contractor______________________

OWNER

NAME______________________

STREET______________________

CITY______________ STATE______________ ZIP CODE______

PRE-OPERATION CHECK LIST

[1] Unit received damaged. YES______ NO______ If yes attach full report.

[2] Equipment received as ordered.

[3] Adequate clearance for servicing.

[4] Record system voltage ____________v

[5] Check all electrical terminals for tightness.

[6] Retighten all set screws and bolts in fan wheels, bearing collars and pulleys.

[7] Check blower belt adjustment.

[8] NOTE: All units shipped with compressor fuses removed. Do not install these fuses before crankcase heaters have compressor oil warm.

[9] Open compressor service valves and install gauges.

[10] Record ambient air temperature________F

[11] Through charging and gauge manifold build up low side pressure to 30 PSI.

[12] Check complete refrigeration system for leaks.

[13] External spring mounted only: Loosen compressor -hold down shipping nuts.

[14] Remove supply and return air blower shipping brackets.

[15] Check gas burner for leaks.

[16] Check incoming gas pressure ________"w.c.

[17] Check wiring diagram supplied with unit.
Is all field wiring correct? ______YES ______NO
NOTE: Wiring diagram indicates correct setting of all controls.

[18] Check all controls for correct setting.

[19] Become fully oriented with the sequence of operation of the complete unit.

[20] Is condenser drain trap installed ________YES
(NOTE: This is to be field supplied) ________NO

[21] Are air filters clean. ________YES ________NO

OPERATIONAL CHECK LIST

[22] Check rotation of blowers.
Note: If rotation is wrong change only main power leads.

[23] Supply Blower __________RPM __________AMPS
Return Blower __________RPM __________AMPS

[24] Check compressor crankcase heaters.

[25] Install compressor fuses.

[26] Record compressor operation
1______AMPS 1______disc. PSI 1______suct. PSI
2______AMPS 2______disc. PSI 2______suct. PSI
3______AMPS 3______disc. PSI 3______suct. PSI
4______AMPS 4______disc. PSI 4______suct. PSI

Controls By

Governair______ Johnson Service______ Powers______

Barber Coleman______ Robert Shaw______ Honeywell______

TYPE: Electric________ Pneumatic________

[27] Check compressor unloading
1________ 2________ 3________ 4________

[28] Check compressor 1. Opens______PSI Closes______PSI
Hot gas bypass 2. Opens______PSI Closes______PSI

[29] Expansion valve superheat: Taking temperature reading at expansion valve bulb record temperature and suction pressure of compressor.

1. Suct.____PSI 2. Suct.____PSI 3. Suct.____PSI 4. Suct.____PSI
1. Temp.____F 2. Temp.____F 3. Temp.____PSI 4. Temp.____F

[30] Condenser entering air temp.______F D.B.

[31] Check compressor high pressure switch

[32] Check oil safety switch.

[33] Check compressor low pressure switch.
CUT OUT: 1______PSI 3______PSI 2______PSI 4______PSI
CUT IN: 1______PSI 3______PSI 2______PSI 4______PSI

[34] Check condenser fans. 1______AMPS 3______AMPS 2______AMPS 4______AMPS

[35] Check gas burner exhaust motors.

[36] Check combustion inlet air motors.

[37] Check burner gas pressure.
Note: Set gas pressure high fire 3½" w.c. low 1¾" w.c.
Left Burner High____"w.c. Low____"w.c.
Center Burner High____"w.c. Low____"w.c.
Right Burner High____"w.c. Low____"w.c.

[38] Check burner operation.

[39] Check high limit switches.

[40] Check fresh air and return air damper operation and linkage.

[41] Check exhaust air damper operation and linkage.

[42] Check zone damper operation and linkage.

[43] Check all zone thermostats. Are they wired correctly to zone dampers?

[44] Check remote monitoring panel.

[45] Check night setback stat operation.

[46] Check and set all Thermostats.
Cold deck 55 F Hot deck 70 F
Mixed air 55 F Mixed air over ride 70 F
Cooling ambient lockout 55 F heating ambient lock out 70

[47] Recheck refrigeration system for R-22 leaks.

[48] Check compressor oil level.

[49] Check piping for vibration.

[50] Tighten all service valve packing nuts and replace valve caps.

[51] Replace all control covers.

[52] Record final voltages.
Main______ Control Primary______ Secondary______

[53] Check all panels for water and air leaks.

[54] AS INSTALLING CONTRACTOR AND/OR REPRESENTATIVE THEREOF, I certify the check-test and start of this unit completed this date.

Date______________________

Company______________________

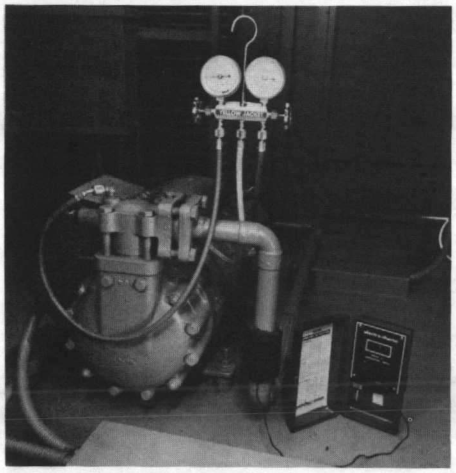
Signature______________________

SER - 103

Crankcase Heaters

When the main power is on and compressor is not operating, the crankcase heater should be heating the compressor oil to vaporize any liquid refrigerant in the compressor crankcase. When the compressor starts the interlock on the compressor starter opens and the crankcase heater is taken out of the line. Failure of the crankcase heater to operate when the compressor is off could result in compressor slugging or bearing failure. Crankcase heaters should be energized 24 hours before compressor starts.

Superheat



VAPOR PRESSURE, PSIG

Degrees F

Temp.	11	12	22	113	114	500	502
–50	28.9	15.4	6.2		27.1		0.0
–45	28.7	13.3	2.7		26.6		2.1
–40	28.4	11.0	0.5		26.0	7.6	4.3
–35	28.1	8.4	2.6		25.4	4.6	6.7
–30	27.8	5.5	4.9	29.3	24.6	1.2	9.4
–25	27.4	2.3	7.4	29.2	23.8	1.2	12.3
–20	27.0	0.6	10.1	29.1	22.9	3.2	15.5
–15	26.5	2.4	13.2	28.9	21.8	5.4	19.0
–10	26.0	4.5	16.5	28.7	20.6	7.8	22.8
– 5	25.4	6.7	20.1	28.5	19.3	10.4	26.8
0	24.7	9.2	24.0	28.2	17.8	13.3	31.2
5	23.9	11.8	28.2	27.9	16.2	16.4	36.0
10	23.1	14.6	32.8	27.6	14.4	19.7	41.1
15	22.1	17.7	37.7	27.2	12.4	23.4	46.6
20	21.1	21.0	43.0	26.8	10.2	27.3	52.5
25	19.9	24.6	48.8	26.3	7.8	31.5	58.7
30	18.6	28.5	54.9	25.8	5.2	36.0	65.4
35	17.2	32.6	61.5	25.2	2.3	40.9	72.6
40	15.6	37.0	68.5	24.5	0.4	46.1	80.2
45	13.9	41.7	76.0	23.8	2.0	51.6	88.3
50	12.0	46.7	84.0	22.9	3.8	57.6	96.9
55	10.0	52.0	92.6	22.2	5.8	63.9	106.0
60	7.8	57.7	101.6	21.0	7.9	70.6	115.6
65	5.4	63.8	111.2	19.9	10.1	77.8	125.8
70	2.8	70.2	121.4	18.7	12.6	85.4	136.6
75	0.0	77.0	132.2	17.3	15.2	93.5	148.0
80	1.5	84.2	143.6	15.9	18.0	102.0	159.9
85	3.2	91.8	155.7	14.3	20.9	111.0	172.5
90	4.9	99.8	168.4	12.5	24.1	120.6	185.8
95	6.8	108.3	181.8	10.6	27.5	130.6	199.7
100	8.8	117.2	195.9	8.6	31.2	141.2	214.4
105	10.9	126.6	210.8	6.4	35.0	152.4	229.7
110	13.2	136.4	226.4	4.0	39.1	164.1	245.8
115	15.6	146.8	242.7	1.4	43.4	176.5	262.6
120	18.2	157.7	259.9	0.7	48.0	189.4	280.3
125	21.0	169.1	277.9	2.2	52.8	203.0	298.7
130	24.0	181.0	296.8	3.7	58.0	217.2	318.0
135	27.1	193.5	316.6	5.4	63.4	232.1	338.1
140	30.4	206.6	337.3	7.2	69.1	247.7	359.1
145	34.0	220.3	358.9	9.2	75.1		381.1
150	37.7	234.6	381.5	11.2	81.4		403.9

Green Numerals—Inches Hg. Below 1 ATM

REFRIGERANTS

Figure-1
To Find Superheat

Figure-2
Example
(Refrigerant-22)

1. Measure temperature of suction line at compressor as shown in Figure-1. — 60°
2. Measure suction pressure — 70 PSIG
3. Convert suction pressure to temperature 70 PSIG = See Figure-2 — 41° F
4. Subtract the two temperatures obtained in (#1 & #3) minus the difference is superheat — 60° – 41° = 19° F

Note: Ideal superheat for close piping of suction line between evaporator and compressor on packaged air conditioning units is 18° to 20° fahrenheit. This does not apply to medium and low temperature equipment.

Caution: Temperature probe should be attached to the suction line approximately six (6) to eighteen (18) inches from the compressor and insulated as shown to prevent heat transfer from the compressor and surrounding ambient air causing an incorrect temperature reading.

Thermostats

Low Ambient Condenser Fan Lockout Thermostat

Function: Set at 70° F to lockout the number one condenser fan on multiple fan units to help control head pressure and prevent short cycling of condenser fans.

Location: Normally behind control box with bulb in ambient air to the condenser coil.

Variable Air Volume, Dual Duct and Multizone Systems

Cooling Air Sensor

Function: Controls signal to master controller that makes and breaks refrigeration solenoid circuit.

Location: Refrigeration panel with sensing element located in the leaving air side of cooling coil.

Heat Air Sensor

Function: Maintains leaving air temperature by cycling the heat source to maintain hot deck temperature as required. Check wiring diagram for sequence of operation.

Location: Sensing element in leaving air of furnace discharge.

Note: VAV systems have the same sensor controlling both heating and cooling.

Single Zone Constant Air Volume Systems

Cooling Sensor

Function: Controls signal to the master controller that makes and breaks the refrigeration solenoid circuit.

Location: In the conditioned space.

Heating Sensor

Function: Controls signal to the master controller that cycles heating on and off.

Location: In the conditioned space.

Note: Usually the same sensor controls both the heating and cooling.

Outside Air and Mixed Air Thermostats

The economizer system is designed to meet cooling requirements with outside air whenever possible.

When the outside air is below the setting of the changeover thermostat, the refrigeration is locked out and the outside air dampers are under control of the mixed air thermostat. As the mixed air temperature increases, the outside air damper is driven toward the open position from the minimum position.

When the outside air is above the setting of the changeover thermostat, the outside air damper is positioned to the minimum position as set by the minimum position switch. The refrigeration is allowed to operate under control of the room thermostat.

The outside air damper is positioned to full closed position on fan shut down.

Common settings are 60° F on the changeover thermostat, and 55° F on the mixed air thermostat. Sometimes job conditions necessitate different settings.

NOTE: CONSULT WIRING DIAGRAM FOR SEQUENCE OF OPERATION AND PROPER WIRING OF THERMOSTATS.

Head Pressure Control

Fan Cycle

Head pressure may be controlled by cycling condenser fans down to approximately 55° F. Below this setting the compressors must be turned off by a thermostat sensing outside air, and cooling should be done with outside air with the economizer cycle. See Figure 1.

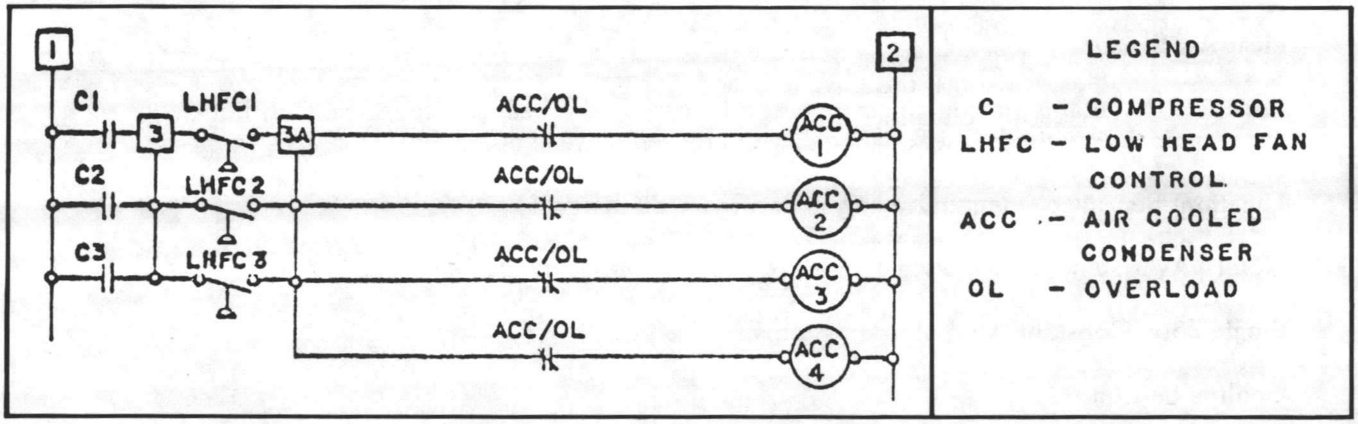


Figure-1 (Typical Illustration)

Flooded Condenser

Head pressure control by flooding condenser is used when operation of the compressors are required below 55° fahrenheit ambient temperature. A flooded condenser is when the flow of refrigerant is restricted from the condenser. This flow of refrigerant is automatically controlled by a specially designed control valve. The valve essentially makes the condenser smaller by holding liquid refrigerant in the coil to maintain a pre-set head pressure. (See Figures 1, 2, and 3) This control requires a greater amount of refrigerant charge. Therefore, a receiver large enough to hold this greater amount of refrigerant is required.

Adjustable ORI/ORD System Operation

As shown in Figure-2, the ORI is located in the liquid drain line between the condenser and the receiver. And the ORD is located in a hot gas line bypassing the condenser. During periods of low ambient temperature, the condensing pressure falls until it approaches the setting of the ORI valve. The ORI then throttles, restricting the flow of liquid from the condenser. This causes refrigerant to back up in the condenser thus reducing the active condenser surface. This raises the condensing pressure. Since it is really receiver pressure that needs to be maintained, the bypass line with the ORD is required.

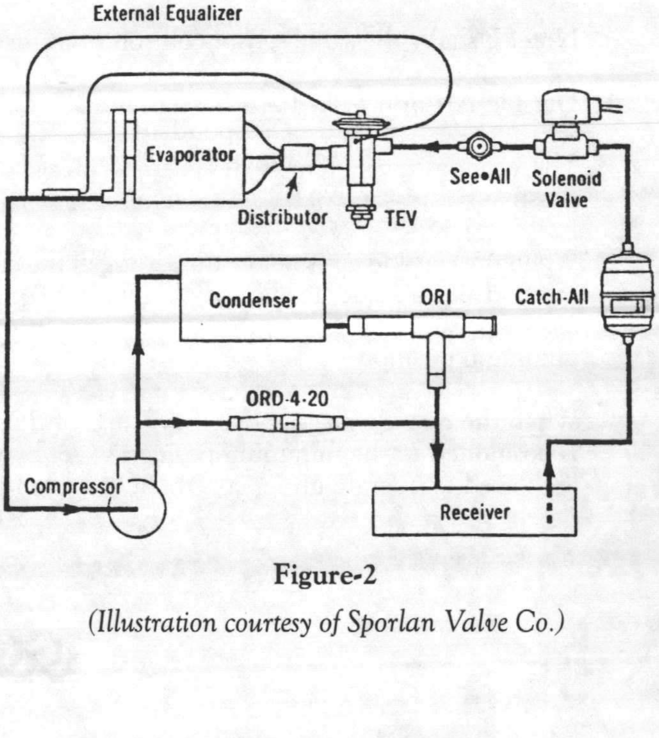


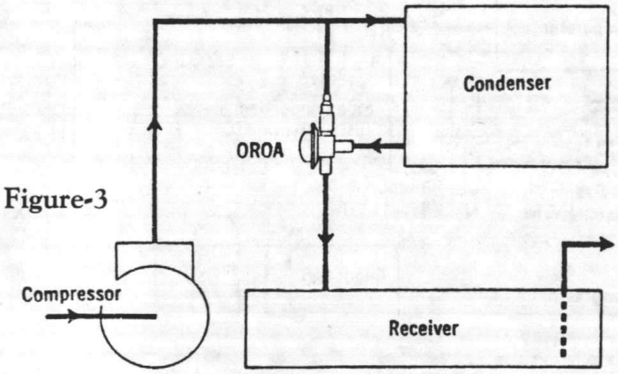
Figure-2

(Illustration courtesy of Sporlan Valve Co.)

The ORD opens after the ORI has offered enough restriction to cause the differential between condensing pressure and receiver pressure to exceed 20 psi. The hot gas flowing through the ORD serves to heat up the cold liquid being passed by the ORI. Thus the liquid reaches the receiver warm and with sufficient pressure to assure proper expansion valve operation. As long as sufficient refrigerant charge is in the system, the two valves modulate the flow automatically to maintain proper receiver pressure regardless of outside ambient.

Non-Adjustable OROA System Operation

Figure-3



(Illustration courtesy of Sporlan Valve Co.)

As shown in Figure-3, the OROA main port is located in the liquid drain line between the condenser and the receiver while the ORD portion of the valve is located in a hot gas line bypassing the condenser. Other than the fact that the main orifice of the **OROA operates in response to its outlet pressure** (receiver pressure), the OROA operates in the same basic manner as the ORI/ORD system. During periods of low ambient temperature, the receiver pressure falls until it approaches the setting of the control point of the OROA main orifice. The main orifice then throttles, restricting the flow of liquid from the condenser. This causes refrigerant to back up in the condenser thus reducing the active condenser surface. This raises the condenser pressure. Since it is receiver pressure that is being maintained, the function of the ORD valve which is located in the bypass fitting of the OROA, is required. The ORD valve opens after the main orifice of the OROA valve has throttled and offered enough restriction to cause the differential between the condensing pressure and the receiver pressure to exceed 20 psi. The hot gas flowing through the bypass line of the OROA and through the ORD serves to heat up the cold liquid being passed through the main orifice of the OROA. Thus the liquid reaches the receiver warm and with sufficient pressure to assure proper expansion valve operation. As long as sufficient refrigerant charge is in the system, the two valves comprising the OROA modulate the flow automatically to maintain proper receiver pressure regardless of outside ambient temperature.

Capacity Control

Compressor Unloading

Capacity control by compressor cylinder unloading is when one or more cylinders of the compressor is de-activated. (See chart D for compressor unloading.)

Hot Gas Bypass

Discharge bypass valves respond to changes in downstream or suction pressure. When the evaporating pressure is above the valve setting, the valve remains closed. As the suction pressure drops below the valve setting, the valve responds and begins to open. As the suction pressure continues to drop, the valve continues to open farther until the limit of the valve stroke is reached. As the suction pressure rises, the valve begins to close.

Without Remote Bulb

To adjust the HGBP valve (without remote bulb), remove the cap and turn the adjustment screw with a 5/16" hex wrench. A clockwise rotation increases the valve setting while a counter-clockwise rotation decreases the setting. When the refrigerant solenoid de-energizes for pumpdown, the HGBP solenoid also de-energizes closing the valve and allowing the system to pumpdown. (See Figure 4)

With Remote Bulb

To adjust the Remote Bulb valve, remove the protective cap from the remote bulb and turn the adjustment screw with a 3/16″ hex wrench. A clockwise rotation increases the valve setting while a counter-clockwise rotation decreases the setting. (See Figure 5)

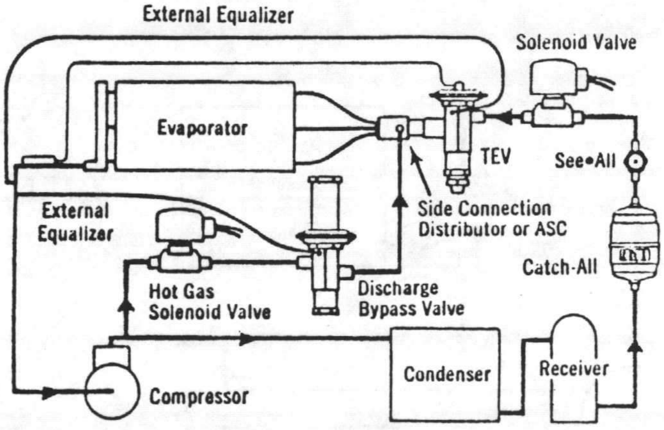


Figure-4

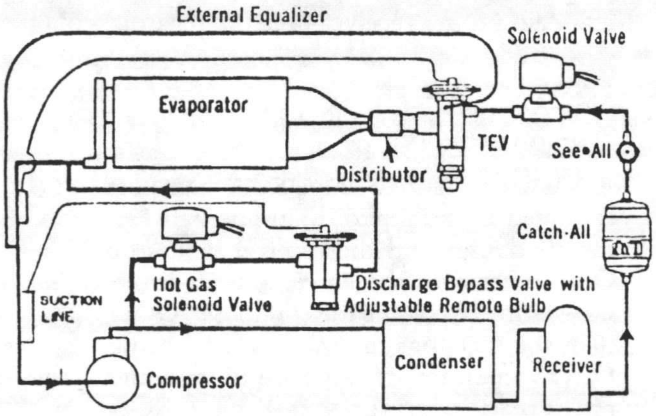


Figure-5

(Illustrations courtesy of Sporlan Valve Co.)

Caution: See Head Pressure Control page 19.
It is necessary to maintain the head pressure high enough to have sufficient heat to maintain evaporator temperature above freezing.

Note: Some applications require both compressor unloading and HGBP capacity control.

High Pressure Cut-Out

The high pressure cut out is pre-set in accordance with the type of condenser, water cooled or air cooled. The recommended hi-pressure cut out settings take into consideration the spring loaded high pressure relief valve settings which are as follows: Chart (A)

CHART (A) HIGH PRESSURE CUT-OUT PRESSURES

CONTROL	CUT-OUT PRESSURE SETTINGS (psig)-R-22	
	Water Cooled	Air Cooled
High Pressure Cut-Out	275	350
Pressure Relief Valve	300	400

Low Pressure Cut-Out

The operational scheme of the equipment determines the cut in and cut out settings of the low pressure switch. Chart (B)

CHART (B) LOW PRESSURE CUT-OUT PRESSURES

EVAPORATOR TYPE	PRESSURE SETTINGS (psig) - R-22	
	Cut - Out	Cut - In
Shell & Tube Types	30	60
Direct Expansion Type	30	60

Head Pressure Control

Where provided on the unit, the fan switch is used to delay condenser fan operation until adequate condensing pressure is reached. In low ambient conditions inadequate condensing pressure may contribute toward poor overall unit performance since the drive on the refrigerant at the expansion valve is dependent upon the condensing pressure. Chart (C)

CHART (C) HEAD PRESSURE CONTROL

TYPE	CONDENSER FAN OPERATION PRESSURES (psig) - R-22	
	Out	In
Air Cooled (w/Conn. On Comp.)	175	265
Air Cooled (w/Conn. On Rec.)	170	225
Water Cooled	175	215

CHART (D) COMPRESSOR UNLOADING & HOT GAS BYPASS

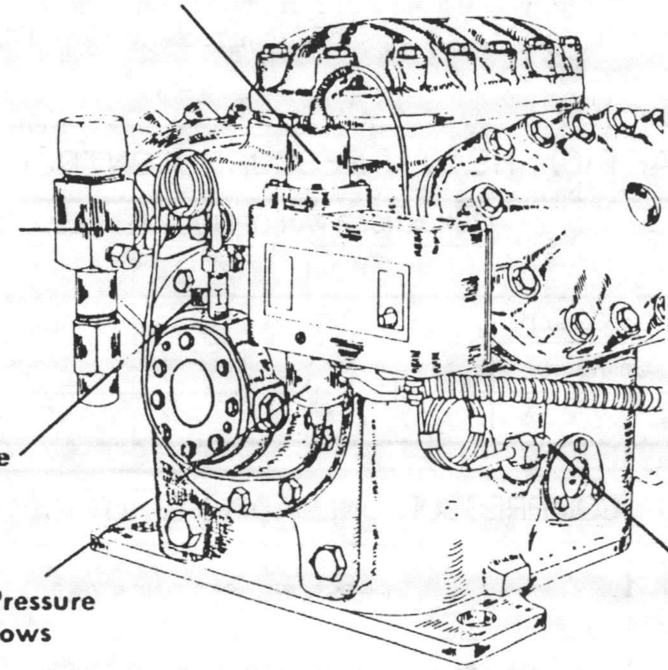
CONTROL OR COMBINATIONS	PRESSURE SETTINGS (psig)		
	1st Step	2nd Step	HGBP
1 Step	63 to 75		
2 Step	67 to 79	62 to 74	

Compressors

Most all Governair units have semi-hermetic and/or direct drive compressors. These are equipped with oil pumps giving a positive lubrication. An oil safety switch is installed with each compressor. If the oil pump loses pressure, the oil safety switch senses the loss of the pressure and shuts the compressor off. The oil safety switch is a manual re-set. Should the oil safety switch shut the compressor off for any reason, check the complete system for the reason it tripped.

Caution: All Governair equipment has a continuous pump down cycle during normal operation. **When the oil safety switch trips, the compressor stops immediately and does not pump down. Therefore, extreme caution must be taken in re-setting the oil safety switch to prevent liquid slugging of the compressor.**

Note: See Trouble Shooting Guide for possible causes of oil safety switch tripping.



Overload Protection

Solid State Module (Compressor)

The Solid State Sensor Motor overload protection applies only to Copeland compressors. This system gives the Quick Response Temperature Sensing and, in addition, gives low voltage and short cycling protection. It also provides a major improvement in motor protection under single phase conditions.

Warning: See Trouble Shooting Guide for checking compressor for suspected defective solid state sensors.

Overload Relays (Motors)

Thermal overload relays are used to protect motors from excessive heat resulting from sustained motor overload, too rapid cycling and stalled rotor. The percentage of overload determines the length of time required to open the circuit.

Manual reset relays are the recommended method of positive motor protection devices.

The ambient compensated overload relay is used because the motor is in a constant ambient temperature and the control is in a varying ambient temperature. The relay responds to the motor current only and compensates for the ambient variation at the control. The compensated bimetal overload relay provides a constant trip time in ambient temperatures from -20° F to +170° F for a given heater rating.

The overloads have a visual trip indicator to help inform the maintenance personnel that an overload has occurred. A manual test button is provided to test the operation of the 3 pole overload relay control contacts. They also are provided with a plus and minus 15% nominal trip current adjustment.

Normal temperature rise inside the enclosure has been taken into account in selecting the NEMA Class 10 Dual Element heater.

Condenser Fans:

Most all fans supplied by Governair are of the propeller blade type. However, at times squirrel cage type fans will be supplied.

It is mandatory that all belts be maintained at the correct tension. See page 44 for setting correct belt tension.

Note: For lubrication – See Lubrication Section.

Condenser Fan Motors

See Motor Section, also Lubrication.

Blowers

All blower wheels should rotate freely and should be rotated by hand and the blower hub set screws retightened prior to actually starting the blower. If the blower wheel has shifted in shipment, it may be corrected by:

1. Loosening the bearing collar set screws and moving the blower and shaft to correct. Then retighten bearing collar set screws.

   CAUTION: This may cause the belts to be misaligned which will require realignment.

2. Loosen the blower hub set screws and move blower wheel to correct.

   CAUTION: Do not operate the blower if there is undue vibration. Such operation can result in bearing failure, sprung shaft, or other serious damage.

Forward curved and backward curved blowers having either spring or rubber-in shear isolation, will have wood shipping blocks between the blower frame and the unit base.

The shipping blocks must be removed and the locking nuts on the spring isolators adjusted so that the assembly rides free and properly absorbs the vibration of the fan assembly.

Bearings may be replaced on either assembly by removing two pillow block bearing bolts, loosening two Allen set screws in the concentric locking collar and sliding the bearing off of the shaft. Bearings are self aligning.

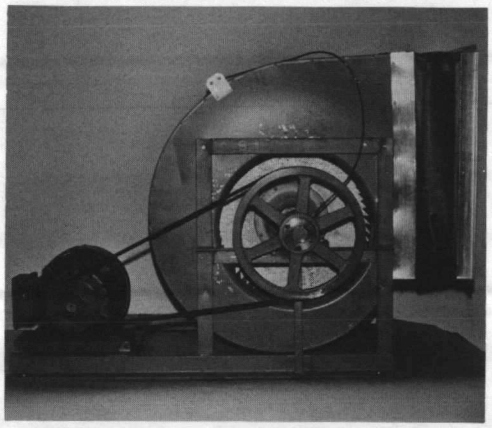
Blower wheels are removed from the forward curved scroll by removing the cutoff in the blower outlet, loosening the bearing and blower wheel set screws to remove the shaft. Remove the wheel through the blower outlet.

Blower wheels are removed from the backward curved blowers through the side of the blower scroll.

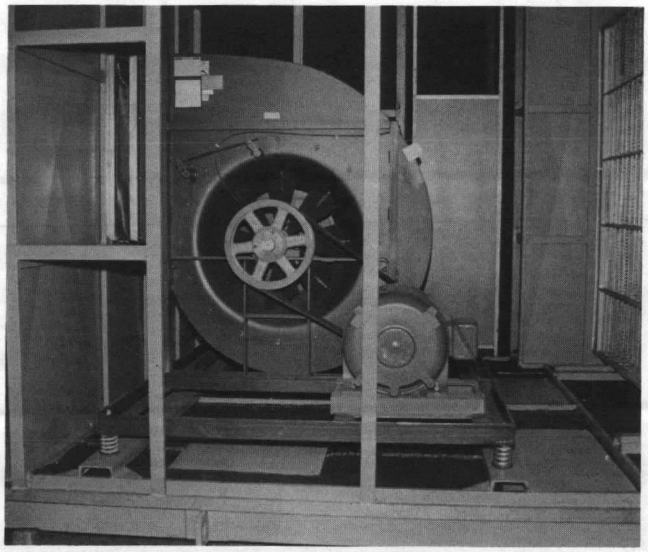
1. Remove the bearing and bearing support.
2. Remove the inlet cone.
3. Remove the wheel through the side of the scroll. See page 23.

Motors

All motors contained in Governair units have been phased at the time of inspection and testing. Should you find the fans or blower wheels operating in a reverse direction, interchange two main supply lines (3 PH.). Do not interchange leads on the motor starters.



Forward Curved Fan Without Spring Isolators



Backward Curved Fan With Spring Isolators

GOVERNAIR
CORPORATION

BACKWARD INCLINED AND AIRFOIL FANS

INSTRUCTIONS TO DISASSEMBLE AND REASSEMBLE LARGE SIZE FANS:

Step Procedure

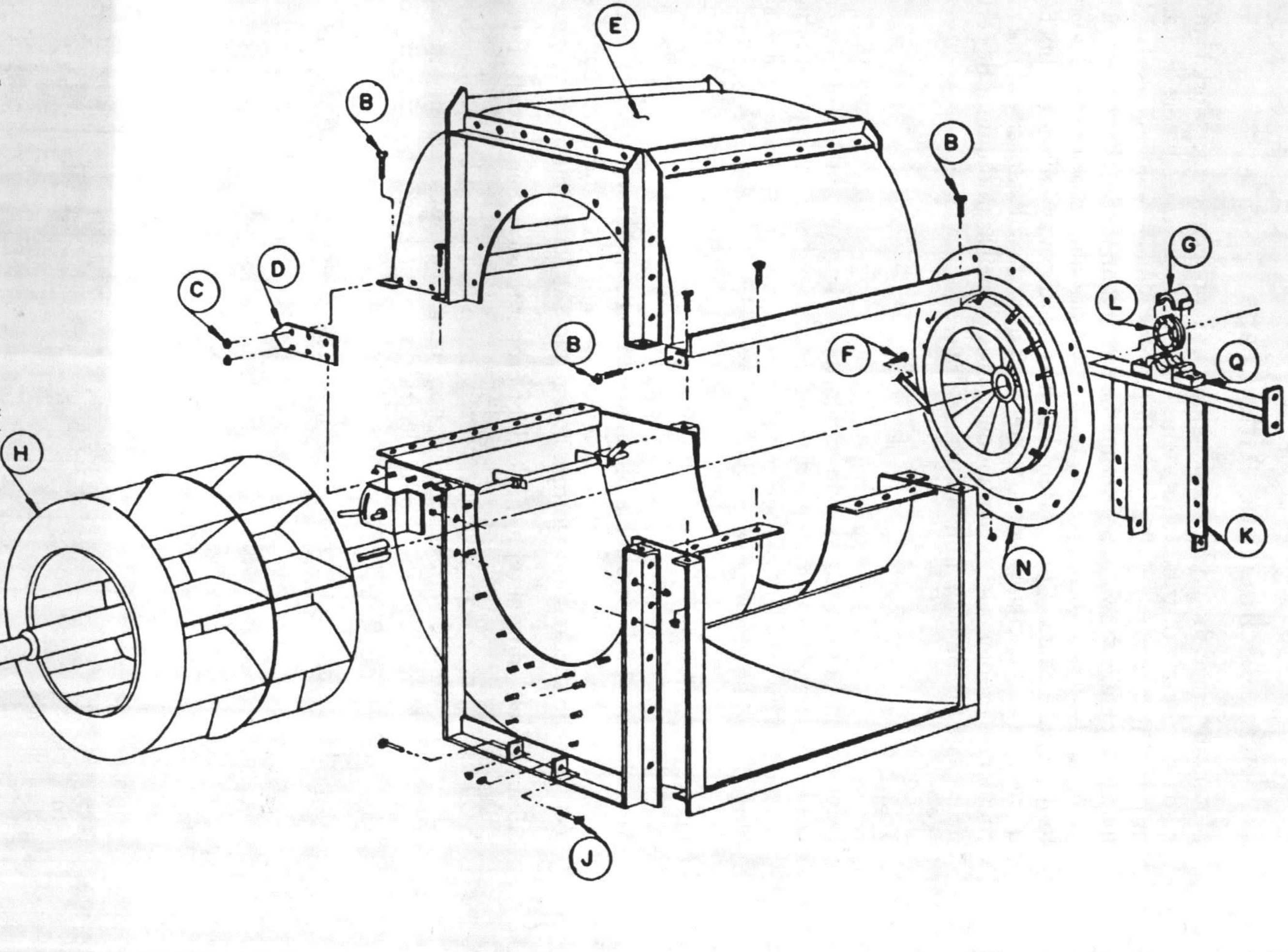
1. Remove funnel bolts (A) , split housing bolts (B) , nuts (C) and flat stock (D) Covering housing split.
2. Remove top half of housing (E)
3. Remove vane linkage bolts (F)
4. Remove bearing caps (G)

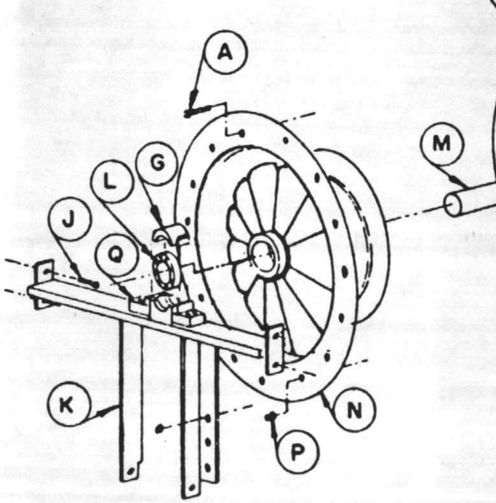
   CAUTION: Bearing caps (G) MUST be marked and placed back onto the exact bearing. Caps ARE NOT interchangeable or reversible.
   DO NOT remove bearing base (Q) from bearing bars (K)
   CLOSELY follow bearing manufacturers instructions included with packing list.
5. Lift wheel (H) and shaft (M) assembly. Support assembly while bearing bars (K) are being removed.
6. Remove bolts (J) and bearing bars (K)
7. Remove bearing races (L) from shaft (M)

   CAUTION: Bearing race (L) must be marked and placed back onto the shaft (M) exactly as it came off. Use spanner wrench or steel drift to remove inner locking nut.
8. Remove nuts (P) and pull funnels (N) from fan.
9. Lift wheel (H) and shaft (M) assembly out of unit.

TO REASSEMBLE UNIT REVERSE ABOVE PROCEDURE.

NOTE: When assembling bearings inner clearances must be feeler guage set to exact tolerances (see bearing instruction sheet.) It is recommended that a representative of bearing company be present for bearing re-assembly. Bearing warranty is void if this is not done.





Backward Inclined and Airfoil Fans

Motor amperage should be checked after the connecting duct work is installed and an air check made on the air distribution system. Only in those cases where the air flow at the outlets is insufficient to meet specifications should the blower speed be changed. The proof of proper motor amperage draw lies not within the motor amp reading, but rather with the effect produced. If the air flow is sufficient at the outlets, do not alter blower speed to bring the motor HP up to nameplate rating. Quite often the motor sizing may fall on the liberal side of the actual requirement and to change speed merely to utilize the HP capacity of the motor may introduce air circulation problems in the conditioned area as well as in the unit. Be certain to check the motor nameplate for the maximum amperage draw.

Belts

Belts should be checked for correct tension at start up and should be checked again after one week of operation. On multiple drive adjustable pulleys, the pitch depth should be checked and equated to insure identical belt travel, power transfer and wear. Adjustable motor bases, either hinged or sliding type, are provided for easy belt adjustment. See section "Belt Adjustment".

Pulley and Drives

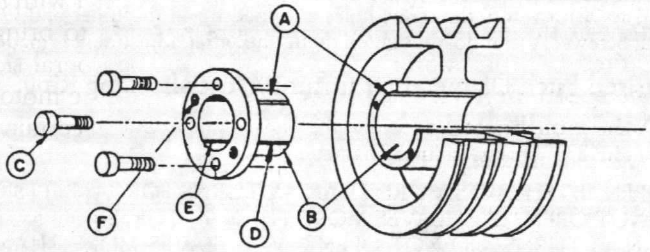
Motor pulleys both adjustable pitch, fixed pitch, and blower shaft pulleys are locked in position with either set screws or split taper lock bushings. It is mandatory that all set screws and/or taper lock bolts be checked for tightness and alignment before putting equipment into operation.

All drive belts must also be checked for proper tension. See section "Belt Adjustment."

NOTE: An incorrectly aligned and tensioned belt can substantially shorten belt life, overload blower and motor bearings shortening their life expectancy and a belt tensioned too tight can overload the motor electrically causing nuisance tripping of the motor overloads and/or motor failure.

For pulley adjustment, removal and installation see page 25, 26 and 27.

Sheaves With
Split Taper Malleable Bushings



A. This key guides bushing into sheave. It provides extra safety and a positive drive.

B. Bushing barrel and bore of sheave are tapered. This assures concentric mounting and a true running sheave.

C. Three cap screws, when tightened, lock bushing in sheave.

D. Bushing is split so that when the locking cap screws force bushing in tapered bore, the bushing grips the shaft with a positive clamping fit. This will withstand vibration and punishing loads without being loosened.

E. Sheave and bushing assembly is keyed to shaft and held in place by compression. This gives added driving strength.

F. Sheave is easily removed from shaft by inserting and tightening two of the cap screws in the tapped holes in the bushing flange. This forces the bushing loose from the sheave and releases the compression so that the entire assembly will slide from the shaft.

WARNING – Do not attempt to pull bushing flange flush with hub end. There should be ⅛″ to ¼″ clearance when tightened.

MVP* Variable Speed Sheaves
Adjustment and Cleaning Instructions

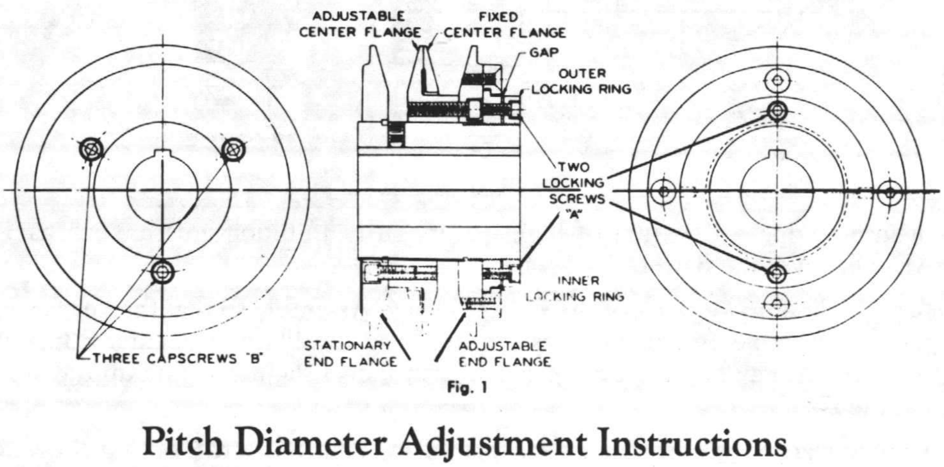


Fig. 1

Pitch Diameter Adjustment Instructions

1. Slack off all Belt Tension by moving motor towards driven shaft until Belts are free of grooves. For easiest adjustment, remove the Belts from the grooves.

2. Loosen both Locking Screws "A" in Outer Locking Ring, but **Do Not Remove Them From The Sheave.**

   (There is a gap of approximately 1/32" between Inner and Outer Locking Rings. This gap must be maintained for satisfactory locking of the Sheave. If the Locking Screws "A" are removed by accident and gap is lost, screw the Outer Locking Ring down until it touches the Inner Locking Ring. Then back off the Outer Ring ½ to ¾ turn until the screw holes are lined up in the Inner and Outer Locking Rings. Reinsert Locking Screws "A" but do not tighten them until after adjustment is made.)

3. Adjust Sheave to desired Pitch Diameter by turning Outer Locking Ring.

   (Any Pitch Diameter can be obtained within the Sheave range. One complete turn of the Outer Locking Ring will result in .233" change in Pitch Diameter.)

   DO NOT OPEN "B" SHEAVES MORE THAN 4¾ TURNS FOR "A" BELTS OR 6 TURNS FOR "B" BELTS. DO NOT OPEN "C" SHEAVES MORE THAN 9½ TURNS. DO NOT OPEN "D" SHEAVES MORE THAN 13 TURNS. DO NOT OPEN "5V" SHEAVES MORE THAN 6 TURNS. DO NOT OPEN "8V" SHEAVES MORE THAN 8½ TURNS.

   CAUTION:
   SHEAVES SHOULD NOT BE ADJUSTED IN EITHER DIRECTION TO THE POINT WHERE MOVABLE AND STATIONARY FLANGES ARE IN CONTACT.

4. **Tighten BOTH** Locking Screws "A" in the Outer Locking Ring.

5. Replace Belts and move motor away from driven shaft to apply sufficient Belt Tension to prevent slippage. Check speed. If further adjustment is needed, repeat the steps above.

Caution: Do not loosen any screws other than the two LOCKING Screws "A" in the Outer Locking Ring. These screws should be loosened only while the drive is at rest and adjustment is being made. **They must be tightened securely before drive is operated.**

To Strip Sheave for Cleaning

1. If it becomes necessary to clean dirt, lint, etc from the Sheave, it can be disassembled by removing the three Capscrews "B" in the Stationary End Flange of the Sheave (opposite the Locking Rings). After this is done, the Center Flange Assembly can be removed as a unit by loosening Locking Screws "A" and backing off the Locking Rings until they are disengaged from the threaded end of the Barrel.

2. Clean Sheave Barrel and bore of Center Flange Assembly. If it is necessary to use an abrasive, use only fine grit emery cloth. Do not use a file. If Stationary End Flange or Keys are removed from Barrel, be sure they are reassembled as shown below:

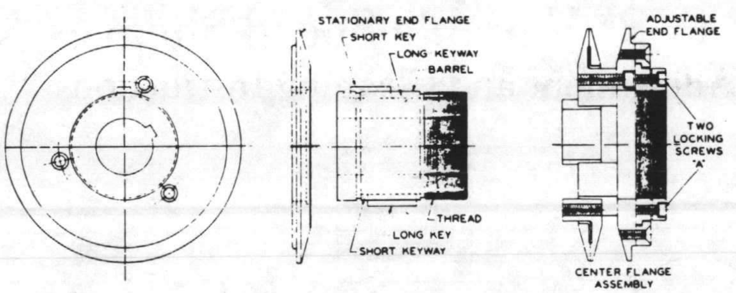


Fig. 2

3. After cleaning, wipe a thin film of high quality rust inhibiting grease, such as TEXACO THREAD-TEX over the Barrel.

4. To reassemble, line up keyways of the Center Flange Assembly so that the keyway extending through the Adjustable End Flange goes over the long key. Place the Center Flange Assembly over the Barrel. It may be necessary to move each flange slightly to line up the keyway with the key in the Barrel.

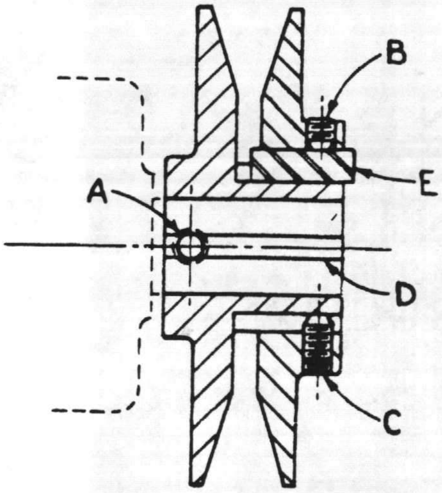
5. When Center Flange Assembly has been placed over Barrel, turn Locking Rings to engage thread on Barrel. Screw Locking Rings onto Barrel thread until Center Flange Assembly is tight against Stationary End flange, then back off ¼ turn.

6. After Sheave is assembled in this position, reinsert Capscrews "B" with lock washers and tighten. Sheave is now ready to readjust for operation.

Caution: Do not remove any screws other than those marked in sketches. This Sheave has been finished grooved and balanced after assembly for true running and quiet operation. Further disassembly offers possibility of Center Flanges being mixed up, which will create unbalance and groove run-out.

Instructions for Mounting and Adjusting

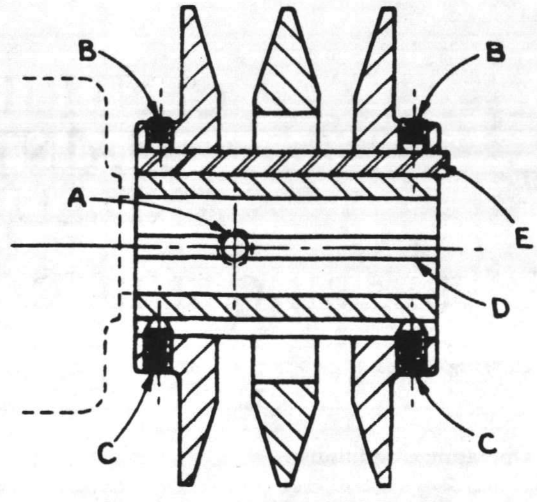
VARIABLE PITCH KEY TYPE SHEAVES



Single Groove

Key "E" projects to provide a grip for removing.

Do not operate sheave with flange projecting beyond the hub end.



Two Groove

Mounting:

1. All sheaves should be mounted on the motor or driving shaft with the end containing the setscrew "A" toward the motor.
2. Be sure both driving and driven sheaves are in alignment and that shafts are parallel.
3. Fit internal key "D" between sheave and shaft, and lock setscrew "A" in place. Wrench Torque 110″ lbs. min. – 130″ lbs. max.

Adjusting:

1. Loosen setscrews "B" and "C" in moving parts of sheave and pull out external key "E". (This key projects a small amount to provide a grip for removing.)
2. Adjust sheave pitch diameter for desired speed by opening moving parts by half or full turns from closed position. DO NOT OPEN MORE THAN FIVE FULL TURNS FOR "A" BELTS OR SIX FULL TURNS FOR "B" BELTS.
3. Replace external key "E" and tighten setscrews "B" over key and setscrews "C" into keyway in fixed half of the sheave. Wrench Torque 110″ lbs. min. – 130″ lbs. max.
4. Put on belts and adjust belt tension (Do not force belts over grooves.)
5. Future adjustments should be made by loosening the belt tension and increasing or decreasing the pitch diameter of the sheave by half or full turns as required. Readjust belt tension before starting drive.
6. Two groove sheaves must have both halves adjusted by the same number of turns from closed position to insure the same pitch diameter.
7. Be sure that ALL keys are in place and that ALL setscrews are torqued properly before starting drive. Check setscrews and belt tension after 24 hours service.
8. Recheck motor running load amps with motor name plate R.L.P.

Lubrication

Motors: check the name plate of each for proper lubricant to use. If no lubrication instructions are on the motor name plate the following lubricating instructions are to be followed.

Motors are equipped with double-shield ballbearings* having sufficient grease to last indefinitely under normal service. Where the motor is used constantly in dirty, wet or corrosive atmospheres, it is advisable to add one quarter ounce of grease per bearing every three months. Use a good quality rust inhibited polyurea based grease, such as Chevron SR1.

When greasing the bearings, keep all dirt out of the area. Wipe the fittings completely clean and use clean equipment. More bearing failures are caused by dirt introduced during greasing than from insufficient grease.

*The blower end bearings of 143T and 145T motors are sealed bearings and need no greasing.

CENTRIFUGAL FAN MAINTENANCE AND LUBRICATION

BEARING LUBRICATION INSTRUCTIONS

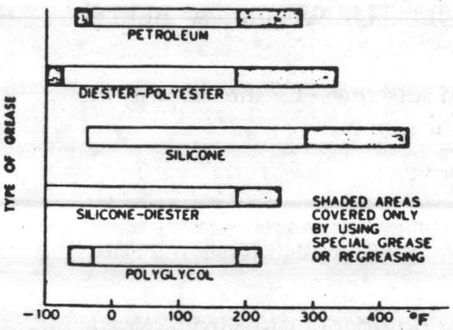
Bearing Types
Governair typically furnishes one of three basic bearing types for centrifugal fans – ball bearing, spherical roller bearing, spherical roller bearing with split housing. The bearing type and manufacturer are indicated on each bearing.

Operating Conditions
Bearings should not be located in the airstream or an environment with a heavy concentration of abrasive elements. Governair does NOT recommend grease lubricated bearings for ambient temperatures above 200° F. For information on water, or oil cooled bearings contact the factory.

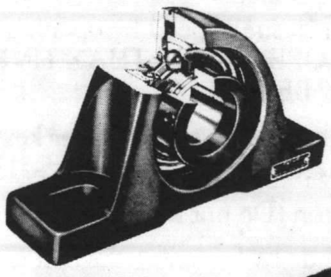
Grease Selection
Various types and brands of grease are suggested below and on the following pages. The brands suggested for your specific bearing type and application can be used. In all cases one should avoid mixing different brands of grease.

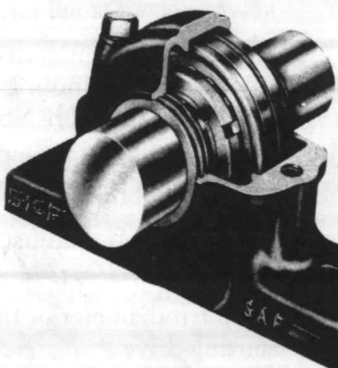
Initial Greasing
All standard bearings provided by Governair should be purged and relubricated before operation. Using the approved grease or an equivalent, lubricate the bearing and housing reservoir through the pressure lubrication fitting. Complete greasing is assured if grease is worked in on one side of the bearing until grease appears on both sides. If the bearing will be operated at less than 150 RPM, and in dirty conditions, more grease is desirable. The bearing will discharge excess grease through seals after a short period of operation. It is not necessary to replace this initial discharge because leakage will cease when the excess grease is worked out.

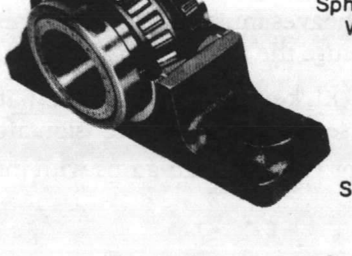
Relubrication
The initial greasing interval can be determined by the conditions or bearing instructions which follow. By carefully observing the condition of the grease expelled from bearings at the time of relubrication, it can be determined whether the maintenance schedule should be altered. When regreasing, avoid mixing different brands of grease.



Temperature Range for Greases


Ball Bearing


Spherical Roller Bearing With Split Housing


Spherical Roller Bearing

Grease Lubrication Chart

Operating condition: Dirt	Operating condition: Moisture	Bearing operating temperature	Greasing interval □	Use grease equivalent to these grades	Remarks
Fairly clean	None	32°F. to 120°F. 120°F. to 160°F. 160°F. to 200°F.	6 to 12 months 1 to 2 months 1 to 4 weeks	Phillips Petroleum Co. Philube L #1	
Moderate to extremely dirty	None	32°F. to 160°F. 160°F. to 200°F.	1 to 4 weeks 1 week	Master Lubricants Co. Lubrike M-3 Spec. Atlantic Refining Co. Atlantic 62 Imperial Oil Ltd. Andok 280	
Fairly clean	Heavy moisture and direct water splash	32°F. to 200°F.	1 week	Standard Oil Co. (Ind.) Amelith #1 Sun Oil Co. Sunoco 844-X New York & New Jersey Lubricant Co. F-925 Mobil Oil Co. Mobilux #1	Customer should provide flinger or place a hood over bearing housing and fasten a disc to shaft just inside of hood shaft opening. Consult Link-Belt.
		32°F. to 200°F.	Determined by frequent inspection of installation.	Shell Oil Co. Alvania EP2 Mobil Oil Co. Sovarex grease L-1	
	None	32°F. to – 40°F.	Consult Link-Belt Application Engineering	Mobil Oil Co. Mobilgrease BRB Zero Texas Co. 2324 Uni Temp. Ep	Cold storage room
	None	Over 200°F. or below – 40°F.	Consult Link-Belt Application Engineering	Special lubrication may be required. Consult Link-Belt.	A different Link-Belt bearing may be required using oil as a lubricant, etc.

□ Frequency of regreasing will vary, depending on the hours of operation, temperature and surrounding conditions.

Storage

Bearings which are to be stored or idle for an extended period of time should be wrapped in a neutral grease-proof paper, foil or plastic film. Compounds can be recommended by the bearing manufacturer to provide protection for several months to several years. During storage the bearings should be rotated monthly to prevent corrosion. After long-term storage, grease should be purged from the bearings and fresh grease injected prior to start up.

Instructions for Specific Bearings

Below and on the following pages are copies of the lubrication instruction labels similar to those for the standard bearings provided by Governair. If additional information is required for these or other bearings provided by Governair, contact the bearing manufacturer directly.

SEAL MASTER BALL BEARING UNITS

prelubricated . . . ready for immediate use

RELUBRICATE WHILE RUNNING IF POSSIBLE,
IF RELUBRICATING WHILE IDLE, ADD ONLY
4 to 5 SHOTS WITH HAND GUN
USE GREASE, NOT OIL

SUGGESTED INTERVAL

Speed	Temperature	Cleanliness	Greasing Interval
0-100 RPM	TO 140°F.	CLEAN	6-12 MONTHS
101-1500 PRM	TO 140°F.	CLEAN	2-6 MONTHS
ANY SPEED	TO 140°F.	DIRTY	1 WK. - 1 MO.
ANY SPEED	TO 200°F.	DIRTY	DAILY - 2 WK.

IF ABNORMAL CONDITIONS EXIST CONSULT
SEALMASTER ENGINEERS FOR
RECOMMENDATIONS.

SEALMASTER BEARING DIVISION

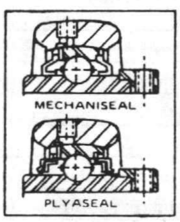
STEPHENS-ADAMSON MFG. CO.

AURORA, ILL. LOS ANGELES, CAL. BELLEVILLE, ONT.

ASSEMBLY AND LUBRICATION INSTRUCTIONS
FOR FAFNIR RELUBRICATABLE MECHANISEAL & PLYASEAL
TRANSMISSION UNITS

INSTALLATION

LOCATE ASSEMBLED UNIT TO POSITION AND LINE-UP SHAFT CAREFULLY. FAFNIR SELF-ALIGNING UNITS WILL AUTOMATICALLY COMPENSATE FOR MISALIGNMENT, BUT SHAFT MUST BE STRAIGHT. BOLT UNIT SECURELY TO SUPPORTING STRUCTURE.



SLIDE COLLAR AGAINST CAM END OF INNER RING. ENGAGE CAMS BY ROTATING COLLAR UNTIL IT SLIDES OVER CAMMED END OF INNER RING. LOCK COLLAR BY TAPPING LIGHTLY IN DIRECTION OF SHAFT ROTATION. TIGHTEN SET SCREW TO DISASSEMBLE. LOOSEN SET SCREW AND TAP COLLAR IN DIRECTION OPPOSITE SHAFT ROTATION.

LUBRICATION

BEARINGS HAVE BEEN FACTORY PRELUBRICATED WITH HIGH QUALITY GREASE AND FOR NORMAL CONDITIONS OF SERVICE REQUIRE NO FURTHER LUBRICATION.

NORMAL SERVICE IS CONSIDERED AS OPERATION IN A CLEAN DRY ATMOSPHERE AT TEMPERATURES BETWEEN -20°F and 180°F AND AT SHAFT SPEEDS UP TO 2100 FT. PER MIN.

WHERE SERVICE IS ABNORMAL WITH RESPECT TO SPEED, TEMPERATURE OR EXPOSURE TO CONTAMINATION, OR EXTREMELY LONG LIFE IS REQUIRED, PERIODIC RELUBRICATION MAY BE ADVISABLE.

LUBRICATION SCHEDULE FOR HORIZONTAL MOUNTED FAN WITH FMC/LINK BELT SERIES 200 BALL BEARING UNITS

LINK-BELT
BEARING DIVISION

CONSULT
MANUFACTURER
FOR SPECIFIC RECOMMENDATIONS

SHAFT SIZE INCHES	OPERATING SPEED (RPM)									
	500	1000	1500	2000	2500	3000	3500	4000	4500	5000
	RELUBRICATION CYCLE (MONTHS)									
1/2 thru 1	6	6	6	6	6	6	4	4	2	2
1-1/16 thru 1-7/16	6	6	6	6	6	6	4	4	2	1
1-1/2 thru 1-3/4	6	6	6	4	4	2	2	2	1	1
7-7/8 thru 2-3/16	6	6	4	4	2	2	1	1	1	
2-1/4 thru 2-7/16	6	4	4	2	2	1	1	1		
2-1/2 thru 3	6	4	4	2	1	1	1			
3-7/16 thru 3-1/2	6	4	2	1	1	1				
3-15/16 thru 4	6	4	2	1	1					

Lubricate with or equivalent to:

Shell — Alvania EP Grease No. 2
Texaco — Molytex Grease No. 2
Mobil — Mobilux EP2
Gulf — Gulfcrown Grease No. 2
American — Amolith Grease No. 2

For operating temperatures below 32°F or above 300°F consult manufacturer.

Condition of temperature, moisture, or dirt will require more frequent lubrication cycle. Use sufficient volume of grease to purge the seals. Rotate bearings during relubrication where good safety practice permits. For corrosion protection, lubricate upon shutdown. Rotate bearings monthly during fan storage.

RECOMMENDED LUBRICATION SCHEDULE FOR FMC/LINK-BELT SERIES 300 BALL BEARINGS USED ON HORIZONTAL MOUNTED FANS

CONSULT
MANUFACTURER
FOR SPECIFIC RECOMMENDATIONS

SHAFT SIZE INCHES	OPERATING SPEED (RPM)									
	500	1000	1500	2000	2500	3000	3500	4000	4500	5000
	LUBRICATION CYCLE (MONTHS)									
5/8 thru 1	6	6	6	6	4	4	4	4	2	2
1-1/8 thru 1-1/2	6	6	6	4	4	4	2	2	2	1
1-5/8 thru 1-15/16	6	6	6	4	4	2	2	1	1	
2 thru 2-1/2	6	6	4	4	2	1	1			
2-11/16 thru 3-3/16	6	4	2	2	1	1	½			
3-7/16 thru 3-15/16	6	4	2	1						

Lubricate with the following greases or their equivalent:

Shell — Alvania EP Grease No. 2
Texaco — Molytex Grease No. 2
Mobil — Mobilux EP2
Gulf — Gulfcrown Grease No. 2
American — Amolith Grease No. 2

If bearings are subjected to temperatures below 32° or above 200°F, consult fan manufacturer for proper lubrication.

Apply sufficient grease when relubricating to cause some purging of grease at seals.

Increase the frequency of relubrication in conditions of abnormal moisture or dirt.

Lubricate for extended shutdown or storage and rotate shaft monthly for corrosion protection.

601-64 272 FMC CORPORATION • LINK-BELT BEARING DIVISION • INDIANAPOLIS, INDIANA

Grease lubrication schedule

Link-Belt® spherical roller bearings — Series B22400 and B22500
For use on horizontal shaft equipment

Shaft sizes		Amount of grease		Operating speed (rpm)									
				500	1000	1500	2000	2200	2700	3000	3500	4000	4500
Inches	MM	IN³	CM³	Lubrication cycle (months)									
3/4 - 1	25	0.39	6.4	6	6	6	4	4	4	2	2	1	1
1-1/8 - 1-1/4	30	0.47	7.7	6	6	4	4	2	2	1	1	1	1
1-7/16 - 1-1/2	35	0.56	9.2	6	4	4	2	2	1	1	1	1	½
1-5/8 - 1-3/4	40	0.80	13.1	6	4	2	2	1	1	1	1	½	
1-15/16 - 2	45-50	0.89	14.6	6	4	2	1	1	1	1	½		
2-3/16 - 2-1/4	55	1.09	17.9	6	4	2	1	1	1	½			
2-7/16 - 2-1/2	60	1.30	21.3	4	2	1	1	1	½				
2-11/16 - 3	65-75	2.42	39.7	4	2	1	1	½					
3-3/16 - 3-1/2	80-85	3.92	64.2	4	2	1	½						
3-11/16 - 4	90-100	5.71	93.6	4	1	½							
4-3/16 - 4-1/2	100-115	6.50	106.5	4	1	½							
4-15/16 - 5	125	10.00	163.9	2	1	½							

These guidelines are for usage on applications approved by FMC.

Lubricate with a multi-purpose roller bearing NLGI Grade 1 or 2 grease having rust inhibitors, anti-oxidant additives, and a minimum oil viscosity of 400 SSU at 100°F. For operation requiring a monthly or less cycle the grease should also be suitable for temperatures up to 250°F continuous, dynamically stable and must not churn or whip.

Some greases having the desired properties are:

American — Rykon Grease No. 2 EP, Mobil — Mobilgrease® 28, Texaco — Molytex EP2 grease.

If bearings are subjected to temperatures below 32° or above 200°F, consult equipment manufacturer for proper lubrication.

Conditions of vibration exceeding 1 to 2 mils, moisture or dirt will require a more frequent lubrication cycle or special lubricant selection. Rotate bearings during relubrication where good safety practice permits.

Lubricate bearing prior to extended shutdown or storage and rotate shaft monthly to aid corrosion protection.

601-65-084 FMC Corporation • Bearing Division • Indianapolis, Indiana 46206

SKF SPHERICAL ROLLER BEARINGS

RELUBRICATE ON THIS SCHEDULE UNDER NORMAL OPERATING CONDITIONS

LUBRICATION IN HOURS

SHAFT DIA. (IN.)	SPEED IN R.P.M. 300	500	700	900	1100	1300	1500	1800	2400	2700	3000
2-3/16	6060	3550	2470	1875	1490	1230	1035	825	565	475	410
2-7/16	5520	3220	2220	1670	1320	1070	900	700	465	380	
2-11/16	5090	2930	2010	1495	1170	940	780	600	375		
2-15/16	5090	2930	2010	1495	1170	940	780	600	375		
3-7/16	4560	2590	1745	1280	985	770	625	460			
3-15/16	4270	2400	1600	1155	875	675	535	375			
4-7/16	3580	1940	1240	845	600	425					
4-15/16	3380	1800	1125	750	515						
5-7/16	3050	1570	940	590	370						
5-15/16	2900	1470	850	510							

LUBRICATION NOTES

The upper half of the housing has two tapped holes 30° from the vertical center line. One hole is in the center of the housing; the other is to the side. Lubricate through the center hole for spherical roller bearings with W33 feature (with groove around the outer ring) and lubricate through the side hole for self-aligning ball bearings and spherical roller bearings without W33 feature (without groove around outer ring). *This is important! The lubricant will not get to the bearing if it is applied through the center hole when a bearing without the grooved outer ring is used.*

GREASE LUBRICATION: If grease is used as a lubricant it should be smeared between the rolling elements and worked in. The lower half of the housing should be packed 1/3 to 1/2 full.

BALL BEARINGS: An apparent channeling grease with a ASTM penetration of 190 minimum should be used.

ROLLER BEARINGS: Greases to be used should have an ASTM penetration above 300 and should not channel.

GREASE CLASSIFICATION

CLASS	TYPE OF BASE (1)	OIL VISCOSITY SAYBOLT SECOND (Approx.) SSU @ 100°F.	@ 210°F.	NLGI (2) GRADE
A	Lithium or Equal	200-500	48-55	0
B	" " "	400-600	58-68	1
C	" " "	800-1000	75-82	1
D	Lithium Only	800-1000	75-82	2

TYPE OF GREASE & RELUBE CYCLE RECOMMENDED

Operating Temp. of Brg. (4)	Grease Class Requirement (From Above Chart) for Different Speeds (3) Low (5)	Medium	High	Suggested (8) Relube Cycle
0-70	A or B	A or B		6-12 months
70-120	B or C (6)	B or C		6-12 months
120-160	B or C (6)	C or D	D (7)	2-3 weeks
160-200	C	C or D	D (7)	1-4 weeks

(1) *Calcium Complex Greases Not Recommended For Spherical Roller Bearings.*
(2) National Lubricating Grease Institute Consistency Code.
(3) Definition of speed categories:
Low Up to ¼ of catalog speed limit for static oil lubication.
Medium ¼ to ½ catalog speed limit for static oil lubication.
High ½ to full catalog speed limit for static oil lubrication.
(4) Consult SKF Engineering if temperature is below 0° or above 200°F.
(5) Extremely slow speed, will require special consideration if loads are high.*
(6) Use type "C" where load is heavy, 15,000 hours bating life or less and/or speeds are less than 100 RPM.
(7) Consult SFK Engineering – Grease lube not normally recommended under this combination of operating conditions.
(8) Clean – Dry applications only
For moderate conditions of dirt and /or moisture, use cycle of 1 to 2 months.
For extreme conditions of dirt and/or moisture use cycle of 1 week.
Vertical applications normally require shorter than normal relube cycle.
(9) Never mix greases with unlike bases.
(10) Remove old grease at least once a year.

*Under all conditions, application should be checked using the SKF lubricant film parameter found in the Engineer Date Catalog.

SAF 225/226 SPIT HOUSING PILLOW BLOCKS WITH SKF SPHERICAL ROLLER BEARINGS

RELUBRICATE ON THIS SCHEDULE

RELUBRICATION INTERVAL (HOURS)

PILLOW BLOCK NUMBER 225/226	SHAFT DIA.	SPEED (R.P.M.)											GREASE ADDED AT EACH INTERVAL (OUNCES) PILLOW BLOCK SERIES	
		300	500	700	900	1100	1300	1500	1800	2400	2700	3000	225	226
09	1-7/16	6775	3995	2800	2140	1715	1425	1210	980	690	595	515	0.35	0.52
10	1-11/16	6400	3760	2630	2000	1600	1325	1120	900	625	535	515	0.37	0.79
11	1-15/16	6070	3555	2475	1880	1495	1230	1040	830	565	480	410	0.45	0.93
13	2-3/16	5530	3215	2220	1670	1320	1075	900	705	465	385	320	0.67	1.21
15	2-7/16	5090	2935	2010	1495	1170	945	780	600	375	300		0.72	1.58
16	2-11/16	4900	2810	1915	1420	1105	885	725	550	330	260		0.83	1.77
17	2-15/16	4720	2700	1830	1345	1040	830	670	505	295			0.97	1.94
18	3-3/16	4560	2590	1750	1280	980	775	625	460				1.15	2.19
20	3-7/16	4265	2400	1600	1155	875	675	535	380				1.49	2.82
22	3-15/16	4010	2230	1465	1045	775	585	450	300				1.91	3.45
24	4-3/16	3780	2075	1385	940	680	505	370					2.24	4.02
26	4-7/16	3575	1935	1235	845	595	425	300					2.65	4.68
28	4-15/16	3385	1805	1130	755	515	350						3.06	5.50
30	5-3/16	3210	1685	1035	670	440	280						3.54	6.21
32	5-7/16	3050	1575	940	590	365							4.17	6.97
34	5-15/16	2900	1470	855	515	295							4.79	7.77

Notes:
1. Lubricate with a Grade 2 lithium or non-soap base grease having an oil viscosity of 500-1000 SUS at 100°F.
2. Should bearing operating temperature be below 32°F. or above 200°F. consult fan manufacturer for lubrication recommendations.
3. Clean and repack annually.
4. If fans are to be stored after arrival at job site, bearings should be immediately relubricated and shaft rotated monthly for corrosion protection.

Air Filters

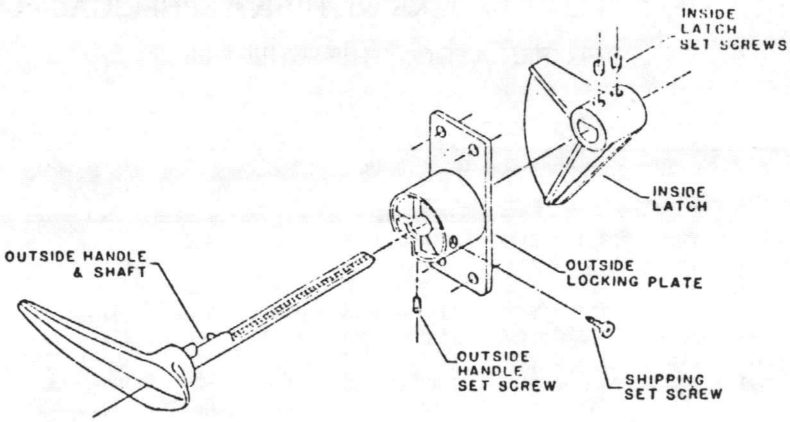
All filters are shipped loose in boxes inside of unit. See packing list received with each unit showing what section of unit filters are shipped in. It is mandatory that filters be installed in the filter frames of each unit before putting the unit into operation to protect the coils and keep them clean.

Upstream access filter frames have a removable section of the frame secured in place with sheet metal screws. It is necessary to remove this section for each horizontal row of filters, install the filters and secure the removable frame section back in place.

Side access slide filters have a side plate to the filter frame secured on with sheet metal fasteners. The opposite side is hinged. Remove the fasteners, swing open side plate, slide filters into filter frame, close side plate and re-install sheet metal fasteners.

Due to the wide variety of bag filters, hepa filters, roll filters and odor removing filters it is not possible to cover all of them in this manual. However, when these filters are supplied installation instructions are shipped with each type.

Caution: If equipment is to be run during construction, roll filter media installed across the return air opening should be used as a temporary filter and changed frequently.



VENTLOCK # 333 DOOR LATCH

Door Latch

Remove shipping set screw before attempting to open door.

The first quarter turn of the latch handle engages the flange, and during the next quarter turn not only does the bevel on the flange impart compression amounting to 5/32″, but a stud on the latch handle works against a cam in the latch barrel pulling in the striker another 1/8″. In other words, total compression of over 1/4″ is provided by this latch.

The door handle should be checked for proper adjustment so that the door makes a positive seal against the door gasket. To adjust door handle, loosen locking set screws, move flange to desired position on latch shaft, retighten locking set screws.

Door Gaskets

3/16″ x 3/4″ closed cell door gasketing is applied to the door frame opening. At time of startup, the door frame and gasketing should be inspected for possible damage by workmen during the hookup of the equipment.

Dampers

Caution: Dampers, operators, controls and linkage must be checked prior to applying power to the operators making sure nothing will obstruct the operation of the damers. Do not over-drive damper operators as this may cause damage to the dampers.

Multizone Damper Motor

Function: Positions zone dampers in response to zone thermostat. One end switch from each motor should be connected in series to prevent heating source from operating until at least one zone is calling for heat.

Location: Discharge end of unit above or below dampers.

Fresh Air — Return Air and Exhaust Air Damper Motors

Function: One or more damper motors operate outside air, return air and exhaust air dampers, which function in response to mixed air thermostat or through mixed air lock out to minimum position. Spring return on damper motors close outside air dampers, close exhaust dampers and open return air dampers when there is no power to the motors.

Location: Mixed air section, return air section and/or exhaust air section.

Minimum Position Potentiometer (If Supplied)

Function: To maintain minimum outside air setting when energized. Position may be tailored to suit individual job.

Location: Inside of damper motor in mixed air section or in remote control panel.

A good check-out should guarantee that:

1. The motor operates the load properly.
2. The motor responds properly to a controller.
3. The motor returns the damper to the starting position whenever power to the motor is interrupted.
4. There is no binding or stalling of the motor as the motor travels through its entire range.

Note: To simplify checkout procedure it is suggested that an auxiliary potentiometer be substituted for the controller. This may be obtained through your local controls supplier.

Enthalpy Control or Economizer Change Over Thermostat

Function: To drive fresh air dampers and exhaust air dampers to the minimum or closed position and the return air dampers to full open position. When the outside air temperature is below the setting of the control the fresh air dampers, return air dampers and exhaust air dampers are in full economizer cycle operation.

Location: Return air section with the sensing element extending into the fresh air section.

Parts Replacement Ordering

Due to the variation of components supplied with this type of equipment, it is not possible to publish a generalized parts list. When requesting replacement parts, the following information must be given:

1. Complete Governair nameplate data such as model and serial number.

2. Name of part, giving full description, including model and serial number, if available.

Coils

Chilled Water and Direct Expansion Coils:

Chilled water and direct expansion coils must not exceed 600 feet per minute to prevent condensate water from being pulled off the coil and outside the condensate drain pan. Air velocity of 500 feet per minute is more desirable.

The static pressure drop across each coil will change with the number of rows deep and other design conditions. Consult the written submittal for each unit on each job.

Note: 1. For condensate drain traps, see Table of Contents under "Drain Traps."

2. For winterizing see Table of Contents, "Freeze Protection of Coils."

Hot Water Coils

The static pressure across hot water coils will change with the number of rows deep and fins per inch. This also is closely related with the temperature rise desired leaving the coil.

The temperature rise of the air leaving the coil is also dependent on the airflow across the coil, the gallons of water flow through the coil and the entering water temperature into the coil. Consult the submittal for each specific job for the above information.

Note: When using ethylene glycol or other antifreeze solutions, consult Governair for the required de-rating of each coil. It will be necessary to give the percentage of ethylene glycol required.

Winterizing — See "Freeze Protection of Coils."

Steam Coils

The static pressure drop across steam coils will change with the number of rows deep and fins per inch. Consult the submittal issued for each specific unit for above information.

DTH Steam Coils are commonly called non freeze coils. Caution: There is no coil that is absolutely free from freezing.

Winterizing — See Table of Contents "Freeze Protection of Coils."

Piping & Control

Consult the job specification for the specific piping requirements for each unit.

Freeze Protection of Coils

All chilled water, hot water and steam coils can be damaged during freezing weather. Precautionary measures must be taken to prevent freezing such as:

1. Draining each coil and related piping, making sure that all low areas also drain.
2. After draining, flush coils with an antifreeze solution such as ethylene glycol. A solution of 50% ethylene glycol and 50% water will protect from freezing to approximately 35° F below zero at sea level.
3. In case of unit shutdown during winter operation, such as unit power failure, night shutdown and weekend shutdown the controls must be installed so the valves will go to the full heat position, all fresh air dampers and exhaust dampers go to the full closed position, and all return air dampers go to the full open position. The water circulation pumps must keep circulating water through the coils and/or auxiliary heat must be maintained within the unit cabinet.

Condenser Coils:

Condenser coils must be kept clean at all times. Debris such as paper, cottonwood lint, etc. restricting the air flow across the coil must be removed at once. Dirty coils and restricted air flow will cause nuisance tripping of the high pressure control and higher operating costs. Where condenser coils are exposed to a contaminated atmosphere it will be necessary to clean the coils with some type of cleaner to remove the contamination. Most refrigeration wholesalers can recommend a cleaner for your specific need.

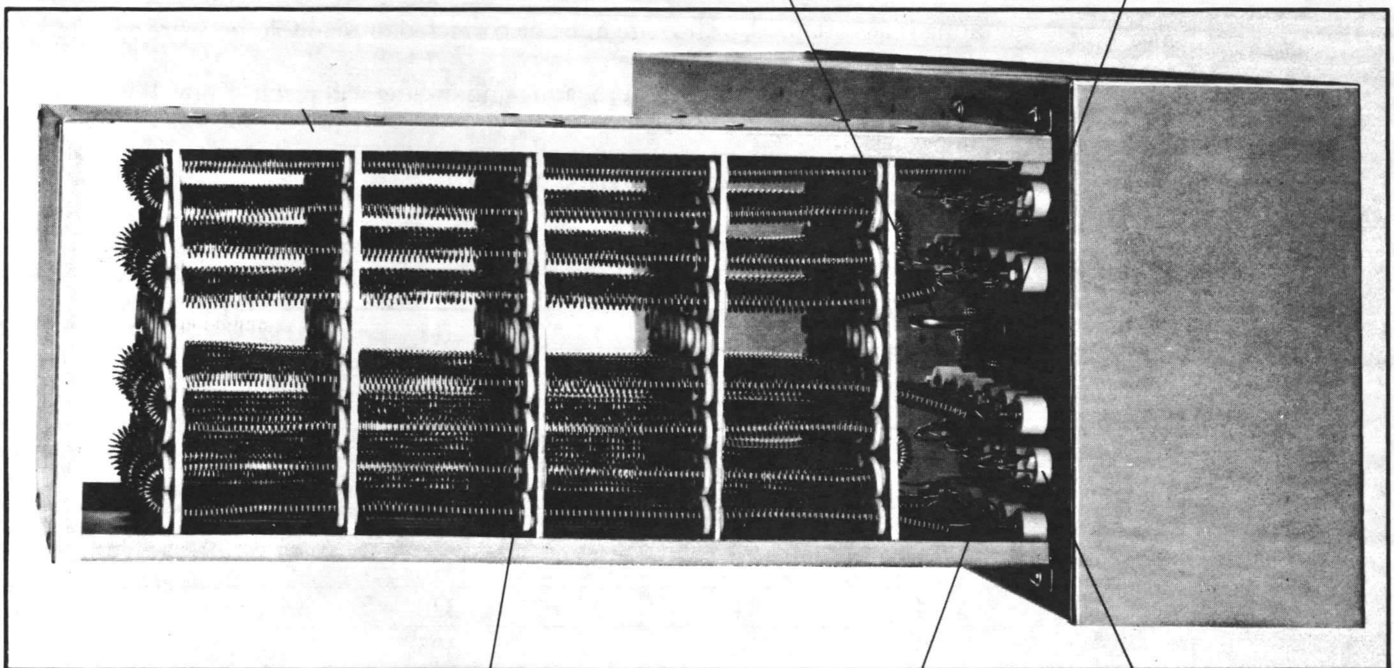
Note: See Trouble Shooting Guide.

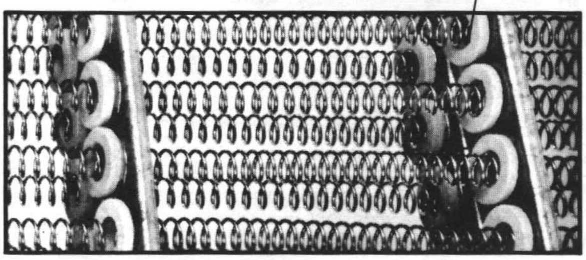
ELECTRIC HEATER TYPICAL

NOTE: When ordering replacement parts give the complete model and serial number of both the electric heater and the Governair unit.

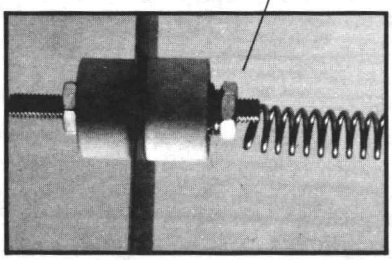
Air Pressure Switch sensing tube removable inside the heater control panel.

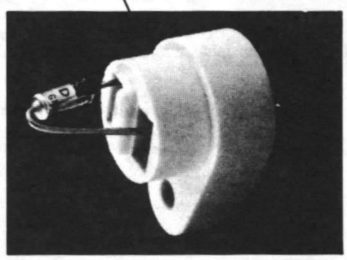
Automatic primary hi-limit





Ceramic holders





Secondary hi-limit safety device. Without removing heater from duct, the heat limiter, or fuse link is manually replaceable in the control panel by removing one screw.

Gas Heating

Piping

All piping must run in accordance with requirements outlined in the pamphlet, "Installation of Gas Appliances and Gas Piping," ASA221:30 published by the American Gas Association. Pressure test the gas supply piping before connecting furnace using pipe cap or high pressure gas cock. A ground joint union is provided for burner rack removal. Install manual gas cock and provide ground joint union for ease of installation.

The gas input to the duct furnace can be obtained by reading the gas meter supplying the unit. Make certain that no other appliance is being served through the meter; if so, shut them off. Then determine flow through gas meter for a one minute interval. Input to unit can be determined from the following formula:

> 60 X gas flow for one minute (in cubic feet) X heating value of gas (in BTU per cubic foot) = input to unit (BTU/Hr.).

If correct input rating is not attained, orifice size must be corrected or manifold pressure adjusted.

Never overfire the duct furnace. Short life, overheating and cycling will result. Know how much gas you are using and properly set the input.

SIZING GAS SUPPLY LINES

TABLE 1 — Capacity of piping in cubic feet per hour based on 0.3 inches water column and 0.6 specific gravity.

LENGTH OF PIPE	DIAMETER OF PIPE — INCHES					
	½	¾	1	1¼	1½	2
20 Feet	92	190	350	730	1100	2100
30 Feet	73	152	285	590	890	1650
40 Feet	63	130	245	500	760	1450
50 Feet	56	115	215	440	670	1270
60 Feet	50	105	195	400	610	1150
70 Feet	46	96	180	370	560	1050
90 Feet	40	84	160	320	490	930
100 Feet	38	79	150	305	460	870
125 Feet	34	72	130	275	410	780

TABLE 2 — Conversion table to be used when gases of specific gravity are other than 0.60.

S.G.*	M.**	S.G.*	M.**	S.G.*	M.**	S.G.*	M.**
.35	1.31	.65	.960	1.00	.780	1.60	.610
.40	1.23	.70	.930	1.10	.740	1.70	.590
.45	1.16	.75	.900	1.20	.710	1.80	.580
.50	1.10	.80	.870	1.30	.680	1.90	.560
.55	1.04	.85	.840	1.40	.660	2.00	.550
.60	1.00	.90	.820	1.50	.630	2.10	.540

***Specific Gravity** ****Multiplier**

EXAMPLE: (1) Input of unit: 175,000 BTU/Hr. **(2)** Length of pipe needed: 30 feet. **(3)** If gas is 1.60 specific gravity propane with a heating value of 2,500 BTU/Hr.

$$\text{Then: } \frac{175{,}000 \text{ BTU/Hr.}}{2{,}500 \text{ BTU/Hr.}} = 70 \text{ Cu. Ft./Hr.}$$

(From Table 2) 1.60 specific gravity has a multiplier of 0.610. Multiply 70 by 0.610 or 42.76 (43) cu. ft./hr. Referring to Table 1, a ½″ pipe at a flow rate of 73 cubic feet per hour.

Gas Leak Test

Pipe joint compound resistant to the action of liquified petroleum gases should be applied to all pipe connections. After all connections are made, disconnect the pilot supply, at pilot cock, and bleed system of all air. Reconnect pilot line and pressure test all supply lines. Use soap solution for leak detection. Never use an open flame for leak testing.

Caution: All safety and operating controls have been checked during the factory test period; however, it is advisable to complete a similar check when first operating the unit. BEFORE ATTEMPTING ANY SERVICE WORK, MAKE SURE ALL ELECTRICAL SWITCHES AND MANUAL VALVES ARE CLOSED.

Duct Furnace

To provide adequate gas pressure at furnace, refer to Table 1 and 2 for correct sizing of gas supply line. The unit is equipped for a maximum gas supply pressure of ½ pound, or 8 ounces, and requires a minimum of 3 ounces supply pressure. Higher supply pressure requires an additional service regulator to reduce to the ½ pound maximum.

Remove ⅛″ pipe plug from furnace manifold and connect to a manometer to measure the gas pressure with unit in operation. Turn gas pressure regulator adjusting screw IN (clockwise) to increase pressure and OUT (counter clockwise) to decrease pressure. A manifold pressure of less than 2.5″ is not recommended.

Electronic Proven Pilot System

This solid state ignition control lights a pilot burner by spark. Pilot gas is ignited and burns during each running cycle (intermittent pilot). Main burner and pilot gas are extinguished during the "off" cycle. Applicable to all gas burning equipment using a proven pilot. (See figure 1)

Operation

The sensing circuit is continuously monitored and when the thermostat calls for heat, if no defects have occured, the electric spark and pilot valve are automatically energized to produce a pilot flame on each operating cycle. The sensing probe proves the presence of the pilot flame; internal switch action de-energizes the spark gap and energizes the main burner electric valve. The main gas ignites and the heating cycle is in normal operation. When the thermostat is satisfied the main burner valve and the pilot valve are de-energized. (See figure 2)

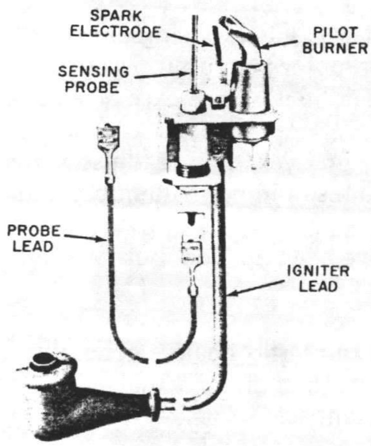


Figure 1 — Type J999EKW pilot burner with integral spark electrode.

NORMAL OPERATING SEQUENCE

- Sensing circuit is continuously monitored.
  - Thermostat calls for heat.
    - If no failure exists, power is provided to relay Q through R_3, Q_1 closes.
      Pilot valve opens.
      Spark gap is energized and ignites pilot gas.
      - Relay R is energized, R_1 and R_3 open, de-energized spark gap, R_2 closes arming main valve circuit, relay Q remains energized.

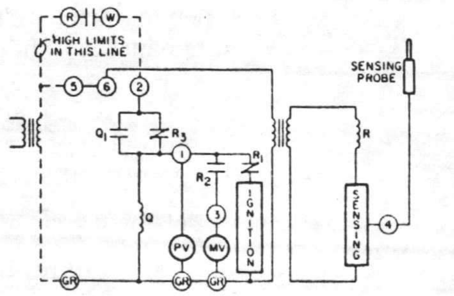


Figure 2

Start-Up – Power Modulating Burners

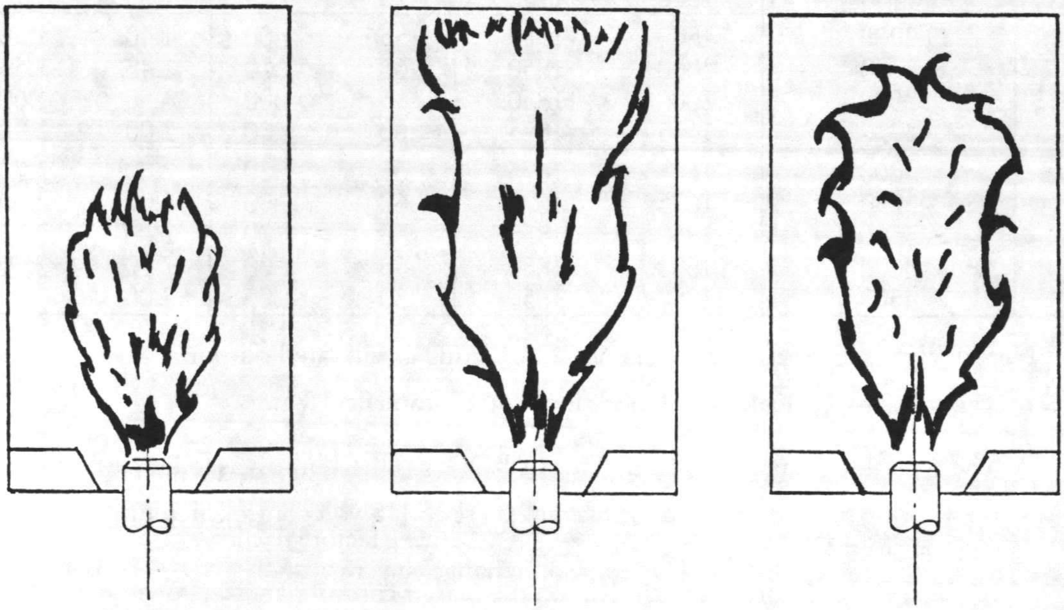
All safety and operating controls have been checked during the factory test period; however, it is advisable to complete a similar check when first operating the unit. Before attempting any service work, make sure all electrical switches and manual valves are closed.

A. PROCEDURE

1. Remove any shipping blocks from:
   a. Gas pressure switch(s) (if required) may have shipping screws. Remove screws if supplied.
   b. Unit programming controller may be shipped with a paper shipping block. Remove programmer cover and remove paper shipping block – reinstall cover and adjust manual reset.
2. The high limit should be set for 200° F. The fan control should be set at 120° F on high and 90° F on low. Note that fan operation is intermittent.
3. Combustion air and exhaust air proving switches are factory set for 0.2″ to 0.4″ W.C.
4. Open pilot gas cock and purge air from gas line through plugged tee in pilot line. Do not depend on sensing the odor of gas to determine if the gas line is purged.
5. Push reset button on unit programming controller.
6. Close main disconnect switch.
7. The On-Off burner switch on the master control panel will operate the fans.
8. All three phase motors were properly phased during factory testing. If rotation is reversed, interrupt main power supply and interchange any two of the incoming power leads. Reestablish power and recheck fan operation.
9. On three phase units, the starter contacts should pull in and hold quietly without "clatter." If they do not operate quietly, check immediately for proper line voltage. Even temporary low voltage at start-up will cause constant operating trouble and must be corrected before the Counterflo heater is placed in service.
10. Recheck all set screws on motor sheave and fan sheave. Check alignment of belt(s) and pulley(s). Run blower for a few minutes and adjust motor take-up if necessary. Motor is mounted on an adjustable base. Do not over-tighten belt(s) since excessive tension will reduce belt life and cause excessive load on bearings. After initial start, allow the belts a few days' running time to become seated in pulley grooves, then readjust as necessary. Do not roll belts over grooves or sheaves as this will result in permanent belt damage.
11. Open manual hand valves. After manual valves have been opened, burner should ignite automatically if thermostat is in control circuit.
12. The burner assembly for either gas or oil fired Counterflo heaters generally requires readjustment of the flame test settings for proper operation under actual field conditions. The most accurate guides to proper burner adjustment are:
    a. Flame travel within the combustion chamber.
    b. Temperature and CO_2 content of the flue gasses.
    c. Proper action of the flame sensor.

Warning: Never stand within the swing radius of the access door when making flame observations through the peephole.

Proper flame travel within the stainless steel combustion chamber differs from the pattern usually desired for a refractory lined furnace. Never adjust the burner to produce a short "bushy" flame concentrated in the front end of chamber as shown in Figure 1A. Such a flame concentrates heat release in the front end of the chamber and creates a short circuit between the burner and economizer tube section which results in high stack temperature. Figure 1B illustrates a flame that is much too long and will cause over-heating of the rear wall. A correct flame should be fairly vigorous, free of smoky haze, and should barely impinge on the rear wall of the chamber. Figure 1C illustrates proper flame travel. This long steady flame provides adequate time for complete combustion and balanced heat release to all surfaces of the chamber. Typical draft conditions noted in Figure 2 for firing at full rate capacity. Adjust to field conditions when necessary.



A. Flame Too Short **B. Flame Too Long** **C. Proper Flame**

Figure 1 — Flame Patterns

13. Burner Start-Up

a. Gas Systems:

Open the air louver on the air inlet to approximately the one-half open position. Open the manual gas valve slowly, burner will ignite. Open valve until gas pressure on the gauge is approximately 4 ounces. Observe flame conditions. If gas flame has yellow or yellow tip appearance, open combustion air louver wider until flame appears short and hard.

Adjust gas pressure regulator to hold 4 ounces gas pressure on burner while firing with the manual gas cock in the wide open position. Read gas meter serving burner, input should be approximately that stated on the burner nameplate. If not, readjust regulator to obtain rates input. **Note:** Check to see if other appliances are on before reading meter.

When the gas input rate is established, air adjustments may be made. The final air setting should produce a flue gas analysis of between 8½% and 9½% CO_2 without CO. Your local gas utility may aid you in making burner adjustments if you do not have the proper instruments.

Start and stop burner several times to insure proper operation. Check for proper functioning of high limit and operating control. Burner is now ready for normal operation.

COUNTERFLO MODEL #	FULL RATED MBH OUTPUT	EXHAUSTER RPM		CHAMBER PRESSURE (Neg. "W.C.)		BREECHING PRESSURE (Pos. "W.C.)	
		GAS	OIL	GAS	OIL	GAS	OIL
40	400	1400	1400	.05	.07	.055	.033
55	550	1500	1500	.05	.33	.38	.71
60	600	1300	1300	.25	.70	.60	.90
85	850	2030	2030	.15	.60	.50	.80
100	1000	1500	1500	.20	.55	.75	1.00
125	1250	1900	2000	.45	.70	.90	1.10
150	1500	1700	1550	.50	.40	1.10	1.10
175	1750	1800	1750	.70	.55	1.25	1.10
200	2000	1800	1750	.55	1.00	1.40	1.50
225	2250	2000	1850	.60	1.00	1.48	1.55
250	2500	2000	1850	.65	1.00	1.50	1.60
275	2750	1635	1675	.60	1.00	2.00	2.90
300	3000	1635	1675	.65	1.30	2.00	2.70
325	3250	1635	1675	.60	1.00	2.00	2.80
350	3500	1850	1850	.50	1.00	2.00	2.90
400	4000	1850	1850	.50	1.00	2.00	2.70
450	4500	1850	1850	.30	1.00	2.00	2.80

Note: Valves shown are those obtained when firing at full rated output.

Figure 2 — Typical Draft Conditions for Counterflo Heaters

14. The typical sequence of operation for ON-OFF gas fired unit is as follows:

    a. Closing fused disconnect switch will energize 115 volt control circuit through control transformer.

    b. The On-Off burner switch (XB) on the master control panel will operate the blower. Unit burner operation is controlled by the On-Off thermostat (RT). Blower motor (M1) will operate through blower motor starter (1M) if starter overloads are all operational and bonnet temperature is above bonnet fan switch set point. The bonnet fan switch will remain in the electrical circuit after burner shutdown until blower has cooled heat exchanger to a temperature below the setpoint of the control.

    c. After continuous flame has been established, ignition transformer and pilot valve drop out of circuit.

    d. If safety shutdown should occur upon failure to ignite pilot, failure to light the main burner flame, or loss of flame while main burner is firing, the internal lockout switch will trip and lockout the protectorelay.

Maintenance Schedule and Lubrication Requirements

A. MAINTENANCE SCHEDULE

Weekly

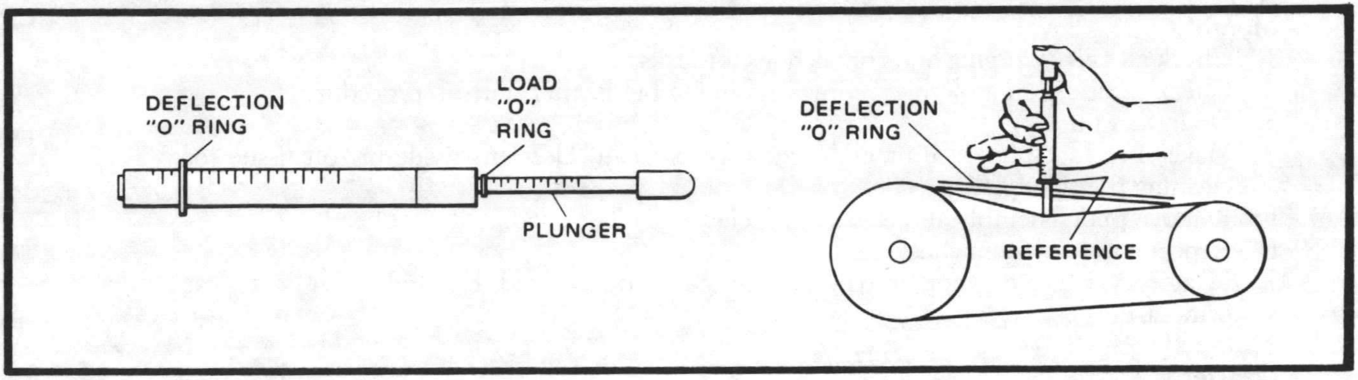
1. Check that fan belts are tight and sheaves are lined up.
2. Turn cleaning handle of fuel oil filter.
3. Inspect oil pump and burner for oil leakage.
4. Remove burner drawer assembly, inspect nozzle and electrode tips, and remove any carbon deposits.
5. Check fuel oil supply.
6. Check gas pressure at burner.

Monthly
1. Check all valves, piping and connections for leaks.
2. Check combustion air louver settings as outlined in burner start-up procedures.
3. Drain fuel filter.
4. Make sure that photocell or UV sight glass is clean. Use lens tissue or soft tissue for cleaning the sight glass.
5. Remove pilot assembly and check spark electrode, flame rod, and pilot head.
6. Repeat control system check-out.
7. If coke oven gas or another type of dirty gas is being used, clean all valve seats, gas orifices, etc.

Quarterly
1. Check limit control to insure operation.
2. Check stack condition and stack connection, supports and draft.
3. Lubricate exhaust pillow block ball bearing units with a good grade of ball bearing grease.

Preventative Maintenance

ITEM	DESCRIPTION	SUGGESTED SCHEDULE		
		Monthly	Semi-Annually	Annually
1.	Clean filters or replace (more often if necessary)	X		
2.	Check belts – adjust or replace	X		
3.	Check for possible stoppage of condensate drain line	X		
4.	Check for obstructed or dirty condenser coils	X		
5.	Check for shortage of R-22	X		
6.	Check compressor crankcase heaters	X		
7.	Check operation of all controls	X		
8.	Check all starter and contacts		X	
9.	Grease all bearings (see lubrication sections, motors, and bearings)		X	
10.	Clean condenser coils			X



Belt Tensioning Gauge

Troubleshooting Air Side

An air moving system consists of the entire air circuitry through which air flows. Included in the system are such components as duct work, fittings, branch ducts, dampers, heat exchangers, filters, coils, elbows, registers, grilles, and other items through which air flows or which offer obstruction to air flow.

While differences in temperature and humidity may cause air movement, it may be considered very slight in comparison to the positive circulation required in an air conditioning system. To accomplish this air movement, a fan has two functions to perform.

1. To produce sufficient pressure or head to accelerate the mass of air from a state of rest to the required velocity, and
2. To produce sufficient pressure to overcome any resistances to the flow of air

The determination of these pressures is a very important part of troubleshooting an air conditioning system. The generally accepted standard instrument for measuring these unit pressures is the Pitot Tube (see Figure 1). The Pitot Tube is used in conjunction with an Inclined Manometer, Magnehelic Gauge, or a Tube Manometer.

When the Pitot Tube is used in conjunction with these instruments, one is able to read velocity pressure (Vp), static pressure (Sp), and total pressure (Tp) within the system.

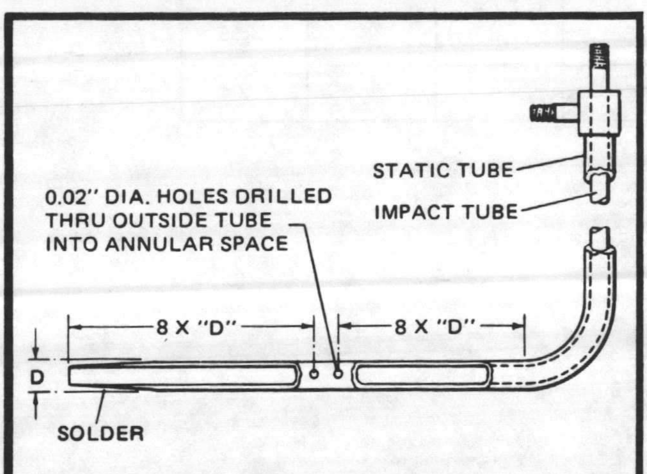


Figure 1 — Construction of Pitot Tube

Pitot Tube

The pitot consists of an impact tube within a larger static tube. When the impact tube is pointed directly into the air stream, the small static pressure holes are perpendicular to the air stream and are not affected by air velocity.

To read velocity pressure, the total pressure tap at the end of the pitot tube is connected to one leg of a manometer and the static pressure tap at the side of the pitot tube is connected to the other leg of the manometer. Refer to Figure 2.

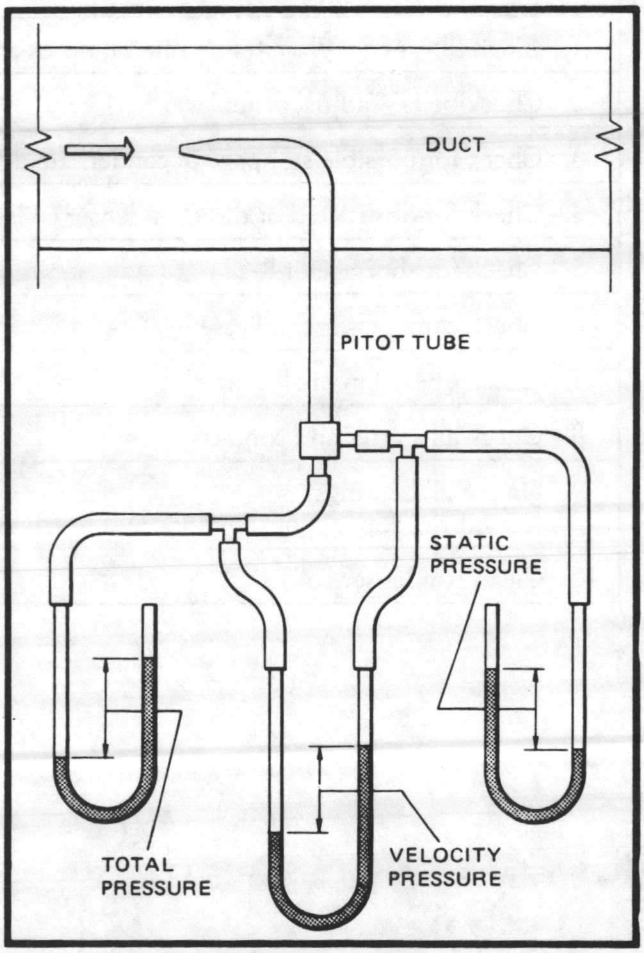


Figure 2 — Pitot Tube Connections

Inclined Manometer

This instrument, also known as a draft gauge, is a simple, foolproof device, which responds directly to the air pressure exerted against it (transmitted from the Pitot tube), and reads directly in inches of water. Ranges for these instruments vary, and the technician should have one or more instruments to cover the range of 0 to 8 inches of water. Refer to Figure 3.

Magnahelic Pressure Gauge

"Magnahelic" is not a generic term but is registered by Dwyer Instrument Company. The magnahelic gauge is a diaphragm-operated gauge that has several advantages over a liquid manometer; (1) It need not be leveled to 0 and can be used easily on a ladder or unlevel surface. (2) When hooked up to the Pitot tube it need not be purged of air bubbles as the liquid manometer may. (3) There is less chance of parallax error in reading the dial face. (4) It is easily transported without the chance of losing the liquid charge. Unless extreme accuracy is required, this instrument may replace the manometer for average air conditioning work, and like the manometer, is available in a variety of ranges. The dial is only 4 inches in diameter and therefore has a limited scale; several instruments are required to cover the normal ranges encountered in average air conditioning jobs. Refer to Figure 4.

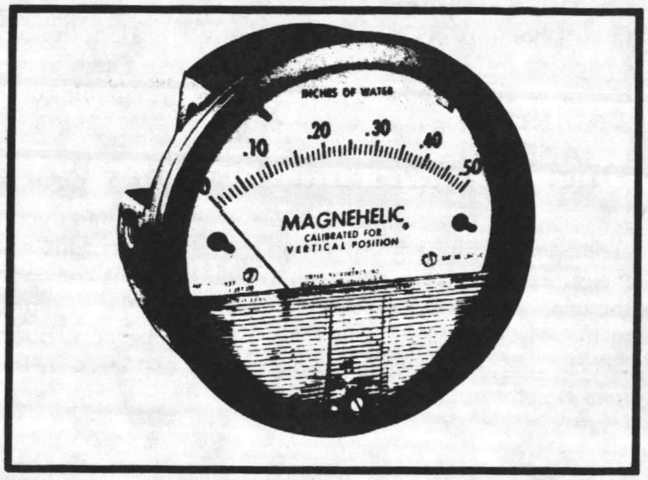


Figure 4 — Magnahelic Pressure Gauge

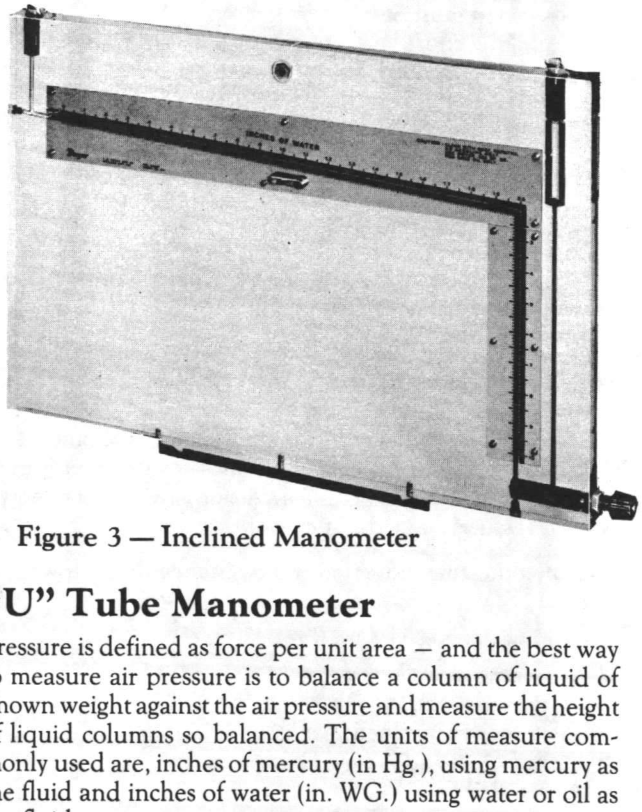


Figure 3 — Inclined Manometer

"U" Tube Manometer

Pressure is defined as force per unit area – and the best way to measure air pressure is to balance a column of liquid of known weight against the air pressure and measure the height of liquid columns so balanced. The units of measure commonly used are, inches of mercury (in Hg.), using mercury as the fluid and inches of water (in. WG.) using water or oil as the fluid.

Instruments employing this principle are called manometers. The simplest form is the basic well known U-tube manometers (see Figure 5). This device indicates the difference between two pressures or between a single pressure and atmosphere, when one side is open to atmosphere.

If a U-tube is filled to the half way point with water and air pressure exerted on one of the columns, the fluid will be displaced. Thus one leg of water column will rise and the other falls. The difference in height "h" which is the sum of the readings above and below the half way point, indicates the pressure in inches of water column.

The U-tube manometer is a primary standard because the difference in height between the two columns is always a true indication of the pressure regardless of variations in the internal diameter of the tubing.

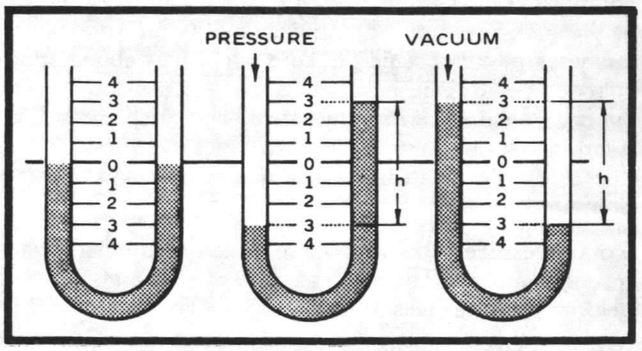


Figure 5 — "U" Tube Manometers

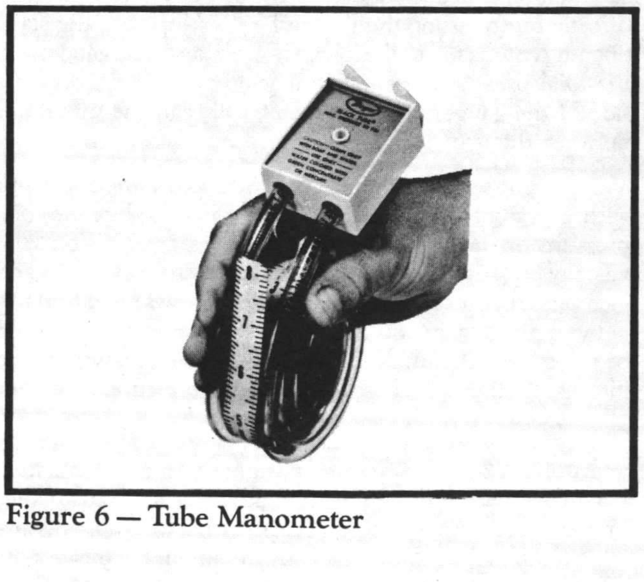


Figure 6 — Tube Manometer

The Dwyer Slack Tube Manometers are as accurate as the finest laboratory "U" gauges and they are made to roll up compactly for easy carrying and to withstand rough usage. For use on all Governair units the manometers should cover at least a 16 inch range. See Figure 6.

Duct Pressures and How They Work

Velocity – When air moves at a given velocity in a duct it creates a pressure corresponding to the velocity; this is a measure of the kinetic energy in the fluid and it is known as the *velocity pressure* (Vp). Velocity pressure is always exerted in the direction of air flow. The relationship between the velocity and the velocity pressure may be expressed by the following formulas:

$$Vp = \frac{V}{4005}^{\;2}$$

$$V = 4005 \quad Vp$$

It is therefore a simple matter to determine the velocity (fpm) of an airstream if the Vp can be measured. For example, if a Pitot tube manometer hook-up reads 0.250 in. water, we substitute for the above equation:

$$4005 \quad 0.250 \quad = 2002 \text{ fpm}$$

Static Pressure – Independent of its velocity, air, when confined within an enclosure such as a duct or tank, will exert itself perpendicularly to the walls of the enclosure. This is the compressive pressure existing in a fluid, and it is known as the static pressure (Sp). Unlike velocity pressure) which is always positive, static pressure when it is above atmospheric pressure will be positive, but when below atomospheric pressure it will be negative. The discharge side of a fan in a supply system will read a positive pressure, the inlet side of the fan in an exhaust system will read a negative or minus pressure.

Total Pressure – Static pressure is exerted whether air is at rest or in motion. The algebraic sum of static pressure and velocity pressure gives the *total pressure* (Tp). Therefore:

$$Vp = Tp - Sp$$

The manometer does not sense the actual velocity pressure directly but by using the Pitot tube hook-up with the static opening connected to the low pressure side of the gauge, and the total pressure opening connected to the high pressure side of the gauge, the manometer will read the difference between the two, or the *velocity pressure.*

Velocity pressure and static pressure change in the duct work with every change in the duct configuration, but the total pressure, on the other hand, remains constant. Hence, as the velocity pressures decreases, the static pressure increases and vice versa, because the static pressure is always the difference between the total pressure and the velocity pressure. It should be remembered, however, that in an actual duct system, the internal friction will cause a loss of total pressure.

The static pressure in an exhaust system is always below atmospheric pressure, and it is customary among ventilation engineers to omit the minus sign affecting the static (gauge pressure). These men know, of course, that the total pressure is higher than the static pressure by the amount of the velocity pressure.

When the unit is designed for connection to a duct system and the installing contractor assembles ducts, elbows, registers, grilles, etc. to the outlet and/or inlet of the unit, the static pressure drop through this external duct work is called external static pressure. See Figure 7.

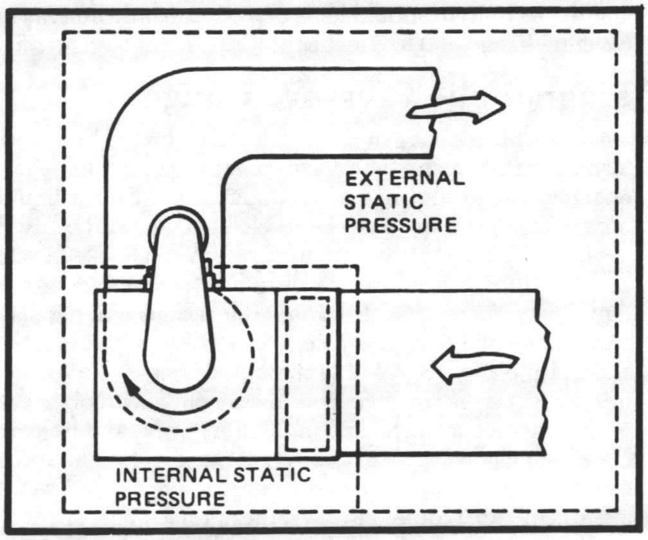


Figure 7 — Air Moving System

Fans selected must be capable of moving the desired air flow through the entire air moving system including the unit (internal SP) and also the duct system (external SP).

At a given flow rate the internal static pressure losses plus the external static pressure losses equal the system static pressure or the summation static pressure. These pressures are of great importance when troubleshooting for causes of reduced capacity, vibration, and noise.

Changes in the cross sectional area of duct (contractions or enlargements) cause changes in the velocity of the air flowing through the duct.

When the velocity decreases, the velocity pressure also decreases. Some of the velocity energy is lost as a result of the design of the duct where the area changes. Some of the velocity energy is converted into static pressure energy in the continuing duct work. This conversion of velocity energy to static pressure is called static regain.

When contacting Governair for assistance the following information will be required:

1. Unit Model No.
2. Job Name (Not Contractor)
3. Unit Model No.
4. Customer's Unit Identification
5. Design Data and Actual Data.
   A. Fan RPM
   B. Unit SP (Across Fan)
   C. Unit CFM
   D. Pressure Drop of Water Across Cooling Coil – (PSIG)
   E. Air Pressure Drop Across Coil – (In. of Water)
   F. Temperature Differential Across Cooling Coil (°F)
   G. Voltage
   H. Amperes
6. For Fan or Motor RPM (Use a Tachometer, Stroboscope or Revolution Counter).

7. The Voltage and Amperes can be obtained by using a separate meter or a clamp-on type AMP meter.
8. A sketch of the Duct Configuration would assist us in trying to resolve the problem.
9. The most important item is to provide a detailed explanation of the problem.
10. Most of us recognize that an orifice is the best method of measuring flow in piping. This is also true in an air system and is the reason for reading step 5D.

For further assistance in troubeshooting the air unit refer to the troubleshooting chart which follows:

TROUBLESHOOTING CHART

SYMPTOM		SOURCE	PROBABLE CAUSE
	1.	IMPELLER HITTING INLET RING	Impeller not centered (check shaft clamp.) Inlet ring damaged or not adjusted. Shaft loose in bearing (check locking Collar.) Impeller loose on shaft (check shaft clamp.) Bearing loose in bearing support (check mounting bolts.)
	2.	DRIVE	Sheave not tight on shaft (motor or fan.) Belts hitting belt guard. Belts loose. Adjust after 48 hours operation. Belts too tight. Belts wrong cross section. Belts not "matched" in length on multi-belt drive. Variable pitch sheaves not adjusted so each groove has same pitch diameter (multi-belt drives.) Misaligned sheaves. Belts worn. Motor, motor base or fan not securely anchored. Belts oily or dirty.
	3.	BEARING	Defective bearing. Needs lubrication. Loose on bearing support. Loose on shaft (check locking collar.) Misaligned (check alignment binding.) Foreign material inside bearing. Worn bearing. Fretting corrosion between inner race and shaft.
NOISE	4.	Loose on shaft (check shaft clamp.)	Defective impeller. Do not run fan. Contact manufacturer. Unbalance. Foreign material on fan blades.
	5.	HOUSING	Foreign material in housing. Inlet cones loose or not adjusted.
	6.	ELECTRICAL	Lead-in cable not secure or is too rigid. AC hum in motor or relay. Starting relay chatter. Motor bearings. Single phasing a 3-phase motor.
	7.	SHAFT	Bent. Undersized. May cause noise at impeller, bearings or sheave. Loose internal balance weights. Bearing alignment.
	8.	HIGH AIR VELOCITY	Duct work too small. Fan running too fast. Fan selection too small. Static pressure lower than expected. Registers and grilles too small. Insufficient fade area of heating or cooling coil.
	9.	OBSTRUCTION IN HIGH VELOCITY AIR STREAM MAY CAUSE RATTLE, OR PURE TONE WHISTLE	Dampers. Registers. Loose dampers or splitters. Grilles. Sharp elbows. Sudden expansion of duct work. Sudden contraction of duct work. Turning vanes.

SYMPTOM		SOURCE	PROBABLE CAUSE
NOISE	10.	PULSATION OR SURGE	Oversized duct work. Parallel fan operation. Loose dampers or splitters. System instability. Ducts vibrate at same frequency as fan pulsations. Organ pipe action on long duct.
	11.	HIGH VELOCITY THROUGH CRACKS, HOLES OR PAST OBSTRUCTIONS	Leaks in duct work. Registers or grilles.
	12.	RATTLES AND/OR RUMBLES	Excessive duct velocities. Vibrating ductwork. Flex connector too tight or touching. Vibrating parts not isolated from building.
CFM — LOW	13.	FAN	Forward curve impeller installed backwards. Fan running backwards. Impeller not centered with inlet cones. Fan speed too slow.
	14.	DUCT SYSTEM	Actual system is more restrictive (more resistance to flow) than expected. Dampers closed. Splitter rod disconnected. Registers closed. Leaks in supply ducts. Open duct seams. Insulating duct liner loose. Fire dampers closed.
	15.	FILTERS	Dirty or clogged (dirt, lint, snow, grass.)
	16.	COILS	Dirty or clogged (construction trash.)
	17.	RECIRCULATION	Internal cabinet leaks in bulkhead separating fan outlet (pressure zone) from fan inlets (suction zone.) Leaks around fan outlet at connection through cabinet bulkhead.
	18.	OBSTRUCTED FAN INLETS	Elbows, cabinet walls or other obstructions restrict air flow. Inlet obstructions cause restrictive systems but do not cause increased negative pressure readings near the fan inlet(s). Fan speed may be increased to counteract the effect of restricted fan inlet(s). (Observe fan RPM limits).
	19.	NO STRAIGHT DUCT AT FAN OUTLET	Fans which are normally used in duct systems are tested with a length of straight duct at the fan outlet. If there is no straight duct at the fan outlet, decreased performance will result. If it is not practical to install a straight section of duct at the fan outlet the fan speed may be increased to overcome this pressure loss. Observe fan RPM limits.
	20.	OBSTRUCTIONS IN HIGH VELOCITY AIR STREAM	Obstruction near fan outlet. Sharp elbows near fan outlet. Improperty designed or no turning vanes.
CFM — HIGH	21.	SYSTEM	Oversized duct work. Access door open. System not balanced. Resistance less than specified. Registers or grilles not installed. Dampers set to by-pass coils. Filter(s) not in place.
	22.	FAN	Backward inclined impeller installed backwards (HP will be high.) Variable motor sheave not adjusted. Fanspeed too fast.
STATIC PRESSURE INCORRECT	23.	SYSTEM FAN OR INTERPRETATION OF MEASUREMENTS	GENERAL DISCUSSION The velocity at any point of measurement is a function of the velocity of the air and its density. The static pressure at a point of measurement in the system is a function of system design (resistance to flow), air density and the amount of air flowing through the system. The static pressure measured in a "loose" or oversized system will be less than the static pressure in a "tight" or undersized system for the same airflow rate. In most systems, pressure measurements are indicators of how the installation is operating. These measurements are the result of air flow and as such are useful indicators in defining system characteristics.

REFER TO THE TROUBLESHOOTING SECTION FOR THE PROPER METHODS OF OBTAINING CORRECT READINGS

SYMPTOM		SOURCE	PROBABLE CAUSE
STATIC PRESSURE LOW CFM HIGH	24.	SYSTEM	System has less resistance to flow than expected. This is a common occurrence. Fan speed may be reduced to obtain desired flow rate. This will reduce HP, conserve energy, and save operating costs.
	25.	AIR DENSITY	Pressures will be less with high temperature air or at high altitudes.
	26.	FAN	Backward inclined impeller installed backwards, HP will be high. System resistance less than specified. Fan speed too high.
STATIC PRESSURE LOW, CFM LOW	27.	SYSTEM	Fan inlet and/or outlet conditions not same as tested. See general discussion (23). Also see 13 thru 20.
STATIC PRESSURE HIGH, CFM LOW	28.	SYSTEM	Obstruction in system. Dirty Filters. Dirty coil. Closed fire damper. System too restricted. Also see 13 through 20.

SYMPTOM	SOURCE	PROBABLE CAUSE

SYMPTOM	SOURCE	PROBABLE CAUSE

Motor Trouble Shooting Guide

Apparent Trouble	Possible Causes	Correction
High Current Draw	First check accuracy of ammeter reading on all three phases	
Running Idle	High Line Voltage 5 to 10% over nameplate. Smaller motors (140-213 frames) may increase current at a faster rate.	Consult power company — possibly reduce by using lower transformer tap.
Running Under Load	Motor Overloaded	Reduce load or use larger motor
	High Line Voltage 5 to 10% over motor nameplate voltage on small motors (140-213 frames only)	Consult power company — possibly reduce by using lower transformer tap.
	200 volt motor on 230 or 240 volt system	Change to 230 volt motor.
	Low Line Voltage 5 to 10% lower than nameplate voltage on any size	Consult power company — possibly increase by using high transformer tap.
	230 volt motor on 208 volt system	Change to 200 volt motor.
Unbalanced Current Draw (5% or more of the average current draw)	Unbalanced Line Voltage due to: a. Power Supply b. Unbalanced System Loading c. High Resistance Connection d. Undersized Supply Lines	Carefully check voltage across each phase **at the motor terminals** with a good, properly calibrated voltmeter. If the voltage per phase is more than 1% out of balance, the current will be out of balance by an even greater percentage. If there is doubt as to whether the trouble lies with the power supply or the motor, check per the following:

Trouble Shooting Guide — Motors, continued

APPARENT TROUBLE	POSSIBLE CAUSE	CORRECTION
	Defective Motor	Rotate **all three input power lines** to the motor by one position — i.e., move line #1 to #2 motor lead, line #2 to #3 motor lead and line #3 to #1 motor lead. a. If the unbalanced current draw pattern follows the **input power lines,** the problem is in the power supply. b. If the unbalanced current draw pattern follows the **motor leads,** the problem is in the motor. Correct the voltage balance of the power supply or replace the motor, depending on answer to a. & b. above.
Excessive Voltage Drop (more than 2 or 3% of nominal supply voltage)	Excessive Starting or Running Load	Reduce load or install larger motor.
	Inadequate Power Supply	Consult power company
	Undersized Supply Lines	Increase Line sizes
	High Resistance Connections	Check motor leads and eliminate poor connections
Overload Relays Tripping		
Upon Starting	Slow Starting (10 - 15 seconds or more) due to High Inertia Load	Reduce starting load. Increase motor size if necessary.
	Low voltage at motor terminals	Improve power supply and/or increase line size.
Under Load	Overload	Reduce load or increase motor size.
	Unbalanced Current Draw	Balance supply voltage.
	Single Phasing	Eliminate.
	Excessive Voltage Drop	Eliminate.
	Too frequent starting or intermittent overloading	Reduce frequency of starts and overloading or increase motor size.
	High Ambient Starter Temperatures	Reduce.
	Wrong Size Relays	Correct size per nameplate amperes of motor. Relays have built in allowance for service factor ampere draw.
Motor Runs Excessively Hot	Overloaded	Reduce load or load peaks and number of starts in cycle or increase motor size.
	Blocked Ventilation a. TEFC's	Clean External ventilation system — check fan.
	b. O.D.P.'s	Blow out internal ventilation passages. Eliminate external interference to motor ventilation.
	High Ambient Temperature over 40° or 105° F	Reduce ambient temperature or provide outside source of cooler air.
	Unbalanced Current Draw	Balance supply voltage. Check motor leads for tightness.
	Single Phased	Eliminate.
Won't Start (just hums and heats up)	Single Phased	Shut power off. Eliminate single phasing. Check motor leads for tightness.
	Rotor or bearings locked	Shut power off. Check shaft for freeness of rotation. Be sure proper sized overload relays are in **each of the 3 phases** of starter
Runs Noisy Under Load (excessive electrical noise or chatter under load)	Single Phased	Shut power off. If motor cannot be restarted, it is single phased. Eliminate single phasing. Be sure proper sized overload relays are in **each of the 3 phases** of the starter.

APPARENT TROUBLE	POSSIBLE CAUSE	CORRECTION
Slow Starting (10 or more seconds on small motors - 15 or more seconds on large motors)		
Across the Line Start	Excessive Voltage Drop (5 - 10% voltage drop causes 10 - 20% or more drop in starting torque)	Consult power company — Check system. Eliminate voltage drop.
	High Inertia Load	Reduce starting load or increase motor size.
Reduced Voltage Start	Excessive Voltage Drop. Loss of Starting Torque.	Check and eliminate per above.
Y-Delta	Starting Torque Reduced to 1/3	Reduce starting load or increase motor size, or
PWS	Starting Torque Reduced to 1/2	Choose type of starter with higher starting torque, or
Auto. Transformer	Starting Torque Reduced to 1/4 to 5/8	Reduce time delay between 1st and 2nd step of starter — get motor across the line sooner.
Load Speed Appreciably Below Nameplate Speed	Overload	Reduce load or increase voltage.
	Excessively Low Voltage	NOTE: A reasonable overload or voltage drop of 10 - 15% will reduce speed only 1-2% A report of any greater drop would be questionable.
	Wrong Nameplate	If speed is off appreciably, i.e., from 1800 to 1200 RPM, check Lincoln code stamp on stator with nameplate. If codes do not agree, replace with motor of proper speed.
	Inaccurate method of measuring RPM.	Check meter using another device or method.
Excessive Vibration (mechanical)	Out of Balance a. Motor Mounting	Be sure motor mounting is tight and solid.
	b. Load	Disconnect belt or coupling — restart motor — if vibration stops, the unbalance was in load.
	c. Sheaves or Coupling	Remove sheave or coupling — tape 1/2 key in shaft keyway and restart motor — if vibration stops, the unbalance was in the sheave or coupling.
	d. Motor	If the vibration does not stop after checking a, b and c above, the unbalance is in the motor — replace the motor.
	e. Misalignment on Close Coupled Application	Check and realign motor to the driven machine.
Noisy Bearings (listen to bearings)		
Smooth Mid Range Hum	Normal fit	Bearing OK
High Whine	Internal fit of bearing too tight	Replace bearing - check fits
Low Runble	Internal fit of bearings too loose	Replace bearing - check fits
Rough Clatter	Bearing Destroyed	Replace bearing — Avoid: a. Mechanical Damage b. Excess Greasing c. Wrong Grease d. Solid Contaminants e. Water running into motor f. Misalignment on close coupled application
Mechanical Noise	Driven Machine or Motor Noise?	Isolate motor from driven machine — check difference in noise level.
	Motor Noise Amplified by resonant mounting	Cushion motor mounting or dampen source of resonance.
	Driven Machine Noise transmitted to motor through drive	Reduce noise of driven machine or dampen transmission to motor.
	Misalignment on close coupled application	Improve alignment.

Trouble Shooting Guide
Cooling Cycle

Complaint	Cause	Correction
A. Cooling will not start	1. Main and/or control fuses open. **Note:** check all lock out devices	1. Replace fuse. **Note:** As per unit wiring diagram
	2. Cool switch in remote panel in off or heat position	2. Reset to on or cooling position
	3. Low ambient outside lockout thermostat	3. Reset thermostat to 55 degrees
	4. Cold deck sensor on multizone unit only	4. Reset. Replace if defective
	5. Room sensor on single zone unit only	5. Reset. Replace if defective
	6. Supply and return blower overload relays. (**Note:** not all units have return air motors)	6. Reset overloads. Check for cause of tripping
	7. Condenser fan overload relays	7. Reset overloads. Check for cause of tripping
	8. Oil safety tripped	8. Reset. **Note:** control circuit being energized prior to installation of compressor fuses will trip oil safety. Check for slipping or broken blower belts and dirty filters
	9. Cooling relay interlock	9. If defective, replace
	10. Low pressure switch will not close	10. Check for refrigerant leak. If leak, repair & recharge with refrigerant. If defective low pressure switch, replace
	11. Compressor "off" on internal overload	11. Allow one (1) hour for compressor to cool before condemning compressor
	12. Overload sensor in compressor defective. **Caution:** use an OHM meter or proper resister when checking sensors or the remaining good sensors will also be damaged (Contact Governair for proper resister)	12. If sensors are open, these may be replaced with a radio type resister. The remaining sensors will still be protection for the compressor. The sensor cannot be replaced
	13. Liquid line solenoid will not open	13. Check holding coil, replace if defective. If complete valve defective, replace valve
B. Compressor runs but little or no cooling	1. Low on refrigerant	1. Locate leak – repair and recharge
	2. Dirty filters	2. Clean and/or replace. **Note:** if cleanable filters, spray with a good grade of filter coating
	3. Loose or broken belts	3. Tighten or replace
	4. Zone damper closed, multizone units only	4. Room thermostats set above room temperature – reset
	5. Zone damper motor loose or broken	5. Tighten or replace
	6. Defective zone damper	6. Replace motor

Trouble Shooting Guide – Cooling Cycle, continued

Complaint	Cause	Correction
B. Compressor runs but little or no cooling (continued)	7. Zone damper motor and room thermostat wiring reversed	7. Correct wiring
	8. Fresh air dampers open above 70 degrees F.	8. Reset thermostat to 70 degrees F.
	9. Fresh air and return air damper linkage loose or broken	9. Readjust or repair
	10. Defective fresh air & return air damper motor holding dampers open above 70 degrees outside ambient	10. Replace damper motor
	11. Low on refrigerant	11. Check for leak – repair and recharge
	12. Weak or damaged valve plates in compressor	12. Replace valve plates
	13. Broken pistons & rods in compressor	13. Replace compressor. **Note:** some compressors have replaceable pistons, rods, and crankshafts
C. Conditioned area too cold	1. Room thermostat set too low	1. Readjust thermostat
	2. Mixed air thermostat set too low if on economizer	2. Reset mixed air stat to 55 degrees Fahrenheit
	3. Zone damper linkage loose or broken – multizone units only	3. Adjust linkage, tighten, and/or repair
D. Compressor will not shut off	1. Room thermostat set too low or defective on single zone units	1. Reset room thermostate or replace
	2. Cold deck thermostat on multizone units set too low or defective	2. Reset cold deck thermostat or replace
	3. Liquid line solenoid and/or hot gas bypass solenoid will not shut off	3. Check for dirt under valve seat. If defective – replace
E. Compressor short cycles	1. Low on refrigerant – cycling on low pressure control	1. Check for leak – repair and recharge
	2. Dirty filters – or broken blower belts	2. Replace filters – tighten or replace belts
	3. Solenoid leaking	3. Check for dirt under valve seat. If defective, replace
	4. Compressor valve plate reeds leaking	4. Replace valve plate
F. Compressor tripping out oil safety	1. Incorrect superheat setting of expansion valve.	1. Adjust superheat. **Note:** see section "Adjusting Superheat"
	2. Defective oil safety switch	2. Replace
	3. Defective oil pump	3. Check oil pressure, oil pressure should be between 10 to 30 lbs. suction pressure. (Copeland Compressor)
	4. Worn compressor bearing resulting in low oil pressure (See section "Checking Oil Pressure")	4. Replace compressor. **Note:** Some type of compressors may have internal parts replaced

Trouble Shooting Guide – Cooling Cycle, continued

Complaint	Cause	Correction
G. Compressor tripping on internal heat overload	1. Short of refrigerant with insufficient cooling of motor windings	1. Check for leak – repair and recharge. Check for high superheat. (See section "Setting Superheat")
	2. Too high of condenser temperature (high head pressure). Possible restricted condenser, broken fan blade or burned out condenser fan motor	2. Lower condensing temperature (head pressure). Replace condenser fan or fan motor.
	3. Defective expansion valve power element causing wide super heat	3. Replace power element. **Note:** When replacing power element, readjust superheat. (See section "Adjusting Superheat")
	4. Low or high line voltage	4. Correct voltage
H. Noisy Compressor	1. Shipping hold-down nuts tight, not permitting compressor to float free on mounting springs	1. Loosen hold-down nuts
	2. Broken valve reeds causing compressor to vibrate	2. Replace valve plates
	3. Broken pistons and rods causing compressor to vibrate or rattle	3. Replace compressor. **Note:** Some compressors have replaceable pistons, rods and crankshafts
	4. Discharge or suction line clamp loose	3. Tighten or replace clamp
I. Off due to high head pressure safety switch	1. Restricted air flow across condenser	1. Remove restriction
	2. Slipping or broken fan belts	2. Tighten or replace belts
	3. Overcharge of refrigerant	3. Correct charge

Heating Cycle

Complaint	Cause	Correction
A. No heat — all types. Also see each type heat for additional causes	1. Open fuse in control circuit	1. Replace fuse. **Note:** as per unit wiring diagram
	2. Outside ambient lockout thermostat set below outside temperature	2. Reset above ambient temperature – replace if defective
	3. Heat switch in remote panel in off or cool position	3. Reset to "on" or heating position
	4. Hot deck thermostat set too low – Multizone units only.	4. Reset to desired temperature. Replace if defective
	5. Space (wall) thermostat keeping hot deck dampers closed – Multizone units only	5. (a) Set above room temperature (b) Check wiring. If wrong, correct (c) If defective, replace
	6. Space (wall) thermostat set too low – single zone units only	6. Set above room temperature, replace if defective
	7. Leaving air thermostat set too low	7. Raise setting – replace if defective
	8. Safety interlocks not made	8. Check safety interlocks

Trouble Shooting Guide – Heating Cycle, continued

Complaint	Cause	Correction
B. No Heat — Gas Duct Furnace	1. Exhaust motor defective	1. Replace
	2. Pilot or main gas cock in closed position	2. Open gas cock
	3. Ignition control defective	3. Replace. Do not attempt to repair
	4. Ignition electrode defective	4. Adjust or replace
	5. Low or High pressure gas safety switch open	5. Check for gas pressure – replace if defective
C. Pilot will not ignite, but ignition sparks	1. (A) No gas pressure (B) Pilot shut off cock in off position (C) Pilot gas solenoid will not open	1. (A) Turn on gas (B) Turn to on position (C) Check for 24 volt power at solenoid coil – replace if defective
D. Pilot lights, but gas valve will not open	1. (A) Thermocouple or flame rod defective (B) Broken wire to valve (C) Defective valve	1. (A) Replace (B) Repair wire (C) Replace valve
E. Burner lights but will not come up to high fire	1. Low gas pressure	1. (A) Let low fire at 1¾″ w.c. (B) Set high fire at 3½″ w.c. (C) If low incoming gas pressure to unit, check with gas company
F. Raw gas smell	1. Gas leak in gas piping	1. Repair leak
G. Sooting of the burner	1. (A) Blockage of combustion air (B) Over firing of burner	1. (A) Remove blockage, also, check exhaust motor (B) Check gas pressure – may be too high
H. No heat electric	1. Manual high limit tripped	1. Reset – check for reason of tripping
	2. Broken heating element	2. Replace
	3. Heat limiters blown	3. Replace
	4. Fuses blown	4. Replace
I. No heat — hot water and steam	1. Defective control motor	1. Replace
	2. Broken control linkage from motor to valve	2. Repair or replace
	3. Defective control valve	3. Replace

Trouble Shooting Guide
Dampers & Damper Actuators

Complaint	Cause	Correction
J. Fresh air and return air dampers will not modulate	1. (A) Outside ambient override thermostat or enthalpy control incorrectly set	1. (A) Reset to correct setting. Replace if defective
	(B) Minimum pot incorrectly set	(B) Reset
	(C) Damper linkage loose or broken	(C) Repair
	(D) Control circuit open	(D) Find open wire – repair
	(E) No power to damper motor	(E) Check power source – replace fuses if blown
	(F) No power to damper motor	(F) Replace
K. Mixed air too warm or too cold	1. (A) Thermostat set incorrectly	1. (A) Set at 55° F. If defective, replace
	(B) Manual potentiometer set incorrectly	(B) Reset for correct minimum fresh air
	(C) Damper linkage	(C) Repair
L. Fresh air and exhaust dampers will not go to closed position when power is off	1. (A) Damper motor linkage loose or broken	1. (A) Repair or adjust
	(B) Damper binding	(B) Relieve location where binding

GOVERNAIR

Manufacturers of Air Conditioning and Refrigeration Equipment

4841 N. Sewell Street • Oklahoma City, Oklahoma 73118 • (405) 525-6546 • Telex 796-268

SER 1002-8185

GOVERNAIR CORPORATION
A Nortek Company

25997

SUBMITTAL DATA

PROJECT: A/C BUILDING AS-205
CAMP LEJEUNE, NC

DATE: 12/11/87

SERIAL NO.: 25997

SOLD TO: HUMPHREY HEATING
& ROOFING, INC.
P.O. BOX 1268
JACKSONVILLE, NC 28540

REF. DWG.: 32636

TAG: AC-1

MODEL NO.: ACU-302

NO. UNITS: 1

AIR COOLED CONDENSERS

DRAWINGS FOR
RECORD ONLY

UNIT CAPACITY:

CAPACITY BALANCED WITH RSA-01 REFERENCE DRAWING NUMBER 32637

27,900 CFM THRU CONDENSER

CONSTRUCTION:

BASE FRAME	- Structural formed steel base,
CABINET - FLOOR	- 14 gauge galvanized steel single wall,
WALLS	- 20 gauge galvanized steel single wall
ROOF	- 20 gauge galvanized steel single wall,
PAINT	- "Landmark Beige" enamel finish inside & out,
ACCESS DOORS	- Single wall construction with hinges,
DOOR LATCHES	- Ventlok 333,

COMPRESSOR SECTION:

COMPRESSOR (1 REQ'D)	- Semi-hermetic model 3DB1-1000, Spring isolated, Suction and discharge line vibrasorbers, 1/2" armaflex suction line insulation,
COMPRESSOR (1 REQ'D)	- Semi-hermetic model 3D51-1500, Spring isolated, Suction and discharge line vibrasorbers, 1/2" armaflex suction line insulation,

CONDENSER SECTION:

CONDENSER COIL:	- 3 row, 1/2" copper tubes, 10 aluminum fins per inch, 35" fin width, 84" fin length, 12 pass with sub-cool circuit, 1 req'd,
CONDENSER COIL	- 3 row, 1/2" copper tubes, 10 aluminum fins per inch, 30" fin width, 66" fin length, 12 pass with sub-cool circuit,
PROP FANS	- 27 1/4" dia,(3 req'd), direct drive, setup 27/2,
MOTORS	- 2 horsepower, 208/3/60 TEFC, 1140 RPM, 56 frame,
LOW AMBIENT OPERATION	- Adjustable to 0 F degrees with flooded condenser head pressure control valves,

REFRIGERANT CIRCUIT (EACH COMPRESSOR):

RECEIVER	- ASME full charge with relief, Inlet and outlet valves,
FILTER DRIER	- Sealed,
SIGHT GLASS	- One per circuit,
SOLENOID VALVE	- Liquid line,

ELECTRICAL REQUIREMENTS:

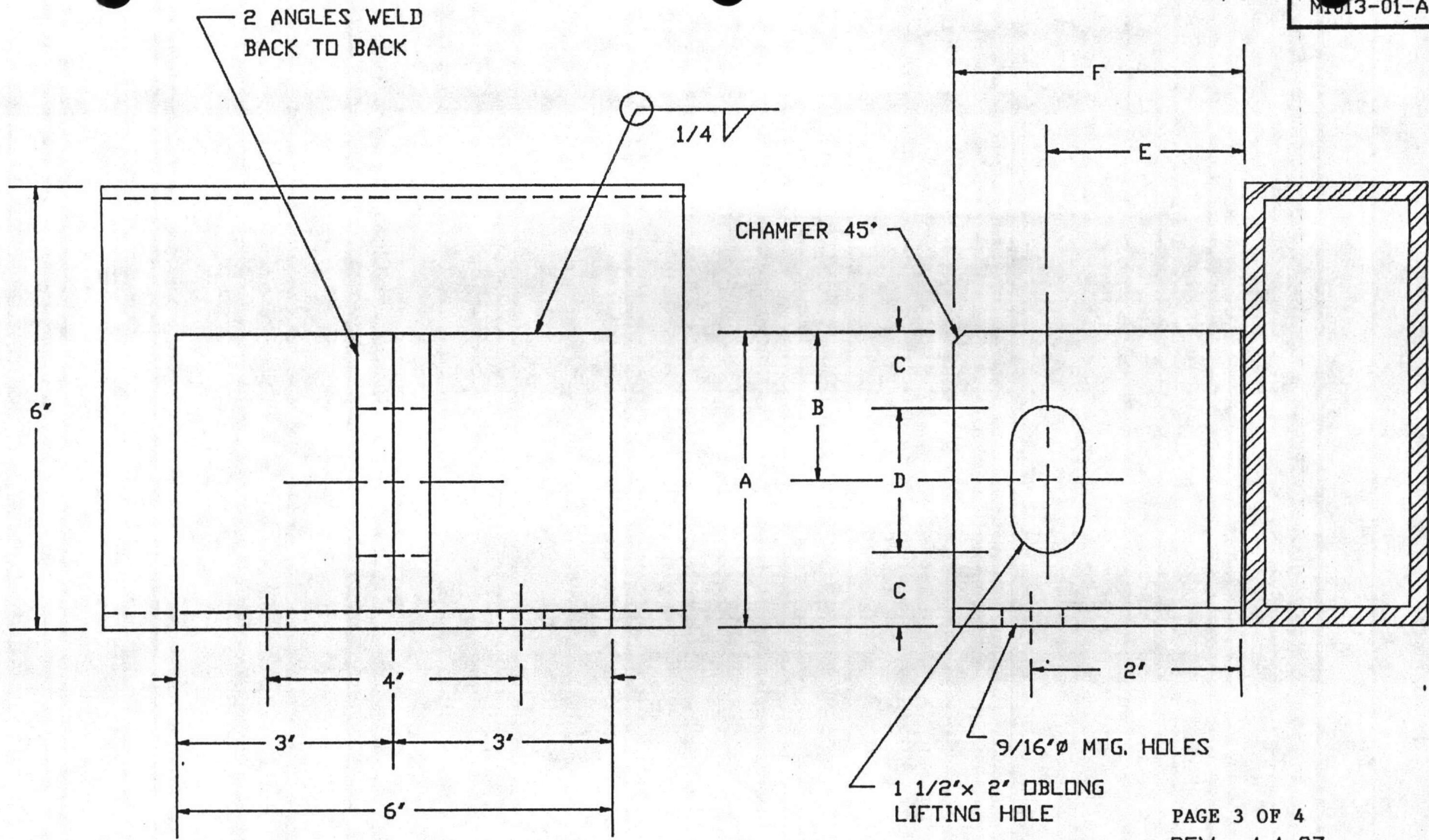
208/3/60 power with 120 volt control,
120 volt transformer furnished and installed,

ELECTRICAL CONTROLS:

See Wiring Diagram WD-32636

*4841 N. Sewell*OKC,OK 73118*(405)525-6546*

M1013-01-A



PAGE 3 OF 4
REV. 4-1-87

BOLT DOWN UNIT LIFTING LUG

PANELS	A	B	C	D	E	F	MAX. LIFTING CAPACITY
1″					1 1/2″	3″	8000 #
1 1/4″	4 3/4″	2 3/8″	1 3/8″	2″	2″	5″	7500 #
2″					2 1/4″	5″	7000 #

6″ TUBE

GOVERNAIR
A NORTEK COMPANY
4841 N. SEWELL
OKLAHOMA CITY, OK 73118
(405)525-6546 TELEX 796-268

MODEL: ACU-302		DATE: 12/14/87	TAG AC-1
SERIAL NO. 25998		DRAWING NO. 32636	

Job: A/C Building AS-205
12/18/87
Tag: AC-1
Model: ACU-302
Serial No. 25997
Drwg. No. WD-32636

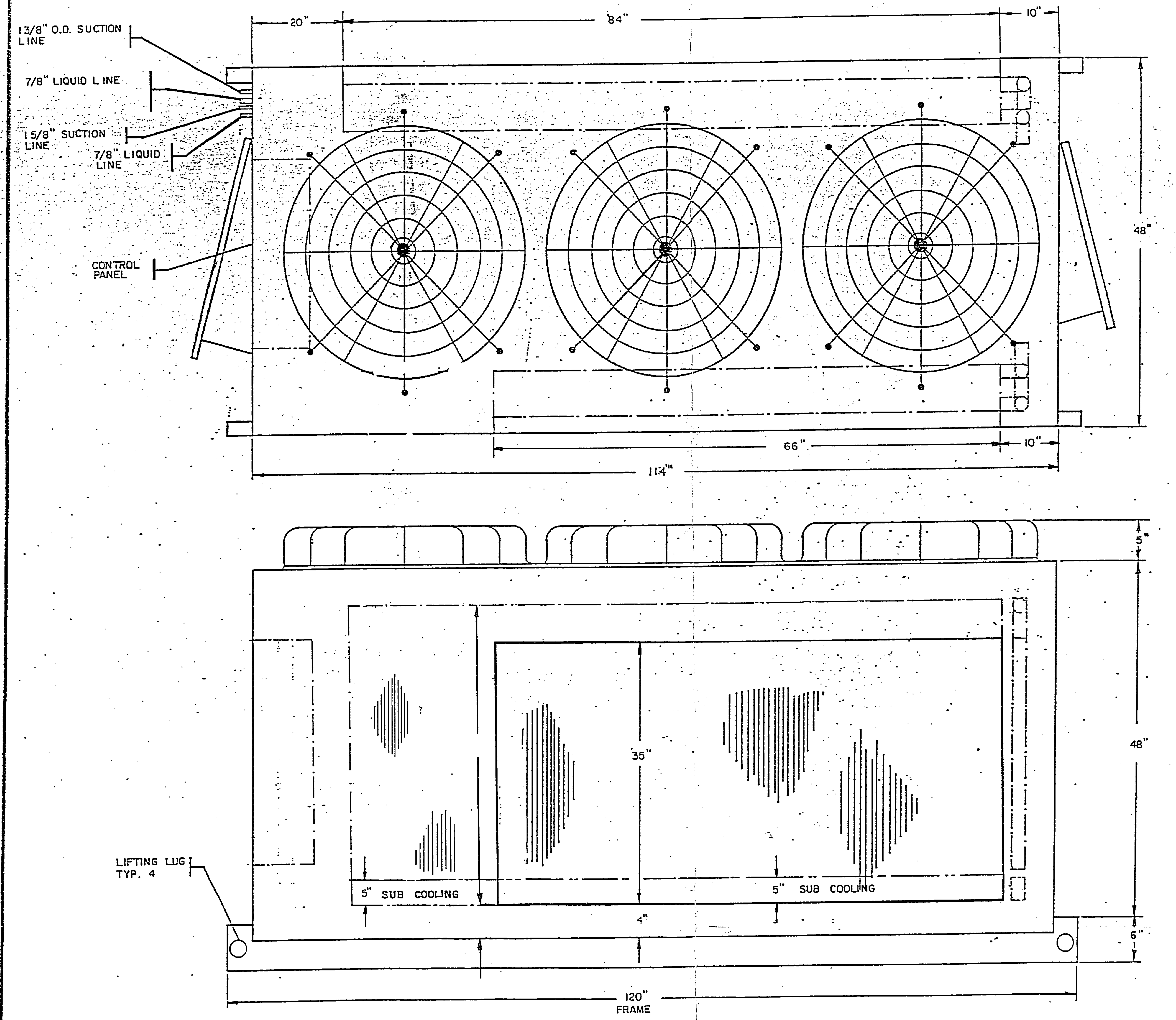
S E Q U E N C E O F O P E R A T I O N

(COMPRESSOR CIRCUIT TYPICAL)

When CR1 contacts close power is applied thru the compressor safeties energizing the liquid line solenoid RS-1 and time delay relay TD1. The compressor contactor C1 and the oil pressure switch OP1 will be energized for three minutes before being under control of the low pressure switch Low1 for low ambient control. The low pressure switch allows the compressor to pumpdown after CR1 contacts open. Contacts at terminal 3 close and bring on the condenser fans according to ambient temperature. TD2 is a delay-on-make timer used to lock out the compressor for five minutes during recycle.

The control panel contains a lead-lag switch to switch compressor operation according to the room thermostat.

NOTE: REFRIGERANT CONNECTING LINES TO BE SIZED FOR SPECIFIC JOB REQUIREMENT

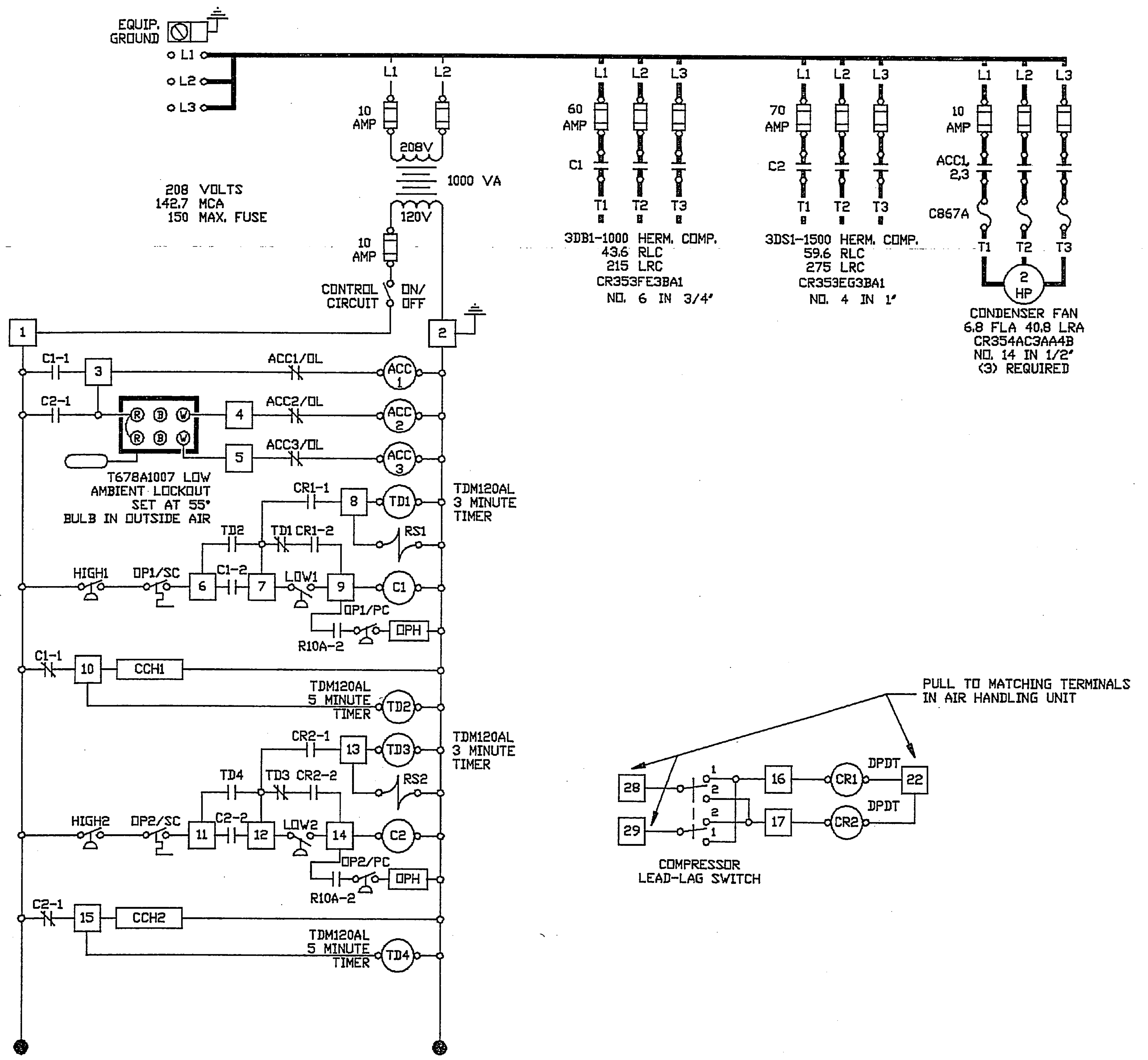


PLAN VIEW

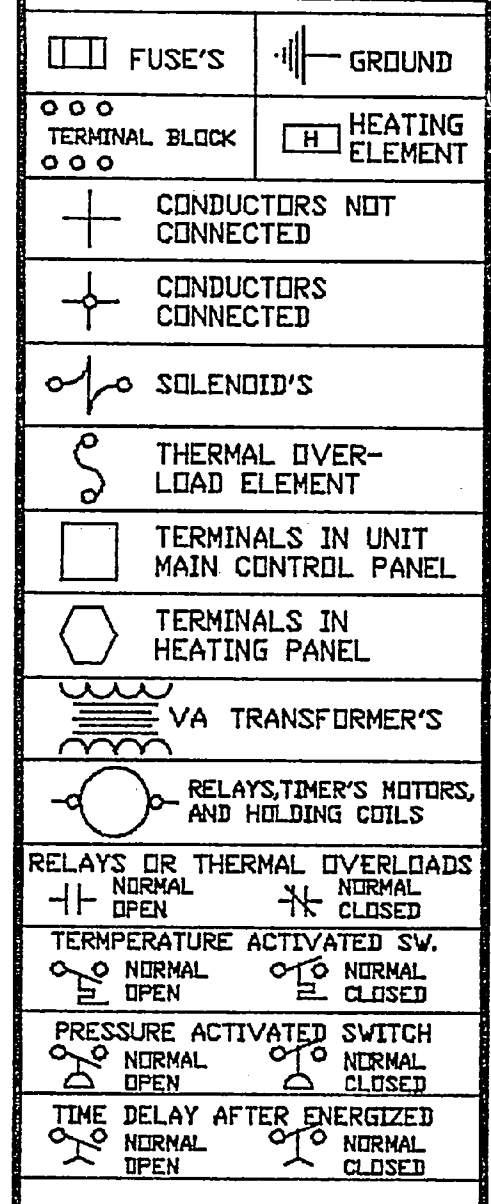
FRONT VIEW

APPROX. TOTAL UNIT WEIGHT: 2,000 LBS.

ISSUE	APPROVED	ISSUE	APPROVED	ISSUE 1	12/11/87 APPROVED	GOVERNAIR. A Harsco Company 4841 N. Sewell • Oklahoma City, OK 73118 (405) 525-6546 • Telex 796-268	MODEL: ACU-302	TAG AC-1	
PREPARED BY	ELECT. CKD.	PREPARED BY	ELECT. CKD.	PREPARED BY REH	ELECT. CKD.		SERIAL NO. 25997	DRAWING NO. 32636	
MECH. CKD.	CONST. CKD.	MECH. CKD.	CONST. CKD.	MECH. CKD.	CONST. CKD.				



ELECTRICAL SYMBOLS



ELECTRICAL LEGEND

ACC - AIR COOLED CONDENSER FAN CONTACTOR
AH - CONDITIONER FAN MOTOR CONTACTOR
C - COMPRESSOR MOTOR CONTACTOR
CCH - CRANKCASE HEATER IN COMPRESSOR
C-OL - COMPRESSOR OVERLOADS AND FUSES ARE IN COMP. TERMINAL BOX
CO - HEAT/COOL CHANGEOVER RELAY
CR - COOLING RELAY
DR - DAY OPERATION RELAY
FR - FAN RELAY
HC - HEATER CONTACTOR
HG - HOT GAS BYPASS SOLENOID VALVE
HIGH - HIGH PRESSURE SWITCH (MANUAL RESET)
HR - HEATER RELAY
I - IGNITOR
IT - 'IT' IS INTERNAL IN COMPRESSOR
LC - LIMIT CONTROL
LHFC - LOW HEAD FAN CONTROL
LOW - LOW PRESSURE SWITCH
NSR - NIGHT SET BACK RELAY
OL - OVERLOAD'S
OP - OIL PRESSURE SAFETY SWITCH
PC - PRESSURE CONTACTS ON SAFETY SWITCH
PS - PRESSURE SWITCH TO ACTIVATE COMPRESSOR UNLOADING SOLENOID VALVE
PV - PILOT VALVE
R - RELAY
RA - RETURN AIR FAN CONTACTOR
RS - REFRIGERANT SOLENOID VALVE
SC - SAFETY CONTACTS ON OIL PRESSURE SAFETY SW.
SG - SAFETY GROUND
SSM - SOLID STATE MODULE
TD - TIME DELAY RELAY
UL - COMPRESSOR UNLOADING SOLENOID VALVE
VR - INLET VANE RELAY

ISSUE		ISSUE		ISSUE		ISSUE		ISSUE 1	12/17/87
PREPARED BY		PREPARED BY		PREPARED BY		PREPARED BY		PREPARED BY	JCH
APPROVED		APPROVED		APPROVED		APPROVED		APPROVED	

GOVERNAIR
A NORTEK COMPANY
4841 N. SEWELL
OKLAHOMA CITY, OK 73118
(405)525-6546 TELEX 796-268

MODEL: ACU-302	TAG AC-1
SERIAL NO. 25997	DRAWING NO. WD-32636

GOVERNAIR CORPORATION
A Nortek Company

SUBMITTAL DATA
ISSUE A

PROJECT: A/C BUILDING AS-205
CAMP LEJUENE, NC

DATE: 12/11/87
12/30/87
SERIAL NO.: 25998

SOLD TO: HUMPHREY HEATING
& ROOFING, INC.
P.O. BOX 1268
JACKSONVILLE, NC 28540

REF. DWG.: 32637-A

TAG: AH-1

MODEL NO.: RSA-02

DRAWINGS FOR RECORD ONLY

NO. UNITS: 1

ETL LABEL

AIR FLOW DATA:

SUPPLY AIR: 9,000 CFM at .10" Electronic Air Cleaner-Future
.15" Damper/Hood
.25" Filters
.88" Coil - DX
.07" Coil - HW
.25" Unit
.50" External Static - Available

2.20" Total Static Design

COOLING CAPACITY	- R-22
BTU/HR TOTAL	- 358,500
BTU/HR SENSIBLE	- 125,969
ENTERING AIR	- 79.1 deg. DB, 66.2 deg. WB,
LEAVING AIR	- 60 deg. DB, 57.0 deg. WB,
SUCTION TEMP.	- 45.5 deg.
AMBIENT TEMP.	- 90 deg.
A.P.D.	- 0.88

HEATING CAPACITY	- Water
BTU/HR TOTAL	- 388,124
ENTERING AIR	- 20 deg. DB,
LEAVING AIR	- 59.8 deg. DB,
ENT./LVG. WATER	- 180.0 deg./160 deg.
GPM	- 40
FEET P.D.	- 1.6
A.P.D.	- 0.07

*4841 N. Sewell*OKC,OK 73118*(405)525-6546*

CONSTRUCTION:

BASE FRAME - Structural steel tube electrically welded,
LUGS, LIFTING - Fixed,
CABINET - FLOOR - 18 gauge galvanized steel single wall,
WALLS - 18 gauge galvanized steel single wall
ROOF - 18 gauge galvanized steel single wall,
PAINT - "Landmark Beige" enamel finish inside & out,
INSULATION - 1" fiberglass, 1 1/2 lb. density,
ACCESS DOORS - Double wall construction with standard galvanized steel hinges,
DOOR LATCHES - Ventlok 333,

CONDITIONER SECTION:

COOLING COIL - DX 5 row, 5/8" copper tubes, 12 aluminum fins per inch, 19.38 sq. ft. total, 45" fin width, 62" fin length, 10 pass, 1 req'd,
EXPANSION VALVE - One per compressor with distributor,
BLOWER ASSEMBLY - One - 20" forward curve, class I, DWDI, 778 RPM, 2118 outlet velocity, 5.32 B.H.P.
Isolators - spring,
Relubrication lines extended to drive side,
Variable pitch sheaves,
MOTOR - 7 1/2 horsepower, 208/3/60 ODP, 1750 R.P.M., 213T frame, pivot base,
DRAIN PAN - Insulated with drain connection, mastic coated, traps furnished and installed "By Others",
FILTER RACK - Angle with 2" throwaway filters,
HEATING COIL RE - 1 row, hot water,
5/8" copper tubes, 8 aluminum fins per inch, 19.38 sq. ft. total, 45" fin width, 62" fin length, 2 pass,
OA-RA DAMPERS - Outside air rainhood,
Opposed blade,
Damper motor and controls furnished and installed "By Others",

*4841 N. Sewell*OKC,OK 73118*(405)525-6546*

ELECTRICAL REQUIREMENTS:

208/3/60 power with 24 and 120 volt control,
24 volt transformer furnished and installed,
120 volt transformer furnished and installed,

ELECTRICAL CONTROLS:

See Wiring Diagram WD-32637

*4841 N. Sewell*OKC,OK 73118*(405)525-6546*

GOVERNAIR CORPORATION
A Nortek Company

25998

PROJECT: A/C BUILDING AS-205
CAMP LEJUENE, NC

DATE: 12/11/87

SERIAL NO.: 25998-A

SOLD TO: HUMPHREY HEATING
& ROOFING, INC.
P.O. BOX 1268
JACKSONVILLE, NC 28540

REF. DWG.: 32637-A

TAG: AH-1

MODEL NO.: RSA-02

NO. UNITS: 1

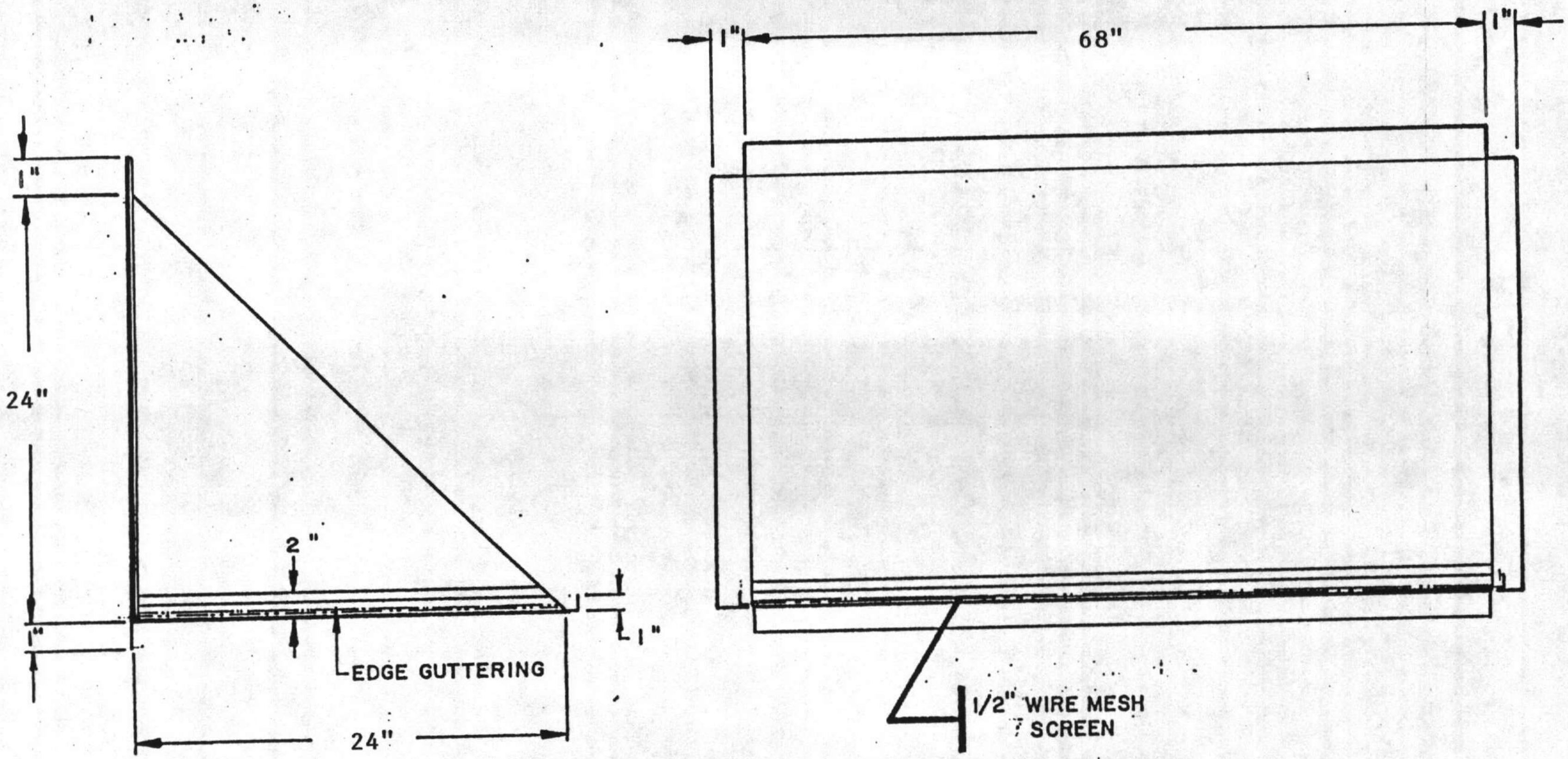
LOOSE PARTS SHIPPED WITH UNIT FOR FIELD INSTALLATION

ITEM	QUANTITY PER UNIT	DESCRIPTION
1	9	25" x 20" x 2" Throwaway Filters
2	1	O.A. Rainhood
3	1	Q674B1034 Honeywell Subbase
4	1	T874B1019 Honeywell Thermostat
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

LOOSE PARTS SHIPPED SEPARATE FROM UNIT FOR FIELD INSTALLATION

ITEM	QUANTITY PER UNIT	DESCRIPTION
1		
2		
3		
4		

*4841 N. Sewell*OKC,OK 73118*(405)525-6546*

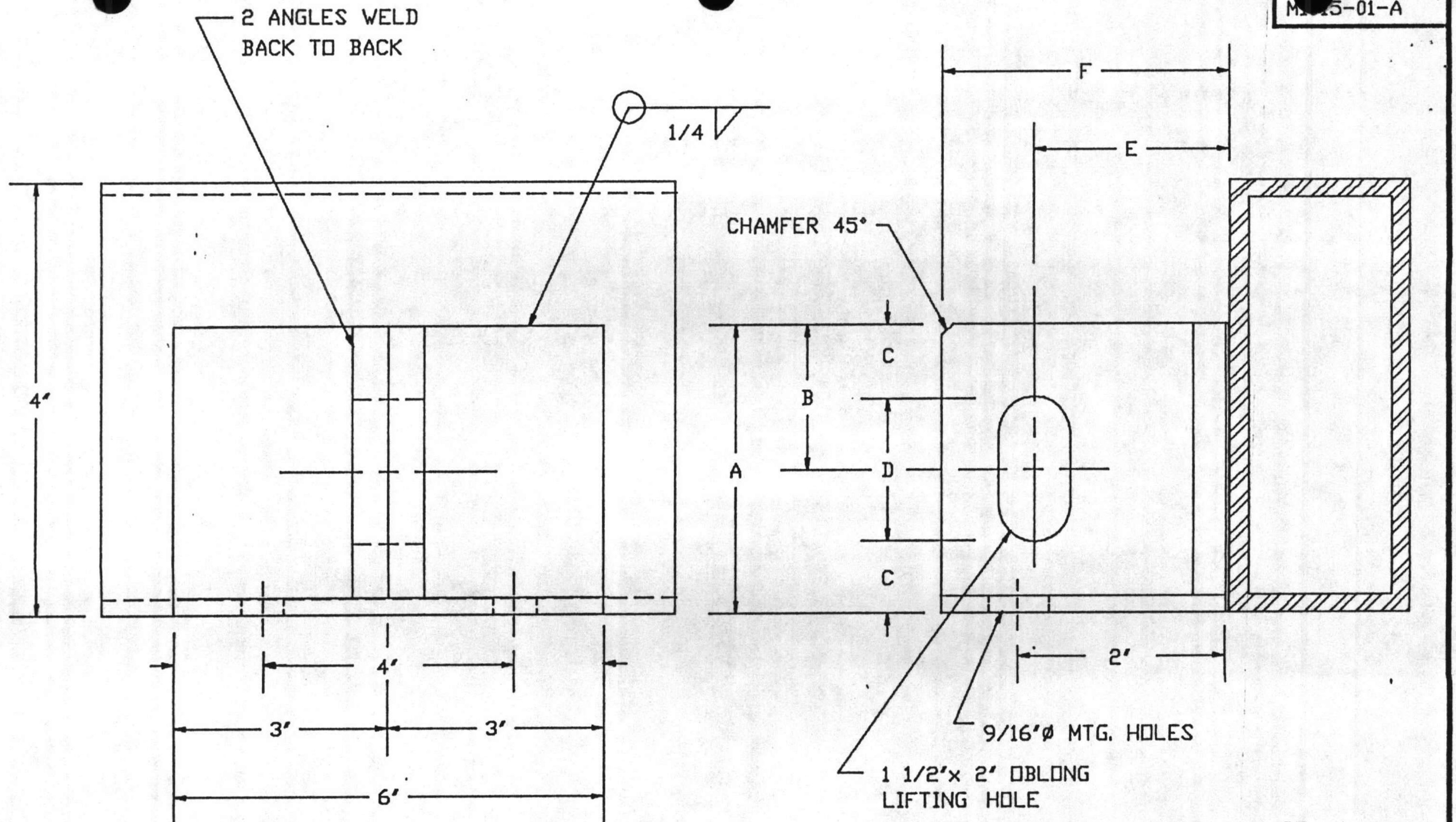


18 GA. GALV. STEEL RAIN HOOD FOR
(x) OUTSIDE, (   ) EXHAUST AIR

1 REQ'D

PAGE 5 OF 7

GOVERNAIR CORPORATION 4840 N. Sewell • Oklahoma City, OK 73118 (405) 525-6546 • Telex 747-194	MODEL: RSA-02	DATE: 12/14/87	TAG AH-1
	SERIAL NO. 25998	DRAWING NO. 32637-A	LVH



 REV. 4-1-87

BOLT DOWN UNIT LIFTING LUG

PANELS	A	B	C	D	E	F	MAX. LIFTING CAPACITY
1″	2 3/4″	1 3/8″	3/8″	2″	1 1/2″	3′	3500 #
1 1/4″					2″	5′	3000 #
2″					2 1/4″	5′	2500 #

4″ TUBE

GOVERNAIR
A NORTEK COMPANY
4841 N. SEWELL
OKLAHOMA CITY, OK 73118
(405)525-6546 TELEX 796-268

MODEL: RSA-02	DATE: 12/14/87	TAG AH-1
SERIAL NO. 25998	DRAWING NO. 32637-A	

GOVERNAIR CORPORATION
A Nortek Company

Job: A/C Building AS-205 12/18/87
Tag: AH-1
Model: RSA-02
Serial No. 25998
Drwg. No. WD-32637

SEQUENCE OF OPERATION

The unit is started by the room thermostat subbase. Unit operation is determined by the cool/off/heat switch. Fan operation is determined by the fan on/off switch. Auxillary contacts on the supply fan starter enable the compressors in the ACU.

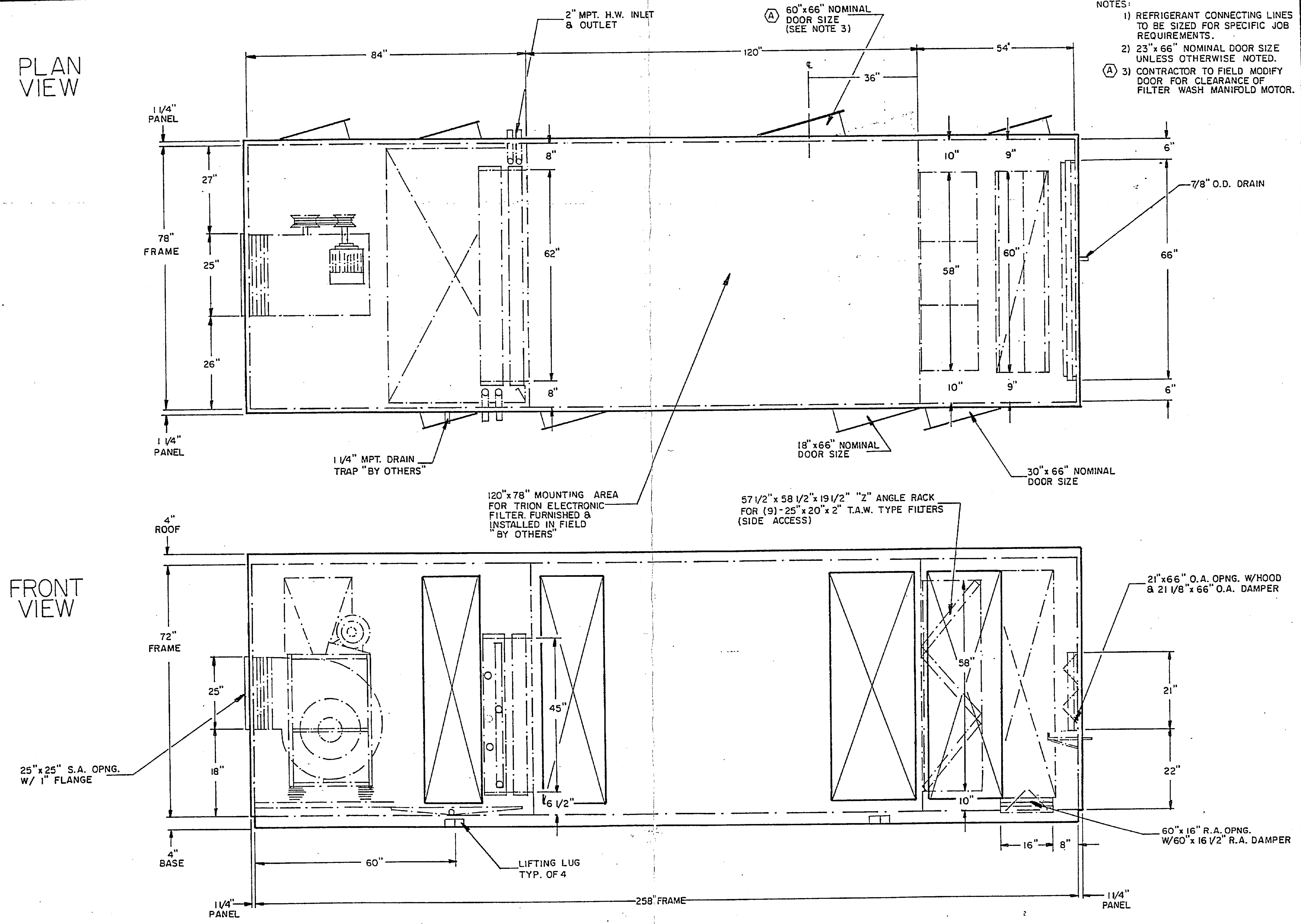
(TEMPERATURE CONTROLS)

The cooling is controlled by a room thermostat. This stages on the compressors to maintain setpoint.

The heating is also controlled by the room thermostat. The thermostat energizes the heat relay "HR" and "HR" contacts enable the heating valve controls furnished and installed "By Others".

Power for the electronic air filters is provided at the control panel between terminals 1 and 2.

NOTES:
1) REFRIGERANT CONNECTING LINES TO BE SIZED FOR SPECIFIC JOB REQUIREMENTS.
2) 23"x 66" NOMINAL DOOR SIZE UNLESS OTHERWISE NOTED.
(A) 3) CONTRACTOR TO FIELD MODIFY DOOR FOR CLEARANCE OF FILTER WASH MANIFOLD MOTOR.

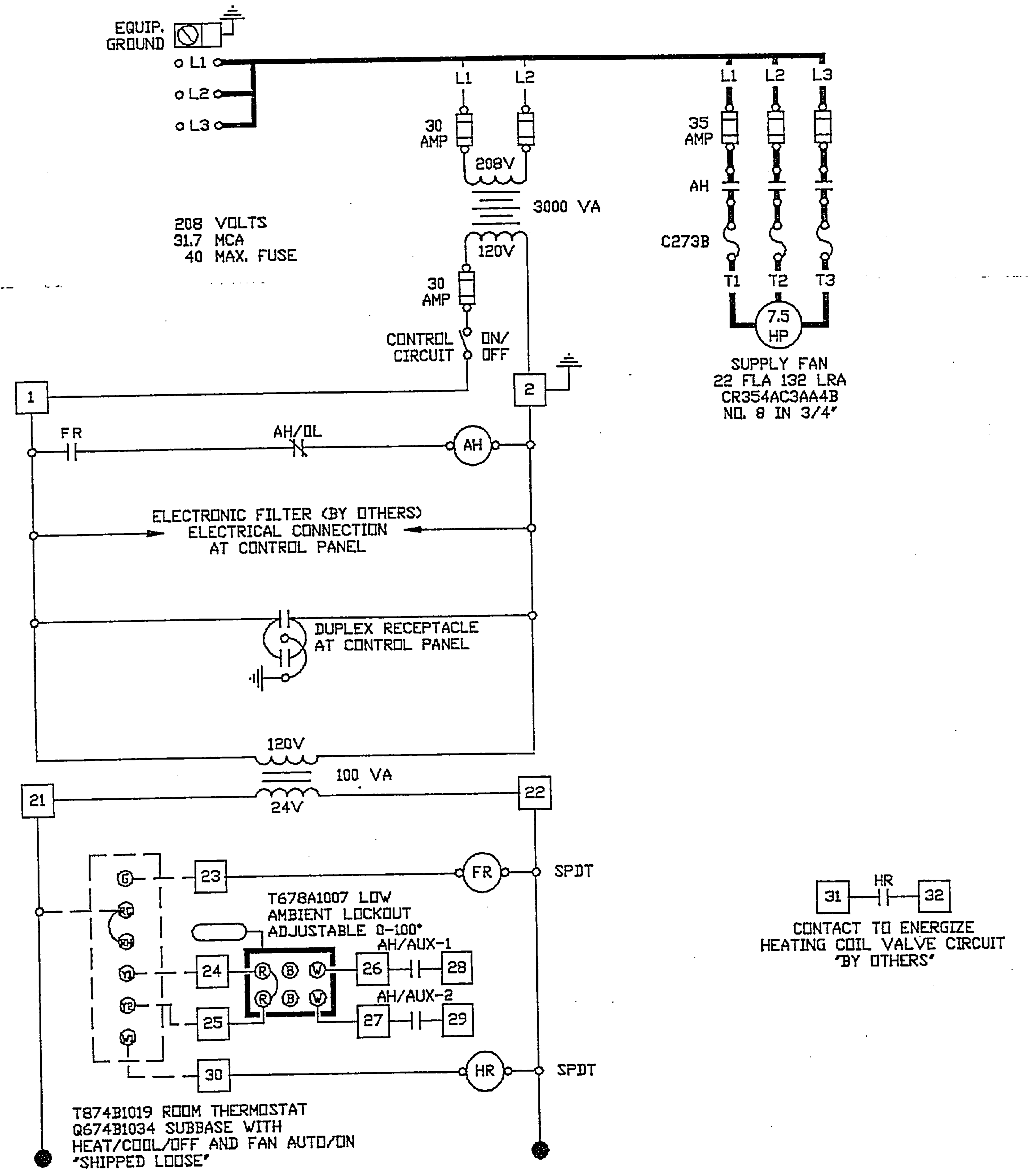


APPROX. TOTAL UNIT WEIGHT: 5,375 LBS.

ISSUE		APPROVED		ISSUE (A)	12/30/87	APPROVED		ISSUE 1	12/14/87	APPROVED	
PREPARED BY		ELECT. CKD.		PREPARED BY	REH	ELECT. CKD.		PREPARED BY	REH	ELECT. CKD.	
MECH. CKD.		CONST. CKD.		MECH. CKD.		CONST. CKD.		MECH. CKD.		CONST. CKD.	

GOVERNAIR.
A Norsek Company
4841 N. Sewell • Oklahoma City, OK 73118
(405) 525-6546 • Telex 796-268

MODEL:	RSA-02	TAG	AH-1
SERIAL NO.	25998	DRAWING NO.	32637-A



ELECTRICAL SYMBOLS

- FUSE'S
- GROUND
- TERMINAL BLOCK
- HEATING ELEMENT
- CONDUCTORS NOT CONNECTED
- CONDUCTORS CONNECTED
- SOLENOID'S
- THERMAL OVER-LOAD ELEMENT
- TERMINALS IN UNIT MAIN CONTROL PANEL
- TERMINALS IN HEATING PANEL
- VA TRANSFORMER'S
- RELAYS,TIMER'S MOTORS, AND HOLDING COILS
- RELAYS OR THERMAL OVERLOADS: NORMAL OPEN / NORMAL CLOSED
- TERMPERATURE ACTIVATED SW.: NORMAL OPEN / NORMAL CLOSED
- PRESSURE ACTIVATED SWITCH: NORMAL OPEN / NORMAL CLOSED
- TIME DELAY AFTER ENERGIZED: NORMAL OPEN / NORMAL CLOSED

ELECTRICAL LEGEND

ACC - AIR COOLED CONDENSER FAN CONTACTOR
AH - CONDITIONER FAN MOTOR CONTACTOR
C - COMPRESSOR MOTOR CONTACTOR
CCH - CRANKCASE HEATER IN COMPRESSOR
C-OL - COMPRESSOR OVERLOADS AND FUSES ARE IN COMP. TERMINAL BOX
CO - HEAT/COOL CHANGEOVER RELAY
CR - COOLING RELAY
DR - DAY OPERATION RELAY
FR - FAN RELAY
HC - HEATER CONTACTOR
HG - HOT GAS BYPASS SOLENOID VALVE
HIGH - HIGH PRESSURE SWITCH (MANUAL RESET)
HR - HEATER RELAY
I - IGNITOR
IT - "IT" IS INTERNAL IN COMPRESSOR
LC - LIMIT CONTROL
LHFC - LOW HEAD FAN CONTROL
LOW - LOW PRESSURE SWITCH
NSR - NIGHT SET BACK RELAY
OL - OVERLOAD'S
OP - OIL PRESSURE SAFETY SWITCH
PC - PRESSURE CONTACTS ON SAFETY SWITCH
PS - PRESSURE SWITCH TO ACTIVATE COMPRESSOR UNLOADING SOLENOID VALVE
PV - PILOT VALVE
R - RELAY
RA - RETURN AIR FAN CONTACTOR
RS - REFRIGERANT SOLENOID VALVE
SC - SAFETY CONTACTS ON OIL PRESSURE SAFETY SW.
SG - SAFETY GROUND
SSM - SOLID STATE MODULE
TD - TIME DELAY RELAY
UL - COMPRESSOR UNLOADING SOLENOID VALVE
VR - INLET VANE RELAY

ISSUE		ISSUE		ISSUE		ISSUE		ISSUE 1	12/18/87
PREPARED BY		PREPARED BY		PREPARED BY		PREPARED BY		PREPARED BY	JCH
APPROVED		APPROVED		APPROVED		APPROVED		APPROVED	

GOVERNAIR
A NORTEK COMPANY
4841 N. SEWELL
OKLAHOMA CITY, OK 73118
(405)525-6546 TELEX 796-268

MODEL: RSA-02	TAG AH-1
SERIAL NO. 25998	DRAWING NO. WD-32637

TAB PLACEMENT HERE

DESCRIPTION:

Farris Safety Valve

☐ Tab page did not contain hand written information

☑ Tab page contained hand written information
*Scanned as next image

Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

Technical Bulletin 286T

Farris

SAFETY AND RELIEF VALVE USER INSTALLATION MANUAL

MCAS, New River
N62470-86-C-5548
PO# 109-284

TELEDYNE
FARRIS ENGINEERING

SAFETY-RELIEF VALVE USER INSTALLATION MANUAL

This booklet is designed to assist in the proper installation of an important safety device, the pressure relief valve. The pressure relief valve which you have received is a precision instrument. Correct installation is essential for plant, property, personnel and public safety. Failure of a pressure relief valve could lead to catastrophic overpressure of pressurized equipment and/or release of fluids under pressure. The discharge of contained fluids may be hazardous and all precautions should be taken to insure safe disposal.

Farris

TELEDYNE FARRIS SAFETY-RELIEF VALVES GENERAL INFORMATION

These definitions are intended to assist you in the correct installation of Teledyne Farris Pressure Relief Valves.

Safety Valve—An automatic pressure relieving device actuated by the static pressure upstream of the valve, and characterized by rapid full opening or pop action. It is used for steam, gas or vapor service.

Relief Valve—An automatic pressure relieving device actuated by the static pressure upstream of the valve, which opens in proportion to the increase in pressure over the opening pressure. It is used primarily for liquid service.

Safety Relief Valve—An automatic pressure actuated relieving device suitable for use as either a safety or relief valve, depending on application.

Pressure Relief Valve—A pressure relief valve is a pressure relief device which is designed to reclose and prevent the further flow of fluid after normal conditions have been restored.

Set Pressure—Set pressure, in pounds per square inch gage, is the inlet pressure at which the pressure relief valve is adjusted to open under service conditions. In a safety or safety relief valve in gas, vapor, or steam service, the set pressure is the inlet pressure at which the valve pops under service conditions. In a relief or safety relief valve in liquid service, the set pressure is the inlet pressure at which the valve starts to discharge under service conditions.

Differential Set Pressure—The pressure differential in pounds per square inch between the set pressure and the constant superimposed back pressure. It is applicable only when a conventional type safety relief valve is being used in service against constant superimposed back pressure.

Cold Differential Test Pressure—Cold differential test pressure, in pounds per square inch gage, is the inlet static pressure at which the pressure relief valve is adjusted to open on the test stand. This pressure includes the corrections for service conditions of back pressure or temperature, or both.

Operating Pressure—The operating pressure of a vessel is the pressure, in pounds per square inch gage, to which the vessel is usually subjected in service. A vessel is usually designed for a maximum allowable working pressure, in pounds per square inch gage, which will provide a suitable margin above the operating pressure in order to prevent any undesirable operation of the relief device. (It is suggested that this margin be as great as possible consistent with economical vessel and other equipment design, system operation and the performance characteristics of the pressure relieving device.)

Maximum Allowable Working Pressure—Maximum allowable working pressure is the maximum gage pressure permissible at the top of a completed vessel in its operating position for a designated temperature. This pressure is based on calculations for each element in a vessel using nominal thicknesses, exclusive of allowances for corrosion and thickness required for loadings other than pressure. It is the basis for the pressure setting of the pressure-relieving devices protecting the vessel. The design pressure may be used in place of the maximum allowable working pressure in cases where calculations are not made to determine the value of the latter.

Overpressure – Overpressure is a pressure increase over the set pressure of a pressure relief valve, usually expressed as a percentage of set pressure.

Accumulation – Accumulation is the pressure increase over the maximum allowable working pressure of the vessel during discharge through the pressure relief valve, expressed as a percent of that pressure or in pounds per square inch.

Blowdown – Blowdown is the difference between actual popping pressure of a pressure relief valve and actual reseating pressure expressed as a percentage of set pressure or in pressure units.

Lift – Lift is the actual travel of the disk away from closed position when a valve is relieving.

Back Pressure – Back pressure is the static pressure existing at the outlet of a pressure relief device due to pressure in the discharge system.

Constant Back Pressure – Back pressure which does not change appreciably under any condition of operation whether the pressure relief valve is closed or open.

Variable Back Pressure – Back pressure which may change appreciably when the valve is open.

Built-Up-Back Pressure – Built-up back pressure is pressure existing at the outlet of a pressure relief device occasioned by the flow through that particular device into a discharge system.

Superimposed Back Pressure – Superimposed back pressure is the static pressure existing at the outlet of a pressure relief device at the time the device is required to operate. It is the result of pressure in the discharge system from other sources.

STORAGE & HANDLING PRECAUTIONS

Because cleanliness is essential to the satisfactory operation and tightness of a pressure relief valve, all necesary precautions should be taken to keep out all foreign materials. Valves which are not installed soon after receipt should be closed off properly at both inlet and outlet flanges or screwed ends. Particular care should be taken to keep the valve inlet and internals absolutely clean. Preferably, valves should be stored indoors or in a location where dirt and other forms of contamination are at a minimum. Valves should be handled carefully and not subjected to heavy shocks. If due consideration is not given to this point, some internal damage or misalignment can result and seat tightness may be adversely affected. Store, transport and install valves with the stem in the vertical position.

INSPECTION ON DELIVERY

Visual Inspection – When a valve is first received, it should be given a visual inspection to note its condition. If any problems are noticed, they should be reported to the manufacturer, or his local representative. All wire seals must remain intact to insure warranty.

Points that should be checked:

1. Look for any shipping damage.
2. Confirm the nameplate data and the valve size, type and trim/options against ordering documents.
3. Insure that factory wire seals are intact.
4. If the valve will not be installed immediately, store it properly.
5. Confirm by test that valve is ready for installation.

DETERMINATION OF AS-RECEIVED RELIEVING PRESSURE

Before the valve is installed, it is considered important to determine the set pressure of the valve as recieved. Test procedures for determining relieving pressure vary with local plant practices. Note, cold differential test pressures must be taken into account.

CHECKING THE VALVE FOR TIGHTNESS

After the valve is satisfactorily checked for set pressure, check for leakage. It is important to minimize leakage from pressure relief valves. Excessive leakage could lead to fouled or inoperable valves and serious product loss, and could also be hazardous to personnel and equipment.

The valve can be tested for tightness on the test stand by increasing the pressure on the valve up to 90 percent or more of the set pressure and observing the discharge side of the valve for evidence of leakage. Methods of determining leakage are covered by applicable standards and specific user requirements. One reference for seat tightness testing is API Standard 527. A summary of set pressure tolerances and leak rates is contained in the tables on this page.

COMPLETION OF NECESSARY RECORDS

All necessary records should be completed before the valves go into service. These records are important for effective future use of the valve. They will provide some guidance as to when to retire valves and replace components as well as providing the historical record of the conditions and services under which the valve operated. One publication for reference on pressure relieving devices is the American Petroleum Institute's "Guide for Inspection of Refinery Equipment, Chapter XVI".

OPERATING DIFFERENTIALS GENERAL GUIDE FOR SELECTING DIFFERENTIAL BETWEEN OPERATING AND SET PRESSURES

The variety of service conditions encountered in Section VIII applications precludes a rigid set of rules. Operational difficulties will be minimized by providing as much differential as possible for known conditions of a particular application. The following are suggested minimum differentials:

General Gases, Vapors & Liquids

Seat Type & Construction	Pressures		
	Set Pressure PSIG	Set Pressure Tolerance (+) or (−)	Minimum Differential Suggested
Metal Seat & Soft Seat	16 to 70	2 PSIG	5 PSIG
Metal Seat	71 to 1000	3%	10%
Special Category Metal Seat			7%
Soft Seat			5%
Metal Seat	1001 to 6000	3%	7%
Soft Seat			5%

Leakage Rates for Safety Relief Valves for Set Pressures to 1000 Pounds Per Square Inch Gage (6.9 Megapascals at 60° F) (15.6°C)

Type of Valve	Manufacturer's Orifice Size	Maximum Leakage Rate (Bubbles per Minute)	Approximate Leakage Rate	
			(Standard Cubic Feet per 24 Hour)	(Standard Cubic meter per 24 Hour)
Conventional	F and smaller	40	0.60	0.017
	G and larger	20	0.30	0.0085
Balanced bellows	F and smaller	50	0.75	0.021
	G and larger	30	0.45	0.013

Note: Leak tests are performed as follows: For Flanged Valves—90% of set pressure. For Screwed Valves—85% of set pressure.

FOR SAFE INSTALLATION

DO

Store valves in original packing in a clean, dry area until ready to install.

Test valves, if possible, prior to installing.

Install close to pressure source; in no case exceed a 2 to 3% pressure drop

Allow space for disassembly.

Install to allow in-line maintenance and adjustment.

Remove body pipe plug to allow valve body to drain and check periodicially.

Remove plastic push plug from the bonnet of bellows type valves.

Remove inlet and outlet flange protectors.

DO NOT

Lift valves up by the test lever.

Remove flange protectors until just before installing.

Tighten flange bolts unevenly.

Place intervening valves of any sort between the safety-relief valves and the vessels or lines they protect.

Place heavy discharge piping on valve outlets without sufficient support.

Install valve other than in a vertical position.

Install a valve fitting with diameter less than valve inlet.

INSPECTION OF INLET AND OUTLET PIPING

Before pressure relief valve is installed in service the upstream and downstream piping is open and available for inspection. New systems, especially, are likely to contain welding beads, pipe scale or other foreign material which can be inadvertently trapped during construction and destroy the seating surface the first few times the valve opens. Wherever possible, the system should be purged thoroughly before the valve is installed.

A reference on pressure relief valve installation is the American Petroleum Institutes RP-520 Pt. II, Installation of Pressure Relief Valves.

VALVE LOCATION AND POSITION

Always install pressure relief valves with the stem in a vertical position, inlet at the bottom, outlet on the side. There are some rare exceptions, but there are very few valves which can operate dependably in other positions.

On installations where there are pressure fluctuations at the pressure source (as with valves on compressor discharge) which peak close to the set pressure of the valve, it will be beneficial to locate the pressure relief valve farther from the source and in a more stable pressure region.

Regarding proximity to other valve equipment, it is recommended that valves be mounted a sufficient distance downstream from any source of turbulence, such as:

Reducing Stations
Orifice Plates and Flow Nozzles
Other Valves and Fittings

Also, most top guided pressure relief valves are suitable for mounting on stationary equipment only, otherwise, they cannot operate dependably.

Where liquid valves are installed, ensure the inlet is below the liquid level.

LIFTING LEVER

To prevent stem damage, the valve should have a minimum of 75% of set pressure under the disc before engaging the test lever.

PRESSURE RELIEF VALVE INSTALLATION

Caution should be taken to be certain that all protective material on the valve flanges and any extraneous materials inside the valve body or nozzle are completely removed. Some of these materials may damage the seats or be trapped between the seats causing leakage.

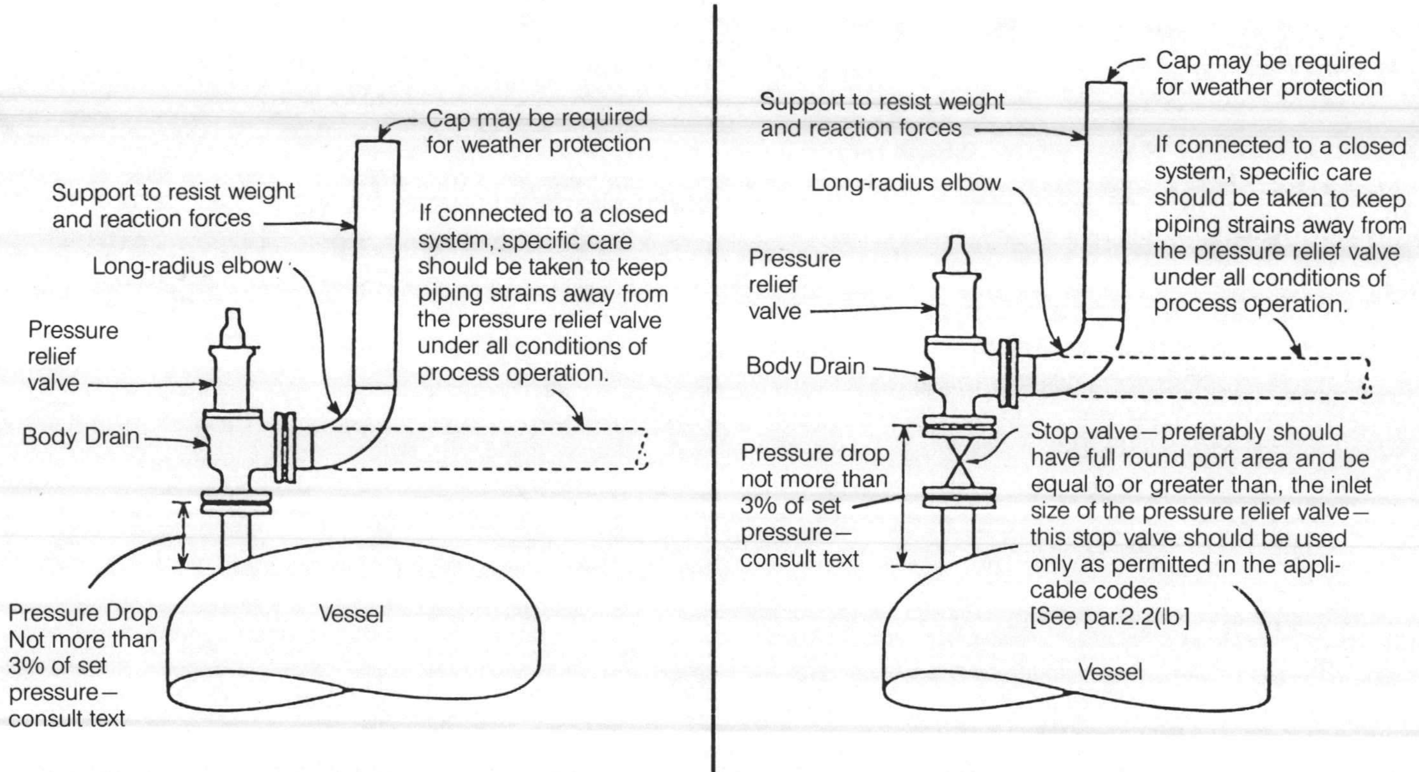
Be sure the bonnets on balanced bellows valves are vented. Remove the plastic push plug inserted for shipment. Plan the disposal of the potential small fluid discharge to a safe place to avoid possible ignition or hazard to personnel.

Whenever any connection is made to an outlet, provide drainage from that piping or from the valve body. This can also be handled by sloping the piping, thus avoiding disposal problems. Properly support discharge piping. Confirm that the pressure relief valve is being installed in the proper location. Use proper gaskets or sealants to install the valve, insuring that they do not block or contaminate the inlet or outlet of the valve. Torque flange bolting or use wrenching flats for screwed type valves. Release any shipping straps from lifting levers and confirm proper lever freedom.

It is recommended that the valve be isolated during pressure testing of the system, either by blanking or closing a stop valve. If gagging is used, extreme caution must be exercised to avoid damaging the valve and to insure that the gag is removed after use.

INSTALLATION

API RP 520, Part II – Installation



Recommended Typical Pressure Relief Valve Installation Without Shutoff Valve

Recommended Typical Pressure Relief Valve Installation With Shutoff Valve

GENERAL NOTES

These reference materials are available and should be helpful in the installation and testing of Pressure Relief Valves.

Since it is impossible to include all the industry practices that are used in the installation of a Pressure Relief Valve, this manual has been prepared to describe routine field handling and installation procedures to make a safe and acceptable installation.

American National Standards Institute, New York, N.Y.

ANSI B16.5—Steel Pipe Flanges and Flanged Fittings

ANSI B16.34—Steel Valves, Flanged and Butt-welding End.

ANSI B95.1—Terminology for Pressure Relief Devices.

ANSI/ASME PTC 25.3—Performance Test Code, Safety and Relief Valves.

ANSI/ASHRAE 15-78—Safety Code for Mechanical Refrigeration, [B9.1].

American Petroleum Institute Washington, D.C.

API RP 520, Recommended Practice for the Design and Installation of Pressure Relieving Systems in Refineries, Part I—Design.

API RP 520, Part II—Installation.

API RP 521, Guide for Pressure Relief and Depressuring Systems.

API Standard 526, Flanged Steel Safety Relief Valves.

API Standard 527, Commercial Seat Tightness of Safety Relief Valves with Metal-to-Metal Seats.

API Standard 2510, Design and Construction of LP-Gas Installations at Marine and Pipeline Terminals, Natural Gas Processing Plants Refineries, and Tank Farms.

Guide for Inspection of Refinery Equipment, Chapter XVI, Pressure-Relieving Devices.

API PAPER 62-73, Computerized Safety Valve Maintenance Records by J.H. Forrester, Jr., May 17, 1973.

American Society of Mechanical Engineers, New York, N.Y.

Section VIII, Rules for Construction of Pressure Vessels, Division I.

Section I, Rules for Construction of Power Boilers.

Compressed Gas Association, Inc., New York, N.Y.

Safety Relief Device Standards:

Part 1—Cylinders for Compressd Gases, Pamphlet S-1.1.

Part 2—Cargo and Portable Tanks for Compressed Gases, Pamphlet S-1.2.

Part 3—Compressed Gas Storage Containers, Pamphlet S-1.3.

National Board of Boiler and Pressure Vessel Inspectors, Columbus, Ohio.

National Board Inspection Code, NB-23.

National Board Authorization to Repair ASME and National Board Stamped Safety Valves and Safety Relief Valves, NB-65.

National Fire Protection Association, Quincy, Massachusettes.

NFPA No. 30, Flammable and Combustible Liquids Code.

NFPA no. 58, Standard for the Storage and Handling of Liquefied Petroleum Gases.

NFPA No. 59, Standard for the Storage & Handling of Liquified Petroleum Gases at Utility Gas Plants.

NFPA No. 59A, Standard for the Production, Storage & Handling of Liquified Natural Gases (LNG).

Farris

GUARANTEE

All products manufactured by Teledyne Farris Engineering are guaranteed free of defects in material and workmanship, when used within the range recommended, for a period of one year. When authorized, any defective product may be returned to the factory, and if found defective, will be repaired or replaced free of charge, F.O.B. our factory. No charge for labor or other expense incurred will be allowed as the liability of Teledyne Farris Engineering is measured by the refund price of the defective product only.

TELEDYNE FARRIS ENGINEERING

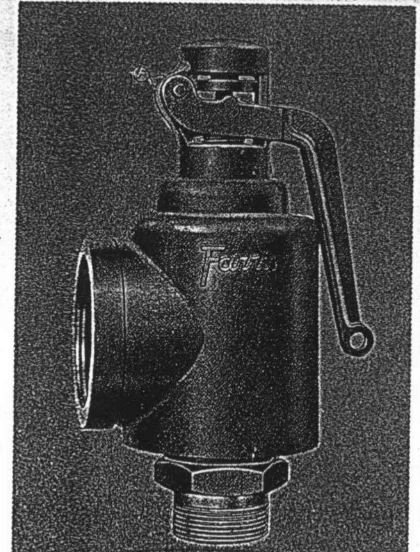
400 Commercial Ave. • Palisades Park, N.J. 07650 • Phone: 201-944-6300 • Telex: 135486
Plants in: U.S.A., Canada, England, Scotland, France, Australia and Brazil

Farris

ASME-NB CERTIFIED

1855-OL SERIES
SAFETY VALVES

1856M SERIES
SAFETY-RELIEF VALVES



1855-OL SERIES

1856M SERIES

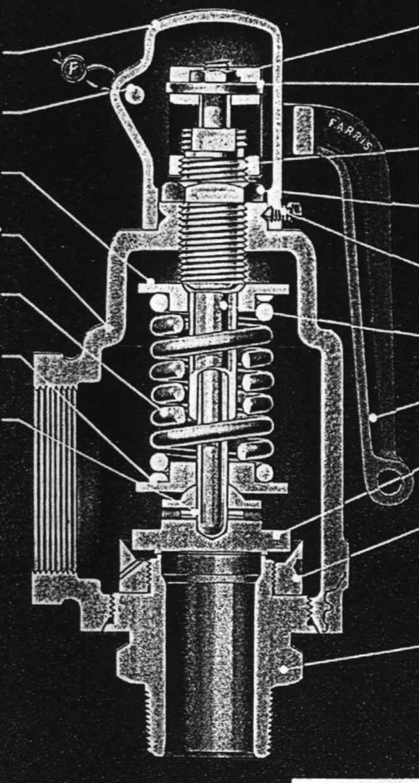
FOR STEAM,
LIQUIDS, GAS,
AND
LIQUEFIED GASES

po# 109-284
MCAS, New River
N62470-86-C-5548
Jacksonville, NC

TELEDYNE FARRIS ENGINEERING
400 Commercial Ave. • Palisades Park, N.J. 07650 • Phone: 201-944-6300 • Telex—135486
Plants in U.S.A., Canada, England, Scotland, France and Australia

Teledyne Farris Safety Valves/High Capacity/Screwed Connections

1855-OL SERIES



TYPE 1855-OL Male Inlet, Female Outlet, Open Lever

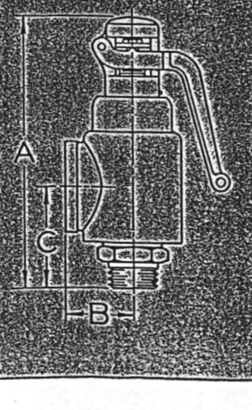
The Teledyne Farris 1855-OL Series embodies the most progressive engineering design features for three-way High Capacity operation—High Capacity with minimum inlet pipe size; High Capacity with ASME-NB certification; High Capacity with the greatest economy to you. Temp. Range −20°F to +450°F.

The 1855-OL Series has extra-long top guiding for safe, positive protection. This valve also features optically machined and lapped flat seat and SELF-ALIGNING disc for maximum tightness and positive shut-off.

VALVE SIZE		INLET	½	¾	1	1½	2	2½	3
		OUTLET	¾	1¼	1½	2½	3	4	4
SEAT DIA.			½	¾	1	1½	2	2½	3
MAX. SET PRESS. PSIG			300	300	300	300	300	250	250
A	PLAIN CAP		6¼	6⅝	7⅛	9	11½	13¼	15¼
	OPEN LEVER		6⅝	7⅛	7⅝	9¾	12½	14¼	16⅜
	PACKED LEVER		7¾	8¼	8¾	11⅜	14⅛	16	18¼
B			1 9/16	1 11/16	1 15/16	2⅝	3 3/16	3 13/16	4⅛
C			2 7/16	2 13/16	3⅛	4	4⅜	5 9/16	6 5/16
APPROX. WEIGHT			3	3½	5	11	20	30	40

NOTES:
1. Conforms to ASME Pressure Vessel Code, Section VIII and has been tested and rated for capacity by the National Board of Boiler and Pressure Vessel Inspectors.
2. Flanged inlets available on quantity orders.
3. "O" Ring Seat Seal for additional tightness optional. Add "R" to type number (example: 1855R-OL).
4. Plain cap (no lever) & packed lever designs available on application.
5. Test lever required for Air, Steam & Hot Water Service.
6. Types 1855 and 1855-PKD may be used for back pressure to 50 PSIG when specified.

PART NAME	MATERIAL
Body	ASTM B16 H.H. Brass or ASTM B62, Bronze
Bonnet	ASTM A126 CL B, Cast Iron
Disc	ASTM B16 H.H. Brass
Blow Down Ring	ASTM B16 H.H. Brass
Cap	ASTM A47 Gr. 32510, Mall. Iron
Stem	ASTM A581 Type 303 St. St.
Spring Adj. Screw	ASTM B16 H.H. Brass
Jam Nut	ASTM B16 H.H. Brass
Spring Button, Upper	ASTM A108 Gr. 1117
Spring Button, Lower	Carbon Steel, Plated
Groov-Pin	Stainless Steel, Hardened
Spring	Carbon Steel, Rust Proofed
Test Lever	ASTM A47 Gr. 32510, Mall. Iron
Stem Test Washer	AISI C1117
Stem Jam Nut	Steel, Plated
Button H'd Rivet	Steel
Set Screw	Steel, Plated



CAPACITIES: 1850 SERIES

STEAM—10% OVERPRESSURE

Saturated steam in pounds per hour at 10% overpressure
ASME Pressure Vessel Code (UV) Section VIII

90% RATING

SET PRESS. PSIG	VALVE TYPE AND SIZE								
	1855	½x¾	¾x1¼	1x1½	—	1½x2½	2x3	2½x4	3x4
	1856M(C)	½x¾ ¾x¾	1x1¼	—	1½x2	2x2½	2½x3	3x4	—
1# INCR	4		9	15	25	35	57	98	142
5# INCR	20		45	76	123	175	285	492	710
10	92		207	355	575	827	1332	2299	3311
20	131		296	507	821	1182	1902	3284	4728
30	171		384	659	1067	1536	2472	4268	6145
40	210		473	811	1313	1890	3042	5252	7563
50	249		561	963	1559	2245	3612	6236	8981
60	289		650	1115	1805	2599	4182	7220	10400
70	328		738	1267	2051	2953	4752	8204	11820
80	368		827	1418	2297	3307	5322	9189	13230
90	407		916	1570	2543	3661	5892	10170	14650
100	446		1004	1722	2789	4015	6462	11160	16070
110	486		1093	1874	3035	4370	7032	12140	17490
120	525		1181	2026	3281	4724	7602	13130	18900
130	564		1270	2178	3527	5078	8172	14110	20320
140	604		1358	2330	3774	5433	8742	15090	21730
150	643		1447	2482	4020	5787	9312	16080	23150
160	683		1536	2634	4266	6141	9882	17060	24570
170	722		1624	2786	4512	6495	10450	18050	25990
180	761		1713	2938	4758	6850	11020	19030	27400
190	801		1801	3090	5004	7204	11590	20010	28820
200	840		1890	3241	5250	7558	12160	21000	30240
210	879		1978	3393	—	7912	12730	21980	31660
220	919		2067	3545	—	8267	13300	22970	33070
230	958		2156	3697	—	8621	13870	23950	34490
240	998		2244	3849	—	8976	14440	24940	35910
250	1037		2333	4001	—	9331	15010	25920	37320
260	1076		2421	4153	—	9685	15580	—	—
270	1116		2510	4305	—	10040	16150	—	—
280	1155		2598	4457	—	10393	16720	—	—
290	1194		2687	4609	—	10745	17290	—	—
300	1234		2776	4761	—	11097	17860	—	—

NOTE: Heavy black line indicates pressure limits of 1856M(C)

AIR—10% OVERPRESSURE

Air in standard cubic feet per minute at 10% overpressure and 60°F
ASME Pressure Vessel Code (UV) Section VIII
For other gases correct for specific gravity and temperature then multiply by 0.885

90% RATING

SET PRESS. PSIG	VALVE TYPE AND SIZE								
	1855	½x¾	¾x1¼	1x1½	—	1½x2½	2x3	2½x4	3x4
	1856M(C)	½x¾ ¾x¾	1x1¼	—	1½x2	2x2½	2½x3	3x4	—
1# INCR	1.4		3.1	5	9	12	20	35	50
5# INCR	7.0		16	27	44	62	101	175	252
10	33		74	126	204	294	473	816	1175
20	47		105	180	291	420	675	1166	1678
30	61		136	234	379	546	877	1515	2181
40	75		168	288	466	671	1079	1864	2684
50	89		199	342	553	796	1282	2214	3187
60	102		231	395	641	922	1484	2563	3690
70	117		262	449	728	1048	1686	2912	4193
80	130		294	503	815	1174	1889	3262	4696
90	144		325	557	903	1300	2091	3611	5200
100	158		357	611	990	1426	2293	3960	5703
110	172		388	665	1078	1551	2496	4310	6206
120	186		420	719	1165	1677	2698	4659	6709
130	200		451	773	1252	1803	2900	5009	7212
140	214		483	827	1340	1928	3102	5358	7715
150	228		514	88[illegible]	1427	2054	3305	5707	8218
160	242		545	934	1514	2180	3507	6057	8721
170	256		577	988	1602	2306	3709	6406	9224
180	270		608	1042	1689	2431	3912	6755	9727
190	284		640	1096	1776	2557	4114	7105	10230
200	298		671	1150	1864	2683	4316	7454	10730
210	312		703	1204	1951	2809	4518	7805	11236
220	326		734	1258	2047	2935	4721	8153	11739
230	340		766	1312	2118	3060	4923	8502	12242
240	354		797	1366	2213	3186	5126	8852	12745
250	368		829	1420	2301	3311	5328	9201	13250
260	382		860	1473	2388	3437	5530	—	—
270	396		892	1527	2476	3563	5732	—	—
280	410		923	1581	2563	3689	5935	—	—
290	424		954	1635	2650	3815	6137	—	—
300	438		986	1689	2761	3941	6339	—	—

NOTE: Heavy black line indicates pressure limits of 1856M(C)

WATER—25% OVERPRESSURE

Water in gallons per minute at 25% overpressure.
For capacities at 10% overpressure, multiply values in table by 0.6

SET PRESS. PSIG	VALVE TYPE AND SIZE								
	1855	½x¾	¾x1¼	1x1½	—	1½x2½	2x3	2½x4	3x4
	1856M(C)	½x¾ ¾x¾	1x1¼	—	1½x2	2x2½	2½x3	3x4	—
10	3.7		8.4	15	23	34	60	93	133
20	5.3		11.9	21	33	48	85	132	188
30	6.5		14.5	26	41	58	103	161	230
40	7.5		16.8	30	47	67	119	187	266
50	8.3		18.8	33	52	75	133	209	297
60	9.1		20.6	36	57	82	146	228	326
70	9.9		22.[illegible]	39	62	89	158	246	352
80	10.5		23.8	42	66	95	168	263	376
90	11.2		25.2	45	70	101	179	280	398
100	11.8		26.6	47	74	106	189	295	421
110	12.3		28	49	77	111	198	309	442
120	12.9		29.2	52	81	116	207	324	461
130	13.4		30.3	54	84	121	215	336	480
140	14.0		31.5	56	87	126	223	350	498
150	14.4		32.6	58	91	130	231	361	516
160	14.9		33.6	60	94	134	239	373	533
170	15.3		34.7	61	96	138	246	384	548
180	15.8		35.7	63	99	143	254	396	564
190	16.2		36.6	65	102	146	260	406	579
200	16.5		37.6	67	105	150	267	417	594
210	17.1		38.[illegible]	68	107	154	273	426	608
220	17.5		39.4	70	110	157	280	436	622
230	17.7		40.4	71	112	161	286	447	637
240	18.2		41.2	73	114	164	292	456	651
250	18.6		42	75	117	168	298	466	665
260	19.0		43	76	119	171	304	—	—
270	19.4		43.7	78	121	174	310	—	—
280	19.7		44.5	79	124	178	316	—	—
290	20.0		45.4	80	126	181	322	—	—
300	20.4		46.2	82	128	184	327	—	—

NOTE: Heavy black line indicates pressure limits of 1856M(C)

TAB PLACEMENT HERE

DESCRIPTION:

Valves

☐ Tab page did not contain hand written information

☑ Tab page contained hand written information
*Scanned as next image

Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

Simmons

AMERICAN MADE

Foot Valves
Check Valves

Simmons Manufacturing Company

Post Office Box 509 McDonough, Georgia 30253

Telephone (404) 957-3976

887-2 Printed in U.S.A.

Simmons

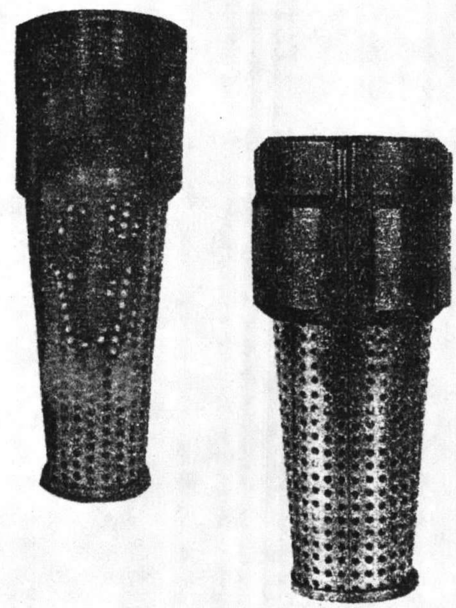
AMERICAN MADE

Simmons

Check these outstanding features . . . of Simmons Foot and Check Valves

- "O" RING—BUNA "N". . . Suited for hot and cold water, in a full range of sizes.
- CAST BRONZE POPPET. . . One piece construction, with stainless steel self-locking nut.
- MONEL POPPET SPRING . . . This premium quality spring is used on all Simmons valves . . . both foot and check.
- VALVE SEAT. . .Tapered for positive sealing and self-cleansing.
- CAST BRONZE VALVE BODY. . . Durable, heavy, one-piece construction—same composition as bronze poppet.

400 Series
Foot Valve



Available with solid brass perforated strainer as shown or with stainless steel perforated strainer.

MADE IN AMERICA

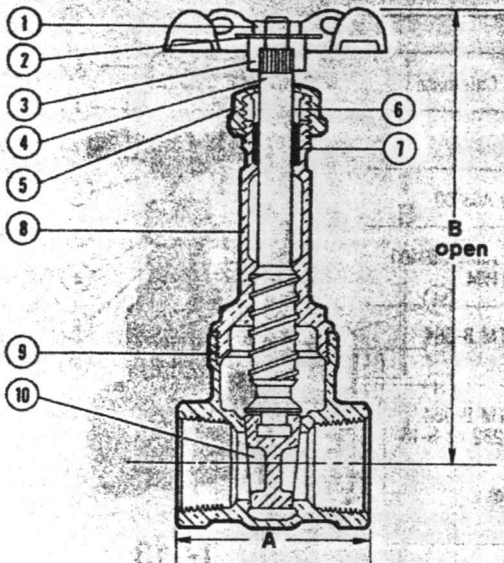
NIBCO

class 125 bronze gate

Screw-in Bonnet • Rising Stem • Solid Wedge

125 PSI Steam to 406°F or 207°C
200 PSI Non-Shock Cold Water, Oil, or Gas

Conforms to MSS SP-80
(MSS SP-80 replaces Federal Spec. WW-V-54 cancelled April, 1983)



T-111 N.P.T. to N.P.T.

MATERIAL LIST

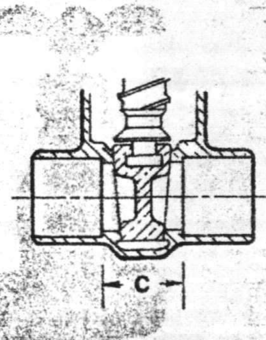
PART	SPECIFICATION
1. Handwheel Nut	Zinc Plated Steel with Clear Chromate
2. Identification Plate	Aluminum
3. Handwheel	Aluminum ASTM B-85, Alloy A03800
4. Stem	Silicon Bronze ASTM B-371 Alloy C69400 or ASTM B-99 Alloy C65100 H04
5. Packing Nut	Bronze ASTM B-62 or ASTM B-584 Alloy C84400
6. Packing Gland	Bronze ASTM B-62 or ASTM B-584 Alloy C84400 or ASTM B-282 or B-16
7. Packing	TFE Impregnated Asbestos or Non Asbestos Fibres
8. Bonnet	Bronze ASTM B-62
9. Body	Bronze ASTM B-62
10. Wedge	Bronze ASTM B-62

T-111
threaded

DIMENSIONS — WEIGHTS — QUANTITIES

Nominal Size	Dimensions A	Dimensions B	Dimensions C	Approx. Net Wt. T-111	Approx. Net Wt. S-111	Master Carton Quantity
1/4†	1 11/16	4 5/8	11/16	.6	x	100
3/8†	1 11/16	4 5/8	11/16	.6	.6	100
1/2†	1 15/16	4 7/8	3/4	.7	.6	100
3/4	2 1/16	5 13/16	7/8	1.0	.9	50
1	2 7/16	7 3/32	1	1.7	1.5	30
1 1/4	2 5/8	8 1/8	1 3/16	2.4	2.1	20
1 1/2	2 7/8	9 13/16	1 1/4	3.3	3.1	10
2	3 1/16	11 9/16	1 5/16	5.0	4.7	10
2 1/2	4 1/8	14 5/16	1 13/16	10.5	9.4	4
3	4 1/2	16 1/2	1 15/16	15.0	13.3	4

† No packing gland, packing only in these sizes.
x Not available this size



S-111 Copper to Copper

S-111
solder

MADE IN AMERICA

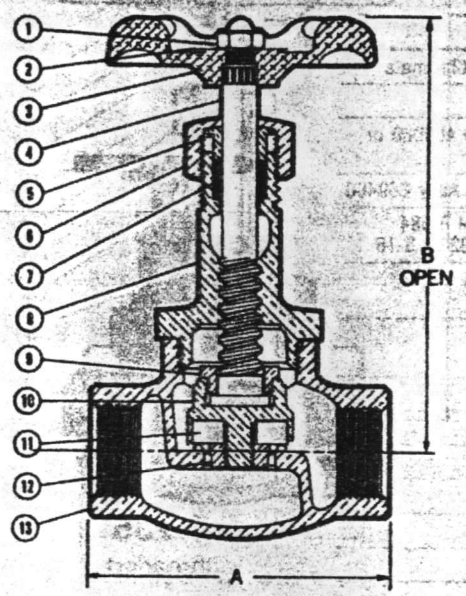
NIBCO

class 125 bronze globe

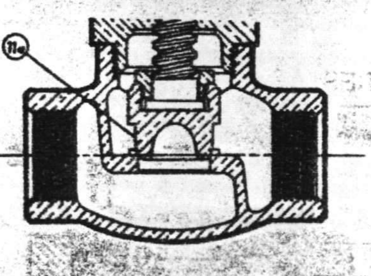
Screw-in Bonnet • Integral Seat • Renewable Discs

125 PSI Steam to 406°F or 207°C
200 PSI Non-Shock Cold Water, Oil, or Gas

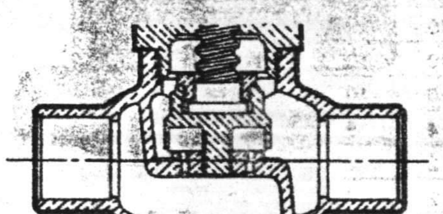
Conforms to MSS SP-80
(MSS SP-80 replaces Federal Spec. WW-V-51 cancelled April, 1983)



T-211-Y N.P.T. to N.P.T.



T-211-B N.P.T. to N.P.T.



S-211-Y Copper to Copper

MATERIAL LIST

PART	SPECIFICATION
1. Handwheel Nut	Zinc Plated Steel with Clear Chromate
2. Identification Plate	Aluminum
3. Handwheel	Aluminum ASTM B-85 Alloy A03800
4. Stem	Silicon Bronze ASTM B-371 Alloy C69400
5. Packing Gland	Bronze ASTM B-62 or ASTM B-584 Alloy C84400 or ASTM B-282 or B-16
6. Packing Nut	Bronze ASTM B-62 or ASTM B-584 Alloy C84400
7. Packing	TFE Impregnated Asbestos or Non Asbestos Fibres
8. Bonnet	Bronze ASTM B-62
9. Disc Holder Nut	Bronze ASTM B-140 Alloy C31400 or B-62
*10. Disc Holder	Bronze ASTM B-62
11. Seat Disc	Water, Oil or Gas Steam (TFE) (Y)
*11a. Seat Disc	Bronze ASTM B-62 (B)
*12. Disc Nut	Bronze ASTM B-62
13. Body	Bronze ASTM B-62

*The Bronze Disc does not require a Disc Nut. When converting from (B) Disc to (Y), Disc, order Disc Nut (12) and Disc Holder (10) and proper disc (11).

NOTE: S-211 not available with (B) Disc.

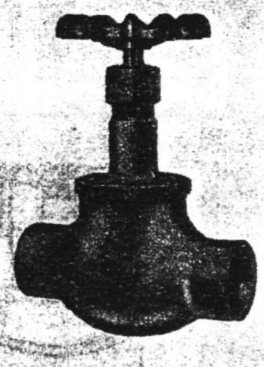
DIMENSIONS — WEIGHTS — QUANTITIES

Nominal Size	Dimensions A	B	C	Approx. Net Wt. T-211	S-211	Master Carton Quantity
*1/8†	2 3/8	3 3/8	1 13/16	.9	.8	50
*1/4†	2 3/8	3 3/8	1 13/16	.9	.8	50
*3/8†	2 3/8	3 3/8	1 13/16	.8	.8	50
*1/2†	2 9/16	3 3/8	1 11/16	.9	.8	50
3/4	3 1/16	4 3/4	2 1/4	1.6	1.7	30
1	3 11/16	5 11/16	2 13/16	2.6	2.7	20
1 1/4	4 5/16	6 1/8	3 1/16	3.5	3.3	10
1 1/2	4 11/16	7 3/16	3 9/16	5.5	4.9	10
2	5 5/8	7 15/16	4 5/16	8.0	7.8	6
2 1/2	6 5/8	10 3/16	5 1/4	15.5	15.4	2
3	7 3/4	11 3/16	6 1/2	22.2	20.1	2

* Stem and Disc (or Disc Holder) are integral.
† No packing gland, packing only in these sizes.

ORDERING: T-211 is normally furnished with a TFE Steam Disc (T-211-Y) Available with Bronze Disc (T-211-B) S-211 is furnished only with TFE Disc (S-211-Y).

T-211
threaded



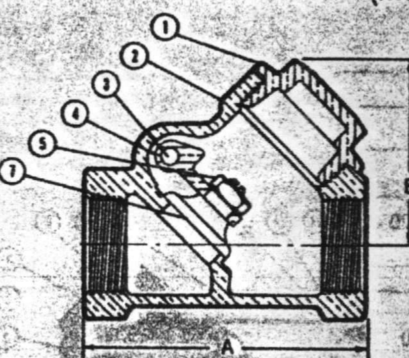
S-211
solder

class 125 bronze check

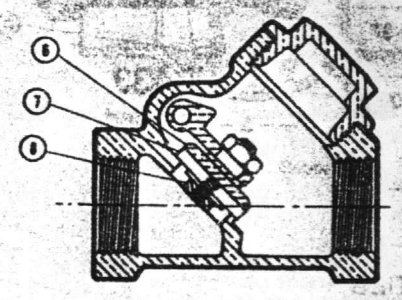
Horizontal Swing • Regrinding Type • Y-Pattern • Renewable Discs

125 PSI Steam to 406°F or 207°C
200 PSI Non-Shock Cold Water, Oil, or Gas

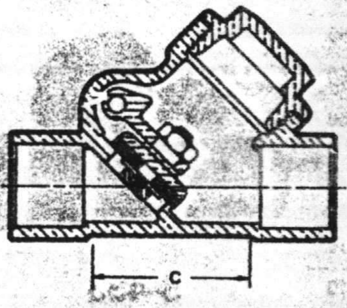
Conforms to MSS SP-80
(MSS SP-80 replaces Federal Spec. WW-V-51 cancelled April, 1983)



T-413-B N.P.T. to N.P.T.



T-413-Y N.P.T. to N.P.T.

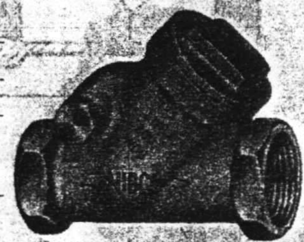


S-413-W Copper to Copper

MATERIAL LIST

PART	SPECIFICATION
1. Bonnet	Bronze ASTM B-62
2. Body	Bronze ASTM B-62
3. Hinge Pin	Bronze ASTM B-140 Alloy C31400 or B-134 Alloy C23000
4. Disc Hanger	Bronze ASTM B-62
5. Hanger Nut	Bronze ASTM B-97 Alloy C65500
6. Disc Holder	Bronze ASTM B-62
7. Seat Disc	Water, Oil or Gas (Buna-N) (W) Steam (TFE) (Y) Bronze ASTM B-62 (B) Screw Driver Slot for Regrind
8. Seat Disc Nut	Bronze ASTM B-16 or B-62, or B-97 Alloy C65500
9. Hinge Pin Plug (Not Shown)	Bronze ASTM B-140 Alloy C32000
*10. Seat Disc Washer	ASTM B-124 Alloy C65500

*Sizes ¾", 1", 1¼", and 1½" only.



T-413
threaded

S-413
solder

DIMENSIONS — WEIGHTS — QUANTITIES

Nominal Size	Dimensions A	Dimensions B	Dimensions C	Approx. Net Wt. T-413	Approx. Net Wt. S-413	Master Carton Quantity
$\frac{1}{4}$	$2\frac{1}{8}$	$1\frac{5}{8}$	$1\frac{1}{4}$	.5	.5	50
$\frac{3}{8}$	$2\frac{1}{8}$	$1\frac{5}{8}$	$1\frac{5}{16}$	.5	.5	50
$\frac{1}{2}$	$2\frac{7}{16}$	$1\frac{11}{16}$	$1\frac{1}{2}$	.6	.5	50
$\frac{3}{4}$	$2\frac{15}{16}$	$1\frac{7}{8}$	$1\frac{7}{8}$	1.0	.8	50
1	$3\frac{9}{16}$	$2\frac{5}{16}$	$2\frac{1}{4}$	1.5	1.2	30
$1\frac{1}{4}$	$4\frac{3}{16}$	$2\frac{11}{16}$	$2\frac{3}{4}$	2.2	1.8	20
$1\frac{1}{2}$	$4\frac{1}{2}$	$2\frac{15}{16}$	$3\frac{1}{8}$	2.9	2.5	10
2	$5\frac{1}{4}$	$3\frac{13}{16}$	$3\frac{3}{4}$	5.0	4.2	10
$2\frac{1}{2}$	8	$5\frac{1}{16}$	$5\frac{5}{16}$	12.0	10.5	5
3	$9\frac{1}{4}$	$6\frac{1}{4}$	$6\frac{1}{4}$	18.2	15.5	4

ORDERING: T-413 and S-413 normally furnished with Bronze Disc (T-413-B) or (S-413-B). Both available with TFE Steam Disc (T-413-Y), (S-413-Y), or W.O.G. Disc (T-413-W), (S-413-W).

NIBCO check valves may be installed in both *horizontal* and *vertical* lines with upward flow or in any intermediate position. They will operate satisfactorily in a declining plane (no more than 15°).

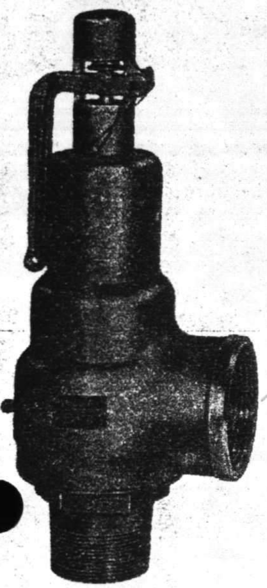
WARNING — Do Not Use For Reciprocating Air Compressor Service.

FIGURE 6000

BRONZE SAFETY VALVES

High Capacity, Full Nozzle

A.S.M.E. Standard—N.B. Certified



PRESSURE SETTINGS:
STEAM TO 250 PSI. 406° F.
AIR/GAS TO 300 PSI. 300° F.

Forged copper alloy—disc and full nozzle. Seats lapped to optical flatness. Valve housing is heavy cast bronze. Wide hex on body provides ample wrench clearance for easy installation. Factory tested and adjusted for precise opening without simmer, and for correct blowdown.

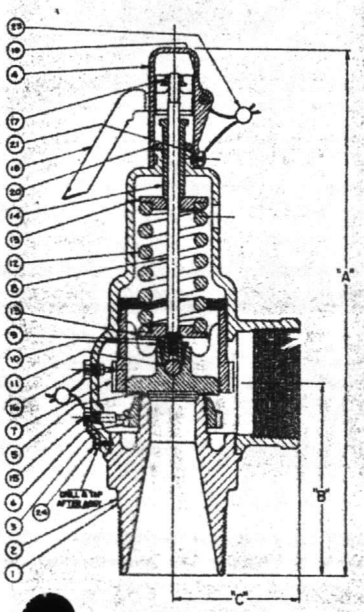
APPLICATIONS

Steam boilers, generators, lines, unfired vessels. Compressor intercoolers, aftercoolers, receivers.

PARTS LIST

ITEM	DESCRIPTION	MATERIAL	ITEM	DESCRIPTION	MATERIAL
1	Body	Forged Copper Alloy	14	Pressure Screw	Brass
3	Cap	Bronze	15	Reg. Ring Set Screw	Brass
4	Hood	Brass Die Cast	16	Guide Set Screw	Brass
5	Disc	Forged Copper Alloy	17	Lift Nut	Steel-Cad. Plated
6	Regulator ring	Bronze	18	Lever	Stl. Stamp Br. Plt.
7	Guide	Bronze	19	Spring Pin	Stn. Stl.
8	Spindle	Steel-Cad. Plated	20	Press. Screw L'Nut	Brass
9	Spindle Retainer	Brass	21	Hood Set Screw (FHMS)	Brass Pl.
10	Sp. Retainer Locknut	Brass	22	Name Plate Screw (Dr.)	Steel Brs. Plt.
11	Ball	St. Steel	23	Seal	Lead & Wire
12	Spring	Steel-Cad. Plated	24	Body Set Screw	Stl. Brs. Plt.
13	Spring Plate (top)	Steel-Cad. Plated		Name Plate	Brass
			25	Vibration Damp. Sp.	Ph. Br.

*Item 25—Optional at Extra Cost. (Not Shown)



DIMENSIONS

Inlet × Orifice × Outlet	Figure Number	Discharge Area Sq. In.	Connections Inlet "D"	Connections Outlet "E"	Overall Height "A"	CL to Inlet "B"	CL to Outlet "C"	Approx. Wt. Lbs.
½ × D × ¾	6000-D-1	0.121	½"M.	¾"FE.	6⅜	2⅛	1⅝	1½
¾ × D × ¾	6000-D-2	0.121	¾"M.	¾"FE.	6⅜	2⅛	1⅝	1¾
¾ × E × 1	6000-E-1	0.216	¾"M.	1" FE.	7½	2⅜	1¾	2½
1 × E × 1	6000-E-2	0.216	1" M.	1" FE.	7⅝	2½	1¾	2¾
1 × F × 1¼	6000-F-1	0.338	1" M.	1¼"FE.	8½	2⅝	2	3¾
1¼ × F × 1¼	6000-F-2	0.338	1¼"M.	1¼"FE.	8⅝	2⅞	2	4
1¼ × G × 1½	6000-G-1	0.554	1¼"M.	1½"FE.	9⅝	3⅛	2⅜	5¾
1½ × G × 1½	6000-G-2	0.554	1½"M.	1½"FE.	9⅞	3⅜	2⅜	6
1½ × H × 2	6000-H-1	0.863	1½"M.	2" FE.	10⅝	3⅝	2¾	8
2 × H × 2	6000-H-2	0.863	2" M.	2" FE.	11⅛	4⅛	2¾	8½
2 × J × 2½	6000-J-1	1.414	2" M.	2½"FE.	13⅝	4¼	3⅜	14½
2½ × J × 2½	6000-J-2	1.414	2½"M.	2½"FE.	13⅞	4½	3⅜	15

CAPACITIES

See page 3

Manufactured for Spirax Sarco, Inc. by Kunkle Valve Co.

FIGURE 6000 SERIES

CAPACITY IN POUNDS OF SATURATED STEAM PER HOUR

To correct capacities for superheat see page 6

ORIFICE	D		E		F		G		H		J	
AREA	.121 sq. in.		.216 sq. in.		.338 sq. in.		.554 sq. in.		.863 sq. in.		1.414 sq. in.	
Set Pressure PSIG	Lbs./Hour Steam 3% Acc.	Lbs./Hour Steam 10% Acc.	Lbs./Hour Steam 3% Acc.	Lbs./Hour Steam 10% Acc.	Lbs./Hour Steam 3% Acc.	Lbs./Hour Steam 10% Acc.	Lbs./Hour Steam 3% Acc.	Lbs./Hour Steam 10% Acc.	Lbs./Hour Steam 3% Acc.	Lbs./Hour Steam 10% Acc.	Lbs./Hour Steam 3% Acc.	Lbs./Hour Steam 10% Acc.
5	99	110	176	196	275	308	450	504	703	786	1153	1289
10	124	140	221	250	347	391	568	641	886	1001	1453	1640
15	150	170	267	303	418	475	685	778	1069	1215	1752	1991
20	175	200	312	357	489	558	802	916	1251	1429	2051	2342
25	201	230	358	410	561	642	919	1053	1434	1644	2350	2693
30	226	260	404	464	632	725	1036	1191	1616	1858	2650	3045
35	252	290	449	517	703	809	1152	1328	1799	2072	2949	3396
40	278	320	495	571	775	893	1269	1465	1981	2286	3248	3747
45	303	350	540	625	846	977	1386	1602	2164	2500	3547	4098
50	329	380	586	678	918	1061	1503	1739	2347	[illegible]714	3846	4449
55	354	410	631	732	989	1145	1620	1876	2529	2928	4146	4800
60	386	440	677	785	1060	1229	1737	2014	2711	3142	4445	5151
65	405	470	723	839	1132	1312	1854	2151	2894	3356	4744	5503
70	431	500	768	892	1203	1396	1971	2289	3076	3570	5043	5854
75	457	530	814	946	1274	1479	2088	2426	3259	3784	5343	6205
80	482	560	860	1000	1346	1563	2205	2563	3441	3999	5642	6556
85	508	590	905	1053	1417	1647	2322	2700	3624	4213	5941	6907
90	533	620	950	1106	1489	1731	2439	2837	3806	4427	6240	7258
95	559	650	996	1159	1560	1815	2556	2974	3989	4641	6540	7609
100	586	680	1042	1212	1631	1899	2673	3111	4171	4855	6839	7960
105	610	710	1087	1265	1703	1983	2790	3248	4354	5069	7138	8311
110	636	740	1133	1319	1774	2067	2907	3385	4536	5283	7437	8662
115	661	770	1178	1372	1845	2151	3024	3522	4719	5497	7736	9013
120	687	800	1224	1425	1917	2235	3141	3660	4901	5711	8036	9365
125	712	830	1269	1479	1988	2318	3258	3797	5084	5925	8335	9716
130	738	860	1315	1532	2060	2402	3375	3935	5266	6140	8634	10067
135	764	890	1361	1586	2131	2486	3492	40[illegible]2	5449	6354	8933	10418
140	789	920	1406	1640	2202	2569	3608	4[illegible]09	5632	6568	9233	10769
145	815	950	1452	1694	2273	2653	3725	[illegible]346	5814	6782	9532	11120
150	840	980	1497	1747	2345	2736	3842	[illegible]483	5997	6996	9831	11471
160	891	1040	1588	1853	2488	2904	4076	4757	6362	7424	10430	12173
170	943	1100	1680	1961	2631	3071	4310	5032	6727	7832	11028	12875
180	994	1160	1771	2068	2773	3239	4544	5306	7092	8281	11627	13578
190	1045	1220	1862	2174	2916	3406	4778	5581	7457	8709	12225	14280
200	1096	1280	1953	2282	3059	3574	5012	5855	7822	9138	12824	14982
210	1147	1340	2044	2389	3202	3642	5246	6130	8187	9566	13422	15684
220	1198	1400	2135	2496	3344	3809	5480	6404	8552	9994	14021	16386
230	1249	1460	2226	2603	3487	4077	5714	6678	8917	10423	14619	17088
240	1301	1520	2318	2710	3630	4244	5948	6953	9282	10851	15218	17790
250	1352	1580	2409	2816	3773	4411	6181	7227	9647	11279	15816	18492

Lbs./Hour Steam, 90% basis
3% Accumulation

The capacities shown in these columns are for saturated steam and apply to valves for use on power boilers in accordance with current A.S.M.E. Code, Section I.

Lbs./Hour Steam, 90% basis
10% Accumulation

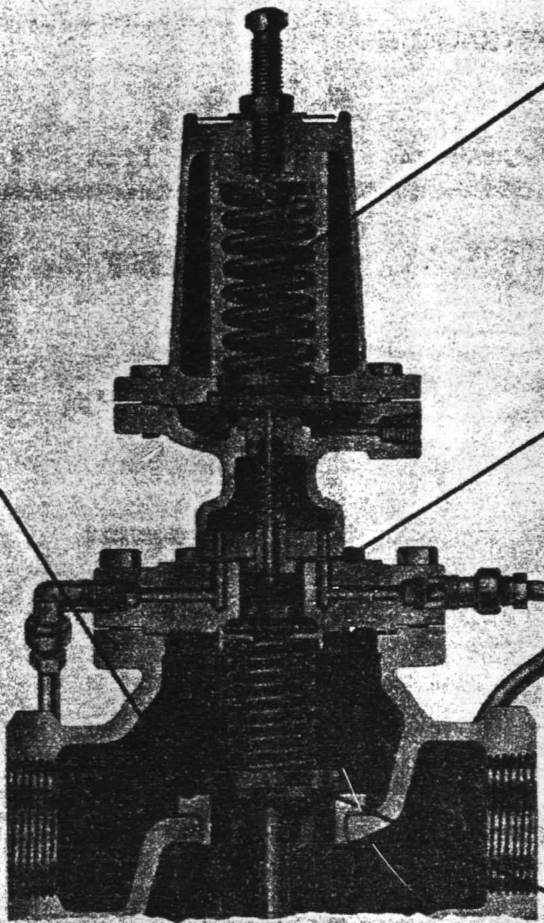
The capacities shown in these columns are for saturated steam and are in accordance with A.S.M.E. Unfired Pressure Vessel Code, Section VIII.

Note: For Air/Gas Capacity Please Contact The Factory.

FEATURES OF THE 25-SERIES REGULATORS FOR PRESSURE

High-Performance Materials

Sarco builds 25-Series Regulators with high-quality heat- and corrosion-resisting materials at all critical points. For example, valve stems are stainless steel; head and seat are hardened stainless steel; diaphragms are two-ply phosphor bronze; and pilot valve seals are Teflon. The engineering design has been thoroughly proven in service.



Interchangeable Pressure Pilot Springs

The pressure pilot accommodates any one of three easily interchangeable pilot springs—each designed to give best performance in a given pressure range. Pilot springs are color coded by Sarco for error-free selection. Spring installation is a quick, simple task.

Choice of Pilots

Shown here with a pressure pilot, these Sarco regulators are also available with multiple-pilot combinations. An electrically actuated auxiliary pilot can be used with either the pressure or temperature pilot. Pressure and temperature pilots can be combined on one valve body, and this combination can have an electrically actuated auxiliary pilot. Or, an electric pilot alone can operate the valve for on-off control. All pilots and all their combinations are interchangeable.

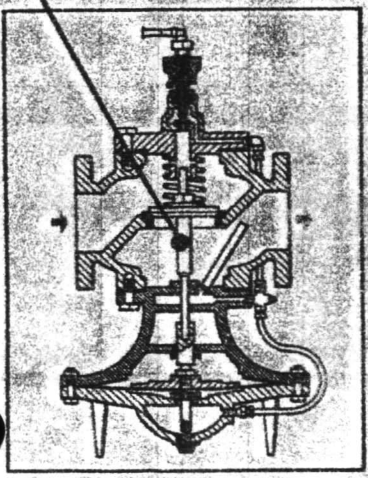
Low Maintenance Cost

Whenever inspection or maintenance does become necessary, a Sarco 25 Regulator saves downtime and labor because all its key parts are more readily accessible than corresponding parts of any other currently available regulator valve. For example, with the body cap removed, the main valve head lifts off its stem, and the seat comes out with a conventional hex socket wrench. The extreme simplicity of these and other maintenance operations is a long-term user benefit.

Dead-End Shutoff

Whenever a pilot valve closes, the single-seated main valve shuts off tight. No leakage! The main valve return spring plus steam pressure acting on the valve head insure dead-end shutoff.

Proportions and details are somewhat different in larger, flanged valve bodies. Principles are the same.



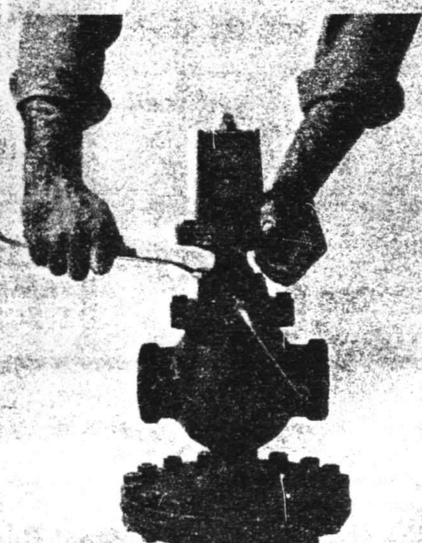
Easier Pilot Interchangeability

Inventories can be reduced considerably, because it is not necessary to stock each valve size you will need with every type of pilot control it might require. Just put the desired pilot on the right size valve. Sarco will be glad to ship valves and pilots boxed separately so that they can be assembled as required without the trouble of switching components.

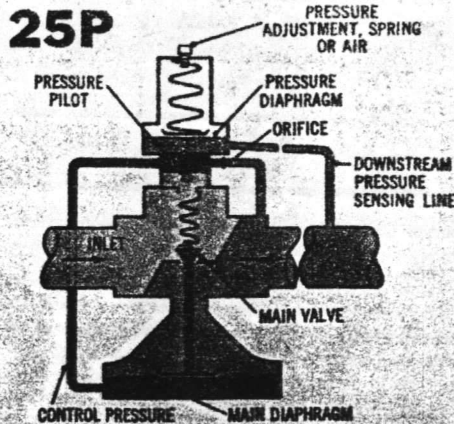
It has always been possible to install any type of pilot—or combination of pilots—on a 25-Series valve body. Now it is easier than ever.

No need to change integral tubing connection: Just bolt the pilot you select to the flanged cover plate. Or bolt on the flanged adapter plate and install a combination of two or three pilots on the same valve body. These are simple jobs, and they take only a few minutes.

Any size 25-Series valve body—from ½-inch to 6-inch—can be equipped for any functional operating mode in exactly the same way. Pilots are completely interchangeable.



PRESSURE REDUCING VALVE TYPE 25P



The 25P is an accurate, reliable regulator that allows steam from a high pressure supply to be used at a more economical low pressure, and protects valuable equipment from overpressure.

HOW THE 25P, 25PA & 25PI WORK

Normal positions before start-up are with the main valve closed and the pilot valve held open by spring force or air pressure. Entering steam passes through the pilot valve into the main diaphragm chamber and out through the control orifice. As flow through the pilot valve exceeds flow through the orifice, control pressure increases in the diaphragm chamber, and that opens the main valve. As steam flows through the main valve, the increase in downstream pressure feeds back through the pressure sensing line to the underside of the pressure diaphragm. When the force below that diaphragm balances the compression force of the spring above it, the pilot valve throttles. The control pressure maintained in the main diaphragm chamber positions the main valve to deliver just enough steam for the desired delivery pressure. Adjustment of the spring or air pressure above the pressure diaphragm changes the downstream pressure set point. When steam is not longer required, the Sensing Line pressure increases closing the pressure pilot and the control pressure bleeds back through the control orifice. This allows the main valve to hold the desired reduced pressure and it may close tight for a dead-end shutoff.

HOW TO SIZE AND INSTALL THE 25P PRESSURE REDUCING VALVE

From the inlet and reduced pressure conditions select the standard or reduced port valve, from page 12 or 13, which meets the actual steam capacity requirements. Reduced port valves have less capacity for lower steam velocities through the valve. Satisfactory performance and low maintenance depends on selecting the valve correctly. An undersized valve will not be able to hold the reduced pressure under maximum load conditions. An oversized valve may hunt because the main valve will be barely cracked open, and can subject the valve seat and head to premature wear.

Complete the valve section with the pilot Valve Spring Color which meets the downstream pressure condition.

How to order

When ordering a Sarco 25P Pressure Reducing Valve, please include all the following data:

- valve size by nominal pipe/flange size
- body construction of cast iron or cast steel
- type of control—25P for pressure reduction
- steam supply pressure
- reduced pressure range and color of pilot valve spring selected
- intended application

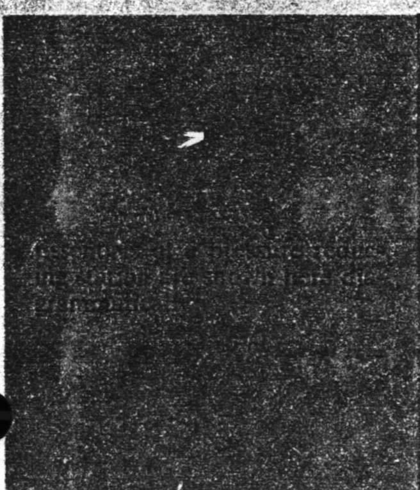
For example: Sarco 1″ Cast Iron Pressure Reducing Valve Type 25P for 150 psig inlet pressure, yellow spring for 3 to 30 psig reduced pressure, for 15 psig process heating.

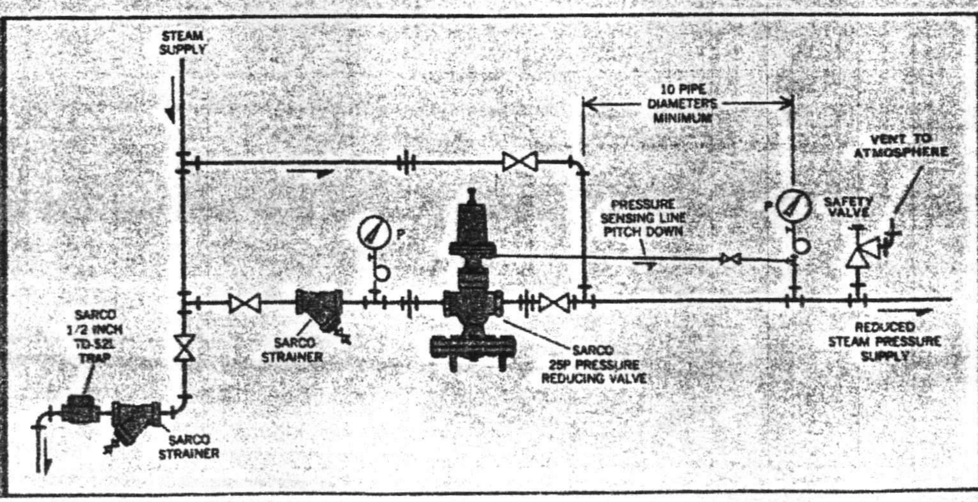
Piping layout should be planned so that the reducing valve will be on a horizontal run with bypass piping provided so that the system can be operated under manual control while the reducing valve is isolated for servicing.

Pipe sizes should be determined on the basis of steam velocity and sized from the table on page 19. The reducing valve, sized from the table on page 12 or 13, is likely to be smaller than inlet piping and will almost always be smaller than downstream piping.

PILOT VALVE SPRING RANGES

Downstream Pressure	Color Code
3 to 30 psig	YELLOW
20 to 100 psig	BLUE
80 to 250 psig	RED





CAPACITIES FOR STANDARD 25P-25PA-25PI-25PE VALVES

pounds of saturated steam per hour

INLET STEAM PRESSURE, PSIG	OUTLET STEAM PRESSURE, PSIG	NOMINAL VALVE SIZE ½″	¾″	1″	1¼″	1½″	2″	2½″	3″	4″	6″
[redacted]											
15	10	95	175	285	380	540	950	1,500	2,000	3,100	7,000
	5	135	250	405	545	780	1,365	2,185	2,890	4,480	10,170
	3	155	285	465	620	880	1,550	2,470	3,260	5,080	11,440
20	12	120	230	365	490	700	1,225	1,960	2,590	4,025	9,100
	8	155	290	470	630	900	1,575	2,520	3,330	5,175	11,700
	0-5	180	335	540	720	1,025	1,795	2,870	3,790	5,895	13,325
25	15	145	270	435	580	830	1,450	2,325	3,070	4,770	10,790
	10	195	360	580	775	1,110	1,950	3,110	4,110	6,385	14,430
	0-7	205	385	620	825	1,180	2,065	3,305	4,360	6,785	15,340
30	20	155	290	470	630	900	1,575	2,520	3,330	5,175	11,700
	15	220	410	665	890	1,270	2,220	3,555	4,700	7,300	16,510
	0-12	230	430	695	925	1,320	2,310	3,695	4,885	7,590	17,160
40	30	155	290	470	630	900	1,575	2,520	3,330	5,175	11,700
	25	250	470	755	1,010	1,440	2,520	4,030	5,330	8,280	18,720
	0-18	280	525	850	1,135	1,620	2,835	4,535	5,995	9,315	21,060
50	40	190	355	575	770	1,100	1,925	3,080	4,070	6,325	14,300
	30	315	585	955	1,275	1,820	3,185	5,095	6,735	10,465	23,660
	0-21	350	650	1,050	1,400	2,000	3,500	5,600	7,400	11,500	26,000
60	45	280	520	840	1,120	1,600	2,800	4,480	5,920	9,200	[illegible]
	35	360	670	1,080	1,440	2,060	3,605	5,770	7,620	11,845	[illegible]
	0-27	385	720	1,165	1,555	2,220	3,885	6,215	8,215	12,765	28,860
75	60	280	525	850	1,135	1,620	2,835	4,535	5,995	9,315	21,060
	50	415	775	1,250	1,665	2,380	4,165	6,665	8,800	13,685	30,940
	0-35	470	875	1,415	1,890	2,700	4,725	7,560	9,990	15,525	35,100
85	70	290	540	870	1,160	1,660	2,905	4,650	6,140	9,545	21,580
	50	490	915	1,480	1,975	2,820	4,935	7,895	10,435	16,215	[illegible]
	0-43	515	960	1,555	2,070	2,960	5,180	8,290	10,950	17,020	[illegible]
100	80	370	690	1,115	1,485	2,120	3,710	5,935	7,845	12,190	27,560
	60	580	1,080	1,740	2,325	3,320	5,810	9,295	12,285	19,090	43,160
	0-48	600	1,120	1,815	2,420	3,460	6,055	9,690	12,800	19,895	45,000
125	100	440	825	1,335	1,780	2,540	4,445	7,110	9,400	14,600	33,000
	80	680	1,275	2,060	2,745	3,920	6,860	10,975	14,500	22,540	50,960
	0-62	730	1,365	2,200	2,940	4,200	7,350	11,760	15,540	24,150	54,600
150	125	490	910	1,470	1,960	2,800	4,900	7,840	10,360	16,100	36,400
	100	800	1,490	2,400	3,205	4,580	8,015	12,825	16,945	26,335	59,540
	0-76	860	1,600	2,590	3,460	4,940	8,645	13,830	18,280	28,400	64,220
175	150	490	915	1,480	1,975	2,820	4,935	7,895	[illegible]	16,215	36,660
	125	870	1,630	2,635	3,515	5,020	8,785	14,055	[illegible]	28,865	65,260
	0-87	985	1,840	2,970	3,960	5,660	9,900	15,850	[illegible]	32,545	73,580
200	150	840	1,600	2,540	3,390	4,840	8,470	13,550	17,900	27,830	65,920
	125	1,075	2,000	3,240	4,330	6,180	10,815	17,300	22,870	35,530	80,340
	0-103	1,125	2,100	3,390	4,520	6,460	11,300	18,000	23,900	37,145	83,980
225	175	880	1,650	2,670	3,560	5,080	8,890	14,225	18,800	29,210	66,000
	150	1,160	2,180	3,500	4,660	6,660	11,655	18,650	24,640	38,300	86,600
	0-117	1,250	2,340	3,780	5,000	7,200	12,600	20,160	26,640	41,400	93,600
250	200	925	1,730	2,790	3,720	5,320	9,300	14,900	19,680	30,600	69,200
	150	1,340	2,500	4,050	5,400	7,720	13,500	21,600	28,600	44,400	100,360
	0-131	1,365	2,590	4,180	5,570	7,960	13,930	22,300	29,450	45,800	103,500
[redacted]											

*Cast steel construction required for service above 250 psig.

Capacities are based on an accuracy of regulation of 1. P.S.I. and with pipe sizes to insure reasonable steam velocities. Refer to pipe sizing Chart Page 19.

Bold faced numbers in outlet steam pressure column indicate pressures at which maximum capacity occurs. Lower outlet pressures do not increase valve capacity.

TAB PLACEMENT HERE

DESCRIPTION:

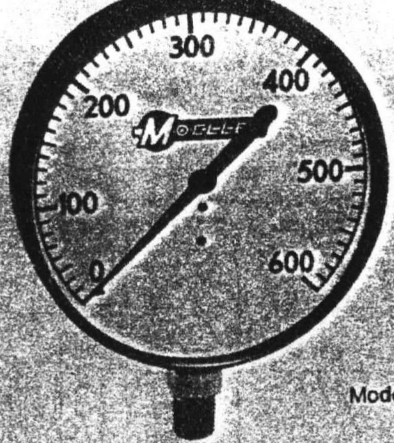
Gauges

☐ Tab page did not contain hand written information

☑ Tab page contained hand written information
*Scanned as next image

Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

MECHANICAL CONTRACTORS GAUGE



Model 413107

APPLICATION

Designed to meet the requirements of Heating, Ventilating and Air Conditioning contractors and equipment manufacturers.

SPECIFICATIONS

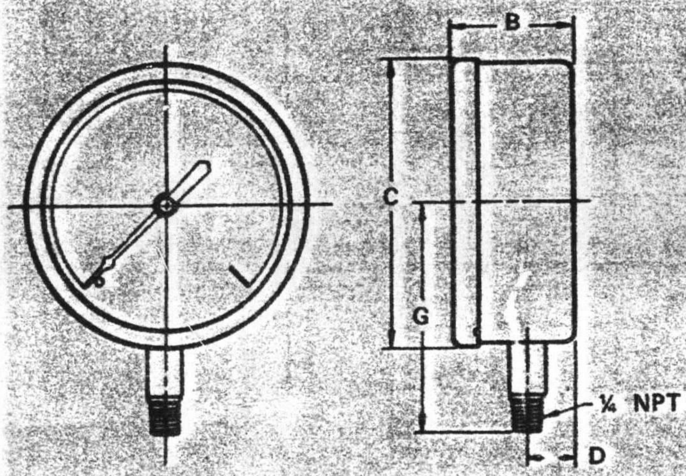
Accuracy: 1% in the working range. 1½% at upper and lower scale extremes. Meets ASA Grade A.

Case & Ring: Black enamel finish. 4½" drawn steel case with friction fit ring.

Dial: White metal dial with black figures and graduations. Plain balanced pointer Glass dial face.

Construction: Phosphor bronze bourdon tube with brass socket and tip. ¼" male NPT bottom connection.

Movement: Quality brass construction. Precision gears and finely finished bearing surfaces insure smooth motion and extended service life.

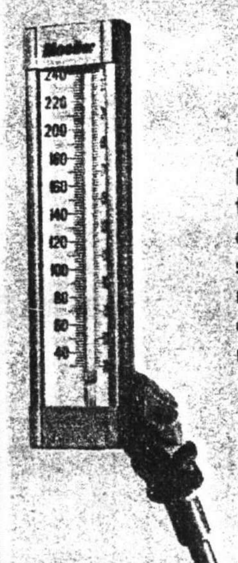


GAUGE SIZE	B	C	D	[illegible]
4-1/2	1-11/32	4-23/32	15/32	3-13/32

PRESSURE
0 - 30 psi
0 - 60 psi
0 - 100 psi
0 - 160 psi
0 - 200 psi
0 - 300 psi
0 - 600 psi

VACUUM
0 - 30" Hg.

COMPOUND
30" - 0 - 30 psi
30" - 0 - 60 psi



A NATURAL PARTNER for Moeller's "Award Winner" fully adjustable pipeline/air duct thermometer. Both designed expressly for the HVAC market. Both offer contractor-level specifications with maximum exonomy.

TAB PLACEMENT HERE

DESCRIPTION:

thermometers

☐ Tab page did not contain hand written information

☑ Tab page contained hand written information
*Scanned as next image

Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

MOELLER

MODEL 4000 & 4250

BACK ANGLE BIMET THERMOMETERS

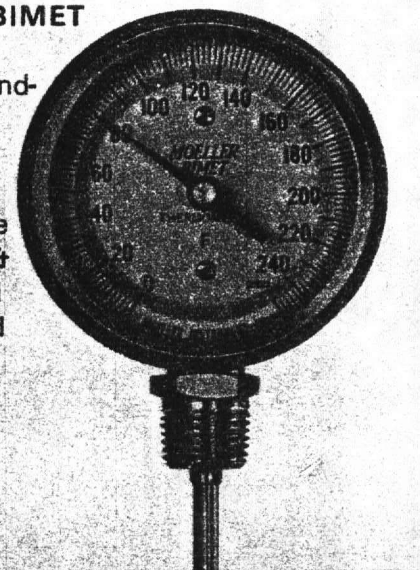
These rugged, fixed back angle thermometers are available in 2 different dial sizes, 5" (4000 series), 3" (4250 series) to fit all standard installations requiring this form. All standard stem lengths and ranges are available.

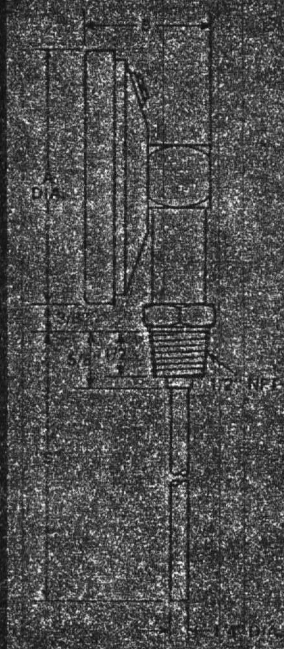
	A	B
4000	4 57/64	1 17/64
4250	3 13/64	13/16

MODEL 4500 & 4750

STRAIGHT FORM BIMET THERMOMETERS

As rugged and dependable as all Moeller BIMETS, the fixed bottom connected BIMETS are available in 5" (4500 series) & 3" (4750 series) dial sizes and are offered in all standard stem lengths and ranges.





	A	B
4500	[illegible]	[illegible]
4750	[illegible]	[illegible]

MOELLER BIMET

Moeller BIMET thermometers offer excellent performance for industrial process applications as well as general commercial and industrial use. Field proven for accurate and fast response to temperature changes, these rugged instruments feature weather proof and fume-proof cases with easy reading anti-parallax dials. Stainless steel construction gives maximum protection against corrosion.

FEATURES

- Weatherproof, fume-proof case with gasketed removable bezel, all 304 stainless steel construction.
- External calibration—simple zero reset screw adjustment at back of case.
- Stainless steel stems with all joints welded. Fixed or union connections.
- Anti-parallax scale, white aluminum dial with black easy reading numbers and graduations. Black finished, balanced pointer.
- BIMET helix—low mass, single coil is silicone dampened to limit pointer oscillation and accelerate heat transfer for faster response.
- Accuracy within 1% of included range.
- Clear extra heavy glass front standard. Plastic or shatterproof glass crystals available.

TAB PLACEMENT HERE

DESCRIPTION:

Traps

☐ Tab page did not contain hand written information

☒ Tab page contained hand written information
*Scanned as next image

Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

FT-15 to FT-125 SERIES

Sizes

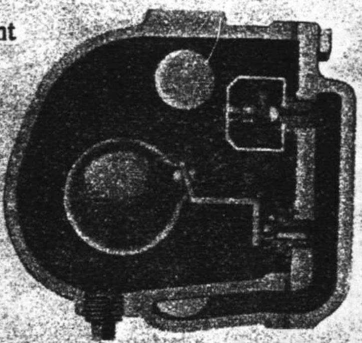
3/4'', 1'', 1 1/4'', 1 1/2'', 2''
All sizes supplied with thermostatic air vent containing a welded stainless steel bellows.

Materials

Body and Cover: Cast Iron
Internals: Stainless Steel

Pipe Connections

Screwed NPT



Features:

- Integral stainless steel air vent as standard.
- Corrosion resistant stainless steel float and main valve assembly.
- All working parts attached to cover. Removable for easy in-line maintenance.

Limiting Conditions

Maximum operating pressure of each trap series in determined by orifice size and is noted by trap type (Example: 3/4'' FT-75 equals 75 psi.

Options

All available without air vent and with optional NPT tapping as drain traps.
Some sizes can be supplied combined with steam lock release (SLR). Consult factory for details.

Typical Specification

Steam traps shall be of the mechanical ball float type having iron bodies with screwed connections and stainless steel heads and seats. Traps shall incorporate a stainless steel thermostatic air vent.

DIMENSIONS (Refer to Figure No.)

TYPE	SIZE NPT	See Fig. No.	A in.	A mm	B in.	B mm	C in.	C mm	D in.	D mm	E in.	E mm	F in.	F mm	APPROX. WEIGHT Lb.	APPROX. WEIGHT Kg.
FT-15	3/4''	1	6 3/16	157	4 5/8	117	3 5/16	84	3 1/32	77	5 3/4	146	1 5/16	33	9	4.1
FT-15	1''	1	6 3/16	157	4 5/8	117	3 5/16	84	3 1/32	77	5 3/4	146	1 5/16	33	9	4.1
FT-15	1 1/4''	1	6 3/16	157	4 11/16	119	3	76	2 27/32	72	5 3/4	146	1 1/2	38	9 1/2	4.3
FT-15	1 1/2''	2	8 1/2	216	4 1/4	108	3	76	11/16	17	8 3/8	213	3 1/2	89	18	8.2
FT-15	2''	2	9 13/16	249	4 7/8	124	4 15/16	125	1/8	3	9 1/16	230	1 15/16	49	26	11.8
FT-30	3/4''	1	6 3/16	157	4 5/8	117	3 5/16	84	3 1/32	77	5 3/4	146	1 5/16	33	9	4.1
FT-30	1''	1	6 3/16	157	4 5/8	117	3 5/16	84	3 1/32	77	5 3/4	146	1 5/16	33	9	4.1
FT-30	1 1/4''	1	6 3/16	157	4 11/16	119	3	76	2 27/32	72	5 3/4	146	1 1/2	38	9 1/2	4.3
FT-30	1 1/2''	2	8 1/2	216	4 1/4	108	3	76	11/16	17	8 3/8	213	3 1/2	89	18	8.2
FT-30	2''	2	9 13/16	249	4 7/8	124	4 15/16	125	1/8	3	9 1/16	230	1 15/16	49	26	11.8
FT-75	3/4''	1	6 3/16	157	4 5/8	117	3 5/16	84	3 1/32	77	5 3/4	146	1 5/16	33	9	4.1
FT-75	1''	1	6 3/16	157	4 5/8	117	3 5/16	84	3 1/32	77	5 3/4	146	1 5/16	33	9	4.1
FT-75	1 1/4''	2	8 1/2	216	4 1/4	108	3	76	11/16	17	8 3/8	213	3 1/2	89	18	8.2
FT-75	1 1/2''	2	8 1/2	216	4 1/4	108	3	76	11/16	17	8 3/8	213	3 1/2	89	18	8.2
FT-75	2''	3	9 13/16	249	4 7/8	124	4 15/16	125	1/8	3	9 1/16	230	1 15/16	49	26	11.8
FT-125	3/4''	1	6 3/16	157	4 5/8	117	3 5/16	84	3 1/32	77	5 3/4	146	1 5/16	33	9	4.1
FT-125	1''	1	6 3/16	157	4 5/8	117	3 5/16	84	3 1/32	77	5 3/4	146	1 5/16	33	9	4.1
FT-125	1 1/4''	2	8 1/2	216	4 1/4	108	3	76	11/16	17	8 3/8	213	3 1/2	89	18	8.2
FT-125	1 1/2''	2	8 1/2	216	4 1/4	108	3	76	11/16	17	8 3/8	213	3 1/2	89	18	8.2
FT-125	2''	3	9 13/16	249	4 7/8	124	4 15/16	125	1/8	3	9 1/16	230	1 15/16	49	26	11.8

DIFFERENTIAL PRESSURE

TYPE	SIZE NPT	psig / bar / Orifice	1/4 (.017)	1/2 (.035)	1 (.07)	2 (.14)	5 (.34)	10 (.69)	15 (1.0)	20 (1.4)	25 (1.7)	30 (2.1)	40 (2.8)	50 (3.5)	75 (5.2)	100 (6.9)	125 (8.6)
FT-15	3/4''	.218	279	369	489	650	785	1000	1075								
FT-15	1''	.218	279	369	489	650	785	1000	1075								
FT-15	1 1/4''	.312	600	770	980	1240	1640	2000	2340								
FT-15	1 1/2''	.500	1100	1700	2400	3300	5000	6600	7600								
FT-15	2''	.625	2300	2800	3600	4650	6900	9000	10900								
FT-30	3/4''	.218	279	369	489	650	785	1000	1075	1210	1300	1370					
FT-30	1''	.218	279	369	489	650	785	1000	1075	1210	1300	1370					
FT-30	1 1/4''	.228	375	500	690	910	1200	1500	1680	1800	1900	2000					
FT-30	1 1/2''	.390	1000	1300	1700	2300	3400	4600	5500	6000	6600	7000					
FT-30	2''	.500	1300	1800	2500	3400	5200	6800	7800	8600	9300	10000					
FT-75	3/4''	.166	160	213	280	365	520	700	795	875	930	970	1120	1230	1450		
FT-75	1''	.166	160	213	280	365	520	700	795	875	930	970	1120	1230	1450		
FT-75	1 1/4''	.312	550	725	960	1300	1900	2650	3050	3400	3700	4000	4400	4750	5400		
FT-75	1 1/2''	.312	550	725	960	1300	1900	2650	3050	3400	3700	4000	4400	4750	5400		
FT-75	2''	.421	850	1100	1500	2000	3100	4150	4750	5200	5500	5800	6400	6800	7700		
FT-125	3/4''	.125	100	135	175	230	330	415	500	565	620	665	750	830	970	1110	1190
FT-125	1''	.125	100	135	175	230	330	415	500	565	620	665	750	830	970	1110	1190
FT-125	1 1/4''	.246	400	520	680	890	1300	1700	2050	2300	2500	2700	3000	3200	3800	4200	4500
FT-125	1 1/2''	.246	400	520	680	890	1300	1700	2050	2300	2500	2700	3000	3200	3800	4200	4500
FT-125	2''	.332	550	675	880	1225	1950	2600	3000	3250	3500	3800	4200	4600	5500	6100	6600

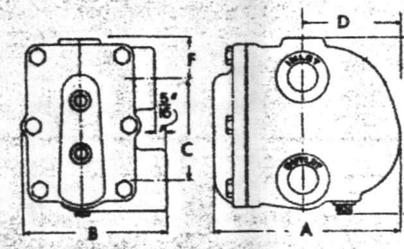


FIGURE 1

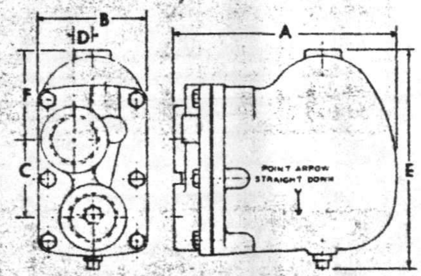


FIGURE 2

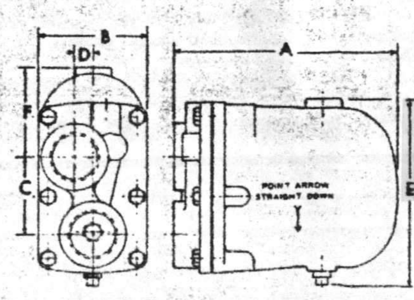


FIGURE 3

SARCO
Type B Inverted Bucket Steam Traps

Size	Standard	With Bimetal Air Vent (see Fig. 5)
½" or ¾"	B1-X	B12-X
¾"	B2	B22
1"	B3	B32
1¼"	B4	B42
2"	B5	B52

Type B1-X and B12-X traps with sta. steel buckets and monel strainers. All other traps with brass buckets and brass strainers. Optional stainless steel buckets and strainers available at extra cost.

When ordering, please see the opposite page and give the complete catalog number. Example of an order correctly written: one ¾" B2-125.

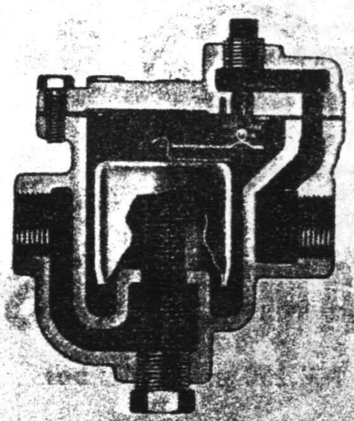


Fig. 3—Sarco type B1-X steam trap, sizes ½" or ¾".

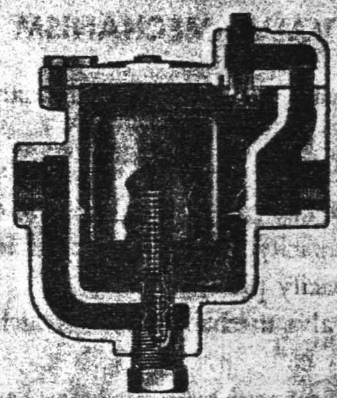


Fig. 4—Sarco type B steam trap, sizes ¾" to 2".

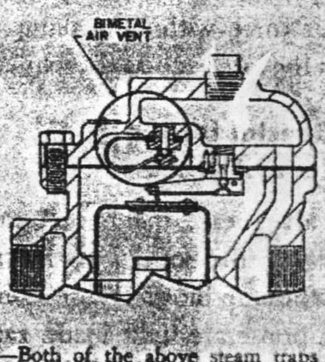
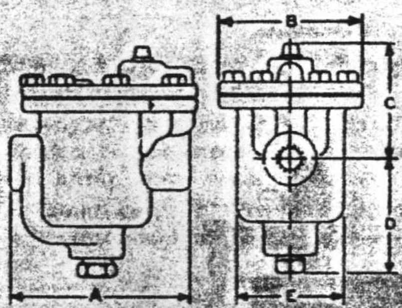


Fig. 5—Both of the above steam traps available with bimetal air vents. Please note that *all* bimetal vents close at about 210°F. and remain *closed* to air-steam mixtures which are often as much as 20°F. below steam temperature. When air venting is a problem, please see page 4 and select another type of steam trap.



Type B Inverted Bucket Traps

SIZE	TYPE	DIMENSION A	B	C*	C-1*	D	E	NET WT.
½ or ¾"	B1-X or B12-X*	5"	4"	3⅜"	3 13/16"	3"	2⅞"	6¼ Lb.
		[illegible]	102 mm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
¾"	B2 to B22	6⅝"	5 5/16"	3⅞"	4 1/16"	4¼"	3 15/16	12½ Lb.
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	100 mm	[illegible]
1"	B3 or B32	7⅞"	5⅞"	4½"	4 7/16"	4⅞"	4½"	19½ Lb.
		200 mm	149 mm	114 mm	[illegible]	124 mm	114 mm	[illegible]
1¼"	B4 or B42	9 5/16"	7"	5⅝"	5½"	7⅜"	5¼"	40 Lb.
		202 mm	178 mm	[illegible]	140 mm	[illegible]	[illegible]	[illegible]
2"	B5 or B52	11¼"	8¾"	6 13/16"	6⅝"	10¾"	6⅞"	75 Lb.
		[illegible]	222 mm	173 mm	168 mm	[illegible]	[illegible]	[illegible]

*C—For traps without air vents. C-1—For traps with bimetal vents.

Construction Details

Parts	Type B1-X B12-X	Type B2 to B5 B22 to B52
Body, Cover	Cast iron—ASTM A126, Class B	
Seat, head	stainless steel, hardened	
Mechanism	stainless steel	
Bucket	stainless steel	brass*
Strainer Screen	Monel* Mesh	brass* perf.
Seat gasket	stainless steel	
Cover gasket	graphite asbestos	
Cover screws	steel	

* Optional stainless steel buckets and strainers available at extra cost.

ALL TRAP BODIES ARE SUITABLE FOR 250 psig/17.2 bar
MAXIMUM OPERATING PRESSURE IS DETERMINED BY ORIFICE SIZE.

SPARE PARTS SHEET No. P10 AVAILABLE ON REQUEST

HOW TO SELECT SARCO BUCKET TRAPS

The tables below show the maximum capacities on continuous discharge at approximate steam temperature. Cold water discharge capacities are much higher.

When calculating the capacity requirement for the steam trap, use a safety factor of 2 or 3 times the normal load depending on the application. Then from the capacity table below select the trap with the required capacity and pressure range. Caution: Oversizing bucket traps, especially on light load applications such as main drips, can cause the trap to lose its seal and pass steam.

Be careful to select the inverted bucket trap with a seat suitable for the maximum pressure differential and with sufficient capacity to handle the load at the minimum expected pressure differential. The trap will not open if subjected to pressures above the orifice rating.

CAPACITY IN LBS. OF CONDENSATE PER HR.

INLET PRESSURE	TRAP SIZE →	1/2"—3/4"	3/4"	1"	1-1/4"	2"
1 - 15 psi	CAT. No.	B1-X — 15 B12-X — 15	B2 — 15 B22 — 15	B3 — 15 B32 — 15	B4 — 15 B42 — 15	B5 — 15 B52 — 15
	ORIFICE	1/4"	3/8"	1/2"	5/8"	1 1/16"
	1	665	1700	2140	3940	11,600
	2	715	1920	2330	4090	12,100
	3	755	2110	2600	4350	13,200
	5	835	2370	2920	4980	14,700
	10	960	2810	3590	5990	17,800
	15	1040	3220	3900	6560	20,000
5 - 30 psi	CAT. No.	B1-X — 30 B12-X — 30	B2 — 30 B22 — 30	B3 — 30 B32 — 30	B4 — 30 B42 — 30	B5 — 30 B52 — 30
	ORIFICE	3/16"	5/16"	3/8"	1/2"	3/4"
	5	615	1920	2340	4150	10,000
	10	715	2260	2840	4930	12,100
	15	810	2580	3230	5680	14,000
	20	895	2870	3630	6200	15,600
	25	945	3060	3900	6720	17,100
	30	1000	3220	4120	7140	18,500
10 - 75 psi	CAT. No.	B1-X — 75 B12-X — 75	B2 — 75 B22 — 75	B3 — 75 B32 — 75	B4 — 75 B42 — 75	B5 — 75 B52 — 75
	ORIFICE	5/32"	1/4"	9/32"	3/8"	9/16"
	10	500	1250	1970	3840	9,860
	20	610	1600	2500	4720	12,400
	30	705	1850	2860	5470	13,900
	40	770	2000	3120	6080	15,200
	60	905	2350	3640	7150	17,900
	75	965	2550	3960	7570	19,200
20 - 125 psi	CAT. No.	B1-X — 125 B12-X — 125	B2 — 125 B22 — 125	B3 — 125 B32 — 125	B4 — 125 B42 — 125	B5 — 125 B52 — 125
	ORIFICE	1/8"	13/64"	1/4"	11/32"	1/2"
	20	446	1100	2080	4450	10,800
	40	600	1440	2600	5530	13,500
	60	695	1700	3020	6350	15,600
	80	765	1900	3380	7110	17,100
	100	830	2080	3640	7750	18,900
	125	920	2240	4100	8540	20,000
60 - 180 psi	CAT. No.	B1-X — 180 B12-X — 180	B2 — 180 B22 — 180	B3 — 180 B32 — 180	B4 — 180 B42 — 180	B5 — 180 B52 — 180
	ORIFICE	3/32"	5/32"	7/32"	9/32"	7/16"
	60	585	1500	2580	4250	13,650
	80	642	1700	2830	4730	15,100
	100	703	1800	3070	5080	16,600
	125	765	1940	3380	5680	18,400
	150	816	2100	3580	5980	19,100
	180	867	2220	3780	6300	20,500
125 - 250 psi	CAT. No.	B1-X — 250 B12-X — 250	B2 — 250 B22 — 250	B3 — 250 B32 — 250	B4 — 250 B42 — 250	B5 — 250 B52 — 250
	ORIFICE	.070"	3/64"	3/16"	1/4"	3/8"
	125	562	1825	2760	4730	15,000
	150	600	1940	2910	4980	16,100
	175	630	2060	3120	5130	16,800
	200	665	2120	3380	5500	17,800
	225	695	2240	3460	5780	18,900
	250	720	2300	3630	6040	19,400

For Kg./Hr. multiply Lb./Hr. by .454

TAB PLACEMENT HERE

DESCRIPTION:

Circuit

Setters

☐ Tab page did not contain hand written information

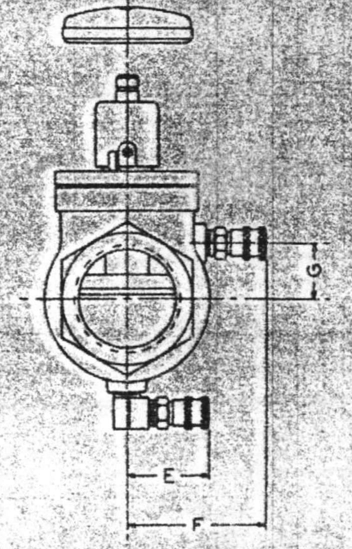
☑ Tab page contained hand written information
*Scanned as next image

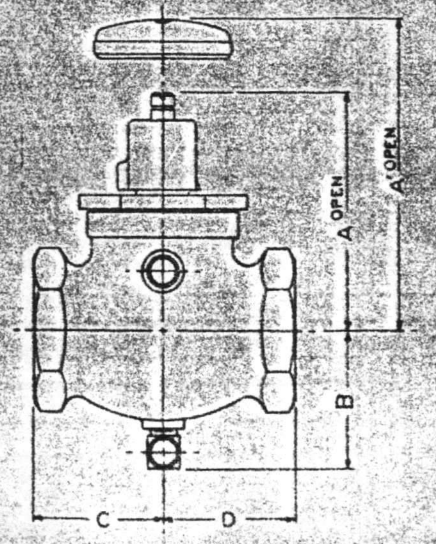
Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

TYPE MPP-G & MSS-G
METERED BALANCE MASTER RATINGS
300 psig 250°F/20.7 bar 121°C

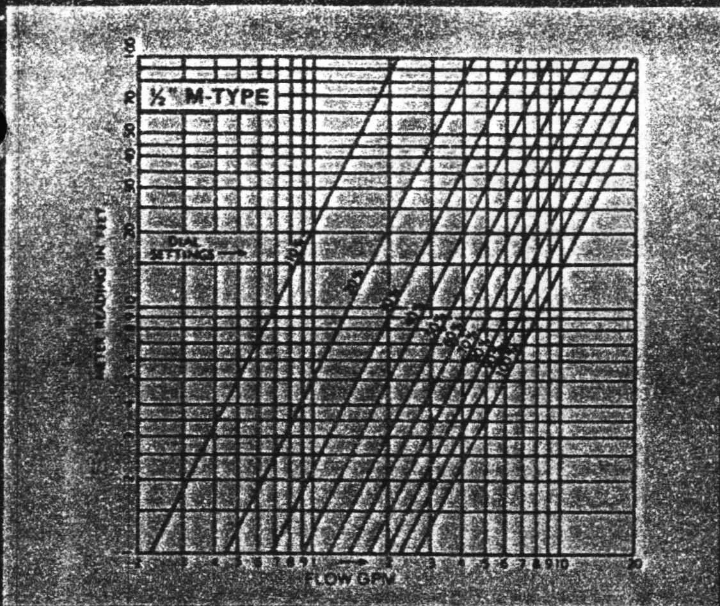
When precise flows must be supplied and maintained to any piece of terminal equipment or zone, the Spirax Sarco Metered Balance Master enables you to supply this need. To the many fine features of our Balance Master (calibrated dial, stop-balancing features, pre-set flow) we have now added the ability to measure the precise flow going through the valve. This is accomplished by a differential meter that measures the pressure drop across the valve. A simple graph then converts that reading to flow.
The Metered Balance Master and the Meter are equipped with "quick connectors" for quick-easy use. All measurements are made with the system in operation — no shut down is required.
And once the Metered Balance Master is set it will always return to the same flow after a shutdown.
All include wheel handle.

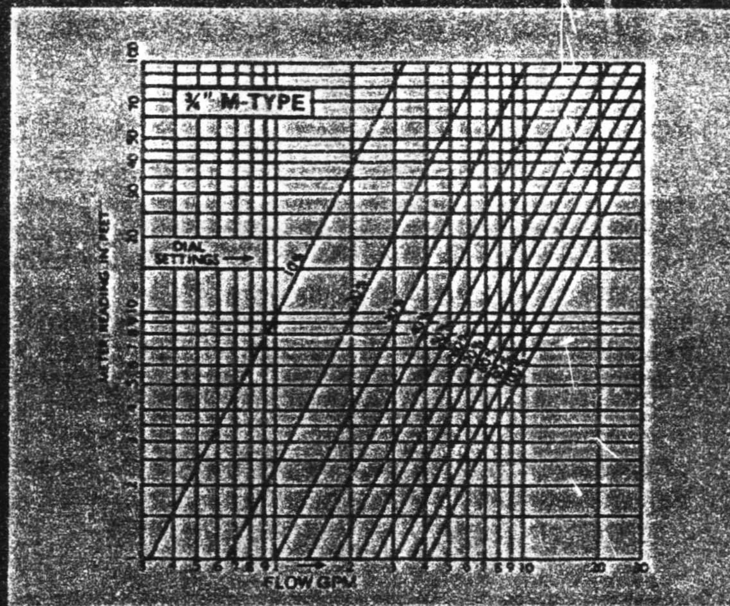
		DIMENSIONS							
TYPE	Size	A	A'	B	C	D	E	F	G
MPP-G	1/2	2 13/16	3 3/16	1 7/16	1 11/32	1 11/32	1 1/2	2	3/8
MPP-G	3/4	2 13/16	3 3/16	1 9/16	1 1/2	1 1/2	1 1/2	2 1/8	3/8
MPP-G	1	3 1/8	3 1/2	1 11/16	1 3/4	1 3/4	1 1/2	2 1/4	15/32
MPP-G	1 1/4	3 5/8	4	1 7/8	1 15/16	1 15/16	1 1/2	2 3/8	7/8
MPP-G	1 1/2	—	6 1/8	2 3/16	2 1/8	2 1/8	1 1/2	2 5/8	7/8
MPP-G	2	—	6 3/16	2 1/2	2 9/16	2 9/16	1 1/2	2 7/8	7/8
MSS-G	1/2	2 13/16	3 3/16	1 7/16	1 13/32	1 13/32	1 1/2	2	3/8
MSS-G	3/4	2 13/16	3 3/16	1 9/16	1 3/4	1 3/4	1 1/2	2 1/8	3/8

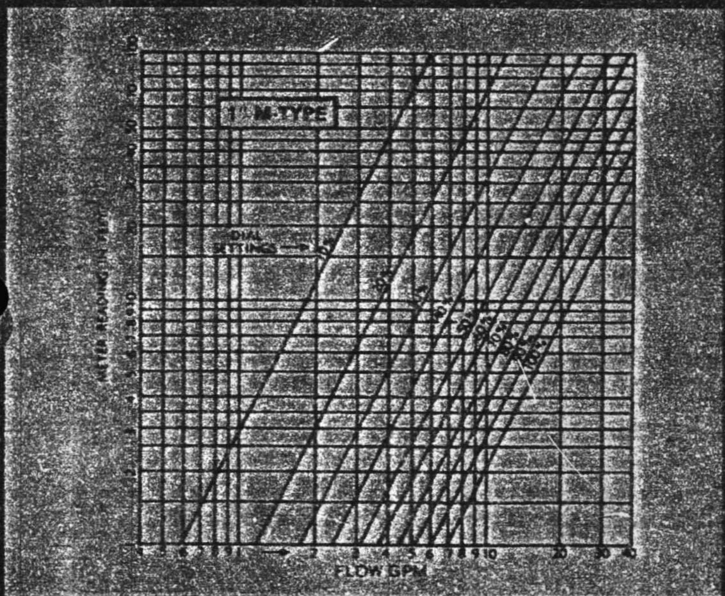


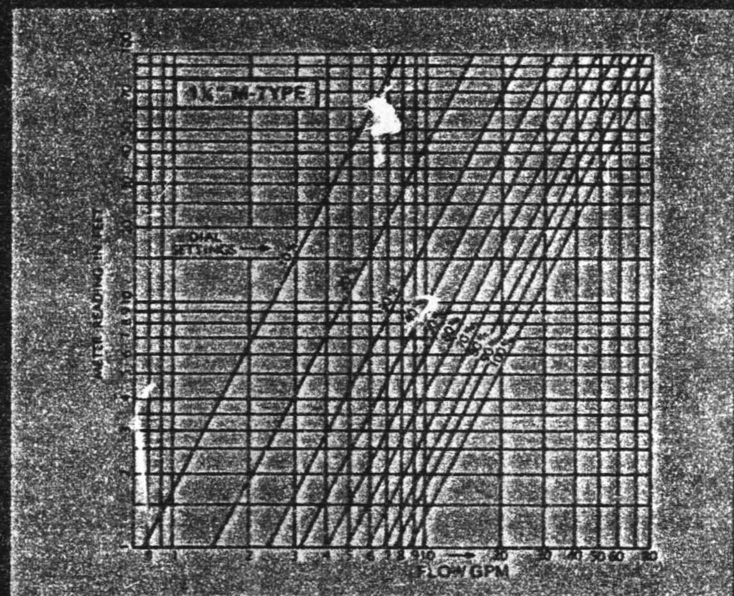


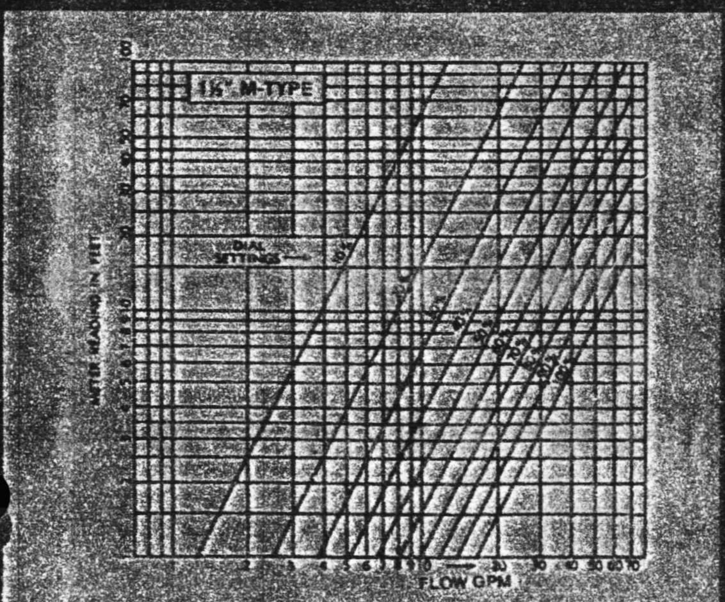
CIRCUIT SETTERS

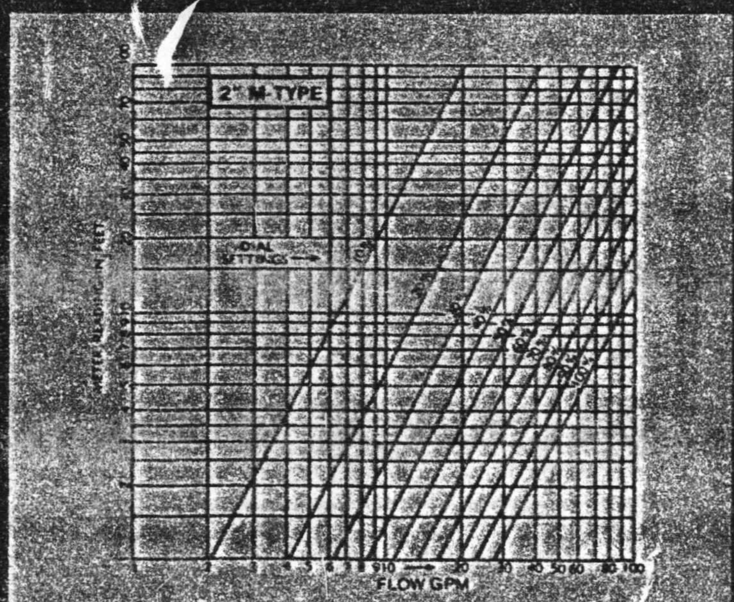

½" M-TYPE
DIAL SETTINGS
FLOW GPM


¾" M-TYPE
DIAL SETTINGS
FLOW GPM


1" M-TYPE
DIAL SETTINGS
FLOW GPM


DIAL SETTINGS
FLOW GPM


1½" M-TYPE
DIAL SETTINGS
FLOW GPM


2" M-TYPE
DIAL SETTINGS
FLOW GPM

TAB PLACEMENT HERE

DESCRIPTION:

Strainers

☐ Tab page did not contain hand written information

☑ Tab page contained hand written information
*Scanned as next image

15501-2.2.2.i (51)

MUESSCO®

CAST IRON FLANGED "Y" TYPE STRAINERS

WORKING PRESSURES - NON SHOCK	Saturated Steam	Cold Water, Oil, Gas
#751 To 12"	125 PSI @ 450°F	200 PSI @ 150°F
14"-24"	100 PSI @ 353°F	150 PSI @ 150°F
#752 to 12"	250 PSI @ 450°F	500 PSI @ 150°F
14"-24"	200 PSI @ 406°F	300 PSI @ 150°F
#751-SW to 12"	not recommended	175 PSI
#751-HC 14"-24"	not recommended	150 PSI

SERVICE RECOMMENDATIONS: Used extensively to strain foreign matter from pipe lines and provide inexpensive protection for costly pumps, meters, valves, and similar mechanical equipment.

SCREENS: Normally furnished made from heavy gauge perforated stainless steel sheet, re-inforced in larger sizes for liquid service. 3/64" perforations usually furnished for steam service in sizes through 10"; 1/16" perforations for larger sizes in steam service. Strainers for liquid service usually furnished with 1/16" perforation in sizes through 4" and 1/8" perforations are available. For services requiring extremely fine straining we suggest 5/32" perforated metal screens lined with an appropriate wire mesh. See page B-3.

MUELLER "BREECH-LOK" STRAINERS
Furnished as standard in sizes 8" and larger. A one-quarter turn securely locks the screen in its seat and frees the serviceman for bolting the cover flange to the body of the strainer.

CONSTRUCTION: All 751 type strainers feature machined seats in both the body and cover flange for secure screen retention. Cover flanges for the #751-SW are light enough for easy handling -- the hinge arrangement on the #751-HC minimizes the inconvenience of servicing large strainers. O-ring sealed cover flanges are available.

SELF CLEANING is done by opening the valve or plug connected to the blowoff outlet. Advise when strainers are to be mounted in vertical piping; we can rotate the cover bringing the blowoff to the lowest point.

BLOWOFF OUTLETS: Tapped NPT, sizes specified below. Not normally furnished plugged.

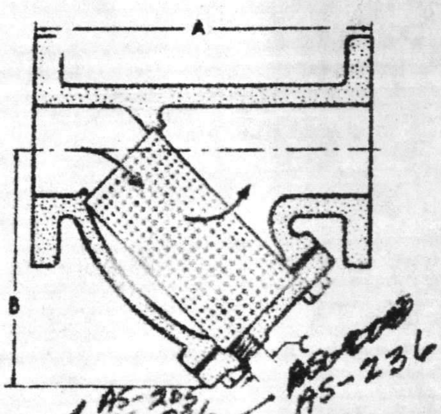
CAPACITY: These strainers have screens with open areas many times greater than the corresponding pipe size and thereby reduce pressure loss to a minimum. Dependent upon the selection of perforations, ratios as great as six to one are available.

PRESSURE DROP: See charts, page C-1.

GALVANIZED STRAINERS available from stock in all sizes.

INDIVIDUALLY HYDROSTATICALLY TESTED

MATERIAL: Cast Iron ASTM A126-B

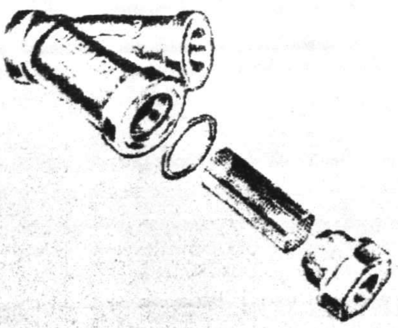


DIMENSIONS AND WEIGHTS APPROXIMATE "APPLY FOR CERTIFIED DRAWINGS"

	SIZE	1-1/2"	2"	2-1/2"	3"	3-1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"
A	751	7 1/2	9	10 1/2	12	13 3/8	14 9/16	16 7/8	18 3/4	24	27 5/8	32 1/4	37 1/4	42 3/8	46 1/6	54 1/2	55 3/4
	752	8 1/16	9 5/16	11 1/16	12 5/8	14 3/8	15 5/8	18 1/4	20 3/16	25 1/8	29 1/8	33 3/4	38 3/4	44 1/8	47 3/4	56	57 3/4
	751-SW	7 1/2	9 1/8	10 1/2	12		14 9/16	16 7/8	18 3/4	24							
	751-HC										27 5/6	32 1/4	37 1/4	42 3/8	46 1/6	54 1/2	55 3/4
B	751,752,751-HC	4 3/4	6	7 1/8	9 1/8	9	10 7/8	12 15/16	14 1/2	16 7/16	18 1/4	22 7/9	26 1/2	29 5/8	36 11/16	40 1/2	44 1/16
	751-SW	7	8 1/4	8 3[illegible]	11		13	16 1/8	17 3/8	18 1/2							
C		1/2	1/2	1	1 1/4	1 1/4	1 1/2	2	2	2	2	2	2	2	2	2	2
Wt.	751	13	23	32	46	56	76	[illegible]	176	26	346	716	853	1380	2273	2512	4016
	752	24	26	40	58	76	93	146	194	316	475	760	906	1135	2400	3350	4706
	751-SW	22	26	42	48		106	142	[illegible]	266							
	751-HC										420	706	850	1060	2120	3020	4080
Screen Area sq. in.			20	38	56	75	91	[illegible]	278	387	577	796	1083	1409	1810	2280	2859

15501-2 2.2.u (51)

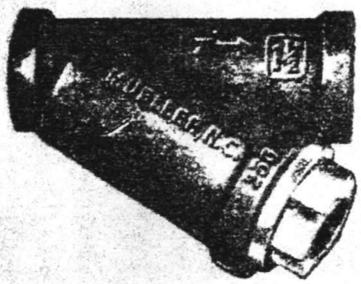
MUESSCO SELF CLEANING "Y" TYPE SCREWED END STRAINERS



#11

1/4" THROUGH 4"

4" equipped with bolted cover

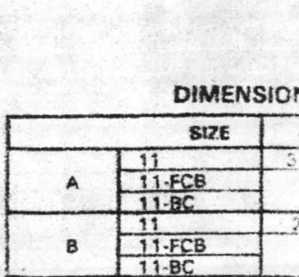


#11-FCB

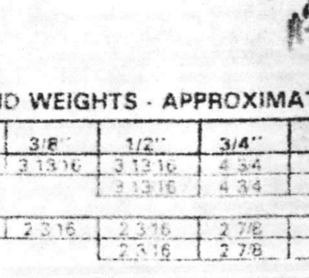
SIZES THROUGH 2"

#11-BC

2"-2½" AND 3"



#11, 11-FCB



#11-BC

EXTRA HEAVY IRON BODY

WORKING PRESSURES – NON-SHOCK	
Steam	250 PSI @ 400°F.
Water-Oil-Gas	400 PSI @ 150°F

SERVICE RECOMMENDATIONS: Used extensively to strain foreign matter from pipe lines and provide inexpensive protection for costly pumps, meters, valves and other similar mechanical equipment. The #11-FCB features a bronze, straight threaded and gasketed cap which can be removed for cleaning. The #11-BC provides the same features with a bolted cover. The #11-FCB is available in sizes through 2" and the #11-BC is stocked in 2", 2½" and 3" sizes.

SCREENS: 20 mesh stainless steel screens (1/32" openings) usually furnished in all sizes through 2" for water service and 30 mesh (1/50" openings) for steam service in those sizes. 2½", 3" and 4" strainers furnished with perforated stainless steel screens, 3/64" openings for steam and 1/16" openings for water. The #11-FCB supplied with 20 mesh stainless steel screens for water service and 30 mesh for steam service. #11-BC normally supplied in all sizes with perforated stainless steel screens, 3/64" openings for steam and 1/16" for water. A large variety of perforated metals and wire mesh screens other than those normally furnished are available, see page B-3.

CONSTRUCTION: All sizes feature a machined seat in the body, designed to make the screen self aligning, and at the same time holding the screen securely in place by a straight threaded and gasketed cap. The 4" size features a flanged blowoff cap, similar to those used with our flanged "Y" strainers.

FEATURES: The machined seats in both the body and cap allow easy assembly and disassembly. The alternative is a strainer which employs a pipe bushing to lock the screen in place which will likely deform the screen, allowing sediment to bypass the strainer.

SELF CLEANING is accomplished by opening the valve or plug connected to the blowoff outlet.

BLOWOFF OUTLETS: Tapped NPT, sizes specified below. Not normally furnished plugged.

CAPACITY: Generously proportioned bodies, with screens that have an open area many times greater than the corresponding pipe size, insure low pressure loss.

PRESSURE DROP: See charts, page C-1.

GALVANIZED STRAINERS: Available from stock in all sizes.

INDIVIDUALLY HYDROSTATICALLY TESTED.

MATERIAL: Cast Iron ASTM A-126 Class B.

AS-236 305/AS-236 AS236 AS-236

DIMENSIONS AND WEIGHTS - APPROXIMATE / APPLY FOR CERTIFIED DRAWING

SIZE		1/4"	3/8"	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	4"
A	11	3 13/16	3 13/16	3 13/16	4 3/4	5 7/16	6 5/16	7 1/2	8 1/8	10 1/2	12 1/2	15 3/16
	11-FCB			3 13/16	4 3/4	5 7/16	6 5/16	7 1/2	8 1/8			
	11-BC								7 13/16	12	12	
B	11	2 3/16	2 3/16	2 3/16	2 7/8	3 1/4	3 3/4	4 11/16	5 1/2	6 5/8	6 7/8	11 1/4
	11-FCB			2 3/16	2 7/8	3 1/4	3 3/4	4 11/16	5 1/2			
	11-BC								6	8 3/4	8 3/4	
C	11	3/8	3/8	3/8	1/2	3/4	3/4	1	1 1/4	1 1/2	1 1/2	1 1/2
	11-FCB			3/8	1/2	3/4	3/4	1	1 1/4			
	11-BC								1	1	1	
Weight	11	1 1/4	1 1/4	1 3/4	2 3/4	4	6 1/4	10 1/2	15	25	36	70
	11-FCB			2	2 1/2	4	6 1/2	10 1/2	15 1/2			
	11-BC								16	47	47	

TAB PLACEMENT HERE

DESCRIPTION:

Values

☐ Tab page did not contain hand written information

☑ Tab page contained hand written information
*Scanned as next image

Bronze Gate Valves

MATERIAL

Hammond industrial bronze gate valves class 125 and class 150 pressure-containing parts are cast of ASTM B-62 bronze alloy. Class 200, class 300 and class 350 pressure-containing parts are cast of ASTM B-61 bronze alloy.

WHERE TO USE GATE VALVES

- For fully-open or fully-closed service. NOT FOR THROTTLING
- For minimum line-pressure drop.
- For minimum fluid entrapment in the line.
- For relatively infrequent operation.

STEM AND DISC SELECTION GUIDE

Rising stem, solid wedge disc valves, simplest and most widely used gate valves, offer four major advantages:

- Operator can determine at a glance whether the valve is open or closed.
- Stem threads are out of the fluid flow when fully open and protected by the back seat.
- Solid wedge disc valves most successfully handle viscous fluids. Recommended for steam service.
- Can be installed with stem in any position.

Rising stem, double disc (or split wedge) valves also have the advantage of easy readability for open or closed. In addition they:

- Are recommended for non-condensing gases and liquids at normal temperatures. NOT FOR STEAM SERVICE.
- Can adjust to the seating surface even though one-half of the disc is out of alignment due to foreign matter between the seat and the disc.
- Can remain pressure-tight despite slight distortion of the valve body.
- Should be installed with stem vertical only.

Non-rising Stem Valves

- Usually installed where space is limited.
- Usually shorter-lived than rising stem because stem threads are always in contact with the fluid.

BONNET SELECTION GUIDE

Union bonnet gates:

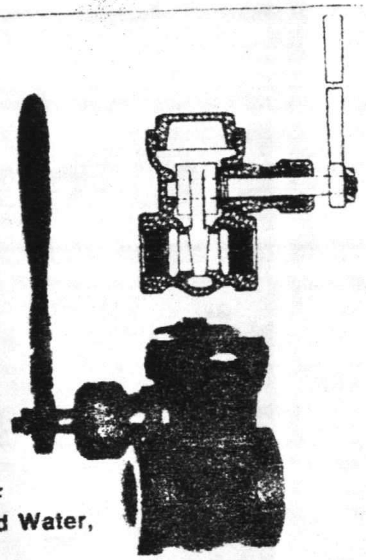
- Easily dismantled without risk of injury to body-bonnet bearing surface.
- Stronger because of their heavy union nut.
- Safer — no danger of bonnet being screwed off in normal operation.

Inserted bonnet gates are lower priced but are not recommended when pressure and temperature extremes are likely.

CLASS 125 — IB610

Features:

- Threaded Ends
- Quick Open Cam Action
- Sizes ½" thru 2"

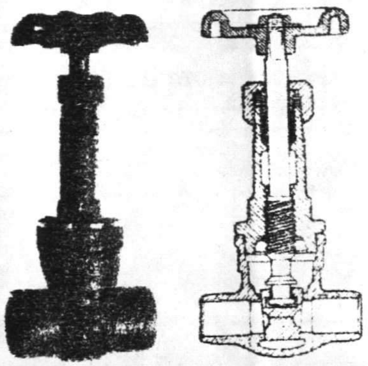


125 psi Steam to 406°F
200 psi Non-Shock Cold Water, Oil or Gas

CLASS 125 — IB635

Features:

- Solder Ends
- Threaded Bonnet
- Rising Stem
- Solid Wedge
- Integral Seat
- Malleable Iron Handwheel
- Meets WWV54, Type II, Class A
- Meets MSS SP-80
- Sizes ⅜" thru 3"

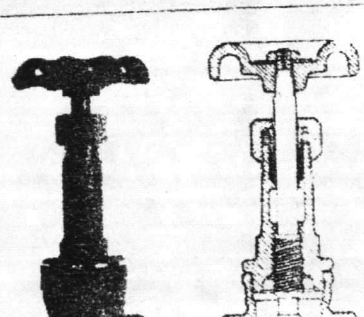


125 psi Steam to 406°F
200 psi Non-Shock Cold Water, Oil or Gas

CLASS 125 — IB640

Features:

- Threaded Ends
- Threaded Bonnet
- Rising Stem
- Solid Wedge
- Integral Seat
- Malleable Iron Handwheel
- Meets WWV54, Type II, Class A
- Meets MSS SP-80
- Sizes ½" thru 3"



125 psi Steam to 406°F
200 psi Non-Shock Cold Water, Oil or Gas

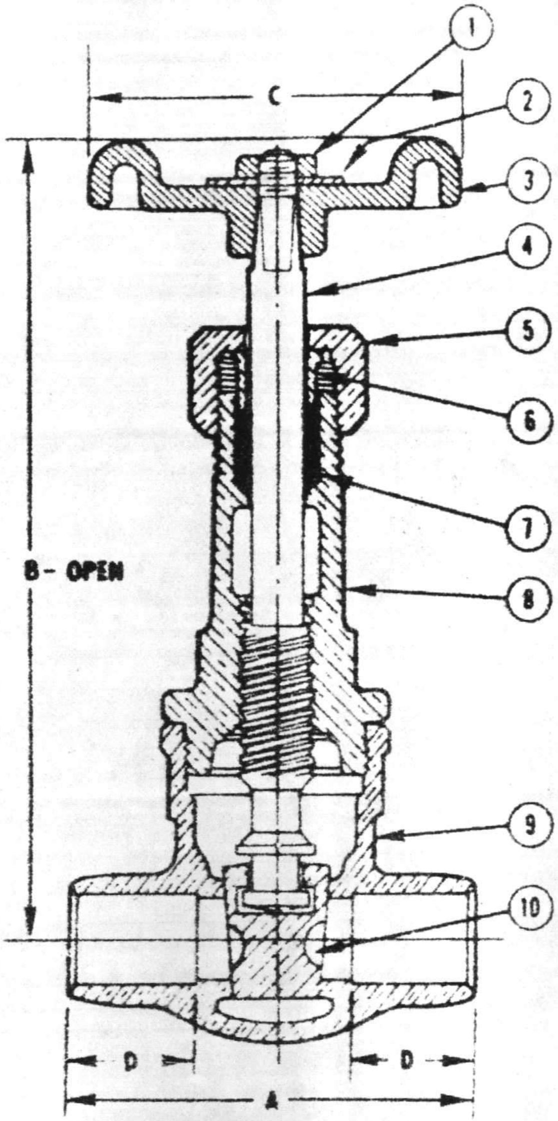
Class 125
Bronze Gate

HAMMOND
IB635

Class 125 Bronze Gate Valve
Screwed Bonnet-Rising Stem
Solid Wedge Disc
Solder Ends

2-85

RATING
125 PSI Steam To 406°F
200 PSI Non-Shock
Cold Water, Oil or Gas
Federal Specification WW-V-54
Type II, Class A
MSS SP-80



DIMENSIONS IN INCHES

SIZE	A	B	C	D
3/8	2-1/4	5	2	11/16
1/2	1-29/32	5-1/16	2	1/2
3/4	2-15/32	6-9/32	2-3/8	3/4
1	2-13/16	7-1/4	2-3/4	29/32
1-1/4	3-5/32	8-1/2	3	31/32

SIZE	A	B	C	D
1-1/2	3-9/16	10-1/16	3-1/2	1-3/32
2	4-1/8	12-1/16	4	1-11/32
2-1/2	5-1/4	15-15/32	5 1/4	1-5/8
3	6-1/16	18	6	1-7/8

MATERIAL SPECIFICATIONS

1	Handwheel Nut	Steel	
2	Identification Plate	Aluminum	
3	Handwheel	Malleable Iron	ASTM A-47 (32510)
4	Stem	Cast Bronze	ASTM B-62
5	Packing Nut ⅜"-1"	Brass Rod	ASTM B-16
	1¼"-3"	Cast Bronze	ASTM B 584 Alloy 844

5	Gland Follower	Sintered Brass	ASTM B-282 Type I
7	Packing Ring	Teflon - Asbestos	
8	Bonnet	Cast Bronze	ASTM B-62
9	Body	Cast Bronze	ASTM B-62
10	Disc	Cast Bronze	ASTM B-62

HAMMOND
VALVE CORP
1844 Summer Street
Hammond, Indiana 46320
(219) 931-3200

Class 125
Bronze Gate

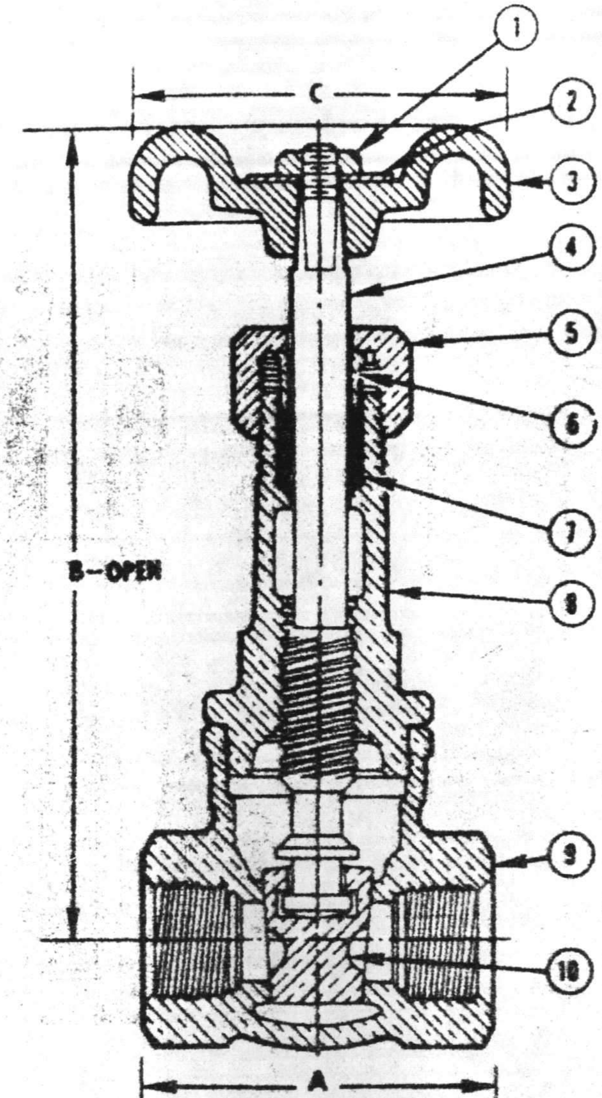
HAMMOND
IB640

Class 125 Bronze Gate Valve
Screwed Bonnet - Rising Stem
Solid Wedge Disc
Threaded Ends

2-85

RATING

125 PSI Steam To 406°F
200 PSI Non-Shock
Cold Water, Oil or Gas
Federal Specification
WW-V-54 Type II, Class A
MSS SP-80



DIMENSIONS IN INCHES

SIZE	A	B	C
1/4	1-29/32	5	2
3/8	1-29/32	5	2
1/2	2-1/16	5-1/16	2
3/4	2-3/16	6-9/32	2-3/8
1	2-7/16	7-1/4	2-3/4

SIZE	A	B	C
1-1/4	2-25/32	8-1/2	3
1-1/2	2-29/32	10-1/16	3 1/2
2	3-5/32	12-1/16	4
2-1/2	4-11/16	15-15/32	5-1/4
3	5-1/8	18	6

MATERIAL SPECIFICATIONS

1	Handwheel Nut	Steel	
2	Identification Plate	Aluminum	
3	Handwheel	Malleable Iron	ASTM A-47 (32510)
4	Stem	Cast Bronze	ASTM B-62
5	Packing Nut ¼ 1 1¼ 3	Brass Rod Cast Bronze	ASTM B-16 ASTM B-584 Alloy 844

6	Gland Follower	Sintered Brass	ASTM B-282 Type I
7	Packing Ring	Teflon - Asbestos	
8	Bonnet	Cast Bronze	ASTM B-62
9	Body	Cast Bronze	ASTM B-62
10	Disc	Cast Bronze	ASTM B-62

HAMMOND
VALVE CORP
1844 Summer Street
Hammond, Indiana 46320
(219) 931-3200

Taco

Submittal Data Information

Pressure Reducing Valves, Dual Controls and Pressure Relief Valve

101-005

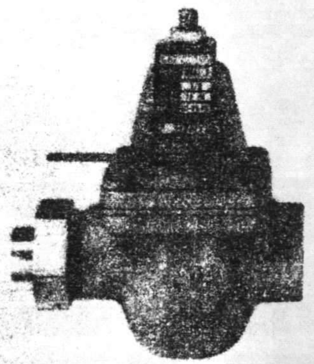
Numbers: 329, 329T, 335, 334, 334T and 333 SUPERSEDES: SD100-2.2

Job: VARIOUS BLDG (B5554B) NEW RIVER, M.C.A.S

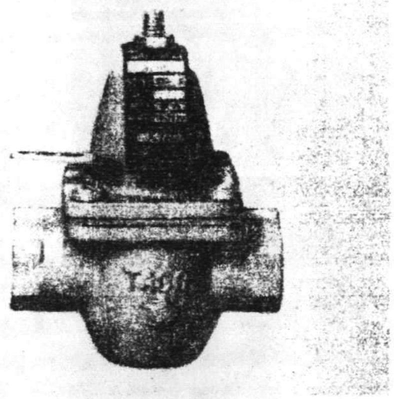
PRESSURE REDUCING VALVES — 329 AND 335

PURPOSE: To automatically feed water to a hot water heating system whenever pressure in the system drops below the pressure setting of the valve

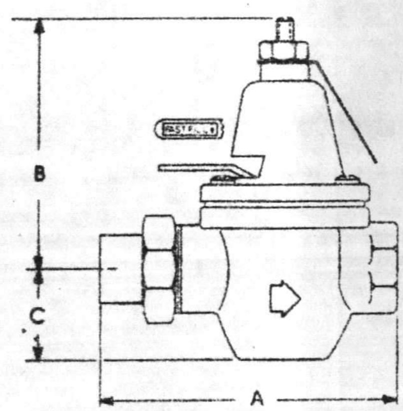
FEATURES:
- Fast fill rate on all models
- Pressure setting adjustment separated from fast fill lever for easy, fast adjustment
- Built-in check to prevent emptying system if incoming pressure fails
- System pressure adjusting range 10 to 25 PSI

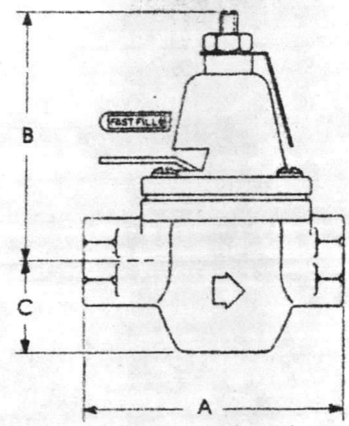


329, 329T



335





PRODUCT NO.	CONSTRUCTION MATERIAL	SIZE & TYPE CONNECTION	MAXIMUM SUPPLY SIDE PRESSURE	MAXIMUM TEMPERATURE	DIMENSIONS, INCHES			SHIPPING WT./LB.	
					A	B	C	EA.	CTN.
329	CAST IRON	½" (15MM) NPT & SWEAT	200 PSI (1380 KPA)	212°F (100°C)	4¼ (108MM)	3¾ (95MM)	1⅜ (35MM)	2.4 (1.1 KG)	30 (14 KG)
329T	CAST IRON	½" (15MM) NPT			4⅜ (111MM)	3¾ (95MM)	1⅜ (35MM)		
335	BRONZE	¾" (20MM) NPT			3¾ (95MM)	3¾ (95MM)	1⅜ (35MM)		

Quality Through Design — COMPARE.

TACO, Inc., 1160 Cranston St., Cranston, RI 02920 (401) 942-8000 Telex 92-7627
TACO, (Canada) Ltd., 1310 Aimco Blvd., Mississauga, Ontario L4W 1B2 (416) 625-2160 Telex 06-961179

Bronze Check Valves

Check valves are used to check or prevent backflow in lines. Line pressure forces the disc to open and allow flow in the direction desired. When pressure drops, gravity and line back-pressure close the disc, preventing backflow.

MATERIAL

Hammond industrial bronze check valves class 125 and class 150 pressure-containing parts are cast of ASTM B-62 bronze alloy. Class 300 and class 350 pressure-containing parts are cast of ASTM B-61 bronze alloy.

SWING CHECK VALVES

Swing check valves are used:

- To control direction of flow and for quick, automatic reactions to flow change.
- For minimum resistance to flow.
- Some Hammond bronze swing check valves offer T-pattern design; others offer Y-pattern design, regrinding, with free floating hinge pin.

Swing check valves are recommended for use in conjunction with gate valves. They should not be used in a rapid cycling system i.e., with a reciprocating pump, or for air compressor service where they could cause chatter and damaging vibration.

LIFT CHECK VALVES

Lift check valves differ from swing check valves in that their flow characteristics are the same as globe valves, with a resultant increased pressure drop. They are generally used in conjunction with globe valves, and are recommended for use with reciprocating pump and air compressor systems.

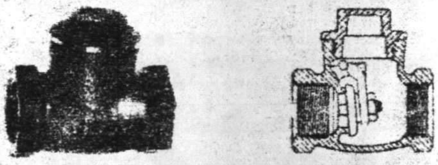
Check valves equipped with TFE discs are recommended for the following services:

- For water service where foreign matter such as dirt or sand may be in the line. Soft disc protects the seats.
- For positive shutoff at low line pressure.
- For quieter operation where noise might be objectionable.

CLASS 125 — IB904

- Threaded Ends
- T-Pattern
- Bronze Disc

Features:
- Meets WV51, Type IV, Class A
- Meets MSS SP-80
- Sizes ¼" thru 2"

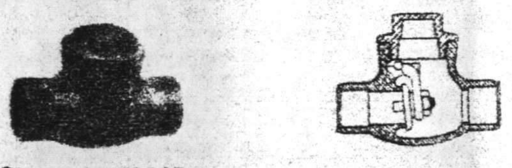


125 psi Steam to 406°F
200 psi Non-Shock Cold Water, Oil or Gas
**Warning — Do not use for reciprocating air compressor service.*

CLASS 125 — IB912

- Solder Ends
- T-Pattern
- Bronze Disc

Features:
- Meets WWV51, Type IV, Class A
- Meets MSS SP-80
- Sizes ⅜" thru 2"

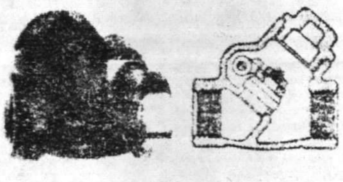


125 psi Steam to 406°F
200 psi Non-Shock Cold Water, Oil or Gas
**Warning — Do not use for reciprocating air compressor service.*

CLASS 125 — IB940

- Threaded Ends
- Y-Pattern
- Renewable Bronze Disc

Features:
- Meets WWV51, Type IV, Class A
- Meets MSS SP-80
- Sizes ¼" thru 3"

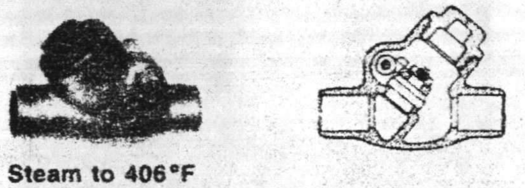


125 psi Steam 406°F
200 psi Non-Shock Cold Water, Oil or Gas
**Warning — Do not use for reciprocating air compressor service.*

CLASS 125 — IB941

- Solder Ends
- Y-Pattern
- Renewable Bronze Disc

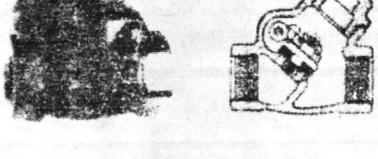
Features:
- Meets WWV51, Type IV, Class A
Meets MSS SP-80
- ⅜" thru 3"



125 psi Steam to 406°F
200 psi Non-Shock Cold Water, Oil or Gas
**Warning — Do not use for reciprocating air compressor service.*

CLASS 125 — IB942

Features:
- Threaded Ends
- Y-Pattern
- TFE Disc
- Meets MSS SP-80
- Sizes ½" thru 2"



125 psi Steam to 406°F
200 psi Non-Shock Cold Water, Oil or Gas
**Warning — No not use for reciprocating air compressor service.*

CLASS 150 — IB944

Features:
- Threaded Ends
- Y-Pattern
- Renewable Bronze Disc
- Meets MSS SP-80
- Sizes ¼" thru 3"

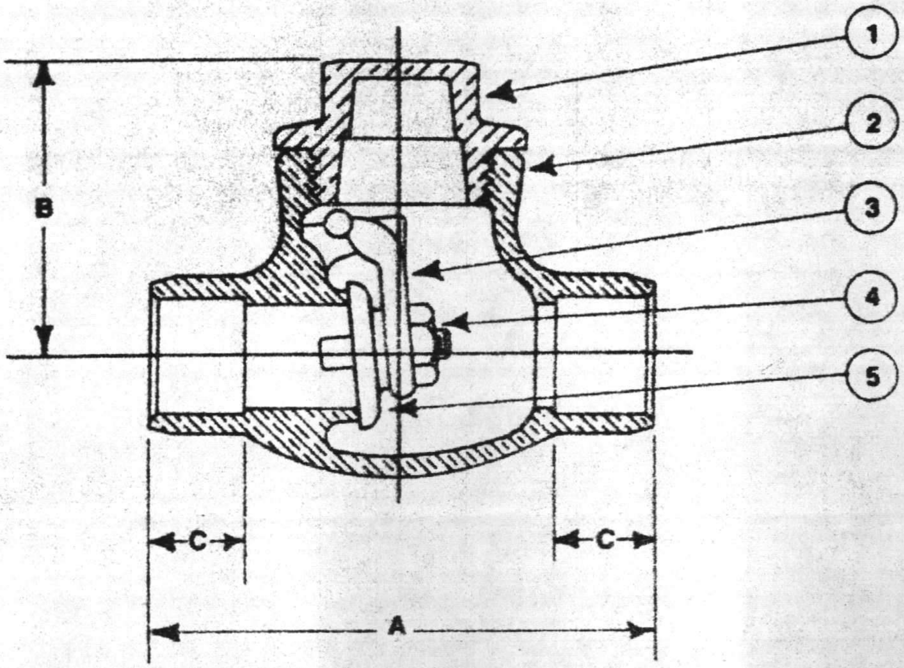
125 psi Steam to 406°F
200 psi Non-Shock Cold Water, Oil or Gas
**Warning — Do not use for reciprocating air compressor service.*

Class 125
Bronze Swing Check

HAMMOND IB912

**Class 125 Bronze Swing Check Valve
With Bronze Disc
Solder Ends**

2-85



RATING

**125 PSI Steam To 406°F
200 PSI Non-Shock
Cold Water, Oil or Gas
Federal Specification
WW-V-51 Type IV, Class A
MSS SP-80**

Warning - Do not use for reciprocating air compressor service.

DIMENSIONS IN INCHES

SIZE	A	B	C
3/8	2-9/16	1-17/32	3/8
1/2	2-9/16	1-17/32	1/2
3/4	3-5/16	1-3/4	3/4
1	4-1/16	2-1/32	29/32
1-1/4	4-5/16	2-3/16	31/32

SIZE	A	B	C
1-1/2	4-15/16	2-1/2	1-3/32
2	5-7/8	2-7/8	1-11/32

MATERIAL SPECIFICATIONS

1	Bonnet	Cast Bronze	ASTM B-584 Alloy 844
2	Body	Cast Bronze	ASTM B-62
3	Hinge	Cast Bronze	ASTM B-584 Alloy 844
4	Disc Nut	Brass Rod	ASTM B-16

5	Disc	3/8"-3/4"	Brass Rod	ASTM B-16
		1"-2"	Cast Bronze	ASTM B-62

HAMMOND
VALVE CORP
1844 Summer Street
Hammond, Indiana 46320
(219) 931-3200

TAB PLACEMENT HERE

DESCRIPTION:

Backflow

Preventors

☐ Tab page did not contain hand written information

☑ Tab page contained hand written information
*Scanned as next image

Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

FORM B632-2

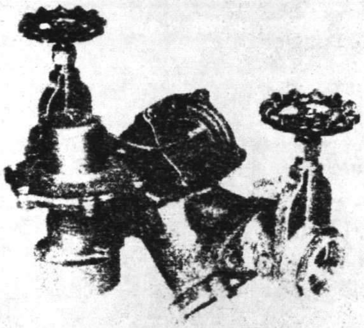
WILKINS

HWS - HWR - CW
WATER MAKE-UP

MODEL 575

BACKFLOW PREVENTERS
REDUCED PRESSURE PRINCIPLE
Sizes 3/4" - 2"

BACKFLOW PREVENTORS



FEATURES

LOW HEAD LOSS

- Exceeds all standards
- Lowest in industry

LOW MAINTENANCE COSTS

- No special tools required to service units
- Few moving parts
- In-line serviceability

COMPACT SIZE

- Easy to install

CAST BRONZE MAINCASE

- Sturdy, durable, corrosion resistant

POPPET TYPE CHECK VALVES

- Independently operated
- Spring loaded, stainless steel springs
- Corrosion resistant

HYDRAULICALLY ACTUATED RELIEF VALVE

- Discharges backflow to atmosphere

PERFORMANCE

Wilkins' Model 575 Reduced Pressure Backflow Preventers EXCEED the requirements of AWWA, for flow rates and head loss and are fully approved by U.S.C. Research Foundation, IAPMO, ASSE and C.S.A.

Head loss is the lowest in the industry.

Proper performance is dependent upon the user adhering to recommended installation procedures, and having licensed, qualified personnel perform regular, periodic inspection and maintenance.

Two shut-off valves and four test cocks are provided for testing. All Model 575 devices can be disassembled and repaired without removing the unit from the line.

APPLICATION

The Model 575 has been designed for installation in potable water lines where a potential heath hazard exists.

Wilkins' low head loss makes the device most suitable where system pressures are low or where it is important to hold pressure loss to a minimum.

CONSTRUCTION

Wilkins' Model 575 Reduced Pressure Backflow Preventer consists of a main body with two check valves and a connecting external pressure relief valve located between the two check valves. Check valves are spring loaded and operate independently. The relief valve functions automatically by sensing the pressure differential across the first check valve and discharges backflow to atmosphere in the event the check valves become damaged or fouled. Springs are made of stainless steel and all other component parts are made of corrosion resistant material.

WARRANTY

Wilkins' Backflow Preventers are warranted against defects in material and workmanship for a period of one year from date of shipment strictly in accordance with Wilkins' Certificate of Limited Warranty.

All Model 575 Backflow Preventers manufactured by Wilkins contain only Wilkins authorized parts. Replacement of any part of the Model 575 Backflow Preventer with a part other than a Wilkins' authorized part immediately voids Wilkins' Limited Warranty.

Certificates of Limited Warranty are available upon request.

CAUTION

Installation and Maintenance

All Model 575 Backflow Preventers should be installed and maintained only by licensed personnel. Proper performance is dependent upon regular inspection and maintenance. These should be performed in accordance with Wilkins' specifications and instructions and prevailing governmental and industry standards and codes.

SPECIFICATIONS

The Reduced Pressure Backflow Preventer shall consist of a connecting pressure differential relief valve located between two independently operated spring-loaded poppet type check valves. The maincase shall be of bronze and consist of four test cocks which provide for in-line testing and maintenance. Stainless steel springs and corrosion resistant materials shall be used through-out. Head loss characteristics shall be at least equal to Wilkins' Model 575.

APPLICATION

Designed for potable water systems where a potential health hazard exists.

TEMPERATURE RANGE

33°F — 140°F

MAXIMUM OPERATING PRESSURE

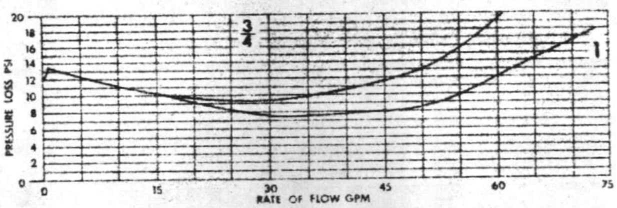
150 PSI

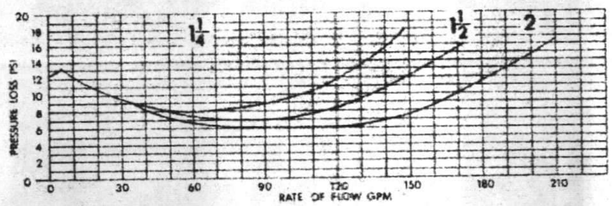
MATERIALS

All corrosion resistant

PRESSURE LOSS AT MAXIMUM ALLOWABLE FLOW RATE:
(ASSE & USC) STANDARD

SIZE	MAX. FLOW RATE	PRESSURE LOSS
3/4"	30 GPM	9.3 PSI
1"	50 GPM	8.4 PSI
1¼"	75 GPM	8.2 PSI
1½"	100 GPM	7.4 PSI
2"	160 GPM	8.4 PSI





Additional flow capacity available within allowable pressure loss.

NOTE: 13.5 PSI MINIMUM NET INLET PRESSURE IS REQUIRED TO INITIATE FLOW.

Damage to the device could result wherever water hammer and/or water thermal expansion could cause excessive line pressure. Where this could occur shock arrestors and/or pressure relief valves should be installed downstream of the device.

OPTIONS

SIZES:
3/4", 1", 1¼", 1½", 2"

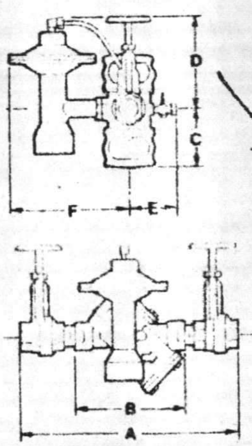
GATE VALVES
Specify: With Gates or Less Gates

POPPETS
Synthetic polymer

CONNECTIONS
Screwed

SENSING LINES
Sizes 3/4" & 1" — Internal
Sizes 1¼" — 2" — External

DIMENSIONS



SIZE, inch	DIMENSIONS (inches) A	B	C	D	E	F	WT. lbs. (approx.)
¾	11⅜	8½	3½	5	3½	7	20
1	11⅜	8½	3½	5	3½	7	21
1¼	16¼	12	4⅝	6 1/16	3¾	7¼	30
1½	16¼	12	4⅝	7 1/16	3¾	7¼	30
2	16¼	12	4⅝	8⅝	3¾	7¼	35

WILKINS REGULATOR CO.

A Division of Zurn Industries, Inc.

1747 Commerce Way
Paso Robles, CA 93446
805-238-7100

TAB PLACEMENT HERE

DESCRIPTION:

N/A

☐ Tab page did not contain hand written information

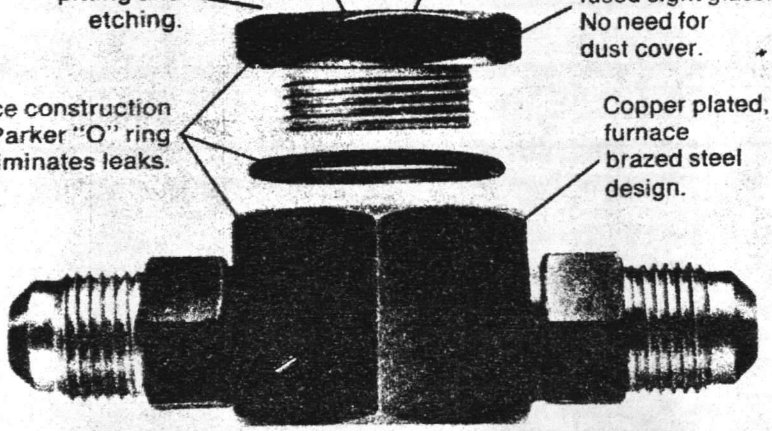
☑ Tab page contained hand written information
*Scanned as next image

Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

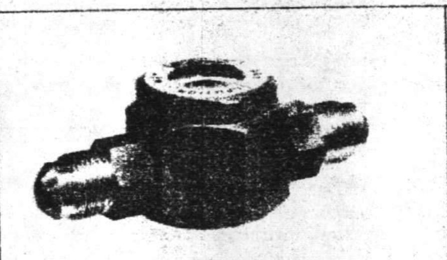
15501-, 2.2.2.M(55)

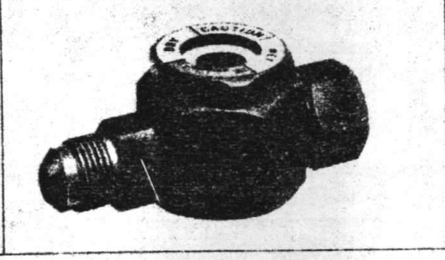
SIGHT GLASS

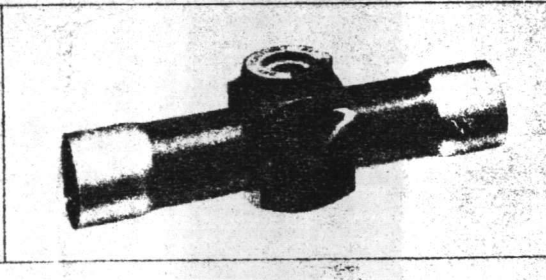
Refrig. piping
liquid line



- Available in all popular connections up to 1⅛".
- Extended copper plated steel fittings permit solder installation without disassembly.
- Compact design, low silhouette, short lay-in length.
- Extremely accurate.
- Easy viewing.
- U.L. listed for 500 psi working pressure. File No. SA4744.







Model No.	SAE Male Flare Connection Size	Overall Length	Model No.	SAE Male x Female Flare Connection Size	Overall Length	Model No.	ODS Sweat Connection Size	Overall Length	Cut-out Length
PSG-2	¼"	3.42"	PSG-2MF	¼"	3.05"	PSG-2S	¼"	4.88"	4.19"
PSG-3	⅜"	3.56"	PSG-3MF	⅜"	3.17"	→ PSG-3S	⅜"	4.88"	4.12"
PSG-4	½"	3.82"	PSG-4MF	½"	3.39"	PSG-4S	½"	4.88"	3.87"
PSG-5	⅝"	4.06"	PSG-5MF	⅝"	3.69"	PSG-5S	⅝"	4.88"	3.62"
						→ PSG-[illegible]S	⅞"	6.25"	4.73"
PSG-10T	replacement indicator element and "O" ring					PSG-9S	1⅛"	6.25"	4.45"

Moisture-color indication in PPM at liquid line specific temperatures

System Refrigerant		R-12		R-22		R-502	
Liquid Line Temperature		75°F	125°F	75°F	125°F	75°F	125°F
System Condition—Indicator Color							
Dry	Green	Below 5	Below 15	Below 30	Below 60	Below 10	Below 30
Caution	Yellow Green	5-15	15-50	30-110	60-220	10-50	30-120
Wet	Yellow	above 15	above 50	above 110	above 220	above 50	above 120

Immediate steps should be taken to protect the system when the moisture indicating element shows "Wet".

The best protection system available is a Parker Ceramic Filter-Kore Dryer and Parker Suction Line Filter Dryer.

The sight-glass moisture indicator should normally be installed between a Parker Ceramic Filter Kore Dryer and a refrigerant control device.

Parker Mfg. Co., Refrigeration Components Group, 2445 S. 25th Ave., Broadview, Ill. 60153
(312) 681-3576 Telex: 728462

TAB PLACEMENT HERE

DESCRIPTION:

f.lTer

Dryer

☐ Tab page did not contain hand written information

☑ Tab page contained hand written information
*Scanned as next image

15501-2:2.2.m(55)

FILTER liquid line-Refrig. piping

Liquid Line Filter Dryer DRYER

- Unique fiber cup gives greater filtration capacity
- Chemically inert molecular sieve dessicant has greater water capacity
- 100% molecular sieve beads for maximum water pick-up. Approved for R-12, R-22, R-500 and R-502

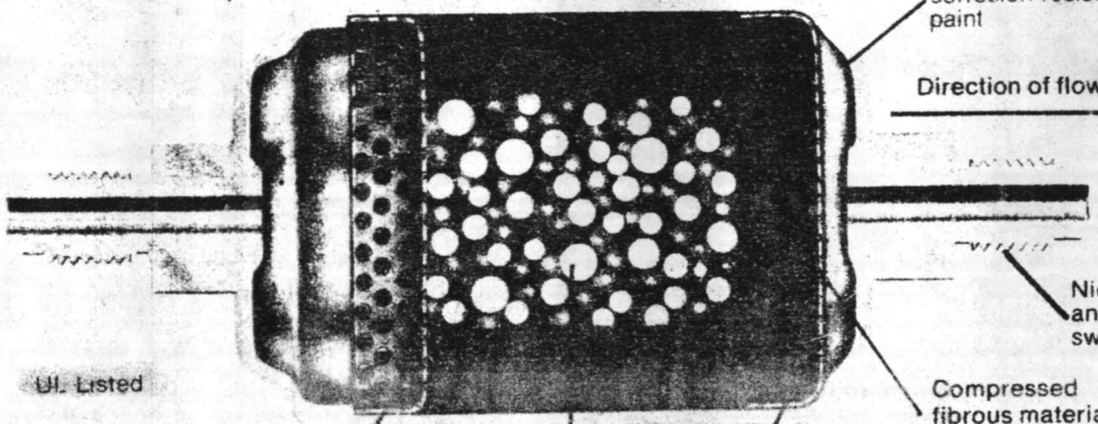
- UL listed for 2500 psig minimum bursting pressure. (UL File No. SA3441)
- Fully welded and atmospherically controlled furnace brazed construction.
- Corrosion resistant paint gives 400 hour salt spray protection.
- Perforated baffle support plates insure rigid internal construction to prevent release of dessicant.

This unique Parker refrigerant dehydrator has the ability to reach very low end-point dryness levels. It is available in a range of sizes for use with the common halocarbon refrigerants.

The fiber cup design, filled with molecular beads, filters out contaminant particles down to 20 microns in size while allowing an unrestricted flow of the maximum amount of refrigerant. This results in the least pressure drop, trouble-free operation, and longer system life. You can virtually forget emergency calls caused by clogged dryers.

The heavy-gauge steel shell is fully welded and brazed in a controlled-atmosphere furnace to withstand pressures, prevent leaks and give longer service life. Available with nickel-plated flare fittings or solid copper solder-type connections. Rated in accordance with ARI Standard No. 710 for liquid-line dryers.

Individually cartoned with protective caps on fittings to keep moisture out and prolong shelf life.



Parker Mfg. Co., Refrigeration Components Group, 2445 S. 25th Ave., Broadview, Ill. 60153
(312) 681-3576 Telex: 728462

TAB PLACEMENT HERE

DESCRIPTION:

chemical

Feeders

☐ Tab page did not contain hand written information

☒ Tab page contained hand written information
*Scanned as next image

- - BY-PASS FEEDERS - -

IMCOR Custom Designed Feeders Are:

Easy to Install

Safe to Use

Suitable for Liquid, Powder, or Briquettes

Maintenance Free

Available in Popular Sizes

Type HV - 2 gallon, and AV - 5 gallon (other sizes available on special order) By-Pass Feeders are equipped with a large 3-1/2" diameter opening. Closing requires only a 1/4" turn for a perfect seal every time, eliminating troublesome fill valves. The cover and "O" ring seal are removed as a unit; however, only when all pressure has been released from the feeder.

All IMCOR Feeders are suitable for hot or cold water applications up to 200 psi working pressure. Feeders are normally furnished without valves and fittings; refer to drawing for these requirements and some suggested piping diagrams.

ANALYSIS - CHEMICALS - EQUIPMENT

Industrial Maintenance Corporation
PHONE (704) 525-6967 / CHARLOTTE, NORTH CAROLINA 28217

IMCOR BY-PASS FEEDERS

(INSTALLATION FIGURES)

FIG. 1

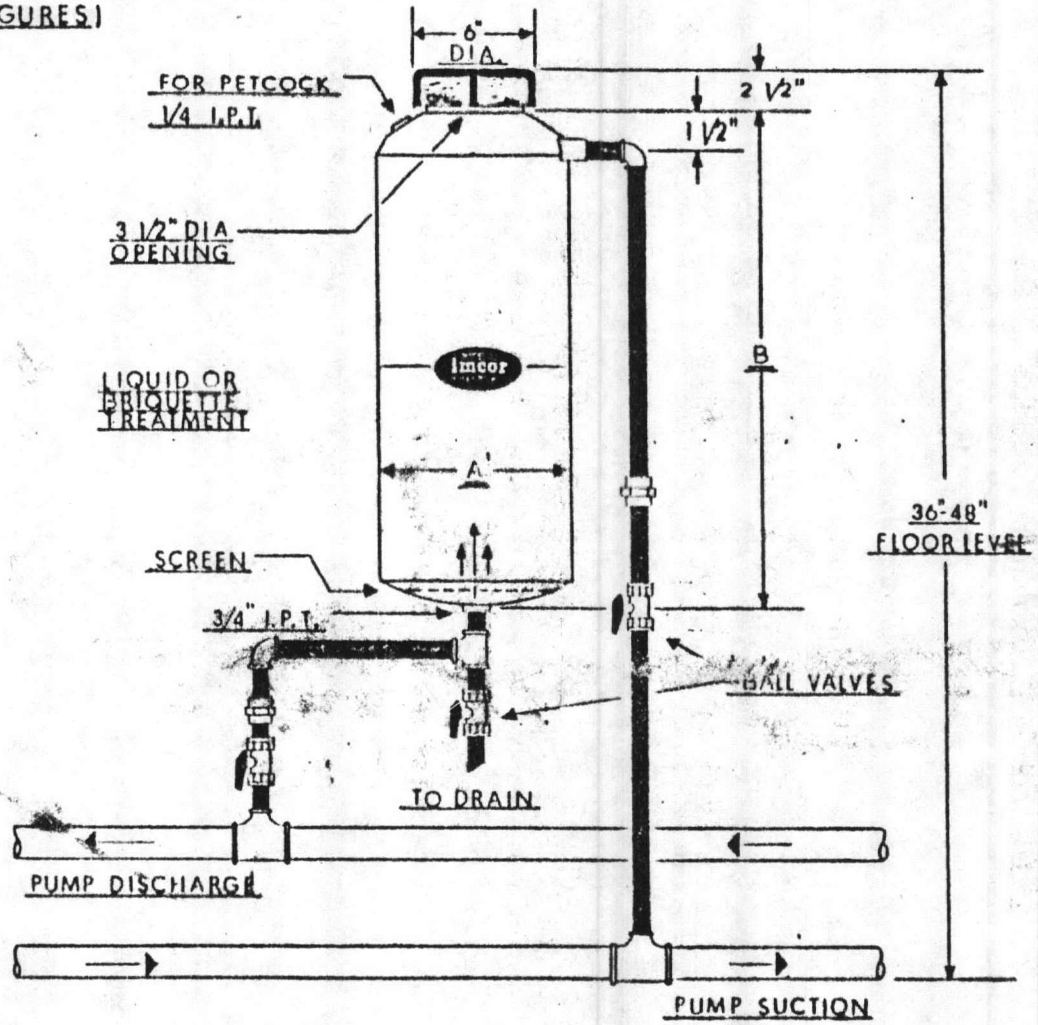


FIG. 3

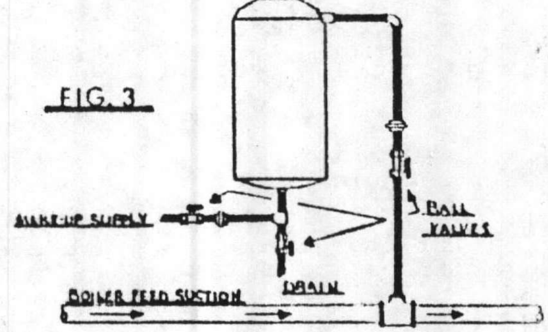
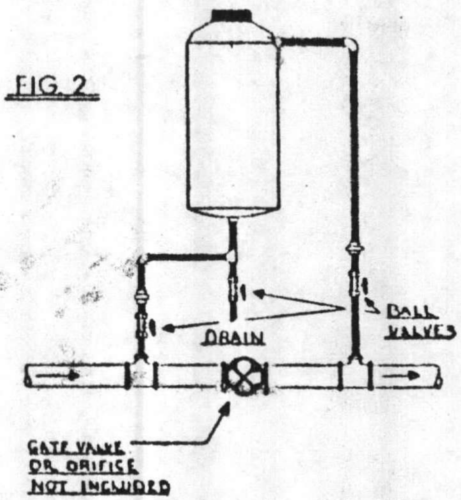


FIG. 2



FEEDER TYPE	CAPACITY GALLONS	MAXIMUM PRESSURE	VALVES AND FITTINGS	DIM A	DIM B
HV	2	200 PSI	3/4 INCH	7 1/4"	14
AV	5	200 PSI	3/4 INCH	10 3/8"	16 1/2

IMCOR BY-PASS FEEDERS 12-51

SCALE NONE

DATE 9/16/87

para. 2.2.2.2.C

Barber-Colman Company
ENVIRONMENTAL CONTROLS DIVISION

Date: August 4, 1987

Issuing Office: Quality Engineering

To: Triangle Automated Controls
6316 Angus Drive
Raleigh, NC 27612
Attn: Tony Battista

Subject: Valves for Contract #05-84-4061 Camp Lejeunne

Dear Tony,

The VB-9213, VB-9223 and VB-9313 valves used in valve assemblies on the subject project, are manufactured in compliance to the following standards:

Cast Bronze - Screwed, Flared and Union End Fittings (VB-9xxx-0-4-Pm VB-111-0-3-P)

Standard: ANSI B16.15-1971

Materials: ASTM B145 Class 4B, 5A or ASTM B62 (4A)

Cast Iron - Flanged End Fittings (VB-9xxx-0-5-P)

Standard: ANSI B16.1-1975

Materials: ASTM A126 Class B

UL Recognized per UL Standard 429 - Electrically Operated Valves
Guide No.: YIOZ2.

Sincerely,

Jack Karch

Jack Karch
Supervisor, Quality Engineering

JK/ka

cc: Eddie Wolmarans
(Jay Johnson Co., Inc.)

TAB PLACEMENT HERE

DESCRIPTION:

Temperature

control system

☐ Tab page did not contain hand written information

☑ Tab page contained hand written information
*Scanned as next image

Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

AS-205

TEMPERATURE CONTROL SUBMITTAL

JOB: REPLACE AIR CONDITIONING UNITS VARIOUS BUILDINGS
MARINE CORPS AIR STATION, NEW RIVER, N.C.
CONTRACT # N62470-86-B-5548

ARCHITECT:

ENGINEER: CHEATHAM AND ASSOCIATES

CONTRACTOR: HUMPHREY HEATING AND ROOFING

Submitted by:

TRIANGLE AUTOMATED CONTROLS, INC.
2716 Discovery Drive
Raleigh, North Carolina 27612
(919)878-8015

JOB: CONTRACT# n62470-86-B-5548
REPLACE AIR CONDITIONING UNITS
VARIOUS BUILDINGS
MCAS, NEW RIVER, N.C.

EQUIPMENT SCHEDULE

Job #: A-024/J-024

DATE: 1/23/88

QNTY.	IDENTIFIER	PART NUMBER	MANUFACTURER	DESCRIPTION	LOCATION
			BUILDING AS-202		
1	SPACE	TC-1103-500	Barber Colman	Space cooling thermostat,2 pos.	In space
1	SUBBASE	AT-603	Barber Colman	Subbase switch for fan AUTO/ON	At space thermostat
			BUILDING AS-205		
1	TS-1	TS-8501	Barber Colman	O.A. temperature sensor	Element in O.A.
1	TS-2	TS-8201	Barber Colman	H.W.S. temperature sensor	Element in H.W.S.
1		AT-215	Barber Colman	Bulb well	With TS-2
1	RC-1	CP-8102	Barber Colman	2 input reset controller for convertor control	In control panel
1	V-2	VS-9223-201-4-5	Barber Colman	Control valve, 2 way, 3/4", proportional, Cv = 5.0	At steam convertor
1	R-3	RH2B-U24	IDEC	Control relay, DPDT, 24 VAC	In control panel
1	T-2	TP-8102	Barber Colman	Space thermostat, heating,proport.	In space
1	V-1	VS-9313-351-4-10	Barber Colman	Control valve, 3 way, 1 1/2" proportional, Cv = 33	At AHU h.w. coil
1		TC-1152	Barber Colman	Space thermostat, cooling, 2 stage	In space
1		AT-608	Barber Colman	Subbase switch, fan AUTO/ON, HEAT/COOL	At cooling thermostat
1		TC-4111	Barber Colman	Thermostat O.A. limit	Bulb in O.A. duct
2	R-2, R-3	RH2B-U24	IDEC	Control Relay, DPDT, 24 VAC	In control panel
3		SH2B-05	IDEC	Relay base	In control panel

JOB: REPLACE AIR CONDITIONING UNITS
VARIOUS BUILDINGS
MCAS, NEW RIVER, N.C.

EQUIPMENT SCHEDULE

Job #: A-024/J-024

DATE: 1/23/88

QNTY.	IDENTIFIER	PART NUMBER	MANUFACTURER	DESCRIPTION	LOCATION
			BUILDING AS-236		
6	COOLING	TC-1103	Barber Colman	Space thermostat cooling, 2 pos	In space
6	T-2	TP-8102	Barber Colman	Space thermostat, heating, proport.	In space
2	V-3	VS-9313-201-4-4	Barber Colman	Control valve, 3 way, 1/2" proportional, Cv = 4	At AHU 3 & 5
3	V-4	VS-9313-201-4-6	Barber Colman	Control valve, 3 way, 3/4" proportional, Cv = 6.8	At AHU 1,2 &6
1	V-5	VS-9313-351-4-11	Barber Colman	Control valve, 3 way, 2" proportional, Cv = 55	At AHU 4
6		AT-603	Barber Colman	Subbase switch, fan AUTO/ON HEAT/COOL	At cooling thermostat
4	O.A. T'stat	TC-4111	Barber Colman	Thermostat, O.A. limit	Bulb in O.A. duct of AHU 1, 2, 4 & 6
12	R-2, R-3	RH2B-U24	IDEC	Control relay, DPDT, 24 VAC	In control panel
13		SH2B-05	IDEC	Relay base	In control panel
1	V-6	VS-9223-351-4-10	Barber Colman	Control valve, 2 way, 1 1/2" N.C. proportional, Cv = 25	At steam convertor
1	TS-1	TS-8501	Barber Colman	O.A. temperature sensor	Element in O.A.
1	TS-2	TS-8201	Barber Colman	H.W.S temperature sensor	Element in H.W.S
1		AT-215	Barber Colman	Bulb Well	With TS-2

JOB: REPLACE AIR CONDITIONING UNITS
VARIOUS BUILDINGS
MCAS, NEW RIVER, N.C.

EQUIPMENT SCHEDULE

Job #: A-024/J-024

DATE: 1/23/88

QNTY.	IDENTIFIER	PART NUMBER	MANUFACTURER	DESCRIPTION	LOCATION
			AS-236 (cont)		
1	RC-1	CP-8102	Barber Colman	2 input reset controller for steam convertor	In control panel
1	R-3	RH2B-U24	IDEC	Control relay, DPDT, 24VAC	In control panel
1				Control panel, 20" X 16"	In mech. room
			BUILDING AS-502		
1	SPACE	TC-1103-500	Barber Colman	Space thermostat, cooling, 2 pos.	In space
1	SUBBASE	AT-603	Barber Colman	Subbase switch, fan AUTO/ON	At cooling thermostat

Sequence of Operation

8.1.1 Building AS-202: When the temperature rises above the setting of the cooling thermostat with the fan selector switch in "AUTO" position, the compressor and the fan shall be energized together. When the fan selector switch is in the "ON" position, the compressor shall cycle and the fan shall run continuously.

8.1.2 Building AS-205: When the thermostat is in the "COOL" position and the fan selector switch is in the "AUTO" position the compressors shall be energized on a temperature rise by two cooling stages of the thermostat and the fan shall cycle with the compressors. When the fan selector switch is in the "ON" position, the fan shall run continuously. When the thermostat is in the "HEAT" position the three way hot water control valve shall modulate hot water from full coil by-pass to full flow through the coil as the space temperature falls. The fan shall run continuously during the heating modes.

8.1.2.1 Converter Controls: A 2 input controller with one sensing element in the outside air and one sensing element in the hot water supply shall control a normally closed steam valve. The supply water temperature shall be reset upwards as the O.A. temperature falls. Reset schedule is such that at 20 degrees O.A., H.W.S. is 180 degrees and at 60 degrees O.A., H.W.S. is 100 degrees.

8.1.2.2 Pump Control: When the steam control valve begins to modulate open, the hot water pump shall be energized and shall remain energized until the steam control valve completely closes.

8.1.2.3 A safety low limit thermostat shall deenergize the air handling unit's fan when the mixed air temperature entering the heating coil drops below 35 degrees F.

8.1.3 Building AS-236: When any of the six thermostats are in the "COOL" position and the fan selector switch is in the "AUTO" position, the compressor shall be energized on a temperature rise and the fan shall cycle with the compressor. When the fan selector switch is in the "ON" position, the fan shall run continuously. When the thermostat is in the "HEAT" position the three way hot water control valve shall modulate hot water from full coil by-pass to full flow through the coil as the space temperature falls. The fan shall run continuously during the heating modes.

8.1.3.1 Converter Controls: A 2 input controller with one sensing element in the outside air and one sensing element in the hot water supply shall control a normally closed steam valve. The supply water temperature shall be reset upwards as the O.A. temperature falls. Reset schedule is such that at 20 degrees O.A., H.W.S. is 180 degrees and at 60 degrees O.A., H.W.S. is 100 degrees.

8.1.3.2 Pump Control: When the steam control valve begins to modulate open the hot water pump shall be energized and shall remain energized until the steam control valve completely closes.

8.1.3.3 A safety low limit thermostat shall deenergize the air handling unit fan when the mixed air temperature entering the heating coil drops below 35 degrees F. Not applicable for AHU 3 and 5.

8.1.4 Building AS-502: When the temperature rises above the setting of the cooling thermostat with the fan selector switch in "AUTO" position, the compressor and the fan shall be energized together. When the fan selector switch is in the "ON" position, the compressor shall cycle and the fan shall run continuously.

8.1.5 Building AS-3502: Existing controls shall be reused. An existing high limit pressure selector and pneumatic electric switch shall energize the new condensing unit and provide full cooling. Existing hot water control valve will be reused and connected to new heating coil in air handling unit.

Para. 2.2.2.9

TS-1, TS-2

BARBER COLMAN COMPANY

General Instructions

Solid State Sensing Temperature and Humidity Series TS-8000 and HS-8000

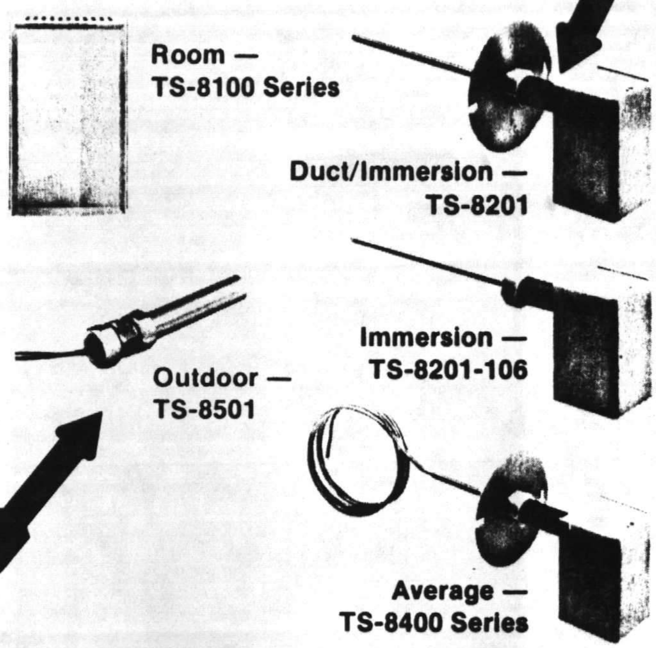
Temperature Sensing

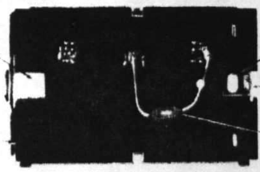
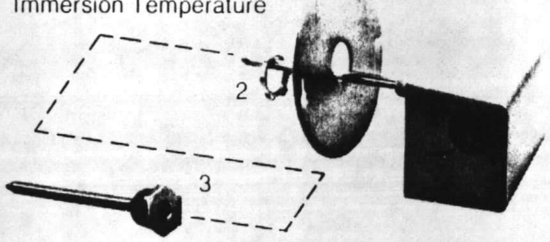
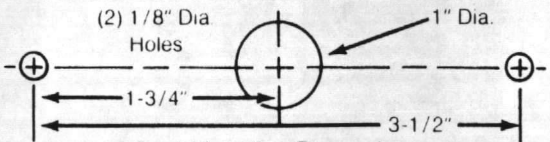
GENERAL INFORMATION

Sensing is accomplished by the use of a temperature sensitive Balco resistance wire packaged in the form of room, duct, averaging and outdoor type configurations. The design of the entire system is around a 1000 Ω sensing element at 70°F.

WIRING

Make all electrical connections to the element in accordance with the installation and wiring diagram for the job. Comply with national and local electrical codes. Do not use the element box as a junction box for other control circuits. It is generally advisable to use flexible conduit for connecting box to rigid conduit. Restrict element leads to shortest length practical. Barber-Colman twisted cable or factory approved cable should be used.



Part No.	Use	Location	Mounting	Terminal Code Wiring
TS-8101	Room Sensor w/o Setpoint	Wall		⑦ ⑧ } Output Terminals
~~TS-8111~~	~~Room Sensor w/ Setpoint~~	Wall		
TS-8201	Duct Immersion 7" Immersion Length	Duct or Well AT-215 3/4" NPT	AT-215 Thermowell Immersion Temperature 	Pigtails: Black, Black } (C) Controlling Black, Black } (L)* Controlling *Found only on the TS-8331
TS-8201 -106	Immersion 4" Insertion Length	Well AT-225 1/2" NPT		
TS-8331	Lagged Sensor	Duct	 Duct Mounting Dimensions	
TS-8405	5' Average	Duct		
TS-8422	22' Average	Duct		
TS-8241	Diffuser	Ceiling	Mount on Face of Ceiling Diffuser. See Instructions for B-C Models PB, PS or SFS, SFB. Pg. 2	Pigtails: Black Black
TS-8261	Light Fixture	Light Fixture	Mount in Return Grill of Light Fixture	Pigtails: Black Black
TS-8501	Outdoor Air	Outside of Building	Use Conduit Connectors	Pigtails: Black, Black } Controlling
TS-8531	Solar	Outside of Building		Orange, Orange } Element (Solar)
TS-8533	Econostat	Outside of Building		Red, Red } Heater (Econostat)

Pará. 2.2.2.g

BARBER COLMAN COMPANY
a Siebe company

General Instructions

Solid State Sensing
Temperature and Humidity
Series TS-8000 and HS-8000

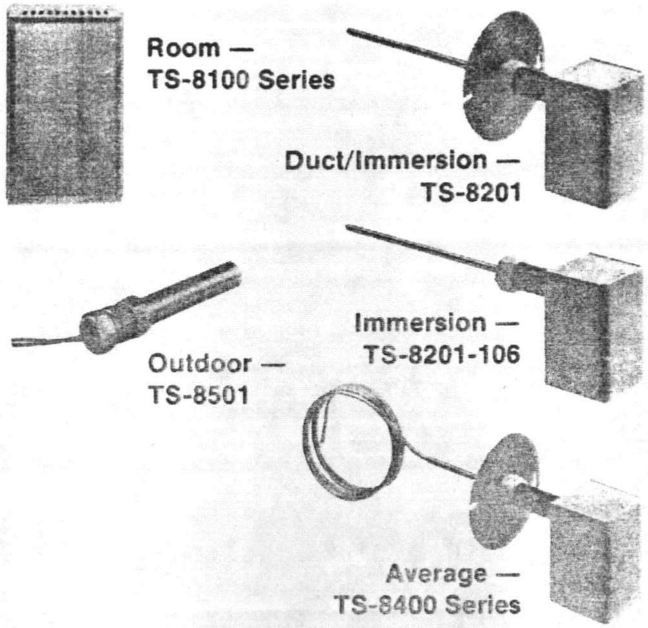
Temperature Sensing

GENERAL INFORMATION

Sensing is accomplished by the use of a temperature sensitive Balco resistance wire packaged in the form of room, duct, averaging and outdoor type configurations. The design of the entire system is around a 1000 Ω sensing element at 70°F.

WIRING

Make all electrical connections to the element in accordance with the installation and wiring diagram for the job. Comply with national and local electrical codes. Do not use the element box as a junction box for other control circuits. It is generally advisable to use flexible conduit for connecting box to rigid conduit. Restrict element leads to shortest length practical. Barber-Colman twisted cable or factory approved cable should be used.



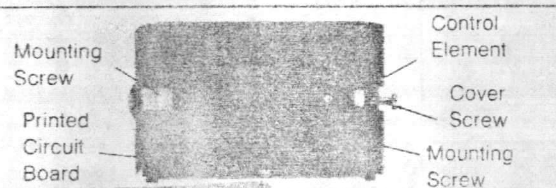
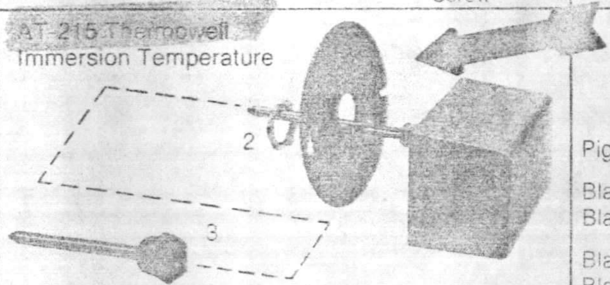
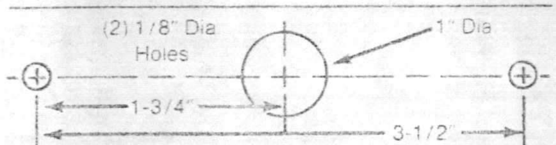
Room — TS-8100 Series

Duct/Immersion — TS-8201

Immersion — TS-8201-106

Outdoor — TS-8501

Average — TS-8400 Series

Part No.	Use	Location	Mounting	Terminal Code Wiring
TS-8101	Room Sensor w/o Setpoint	Wall		⑦ ⑧ } Output Terminals
TS-8111	Room Sensor w/Setpoint	Wall		
TS-8201	Duct Immersion 7" Immersion Length	Duct or Well AT-215 3/4" NPT	AT-215 Thermowell Immersion Temperature 	Pigtails: Black } Black (C) Controlling Black } Black (L)* Controlling *Found only on the TS-8331
TS-8201 -106	Immersion 4" Insertion Length	Well AT-225 1/2" NPT		
TS-8331	Lagged Sensor	Duct	 Duct Mounting Dimensions	
TS-8405	5' Average	Duct		
TS-8422	22' Average	Duct		
TS-8241	Diffuser	Ceiling	Mount on Face of Ceiling Diffuser. See Instructions for B-C Models PB, PS or SFS, SFB. Pg. 2	Pigtails: Black Black
TS-8261	Light Fixture	Light Fixture	Mount in Return Grill of Light Fixture	Pigtails: Black Black
TS-8501	Outdoor Air	Outside of Building	Use Conduit Connectors	Pigtails: Black } Black Controlling
TS-8531	Solar	Outside of Building		Orange } Orange Element (Solar)
TS-8533	Econostat	Outside of Building		Red } Red Heater (Econostat)

Solid State Humidity Sensing

Sensing is accomplished by the use of a nonorganic resistance type material which will be housed either in a room or duct type mounting base. Selection of the proper AH-100 series element will provide the capability of control over a 15% range. Elements are available through the span of 5% to 95% R.H.

The average resistance of each element at midrange is approximately 22,000 ohms; except the violet element, which is 50,000 ohms. A resistor of appropriate value may be substituted in the bridge circuit to verify the element resistance.

CAUTION

Do not measure resistance of element with an ohmmeter, as DC voltage across the element will cause polarization and a new element will be required. Basic element is not repairable. Order a replacement from the factory or local branch office.

CARE OF ELEMENT

The elements are wrapped with a moisture pervious cellophane, which actually is an air filter. On installations using duct elements, where air velocities are reasonably high **do not remove cellophane.** Always install element with wrapping so that perforations in cellophane are on downstream side of air currents. Punch more holes (only in downstream side of cellophane) to increase element sensitivity.

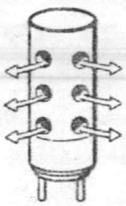


TABLE 1.

Part Number	Sensing Element Color	Relative Humidity Range
AH-100	Violet	85% to 95%
AH-101	Blue	70% to 85%
AH-102	Green	50% to 70%
AH-103	Yellow	40% to 55%
AH-104	Orange	30% to 45%
AH-105	Brown	10% to 30%

WIRING

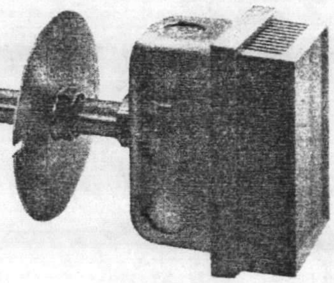
Make all electrical connections to the device in accordance with the installation wiring diagram for the job. Comply with national and local electrical codes. Restrict element leads to shortest length practical, using three conductor twisted cable, 18 gauge minimum.

CAUTION

Power wiring must never be installed in the same conduit.

LOCATION

Locate the sensing element where it will be exposed to unrestricted natural air circulation and to the average conditions of the controlled space. Do not locate it near extreme sources of heat, cold, or moisture.



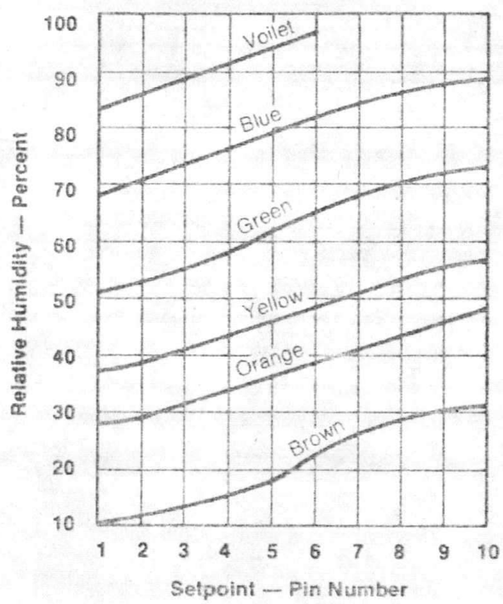
Duct — HS-8200 Series

Room — HS-8100 Series

CALIBRATION

1. Place DC-VOM on output of CP-8102 controller, OP1 (+) and COM (-).
2. Read humidity at the sensor.
3. Place jumper on proper pin, per chart below.
4. Adjust the controller (CAL A) to 7.5 Vdc output.
5. Refer to CP-8102 literature if further details are required.

GENERAL INFORMATION



MOUNTING OF DIFFUSER SENSOR TS-8241

Sensor should be mounted to the face of the ceiling diffuser so that it projects downward into the room. See Figure 1. If the diffuser has an adjustable pattern, the discharge air direction must be adjusted to a horizontal pattern. This will insure a representative sample of room air over the element (Figure 2). The transmitter will not perform satisfactorily if the discharge is adjusted to a vertical pattern.

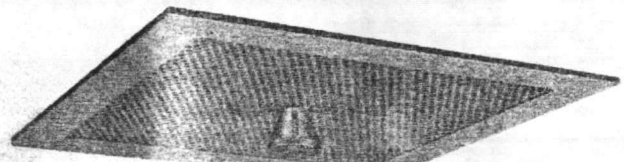


Figure 1.
Sensor Mounted in Perforated Face Ceiling Diffuser Model PB or PS

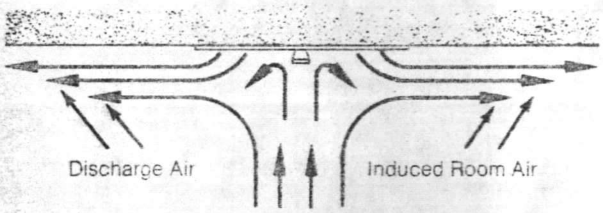


Figure 2.
Room Air Induced over Sensor by Discharged Air

A 7/16-inch hole is required in the diffuser face for mounting.

The SFS and SFB louver faced diffusers are available in nine air patterns, both in the square and rectangular design. For proper installation, use Table 2 which shows sensor location and the mounting figure referred to in the installation procedure. APNS-107 must be ordered separately.

SENSOR MOUNTING PROCEDURE ON SFS AND SFB USING APNS-107 KIT

1. Drill a 5/16" hole for sensor leads.
   a. Fig. 3. Locate hole center on an angled surface about 5/16" from an edge of the 1/2" square so as to avoid drill contact with the welded center plate mounting brackets.
   b. Fig. 4. Locate the hole center on one louver about 5/16" from junction of two center back to back louvers.
   c. Fig. 5. Locate hole center on an end louver about 1/2" from the junction of the louver and the mounting flange.
2. Bring field leads through the 5/16" hole. If required, remove the louver assembly from the mounting flange.
3. Center the APNS-107 bracket over the 5/16" hole (use as a template) and drill 1/8" holes for the mounting screws.
   a. Fig. 3. Drill two holes near edges of square center plate.
   b. Fig. 4. Drill two holes, one each on bottom edge of back to back louvers.
   c. Fig. 5. Drill one hole on end louver.
4. Assemble the sensor to APNS-107 bracket as shown in Figs. 3, 4, and 5.

   Fig. 5. Cut off one side of APNS-107 as shown.
5. Make field connections to sensor leads and push leads up through the 5/16" hole.

   Wrap friction or electrical tape around the leads and fill the 5/16" hole, preventing direct primary air passage over the sensor.
6. Attach APNS-107 as shown in Figs. 3, 4 and 5 using #6 screws.

   Fig. 5. Cover the crack between the end louver and mounting flange at least 12" on each side of the sensor. A 24" length of 3/4" tape stuck to mounting flange can be used.
7. The sensor installation is complete.

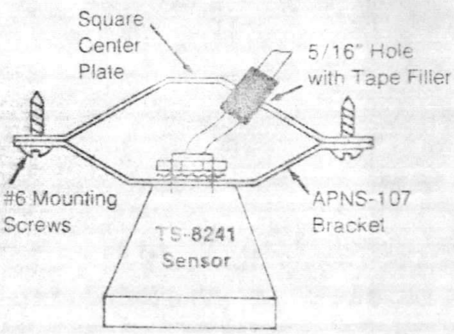


Figure 3

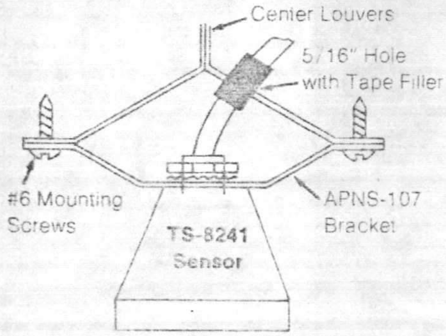


Figure 4

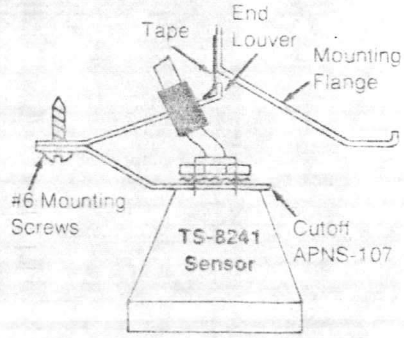


Figure 5

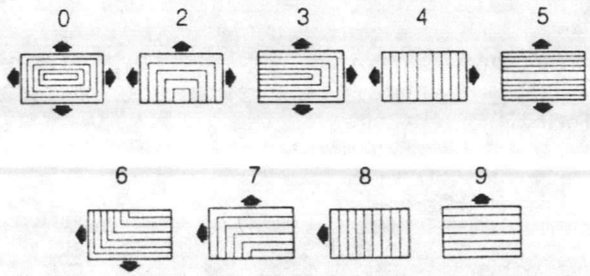
TABLE 2. SENSOR LOCATION AND FIGURE SHOWING MOUNTING DETAILS

Air Pattern	SENSOR LOCATION: Center of Diffuser Sq.	Center of Diffuser Rect.	Center of Side with No Air Throw Sq.	Center of Side with No Air Throw Rect.	Corner Opposite Air Throw Sq.	Corner Opposite Air Throw Rect.	End Opposite Air Throw Sq.	End Opposite Air Throw Rect.
0	Fig. 3	Fig. 4						
2			Fig. 4					
3								
4	Fig. 4							
5								
6					Fig. 3	Fig. 5		
7								
8							Fig. 5	
9								

TS-8241 must not be located nearer than 18" from a wall or corner of a room when used on air patterns 2, 6, 7, 8, or 9. This allows space for induced air to pass over TS-8241.

AIR PATTERNS (As Viewed from Diffuser Face)

Number is air pattern designation when ordering.



Specifications			Temperature Sensors: Room Light Fixture Diffuser*	Duct/ Immersion	Averaging	Selective Ratio Discharge	Humidity Sensors (Sensors must be ordered separately. Refer to Sensor Range Table 1.): Room	Duct
Package		Size**	4⅜×2¾×1⅝	4¾×3½×9⅛	4¾ × 3½ × †	4¾×3½×9⅛	4⅜×2¾×1⅝	4⅜×3½×9⅛
		Mounting	Wall	Duct/ Immersion	Duct	Duct	Wall	Duct
		Mounting Position	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical
		Connection	Terminals	Pigtails	Pigtails	Terminals	Pigtails	Pigtails
		Ambient Temp. Limits	-40 to 250°	-40 to 250°	-40 to 250°	-40 to 250°	35 to 135°	35 to 135°
Sensor		Resistance	1000 Ω	1000 Ω	1000 Ω	1000 Ω		
		Sensitivity	2.2 Ω/°F	2.2 Ω/°F	2.2 Ω/°F	2.2 Ω/°F		
		Length		6"	5' or 22'	6"		6"
Input	Control Range							
	Impedance							
	Adjust	Setpoint Range	55 to 85°				Up to 20% R.H.	Up to 20% R.H.
		Calibration Range					±5%	±5%
		Throttling Range						
		Ratio				5 to 20/1		
Output	Voltage	Impedance						
		Range						
		Reference				Negative	Negative	Negative
	Power Supply	Voltage						
		Current						
		Regulation						
Load		Voltage						
		Current						
Power		Voltage				6.2 Vdc ± .4	24Vac±10%	24Vac±10%
		Current				1 mA	25 mA	25 mA

Barber-Colman Company
ENVIRONMENTAL CONTROLS DIVISION

1354 Clifford Avenue
P.O. Box 2940
Loves Park, IL U.S.A. 61132-2940

LITHO IN U.S.A.

Para. 2.2.2.9

RC-1

BARBER COLMAN COMPANY

General Instructions

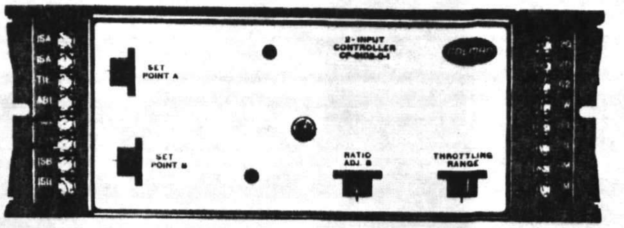
CP-8102 Electronic Two Input Temperature or Humidity Controller

FUNCTIONS

Electronic controller receives temperature or humidity sensor inputs and sends a variable electronic signal, 1 to 15 Vdc, to up to six System 8000® actuators or relays (controlled devices). Additional devices can be controlled with the use of adapters. These actuators or relays operate heating, cooling, humidification or dehumidification equipment in HVAC systems.

FEATURES AND BENEFITS

The reliable, easy to install CP-8102 electronic controller incorporates an amplifier with inputs for 1000ohm Balco® temperature sensors, humidity sensors or remote setpoint adjustor. Two setpoint dials, ratio authority dials, throttling range dials and calibration potentiometers are visable and accessible without removing controller cover allow for easy field adjustment. Coded screw terminals make sensor, remote setpoint, power supply and output signal wiring easy to install and change. The CP-8102 controller is used with other System 8000 devices.



CP-8102

Wiring Connections: Coded screw terminals for all control inputs and outputs.

Safe Ambient Temperature Limits:

Operation: 40 to 135°F (4.4 to 57°C)
Storage: -40 to 160°F (-40 to 71°C)

Dimensions: 4" (102 mm) high × 11" (279 mm) wide × 2-1/2" (64 mm) deep

Table 1. Specifications

Part Number	Control Dial Range Setpoint "A"	Control Dial Range Setpoint "B"	Throttling Range for 3 Vdc Output Change	Authority Ratio Adjustment Setpoint "A" Setpoint "B"	Control Output Voltage†	Power Required	Power Supply Available
CP-8102	20 to 120°F	20 to 120°F	Adjustable 2 to 10°F by Dial*	.5:1 to 25:1 Adjustable by Dial	1 to 15 Vdc 10 mA Max. Factory Set for D.A.	20 Vdc 23 mA	6.2 Vdc 7 mA Max.
CP-8102-116	-6 to 48°C	-6 to 48°C	Adjustable 1 to 6°C by Dial*				

* See ADJUSTMENTS for additional throttling ranges.
† Units factory calibrated for 7.5 Vdc output with sensor at setpoint temperature.

Options: None.

ACCESSORIES:

AD-8122	Signal adaptor for dual outputs (two direct acting)
AD-8123	Signal adaptor for dual outputs (one direct, one reverse acting)
AD-8124	Signal adaptor for dual outputs (one reverse, one direct acting)
AD-8912	12" enclosure
AD-8969-201	Off set resistor kit: 5, 10, 15 & 20°F
AD-8969-901	Extended throttling range jumper
ASP-301	Power supply required for HSP-6X81 humidity transmitter
ASP-581	Indication meter 20 to 80% RH
AT-8122	Remote setpoint adjuster, dual scale 20 to 120°F (-6 to 49°C)
AT-8155	Remote setpoint adjuster, dual scale 50 to 250°F (10 to 121°C)
AT-8158	Remote setpoint adjuster, dual scale 55 to 85°F (13 to 29°C)
AT-8222-101	Setpoint scale for humidity 20% to 100%
AT-8435	Remote setpoint adjuster, dual scale 50 to 450°F (10 to 232°C) for use with TS-8204 only
CN-8101	Multi-purpose bridge
HS-8101	Room humidity sensor
HS-8201	Duct humidity sensor
TS-8101	Room sensor
TS-8111	Room sensor with setpoint
TS-8131	Room button type sensor
TS-8201	Duct/immersion sensor
TS-8204	High temp. duct/immersion sensor requires AT-8435 remote setpoint for all applications except differential control
TS-8241	Diffuser sensor
TS-8261	Light fixture sensor
TS-8331	Lagged sensor (CN-8101 is required)
TS-8405	5' averaging sensor
TS-8422	22' averaging sensor
TS-8501	Outdoor sensor
TS-8531	Solar sensor (CN-8101 is required)
TS-8533	Econostat sensor
Tool-201	Calibration kit for system 8000

DEFINITIONS

Mode of Operation: Either direct-acting or reverse-acting.

Direct-acting (D.A.) means that an increase in temperature at the sensor(s) causes the voltage output (OP1) to increase.

Reverse-acting (R.A.) means that an increase in temperature at the sensor(s) causes the voltage output (OP1) to decrease.

Reset Control Action: The direction of reset determines whether input A setpoint is reset upward or downward on a temperature decrease at input B.

Direct reset: (D.R.) A temperature decrease on input B resets input A setpoint downward.

Reverse reset: (R.R.) A temperature decrease on input B resets input A setpoint upward.

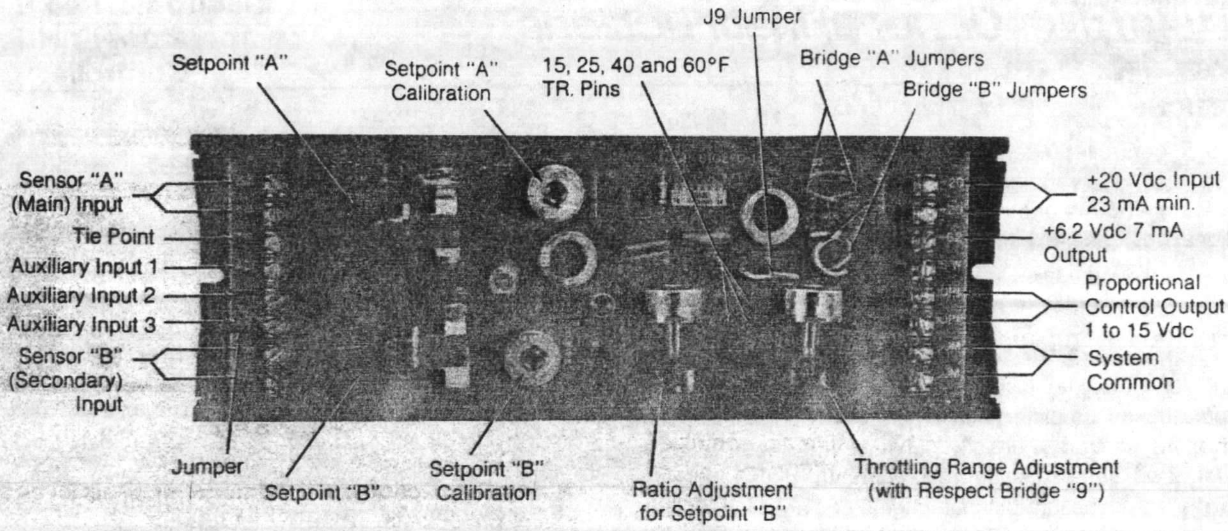


Figure 1. CP-8102

CONTROL TERMINAL INPUTS (See Figure 1)

ISA: Any TS-8000 Temperature Sensor (1000 ohm Balco)

ISB: Any TS-8000 Temperature Sensor (1000 ohm Balco)

AB1, AB2, AB3: Auxiliary inputs; any remote setpoint adjuster AT-8000 series, HS-8X01 humidity sensor, CN-8101 multi-purpose bridge

CONTROL TERMINAL OUTPUT (See Figure 1)

OP1: 1 to 15 Vdc (10 mA maximum). Units factory calibration for 7.5 Vdc output with sensor at setpoint temperature.

ADJUSTMENTS: (See figure 1)

Temperature Setpoint "A": By dial 20 to 120°F (-6 to 48°C), or by remote setpoint adjuster (See Accessories).

Temperature Setpoint "B": By dial 20 to 120°F (-6 to 48°C), or by remote setpoint adjuster (See Accessories).

Setpoint "A" Calibration: By potentiometer.

Setpoint "B" Calibration: By potentiometer. For reset control, set Setpoint "B" at value where Setopint "A" will be reset. Adjust Setpoint "A" at control point required with no reset from sensor "B".

THOTTLING RANGE: By dial 2 to 10°F, 1 to 6°C. By pin selection 15, 25, 40 and 60°F (8, 14, 22, 33°C). Remove J9 jumper from JC9 and attach to required throttling range pin. By extended throttling range adjuster, AD8969-901 (order separately), 55, 65, 75, 85, 100, 115, 125 and 140°F (31, 36, 42, 47, 56, 64, 69 and 78°C). The throttling range is the sum of the T.R. pins connected.

AUTHORITY RATIO ADJUSTMENT: By dial .5 to 25:1. Ratio is the number of degrees change at Sensor "B" required to reset Setpoint "A" one (1) degree. Example: 25:1 means a 25°F (14°C) change at Sensor "B" will reset Setpoint "A" 1°F (.5°C).

Table 2

Controller Function	Jumper Connections Required	
	Bridge "A"	Bridge "B"
Direct Acting*	J4 to JC6 J3 to JC5	J5 to JC5 J6 to JC6
Reverse Acting	J4 to JC5 J3 to JC6	J5 to JC6 J6 to JC5
Internal Setpoint Active*	J1 to JC1	J2 to JC3
Internal Setpoint Inactive for Remote Setpoint	J1 to JC2	J2 to JC4
Disable Bridge "B" for Single Sensor Input	Remove Jumper from AB2 to AB3	

* As supplied from factory.

To Obtain Reverse Reset: Both bridges should have the same action. Example: both direct acting, or both reverse acting.

To Obtain Direct Reset: Bridges should have different action. Example: one direct and one reverse acting.

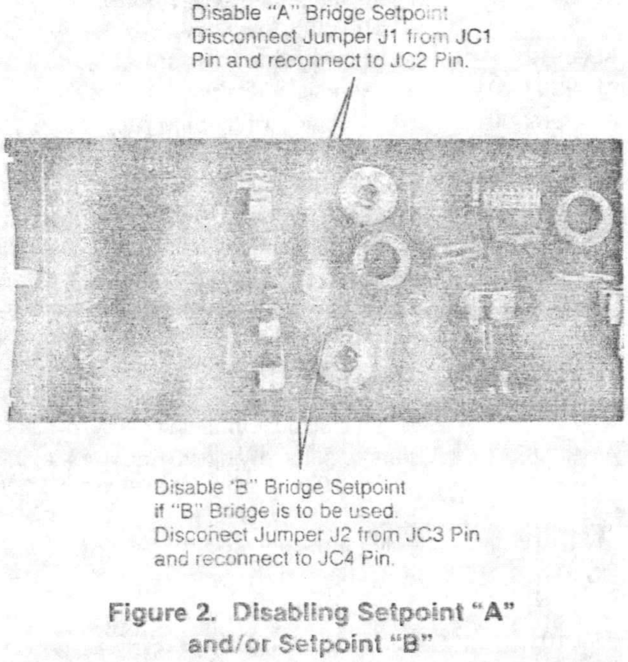


Figure 2. Disabling Setpoint "A" and/or Setpoint "B"

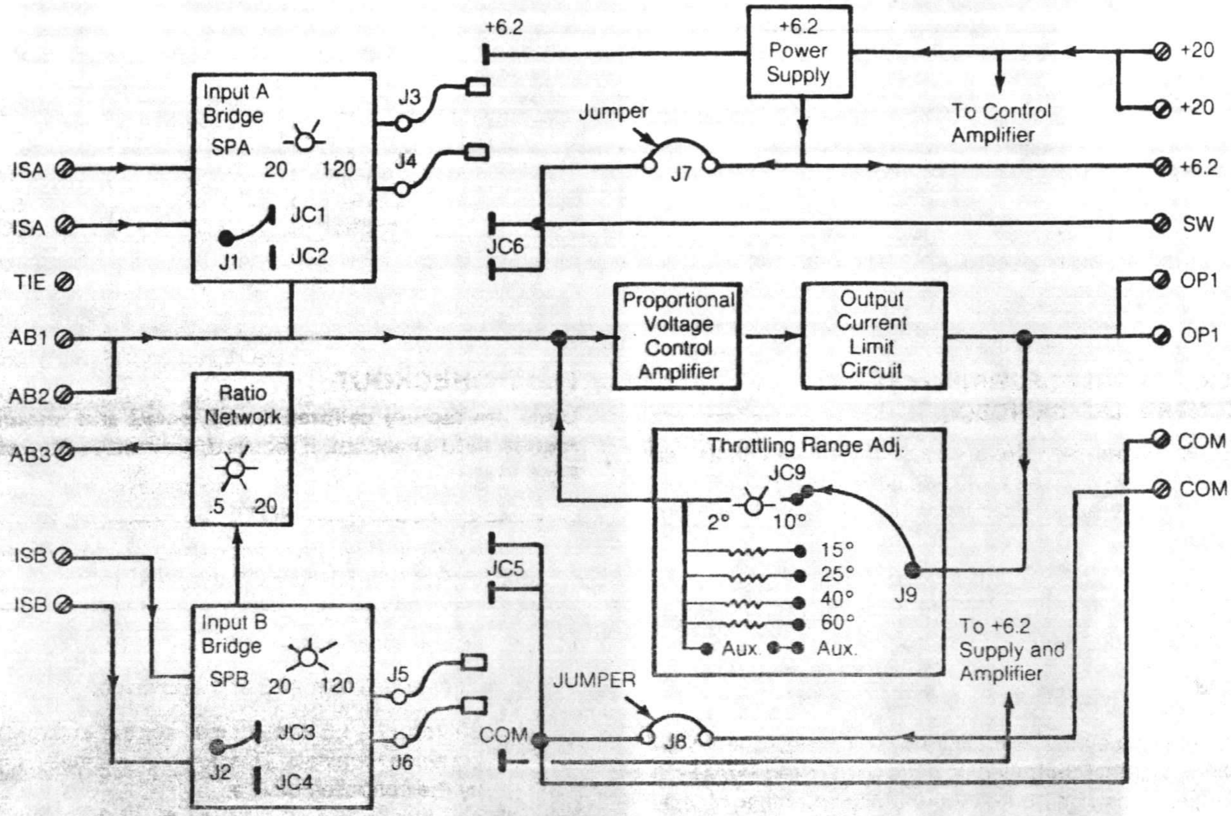


Figure 3. CP-8102 Controller Block Diagram

PRE-INSTALLATION: Open the carton and visually inspect the device for part number and obvious defects before proceeding with the installation.

NOTE

Mounting screws are not provided.

INSTALLATION: Device may be mounted, in any position, in an inside location near the controlled equipment using the two slots in the track. AD-8912 enclosures can be ordered separately for remote installations.

CAUTION

Avoid locations where excessive vibration, moisture, corrosive fumes or vapors are present, or where high radio frequency or electro-magnetic interference generating devices are near.

See Figure 4 for mounting dimensions.

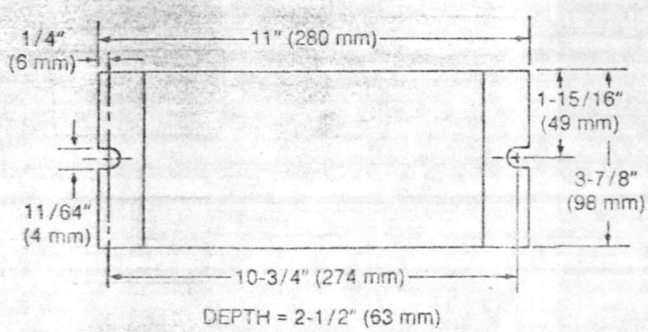


Figure 4. Mounting Dimensions

GENERAL WIRING INFORMATION

Make all connections according to job wiring diagrams and in compliance with national and local codes.

Two separate No. 18 twisted pair wires (six turns per foot [.3m]).
Class II, low voltage, are suitable for up to 1000 feet (300 m) for the sensor leads. See table 3 for longer runs.

CAUTION

Never run line voltage in the same conduit with unshielded sensing element leads. Use copper conductors only.

Shielded cable (Belden No. 8422 or equivalent) must be used when it is necessary to install the DC signal leads in the same conduit with power wiring, or when it is known that high RFI/EMI generating devices are near. Ground the shield at the controller only on the COM (-) terminal.

Table 3. Wiring Lengths

Wire Gauge	LENGTH OF RUN IN FEET**						
	"HS" Sensor To CP-8102	"TS" Sensor To CP-8102	CN-8101, AT-81X4 TS-8601 To CP-8102	"HSP" Transmitter To CP-8102	TSP-8101 To CP-8102	CP-8102 To Controlled Device	CP-8102 To Adaptor*
22	125	—	—	—	Should be in Same Panel as Controller	—	—
18	300	1,000	1,000	250		1,000	1,000
16	—	2,250	—	—		2,250	2,250
14	—	4,000	—	—		4,000	4,000

* AD-8101, AD-812X, AD-8201, AD-8301, AD-8501
**1 Ft. approx. .3 meter

GENERAL RULES FOR WIRING CP-8102 TO CONTROLLED DEVICE(S)

1. Never connect red lead (or +20 terminal) of any controlled device which has a regulated power supply to the red lead (or +20 terminal) of any other controlled device (see Figure 5).
2. Controlled devices (MP-52XX) with unfiltered and unregulated power supplies must be filtered. CP-8102 will provide filtering for a maximum of two MP-52XX by connecting the two red leads together at the controller's +20 terminal (see Figure 6).
3. Controlled devices with filtered and unregulated supplies: Up to six controlled devices with the red leads (+20 terminals) can be connected together. Number of units paralleled depends on the current (mADC) requirements of the controller or adaptor.

Table 4. Controlled Device Power Supply Characteristics

Filtered & Regulated	Filtered & Unregulated	Unfiltered & Unregulated
CC-8101 CC-8102 CC-8103 CC-8111 Series CC-8118 Series CC-8218 Series CP-8161 Series CP-8301 Series* CP-8425 Series CP-8501 Series CP-8502 Series	MP-54XX MS-8XXX Actuators	MP-52XX Actuators

* Except CP-8301-101 which does not have a power supply.

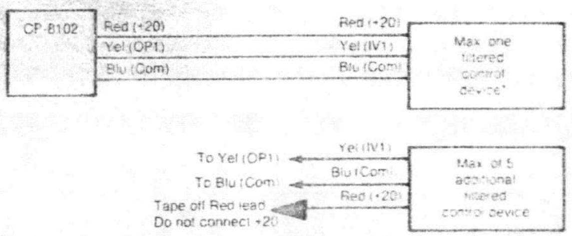


Figure 5. Controlled Devices All Filtered

FIELD CHECKOUT

Units are factory calibrated and tested and should not require field checkout. If required, proceed as follows (see Figure 1):

NOTE

The following procedures can be used for either reverse or direct acting connected CP-8102 controllers.

1. Initial Conditions for CP-8102
   A. Jumper between AB2 and AB3 disconnected.
   B. 20 Vdc +1 - 1.5 Vdc (23 mA) applied to the +20 and common terminals. This power is normally supplied by the controlled device.
2. Connect a 20,000 ohm/volt DC VOM meter between the OP1 (+) terminal and COM (-) terminal of the CP-8102. Use a 20 Vdc or less range.
3. Disconnect the temperature sensing element "A" from the ISA terminals of the CP-8102. Short ISA terminals together and VOM reading should be 1 Vdc or less if bridge "A" is direct acting and more than 15 Vdc if bridge A is reverse acting.
4. Open ISA terminals and VOM reading should be greater than 15 Vdc if bridge "A" is direct acting and less than 1 Vdc if bridge "A" is reverse acting.
5. The CP-8102 is a good unit if it passes tests in steps 3 and 4. Replace the unit if tests 3 and 4 are not met.

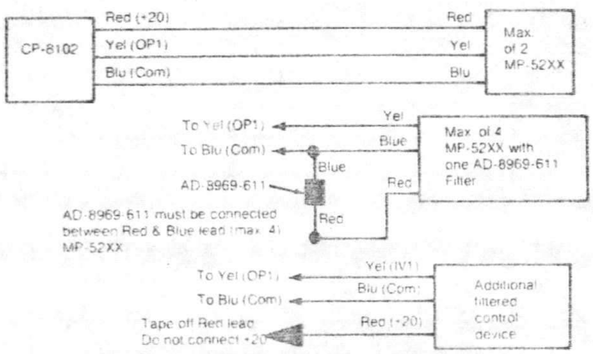


Figure 6. At Least One of the Controlled Devices in MP-52XX (Unfiltered)

FIELD CALIBRATION PROCEDURES FOR CONTROLLERS WITH ONE AND TWO INPUTS

(See Figures 7 and 9):

The following procedures can be used for either reverse or direct acting connected CP-8102 controllers.

The CP-8102 is factory calibrated and shipped with both inputs connected for direct acting output.

Normally, the CP-8102 (connected for either direct or reverse acting) requires no field calibration but if a field calibration check or recalibration becomes necessary, then proceed as follows:

1. Initial Conditions for CP-8102:

   A. Setpoint "A" set for: 70°F.

   B. Setpoint "B" set for: 70°F.

   C. Ratio adjustment set for: 1:1.

   D. Throttling range adjustment set for: 3°F.

   E. Jumper between AB2 and AB3 disconnected.

   F. 20 Vdc (23 mA) applied to the +20 and common terminals. This power is normally supplied by the controlled device.

2. Connect a 20,000 ohm/volt DC VOM meter between the OP1 (+) terminal and COM (-) terminal of the CP-8102. Use a 20 Vdc or less range.

3. Calibration of "A" input. Use one of the following two methods.

   A. Temperature measurement methods:

   Accurately measure the temperature at the temperature sensing element "A". Adjust setpoint "A" until the dial reading agrees with the temperature measured. Rotate setpoint "A" calibration potentiometer (located just to the right of setpoint "A" dial) until a VOM reading of 7.5±.2 Vdc is obtained.

   B. Sensing element substitution method:

   Disconnect the temperature sensing element "A" from the ISA terminals of the CP-8102. Reconnect a 1000 ohm ±.1% wire wound resistor (TOOL-203) to the ISA terminals. Adjust setpoint "A" for 70°F. Rotate setpoint "A" calibration potentiometer (located just to the right of setpoint "A" dial) until a VOM reading of 7.5±.2 Vdc is obtained.

NOTE

Method B above does not calibrate out any errors due to sensing element tolerances or wire lead resistance.

4. Calibration of "A" input complete.

   If "B" input is not being used (jumper between AB2 and AB3 removed) then proceed to step 7 below.

5. Reconnect jumper between AB2 and AB3.

6. Calibration of "B" input. Use one of the following two methods.

   A. Temperature measurement method:

   Accurately measure the temperature at the temperature sensing element "B". Adjust setpoint "B" until the dial reading agrees with the temperature measured. Rotate setpoint "B" calibration potentiometer (located just to the right of setpoint "B" dial) until a VOM reading of 7.5±.2 Vdc is obtained.

   B. Sensing element substitution method:

   Disconnect the temperature sensing element "B" from ISB terminals of the CP-8102. Reconnect a 1000 ohm ±.1%, wire wound resistor (TOOL-203) to the ISB terminals. Adjust setpoint "B" for 70°F. Rotate setpoint "B" calibration potentiometer (located just to the right of setpoint "A" dial) unti a VOM reading of 7.5±.2 Vdc is obtained.

NOTE

Method B above does not calibrate out any errors due to sensing element tolerances or wire lead resistance.

7. CP-8102 calibration is complete. Remove all test meters, test resistor, etc. Reconnect all elements, place setpoints, throttling range and ratio adjustments as required for the application.

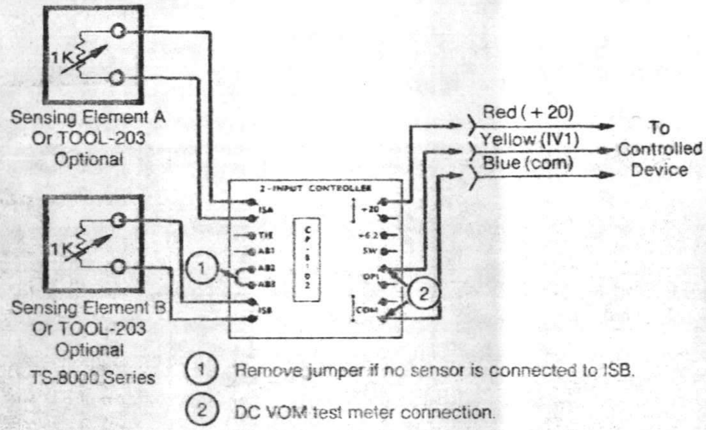


Figure 7. One or Two sensor Application

FIELD SERVICE

Units are factory calibrated and tested for direct acting control (D.A.) and reverse reset (R.R.) and should not require service. If required, proceed as follows (see Figure 8):

Power Supply

Apply +20; +1, −1.5 Vdc (23 mA) to the +20 and common terminals. Proper power supply is always required for unit to function properly. The +6.2 (±.3) Vdc should be available from the controller, if required.

Test

Connect a 20,000 ohm/volt DC VOM meter between +20 and common terminals. Controller power supply +20, +1 −1.5 Vdc (indicated by M1 in Figure 8) should be measured. Power supply is normally supplied by controlled device. Check +6.2 (±.3) Vdc power supply of controller with VOM.

Service

If the +20 Vdc level is not measured, service the (lead) controlled device, power supply or installation wiring as necessary to insure proper power supply.

Controller Output

See Field Calibration Procedures, on this page, for calibration of "A" setpoint using sensor element substitutes.

Test

With signal output measured between OP1 and COM at 7.5 ± .2 Vdc, rotate setpoint "A" dial several degrees (in increments of 1°F) each way from 70° setting to vary the M2 reading from 1 to 15 Vdc. The number of degrees that setpoint dial "A" is changed to vary the reading on M2 3 Vdc should be approximately 3°F (if T.R. is set at 5°F, 3 Vdc will change over 5°F).

Service

See Field Calibration Procedures, on page 5, for calibration of "B" setpoint using sensor element substitutes. (Make certain that jumper is connected to AB2 and AB3.)

Adjusting setpoint "B" several degrees from 70°F setting will cause the M2 reading to vary from 1 to 15 Vdc.

If output voltage cannot be made to vary over a 1 to 15 Vdc range, then replace the CP-8102 as defective.

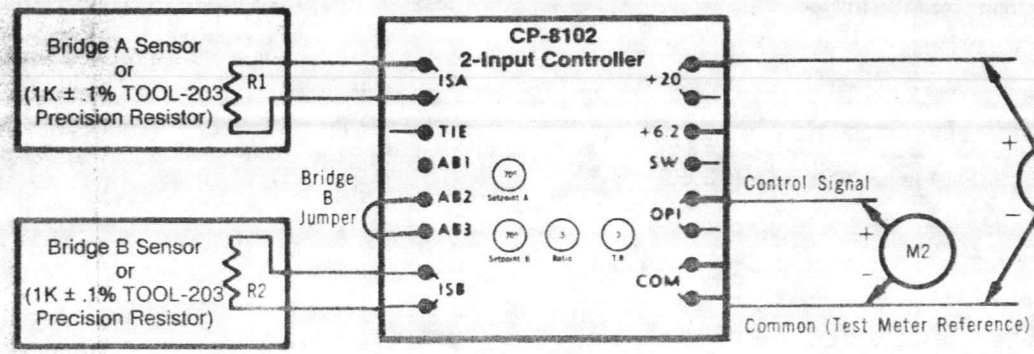


Figure 8.

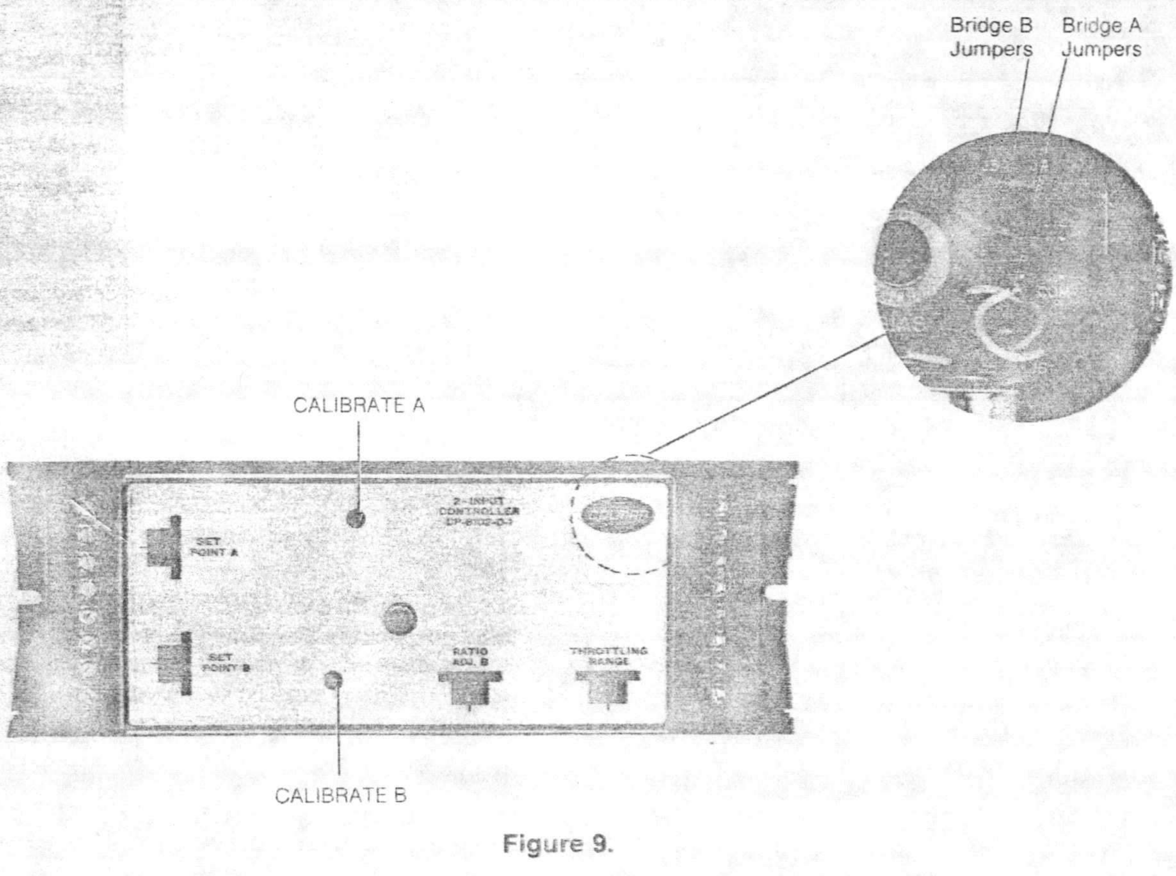


Figure 9.

MAINTENANCE

This is a quality product. Regular maintenance of the total system is recommended to assure sustained optimum performance.

TYPICAL APPLICATIONS

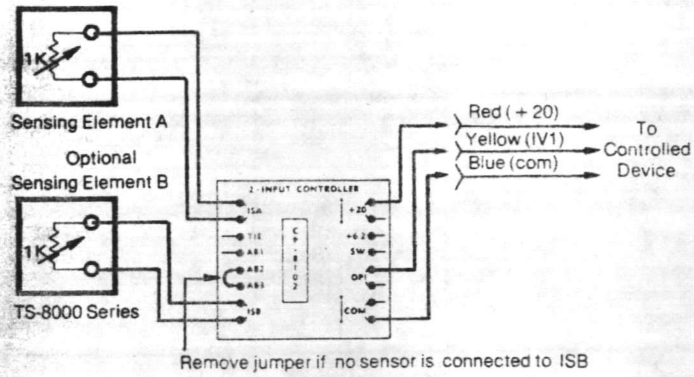


Figure 10. One or Two Temperature Sensor Application

Hot water reset is typical application for a two sensor application of the CP-8102. For example, perimeter radiation temperature, with hot water as a heating medium, is increased as the temperature of the outside air decreases. This method of control is known as reverse reset. A reset schedule shown below in table requires the hot water temperature to increase from 100° to 170°F, a change of 60°F, as the outside air temperature decreases from 60° to 0°F. If the throttling range of the CP-8102 controller is 10°F the setting of the CP-8102 will be as follows:

Setpoint "A": 110°
Setpoint "B": 60°
Ratio Adjustment: 1 (change in outside air temperature/ change in hot water temperature)
Throttling Range: 10°F
Note: Controller function is Direct Acting * (see table 2)
* Factory setting

Table 5. Reset Schedule

Outside Air Temp. (°F)	Water Temperature (°F)
60	110
0	170

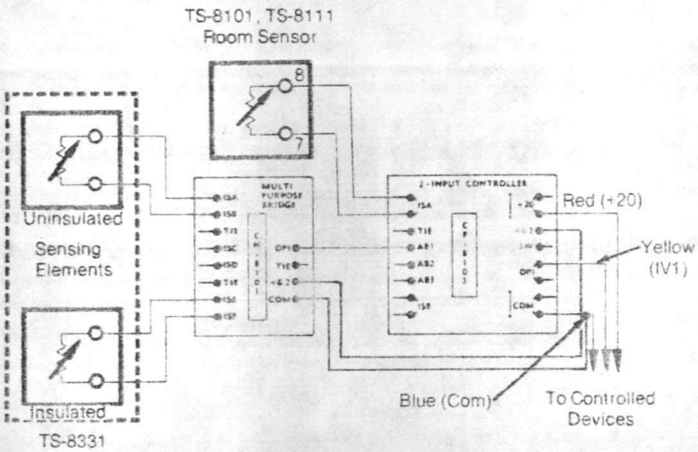
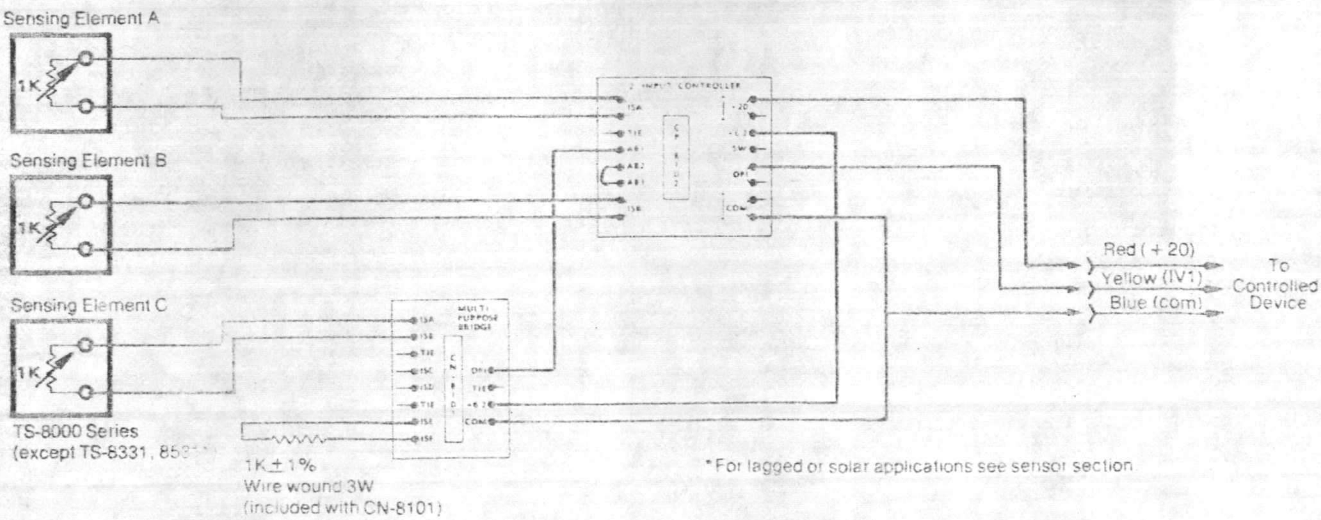


Figure 11. Derivative (Lagged) Sensor



*For lagged or solar applications see sensor section

Figure 12. Three Temperature Sensor Application*

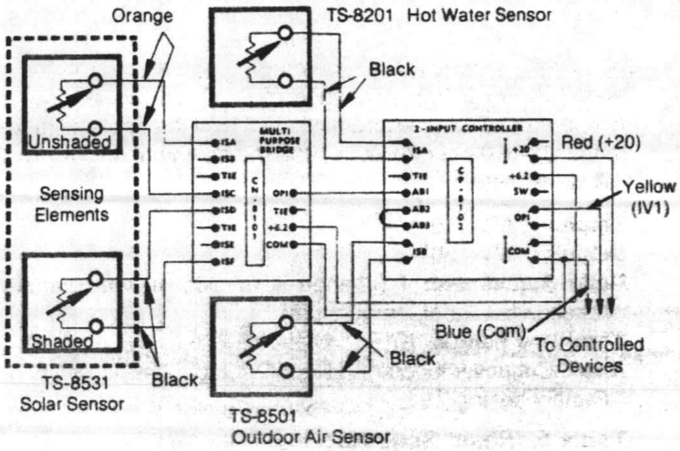
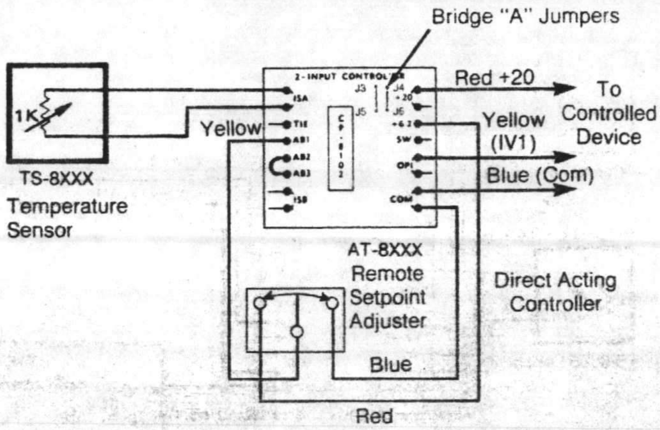


Figure 13. Solar and Outdoor Air Reset of Hot Water (Direct Acting Output)



NOTE: If the controller bridge is reverse acting, the red and blue wires at the AT-8XXX Series must be reversed (red to common, blue to +6.2).

Figure 14. Single Input with Remote Setpoint

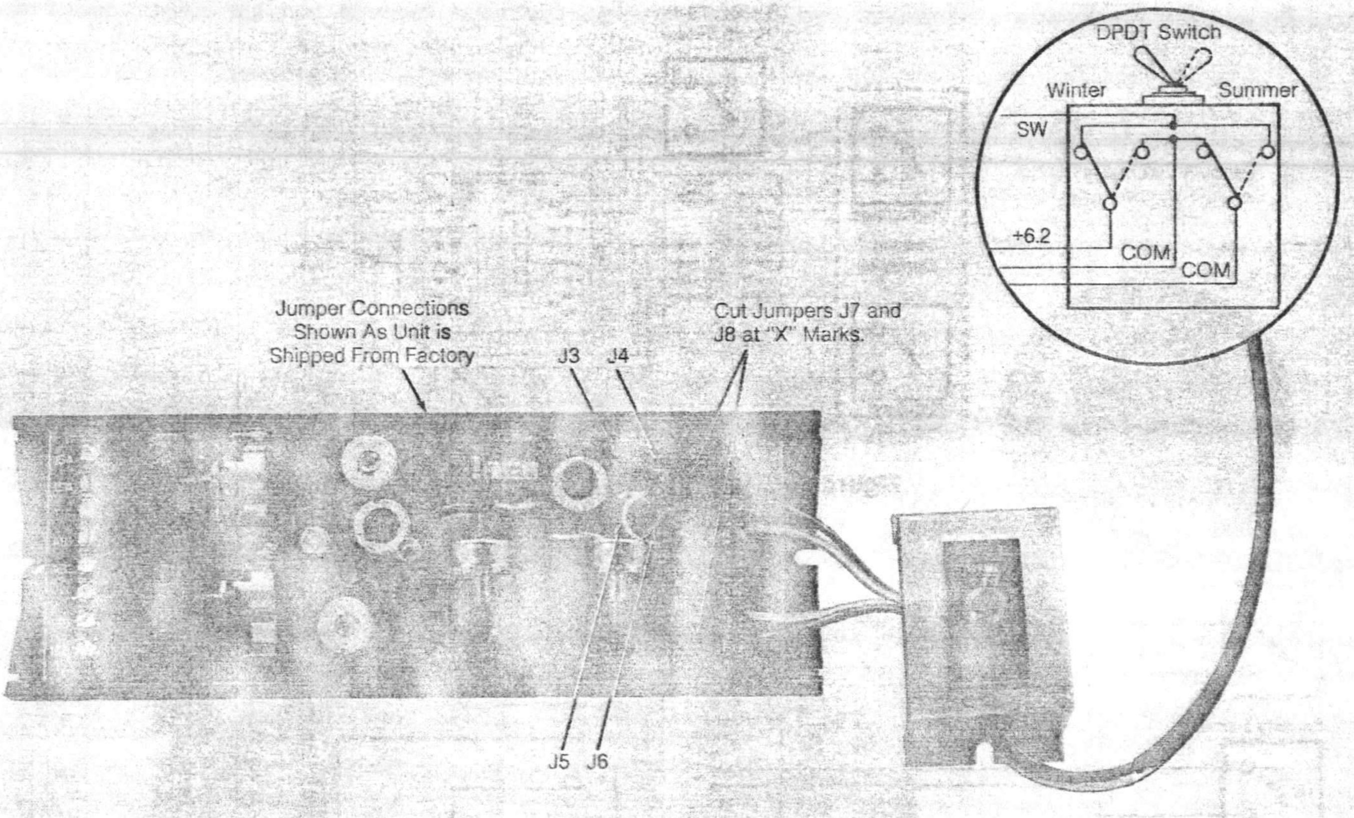


Figure 15. Single Unit Winter-Summer Switching

1. Cut both jumpers that are located between the terminal strip and cover on the left hand side of the device. (See Figure 15).
2. Connect D.P.D.T. Switch (CYZP-11 or equivalent) according to Figure 15.

NOTE

Switch contacts should have pilot duty ratings and maintain a 1 ohm or less contact rating over its normal life.

3. No recalibration of CP-8102 is required.

SINGLE UNIT SUMMER/WINTER SWITCHING (Continued):

Table 6. Bridge Connections for Summer/Winter (See Figure 15.)

BRIDGE "A" (MAIN SENSOR)		BRIDGE "B" (RESET SENSOR)		RESET OF SETPOINT "A"		JUMPER TO PIN CONNECTIONS			
Winter	Summer	Winter	Summer	Winter	Summer	J3	J4	J5	J6
D.A.	R.A.	D.A.		Reverse	Direct	JC5	JC6	COM	+6.2
R.A.	D.A.	D.A.		Direct	Reverse	JC6	JC5	COM	+6.2
D.A.	R.A.	R.A.		Direct	Reverse	JC5	JC6	+6.2	COM
R.A.	D.A.	R.A.		Reverse	Direct	JC6	JC5	+6.2	COM
D.A.		D.A.	R.A.	Reverse	Direct	COM	+6.2	JC5	JC6
R.A.		D.A.	R.A.	Direct	Reverse	+6.2	COM	JC5	JC6
D.A.		R.A.	D.A.	Direct	Reverse	COM	+6.2	JC6	JC5
R.A.		R.A.	D.A.	Reverse	Direct	+6.2	COM	JC6	JC5

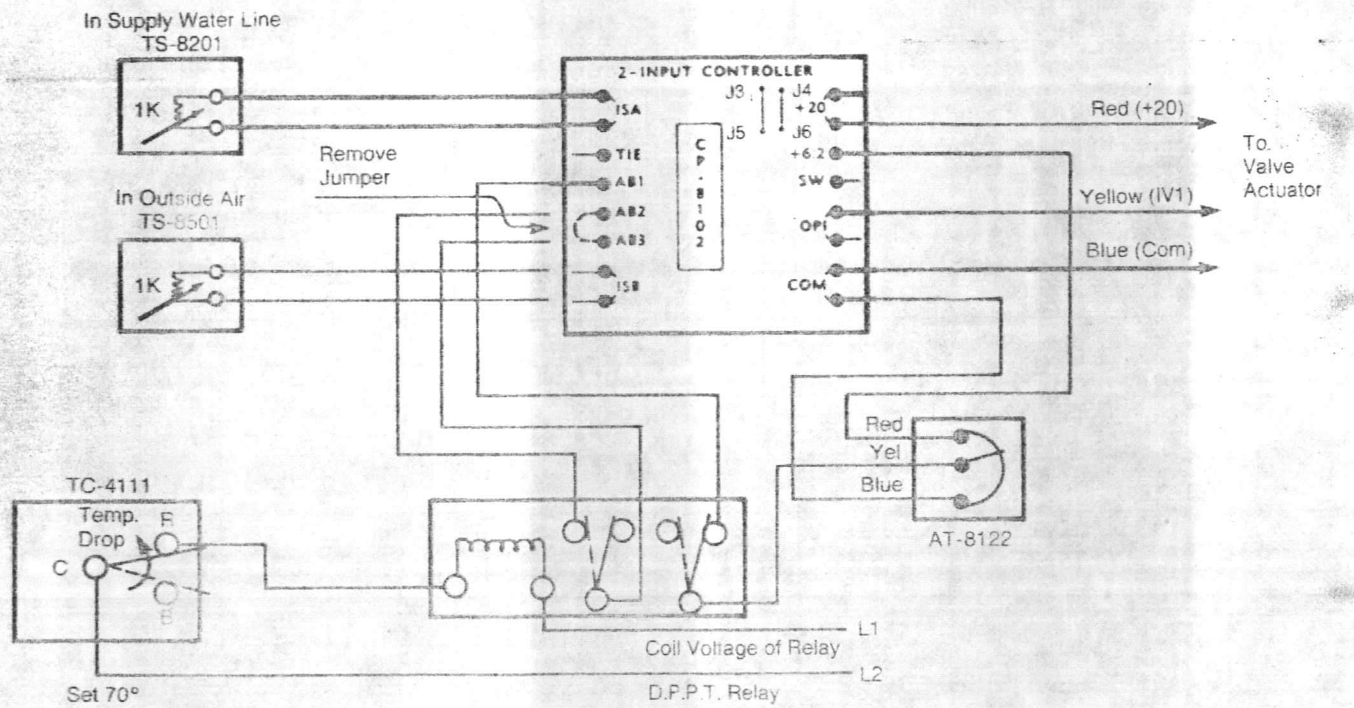


Table 7. Typical Reset Schedule

Outside Air Temp. (°F)	Water Temperature(°F)
70°	110°
0°	140°
Above 70°	85°

Outside air temperature reset of supply water temperature with fixed temperature of 85°F with outside air temperature of 70°F.

Setpoint "A": 110°F

Setpoint "B": 70°F

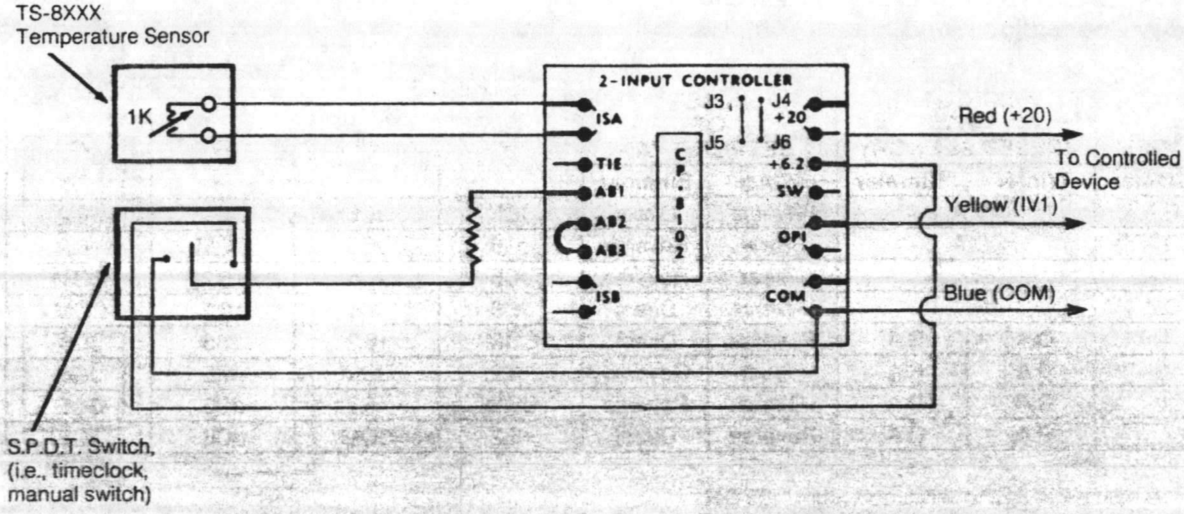
Ratio Adjustment: 2.33

Throttling Range: 10°F

AT-8122: Set 45°F for S.P. of 85 where O.A. is above 70°F.

Relay is energized with outside air temperature below 70°.

Figure 15. Outside Air Temperature Reset of Hot Water with Fixed Temperature with Outside Air Temperature Above Selected Value



Resistor (5, 10, 15, 20°F offset) use AD-8969-201 kit.

Offsetting setpoint for Direct Acting Controller:

Raise, connector resistor to +6.2 terminal.

Lower, connect resistor to COM terminal.

Offsetting setpoint for Reverse Acting Controller:

Raise, connect resistor to COM terminal.

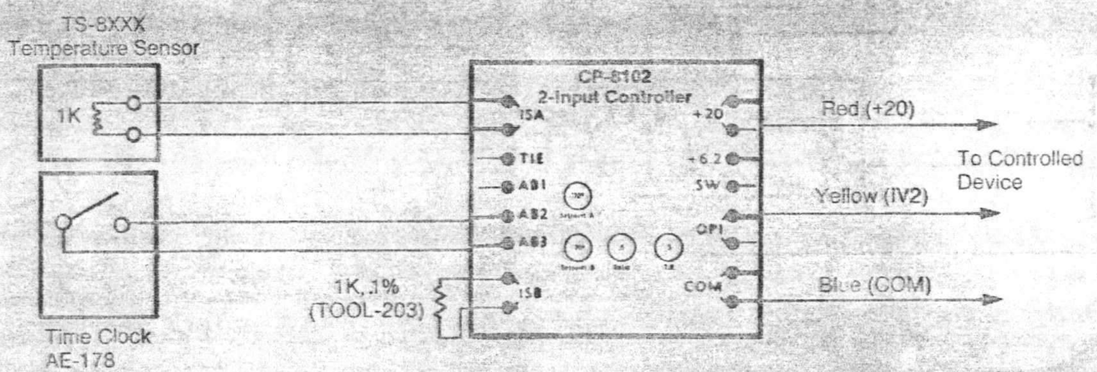
Lower, connect resistor to +6.2 terminal.

NOTE

Standard two conductor twisted wire should be used if remote switching is employed.

Resistor must always be located at stat.

Figure 16. Setpoint Offset

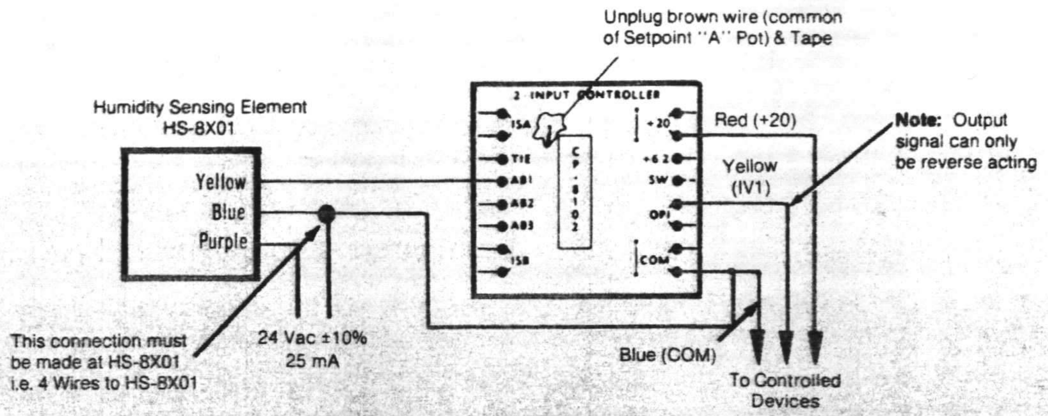


Install 1000 ohm 1% (TOOL-203) resistor in ISB. Install AE-178 7 day time clock. Set setpoint "B" as desired for night setback.

Table 8.

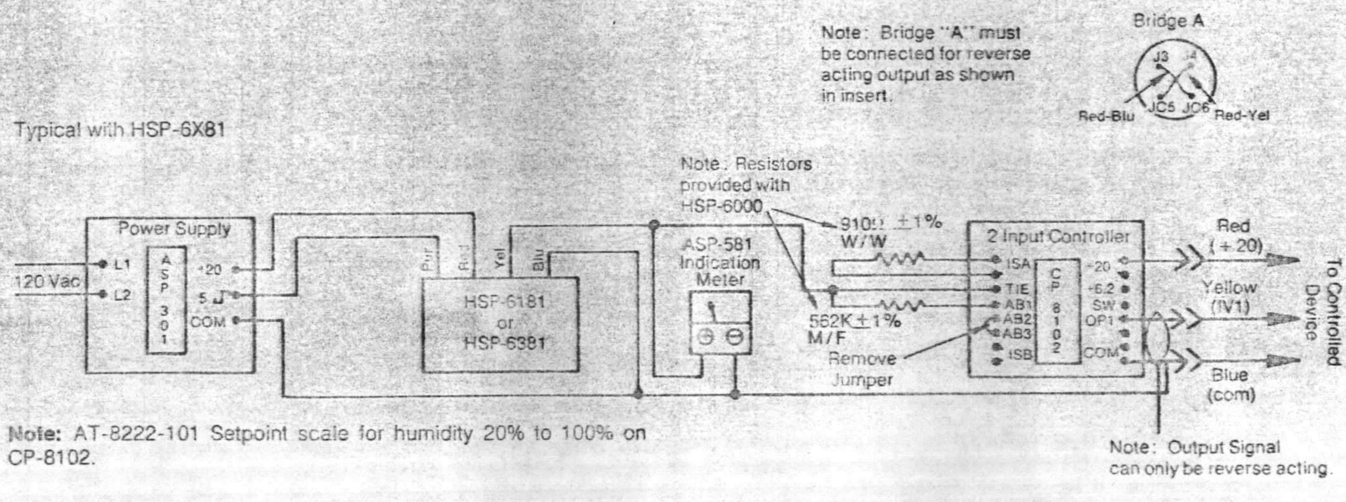
Setpoint "B"	Night Setback
70°F (21.1°C)	No Setback
65°F (18.3°C)	5°F (2.8°C) Setback
60°F (15.6°C)	10°F (5.6°C)Setback
55°F (12.8°C)	15°F (8.3°C) Setback

Figure 17. Night Setback



Note: Settings of 2-6 throttling range result in 2-6% RH throttling range for 3 Vdc output change. 6 TR is maximum setting.

Figure 18. Humidity Control



Note: AT-8222-101 Setpoint scale for humidity 20% to 100% on CP-8102.

Figure 19. Humidity Control & Indication

Barber-Colman Company
ENVIRONMENTAL CONTROLS DIVISION

1354 Clifford Avenue
P.O. Box 2940
Loves Park, IL U.S.A. 61132-2940

para. 2.2.2.9 T-2

General Instructions

TP-8101, TP-8102, TP-8103, TP-8124, TP-8125
Electronic Thermostats
Proportional Controlling

TP-8101, TP-8102, TP-8103 Single Setpoint Adjustment

TP-8124 & TP-8125 Dual Setpoint Adjustment

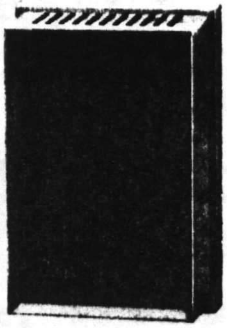


Table 1

Part Number	Dial Marking	Control Dial Range	Throttling Range for 3 Vdc Output Change	Input Voltage	Output Voltage	Control Action	Wiring Connections	Number of Controlled Devices
TP-8101	°F & °C	55-85°F	2, 3, 6 and 20°F Factory Set 3°F By Jumper/Pins	20 Vdc 13 mA	2-15 Vdc or 15-2 Vdc	Factory Set Direct-acting Jumper Terminal 4 to 5 For Reverse-acting Jumper Terminal 4 to 3	3 Color-coded Pigtail Leads Terminals for Options See Figure 2	6 System 8000 Devices or 2 MP-5200 Series Actuators
TP-8101-116	°C	13-29°C						
TP-8102	°F & °C	7-24°C (45-75°F)						
TP-8103	°F & °C	24-41°C (75-105°F)						
TP-8124 Dual Setpoints	°F & °C	Heating 7-24°C (45-75°F) Cooling 21-38°C (70-100°F)	Heating and Cooling 2-10°F Independently Adj. Factory Set 3°F	20 Vdc 23 mA	Heat 2-15 Vdc or 15-2 Vdc Cool 2-15 Vdc	Heating Factory Set Reverse-acting Jumper J7 to pin B for Direct-acting Cooling Direct-acting only	Coded Terminals See Figure 3	6 System 8000 Devices or 2 MP-5200 Series Actuators in both Heating and Cooling
TP-8125 Dual Setpoints	°F & °C	Heating 7-24°C (45-75°F) Cooling 24-41°C (75-105°F)						

DESCRIPTION

TP-8101, TP-8102, TP-8103

These self-contained room temperature controllers conserve energy in heating and/or cooling applications requiring a single setpoint adjustment. See Table 1 for particular characteristics.

The heating and cooling equipment is precisely controlled from a single 1000 ohm Balco sensor operating through a single controller for heating and/or cooling. The controller provides a proportional output to control System 8000 controlled devices for control of valves, dampers, electric heat, DX coils, etc.

TP-8124, TP-8125

These self-contained room controllers conserve energy in heating and/or cooling equipment in applications requiring heating and cooling setpoint adjustment.

See Table 1 for particular characteristics.

The heating and cooling equipment is precisely controlled from a single 1000 ohm Balco sensor operating through independent heating and cooling controllers. These controllers provide proportional outputs to control System 8000 controlled devices for control of valves, dampers, electric heat, DX coils, etc. The heating output (OP1 to COM) can be programmed for direct-acting or reverse-acting operation. The cooling output (OP2 to COM) provides a direct-acting output only.

Features

1. TP-8124 meets ASHRAE 90-75 and DOE requirements. TP-8125 meets DOD requirements.
2. Heating and cooling cannot operate simultaneously.
3. Heating/cooling deadband obtained by adjustable dual setpoints and throttling range.
4. Proportional outputs operate remote System 8000 controlled devices such as valves, dampers, electric heat coils, etc.
5. Concealed adjustments eliminate occupant tampering.

INSTALLATION

Open the carton and visually inspect the device for part number and obvious defects before proceeding with the installation.

Mounting screws are provided.

Locate the controller where it will be exposed to unrestricted natural air circulation and to the average conditions of the controlled space. Do not locate it near sources of heat or cold (such as lamps, motors, sunlight, radiators and concealed pipes or ducts within the wall) which might affect the control point. Avoid locations where excessive vibration, moisture, corrosive fumes or vapors are present, or where high radio frequency or electromagnetic generating devices are near.

Dimensions 111 mm (4-3/8") high × 73 mm (2-7/8") wide × 41 mm (1-5/8") deep.

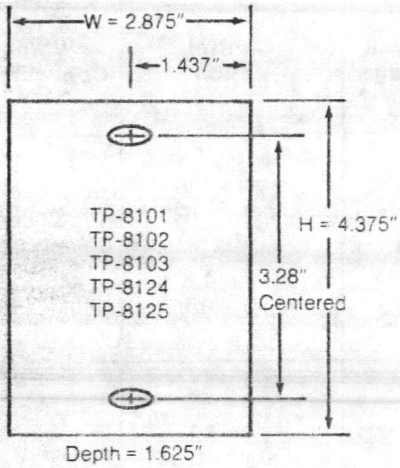


Figure 1

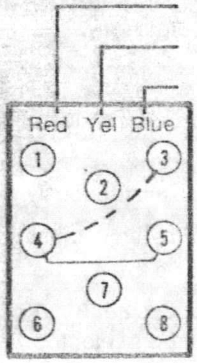
Ambient Limits Operation: 40 to 140°F (4.4 to 60°C). Storage: -40 to 160°F (-40 to 71°C).

MODES OF OPERATION

1. Direct-acting control (DA): Increase in temperature at the sensor causes the controller output signal to increase.
2. Reverse-acting control (RA): Increase in temperature at the sensor causes the controller output signal to decrease.

THROTTLING RANGE

Throttling range (T.R.) is defined as the degrees (°F or °C) change at the temperature sensor in order to cause a 6 to 9 Vdc controller output signal change.



Wire Leads
Red = +20 Vdc (Input)
Yellow = Proportional Output
Blue = Common

Screw Terminals
1 = Common
2 = Auxiliary Input
3,4 = Connect for Reverse-Acting (RA)
4,5 = Connect for Direct-Acting (DA)
7 = 6.2 Vdc
7,8 = Remote Sensor

Figure 2
Terminal Nomenclature
TP-8101, TP-8102 and TP-8103

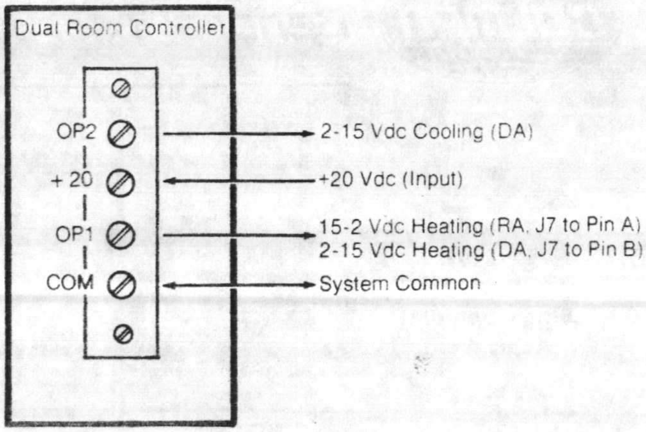


Figure 3
Terminal Nomenclature
TP-8124 and TP-8125

WIRING

Make all electrical connections according to installation wiring diagrams. Comply with national and local electrical codes.

No. 18 multi-conductor thermostat cable may be used. Low voltage Class 2 wire is acceptable, but No. 18 or larger 600V wire should be used if splices are to be made in the same junction box with line voltage wiring.

The controller may be installed on either a 52 mm × 102 mm (2" × 4") flush switch box or a surface switch box. To install, proceed as follows:

1. Wiring for the TP-8101, TP-8102 and TP-8103 is shown in Figures 4 and 5. See Figures 6 and 7 for TP-8124 and TP-8125 typical wiring.
2. "Pull" all wires required.
3. Connect all control wiring to the thermostat.
4. Remove the thermostat cover by loosening the screw at the bottom of the cover. Pull the cover out from the bottom and up to disengage it from the base.
5. Fasten the base to the box with the screws provided.
6. Replace the cover and tighten the cover screw.

WIRING OF CONTROLLED DEVICES TO CONTROLLER

Types of controlled devices and their power supplies:

1. Filtered and regulated power supplies: All System 8000 controlled devices except MP-52XX and MP-54XX series actuators.
2. Filtered and unregulated power supplies: MP-54XX series actuators.
3. Unfiltered and unregulated power supplies: MP-52XX series actuators.

General rules for wiring controllers to controlled devices:

1. Never connect red lead (or +20 terminal) of any controlled device which has a regulated power supply to the red lead (or +20 terminal) of any other controlled device.

2. Controlled devices with unfiltered and unregulated power supplies must be filtered. System 8000 controllers will provide filtering for a maximum of two controlled devices by connecting the two red leads (+20 terminals) together at the controller's red lead (+20 terminal).

3. **Controlled devices with filtered and unregulated supplies: Up to six controlled devices with the red leads (+20 terminals) can be connected together. Number of units paralleled depends on the current (mA DC) requirements of the controller or adaptor.**

4. Devices and their internal supplies:

FILTERED & REGULATED	FILTERED & UNREGULATED	UNFILTERED & UNREGULATED
CC-8101	MP-54XX Actuators	MP-52XX Actuators
CC-8102		
CC-8103		
CC-8118 Series		
CC-8218 Series		
CC-8111 Series		
CP-8301 Series		
CP-8161 Series		
CP-8425 Series		
CP-8501 Series		
CP-8502 Series		

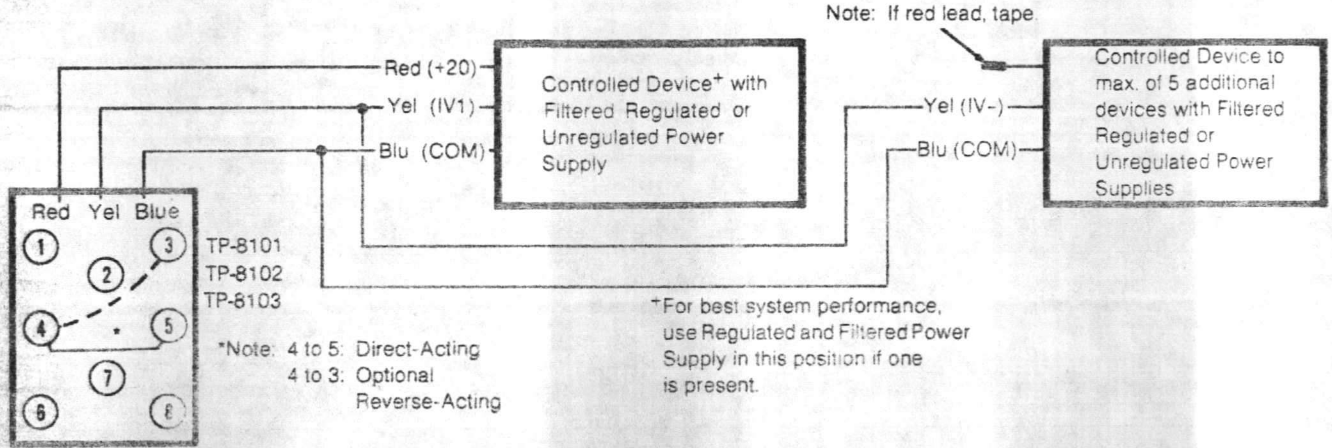


Figure 4
TP-8101, TP-8102 and TP-8103
Typical Wiring *without* MP-52XX Actuators

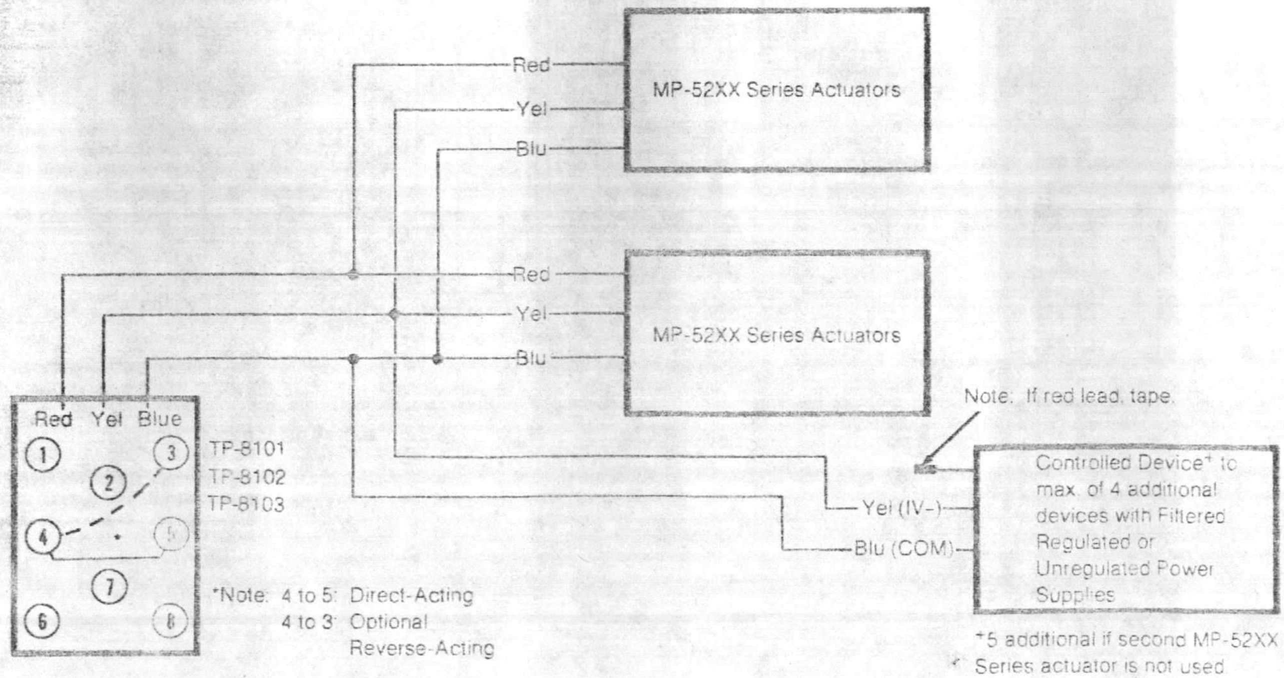
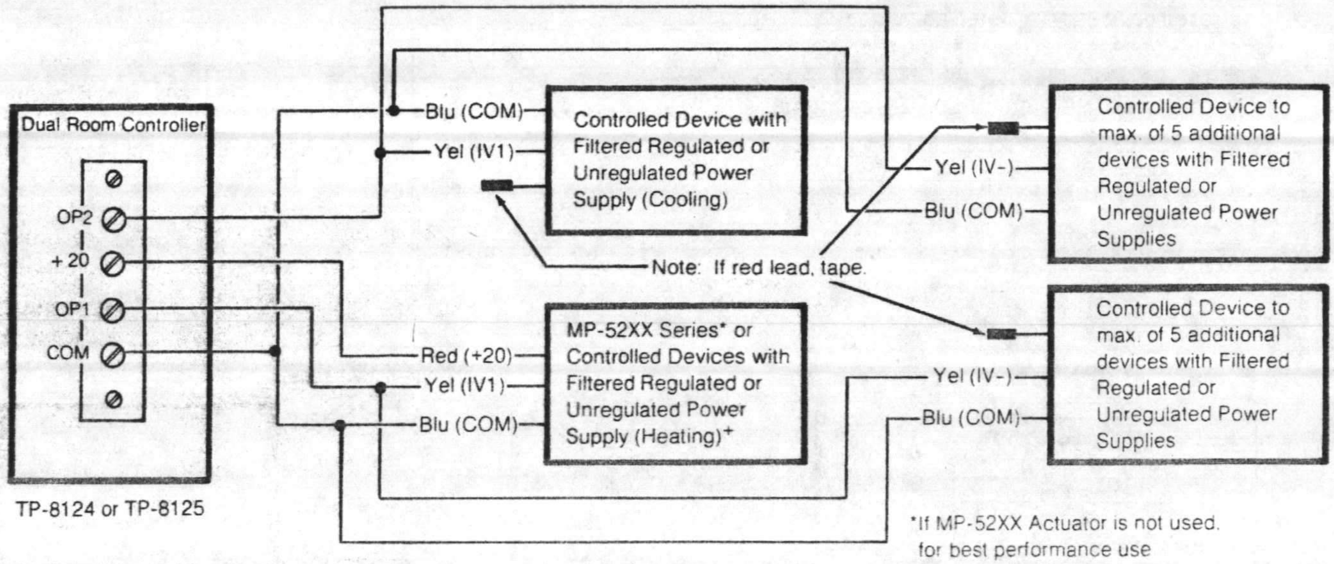


Figure 5
TP-8101, TP-8102 and TP-8103
Typical Wiring *with* MP-52XX Actuators



*If MP-52XX Actuator is not used, for best performance use Regulated and Filtered Power Supply if one is present.

+The MP-52XX Series also may be used as the cooling device.

Figure 6
TP-8124 and TP-8125
Typical Wiring with *One or No* MP-52XX Actuators

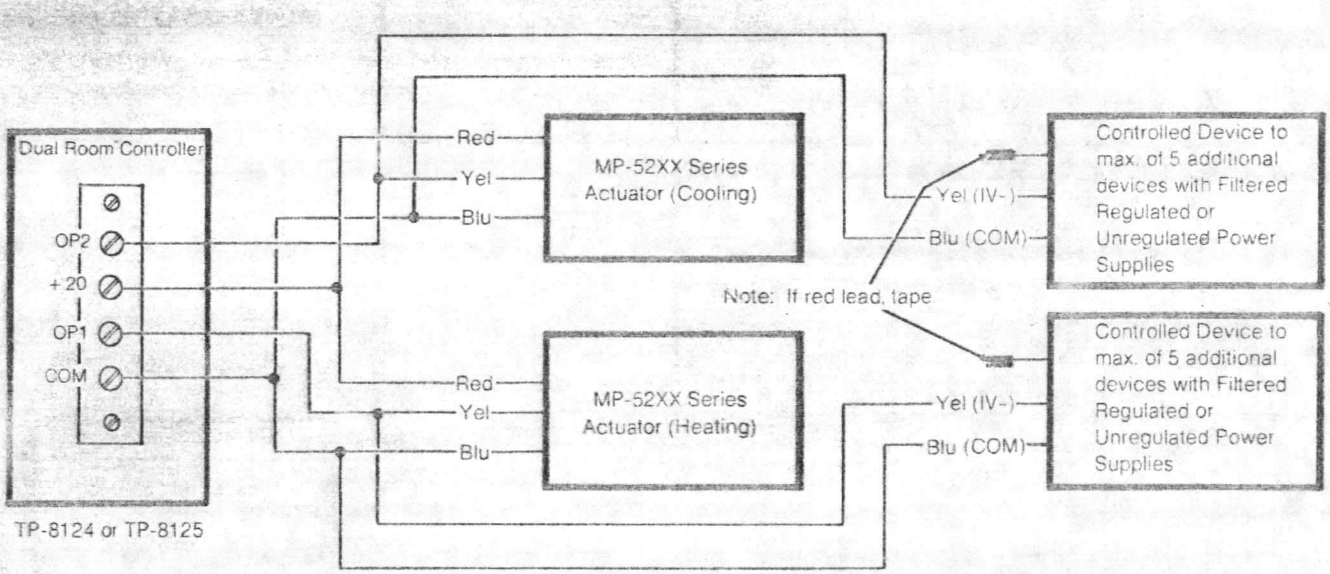


Figure 7
TP-8124 and TP-8125
Typical Wiring with *Two* MP-52XX Actuators

ADJUSTMENTS

TP-8101, TP-8102, TP-8103

1. Turn the setpoint adjuster to the required temperature setting. Normally, no further adjustments are required.
2. Throttling range settings of 2, 3, 6 and 20° are available by placing the T.R. jumper on the proper selector pin. See Figure 8. For other throttling ranges (1 through 60°) add a resistor to the auxiliary pins. Select the resistor from the chart below. Place the T.R. jumper on the auxiliary pin nearest the center of the controller.

Table 2. Throttling Range Resistor Values

°F T.R.	Auxiliary Resistor	Barber-Colman Part Number
1	4.3 Meg. ±5%	E19-23-562
1.5	3.0 Meg. ±5%	
2.0	2.2 Meg. ±5%	CYZR-481-860
2.5	1.8 Meg. ±5%	CYZR-481-580
3.0	1.5 Meg. ±5%	CYZR-481-680
3.5	1.2 Meg. ±5%	CYZR-481-450
4.0	1 Meg. ±5%	CYZR-481-610
4.5	975K, ±1%	CYZR-862-496
5.0	866K, ±1%	
6.0	732K, ±1%	
7.0	619K, ±1%	CYZR-862-477
8.0	549K, ±1%	
9.0	487K, ±1%	
10.0	432K, ±1%	CYZR-862-462
15.0	287K, ±1%	CYZR-862-445
20.0	215K, ±1%	
25.0	174K, ±1%	CYZR-837-913
30.0	143K, ±1%	CYZR-837-130
40.0	107K, ±1%	
50.0	84.5K, ±1%	E19-64-390
60.0	69.8K, ±1%	CYZR-837-890

3. The Temperature Deadband between heating and cooling is the difference in SPB and SPA settings. For example, the deadband is 13°F with SPA at 65°F and SPB at 78°F.
4. The throttling ranges are factory set at 3°F for heating and cooling. These settings should not be changed for normal applications. Increase the throttling range only to achieve control stability (adjustable 2 to 10°F).

   To adjust, turn the T.R. dial to position the required T.R. value closest to the thermostat cover.
5. Replace the cover.

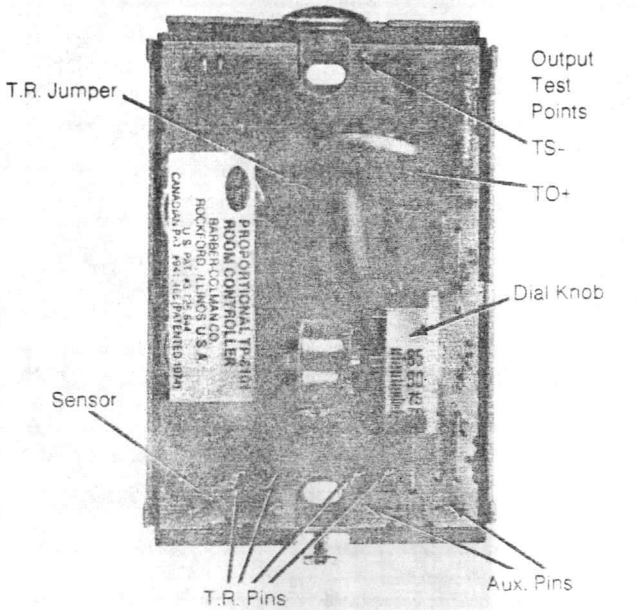


Figure 8
TP-8101, TP-8102 and TP-8103

TP-8124 and TP-8125

1. Remove the cover and turn the setpoint adjuster (SPA) to the required temperature for the heating mode (typically 65°F).

   Turn the setpoint adjuster (SPB) to the required temperature for the cooling mode (typically 78°F).

   The cooling signal is direct-acting, and stages cooling or proportionally opens a normally closed chilled water valve with a temperature increase.

   The heating signal is factory set for reverse-acting. With a temperature decrease, the signal stages electric heat or proportionally increases the electric heat output controlled by a Barber-Colman CP-8400 or CP-80000 Series SCR controller.
2. For applications that require a direct-acting signal in the heating mode, such as a normally open heating valve move jumper J7 to pin "B".

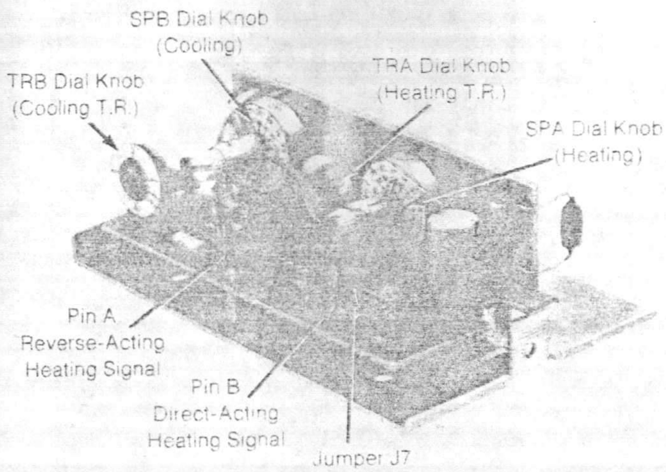


Figure 9a
TP-8124 or TP-8125

SERVICE

TP-8101, TP-8102, TP-8103

NOTE

The TP-8101, TP-8102 and TP-8103 have been factory calibrated to produce a 7.5 Vdc output signal at the yellow and blue leads (TO+ and TS-) when the setpoint and the temperature at the sensing element agree.

1. Verify wiring per job wiring diagram.
2. Measure with a 20,000 ohm per Vdc VOM.
   a. Power supply 20 Vdc: Red (+) to blue (-) wires or test point pins TS- and TS+ (+ end of the 47 μf capacitor).
   b. Output 2 to 15 Vdc: Yellow (+) to blue (-) wires or TO+ and TS- test pins. The voltage varies between 2-15 as the dial knob is rotated.
3. Consult EN 111 for additional service information.
4. Replace the controller if it is defective.

If calibration is necessary, proceed as follows:

1. Connect a 20,000 ohm per Vdc VOM between the yellow (+) and blue (-) leads or TO+ and TS- pins on the thermostat.
2. With the thermostat cover on, insert a 5/64" Allen wrench through the hole on the right-hand side of the thermostat into the setpoint potentiometer shaft.
3. Measure the temperature at the thermostat.
4. Adjust the thermostat setpoint by rotating the Allen wrench until the setpoint dial reading equals the temperature measured in step 3 above.
5. Using the thumb of your left hand, hold the knob in place. Avoid touching the lower left-hand corner of the thermostat where the sensor is located.
6. Rotate the Allen wrench until VOM reads 7.5 ±.3 Vdc.
7. The thermostat is calibrated.

TP-8142 and TP-8125

NOTE

The TP-8124 and TP-8125 have been factory calibrated to produce 6.0 Vdc output signals at OP1 and OP2 to COM terminals when the setpoints and the temperatures at the sensing element agree.

Test the power supply and output as follows:

1. Verify the wiring per the job wiring diagram.
2. Measure with a 20,000 ohm per Vdc VOM:
   a. Power supply 20 Vdc: +20 (+) to COM (-).
   b. Heating output: OP1 (+) to COM (-). Vdc varies between 2-15 as SPA is rotated.
   c. Cooling output: OP2 (+) to COM (-). Vdc varies between 2-15 as SPB is rotated.
3. Replace the controller if it is defective.

If calibration is necessary, proceed as follows:

1. Remove the thermostat cover. Note room temperature.
2. If room temperature is 75°F or greater:
   a. Connect VOM internally to OP2 (+) and COM (-). See Figure 9B for details.
   b. Rotate SPB until VOM reads 6.0 ±.3 Vdc. SPB pointer must indicate the temperature measured. If not, hold SPB shaft and rotate pointer (CCW) until it indicates the temperature measured.

      SPB is calibrated.
   c. Disconnect VOM lead from OP2 and reconnect to OP1. Connect Jumper J7 to Pin A.
   d. Connect 1 MEG ±1% resistor (SYZE-13512 test kit) between AB1 and 6.2 connections.
   e. Rotate SPA until VOM reads 6.0 ±.3 Vdc. SPA should read temperature measured minus 10°F. If not, hold SPA shaft and rotate pointer (CCW) until it indicates temperature measured minus 10°F.

      SPA is calibrated.
3. If room temperature is 74°F or less:
   a. Connect VOM internally to OP1 (+) and COM (-). See Figure 9B for details.
   b. Rotate SPA until VOM reads 6.0 ±.3 Vdc. SPA must indicate the temperature measured. If not, hold SPA shaft and rotate the pointer (CCW) until it indicates the measured temperature.

      SPA is calibrated.
   c. Disconnect VOM lead from OP1 and re-connect to OP2. Connect Jumper J7 to Pin A.
   d. Connect 1 MEG, ±1% resistor (SYZE-13512 test kit) between AB2 and COM connections.
   e. Rotate SPB until VOM reads 6.0 ±.3 Vdc. SPB should read the measured temperature plus 10°F. If not, hold SPB shaft and rotate pointer (CCW) until it indicates the measured temperature plus 10°F.

      SPB is calibrated.

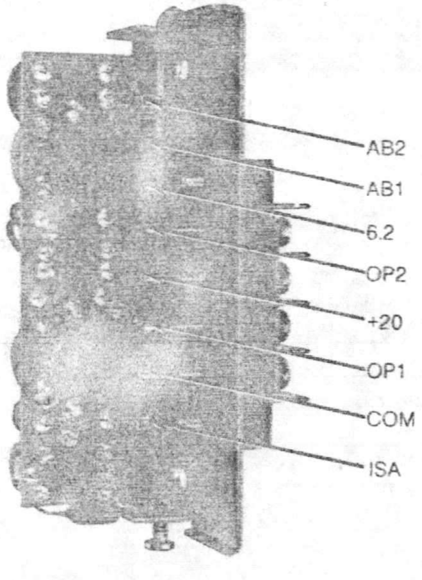


Figure 9b

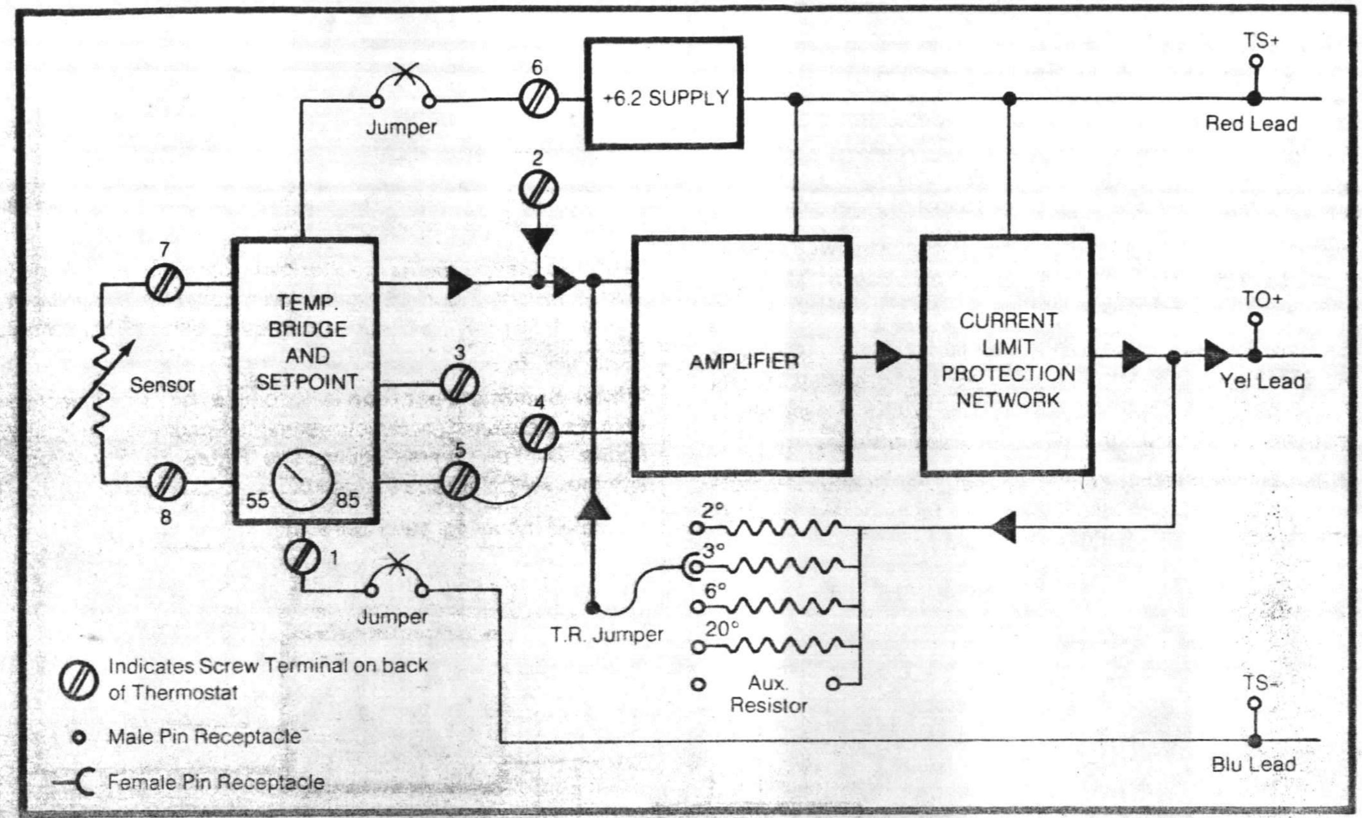


Figure 10
TP-8101, TP-8102 and TP-8103 Block Diagram

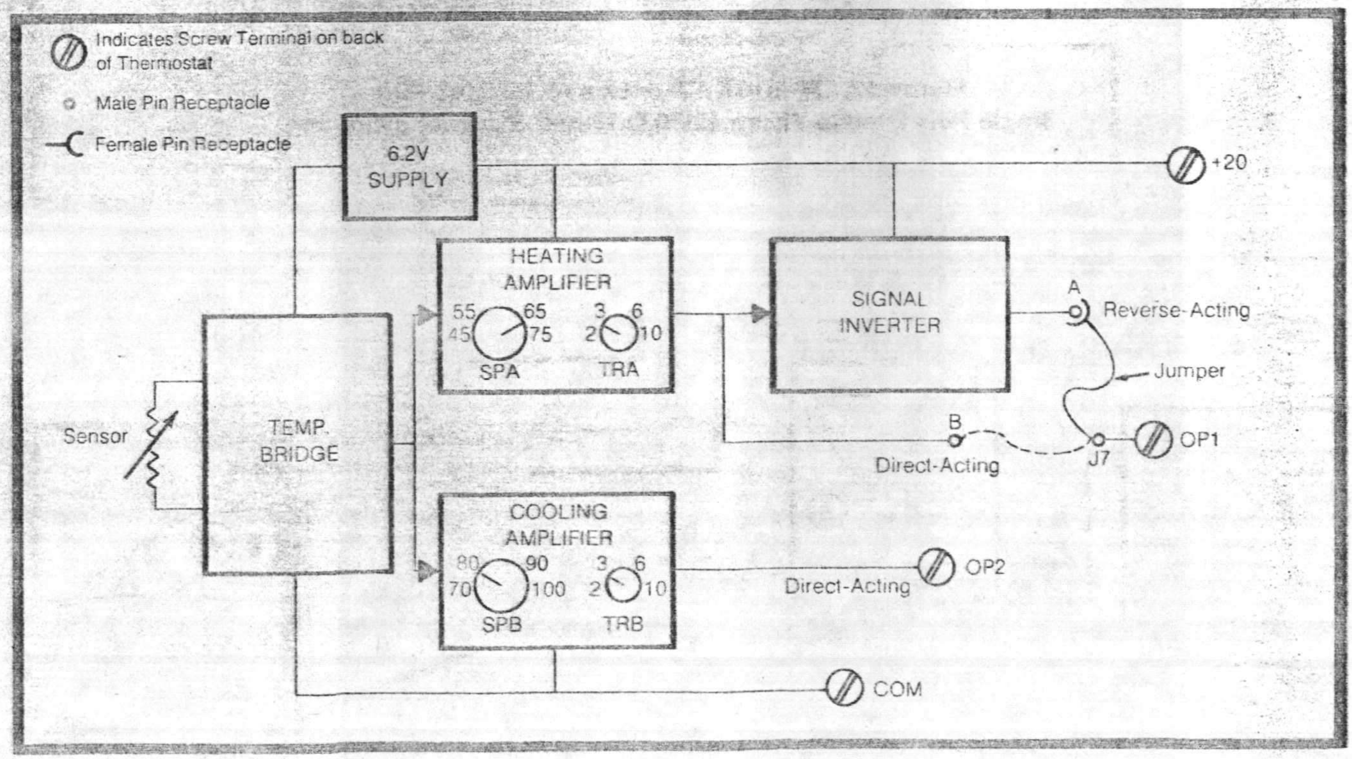


Figure 11
TP-8124 and TP-8125 Block Diagram

OPTIONS

TP-8101, TP-8102, TP-8103
(TP-8124 and TP-8125 have no options.)

Remote Setpoint Install the AT-8100 Series remote setpoint adjuster between terminals 1, 2 and 7. These are used for applications where the setpoint adjustment is mounted remote from the controller. See Figure 14, 15 or 16.

Remove the dial rim from the setpoint knob using wire cutters. Turn the dial to 70°F. The AT-11-404 blank cover is recommended to prevent dust infiltration.

Remote Sensing Remove the internal 1000 ohm sensor and install the remote sensor (TS-8000 Series) between terminals 7 and 8. This is used for applications where the sensor is mounted remote from the controller. See Figure 13.

Summer-Winter Changeover is accomplished without remote setpoints or selective ratio discharge. The controller operates in either the DA or RA mode. See Figure 12.

Jumper 4 to 5 — DA (direct-acting): A temperature increase causes an output voltage increase.

Jumper 3 to 4 — RA (reverse-acting): A temperature increase causes an output voltage decrease.

Selective Ratio Discharge Control Connect the ratio discharge sensor (Figure 19) to the room controller as shown in Figure 14, 15 or 16. This is used for room and discharge control applications.

Winter-Summer Operation is accomplished using selective ratio discharge and/or remote setpoints. For direct-acting, see Figure 14. For reverse-acting, see Figure 15. For winter-summer switching, see Figure 16.

For panel mounting, see Figure 18.

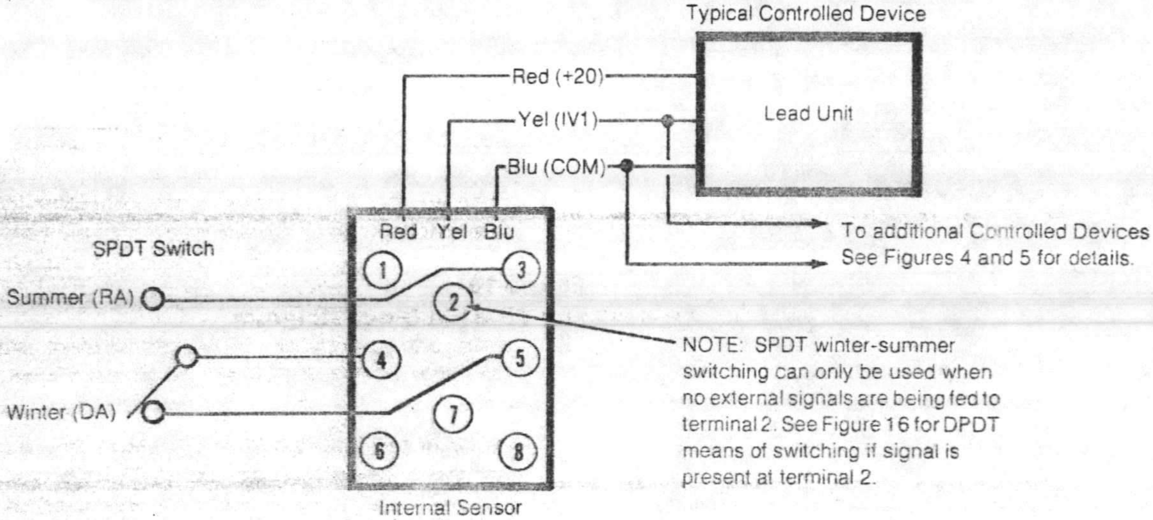


Figure 12. TP-8101, TP-8102 and TP-8103 with Single Pole Double Throw (SPDT) Winter-Summer Switching

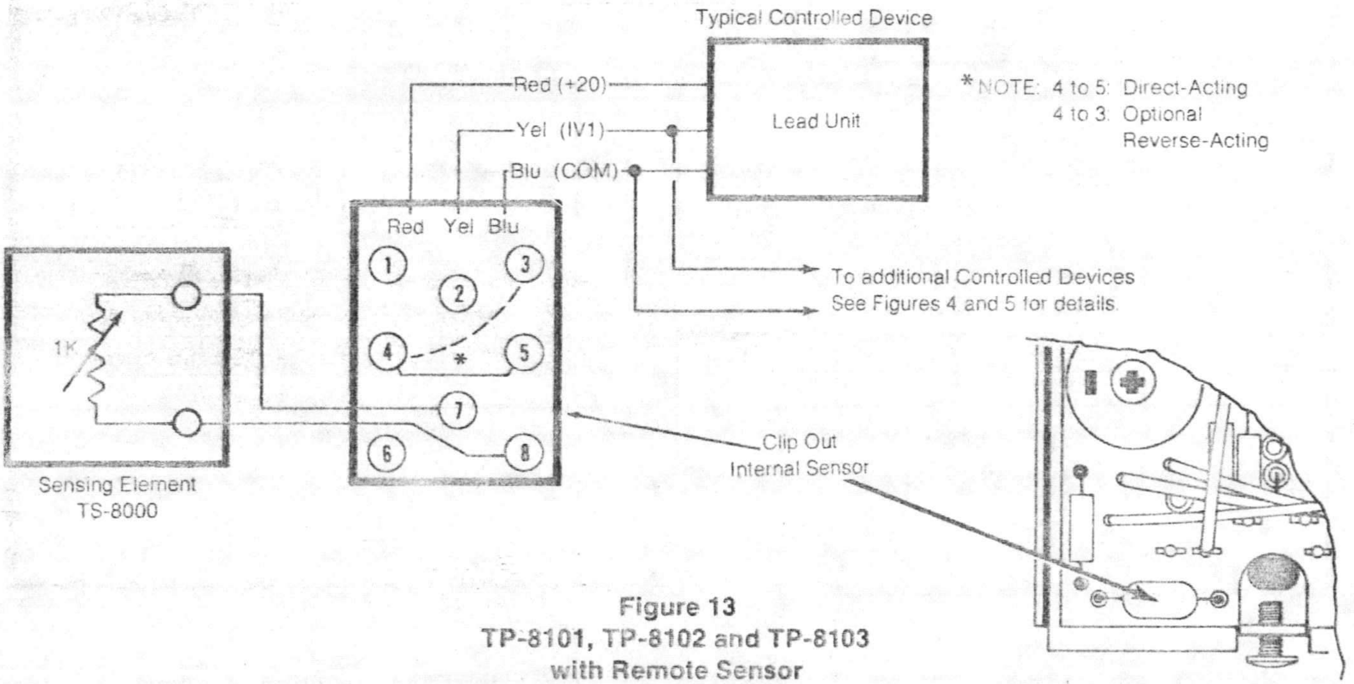


Figure 13
TP-8101, TP-8102 and TP-8103 with Remote Sensor

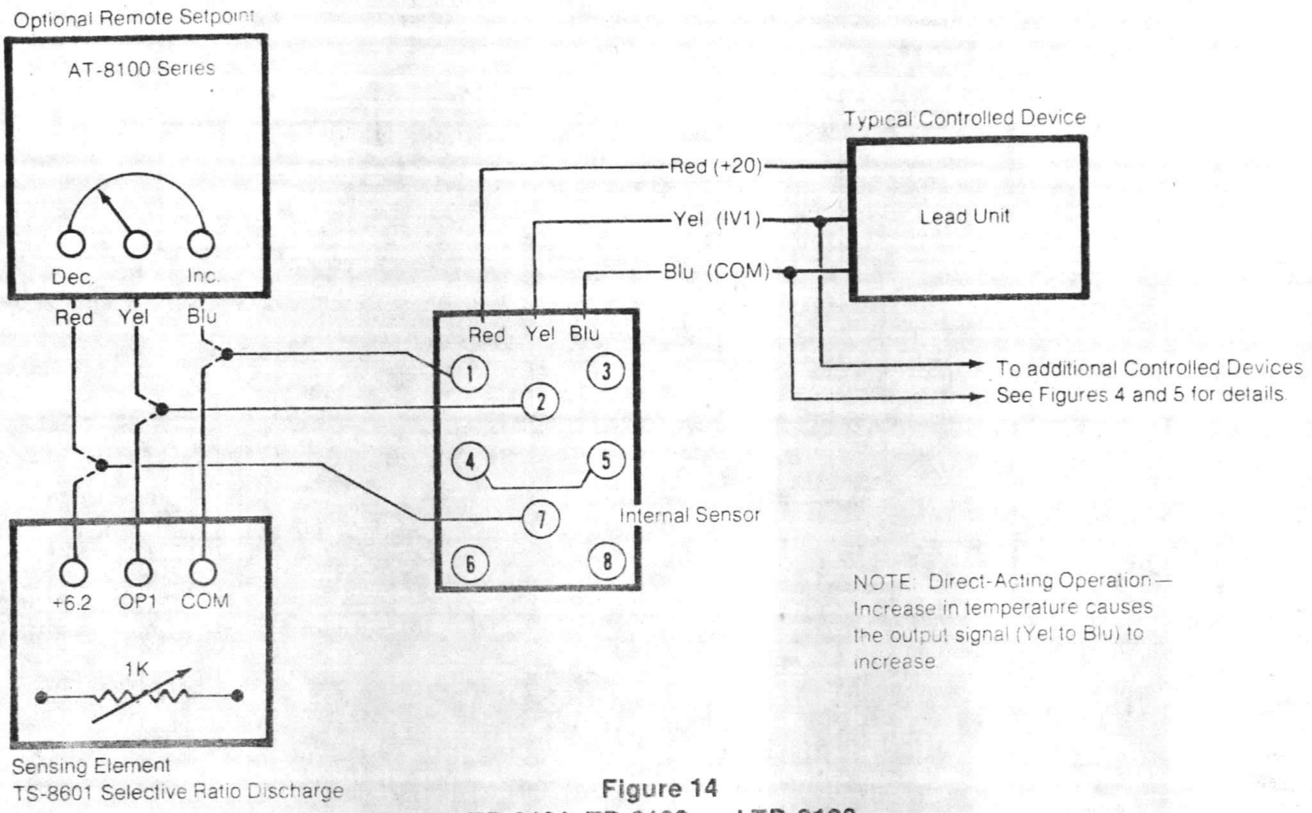


Figure 14
TP-8101, TP-8102 and TP-8103
with Remote Setpoint and/or
Selective Ratio Discharge Sensor
Direct-Acting Output Only

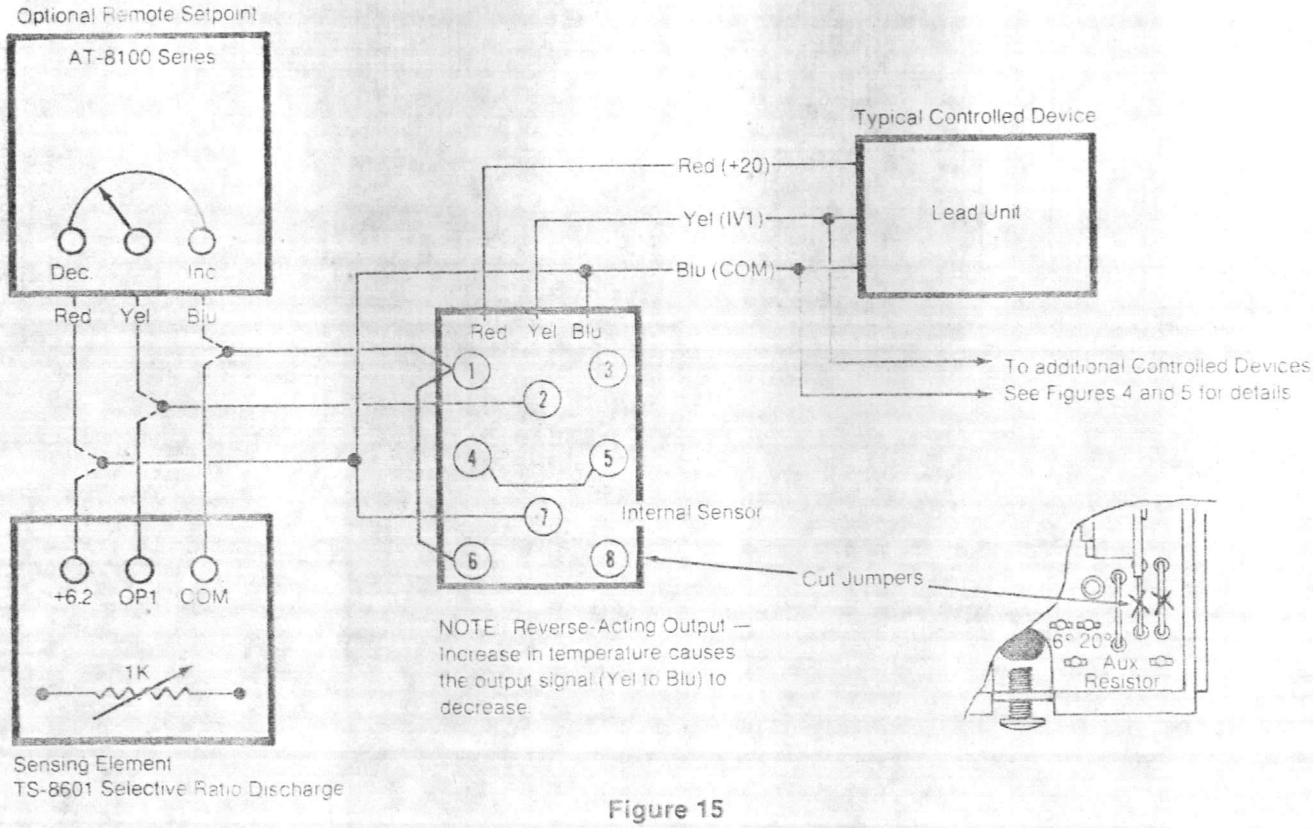


Figure 15
TP-8101, TP-8102 and TP-8103
with Remote Setpoint and/or
Selective Ratio Discharge Sensor
Reverse-Acting Output Only

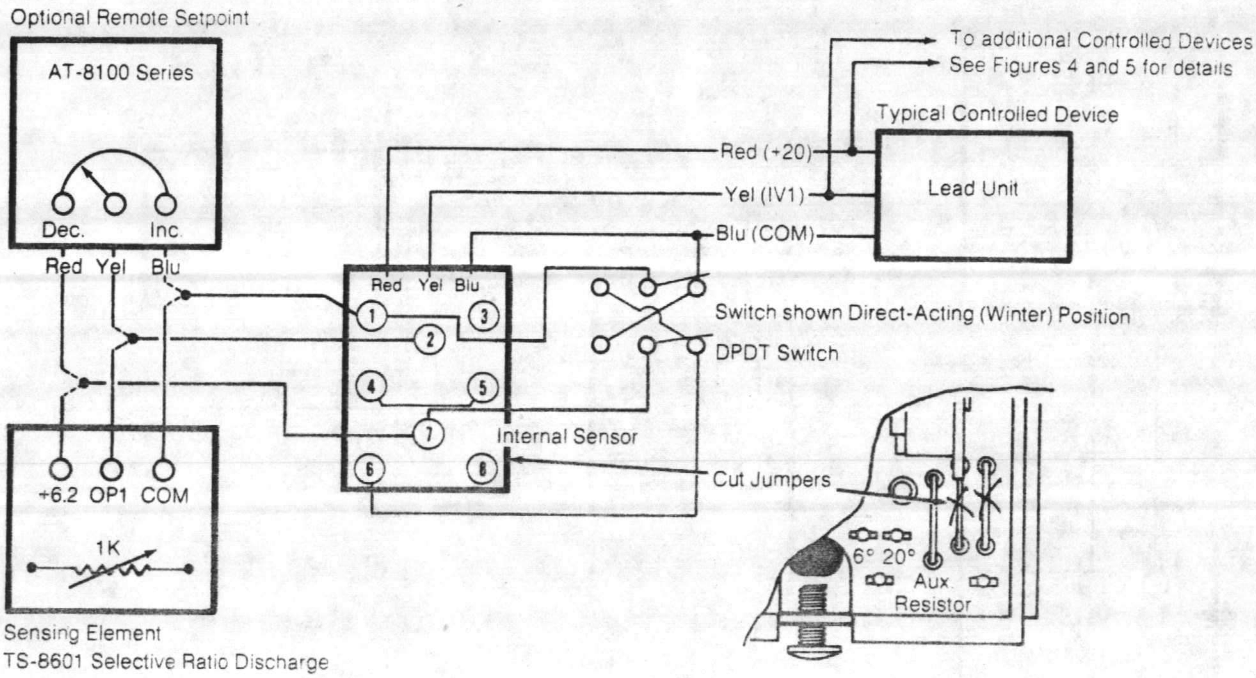
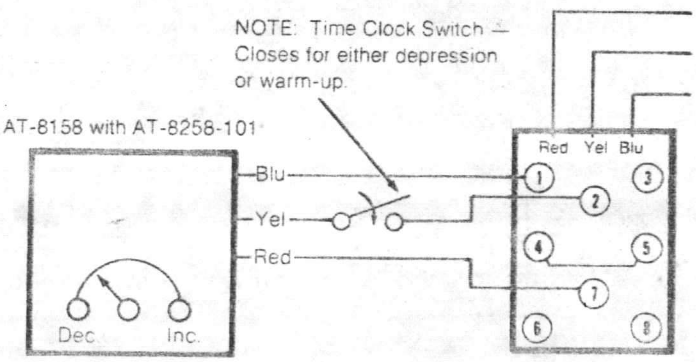
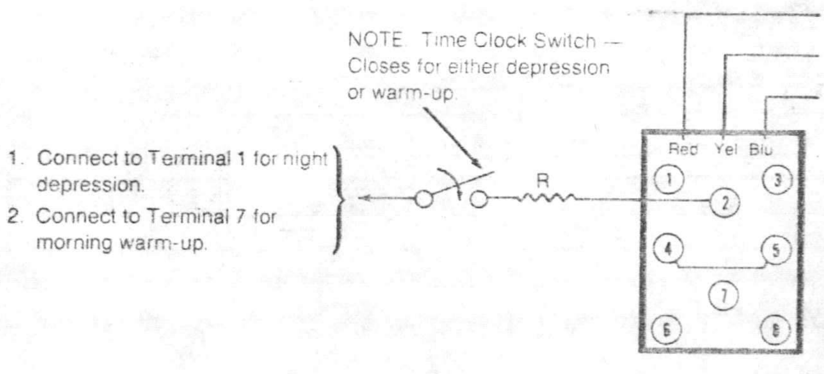


Figure 16
TP-8101, TP-8102 and TP-8103
with Remote Setpoint and/or
Selective Ratio Discharge Sensor
with Double Pole Double Throw (DPDT)
Winter-Summer Switching





RESISTORS		
Degrees	**Resistance**	**B-C Part No.**
5	2.0 MEG. ±5%	CYZR-481-530
10	1.0 MEG. ±1%	CYZR-862-501
15	681K, ±1%, 1/8W	E19-64-481
20	499K, ±1%, 1/8W	CYZR-862-466

Figure 17
TP-8101, TP-8102 and TP-8103
with Night Depression and/or
Morning Warm-Up

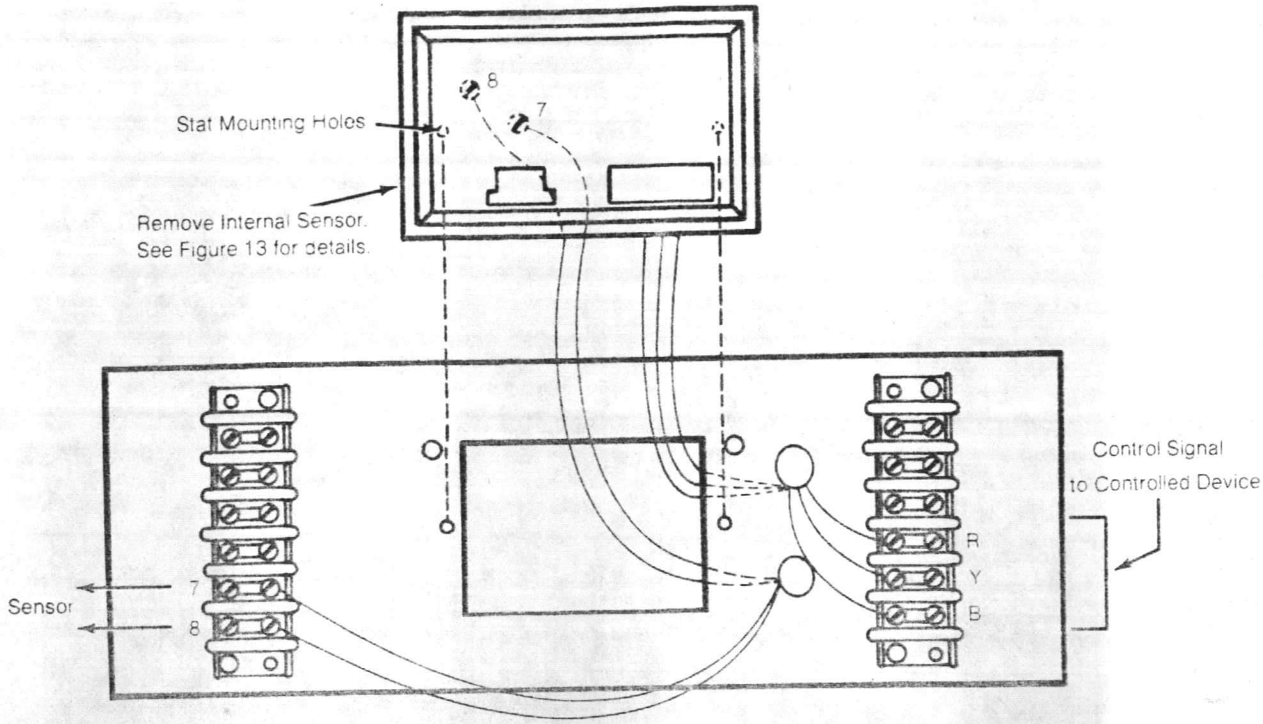
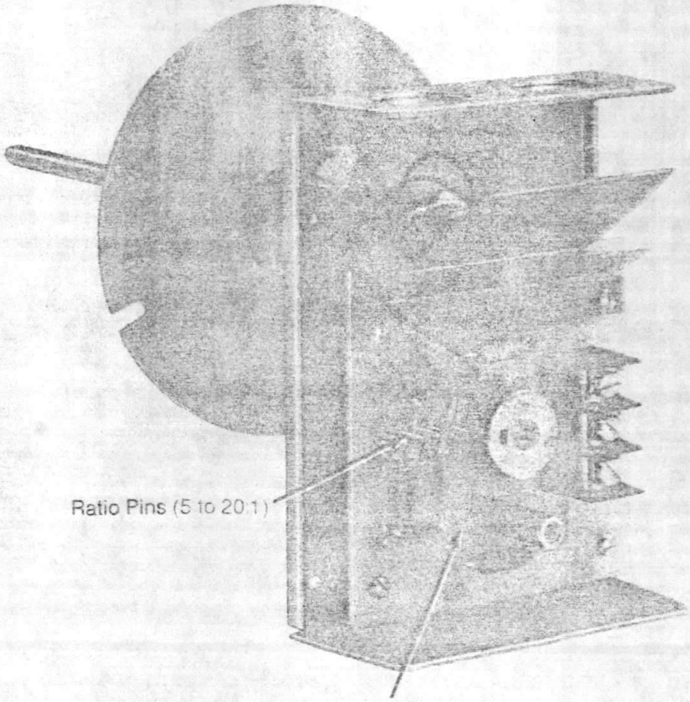


Figure 18
TP-8101, TP-8102 and TP-8103
Mounted on AD-8951



AUXILIARY RESISTORS		
Ratio	**Resistance**	**B-C Part No.**
25:1	59K, ±1%, 1/8W	CYZR-932-66
30:1	71.5K, ±1%, 1/8W	CYZR-868-19
40:1	95.3K, ±1%, 1/8W	[illegible]19-29-395
50:1	121K, ±1%, 1/8W	CYZR-788-12

Figure 19
TS-8601 Ratio Discharge Sensor
for use with
TP-8101, TP-8102 and TP-8103

MAINTENANCE

This is a quality product. Regular maintenance of the total system is recommended to assure optimum performance.

Barber-Colman Company
ENVIRONMENTAL CONTROLS DIVISION

1354 Clifford Avenue
P.O. Box 2940
Loves Park, IL U.S.A. 61132-2940

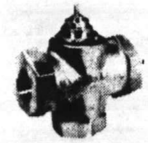
F-18097-4 BK

LITHO IN U.S.A.

3-WAY MIXING AND DIVERTING VALVES, SCREWED (1/2" TO 2") AND FLANGED (2-1/2" TO 4") WITH HYDRAULIC ACTUATORS

para. 2.2.2.9
6.2.12 V-1,3,4,5

TABLE 1. Select **Valve Body** including **P Code** (Valve Size, Cv Rating, Port Code) or select **Valve Assembly** with correct Input Signal (see Table 3 also) less Actuator Code (XXX) including the **P Code** (Size, Cv Rating, Port Code). (See Pages 331-335 for Valve Sizing.)

		APPLICATION			
		Chilled or Hot Water			
		Screwed	Flanged	Screwed	Flanged
					
Size		1/2"—2"	2-1/2"—4"	1/2"—2"	2-1/2"—3"
Valve Body		VB-9313-0-4-P	VB-9313-0-5-P	VB-9323-0-4-P	VB-9323-0-5-P
Valve Assembly 2-15 Vdc, System 8000		VS-9313-XXX-4-P	VS-9313-XXX-5-P	VS-9323-XXX-4-P	VS-9323-XXX-5-P
Valve Assembly 2-Position SPST		VA-9313-XXX-4-P	—	VA-9323-XXX-4-P	—
Normal Position		Stem Up Flow "B" to "AB"	Stem Up Flow "B" to "AB"	Stem Up Flow "B" to "AB"	Stem Up Flow "C" to "L"
Flow Type		Mixing	Mixing	Diverting	Diverting
Material	Body	Bronze	Iron	Bronze	Iron
	Seat	Bronze	Bronze	Bronze	Bronze
	Stem	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
	Plug	Brass	Brass	Stainless Steel	Brass
	Packing	Spring Loaded Teflon Cone	Spring Loaded Teflon Cone	Spring Loaded Teflon Cone	Grafoil
	Disc	None	None	None	None
		WATER			
Pressure (psig)	Static	250	125	250	125
	Recom. Diff.*	35	35	35	35
Fluid Temp. °F (°C)	Min.	40° (4°)	40° (4°)	40° (4°)	40° (4°)
	Max.	281° (138°)	300° (149°)	281° (138°)	300° (149°)

NOTE: These charts are color coded as shown below to assist valve selection. Note it is possible to select either a valve assembly or component parts (actuator, valve linkage, valve body).

ORDERING EXAMPLES:

1. **Valve Assembly** **VS-9313-351-4-11**
2. **Valve Body** **VB-9313-0-4-11**
   Actuator **MS-83013**
   Linkage **AV-430**

■ **Valve Body** Data less P Code (Size, Cv Rating, Port Code) or **Valve Assembly** less Actuator Code (XXX) and less P Code (Size, Cv Rating, Port Code)

■ **P Code** (Size, Cv Rating, Port Code)

■ **Actuator** or **Actuator Code (XXX)** for Valve Assemblies

□ **Valve Linkage**

VALVES

TO SELECT A PORT CODE (P)

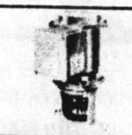
P Code	Valve Size	Cv				
-2**	1/2"	2				
-4		4		6		
-6	3/4"	6.8		8		
-8	1"	12		12		
-9	1-1/4"	16		16		
-10	1-1/2"	33		30	Port	
-11	2"	55		42	"U"	"L"
-12	2-1/2"		74		68	75
-13	3"		101		85	95
-14	4"		170			

*Maximum recommended differential pressure in full open position. Do not exceed recommended differential pressure (pressure drop) or integrity of parts may be affected.
NOTE: Do not exceed close-off rating.
**NOTE: Factory assemblies are not available for 2-position applications using reduced port valve bodies.

3-WAY MIXING AND DIVERTING VALVES, SCREWED (1/2" TO 2") AND FLANGED (2-1/2" TO 4") WITH HYDRAULIC ACTUATORS

TABLE 2. Select **Actuator Type** or **Actuator Code (XXX)** series with correct Input Signal having sufficient close-off for the application. If selecting Component Parts, select **Valve Linkage.**





Valve Linkage VB-9313-0-4-P	AV-600	AV-600	AV-430
Valve Linkage VB-9313-0-5-P	—	—	AV-495
Valve Linkage VB-9323-0-X-P	AV-600	AV-600	AV-430
Input Signal	SPST	2-15 Vdc	2-15 Vdc **
Actuator Code (XXX)	-2XX	-2XX	-35X
Actuator Type	MA-521X-XXX	MP-5X1X-XXX	MS-8XX1X-XXX

Valve	Valve Body	P Code	Size	CLOSE-OFF PRESSURE RATINGS† SU*	SD*	SU*	SD*	SU*	SD*
VA-9313-XXX-4-P VS-9313-XXX-4-P	VB-9313-0-4-P	-2-4	1/2"	100	100	110	100		
		-6	3/4"	55	55	55	55		
		-8	1"	35	35	35	35		
		-9	1-1/4"	22	22	22	22		
		-10	1-1/2"					35	33
		-11	2"					35	33
VS-9313-XXX-5-P	VB-9313-0-5-P	-12	2-1/2"					20	20
		-13	3"					12	12
		-14	4"					6	6
VA-9323-XXX-4-P VS-9323-XXX-4-P	VB-9323-0-4-P	-4	1/2"	250	250	250	250		
		-6	3/4"	250	250	250	250		
		-8	1"	250	250	250	250		
		-9	1-1/4"	250	250	250	250		
		-10	1-1/2"					250	250
		-11	2"					250	250
VS-9323-XXX-5-P	VB-9323-0-5-P	-12	2-1/2"					125	125
		-13	3"					125	125

*SU — Stem Up; SD — Stem Down; See Table(s) 5 for flow pattern, port designations, and normal position.
†Close off ratings for mixing or sequencing valves: (SU ="A" port, SD = "B" port) "A" port (SU) ratings equal pressure at Port "A" minus pressure at port "B"; "B" port (SD) ratings equal pressure at port "B" minus pressure at port "A".
**Certain models have built-in controller (See Table 3).

TABLE 3. Select exact **Actuator** or **Actuator Code (XXX)** if Factory Assembly is available.

Input Signal	Wiring Figure No.	Voltage Vac 50/60 Hz	VA	Aux. Switch	Actuator Part No.	Actuator Code (XXX) For Factory Available Assy
Two-position SPST	See Figure 1 on Page 336	24	18	No	MA-5213	201
		24		Yes	MA-5213-500	202
		120		No	MA-5210	211
		120		Yes	MA-5210-500	212
		208		No	MA-5212	
		208		Yes	MA-5212-500	
		240		No	MA-5211	221
		240		Yes	MA-5211-500	222
2-15 Vdc, System 8000, Stroke occurs 6-9 Vdc approx., Non-positive positioning	See Figure 12 on Page 339	24	18	No	MP-5213	201
		24		Yes	MP-5213-500	202
		120		No	MP-5210	211
		120		Yes	MP-5210-500	212
		208		No	MP-5212	
		208		Yes	MP-5212-500	
		240		No	MP-5211	221
		240		Yes	MP-5211-500	222
2-15 Vdc, System 8000, start 6 Vdc factory set, Adjustable 2-12 Vdc, 3 Vdc span, Positive positioning	See Figure 12 on Page 339	24	18	No	MP-5413	243
		120		No	MP-5410	240
		208		No	MP-5412	
		240		No	MP-5411	241
	See Figure 12 on Page 339	24	36	No	MS-83013	351
		120	37	No	MS-83010	353
		120	37	Yes	MS-83010-500	
		240	39	No	MS-83011	
		240	39	Yes	MS-83011-500	
Built-in System 8000 controller, Uses TS-8XXX sensor	See Figure 19 on Page 343	120	37	No	MS-84110	354
		120	37	No	MS-84110-011*	
		120	37	Yes	MS-84110-500	
		24	36	No	MS-84113	

*Includes TS-8201-105 sensor.

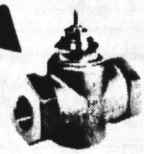
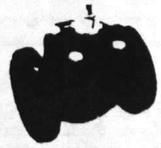
VALVES

2-WAY VALVES, SCREWED (1/2" TO 2") AND FLANGED (2-1/2" TO 4") WITH HYDRAULIC ACTUATORS

Para. 6.2.8
2.2.2.9

V-2,6

TABLE 1. Select **Valve Body** including **P Code** (Valve Size, Cv Rating, Port Code) or select **Valve Assembly** with correct Input Signal (see Table 3 also) less Actuator Code (XXX) including the **P Code** (Size, Cv Rating, Port Code). (See Pages 331-335 for Valve Sizing.)

		APPLICATION			
		Chilled or Hot Water 281°F Max. 35 psig Steam		Hot Water 300°F Max. 100 psig Steam	Hot Water 366°F Max. 150 psig Steam
		Screwed	Flanged	Screwed	
					
	Size	1/2"—2"	2-1/2"—4"	1/2"—2"	1/2"—2"
Normally Open Valves	Valve Body	VB-9213-0-4-P	VB-9213-0-5-P	VB-9253-0-4-P	VB-9273-0-4-P
	Valve Assembly 2-15 Vdc Input, System 8000	VS-9213-XXX-4-P	VS-9213-35X-5-P	VS-9253-XXX-4-P	VS-9273-XXX-4-P
	Valve Assembly, Built-in System 8000 Controller	VS-9213-35X-4-P	VS-9213-35X-5-P	VS-9253-35X-4-P	VS-9273-35X-4-P
	2-Position SPST Valve Assembly	VA-9213-2XX-4-P	—	VA-9253-2XX-4-P	VA-9273-2XX-4-P
Normally Closed Valves	Valve Body	VB-9223-0-4-P	VB-9223-0-5-P	VB-9263-0-4-	VB-9283-0-4-P
	Valve Assembly 2-15 Vdc Input, System 8000	VS-9223-XXX-4-P	VS-9223-35X-5-P	VS-9263-XXX-4-P	VS-9283-XXX-4-P
	Valve Assembly, Built-in System 8000 Controller	VS-9223-35X-4-P	VS-9223-35X-5-P	VS-9263-35X-4-P	VS-9283-35X-4-P
	2-Position SPST Valve Assembly	VA-9223-2XX-4-P	—	VA-9263-2XX-4-P	VA-9283-2XX-4-P
Flow Type		Equal %	Equal %	Equal %	Equal %
Material	Body	Bronze	Cast Iron	Bronze	Bronze
	Seat	Bronze	Bronze	Stainless Steel	Stainless Steel
	Stem	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
	Plug	Brass	Brass	Stainless Steel	Stainless Steel
	Packing	Spring Loaded Teflon Cone	Spring Loaded Teflon Cone	Spring Loaded Teflon Cone	Spring Loaded Teflon Cone
	Disc	Composition	Composition	Teflon	None
STEAM					
Pressure (psig)	Static	250	125	250	250
	Inlet	35	35	100	150
	Recom. Diff.*	20	20	35	50
Fluid Temp. °F (°C)	Max.	281° (138°)	281° (138°)	340° (171°)	366° (180°)
WATER					
Pressure (psig)	Static	250	125	250	250
	Recom. Diff.*	35	35	35	50
Fluid Temp. °F (°C)	Min	40° (4°)	40° (4°)	40° (4°)	40° (4°)
	Max	281° (138°)	281° (138°)	300° (149°)	366° (180°)

NOTE: These charts are color coded as shown below to assist valve selection. Note it is possible to select either a valve assembly or component parts (actuator, valve linkage, valve body).

ORDERING EXAMPLES:

1. **Valve Assembly** **VS-9223-212-4-8**
2. **Valve Body** **VB-9223-0-4-8**
   Actuator **MP-5210-500**
   Linkage **AV-600**

■ **Valve Body** Data less P Code (Size, Cv Rating, Port Code) or **Valve Assembly** less Actuator Code (XXX) and less P Code (Size, Cv Rating, Port Code)

■ P Code (Size, Cv Rating, Port Code)

■ Actuator or Actuator Code (XXX) for Valve Assemblies.

□ **Valve Linkage**

TO SELECT A PORT CODE (P)

P Code	Valve Size	Cv			
1**	1/2"	0.4		0.4	0.4
2**		1.3		1.3	1.3
3**		2.2		2.2	2.2
4		3.6		3.0	3.0
5**	3/4"	5.0		5.0	5.0
6		6.2		6.2	6.2
7**	1"	8.2		8.2	8.2
8		11.0		11.0	11.0
9	1 1/4"	16.0		16.0	16.0
10	1 1/2"	25.0		25.0	25.0
11	2"	40.0		40.0	40.0
12	2-1/2"		56		
13	3"		85		
14	4"		145		

*Maximum recommended differential pressure in full open position. Do not exceed recommended differential pressure (pressure drop) or integrity of parts may be affected.
NOTE: Do not exceed close-off rating.
**NOTE: Factory assemblies are not available for 2-position applications using reduced port valve bodies.

VALVES

2-WAY VALVES, SCREWED (1/2" TO 2") AND FLANGED (2-1/2" TO 4") WITH HYDRAULIC ACTUATORS

TABLE 2. Select **Actuator Type** or **Actuator Code (XXX)** series with correct Input Signal having sufficient close-off for the application. If selecting Component Parts, select **Valve Linkage.**

							
Input Signal					Two-Position SPST	2-15 Vdc System 8000	2-15 Vdc System 8000**
Valve Linkage 1/2" — 1-1/4" Valve					**AV-600**	**AV-600**	—
Valve Linkage 1/2" — 2" Valve					—	—	**AV-430**
Valve Linkage 2-1/2" — 4" Valve					—	—	**AV-495**
Actuator Code (XXX)					**2XX**	**2XX**	**35X**
Actuator Code					**MA-521X-XXX**	**MP-5X1X**	**MS-8XX1X-XXX**
Normal Position	**Factory Avail. Valve Assembly**	**Valve Body**	**P Code**	**Size**	**CLOSE-OFF PRESSURE RATING***		
Normally Open	VA-9213-2XX-4-P	VB-9213-0-4-P	-1-2-3-4	1/2"	180	190	
	VA-9253-2XX-4-P	VB-9253-0-4-P	-5-6	3/4"	75	85	
	VA-9273-2XX-4-P	VB-9273-0-4-P	-7-8	1"	40	45	
	VS-9213-XXX-4-P		-9	1-1/4"	25	30	
	VS-9253-XXX-4-P		-10	1-1/2"			65
	VS-9273-XXX-4-P		-11	2"			35
Normally Open	VS-9213-35X-5-P	VB-9213-0-5-P	-12	2-1/2"			20
			-13	3"			12
			-14	4"			6
Normally Closed	VA-9223-2XX-4-P	VB-9223-0-4-P	-1-2-3-4	1/2"	250	220	
	VA-9263-2XX-4-P	VB-9263-0-4-P	-5-6	3/4"	140	90	
	VA-9283-2XX-4-P	VB-9283-0-4-P	-7-8	1"	75	50	
	VS-9223-XXX-4-P		-9	1-1/4"	45	30	
	VS-9263-XXX-4-P		-10	1-1/2"			65
	VS-9283-XXX-4-P		-11	2"			35
Normally Closed	VS-9223-35X-5-P	VB-9223-0-5-P	-12	2-1/2"			20
			-13	3"			12
			-14	4"			6

*Close-off pressure ratings apply when valves are installed with pressure under the seat. **Certain models have built-in controller.

TABLE 3. Select exact **Actuator** or **Actuator Code (XXX)** if Factory Assembly is available.

Input Signal	Wiring Figure No.	Voltage Vac 50/60 Hz	VA	Aux. Switch	Actuator Part No.	Actuator Code (XXX) For Factory Available Assy
Two-position SPST	See Figure 1 on Page 336	24	18	No	**MA-5213**	**201**
		24		Yes	**MA-5213-500**	**202**
		120		No	**MA-5210**	**211**
		120		Yes	**MA-5210-500**	**212**
		208		No	**MA-5212**	
		208		Yes	**MA-5212-500**	
		240		No	**MA-5211**	**221**
		240		Yes	**MA-5211-500**	**222**
2-15 Vdc, System 8000, Stroke occurs 6-9 Vdc approx., Non-positive positioning	See Figure 12 on Page 339	24	18	No	**MP-5213**	**201**
		24		Yes	**MP-5213-500**	**202**
		120		No	**MP-5210**	**211**
		120		Yes	**MP-5210-500**	**212**
		208		No	**MP-5212**	
		208		Yes	**MP-5212-500**	
		240		No	**MP-5211**	**221**
		240		Yes	**MP-5211-500**	**222**
2-15 Vdc, System 8000, start 6 Vdc factory set, Adjustable 2-12 Vdc, 3 Vdc span, Positive positioning	See Figure 12 on Page 339	24	18	No	**MP-5413**	**243**
		120		No	**MP-5410**	**240**
		208		No	**MP-5412**	
		240		No	**MP-5411**	**241**
	See Figure 12 on Page 339	24	36	No	**MS-83013**	**351**
		120	37	No	**MS-83010**	**353**
		120	37	Yes	**MS-83010-500**	
		240	39	No	**MS-83011**	
		240	39	Yes	**MS-83011-500**	
Built-in System 8000 controller, Uses TS-8XXX sensor	See Figure 19 on Page 343	120	37	No	**MS-84110**	**354**
		120	37	No	**MS-84110-011***	
		120	37	Yes	**MS-84110-500**	

VALVES

3-WAY MIXING AND DIVERTING VALVES, SCREWED (1/2" TO 2") AND FLANGED (2-1/2" TO 4") WITH HYDRAULIC ACTUATORS

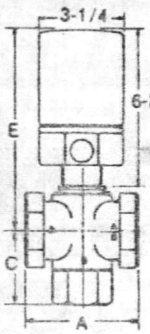
TABLE 4. Dimensions

DIMENSIONS (Inches)					
Valve Body				Actuator Code (XXX)	
				200*	350
Part Number	Size	A	C	E	E
VA-9313-XXX-4-P VS-9313-XXX-4-P VS-9323-XXX-4-P VA-9323-XXX-4-P	1/2"	3	1-7/16	7-15/16	
	3/4"	3-5/8	1-7/8	8-1/4	
	1"	4-5/8	2-1/4	8-1/2	
	1-1/4"	4-5/8	2-3/4	8-1/2	
	1-1/2"	6-1/8	3-7/8		18-5/8
	2"	6-1/8	3-7/8		18-5/8
VS-9313-35X-5-P	2-1/2"	8-1/2	5-3/8		19-7/16
	3"	9-1/2	6-3/8		19-13/16
	4"	11-1/2	8-1/2		20-7/16
VS-9323-35X-5-P	2-1/2"	9	7		20-3/4
	3"	10	8		21-9/16

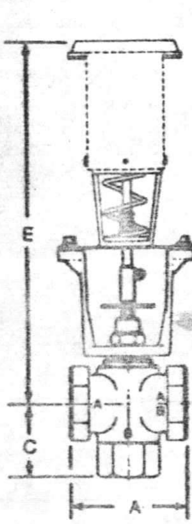
*Add 21/32" (52 mm) to the "E" dimension for a valve assembly using an AV-601 linkage extension that must be purchased separately.

Dimensions in inches (metric conversion 25.4 mm = 1 inch)

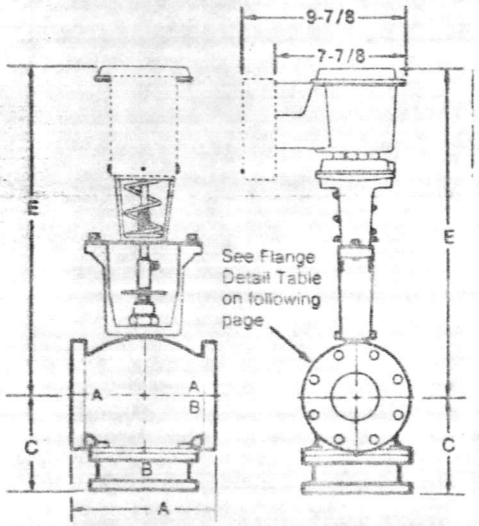
NOTE: Allow 3 inches clearance above actuator for removal.



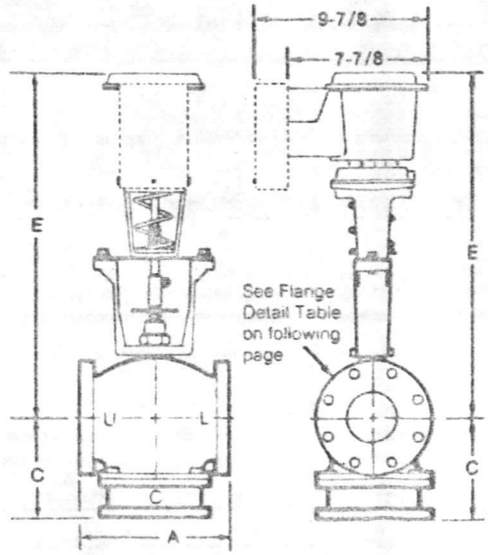
VS-9313-2XX-4-P
VS-9323-2XX-4-P
VA-9313-2XX-4-P
VA-9323-2XX-4-P



VS-9313-35X-4-P
VS-9323-35X-4-P



VS-9313-35X-5-P

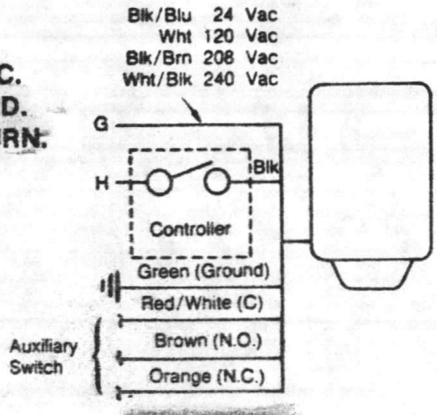


VS-9323-35X-5-P

VALVES

Wiring Figure No. 1

**2-POSITION, 2-WIRE ELECTRIC.
SPST CONTROLLER REQUIRED.
ALL UNITS ARE SPRING RETURN.**

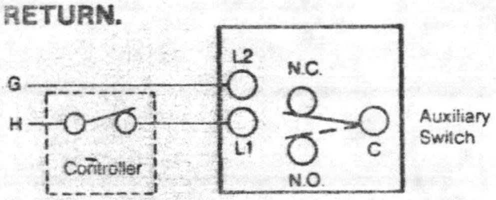


MA-521X-XXX

Valve Assembly	Normal Position	Powered Position
VA-1112-6XX	Open	Closed
VA-921X-2XX		
VA-9253-2XX		
VA-9273-2XX		
VA-922X-2XX	Closed	Open
VA-9263-2XX		
VA-9283-2XX		
VA-9312-2XX	Flow "B" to "AB"	Flow "A" to "AB"
VA-9313-2XX		
VA-9323-2XX	Flow "B" to "AB"	Flow "B" to "A"

Wiring Figure No. 2

**2-POSITION, 2-WIRE ELECTRIC.
SPST CONTROLLER REQUIRED.
ALL UNITS ARE SPRING RETURN.**



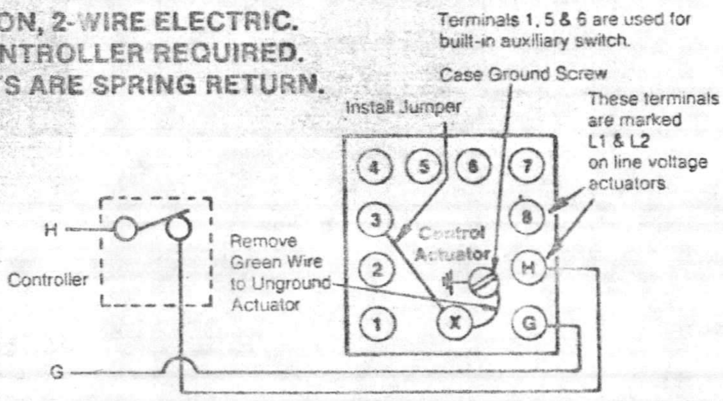
MA-31X or MA-41X

Valve Assembly	Normal Position	Powered Position
VA-9213-30X	Open	Closed
VA-9253-30X		
VA-9273-30X		
VA-9213-31X	Closed	Open
VA-9253-31X		
VA-9273-31X		
VA-9313-30X	Flow "B" to "AB"	Flow "A" to "AB"
VA-9323-30X	Flow "B" to "AB"	Flow "B" to "A"

Wiring Figure No. 3

**2-POSITION, 2-WIRE ELECTRIC.
SPST CONTROLLER REQUIRED.
ALL UNITS ARE SPRING RETURN.**

VALVES



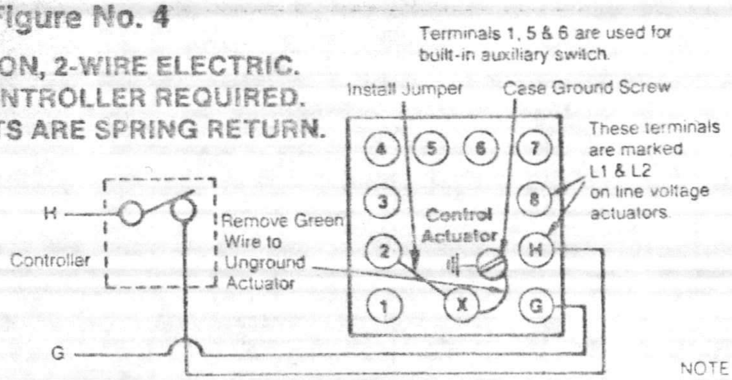
MP-35X, 46X, 46XX ACTUATORS

Valve Assembly	Normal Position	Powered Position
VP-9213-3XX	Closed	Open
VP-9253-3XX		
VP-9273-3XX		
VP-2224-15X		
VP-9313-3XX	Flow "A" to "AB"	Flow "B" to "AB"
VP-9323-3XX-4	Flow "B" to "A"	Flow "B" to "AB"
VP-9323-3XX-5	Flow "C" to "U"	Flow "C" to "L"

NOTE: Switch control circuit is 0.5 amp at approx. 24 Vac on either low or line voltage actuators.

Wiring Figure No. 4

**2-POSITION, 2-WIRE ELECTRIC.
SPST CONTROLLER REQUIRED.
ALL UNITS ARE SPRING RETURN.**



MP-37X, 47X, 47XX

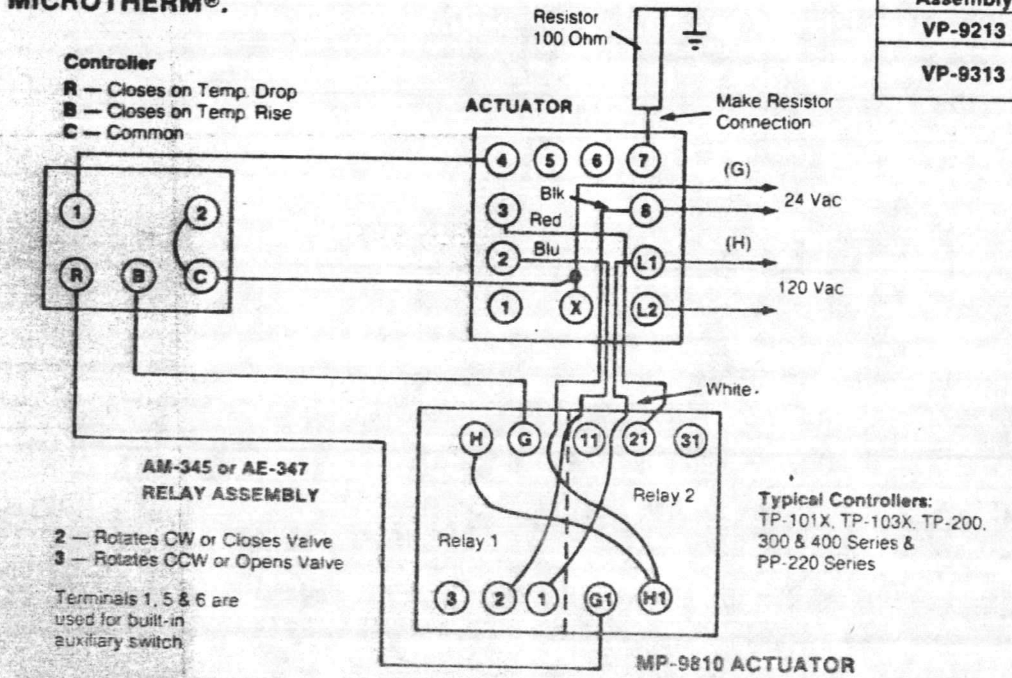
Valve Assembly	Normal Position	Powered Position
VP-9213-3XX	Open	Closed
VP-9253-3XX		
VP-9273-3XX		
VP-2224-15X		
VP-9313-3XX	Flow "B" to "AB"	Flow "A" to "AB"
VP-9323-3XX-4	Flow "B" to "AB"	Flow "B" to "A"
VP-9323-3XX-5	Flow "C" to "L"	Flow "C" to "U"

NOTE: Switch control circuit is 0.5 amp at approx. 24 Vac on either low or line voltage actuators.

Wiring Figure No. 11

MICROTHERM®.

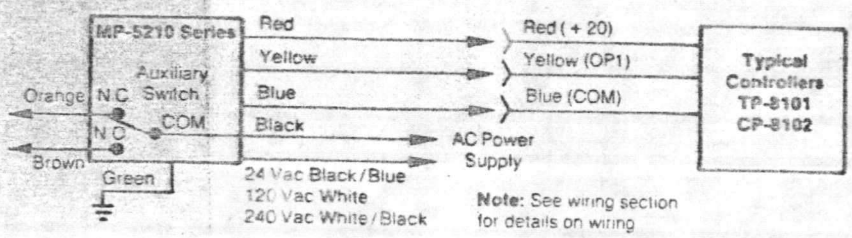
Valve Assembly	"L_1" to "2" on Actuator	"L_1" to "3" on Actuator
VP-9213	Closed	Open
VP-9313	Flow "A" to "AB"	Flow "B" to "AB"

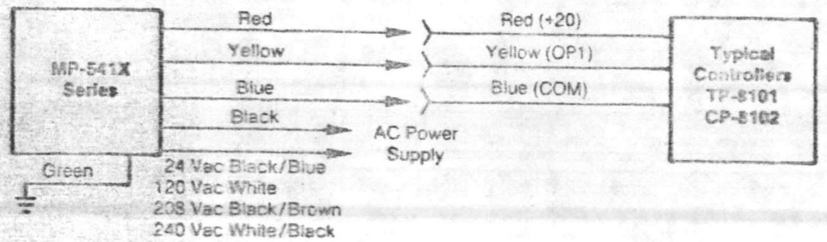


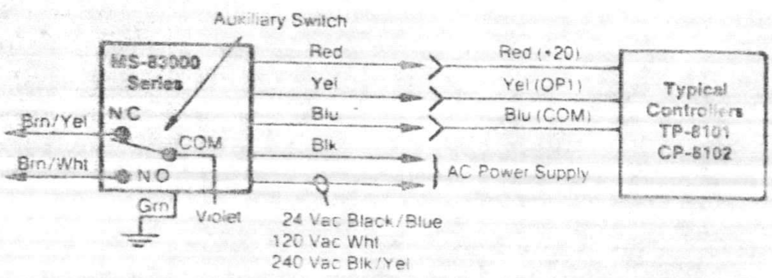
Wiring Figure No. 12

SYSTEM 8000
2-15 VDC INPUT

Valve Assembly	Increasing Vdc Input Signal	Normal Position Decreasing Vdc
VP-1112		
VS-9211		
VS-9212		
VS-[illegible]	Closed	Open
VS-9253		
VS-9273		
VS-9221		
VS-9222		
VS-9223	Open	Closed
VS-9263		
VS-9283		
VS-9313	Flow "A" to "AB"	Flow "B" to "AB"
VS-9323-XXX-4	Flow "B" to "A"	Flow "B" to "AB"
VS-9323-XXX-5	Flow "C" to "U"	Flow "C" to "L"







Auxiliary switch shown with actuator retracted field adjusted 0-100% of stroke

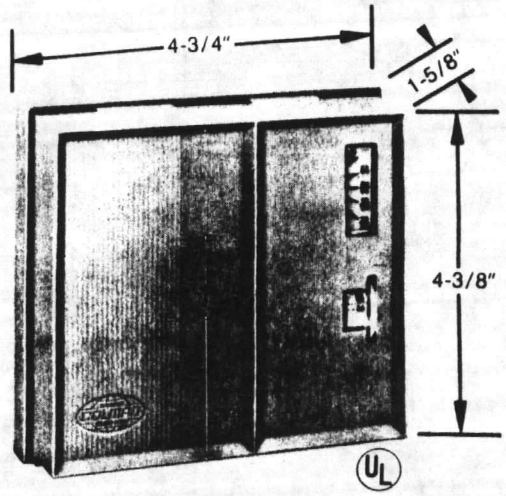
para. 2.2.2.9

BARBER COLMAN COMPANY

General Instructions

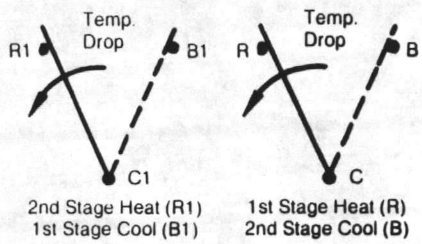
TC-1151, TC-1152, TC-1153
Electric Two-Stage Room Thermostats Two-Position

For on-off control applications which require sequenced switching of two heating devices or two cooling devices.



Two bimetal operated snap action SPDT switches. Coded screw terminals. Switch differential adjustable 1 to 2°F. Differential between stages 2 to 10°F, factory set at 2 to 3°F. Units have plastic covers as standard. Mounts on flush 2-gang switch box or 4" × 4" surface box, or directly to wall (24 volt only).

Dimensions: 4-3/8" high × 4-3/4" wide × 1-5/8" deep.



Note: Thermostat is designed for either heat **or** cool applications, not heat **and** cool.

ACCESSORIES

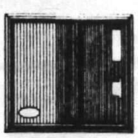
AT-101	Lock cover kit
AT-104	Dial stop pins (note: pins included with each unit)
AT-136	Title plates (day, night, heat, cool)
AT-546	Auxiliary mounting plate
AT-607	Selector switch sub-base DP4T
AT-608	Selector switch sub-base one DP4T, one DPDT
AT-1153	Wire guard
AT-1163	Plastic guard
AT-1165	Plastic guard
Tool-11	Calibration wrench
Tool-13	Contact burnishing tool

Part Number	Control* Dial Range	Full Load Amps 120 Vac	Full Load Amps 240 Vac	Pilot Duty (VA)
TC-1151	55- 85°F (13-29°C)	3.0	1.5	28 @ 24 Vac 140 @ 120/240 Vac
TC-1152	45- 75°F (7-23°C)			
TC-1153	75-105°F (24-40°C)			

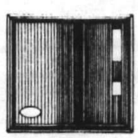
*Units dual marked in °F and °C; dial stop pins included to limit dial range.

OPTIONS

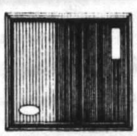
Add "dash-number" (-XXX) suffix to base part number for desired option.

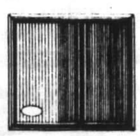

Standard


-400


-401


-402


-403


-404

-500 Parallel Heat Anticipation 24V Standard Cover
-501 Parallel Heat Anticipation 120V Standard Cover
-502 Parallel Heat Anticipation 240V Standard Cover
-601 10°F Night Depression 120V Standard Cover†
-602 10°F Night Depression 24V Standard Cover†
-603 10°F Night Depression 240V Standard Cover†

†Normally, night depression is controlled by a centrally located time clock such as AE-174 or AE-178, or by selector switch sub-bases (AT-602 or AT-603).

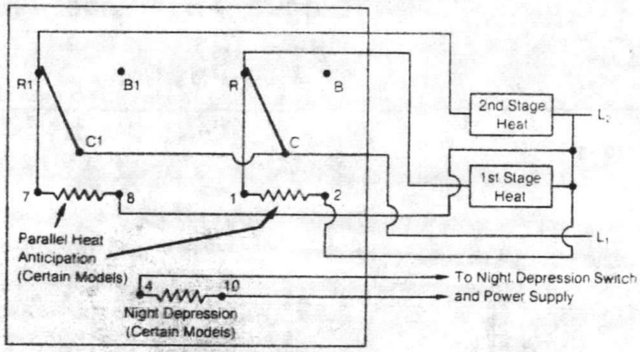
INSTALLATION

Requirements

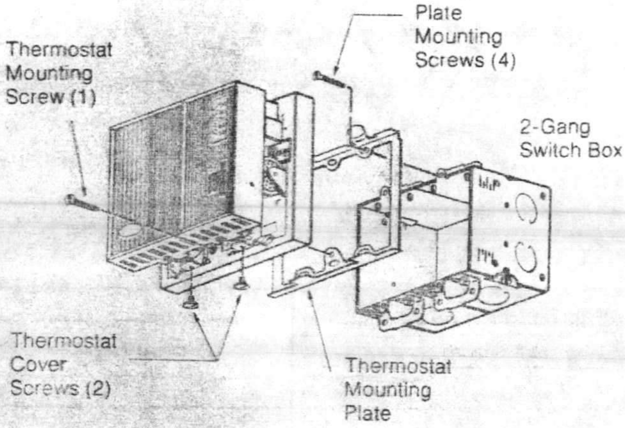
Locate thermostat where it will be exposed to unrestricted circulation of air which represents the average temperature of the controlled space. Do not locate the thermostat near sources of heat or cold, such as lamps, motors, sunlight or concealed ducts or pipes. The thermostat is designed for service in any normally encountered human environment.

Procedure

1. Pull all wires (Use copper wire only.)



2. Fasten mounting plate to box or wall.
3. Make electrical connections to thermostat screw type terminals. Make all connections in accordance with the job wiring diagram and in compliance with national and local electrical codes. Class I wiring is required unless all circuits to contacts are powered from a Class II source.
4. Hook thermostat on top of mounting and swing down into place.
5. Remove thermostat cover, attach thermostat to mounting plate with mounting screw, and attach thermostat cover.



CHECKOUT

After installing a thermostat, make an initial check of the switching action. Verify the switch action by listening to and watching the switch contacts, using a voltmeter between the proper sides of the switch, or observing the controlled device.

1. Slowly turn the setpoint dial to a temperature above ambient. First the "R" contact should make and then "R1" contact should make.
2. Slowly turn the setpoint setting down gradually and "B1" contact should make and "B" contact should make.

CALIBRATION

All thermostats are calibrated at the factory and normally will not require any such attention. However, if recalibration is necessary for any reason, proceed as follows:

1. Disconnect power to thermostat.
2. Set the adjusting dial to correspond to actual room temperature.
3. Remove thermostat cover, remove screw that secures right-hand of insulator, fold back insulator, and remove contact covers. (See Figure 1.)

Do not breathe on the thermostat or handle excessively as this will affect the accuracy of the final calibration.

4. If the right contact blade is not made to "R" contact, use a 3/16" open end wrench to turn dial calibration screw clockwise (looking at the head of screw) until element makes to "R" contact.

Note: Each complete revolution of screw changes calibration approximately 6°F.

5. Turn dial calibration screw counterclockwise until blade just breaks "R" contact.
6. Temporarily replace the cover and set the dial to a higher temperature setting. The difference between the two settings should be equal to the amount of desired differential between stages (2 to 10°F).
7. Remove the cover. If the left contact blade is not made to "R1", turn the between stage differential screw clockwise until element makes "R1" contact.
8. Turn the between stage differential screw counterclockwise until blade just breaks "R1" contact. Unit is now calibrated.
9. Replace contact covers, insulator and thermostat cover.
10. Recheck calibration about 30 minutes later to be sure heat from handling did not result in erroneous setting.

MAINTENANCE

Open areas at bottom and around base of thermostat should be kept clean and free from obstructions to allow proper flow of air. If switch contacts need cleaning, this may be done with a Tool-13 contact burnishing tool.

REPAIR

Field repair of the thermostat is not recommended. If the system is not operating correctly and the reason is traced to the thermostat, it should be replaced.

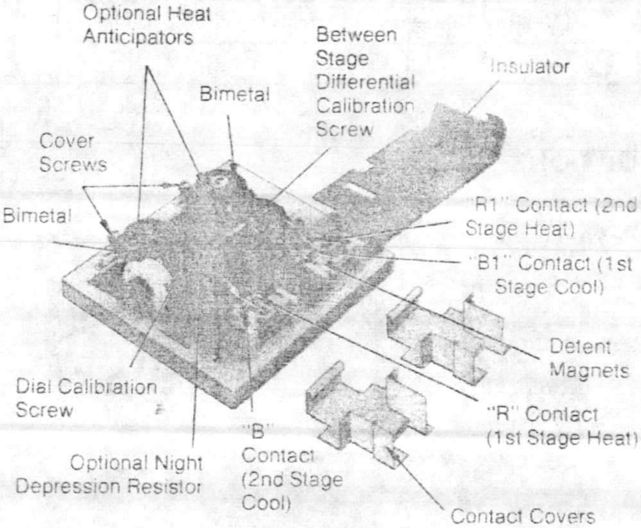


Figure 1

Barber-Colman Company
ENVIRONMENTAL CONTROLS DIVISION
1354 Clifford Avenue
P.O. Box 2940
Loves Park, IL U.S.A. 61132-2940

LITHO IN U.S.A.

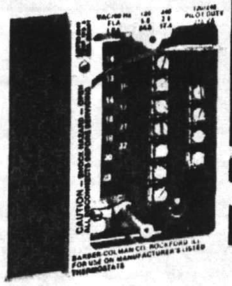
Para. 2.2.2.9

BARBER COLMAN COMPANY

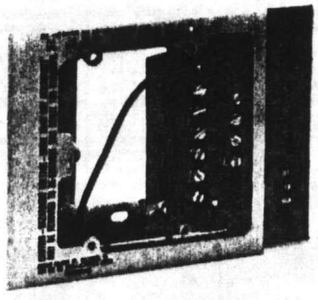
General Instructions

AT-602, 603, 607, 608 & 609-XXX Selector Switch Sub-Bases and Legend Plates

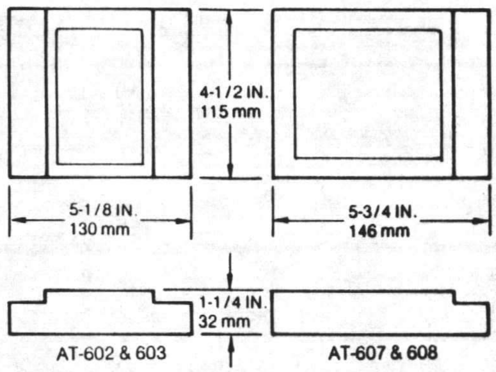
For use at the room thermostat to accommodate switching functions such as heating to cooling, day to night control, etc. **Device:** Rugged one piece molded beige plastic housing. One or two slide switches are double-pole, double throw (DPDT) or double pole-4 position (DP4T) allowing numerous control possibilities. DP4T can be used as two or three position by installing switch legend plates that limit switch travel. Coded screw terminals for the switch contacts are accessible for up to two No. 14 gauge wire connections. See Figure 2.



UL Typical Single Unit Sub-Base



UL Typical Duplex Unit Sub-base

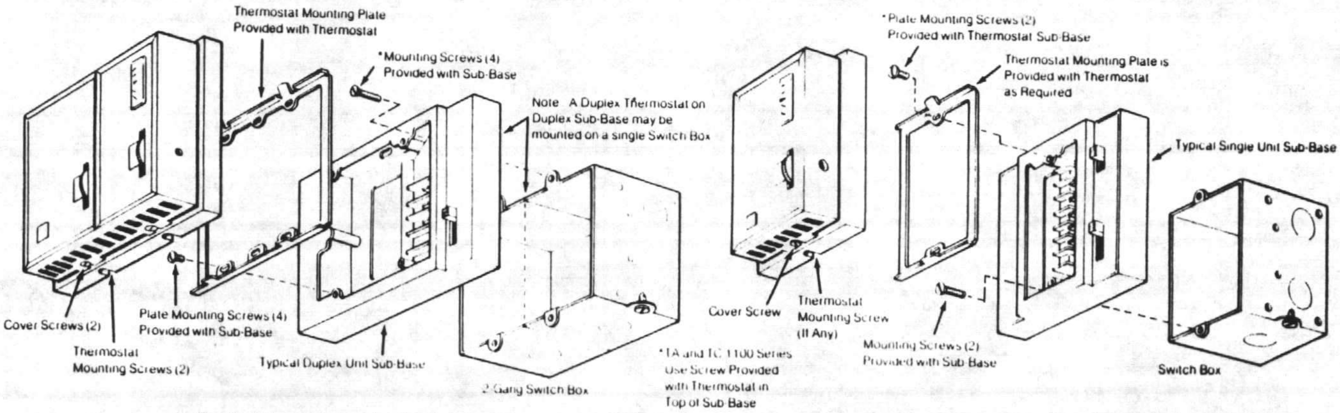


Installation

Use Class I wiring for all connections to switch subbases and to room thermostat unless all circuits are powered from a Class II source. Make all connections in accordance with national and local codes.

Install subbases on a flush switch box, a surface switch box or directly on a wall (for 24V applications only).

1. Pull the required wires.
2. If plastic conduit box is used, connect green wire from subbase to system ground, otherwise clip out the green wire.
3. Mount the subbase (see Figure 1). Screws are provided for switch box mounting.
4. Connect proper wires to subbase screw terminals. Push excess wire into conduit box, allowing field wires (if any) for room thermostat to project through opening in subbase.
5. Make all electrical connections to thermostats and install any jumpers as required. Refer to job wiring diagram and/or General Instruction Sheet for thermostat.
6. Install thermostat on subbase (see Figure 1).
7. To install switch legend plate on subbase strip the paper backing off and press plate into subbase. Note: Legend plates must be ordered separately.



Duplex Thermostat on Duplex Sub-Base — **Single Thermostat on Single Sub-Base**

Figure 1

Part Number	Switch Description: Upper Right	Switch Description: Lower Right	Used With
AT-602		DP4T	All Single Room Thermostats Except TK's, TA-115, TA-121, TA-133, TA-134, TC-114, and TC-142.
AT-603	DPDT	DP4T	
AT-607		DP4T	TA-151, 115X, TC-154, 114X, 115X, 116X, 2-Stage and Duplex Thermostats.
AT-608	DPDT	DP4T	

Total Electrical Rating of Each Sub-Base Switch*

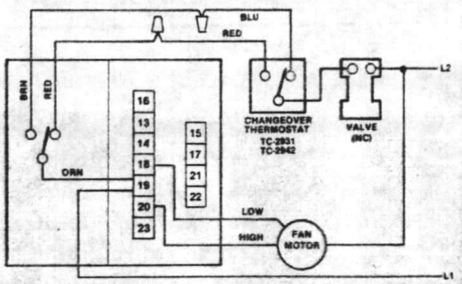
Volts (AC)	Inductive: Full Load Amps	Inductive: Locked Rotor Amps	Non-Inductive Amps	Pilot Duty (VA)
24	5.8	34.8	6	125
120	5.8	34.8	6	125
240	2.9	17.4	3	125

*The total load on both poles of a switch must not exceed the total electrical rating.

LITHO IN U.S.A. 2-84

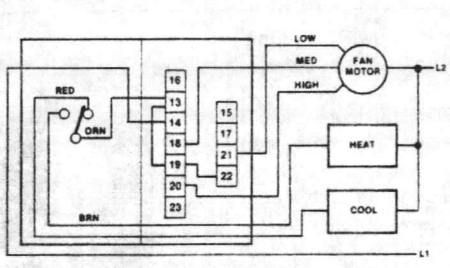
TYPICAL APPLICATIONS

THERMOSTAT CYCLES VALVE, SUMMER/WINTER CHANGEOVER THERMOSTAT, OFF-LOW-HIGH FAN SWITCH



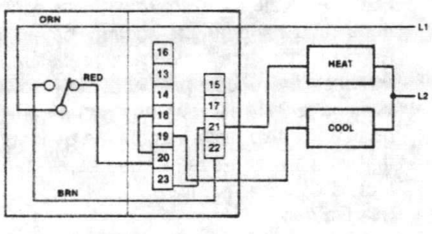
ITEMS: TC-1101, AT-602, AT-609-302

THERMOSTAT PROVIDES SEQUENCED HEAT & COOL, ON-OFF SWITCH, OFF LOCKS OFF SYSTEM & FAN, LOW-MED-HIGH FAN SWITCH



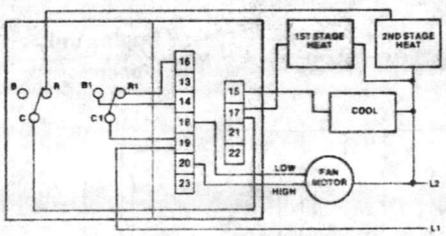
ITEMS: TC-1191; AT-603; AT-609-353

THERMOSTAT PROVIDES SEQUENCED HEAT & COOL OFF-HEAT-AUTO-COOL SWITCH



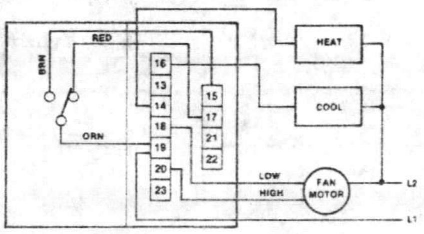
ITEMS: TC-1191, AT-602, AT-609-402

THERMOSTAT CYCLES 2 STAGES HEAT AND 1 STAGE COOL, HEAT-COOL SWITCH, OFF-LOW-HIGH FAN SWITCH



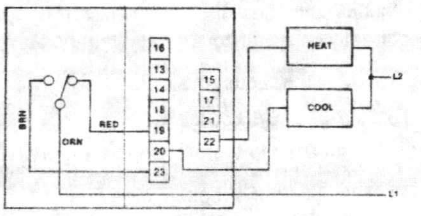
ITEMS: TC-154, AT-608, AT-609-352

THERMOSTAT CYCLES HEAT & COOL, HEAT-COOL SWITCH, OFF-LOW-HIGH FAN SWITCH



ITEMS: TC-1101; AT-603; AT-609-352

THERMOSTAT CYCLES HEAT AND COOL, HEAT-COOL SYSTEM SWITCH



ITEMS: TC-1101, AT-602, AT-609-204

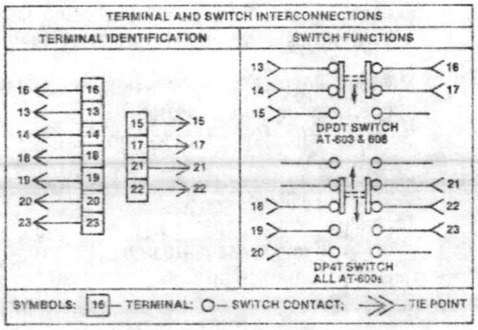


Figure 2

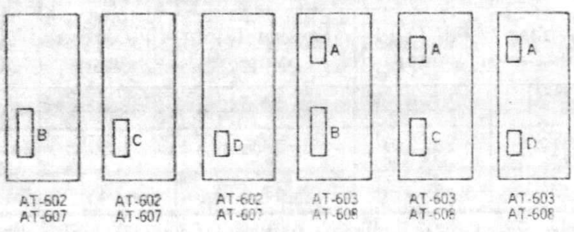
AT-609-XXX
Legend Plates for Switch Sub-Bases

Various switch indicating plates are available and must be ordered separately. These have a brown simulated leather finish with bright letters and pressure sensitive backing for simplified field installation. Blank plate on left side of AT-602 & 603 is factory installed.

Switch Position	Switch Action	AT-609-XXX SWITCH LEGEND PLATES																								
		Blank Plates*						Plates With Legends																		
		201	301	401	250	350	450	202	203	204	205	206	251	252	253†	302	303	305	306	307	351	352	353	402	403	452
A	DPDT												On Off	On Off	On Auto						On Auto Fan	Heat Cool	On Off			On Auto Fan
B	DP4T																							Off Heat Auto Cool	Off Low Med High	Off Heat Auto Cool
C	** DP3T															Off Low High	Heat Off Cool	Occu Off Unoccu	Night Off Day	Off On Auto	Heat Off Cool	Off Low High	Low Med High			
D	** DPDT							On Off	Occu Unoccu	Heat Cool	Night Day	Auto On	Low High	High Low	High Low											

*Special lettering can usually be provided by local nameplate engravers.
**Legend Plate limits travel of DP4T Switch to provide DPDT or DP3T.
†"Fan Operation" legend placed between switches.

SWITCH POSITIONS



Barber-Colman Company
ENVIRONMENTAL CONTROLS DIVISION
1354 Clifford Avenue
P.O. Box 2940
Loves Park, IL U.S.A. 61132-2940

LITHO IN U.S.A.

Para. 2.2.2.9

O.A. T'STAT

General Instructions

TC-4100 Series
TC-4200 Series
Bulb Thermostats
Return Air Thermostats

For on-off control of media temperature in ducts, tanks, liquid lines, etc.

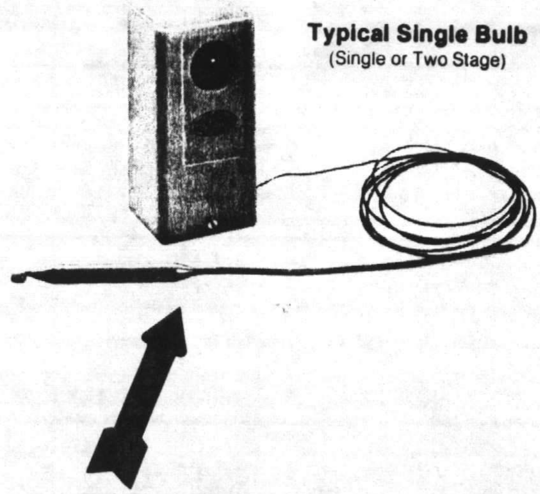
TC-4100 Series **one stage** units control one electrical circuit. Available in single or dual bulb configurations. (See Performance Table.)

TC-4200 Series **two stage** units control two electrical circuits in sequence. Available in single or dual bulb configurations. (See Performance Table.)

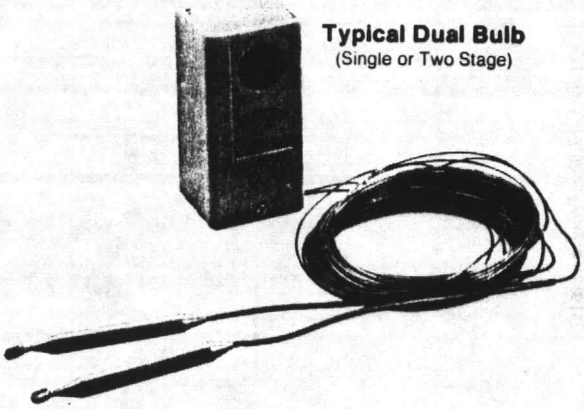
Dual bulb units are used to vary the control point of the controlled media as a function of outside air temperature. The ratio specified is outdoor to indoor. A unit with a 1 to 1-1/2 ratio will increase the water temperature 1-1/2°F for a 1°F decrease in outdoor temperature.

Air bulb units feature a coiled, fast responding air bulb. Used in return air control applications.

Device: Liquid filled thermal element actuates one snap acting SPDT switch per stage. Large color coded terminals. Setpoint adjustment dial plate is marked in °F on one side and °C on the other. The thermal differential is adjustable within the limits shown in the performance table. The mechanism is enclosed in a metal case and the cover, and has 1/2-inch to 3/4-inch conduit opening in the bottom of the case. Remote bulbs are suitable for immersion, duct, or outside air mounting.



Typical Single Bulb
(Single or Two Stage)



Typical Dual Bulb
(Single or Two Stage)

Dimensions

Bulb Units: 2-1/4" (57 mm) Wide × 4-5/8" (117 mm) High × 2" (51 mm) Deep.

Air Bulb Units: 2-1/4" (57 mm) Wide × 9" (229 mm) High × 2" (51 mm) Deep.

Electrical Rating: All Units Except TC-4115*

Switch Rating (50/60 Hz)	24V	120V	240V
Full Load Amps	9.8	9.8	8.0
Locked Rotor Amps	58.8	58.8	48.0
Pilot Duty VA	60	360	360
Non-Inductive Amps (Resistive)	—	—	—
Single Stage	22	22	22
Two Stage	16	16	8.0

*TC-4115 for System 8000 and dry circuit switching.
Electrical Rating: 1.0 amp at 24 Vac; .25 amp at 24 Vdc.

Typical Air Bulb
(Single or Two Stage)

Performance and Selection Table

Type	Part Number	Setpoint Adjustment Range	Dual† Bulb Ratio	Dimensions: Capillary (Copper)	Dimensions: Bulb (Copper)		Differential: Factory Set	Differential: Adjustable	Maximum Safe Bulb Temperature	Case Ambient Temperature
Single Stage Single Bulb	TC-4111	-40 to 120°F		6'	3/8 × 4"		3°F	3 to 16°F	170°F	-40 to 150°F
	TC-4111-020			20'						
	TC-4112	100 to 260°F		6'					310°F	
	TC-4115*	-40 to 120°F							170°F	
	TC-4121			10' Armored						
	TC-4122	100 to 260°F							310°F	
	TC-4123	190 to 350°F							400°F	
					Indoor	Outdoor				
Single Stage Dual Bulb	TC-4151	70 to 120°F	1:1-1/2 **	30' Each Bulb	3/8 × 4"	3/8 × 5-1/2"	3°F	1.5 to 10°F	Total of indoor and outdoor temperatures must not exceed 280°F	-40 to 150°F
	TC-4152		1:1		3/8 × 4"	3/8 × 4"		3 to 16°F		
One Stage Air Bulb	TC-4166	50 to 90°F		None	Coiled 2-1/2 × 2"		2°F Fixed		-40 to 145°F Safe Bulb Range	-40 to 150°F
Two Stage Single Bulb	TC-4211	-40 to 120°F		6'	3/8 × 4"		3°F	Per Stage Fixed Between Stages 2 to 10°F	170°F	-40 to 150°F
	TC-4221			10' Armored						
	TC-4222	100 to 260°F							310°F	
	TC-4223	190 to 350°F							400°F	
					Indoor	Outdoor				
Two Stage Dual Bulb	TC-4251	70 to 120°F	1:1-1/2 **	30' Each Bulb	3/8 × 5-1/2"	3/8 × 4"	3°F	Per Stage Fixed Between Stages 1.5 to 6.5°F	Total of indoor and outdoor temperatures must not exceed 280°F	-40 to 150°F
	TC-4252		1:1		3/8 × 4"	3/8 × 4"		2 to 10°F		
Two Stage Air Bulb	TC-4266	50 to 90°F		None	Coiled 2-1/2 × 2"		3°F	Per Stage Fixed 2°F Between Stage Adj. 1 to 5°F	-40 to 145°F Safe Bulb Range	-40 to 150°F

*TC-4115 for System 8000 and dry circuit switching. Electrical Rating: 1.0 amp at 24 Vac; .25 amp at 24 Vdc.
**TC-4151 and TC-4251 — For 1-1/2:1 ratio reverse bulbs and use extra dial supplied with unit.
†First number of reset ratio typically indicates outdoor air temperature change required to increase the setpoint by the second number.

Ratio Selection Table

Outdoor Temperature (°F)	Ratio	Change in Water Temperature for Different Ratios as Outdoor Temperature Drops from 70°F to Design Temperature: Dial Set at 70°F	Dial Set at 80°F	Dial Set at 90°F	Dial Set at 100°F	Dial Set at 110°F	Dial Set at 120°F
-30	1 to 1-1/2	70 to 220	80 to 230	90 to 240	100 to 250	110 to 260	120 to 270
	1 to 1	70 to 170	80 to 180	90 to 190	100 to 200	110 to 210	120 to 220
	1-1/2 to 1	70 to 137	80 to 147	90 to 157	100 to 167	—	—
-20	1 to 1-1/2	70 to 205	80 to 215	90 to 225	100 to 235	110 to 245	120 to 255
	1 to 1	70 to 160	80 to 170	90 to 180	100 to 190	110 to 200	120 to 210
	1-1/2 to 1	70 to 130	80 to 140	90 to 150	100 to 160	—	—
-10	1 to 1-1/2	70 to 190	80 to 200	90 to 210	100 to 220	110 to 230	120 to 240
	1 to 1	70 to 150	80 to 160	90 to 170	100 to 180	110 to 190	120 to 200
	1-1/2 to 1	70 to 123	80 to 133	90 to 143	100 to 153	—	—
0	1 to 1-1/2	70 to 175	80 to 185	90 to 195	100 to 205	110 to 215	120 to 225
	1 to 1	70 to 140	80 to 150	90 to 160	100 to 170	110 to 180	120 to 190
	1-1/2 to 1	70 to 117	80 to 127	90 to 137	100 to 147	—	—
+10	1 to 1-1/2	70 to 160	80 to 170	90 to 180	100 to 190	110 to 200	120 to 210
	1 to 1	70 to 130	80 to 140	90 to 150	100 to 160	110 to 170	120 to 180
	1-1/2 to 1	70 to 110	80 to 120	90 to 130	100 to 140	—	—
+20	1 to 1-1/2	70 to 145	80 to 155	90 to 165	100 to 175	110 to 185	120 to 195
	1 to 1	70 to 120	80 to 130	90 to 140	100 to 150	110 to 160	120 to 170
	1-1/2 to 1	70 to 103	80 to 113	90 to 123	100 to 133	—	—
+30	1 to 1-1/2	70 to 130	80 to 140	90 to 150	100 to 160	110 to 170	120 to 180
	1 to 1	70 to 110	80 to 120	90 to 130	100 to 140	110 to 150	120 to 160
	1-1/2 to 1	70 to 97	80 to 107	90 to 117	100 to 127	—	—

Dual Bulb Selection

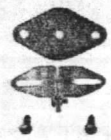
On the dual bulb units, indoor and outdoor bulbs are determined by the ratio selected. See Performance and Selection Table. Ratio refers to the outdoor air temperature change compared to the water temperature change. The dial setpoint is the water temperature setpoint when the outdoor temperature is 70°F.

To select ratio, it is necessary to know only: (1) outdoor design temperature, (2) maximum water temperature at outdoor design temperature, and (3) desired water temperature at 70°F outdoors. Use the Ratio Selection Table to determine the required ratio based on this information and set the dial per item (3). NOTE: If a 1-1/2:1 ratio is selected, the extra dial supplied with the unit must be used.

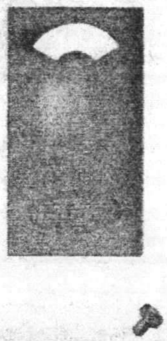
Example: Select ratio for an installation with a -10°F design temperature and estimated supply water temperatures of 75°F at 70°F outdoors and 125°F at -10°F outdoors. From Ratio Selection Table, -10°F for 1-1/2:1 ratio, note by interpolation (70°F to 123°F with dial at 70°F, 80°F to 133°F with dial at 80°F) that water temperature varies from 75°F to 128°F as outdoor temperature drops from 70°F to -10°F.

For this application, the 1-1/2:1 ratio should be selected. The extra dial supplied with the unit would be used, and the dial set at 75°F.

Immersion Well AT-20X



Bulb Duct Mounting Kit AT-208



Concealed Adjustment Kit AT-210

Liquid Line or Tank Bulb Mounting Kit AT-209 (Also Required with AT-201 or AT-203 Well)

Options

Single bulb units are available with optional capillary lengths of 20' or 45'.

Accessories: (Order Separately)

Part No.	Description	
AT-201*	Bulb Well	Copper, 3/4" MNPT 9-1/2"
AT-203*	Bulb Well	Stainless, 3/4" MNPT 9-1/2"
AT-206	Bulb Well	Copper, 1/2" MNPT 4-1/2"
AT-208	Duct Mounting Kit for Bulb	
AT-209	Liquid Line, or Tank, Bulb Mounting Kit. A Bulb Well is recommended. (Required with AT-201 or AT-203.)	
AT-210	Concealed Adjustment Kit. Includes plate to conceal setpoint adjustment and lock cover screw.	
AT-211	Outside Bulb Shield	

*Requires AT-209 Bulb Mounting Kit.

Pre-Installation

Refer to the INSTALLATION and Performance Data applicable to the part number of the device being installed. Make a visual inspection of the device for obvious signs of damage. Avoid locations where excessive moisture, corrosive fumes, vibration or high ambient exists.

Installation

Location

Locate the device allowing proper distance to the bulb location. The case can be mounted in any position. Refer to Figure 1 for case dimensions.

Procedure

Remote Bulb Models

Air Bulb Models — Mounting in Return Air Duct

1. Remove cover and provide 2 holes for #10 round head screws using the housing as the template or by using the dimensions shown in Figure 1.
2. Partially insert the mounting screws in the screw holes. Fit the housing over the screws, slide housing down on the screws and tighten the screws.

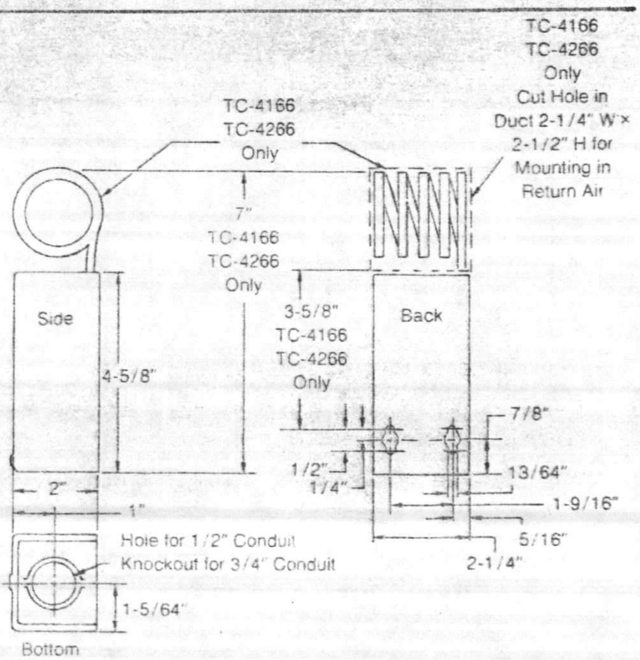


Figure 1. Case Dimensions

Air Bulb Models

Mounting Outside of Return Air Duct

1. Prepare duct for mounting by cutting hole and providing mounting screw holes per Figure 1.
2. Fabricate a cover as shown in Figure 2.
3. Carefully roll bulbs toward back of unit and insert through 2-1/4" × 2-1/2" hole.
4. Remove cover and attach unit to duct with #10 screws.
5. Attach cover over 2-1/4" × 2-1/2" hole.

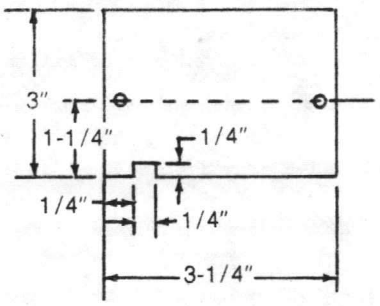


Figure 2. Field Supplied Duct Hole Cover Plate

Remote Bulb Mounting — Duct and Outdoor

Maximum insertion length (6 inches). Maximum safe bulb temperature above scale range. For dual bulbs, total of indoor and outdoor bulb temperatures must not exceed (280°F).

Duct: Install bulb with AT-208 kit as shown in Figure 3.

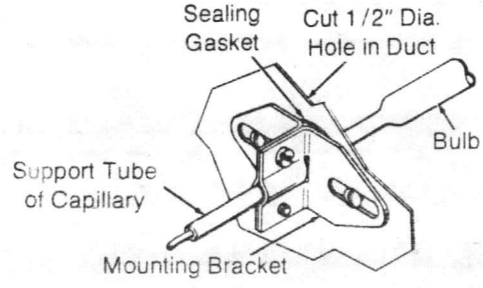


Figure 3. Duct Mounting with AT-208

Outdoor: Install with AT-211 kit as shown in Figure 4.

1. Mount bulb to outside wall or surface with bulb clip.
2. Place shield over bulb and fasten to mounting surface.

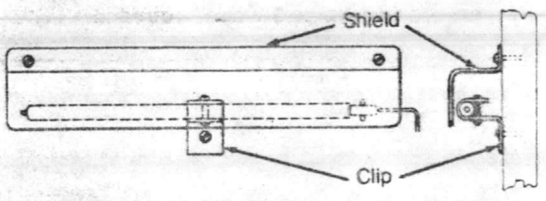
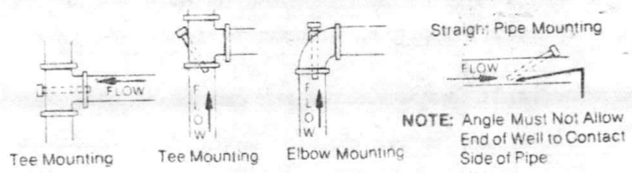


Figure 4. Outdoor Mounting with AT-211

Bulb Mounting — Liquid Line and Tank



Installation Hardware and Application Limitations

Part No.	Description	Mtg. Fitting	Insertion Size	Applications Limitations at 250°F Fluid Temp.*		Installation Per Figure
				Max. Recommended Velocity (FPS)	Max. Recommended Static Press. (PSIG)	
AT-201	Copper Bulb Well**	3/4" MNPT	1/2" Dia. O.D. 9-1/2" Long	11	250	5
AT-203	Stainless Steel Bulb Well**			20	500	
AT-206	Copper Bulb Well	1/2" MNPT	1/2" Dia. O.D. 4-1/2" Long	11	250	5A
AT-209†	Bulb Mounting Kit	3/4" MNPT	Length of Bulb	4	150	5

*Max. Recommended Fluid Temperature is 350°F.
**Requires AT-209.
†Recommended Installation is with a Bulb Well.

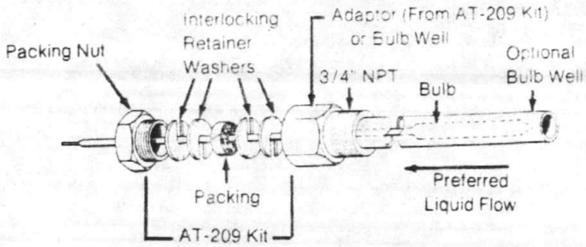


Figure 5. AT-201 or AT-203 Installation

Install bulb well or adaptor from AT-209 into 3/4" FNPT opening. Place packing nut, washers, and packing from AT-209 over bulb support section and insert bulb into well or AT-209 adaptor. Push interlocking washers and packing into well or adaptor and tighten packing nut until firmly seated.

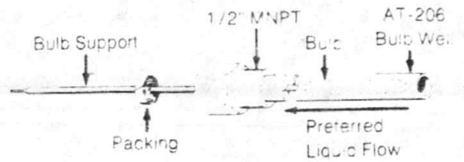


Figure 5A. AT-206 Installation

Install AT-206 bulb well into 1/2" FNPT opening. Place packing (included with AT-206) over bulb support section and insert bulb into well. Push packing into nut on well using a screwdriver.

Concealed Setpoint and Lock Cover Screw

Order AT-210 Concealed Adjustment Kit separately.

1. Peel off adhesive film from the concealed adjustment plate and place into the recess of cover.
2. Remove screw from cover.
3. Install lock cover screw provided with AT-210.

Wiring

The thermostat has one 1/2-inch to 3/4-inch conduit opening in bottom of housing. Make all electrical connections in accordance with the job wiring diagram and in compliance with national and local electrical codes. Terminal coding and switch action is shown in Figure 6, and Figure 7 shows two stage switching sequence.

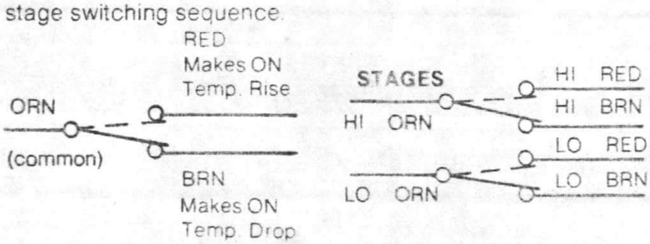


Figure 6. Terminal Coding and Switch Action

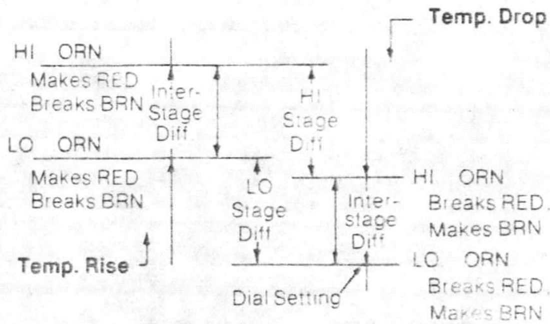


Figure 7. Two Stage Switch Sequence

Typical Applications

Figure 8 shows a typical heating or cooling application for single stage units. Figure 9 shows typical heating and cooling applications for two stage units.

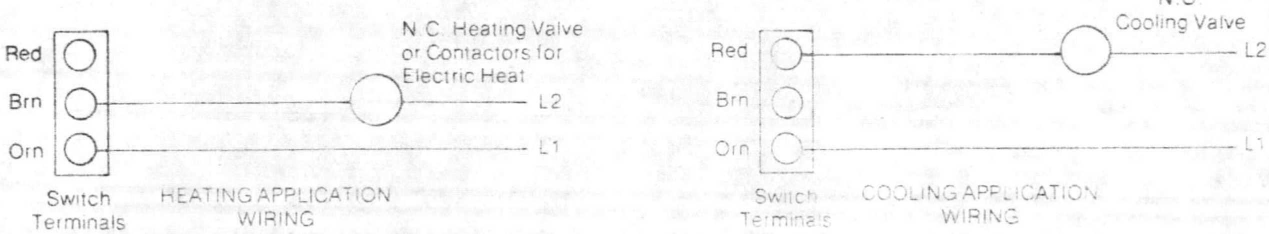
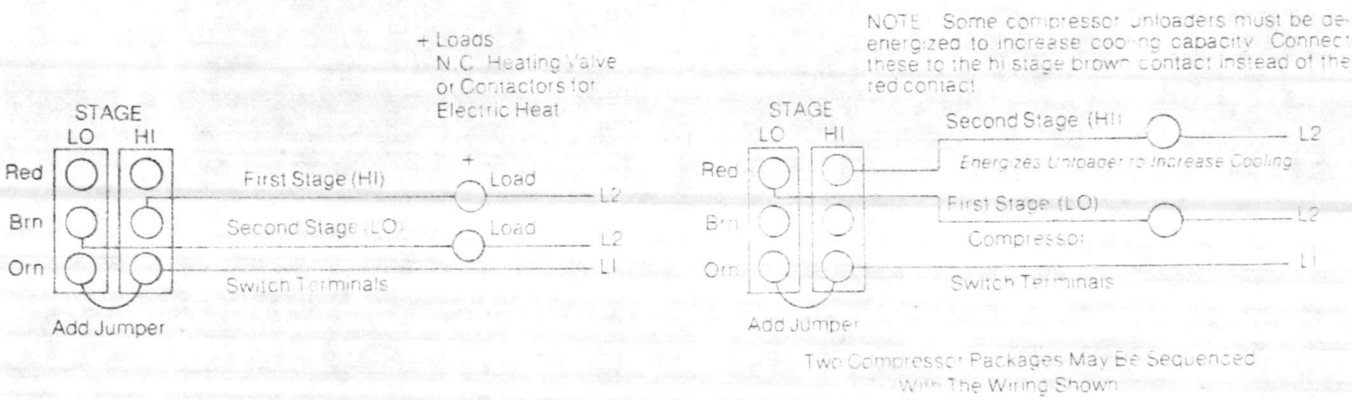


Figure 8. Typical Heating or Cooling Application for Single-Stage Units



TYPICAL HEATING APPLICATION WIRING FOR TWO-STAGE UNITS

TYPICAL COOLING APPLICATION WIRING FOR TWO STAGE UNITS

Figure 9

Checkout

After installing a thermostat, make an initial check of the switching action. Verify the switch action by listening to the switch contacts.

1. Turn the setpoint dial to a temperature above ambient. This should cause the thermostat to switch, making orange to brown.
2. Turn the setpoint dial setting down gradually. Orange to brown must break, making orange to red.
3. Compare the differential of the device to the differential shown on the performance charts by turning the dial. The differential of the devices is the difference in dial reading between the make of orange to brown and the make of orange to red on single switch units.

Run/Adjust

Setpoint

Screwdriver adjustment. Scales dual marked °F on front and °C on back. To change scale, remove spring retaining ring, select scale and replace retaining ring.

Differential Adjustment

The differential is adjustable by turning the adjustor located on side of device (see Figure 10).

Single stage: Each line represents approximately 3°F change.

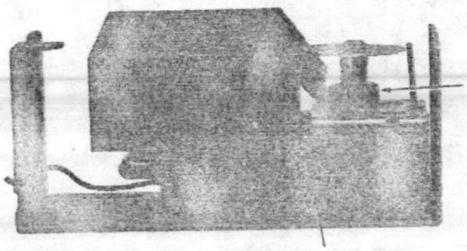


Figure 10

Two stage: Each notch represents approximately 2°F change between stages. (Differential per switch is fixed.)

To adjust differential:

1. Disconnect power to unit.
2. Remove cover.
3. Turn adjustor to approximately desired position.
4. Check out by turning dial and noting dial readings where switch contacts make.
5. After changing differential, recalibrate. See Service and Repair.

Service and Repair

Calibration

1. With all power disconnected, soak bulb(s) for 10 minutes at known temperature (must be 70°F for dual bulb).
2. Turn dial and note where switch contacts make.
3. Turn dial midway between click points.
4. Turn the calibration nut (located under dial) until the temperature of the bulb is indicated on the dial. (See Figure 10.)

NOTE

On two-stage units follow above procedure. "LO" switch is first stage on cooling applications. "HI" switch is first stage on heating applications.

Repair

Field repair is not recommended. Replace defective device.

Barber-Colman Company
ENVIRONMENTAL CONTROLS DIVISION

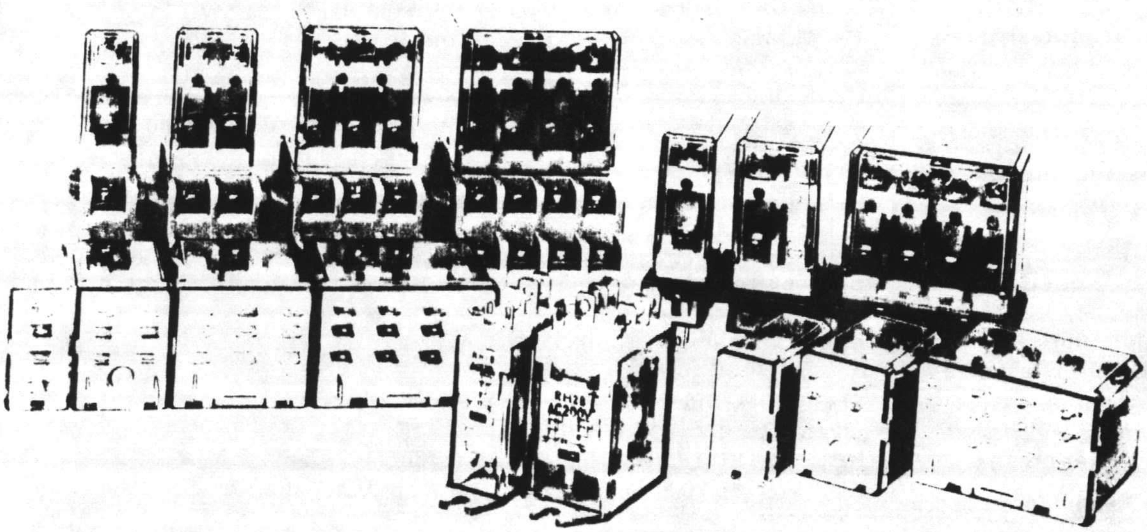
1354 Clifford Avenue
P.O. Box 2940
Loves Park, IL U.S.A. 61132-2940

F-18895-1 BK

LITHO IN U.S.A.

E,S,1-9

MIDGET POWER TYPE RELAYS
LARGE CAPACITY 10AMP-1, 2, 3, and 4 POLES



UL Recognized
File No. E67770
E59804
E64245

CSA Certified
File No. 35144

GENERAL

IDEC's Midget Power RH relays are similar to our general purpose RR series relays with full 10 amp switching capacity. Compact in size, the RH series relays reduce space requirements which are an important feature in todays downsized equipment.

RH Midget Power relays are available in SPDT, DPDT, 3PDT and 4PDT contact configurations driven by AC or DC coils with a choice of either blade or PCB mount .078 inch(2mm) terminals. Top bracket mounting is available for SPDT, DPDT and 4PDT terminal blade models.

FEATURES

- Miniature size package allows compact system designing.
- 10 amp contact capacity.
- Dielectric strength--up to 2,000 volts.
- UL recognized and CSA certified.
- Indicator light or check button available on 2, 3 and 4-pole models.
- Complete accessories include IDEC's broad line of sockets, hold-down springs and mounting rails.

TYPE LIST

Terminal Style	Contact Configuration	Basic Type	With Indicator Light	With Check Button	Top Bracket Mounting Type
B (Blade)	SPDT	RH1B-U	—	—	RH1B-UT
	DPDT	RH2B-U	RH2B-UL	RH2B-UC	RH2B-UT
	3PDT	RH3B-U	—	—	—
	4PDT	RH4B-U	RH4B-UL	RH4B-UC	RH4B-UT
V2 (PCB 0.078" wide)	SPDT	RH1V2-U	—	—	—
	DPDT	RH2V2-U	RH2V2-UL	RH2V2-UC	—
	3PDT	RH3V2-U	—	—	—
	4PDT	RH4V2-U	RH4V2-UL	RH4V2-UC	—

R-1, 2, 3 Para. 2.2.2.9
8

iDEC RH SERIES MIDGET POWER/GENERAL PURPOSE

SPECIFICATIONS

Contact Material	Silver cadmium oxide (Ag-CdO)
Contact Resistance	50 mΩ max. (initial value)
Operate Time	SPDT(RH1), DPDT(RH2) ... 20 msec max., 3PDT(RH3), 4PDT(RH4) ... 25 msec max.
Release Time	SPDT(RH1), DPDT(RH2) ... 20 msec max., 3PDT(RH3), 4PDT(RH4) ... 25 msec max.
Power Consumption (Approx.)	SPDT(RH1) ... AC 1.1 VA (50 Hz), 1 VA (60 Hz), DC 0.8W DPDT(RH2) ... AC 1.4 VA (50 Hz), 1.2 VA (60 Hz), DC 0.9W 3PDT(RH3) ... AC 2 VA (50 Hz), 1.7 VA (60 Hz), DC 1.5W 4PDT(RH4) ... AC 2.5 VA (50 Hz), 2 VA (60 Hz), DC 1.5W
Insulation Resistance	100 MΩ min. (measured at 500V DC megger)
Dielectric Strength	SPDT(RH1) Between live and non-live parts: 2000V AC, 1 minute Between contact circuit and operating coil: 2000V AC, 1 minute Between contacts of the same pole: 1000V AC, 1 minute DPDT(RH2), 3PDT(RH3), 4PDT(RH4) Between live and non-live parts: 2000V AC, 1 minute Between contact circuit and operating coil: 2000V AC, 1 minute Between contact circuits: 1500V AC, 1 minute Between contacts of the same pole: 1000V AC, 1 minute
Frequency Response	1800 operations/hour
Temperature Rise	Coil: 85 deg. max., Contact: 65 deg. max.
Vibration Resistance	0 to 6g (55 Hz max.)
Shock Resistance	SPDT(RH1), DPDT(RH2) ... 20g, 3PDT(RH3), 4PDT(RH4) ... 10g
Operating Temperature	-22° to +158°F (-30°C to +70°C)
Weight (Approx.)	RH1: 24g, RH2: 37g, RH3: 50g, RH4: 74g
Life Expectancy	Electrical: 500,000 operations or more (120V AC, 10A)* Mechanical: 50,000,000 operations or more

Note:* 200,000 operations or more (120V AC, 10A) in SPDT(RH1), 3PDT(RH3), 4PDT(RH4) types.

COIL RATINGS

Rated Voltage (V)		Rated Current (mA) ±15% at 20°C, 60 Hz SPDT	60 Hz DPDT	60 Hz 3PDT	60 Hz 4PDT	50 Hz SPDT	50 Hz DPDT	50 Hz 3PDT	50 Hz 4PDT	Coil Resistance (Ω) ±10% at 20°C SPDT	DPDT	3PDT	4PDT	Continuous Applied Voltage (Max.) 20°C	Pick up Voltage (min.) at 20°C
AC	6V	150	200	280	330	170	238	330	387	18.8	9.6	6.0	5.4	110% of rated voltage without overheating	80% of rated voltage
	12V	75	100	140	165	86	118	165	196	76.8	40.5	25.3	21.2		
	24V	37	50	70	83	42	59.7	81	98	300	156.7	103	84.5		
	120V	7.5	11	14.2	16.5	8.6	12.9	16.4	19.5	7680	4280	2770	2220		
	*240V	—	5.5	7.1	8.3	—	6.5	8.2	9.8	—	15720	12110	9120		
DC		SPDT		DPDT		3PDT		4PDT		SPDT	DPDT	3PDT	4PDT		
	6V	128		150		240		250		47	40	25	24	110% of rated voltage without overheating	80% of rated voltage
	12V	64		75		120		125		188	160	100	96		
	24V	32		36.9		60		62		750	650	400	388		
	48V	18		18.5		30		31		2660	2660	1600	1550		
	110V	8.0		9.1		12.8		15		13800	12100	8600	7340		

Note: Rated voltages marked with * are not available for SPDT models.

CONTACT RATING UL RATINGS (RH1, RH2, RH3, RH4)

VOLTAGE (V)	RESISTIVE (A) SPDT	RESISTIVE (A) DPDT	RESISTIVE (A) 3PDT	RESISTIVE (A) 4PDT	INDUCTIVE (A) SPDT	INDUCTIVE (A) DPDT	INDUCTIVE (A) 3PDT	INDUCTIVE (A) 4PDT	HORSE POWER SPDT DPDT	HORSE POWER 3PDT
120 AC	10	10	10	10	7	7	—	7.5	1/3	1/6
240 AC	10	10	—	7.5	7	7	6.5A/Pole 20A Total	5	1	1/3
30 DC	10	10	10	10	7	7	10	10	—	—

AS-202

TEMPERATURE CONTROL SUBMITTAL

JOB: REPLACE AIR CONDITIONING UNITS VARIOUS BUILDINGS
MARINE CORPS AIR STATION, NEW RIVER, N.C.
CONTRACT # N62470-86-B-5548

ARCHITECT:

ENGINEER: CHEATHAM AND ASSOCIATES

CONTRACTOR: HUMPHREY HEATING AND ROOFING

Submitted by:

TRIANGLE AUTOMATED CONTROLS, INC.
2716 Discovery Drive
Raleigh, North Carolina 27612
(919)878-8015

1/22/88

Sequence of Operation

8.1.1 Building AS-202: When the temperature rises above the setting of the cooling thermostat with the fan selector switch in "AUTO" position, the compressor and the fan shall be energized together. When the fan selector switch is in the "ON" position, the compressor shall cycle and the fan shall run continuously.

8.1.2 Building AS-205: When the thermostat is in the "COOL" position and the fan selector switch is in the "AUTO" position the compressors shall be energized on a temperature rise by two cooling stages of the thermostat and the fan shall cycle with the compressors. When the fan selector switch is in the "ON" position, the fan shall run continuously. When the thermostat is in the "HEAT" position the three way hot water control valve shall modulate hot water from full coil by-pass to full flow through the coil as the space temperature falls. The fan shall run continuously during the heating modes.

8.1.2.1 Converter Controls: A 2 input controller with one sensing element in the outside air and one sensing element in the hot water supply shall control a normally closed steam valve. The supply water temperature shall be reset upwards as the O.A. temperature falls. Reset schedule is such that at 20 degrees O.A., H.W.S. is 180 degrees and at 60 degrees O.A., H.W.S. is 100 degrees.

8.1.2.2 Pump Control: When the steam control valve begins to modulate open, the hot water pump shall be energized and shall remain energized until the steam control valve completely closes.

8.1.2.3 A safety low limit thermostat shall deenergize the air handling unit's fan when the mixed air temperature entering the heating coil drops below 35 degrees F.

8.1.3 Building AS-236: When any of the six thermostats are in the "COOL" position and the fan selector switch is in the "AUTO" position, the compressor shall be energized on a temperature rise and the fan shall cycle with the compressor. When the fan selector switch is in the "ON" position, the fan shall run continuously. When the thermostat is in the "HEAT" position the three way hot water control valve shall modulate hot water from full coil by-pass to full flow through the coil as the space temperature falls. The fan shall run continuously during the heating modes.

8.1.3.1 Converter Controls: A 2 input controller with one sensing element in the outside air and one sensing element in the hot water supply shall control a normally closed steam valve. The supply water temperature shall be reset upwards as the O.A. temperature falls. Reset schedule is such that at 20 degrees O.A., H.W.S. is 180 degrees and at 60 degrees O.A., H.W.S. is 100 degrees.

8.1.3.2 Pump Control: When the steam control valve begins to modulate open the hot water pump shall be energized and shall remain energized until the steam control valve completely closes.

8.1.3.3 A safety low limit thermostat shall deenergize the air handling unit fan when the mixed air temperature entering the heating coil drops below 35 degrees F. Not applicable for AHU 3 and 5.

8.1.4 Building AS-502: When the temperature rises above the setting of the cooling thermostat with the fan selector switch in "AUTO" position, the compressor and the fan shall be energized together. When the fan selector switch is in the "ON" position, the compressor shall cycle and the fan shall run continuously.

8.1.5 Building AS-3502: Existing controls shall be reused. An existing high limit pressure selector and pneumatic electric switch shall energize the new condensing unit and provide full cooling. Existing hot water control valve will be reused and connected to new heating coil in air handling unit.

JOB: CONTRACT# n62470-86-B-5548
REPLACE AIR CONDITIONING UNITS
VARIOUS BUILDINGS
MCAS, NEW RIVER, N.C.

EQUIPMENT SCHEDULE

Job #: A-024/J-024

DATE: 1/23/88

QNTY.	IDENTIFIER	PART NUMBER	MANUFACTURER	DESCRIPTION	LOCATION
			BUILDING AS-202		
1	SPACE	TC-1103-500	Barber Colman	Space cooling thermostat,2 pos.	In space
1	SUBBASE	AT-603	Barber Colman	Subbase switch for fan AUTO/ON	At space thermostat
			BUILDING AS-205		
1	TS-1	TS-8501	Barber Colman	O.A. temperature sensor	Element in O.A.
1	TS-2	TS-8201	Barber Colman	H.W.S. temperature sensor	Element in H.W.S.
1		AT-215	Barber Colman	Bulb well	With TS-2
1	RC-1	CP-8102	Barber Colman	2 input reset controller for convertor control	In control panel
1	V-2	VS-9223-201-4-5	Barber Colman	Control valve, 2 way, 3/4", proportional, Cv = 5.0	At steam convertor
1	R-3	RH2B-U24	IDEC	Control relay, DPDT, 24 VAC	In control panel
1	T-2	TP-8102	Barber Colman	Space thermostat, heating,proport.	In space
1	V-1	VS-9313-351-4-10	Barber Colman	Control valve, 3 way, 1 1/2" proportional, Cv = 33	At AHU h.w. coil
1		TC-1152	Barber Colman	Space thermostat, cooling, 2 stage	In space
1		AT-608	Barber Colman	Subbase switch, fan AUTO/ON, HEAT/COOL	At cooling thermostat
1		TC-4111	Barber Colman	Thermostat O.A. limit	Bulb in O.A. duct
2	R-2, R-3	RH2B-U24	IDEC	Control Relay, DPDT, 24 VAC	In control panel
3		SH2B-05	IDEC	Relay base	In control panel

JOB: REPLACE AIR CONDITIONING UNITS
VARIOUS BUILDINGS
MCAS, NEW RIVER, N.C.

EQUIPMENT SCHEDULE

Job #: A-024/J-024

DATE: 1/23/88

QNTY.	IDENTIFIER	PART NUMBER	MANUFACTURER	DESCRIPTION	LOCATION
			BUILDING AS-236		
6	COOLING	TC-1103	Barber Colman	Space thermostat cooling, 2 pos	In space
6	T-2	TP-8102	Barber Colman	Space thermostat, heating, proport.	In space
2	V-3	VS-9313-201-4-4	Barber Colman	Control valve, 3 way, 1/2" proportional, Cv = 4	At AHU 3 & 5
3	V-4	VS-9313-201-4-6	Barber Colman	Control valve, 3 way, 3/4" proportional, Cv = 6.8	At AHU 1,2 &6
1	V-5	VS-9313-351-4-11	Barber Colman	Control valve, 3 way, 2" proportional, Cv = 55	At AHU 4
6		AT-603	Barber Colman	Subbase switch, fan AUTO/ON HEAT/COOL	At cooling thermostat
4	O.A. T'stat	TC-4111	Barber Colman	Thermostat, O.A. limit	Bulb in O.A. duct of AHU 1, 2, 4 & 6
12	R-2, R-3	RH2B-U24	IDEC	Control relay, DPDT, 24 VAC	In control panel
13		SH2B-05	IDEC	Relay base	In control panel
1	V-6	VS-9223-351-4-10	Barber Colman	Control valve, 2 way, 1 1/2" N.C. proportional, Cv = 25	At steam convertor
1	TS-1	TS-8501	Barber Colman	O.A. temperature sensor	Element in O.A.
1	TS-2	TS-8201	Barber Colman	H.W.S temperature sensor	Element in H.W.S
1		AT-215	Barber Colman	Bulb Well	With TS-2

JOB: REPLACE AIR CONDITIONING UNITS
VARIOUS BUILDINGS
MCAS, NEW RIVER, N.C.

EQUIPMENT SCHEDULE

Job #: A-024/J-024

DATE: 1/23/88

QNTY.	IDENTIFIER	PART NUMBER	MANUFACTURER	DESCRIPTION	LOCATION
			AS-236 (cont)		
1	RC-1	CP-8102	Barber Colman	2 input reset controller for steam convertor	In control panel
1	R-3	RH2B-U24	IDEC	Control relay, DPDT, 24VAC	In control panel
1				Control panel, 20" X 16"	In mech. room
			BUILDING AS-502		
1	SPACE	TC-1103-500	Barber Colman	Space thermostat, cooling, 2 pos.	In space
1	SUBBASE	AT-603	Barber Colman	Subbase switch, fan AUTO/ON	At cooling thermostat

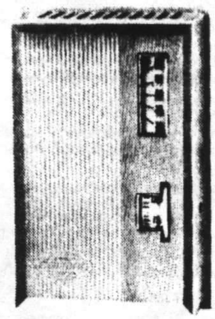
para. 2.2.2.9

SPACE, COOLING

BARBER COLMAN COMPANY

General Instructions

TC-1100 Series, TCR-1101 Two-Position Electric Room Thermostats



APPLICATION

For low or line voltage on-off control of fan coils, fans, motor starters, contactors, two-position electric actuators.

SPECIFICATIONS

Sensing Element: Bimetal.
Differential: 2°F (1°C).
Electrical Switch: Snap action SPDT.
Ratings, See Table 3.
Connections: Color coded 6" (152 mm) leads.
Cover: Beige plastic as standard.
Locations: NEMA Type 1 indoor only.
Mounting: Flush or surface 2 × 4 switch box or directly to wall (24 volt only).
Dimensions: 4-3/8" high × 2-7/8" wide × 1-5/8" deep (111 mm × 73 mm × 41 mm).

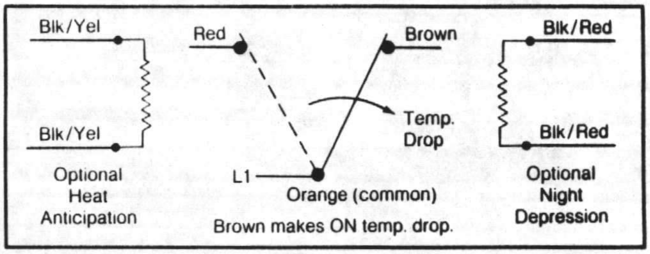
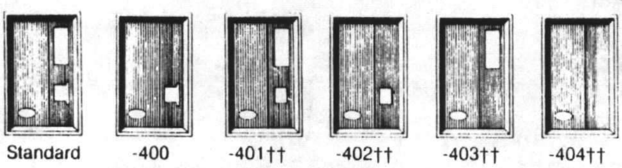


Figure 1. Switch Action and Lead Identification

OPTIONS

Add "dash-number" (-XXX) suffix to base part number for desired option. For metal covers, specify TC2-110X-XXX.

Heat anticipator should be used when system differential varies from specified thermostat differential. Wide system differential may be due to thermostat guards, material on which thermostat is mounted, location of thermostat, etc. For models used in applications requiring series heat anticipators, contact factory.



-500 parallel heat anticipation 24V standard cover
-501 parallel heat anticipation 120V standard cover
-502 parallel heat anticipation 240V standard cover
-601 10°F night depression 120V standard cover
-602 10°F night depression 24V standard cover
-603 10°F night depression 240V standard cover

††5/64" Allen screw used to secure cover.

TABLE 1. SPECIFICATIONS

Part Number	Setpoint Dial Range* °F (°C)	Cover Configurations
TC-1101	55 to 85 (13 to 29)	See Options
TC-1102	45 to 75 (7 to 23)	
TC-1103	75 to 105 (24 to 40)	
TCR-1101	55 to 85 only	One Blank Cover Insert & One Cover Insert with Control Dial Cutout**

*Dual marked (except TCR-1101); dial stop pins included to limit setpoint range.
**One (1) 5/64" Allen head screw and 5/64" Allen wrench for securing cover to thermostat base included along with standard single slotted screw.

TABLE 2. AGENCY APPROVALS†

Configuration	UL	CSA
Metal Case (TC2-110X)	Yes	Yes
Plastic Cover (TC-110X)	Yes	No
Heat Anticipation or Night Depression (-500 or -600 Series)	Yes	Yes

TABLE 3. MAXIMUM ELECTRICAL RATINGS

Full Load Amps		Locked Rotor Amps		Pilot Duty (VA)
24/120 Vac	240 Vac	24/120 Vac	240 Vac	
4.4 Orange to Brown Lead	2.2 Orange to Brown Lead	26.4 Orange to Brown Lead	13.2 Orange to Brown Lead	40 A 24 Vac
3.0 Orange to Red Lead	1.5 Orange to Red Lead	18 Orange to Red Lead	9 Orange to Red Lead	210 @ 120/240 Vac

ACCESSORIES

AE-170 Series	Electric time clock
AT-101	Lock cover kit
AT-104	Dial stop pins (NOTE: Pins included with each unit.)
AT-136	Title plates (day, night, heat, cool)
AT-504	Plaster hole cover kit (small)
AT-505	Surface mounting base
AT-546	Auxiliary mounting plate
AT-602	Selector switch sub-base DP4T
AT-603	Selector switch sub-base one DP4T, one DPDT
AT-1100 Series	Thermostat guards
TOOL-11	Calibration wrench
TOOL-13	Contact burnishing tool

PRE-INSTALLATION

Inspection

Visually inspect the carton for damage. If damaged, notify the appropriate carrier immediately. If undamaged, open the carton and visually inspect the device for obvious defects. Return damaged or defective products.

Required Installation Items

- Wiring diagrams
- Tools (not provided):
  Volt-ohm meter
  Appropriate screwdriver for mounting screws and terminal connections
- Appropriate accessories
- Mounting screws, two (2) provided for securing to a 2 × 4 conduit box

INSTALLATION

CAUTION

1. Installer must be a qualified, experienced technician.
2. Make all connections in accordance with the wiring diagram, and in accordance with national and local electrical codes. Class I wiring is required unless all circuits to contacts are powered from a Class II source. *Use copper conductors only.*
3. Do not exceed ratings of the device.

Mounting

Thermostats require upright mounting on a properly flat vertical surface. Locate the thermostat where it will be exposed to unrestricted circulation of air which represents the average temperature of the controlled space.

CAUTION

Do not locate the thermostat near sources of heat or cold, such as lamps, motors, sunlight or concealed ducts or pipes, or where there is a danger of electrocution (i.e., shower rooms).

The thermostat is designed for service in any normally encountered human environment. Avoid locations where excessive vibration, moisture, corrosive fumes or vapors are present. NEMA Type 1 covers are intended for indoor use primarily to provide a degree of protection against contact with the enclosed equipment.

Thermostats with guards that restrict air flow must have heating or cooling anticipation.

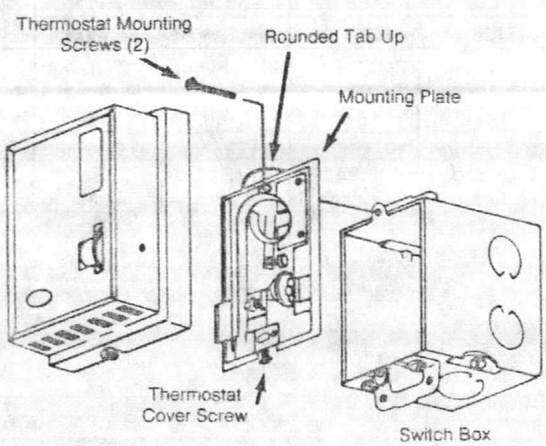


Figure 2. Thermostat Mounting

Procedure

1. Pull all wires.
2. Make electrical connections to thermostat. (Typical heat anticipation and night depression wiring diagrams are shown in Figures 6 through 8.)
3. Remove thermostat cover and fasten thermostat to box or wall.
4. Attach thermostat cover.

CHECKOUT

After installing a thermostat, make an initial check of the switching action. Verify the switch action by listening to and watching the switch contacts or by using a voltmeter between the proper sides of the switch.

1. Run the setpoint dial to a temperature above ambient. This should cause the thermostat to make a circuit between orange and brown leads.
2. Turn the setpoint dial setting down below ambient. This should cause the thermostat to make a circuit between orange and red leads.

CALIBRATION (See Figure 3)

All thermostats are precision calibrated at the factory and normally will not require any further attention. However, if recalibration is necessary, proceed as follows:

1. Turn off control power and power to night depression circuit, where applicable.
2. Set setpoint dial to correspond to actual stable room temperature, as read from an accurate thermometer.
3. Remove thermostat cover. Do not breathe on the thermostat or handle excessively as this will affect the accuracy of the final calibration.
4. If contact blade is made to the left (red) contact, with a small screwdriver, turn calibration screw counterclockwise (looking at head of screw) until blade makes to right (brown) contact.

   NOTE

   Each complete turn of screw changes calibration approximately 15°F (8°C).

   Now turn screw very slowly clockwise until blade just makes the left (red) contact. Thermostat is now properly calibrated.

   If contact blade is originally made to the right (brown) contact, turn calibration screw slowly clockwise until element just makes the left (red) contact. Thermostat is now properly calibrated.
5. Replace thermostat cover.
6. Turn on control power.
7. Recheck calibration about 30 minutes later to be sure heat from handling of or breathing on bimetal element did not result in an erroneous setting.

HEAT ANTICIPATION (See Figures 6 and 7)

Heat anticipation, series or parallel, is recommended for:

- Systems with excess heating capacity that can cause objectionable space temperature swings.
- Thermostats mounted on walls (i.e., concrete) that change temperature slowly and/or have insufficient air flow over the device.

COOLING ANTICIPATION (See Figure 8)

Parallel cooling anticipation is recommended for:

- Cooling anticipations where current draw exceeds 1 ampere. Cooling lockout (self heat of the thermostat causing over cooling of the space) can occur on these applications.
- Systems with excess cooling capacity that can cause objectionable space temperature swings.
- Thermostats mounted on walls (i.e., concrete) that change temperature slowly and/or have restricted air flow over the device.

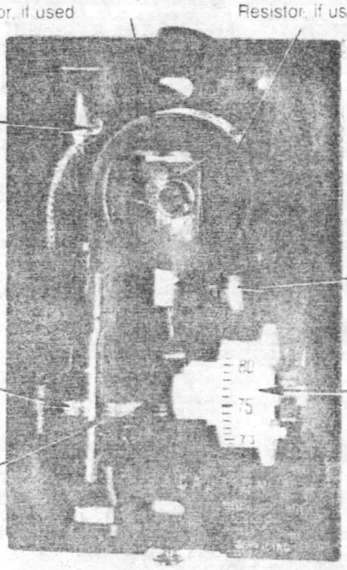


Figure 3.

CONCEALED CONTROL DIAL

Knurled Dial Removal (See Figure 4)

1. Remove thermostat cover.
2. Secure the control dial with hand so that the dial will not rotate.
3. Place needle nose pliers at knurled ring of the control dial at the points where the knurled ring is attached to the control dial.
4. Twist the pliers at each knurled ring attachment point until the entire knurled ring of the control dial is removed.

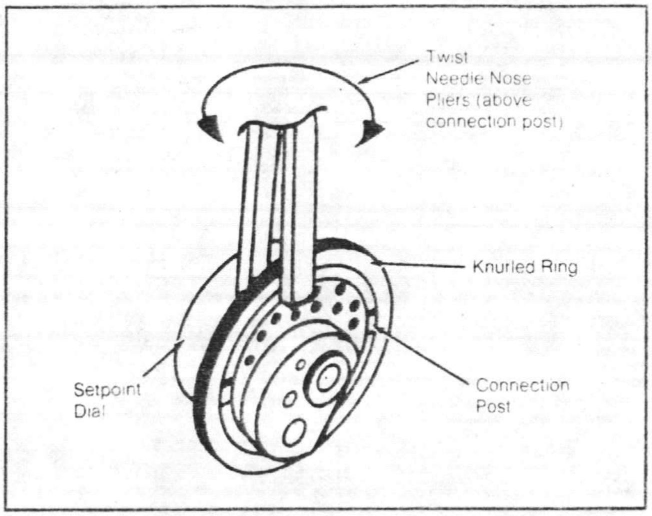


Figure 4. Knurled Dial Removal

LIMIT CONTROL DIAL RANGE

Dial Stop Pin Insertion — Included with Mounting Plate (See Figure 5)

1. Remove thermostat cover.
2. Secure the control dial with hand so that the dial will not rotate.
3. Place a dial stop pin in the jaws of a needle nose pliers.
4. Insert the dial stop pin in the appropriate hole on either (or both) side(s) of the control dial to restrict dial rotation.

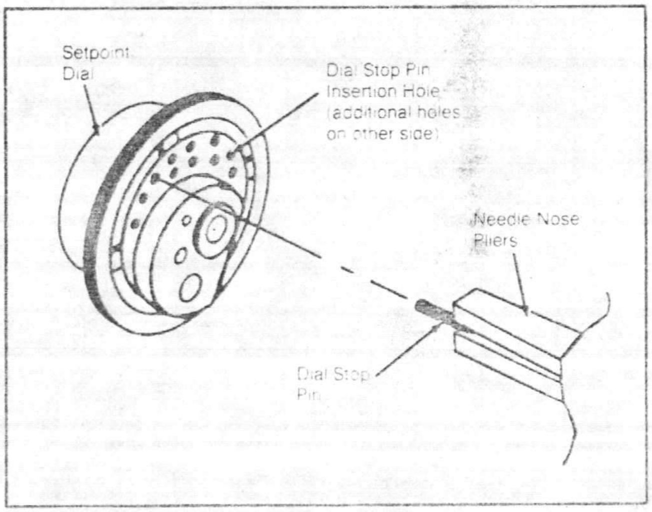


Figure 5. Dial Stop Pin Insertion

MAINTENANCE

Regular maintenance of the total system is recommended to assure sustained optimum performance.

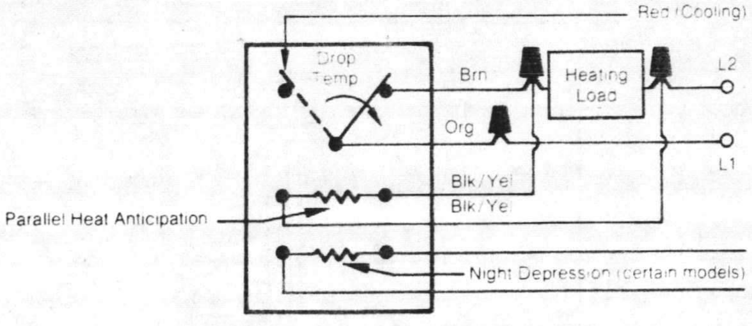
Open areas at bottom and around base of thermostat should be kept clean and free from obstructions to allow proper flow of air. If switch contacts need cleaning, this may be done with TOOL-13 (burnishing tool).

NOTE

Thermostat may require calibration after cleaning the contacts.

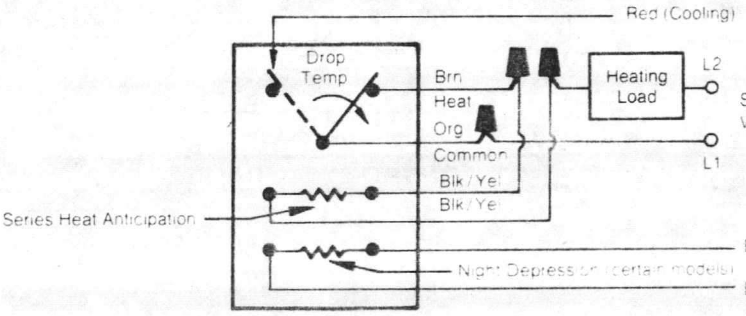
REPAIR

These thermostats are not field repairable. Replace a defective thermostat with a functional unit.



Note: Normally, night depression is controlled by a centrally located time clock such as AE-174 or AE-178, or by selector switch sub-bases (AT-602 or AT-603)

Figure 6. Typical of Parallel Heat Anticipation (heater size determined by voltage) with or without Night Depression



Note: Normally, night depression is controlled by a centrally located time clock such as AE-174 or AE-178, or by selector switch sub-bases (AT-602 or AT-603)

Figure 7. Typical of Series Heat Anticipation (heater size determined by ampere rating of load) with or without Night Depression

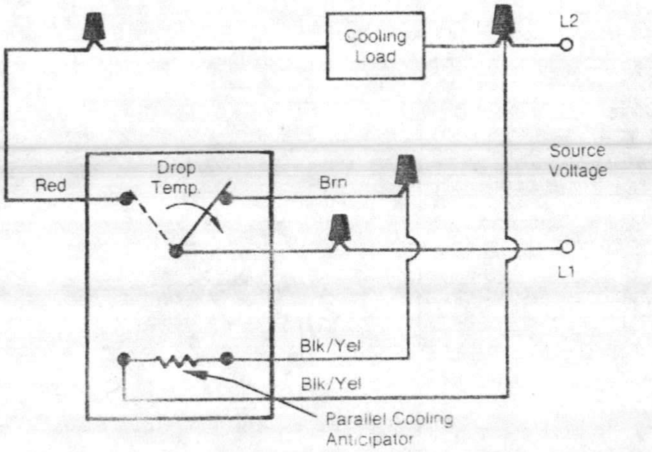
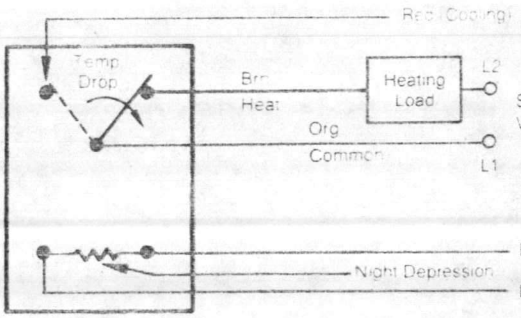


Figure 8. Typical of Parallel Cooling Anticipation (anticipator size determined by voltage)



Note: Normally, night depression is controlled by a centrally located time clock such as AE-174 or AE-178, or by selector switch sub-bases (AT-602 or AT-603)

Figure 9. Typical Night Depression

Barber-Colman Company
ENVIRONMENTAL CONTROLS DIVISION

1354 Clifford Avenue
P.O. Box 2940
Loves Park, IL U.S.A. 61132-2940

LITHO IN U.S.A.

Para. 2.2.2.9

General Instructions

AT-602, 603, 607, 608 & 609-XXX Selector Switch Sub-Bases and Legend Plates

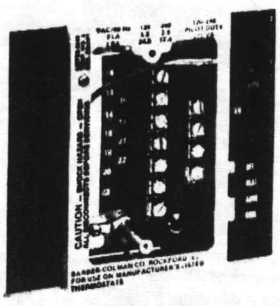
For use at the room thermostat to accommodate switching functions such as heating to cooling, day to night control, etc. **Device:** Rugged one piece molded beige plastic housing. One or two slide switches are double-pole, double throw (DPDT) or double pole-4 position (DP4T) allowing numerous control possibilities. DP4T can be used as two or three position by installing switch legend plates that limit switch travel. Coded screw terminals for the switch contacts are accessible for up to two No. 14 gauge wire connections. See Figure 2.

Installation

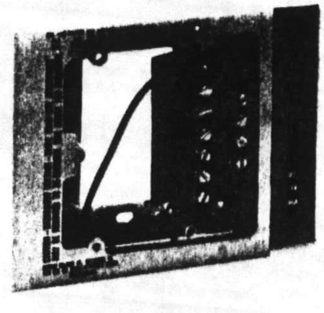
Use Class I wiring for all connections to switch subbases and to room thermostat unless all circuits are powered from a Class II source. Make all connections in accordance with national and local codes.

Install subbases on a flush switch box, a surface switch box or directly on a wall (for 24V applications only).

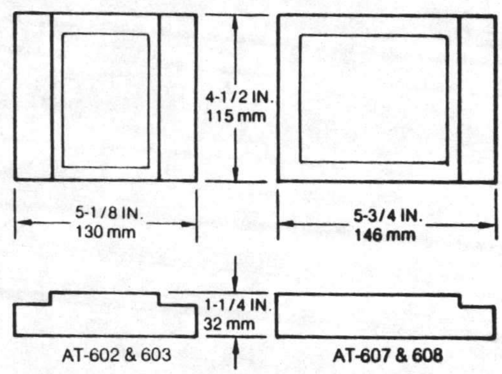
1. Pull the required wires.
2. If plastic conduit box is used, connect green wire from subbase to system ground, otherwise clip out the green wire.
3. Mount the subbase (see Figure 1). Screws are provided for switch box mounting.
4. Connect proper wires to subbase screw terminals. Push excess wire into conduit box, allowing field wires (if any) for room thermostat to project through opening in subbase.
5. Make all electrical connections to thermostats and install any jumpers as required. Refer to job wiring diagram and/or General Instruction Sheet for thermostat.
6. Install thermostat on subbase (see Figure 1).
7. To install switch legend plate on subbase strip the paper backing off and press plate into subbase. Note: Legend plates must be ordered separately.

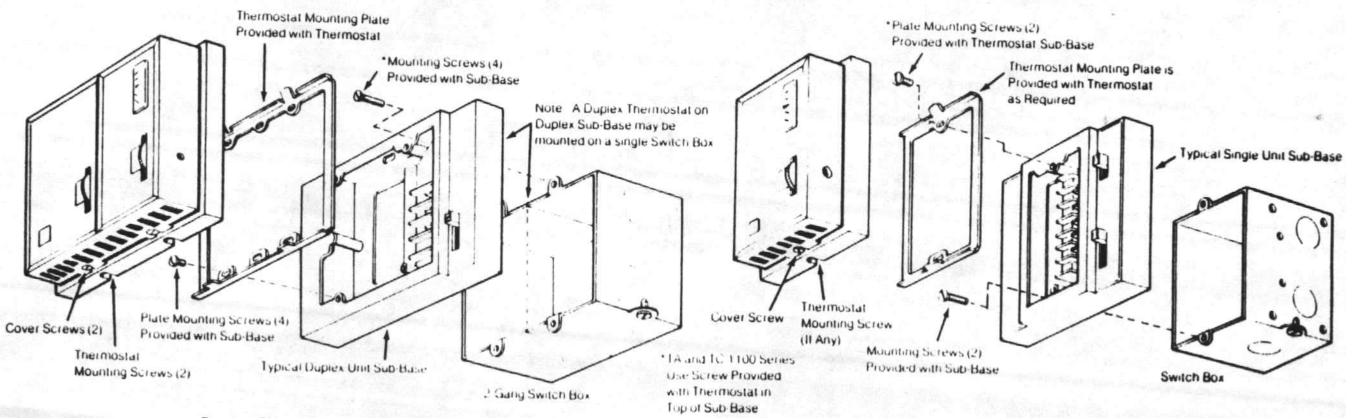


Typical Single Unit Sub-Base



Typical Duplex Unit Sub-base





Duplex Thermostat on Duplex Sub-Base

Single Thermostat on Single Sub-Base

Figure 1

Part Number	Switch Description: Upper Right	Switch Description: Lower Right	Used With
AT-602		DP4T	All Single Room Thermostats Except TK's, TA-115, TA-121, TA-133, TA-134, TC-114, and TC-142.
AT-603	DPDT	DP4T	
AT-607		DP4T	TA-151, 115X, TC-154, 114X, 115X, 116X, 2-Stage and Duplex Thermostats.
AT-608	DPDT	DP4T	

Total Electrical Rating of Each Sub-Base Switch*

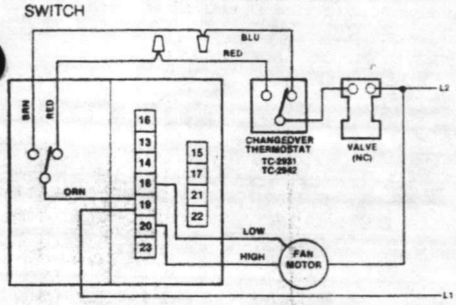
Volts (AC)	Inductive: Full Load Amps	Inductive: Locked Rotor Amps	Non-Inductive Amps	Pilot Duty (VA)
24	5.8	34.8	6	125
120	5.8	34.8	6	125
240	2.9	17.4	3	125

*The total load on both poles of a switch must not exceed the total electrical rating.

LITHO IN U.S.A. 2-84

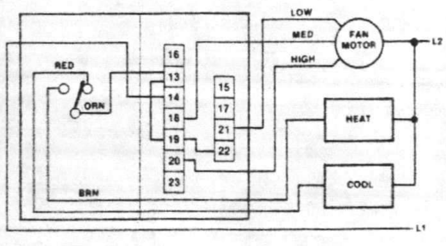
TYPICAL APPLICATIONS

THERMOSTAT CYCLES VALVE, SUMMER/WINTER CHANGEOVER THERMOSTAT, OFF-LOW-HIGH FAN SWITCH



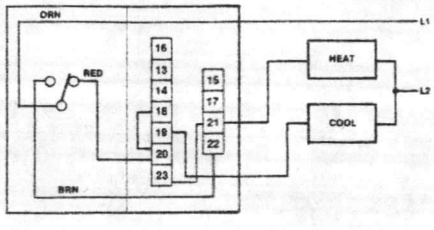
ITEMS: TC-1101, AT-602, AT-609-302

THERMOSTAT PROVIDES SEQUENCED HEAT & COOL, ON-OFF SWITCH, OFF LOCKS OFF SYSTEM & FAN, LOW-MED-HIGH FAN SWITCH



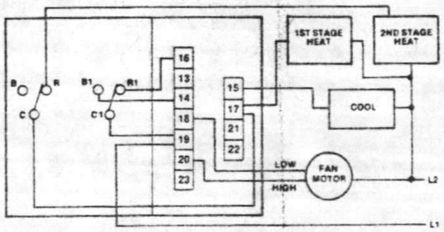
ITEMS: TC-1191; AT-603; AT-609-353

THERMOSTAT PROVIDES SEQUENCED HEAT & COOL OFF-HEAT-AUTO-COOL SWITCH



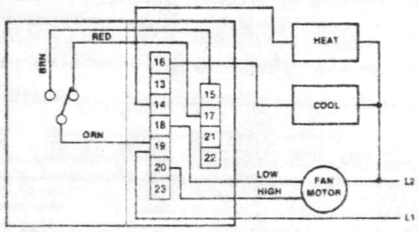
ITEMS: TC-1191, AT-602, AT-609-402

THERMOSTAT CYCLES 2 STAGES HEAT AND 1 STAGE COOL, HEAT-COOL SWITCH, OFF-LOW-HIGH FAN SWITCH



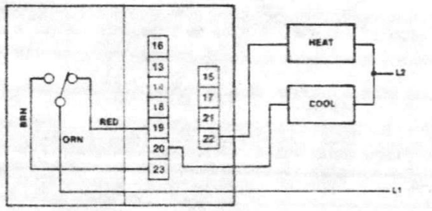
ITEMS: TC-154, AT-608, AT-609-352

THERMOSTAT CYCLES HEAT & COOL, HEAT-COOL SWITCH, OFF-LOW-HIGH FAN SWITCH



ITEMS: TC-1101; AT-603; AT-609-352

THERMOSTAT CYCLES HEAT AND COOL, HEAT-COOL SYSTEM SWITCH



ITEMS: TC-1101, AT-602, AT-609-204

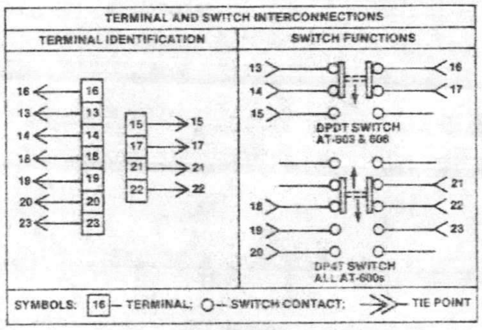


Figure 2

AT-609-XXX
Legend Plates for Switch Sub-Bases

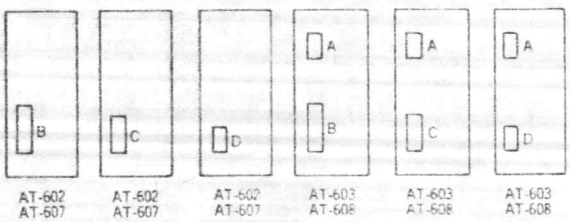
Various switch indicating plates are available and must be ordered separately. These have a brown simulated leather finish with bright letters and pressure sensitive backing for simplified field installation. Blank plate on left side of AT-602 & 603 is factory installed.

AT-609-XXX SWITCH LEGEND PLATES

Switch Position	Switch Action	Blank Plates*						Plates With Legends																		
		201	301	401	250	350	450	202	203	204	205	206	251	252	253†	302	303	305	306	307	351	352	353	402	403	452
A	DPDT												On Off	On Off	On Auto						On Auto Fan	Heat Cool	On Off			On Auto Fan
B	DP4T																							Off Heat Auto Cool	Off Low Med High	Off Heat Auto Cool
C	** DP3T															Off Low High	Heat Off Cool	Occu Off Unoccu	Night Off Day	Off On Auto	Heat Off Cool	Off Low High	Low Med High			
D	** DPDT							On Off	Occu Unoccu	Heat Cool	Night Day	Auto On	Low High	High Low	High Low											

*Special lettering can usually be provided by local nameplate engravers.
**Legend Plate limits travel of DP4T Switch to provide DPDT or DP3T.
†"Fan Operation" legend placed between switches.

SWITCH POSITIONS



Barber-Colman Company
ENVIRONMENTAL CONTROLS DIVISION

1354 Clifford Avenue
P.O. Box 2940
Loves Park, IL U.S.A. 61132-2940

F-16059-3 BK

LITHO IN U.S.A.

AS-502

TEMPERATURE CONTROL SUBMITTAL

JOB: REPLACE AIR CONDITIONING UNITS VARIOUS BUILDINGS
MARINE CORPS AIR STATION, NEW RIVER, N.C.
CONTRACT # N62470-86-B-5548

ARCHITECT:

ENGINEER: CHEATHAM AND ASSOCIATES

CONTRACTOR: HUMPHREY HEATING AND ROOFING

Submitted by:

TRIANGLE AUTOMATED CONTROLS, INC.
2716 Discovery Drive
Raleigh, North Carolina 27612
(919)878-8015

Sequence of Operation

8.1.1 Building AS-202: When the temperature rises above the setting of the cooling thermostat with the fan selector switch in "AUTO" position, the compressor and the fan shall be energized together. When the fan selector switch is in the "ON" position, the compressor shall cycle and the fan shall run continuously.

8.1.2 Building AS-205: When the thermostat is in the "COOL" position and the fan selector switch is in the "AUTO" position the compressors shall be energized on a temperature rise by two cooling stages of the thermostat and the fan shall cycle with the compressors. When the fan selector switch is in the "ON" position, the fan shall run continuously. When the thermostat is in the "HEAT" position the three way hot water control valve shall modulate hot water from full coil by-pass to full flow through the coil as the space temperature falls. The fan shall run continuously during the heating modes.

8.1.2.1 Converter Controls: A 2 input controller with one sensing element in the outside air and one sensing element in the hot water supply shall control a normally closed steam valve. The supply water temperature shall be reset upwards as the O.A. temperature falls. Reset schedule is such that at 20 degrees O.A., H.W.S. is 180 degrees and at 60 degrees O.A., H.W.S. is 100 degrees.

8.1.2.2 Pump Control: When the steam control valve begins to modulate open, the hot water pump shall be energized and shall remain energized until the steam control valve completely closes.

8.1.2.3 A safety low limit thermostat shall deenergize the air handling unit's fan when the mixed air temperature entering the heating coil drops below 35 degrees F.

8.1.3 Building AS-236: When any of the six thermostats are in the "COOL" position and the fan selector switch is in the "AUTO" position, the compressor shall be energized on a temperature rise and the fan shall cycle with the compressor. When the fan selector switch is in the "ON" position, the fan shall run continuously. When the thermostat is in the "HEAT" position the three way hot water control valve shall modulate hot water from full coil by-pass to full flow through the coil as the space temperature falls. The fan shall run continuously during the heating modes.

8.1.3.1 Converter Controls: A 2 input controller with one sensing element in the outside air and one sensing element in the hot water supply shall control a normally closed steam valve. The supply water temperature shall be reset upwards as the O.A. temperature falls. Reset schedule is such that at 20 degrees O.A., H.W.S. is 180 degrees and at 60 degrees O.A., H.W.S. is 100 degrees.

8.1.3.2 Pump Control: When the steam control valve begins to modulate open the hot water pump shall be energized and shall remain energized until the steam control valve completely closes.

8.1.3.3 A safety low limit thermostat shall deenergize the air handling unit fan when the mixed air temperature entering the heating coil drops below 35 degrees F. Not applicable for AHU 3 and 5.

8.1.4 Building AS-502: When the temperature rises above the setting of the cooling thermostat with the fan selector switch in "AUTO" position, the compressor and the fan shall be energized together. When the fan selector switch is in the "ON" position, the compressor shall cycle and the fan shall run continuously.

8.1.5 Building AS-3502: Existing controls shall be reused. An existing high limit pressure selector and pneumatic electric switch shall energize the new condensing unit and provide full cooling. Existing hot water control valve will be reused and connected to new heating coil in air handling unit.

JOB: CONTRACT# n62470-86-B-5548
REPLACE AIR CONDITIONING UNITS
VARIOUS BUILDINGS
MCAS, NEW RIVER, N.C.

EQUIPMENT SCHEDULE

Job #: A-024/J-024

DATE: 1/23/88

QNTY.	IDENTIFIER	PART NUMBER	MANUFACTURER	DESCRIPTION	LOCATION
			BUILDING AS-202		
1	SPACE	TC-1103-500	Barber Colman	Space cooling thermostat,2 pos.	In space
1	SUBBASE	AT-603	Barber Colman	Subbase switch for fan AUTO/ON	At space thermostat
			BUILDING AS-205		
1	TS-1	TS-8501	Barber Colman	O.A. temperature sensor	Element in O.A.
1	TS-2	TS-8201	Barber Colman	H.W.S. temperature sensor	Element in H.W.S.
1		AT-215	Barber Colman	Bulb well	With TS-2
1	RC-1	CP-8102	Barber Colman	2 input reset controller for convertor control	In control panel
1	V-2	VS-9223-201-4-5	Barber Colman	Control valve, 2 way, 3/4", proportional, Cv = 5.0	At steam convertor
1	R-3	RH2B-U24	IDEC	Control relay, DPDT, 24 VAC	In control panel
1	T-2	TP-8102	Barber Colman	Space thermostat, heating,proport.	In space
1	V-1	VS-9313-351-4-10	Barber Colman	Control valve, 3 way, 1 1/2" proportional, Cv = 33	At AHU h.w. coil
1		TC-1152	Barber Colman	Space thermostat, cooling, 2 stage	In space
1		AT-608	Barber Colman	Subbase switch, fan AUTO/ON, HEAT/COOL	At cooling thermostat
1		TC-4111	Barber Colman	Thermostat O.A. limit	Bulb in O.A. duct
2	R-2, R-3	RH2B-U24	IDEC	Control Relay, DPDT, 24 VAC	In control panel
3		SH2B-05	IDEC	Relay base	In control panel

JOB: REPLACE AIR CONDITIONING UNITS
VARIOUS BUILDINGS
MCAS, NEW RIVER, N.C.

EQUIPMENT SCHEDULE

Job #: A-024/J-024

DATE: 1/23/88

QNTY.	IDENTIFIER	PART NUMBER	MANUFACTURER	DESCRIPTION	LOCATION
			BUILDING AS-236		
6	COOLING	TC-1103	Barber Colman	Space thermostat cooling, 2 pos	In space
6	T-2	TP-8102	Barber Colman	Space thermostat, heating, proport.	In space
2	V-3	VS-9313-201-4-4	Barber Colman	Control valve, 3 way, 1/2" proportional, Cv = 4	At AHU 3 & 5
3	V-4	VS-9313-201-4-6	Barber Colman	Control valve, 3 way, 3/4" proportional, Cv = 6.8	At AHU 1,2 &6
1	V-5	VS-9313-351-4-11	Barber Colman	Control valve, 3 way, 2" proportional, Cv = 55	At AHU 4
6		AT-603	Barber Colman	Subbase switch, fan AUTO/ON HEAT/COOL	At cooling thermostat
4	O.A. T'stat	TC-4111	Barber Colman	Thermostat, O.A. limit	Bulb in O.A. duct of AHU 1, 2, 4 & 6
12	R-2, R-3	RH2B-U24	IDEC	Control relay, DPDT, 24 VAC	In control panel
13		SH2B-05	IDEC	Relay base	In control panel
1	V-6	VS-9223-351-4-10	Barber Colman	Control valve, 2 way, 1 1/2" N.C. proportional, Cv = 25	At steam convertor
1	TS-1	TS-8501	Barber Colman	O.A. temperature sensor	Element in O.A.
1	TS-2	TS-8201	Barber Colman	H.W.S temperature sensor	Element in H.W.S
1		AT-215	Barber Colman	Bulb Well	With TS-2

JOB: REPLACE AIR CONDITIONING UNITS
VARIOUS BUILDINGS
MCAS, NEW RIVER, N.C.

EQUIPMENT SCHEDULE

Job #: A-024/J-024

DATE: 1/23/88

QNTY.	IDENTIFIER	PART NUMBER	MANUFACTURER	DESCRIPTION	LOCATION
			AS-236 (cont)		
1	RC-1	CP-8102	Barber Colman	2 input reset controller for steam convertor	In control panel
1	R-3	RH2B-U24	IDEC	Control relay, DPDT, 24VAC	In control panel
1				Control panel, 20" X 16"	In mech. room
			BUILDING AS-502		
1	SPACE	TC-1103-500	Barber Colman	Space thermostat, cooling, 2 pos.	In space
1	SUBBASE	AT-603	Barber Colman	Subbase switch, fan AUTO/ON	At cooling thermostat

para. 2.2.2.9

SPACE, COOLING
General Instructions

BARBER COLMAN COMPANY

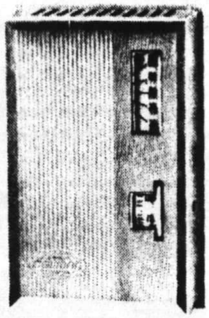
TC-1100 Series, TCR-1101 Two-Position Electric Room Thermostats

APPLICATION

For low or line voltage on-off control of fan coils, fans, motor starters, contactors, two-position electric actuators.

SPECIFICATIONS

Sensing Element: Bimetal.
Differential: 2°F (1°C).
Electrical Switch: Snap action SPDT.
Ratings, See Table 3.
Connections: Color coded 6" (152 mm) leads.
Cover: Beige plastic as standard.
Locations: NEMA Type 1 indoor only.
Mounting: Flush or surface 2 × 4 switch box or directly to wall (24 volt only).
Dimensions: 4-3/8" high × 2-7/8" wide × 1-5/8" deep (111 mm × 73 mm × 41 mm).



UL † CSA †

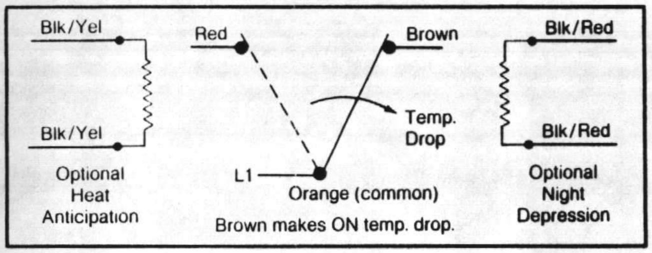
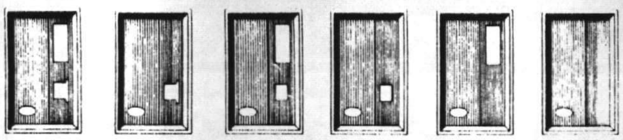


Figure 1. Switch Action and Lead Identification

OPTIONS

Add "dash-number" (-XXX) suffix to base part number for desired option. For metal covers, specify TC2-110X-XXX.

Heat anticipator should be used when system differential varies from specified thermostat differential. Wide system differential may be due to thermostat guards, material on which thermostat is mounted, location of thermostat, etc. For models used in applications requiring series heat anticipators, contact factory.



Standard -400 -401†† -402†† -403†† -404††

-500 parallel heat anticipation 24V standard cover
-501 parallel heat anticipation 120V standard cover
-502 parallel heat anticipation 240V standard cover
-601 10°F night depression 120V standard cover
-602 10°F night depression 24V standard cover
-603 10°F night depression 240V standard cover

††5/64" Allen screw used to secure cover.

ACCESSORIES

AE-170 Series	Electric time clock
AT-101	Lock cover kit
AT-104	Dial stop pins (NOTE: Pins included with each unit.)
AT-136	Title plates (day, night, heat, cool)
AT-504	Plaster hole cover kit (small)
AT-505	Surface mounting base
AT-546	Auxiliary mounting plate
AT-602	Selector switch sub-base DP4T
AT-603	Selector switch sub-base one DP4T, one DPDT
AT-1100 Series	Thermostat guards
TOOL-11	Calibration wrench
TOOL-13	Contact burnishing tool

TABLE 1. SPECIFICATIONS

Part Number	Setpoint Dial Range* °F (°C)	Cover Configurations
TC-1101	55 to 85 (13 to 29)	See Options
TC-1102	45 to 75 (7 to 23)	
TC-1103	75 to 105 (24 to 40)	
TCR-1101	55 to 85 only	One Blank Cover Insert & One Cover Insert with Control Dial Cutout**

*Dual marked (except TCR-1101); dial stop pins included to limit setpoint range.
**One (1) 5/64" Allen head screw and 5/64" Allen wrench for securing cover to thermostat base included along with standard single slotted screw.

TABLE 2. AGENCY APPROVALS†

Configuration	UL	CSA
Metal Case (TC2-110X)	Yes	Yes
Plastic Cover (TC-110X)	Yes	No
Heat Anticipation or Night Depression (-500 or -600 Series)	Yes	Yes

TABLE 3. MAXIMUM ELECTRICAL RATINGS

Full Load Amps		Locked Rotor Amps		Pilot Duty (VA)
24/120 Vac	240 Vac	24/120 Vac	240 Vac	
4.4 Orange to Brown Lead	2.2 Orange to Brown Lead	26.4 Orange to Brown Lead	13.2 Orange to Brown Lead	40 A 24 Vac
3.0 Orange to Red Lead	1.5 Orange to Red Lead	18 Orange to Red Lead	9 Orange to Red Lead	210 @ 120/240 Vac

PRE-INSTALLATION

Inspection

Visually inspect the carton for damage. If damaged, notify the appropriate carrier immediately. If undamaged, open the carton and visually inspect the device for obvious defects. Return damaged or defective products.

Required Installation Items

- Wiring diagrams
- Tools (not provided):
  Volt-ohm meter
  Appropriate screwdriver for mounting screws and terminal connections
- Appropriate accessories
- Mounting screws, two (2) provided for securing to a 2 × 4 conduit box

INSTALLATION

CAUTION

1. Installer must be a qualified, experienced technician.
2. Make all connections in accordance with the wiring diagram, and in accordance with national and local electrical codes. Class I wiring is required unless all circuits to contacts are powered from a Class II source. *Use copper conductors only.*
3. Do not exceed ratings of the device.

Mounting

Thermostats require upright mounting on a properly flat vertical surface. Locate the thermostat where it will be exposed to unrestricted circulation of air which represents the average temperature of the controlled space.

CAUTION

Do not locate the thermostat near sources of heat or cold, such as lamps, motors, sunlight or concealed ducts or pipes, or where there is a danger of electrocution (i.e., shower rooms).

The thermostat is designed for service in any normally encountered human environment. Avoid locations where excessive vibration, moisture, corrosive fumes or vapors are present. NEMA Type 1 covers are intended for indoor use primarily to provide a degree of protection against contact with the enclosed equipment.

Thermostats with guards that restrict air flow must have heating or cooling anticipation.

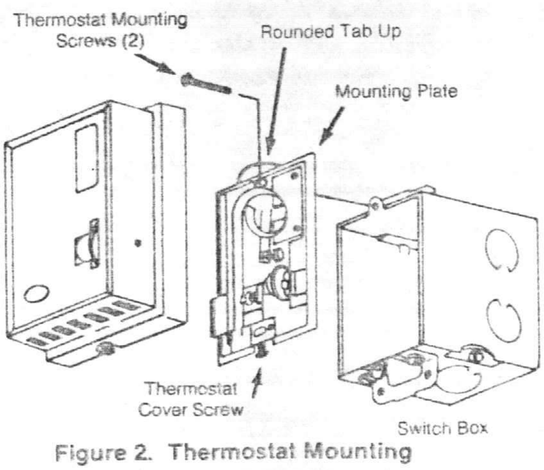


Figure 2. Thermostat Mounting

Procedure

1. Pull all wires.
2. Make electrical connections to thermostat. (Typical heat anticipation and night depression wiring diagrams are shown in Figures 6 through 8.)
3. Remove thermostat cover and fasten thermostat to box or wall.
4. Attach thermostat cover.

CHECKOUT

After installing a thermostat, make an initial check of the switching action. Verify the switch action by listening to and watching the switch contacts or by using a voltmeter between the proper sides of the switch.

1. Run the setpoint dial to a temperature above ambient. This should cause the thermostat to make a circuit between orange and brown leads.
2. Turn the setpoint dial setting down below ambient. This should cause the thermostat to make a circuit between orange and red leads.

CALIBRATION (See Figure 3)

All thermostats are precision calibrated at the factory and normally will not require any further attention. However, if recalibration is necessary, proceed as follows:

1. Turn off control power and power to night depression circuit, where applicable.
2. Set setpoint dial to correspond to actual stable room temperature, as read from an accurate thermometer.
3. Remove thermostat cover. Do not breathe on the thermostat or handle excessively as this will affect the accuracy of the final calibration.
4. If contact blade is made to the left (red) contact, with a small screwdriver, turn calibration screw counterclockwise (looking at head of screw) until blade makes to right (brown) contact.

   NOTE

   Each complete turn of screw changes calibration approximately 15°F (8°C).

   Now turn screw very slowly clockwise until blade just makes the left (red) contact. Thermostat is now properly calibrated.

   If contact blade is originally made to the right (brown) contact, turn calibration screw slowly clockwise until element just makes the left (red) contact. Thermostat is now properly calibrated.
5. Replace thermostat cover.
6. Turn on control power.
7. Recheck calibration about 30 minutes later to be sure heat from handling of or breathing on bimetal element did not result in an erroneous setting.

HEAT ANTICIPATION (See Figures 6 and 7)

Heat anticipation, series or parallel, is recommended for:

- Systems with excess heating capacity that can cause objectionable space temperature swings.
- Thermostats mounted on walls (i.e., concrete) that change temperature slowly and/or have insufficient air flow over the device.

COOLING ANTICIPATION (See Figure 8)

Parallel cooling anticipation is recommended for:

- Cooling anticipations where current draw exceeds 1 ampere. Cooling lockout (self heat of the thermostat causing over cooling of the space) can occur on these applications.
- Systems with excess cooling capacity that can cause objectionable space temperature swings.
- Thermostats mounted on walls (i.e., concrete) that change temperature slowly and/or have restricted air flow over the device.

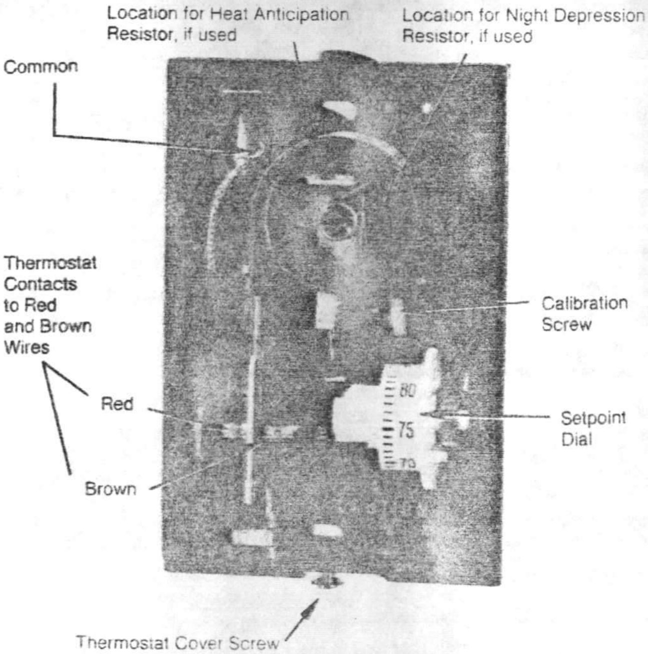


Figure 3.

CONCEALED CONTROL DIAL

Knurled Dial Removal (See Figure 4)

1. Remove thermostat cover.
2. Secure the control dial with hand so that the dial will not rotate.
3. Place needle nose pliers at knurled ring of the control dial at the points where the knurled ring is attached to the control dial.
4. Twist the pliers at each knurled ring attachment point until the entire knurled ring of the control dial is removed.

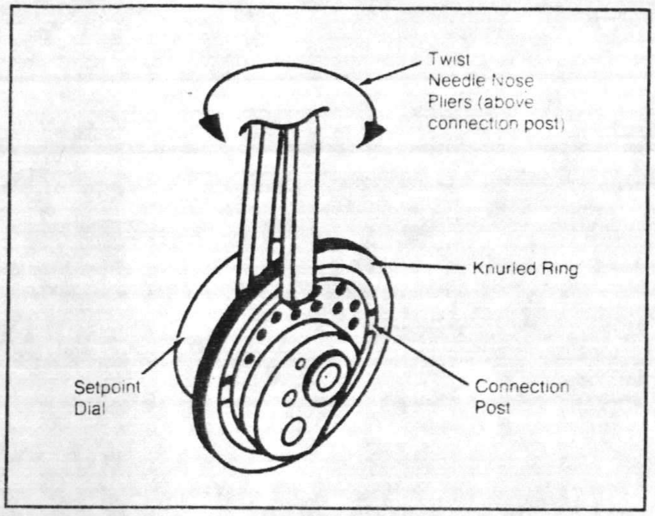


Figure 4. Knurled Dial Removal

LIMIT CONTROL DIAL RANGE

Dial Stop Pin Insertion — Included with Mounting Plate (See Figure 5)

1. Remove thermostat cover.
2. Secure the control dial with hand so that the dial will not rotate.
3. Place a dial stop pin in the jaws of a needle nose pliers.
4. Insert the dial stop pin in the appropriate hole on either (or both) side(s) of the control dial to restrict dial rotation.

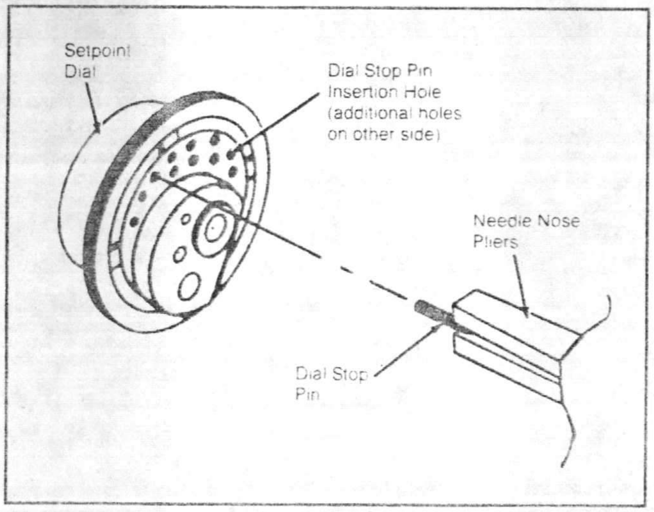


Figure 5. Dial Stop Pin Insertion

MAINTENANCE

Regular maintenance of the total system is recommended to assure sustained optimum performance.

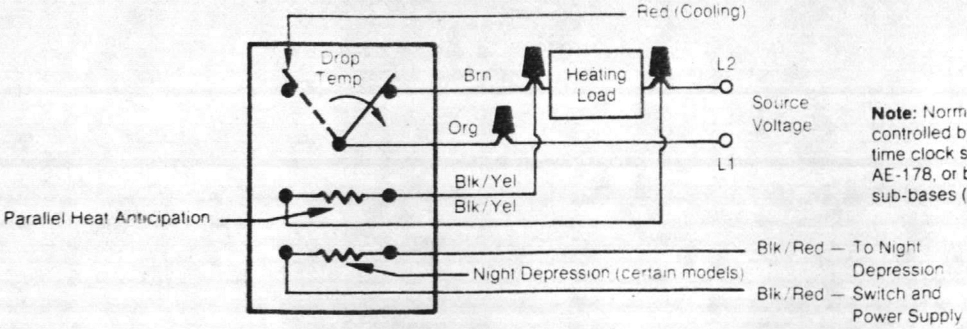
Open areas at bottom and around base of thermostat should be kept clean and free from obstructions to allow proper flow of air. If switch contacts need cleaning, this may be done with TOOL-13 (burnishing tool).

NOTE

Thermostat may require calibration after cleaning the contacts.

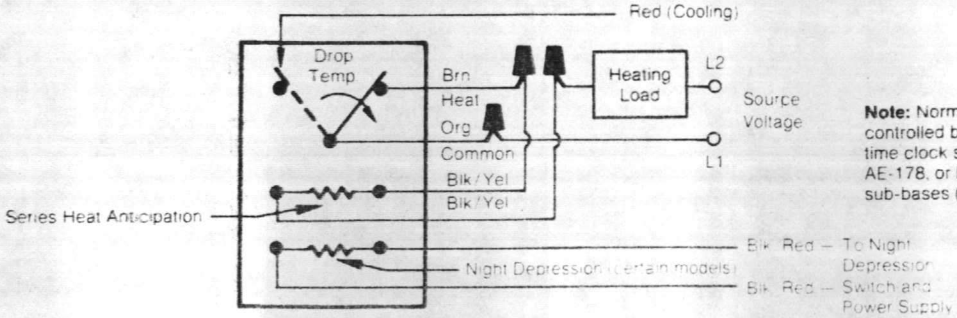
REPAIR

These thermostats are not field repairable. Replace a defective thermostat with a functional unit.



Note: Normally, night depression is controlled by a centrally located time clock such as AE-174 or AE-178, or by selector switch sub-bases (AT-602 or AT-603).

Figure 6. Typical of Parallel Heat Anticipation (heater size determined by voltage) with or without Night Depression



Note: Normally, night depression is controlled by a centrally located time clock such as AE-174 or AE-178, or by selector switch sub-bases (AT-602 or AT-603).

Figure 7. Typical of Series Heat Anticipation (heater size determined by ampere rating of load) with or without Night Depression

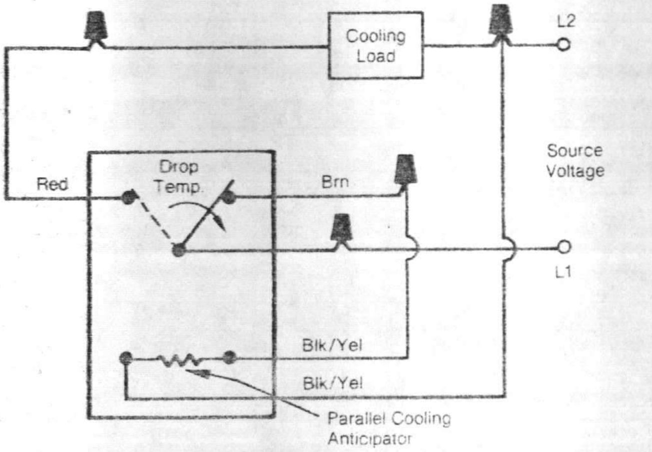
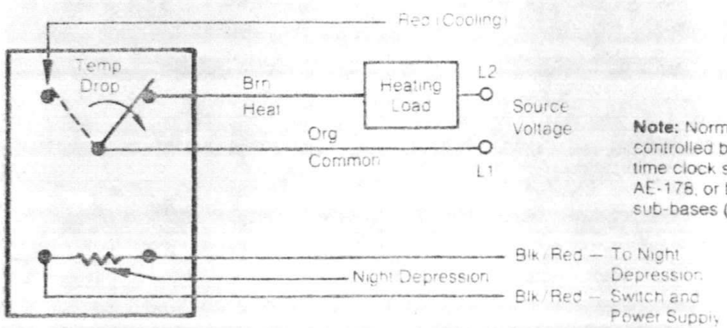


Figure 8. Typical of Parallel Cooling Anticipation (anticipator size determined by voltage)



Note: Normally, night depression is controlled by a centrally located time clock such as AE-174 or AE-178, or by selector switch sub-bases (AT-602 or AT-603).

Figure 9. Typical Night Depression

Barber-Colman Company
ENVIRONMENTAL CONTROLS DIVISION

1354 Clifford Avenue
P.O. Box 2940
Loves Park, IL U.S.A. 61132-2940

LITHO IN U.S.A.

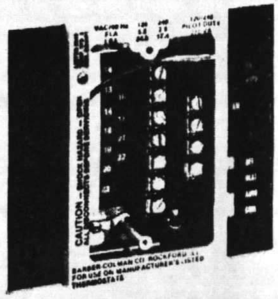
Para. 2.2.2.9

BARBER COLMAN COMPANY

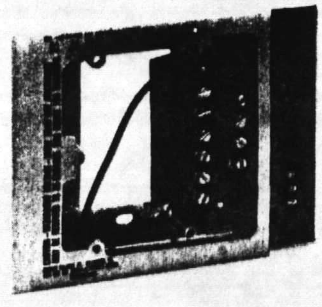
General Instructions

AT-602, 603, 607, 608 & 609-XXX Selector Switch Sub-Bases and Legend Plates

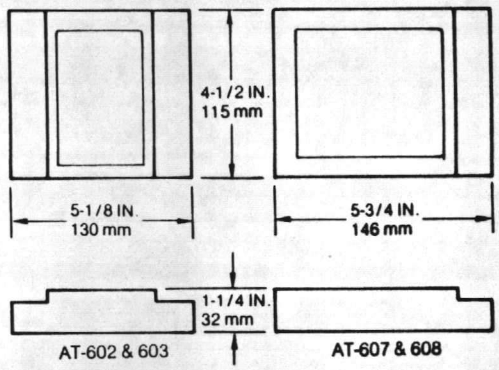
For use at the room thermostat to accommodate switching functions such as heating to cooling, day to night control, etc. **Device:** Rugged one piece molded beige plastic housing. One or two slide switches are double-pole, double throw (DPDT) or double pole-4 position (DP4T) allowing numerous control possibilities. DP4T can be used as two or three position by installing switch legend plates that limit switch travel. Coded screw terminals for the switch contacts are accessible for up to two No. 14 gauge wire connections. See Figure 2.



UL **Typical Single Unit Sub-Base**



UL **Typical Duplex Unit Sub-base**

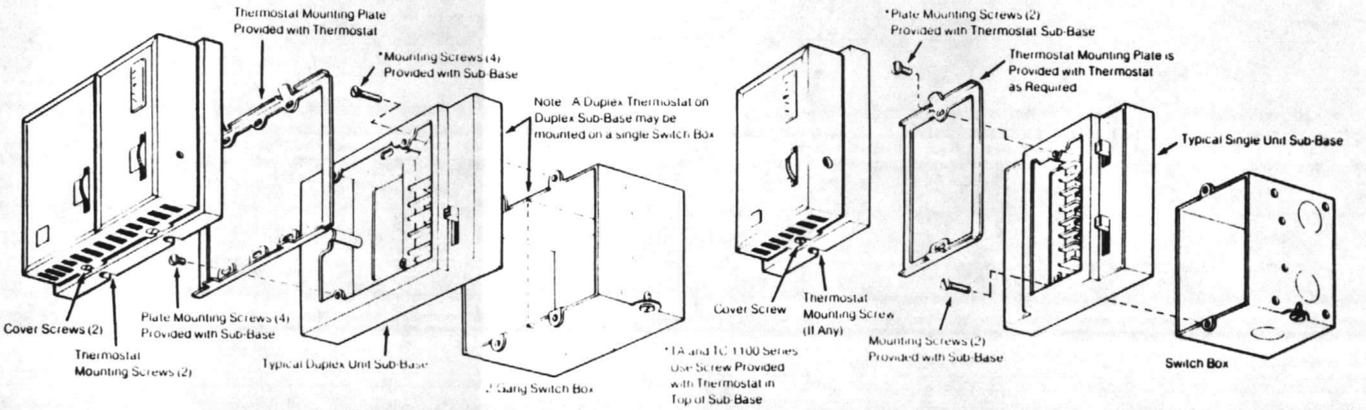


Installation

Use Class I wiring for all connections to switch subbases and to room thermostat unless all circuits are powered from a Class II source. Make all connections in accordance with national and local codes.

Install subbases on a flush switch box, a surface switch box or directly on a wall (for 24V applications only).

1. Pull the required wires.
2. If plastic conduit box is used, connect green wire from subbase to system ground, otherwise clip out the green wire.
3. Mount the subbase (see Figure 1). Screws are provided for switch box mounting.
4. Connect proper wires to subbase screw terminals. Push excess wire into conduit box, allowing field wires (if any) for room thermostat to project through opening in subbase.
5. Make all electrical connections to thermostats and install any jumpers as required. Refer to job wiring diagram and/or General Instruction Sheet for thermostat.
6. Install thermostat on subbase (see Figure 1).
7. To install switch legend plate on subbase strip the paper backing off and press plate into subbase. Note: Legend plates must be ordered separately.



Duplex Thermostat on Duplex Sub-Base **Single Thermostat on Single Sub-Base**

Figure 1

Part Number	Switch Description: Upper Right	Switch Description: Lower Right	Used With
AT-602		DP4T	All Single Room Thermostats Except TK's, TA-115, TA-121, TA-133, TA-134, TC-114, and TC-142.
AT-603	DPDT	DP4T	
AT-607		DP4T	TA-151, 115X, TC-154, 114X, 115X, 116X, 2-Stage and Duplex Thermostats.
AT-608	DPDT	DP4T	

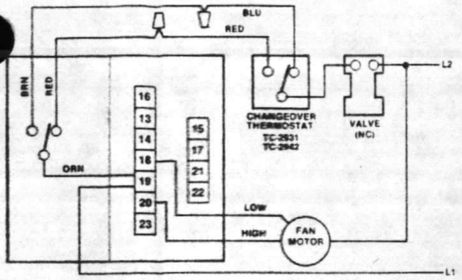
Total Electrical Rating of Each Sub-Base Switch*

Volts (AC)	Inductive: Full Load Amps	Inductive: Locked Rotor Amps	Non-Inductive Amps	Pilot Duty (VA)
24	5.8	34.8	6	125
120	5.8	34.8	6	125
240	2.9	17.4	3	125

*The total load on both poles of a switch must not exceed the total electrical rating.

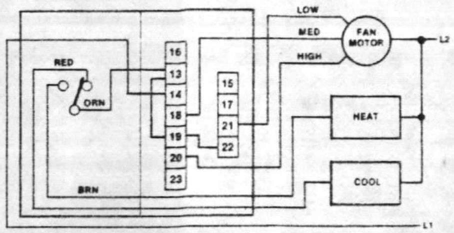
TYPICAL APPLICATIONS

THERMOSTAT CYCLES VALVE, SUMMER/WINTER CHANGEOVER THERMOSTAT, OFF-LOW-HIGH FAN SWITCH



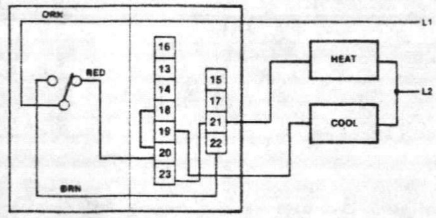
ITEMS: TC-1101, AT-602, AT-609-302

THERMOSTAT PROVIDES SEQUENCED HEAT & COOL, ON-OFF SWITCH, OFF LOCKS OFF SYSTEM & FAN, LOW-MED-HIGH FAN SWITCH



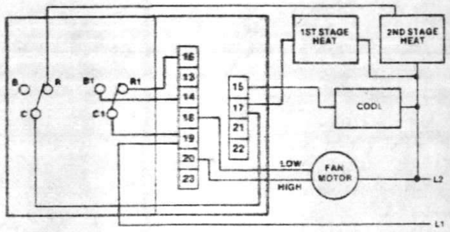
ITEMS: TC-1191; AT-603, AT-609-353

THERMOSTAT PROVIDES SEQUENCED HEAT & COOL OFF-HEAT-AUTO-COOL SWITCH



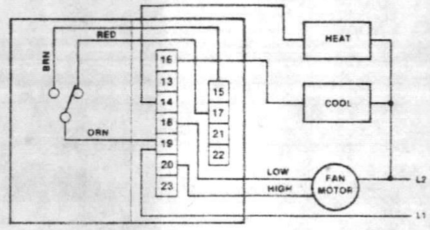
ITEMS: TC-1191, AT-602, AT-609-402

THERMOSTAT CYCLES 2 STAGES HEAT AND 1 STAGE COOL, HEAT-COOL SWITCH, OFF-LOW-HIGH FAN SWITCH



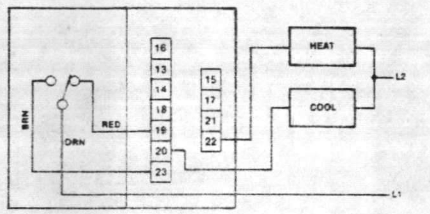
ITEMS: TC-154, AT-608, AT-609-352

THERMOSTAT CYCLES HEAT & COOL, HEAT-COOL SWITCH, OFF-LOW-HIGH FAN SWITCH



ITEMS: TC-1101; AT-603, AT-609-352

THERMOSTAT CYCLES HEAT AND COOL, HEAT-COOL SYSTEM SWITCH



ITEMS: TC-1101, AT-602, AT-609-204

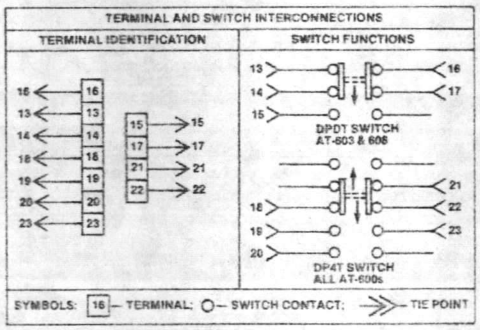


Figure 2

AT-609-XXX
Legend Plates for Switch Sub-Bases

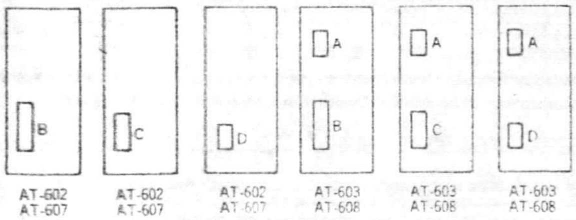
Various switch indicating plates are available and must be ordered separately. These have a brown simulated leather finish with bright letters and pressure sensitive backing for simplified field installation. Blank plate on left side of AT-602 & 603 is factory installed.

AT-609-XXX SWITCH LEGEND PLATES

Switch Position	Switch Action	Blank Plates*						Plates With Legends																		
		201	301	401	250	350	450	202	203	204	205	206	251	252	253†	302	303	305	306	307	351	352	353	402	403	452
A	DPDT												On Off	On Off	On Auto						On Auto Fan	Heat Cool	On Off			On Auto Fan
B	DP4T																							Off Heat Auto Cool	Off Low Med High	Off Heat Auto Cool
C	** DP3T															Off Low High	Heat Off Cool	Occu Off Unoccu	Night Off Day	Off On Auto	Heat Off Cool	Off Low High	Low Med High			
D	** DPDT							On Off	Occu Unoccu	Heat Cool	Night Day	Auto On	Low High	High Low	High Low											

*Special lettering can usually be provided by local nameplate engravers.
**Legend Plate limits travel of DP4T Switch to provide DPDT or DP3T.
†"Fan Operation" legend placed between switches.

SWITCH POSITIONS



Barber-Colman Company
ENVIRONMENTAL CONTROLS DIVISION

1354 Clifford Avenue
P.O. Box 2940
Loves Park, IL U.S.A. 61132-2940

LITHO IN U.S.A.

AS-236

TEMPERATURE CONTROL SUBMITTAL

JOB: REPLACE AIR CONDITIONING UNITS VARIOUS BUILDINGS
MARINE CORPS AIR STATION, NEW RIVER, N.C.
CONTRACT # N62470-86-B-5548

ARCHITECT:

ENGINEER: CHEATHAM AND ASSOCIATES

CONTRACTOR: HUMPHREY HEATING AND ROOFING

Submitted by:

TRIANGLE AUTOMATED CONTROLS, INC.
2716 Discovery Drive
Raleigh, North Carolina 27612
(919)878-8015

1/22/88

Sequence of Operation

8.1.1 Building AS-202: When the temperature rises above the setting of the cooling thermostat with the fan selector switch in "AUTO" position, the compressor and the fan shall be energized together. When the fan selector switch is in the "ON" position, the compressor shall cycle and the fan shall run continuously.

8.1.2 Building AS-205: When the thermostat is in the "COOL" position and the fan selector switch is in the "AUTO" position the compressors shall be energized on a temperature rise by two cooling stages of the thermostat and the fan shall cycle with the compressors. When the fan selector switch is in the "ON" position, the fan shall run continuously. When the thermostat is in the "HEAT" position the three way hot water control valve shall modulate hot water from full coil by-pass to full flow through the coil as the space temperature falls. The fan shall run continuously during the heating modes.

8.1.2.1 Converter Controls: A 2 input controller with one sensing element in the outside air and one sensing element in the hot water supply shall control a normally closed steam valve. The supply water temperature shall be reset upwards as the O.A. temperature falls. Reset schedule is such that at 20 degrees O.A., H.W.S. is 180 degrees and at 60 degrees O.A., H.W.S. is 100 degrees.

8.1.2.2 Pump Control: When the steam control valve begins to modulate open, the hot water pump shall be energized and shall remain energized until the steam control valve completely closes.

8.1.2.3 A safety low limit thermostat shall deenergize the air handling unit's fan when the mixed air temperature entering the heating coil drops below 35 degrees F.

8.1.3 Building AS-236: When any of the six thermostats are in the "COOL" position and the fan selector switch is in the "AUTO" position, the compressor shall be energized on a temperature rise and the fan shall cycle with the compressor. When the fan selector switch is in the "ON" position, the fan shall run continuously. When the thermostat is in the "HEAT" position the three way hot water control valve shall modulate hot water from full coil by-pass to full flow through the coil as the space temperature falls. The fan shall run continuously during the heating modes.

8.1.3.1 Converter Controls: A 2 input controller with one sensing element in the outside air and one sensing element in the hot water supply shall control a normally closed steam valve. The supply water temperature shall be reset upwards as the O.A. temperature falls. Reset schedule is such that at 20 degrees O.A., H.W.S. is 180 degrees and at 60 degrees O.A., H.W.S. is 100 degrees.

8.1.3.2 Pump Control: When the steam control valve begins to modulate open the hot water pump shall be energized and shall remain energized until the steam control valve completely closes.

8.1.3.3 A safety low limit thermostat shall deenergize the air handling unit fan when the mixed air temperature entering the heating coil drops below 35 degrees F. Not applicable for AHU 3 and 5.

8.1.4 Building AS-502: When the temperature rises above the setting of the cooling thermostat with the fan selector switch in "AUTO" position, the compressor and the fan shall be energized together. When the fan selector switch is in the "ON" position, the compressor shall cycle and the fan shall run continuously.

8.1.5 Building AS-3502: Existing controls shall be reused. An existing high limit pressure selector and pneumatic electric switch shall energize the new condensing unit and provide full cooling. Existing hot water control valve will be reused and connected to new heating coil in air handling unit.

JOB: CONTRACT# n62470-86-B-5548
REPLACE AIR CONDITIONING UNITS
VARIOUS BUILDINGS
MCAS, NEW RIVER, N.C.

EQUIPMENT SCHEDULE

Job #: A-024/J-024

DATE: 1/23/88

QNTY.	IDENTIFIER	PART NUMBER	MANUFACTURER	DESCRIPTION	LOCATION
			BUILDING AS-202		
1	SPACE	TC-1103-500	Barber Colman	Space cooling thermostat,2 pos.	In space
1	SUBBASE	AT-603	Barber Colman	Subbase switch for fan AUTO/ON	At space thermostat
			BUILDING AS-205		
1	TS-1	TS-8501	Barber Colman	O.A. temperature sensor	Element in O.A.
1	TS-2	TS-8201	Barber Colman	H.W.S. temperature sensor	Element in H.W.S.
1		AT-215	Barber Colman	Bulb well	With TS-2
1	RC-1	CP-8102	Barber Colman	2 input reset controller for convertor control	In control panel
1	V-2	VS-9223-201-4-5	Barber Colman	Control valve, 2 way, 3/4", proportional, Cv = 5.0	At steam convertor
1	R-3	RH2B-U24	IDEC	Control relay, DPDT, 24 VAC	In control panel
1	T-2	TP-8102	Barber Colman	Space thermostat, heating,proport.	In space
1	V-1	VS-9313-351-4-10	Barber Colman	Control valve, 3 way, 1 1/2" proportional, Cv = 33	At AHU h.w. coil
1		TC-1152	Barber Colman	Space thermostat, cooling, 2 stage	In space
1		AT-608	Barber Colman	Subbase switch, fan AUTO/ON, HEAT/COOL	At cooling thermostat
1		TC-4111	Barber Colman	Thermostat O.A. limit	Bulb in O.A. duct
2	R-2, R-3	RH2B-U24	IDEC	Control Relay, DPDT, 24 VAC	In control panel
3		SH2B-05	IDEC	Relay base	In control panel

JOB: REPLACE AIR CONDITIONING UNITS
VARIOUS BUILDINGS
MCAS, NEW RIVER, N.C.

EQUIPMENT SCHEDULE

Job #: A-024/J-024

DATE: 1/23/88

QNTY.	IDENTIFIER	PART NUMBER	MANUFACTURER	DESCRIPTION	LOCATION
			BUILDING AS-236		
6	COOLING	TC-1103	Barber Colman	Space thermostat cooling, 2 pos	In space
6	T-2	TP-8102	Barber Colman	Space thermostat, heating, proport.	In space
2	V-3	VS-9313-201-4-4	Barber Colman	Control valve, 3 way, 1/2" proportional, Cv = 4	At AHU 3 & 5
3	V-4	VS-9313-201-4-6	Barber Colman	Control valve, 3 way, 3/4" proportional, Cv = 6.8	At AHU 1,2 &6
1	V-5	VS-9313-351-4-11	Barber Colman	Control valve, 3 way, 2" proportional, Cv = 55	At AHU 4
6		AT-603	Barber Colman	Subbase switch, fan AUTO/ON HEAT/COOL	At cooling thermostat
4	O.A. T'stat	TC-4111	Barber Colman	Thermostat, O.A. limit	Bulb in O.A. duct of AHU 1, 2, 4 & 6
12	R-2, R-3	RH2B-U24	IDEC	Control relay, DPDT, 24 VAC	In control panel
13		SH2B-05	IDEC	Relay base	In control panel
1	V-6	VS-9223-351-4-10	Barber Colman	Control valve, 2 way, 1 1/2" N.C. proportional, Cv = 25	At steam convertor
1	TS-1	TS-8501	Barber Colman	O.A. temperature sensor	Element in O.A.
1	TS-2	TS-8201	Barber Colman	H.W.S temperature sensor	Element in H.W.S
1		AT-215	Barber Colman	Bulb Well	With TS-2

JOB: REPLACE AIR CONDITIONING UNITS
VARIOUS BUILDINGS
MCAS, NEW RIVER, N.C.

EQUIPMENT SCHEDULE

Job #: A-024/J-024

DATE: 1/23/88

QNTY.	IDENTIFIER	PART NUMBER	MANUFACTURER	DESCRIPTION	LOCATION
			AS-236 (cont)		
1	RC-1	CP-8102	Barber Colman	2 input reset controller for steam convertor	In control panel
1	R-3	RH2B-U24	IDEC	Control relay, DPDT, 24VAC	In control panel
1				Control panel, 20" X 16"	In mech. room
			BUILDING AS-502		
1	SPACE	TC-1103-500	Barber Colman	Space thermostat, cooling, 2 pos.	In space
1	SUBBASE	AT-603	Barber Colman	Subbase switch, fan AUTO/ON	At cooling thermostat

para. 2.2.2.9

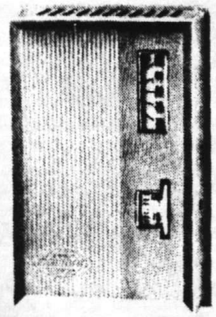
BARBER COLMAN COMPANY

SPACE, COOLING
General Instructions

TC-1100 Series, TCR-1101 Two-Position Electric Room Thermostats

APPLICATION

For low or line voltage on-off control of fan coils, fans, motor starters, contactors, two-position electric actuators.



SPECIFICATIONS

Sensing Element: Bimetal.
Differential: 2°F (1°C).
Electrical Switch: Snap action SPDT.
Ratings, See Table 3.
Connections: Color coded 6" (152 mm) leads.
Cover: Beige plastic as standard.
Locations: NEMA Type 1 indoor only.
Mounting: Flush or surface 2 × 4 switch box or directly to wall (24 volt only).
Dimensions: 4-3/8" high × 2-7/8" wide × 1-5/8" deep (111 mm × 73 mm × 41 mm).

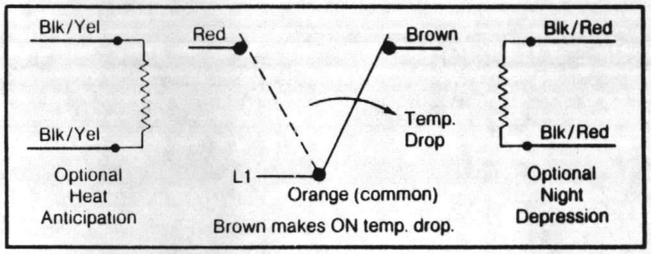
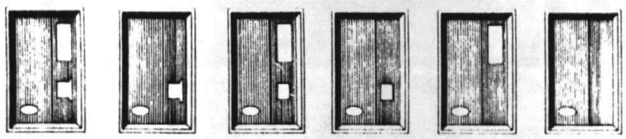


Figure 1. Switch Action and Lead Identification

OPTIONS

Add "dash-number" (-XXX) suffix to base part number for desired option. For metal covers, specify TC2-110X-XXX.

Heat anticipator should be used when system differential varies from specified thermostat differential. Wide system differential may be due to thermostat guards, material on which thermostat is mounted, location of thermostat, etc. For models used in applications requiring series heat anticipators, contact factory.



-500 parallel heat anticipation 24V standard cover
-501 parallel heat anticipation 120V standard cover
-502 parallel heat anticipation 240V standard cover
-601 10°F night depression 120V standard cover
-602 10°F night depression 24V standard cover
-603 10°F night depression 240V standard cover

††5/64" Allen screw used to secure cover.

TABLE 1. SPECIFICATIONS

Part Number	Setpoint Dial Range* °F (°C)	Cover Configurations
TC-1101	55 to 85 (13 to 29)	See Options
TC-1102	45 to 75 (7 to 23)	
TC-1103	75 to 105 (24 to 40)	
TCR-1101	55 to 85 only	One Blank Cover Insert & One Cover Insert with Control Dial Cutout**

*Dual marked (except TCR-1101); dial stop pins included to limit setpoint range.
**One (1) 5/64" Allen head screw and 5/64" Allen wrench for securing cover to thermostat base included along with standard single slotted screw.

TABLE 2. AGENCY APPROVALS†

Configuration	UL	CSA
Metal Case (TC2-110X)	Yes	Yes
Plastic Cover (TC-110X)	Yes	No
Heat Anticipation or Night Depression (-500 or -600 Series)	Yes	Yes

ACCESSORIES

AE-170 Series	Electric time clock
AT-101	Lock cover kit
AT-104	Dial stop pins (NOTE: Pins included with each unit.)
AT-136	Title plates (day, night, heat, cool)
AT-504	Plaster hole cover kit (small)
AT-505	Surface mounting base
AT-546	Auxiliary mounting plate
AT-602	Selector switch sub-base DP4T
AT-603	Selector switch sub-base one DP4T, one DPDT
AT-1100 Series	Thermostat guards
TOOL-11	Calibration wrench
TOOL-13	Contact burnishing tool

TABLE 3. MAXIMUM ELECTRICAL RATINGS

Full Load Amps		Locked Rotor Amps		Pilot Duty (VA)
24/120 Vac	240 Vac	24/120 Vac	240 Vac	
4.4 Orange to Brown Lead	2.2 Orange to Brown Lead	26.4 Orange to Brown Lead	13.2 Orange to Brown Lead	40 A 24 Vac
3.0 Orange to Red Lead	1.5 Orange to Red Lead	18 Orange to Red Lead	9 Orange to Red Lead	210 @ 120/240 Vac

PRE-INSTALLATION

Inspection

Visually inspect the carton for damage. If damaged, notify the appropriate carrier immediately. If undamaged, open the carton and visually inspect the device for obvious defects. Return damaged or defective products.

Required Installation Items

- Wiring diagrams
- Tools (not provided):
  Volt-ohm meter
  Appropriate screwdriver for mounting screws and terminal connections
- Appropriate accessories
- Mounting screws, two (2) provided for securing to a 2 × 4 conduit box

INSTALLATION

CAUTION

1. Installer must be a qualified, experienced technician.
2. Make all connections in accordance with the wiring diagram, and in accordance with national and local electrical codes. Class I wiring is required unless all circuits to contacts are powered from a Class II source. *Use copper conductors only.*
3. Do not exceed ratings of the device.

Mounting

Thermostats require upright mounting on a properly flat vertical surface. Locate the thermostat where it will be exposed to unrestricted circulation of air which represents the average temperature of the controlled space.

CAUTION

Do not locate the thermostat near sources of heat or cold, such as lamps, motors, sunlight or concealed ducts or pipes, or where there is a danger of electrocution (i.e., shower rooms).

The thermostat is designed for service in any normally encountered human environment. Avoid locations where excessive vibration, moisture, corrosive fumes or vapors are present. NEMA Type 1 covers are intended for indoor use primarily to provide a degree of protection against contact with the enclosed equipment.

Thermostats with guards that restrict air flow must have heating or cooling anticipation.

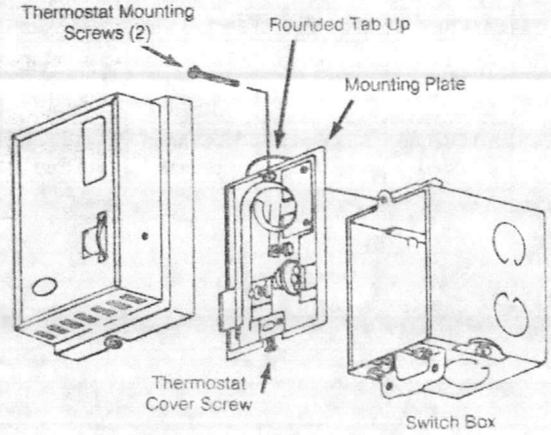


Figure 2. Thermostat Mounting

Procedure

1. Pull all wires.
2. Make electrical connections to thermostat. (Typical heat anticipation and night depression wiring diagrams are shown in Figures 6 through 8.)
3. Remove thermostat cover and fasten thermostat to box or wall.
4. Attach thermostat cover.

CHECKOUT

After installing a thermostat, make an initial check of the switching action. Verify the switch action by listening to and watching the switch contacts or by using a voltmeter between the proper sides of the switch.

1. Run the setpoint dial to a temperature above ambient. This should cause the thermostat to make a circuit between orange and brown leads.
2. Turn the setpoint dial setting down below ambient. This should cause the thermostat to make a circuit between orange and red leads.

CALIBRATION (See Figure 3)

All thermostats are precision calibrated at the factory and normally will not require any further attention. However, if recalibration is necessary, proceed as follows:

1. Turn off control power and power to night depression circuit, where applicable.
2. Set setpoint dial to correspond to actual stable room temperature, as read from an accurate thermometer.
3. Remove thermostat cover. Do not breathe on the thermostat or handle excessively as this will affect the accuracy of the final calibration.
4. If contact blade is made to the left (red) contact, with a small screwdriver, turn calibration screw counterclockwise (looking at head of screw) until blade makes to right (brown) contact.

   NOTE

   Each complete turn of screw changes calibration approximately 15°F (8°C).

   Now turn screw very slowly clockwise until blade just makes the left (red) contact. Thermostat is now properly calibrated.

   If contact blade is originally made to the right (brown) contact, turn calibration screw slowly clockwise until element just makes the left (red) contact. Thermostat is now properly calibrated.
5. Replace thermostat cover.
6. Turn on control power.
7. Recheck calibration about 30 minutes later to be sure heat from handling of or breathing on bimetal element did not result in an erroneous setting.

HEAT ANTICIPATION (See Figures 6 and 7)

Heat anticipation, series or parallel, is recommended for:

- Systems with excess heating capacity that can cause objectionable space temperature swings.
- Thermostats mounted on walls (i.e., concrete) that change temperature slowly and/or have insufficient air flow over the device.

COOLING ANTICIPATION (See Figure 8)

Parallel cooling anticipation is recommended for:

- Cooling anticipations where current draw exceeds 1 ampere. Cooling lockout (self heat of the thermostat causing over cooling of the space) can occur on these applications.
- Systems with excess cooling capacity that can cause objectionable space temperature swings.
- Thermostats mounted on walls (i.e., concrete) that change temperature slowly and/or have restricted air flow over the device.

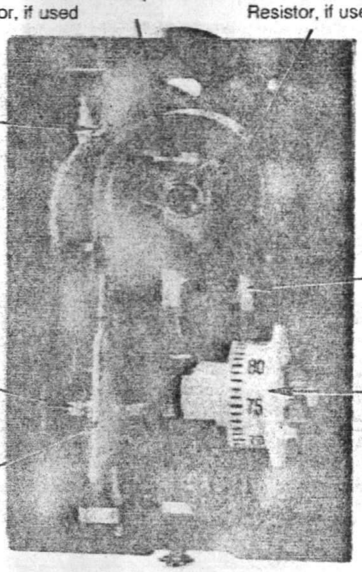


Figure 3.

CONCEALED CONTROL DIAL

Knurled Dial Removal (See Figure 4)

1. Remove thermostat cover.
2. Secure the control dial with hand so that the dial will not rotate.
3. Place needle nose pliers at knurled ring of the control dial at the points where the knurled ring is attached to the control dial.
4. Twist the pliers at each knurled ring attachment point until the entire knurled ring of the control dial is removed.

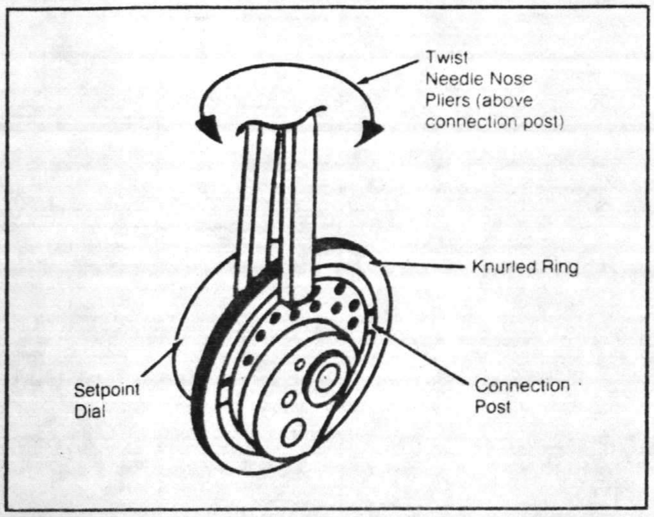


Figure 4. Knurled Dial Removal

LIMIT CONTROL DIAL RANGE

Dial Stop Pin Insertion — Included with Mounting Plate (See Figure 5)

1. Remove thermostat cover.
2. Secure the control dial with hand so that the dial will not rotate.
3. Place a dial stop pin in the jaws of a needle nose pliers.
4. Insert the dial stop pin in the appropriate hole on either (or both) side(s) of the control dial to restrict dial rotation.

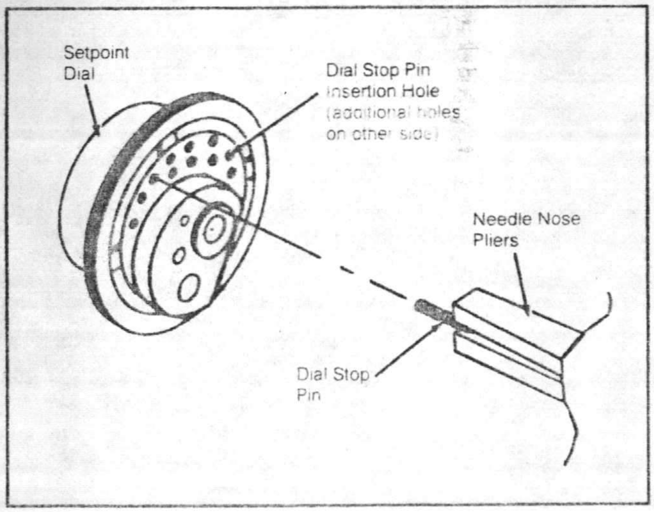


Figure 5. Dial Stop Pin Insertion

MAINTENANCE

Regular maintenance of the total system is recommended to assure sustained optimum performance.

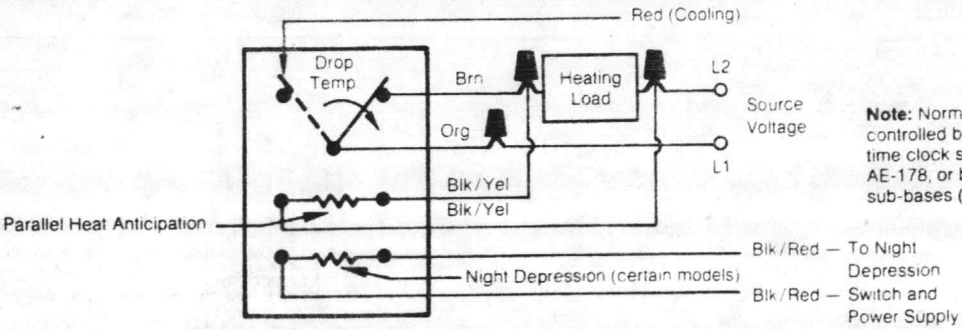
Open areas at bottom and around base of thermostat should be kept clean and free from obstructions to allow proper flow of air. If switch contacts need cleaning, this may be done with TOOL-13 (burnishing tool).

NOTE

Thermostat may require calibration after cleaning the contacts.

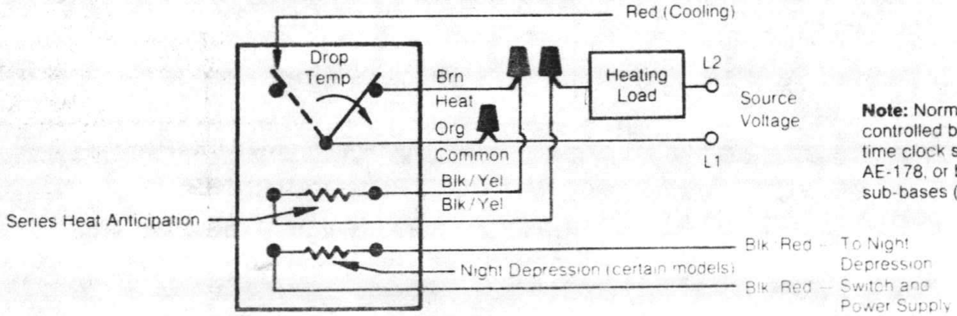
REPAIR

These thermostats are not field repairable. Replace a defective thermostat with a functional unit.



Note: Normally, night depression is controlled by a centrally located time clock such as AE-174 or AE-178, or by selector switch sub-bases (AT-602 or AT-603).

Figure 6. Typical of Parallel Heat Anticipation (heater size determined by voltage) with or without Night Depression



Note: Normally, night depression is controlled by a centrally located time clock such as AE-174 or AE-178, or by selector switch sub-bases (AT-602 or AT-603).

Figure 7. Typical of Series Heat Anticipation (heater size determined by ampere rating of load) with or without Night Depression

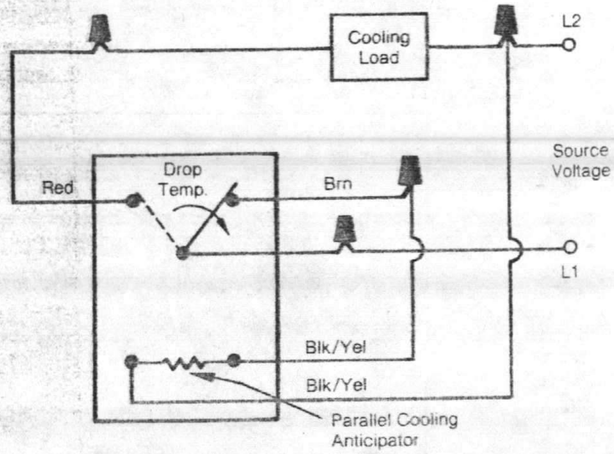
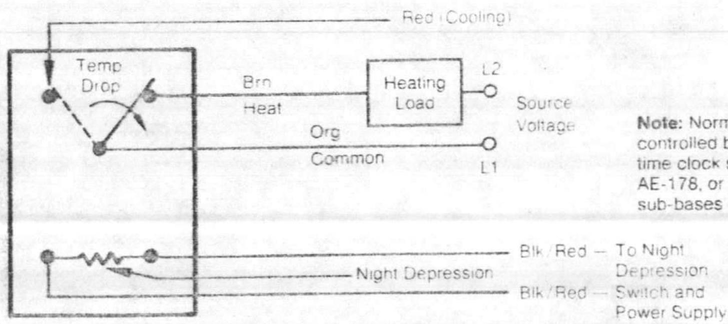


Figure 8. Typical of Parallel Cooling Anticipation (anticipator size determined by voltage)



Note: Normally, night depression is controlled by a centrally located time clock such as AE-174 or AE-178, or by selector switch sub-bases (AT-602 or AT-603).

Figure 9. Typical Night Depression

Barber-Colman Company
ENVIRONMENTAL CONTROLS DIVISION

1354 Clifford Avenue
P.O. Box 2940
Loves Park, IL U.S.A. 61132-2940

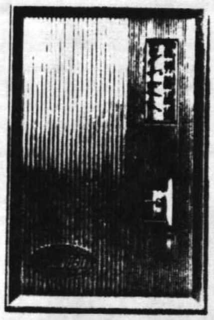
LITHO IN U.S.A.

para. 2.2.2.9 T-2

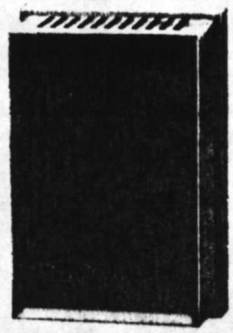
BARBER COLMAN COMPANY

General Instructions

TP-8101, TP-8102, TP-8103, TP-8124, TP-8125 Electronic Thermostats Proportional Controlling



TP-8101, TP-8102, TP-8103 Single Setpoint Adjustment



TP-8124 & TP-8125 Dual Setpoint Adjustment

Table 1

Part Number	Dial Marking	Control Dial Range	Throttling Range for 3 Vdc Output Change	Input Voltage	Output Voltage	Control Action	Wiring Connections	Number of Controlled Devices
TP-8101	°F & °C	55-85°F	2, 3, 6 and 20°F Factory Set 3°F By Jumper/ Pins	20 Vdc 13 mA	2-15 Vdc or 15-2 Vdc	Factory Set Direct-acting Jumper Terminal 4 to 5 For Reverse-acting Jumper Terminal 4 to 3	3 Color-coded Pigtail Leads Terminals for Options See Figure 2	6 System 8000 Devices or 2 MP-5200 Series Actuators
TP-8101-116	°C	13-29°C						
TP-8102	°F & °C	7-24°C (45-75°F)						
TP-8103	°F & °C	24-41°C (75-105°F)						
TP-8124 Dual Setpoints	°F & °C	Heating 7-24°C (45-75°F) Cooling 21-38°C (70-100°F)	Heating and Cooling 2-10°F Independently Adj. Factory Set 3°F	20 Vdc 23 mA	Heat 2-15 Vdc or 15-2 Vdc Cool 2-15 Vdc	Heating Factory Set Reverse-acting Jumper J7 to pin B for Direct-acting Cooling Direct-acting only	Coded Terminals See Figure 3	6 System 8000 Devices or 2 MP-5200 Series Actuators in both Heating and Cooling
TP-8125 Dual Setpoints	°F & °C	Heating 7-24°C (45-75°F) Cooling 24-41°C (75-105°F)						

DESCRIPTION

TP-8101, TP-8102, TP-8103

These self-contained room temperature controllers conserve energy in heating and/or cooling applications requiring a single setpoint adjustment. See Table 1 for particular characteristics.

The heating and cooling equipment is precisely controlled from a single 1000 ohm Balco sensor operating through a single controller for heating and/or cooling. The controller provides a proportional output to control System 8000 controlled devices for control of valves, dampers, electric heat, DX coils, etc.

TP-8124, TP-8125

These self-contained room controllers conserve energy in heating and/or cooling equipment in applications requiring heating and cooling setpoint adjustment.

See Table 1 for particular characteristics.

The heating and cooling equipment is precisely controlled from a single 1000 ohm Balco sensor operating through independent heating and cooling controllers. These controllers provide proportional outputs to control System 8000 controlled devices for control of valves, dampers, electric heat, DX coils, etc. The heating output (OP1 to COM) can be programmed for direct-acting or reverse-acting operation. The cooling output (OP2 to COM) provides a direct-acting output only.

Features

1. TP-8124 meets ASHRAE 90-75 and DOE requirements. TP-8125 meets DOD requirements.
2. Heating and cooling cannot operate simultaneously.
3. Heating/cooling deadband obtained by adjustable dual setpoints and throttling range.
4. Proportional outputs operate remote System 8000 controlled devices such as valves, dampers, electric heat coils, etc.
5. Concealed adjustments eliminate occupant tampering.

INSTALLATION

Open the carton and visually inspect the device for part number and obvious defects before proceeding with the installation.

Mounting screws are provided.

Locate the controller where it will be exposed to unrestricted natural air circulation and to the average conditions of the controlled space. Do not locate it near sources of heat or cold (such as lamps, motors, sunlight, radiators and concealed pipes or ducts within the wall) which might affect the control point. Avoid locations where excessive vibration, moisture, corrosive fumes or vapors are present, or where high radio frequency or electromagnetic generating devices are near.

Dimensions 111 mm (4-3/8") high × 73 mm (2-7/8") wide × 41 mm (1-5/8") deep.

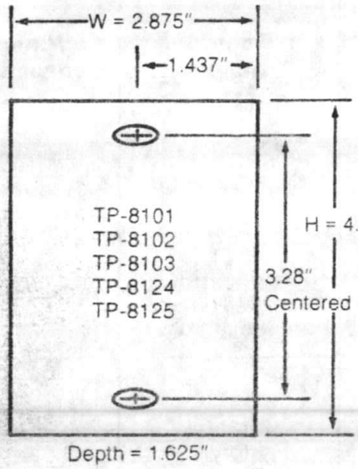


Figure 1

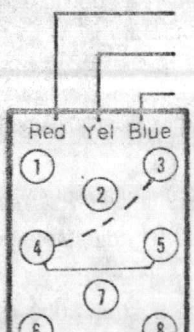
Ambient Limits Operation: 40 to 140°F (4.4 to 60°C). Storage: -40 to 160°F (-40 to 71°C).

MODES OF OPERATION

1. Direct-acting control (DA): Increase in temperature at the sensor causes the controller output signal to increase.
2. Reverse-acting control (RA): Increase in temperature at the sensor causes the controller output signal to decrease.

THROTTLING RANGE

Throttling range (T.R.) is defined as the degrees (°F or °C) change at the temperature sensor in order to cause a 6 to 9 Vdc controller output signal change.



Wire Leads
Red = +20 Vdc (Input)
Yellow = Proportional Output
Blue = Common

Screw Terminals
1 = Common
2 = Auxiliary Input
3,4 = Connect for Reverse-Acting (RA)
4,5 = Connect for Direct-Acting (DA)
7 = 6.2 Vdc
7,8 = Remote Sensor

Figure 2
Terminal Nomenclature
TP-8101, TP-8102 and TP-8103

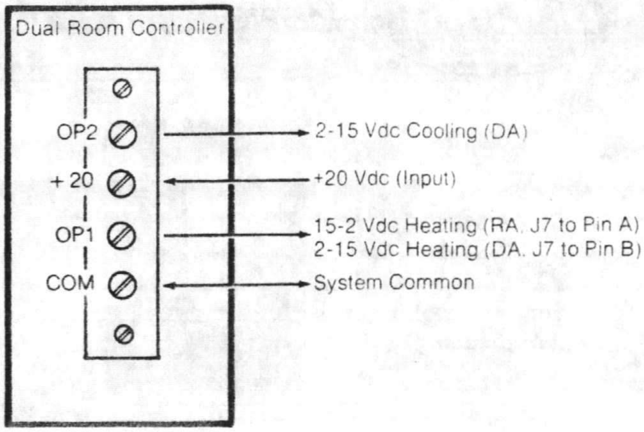


Figure 3
Terminal Nomenclature
TP-8124 and TP-8125

WIRING

Make all electrical connections according to installation wiring diagrams. Comply with national and local electrical codes.

No. 18 multi-conductor thermostat cable may be used. Low voltage Class 2 wire is acceptable, but No. 18 or larger 600V wire should be used if splices are to be made in the same junction box with line voltage wiring.

The controller may be installed on either a 52 mm × 102 mm (2" × 4") flush switch box or a surface switch box. To install, proceed as follows:

1. Wiring for the TP-8101, TP-8102 and TP-8103 is shown in Figures 4 and 5. See Figures 6 and 7 for TP-8124 and TP-8125 typical wiring.
2. "Pull" all wires required.
3. Connect all control wiring to the thermostat.
4. Remove the thermostat cover by loosening the screw at the bottom of the cover. Pull the cover out from the bottom and up to disengage it from the base.
5. Fasten the base to the box with the screws provided.
6. Replace the cover and tighten the cover screw.

WIRING OF CONTROLLED DEVICES TO CONTROLLER

Types of controlled devices and their power supplies:

1. Filtered and regulated power supplies: All System 8000 controlled devices except MP-52XX and MP-54XX series actuators.
2. Filtered and unregulated power supplies: MP-54XX series actuators.
3. Unfiltered and unregulated power supplies: MP-52XX series actuators.

General rules for wiring controllers to controlled devices:

1. Never connect red lead (or +20 terminal) of any controlled device which has a regulated power supply to the red lead (or +20 terminal) of any other controlled device.

2. Controlled devices with unfiltered and unregulated power supplies must be filtered. System 8000 controllers will provide filtering for a maximum of two controlled devices by connecting the two red leads (+20 terminals) together at the controller's red lead (+20 terminal).

3. Controlled devices with filtered and unregulated supplies: Up to six controlled devices with the red leads (+20 terminals) can be connected together. Number of units paralleled depends on the current (mA DC) requirements of the controller or adaptor.

4. Devices and their internal supplies:

FILTERED & REGULATED	FILTERED & UNREGULATED	UNFILTERED & UNREGULATED
CC-8101	MP-54XX Actuators	MP-52XX Actuators
CC-8102		
CC-8103		
CC-8118 Series		
CC-8218 Series		
CC-8111 Series		
CP-8301 Series		
CP-8161 Series		
CP-8425 Series		
CP-8501 Series		
CP-8502 Series		

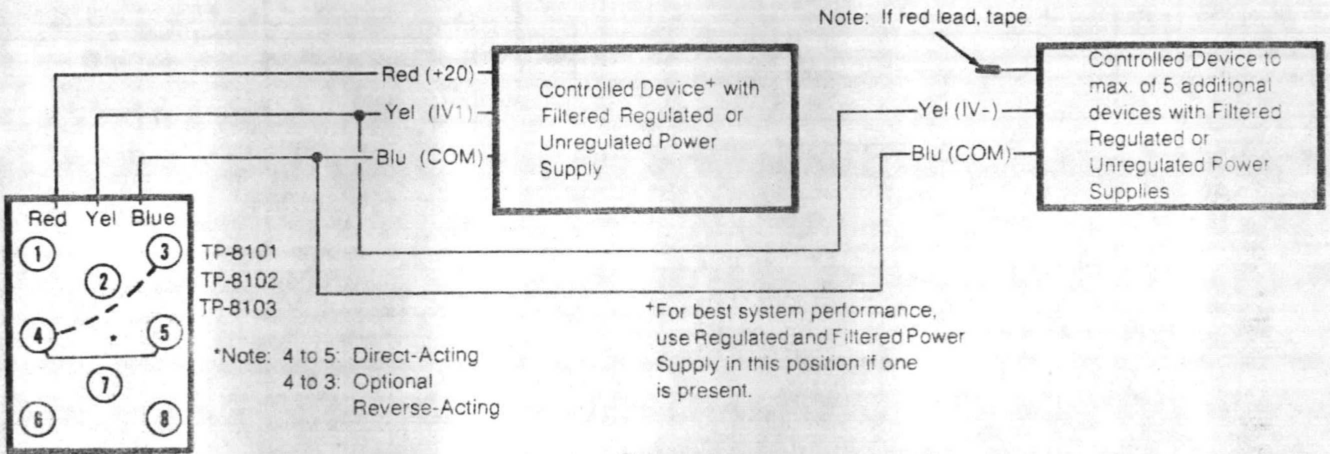


Figure 4
TP-8101, TP-8102 and TP-8103
Typical Wiring *without* MP-52XX Actuators

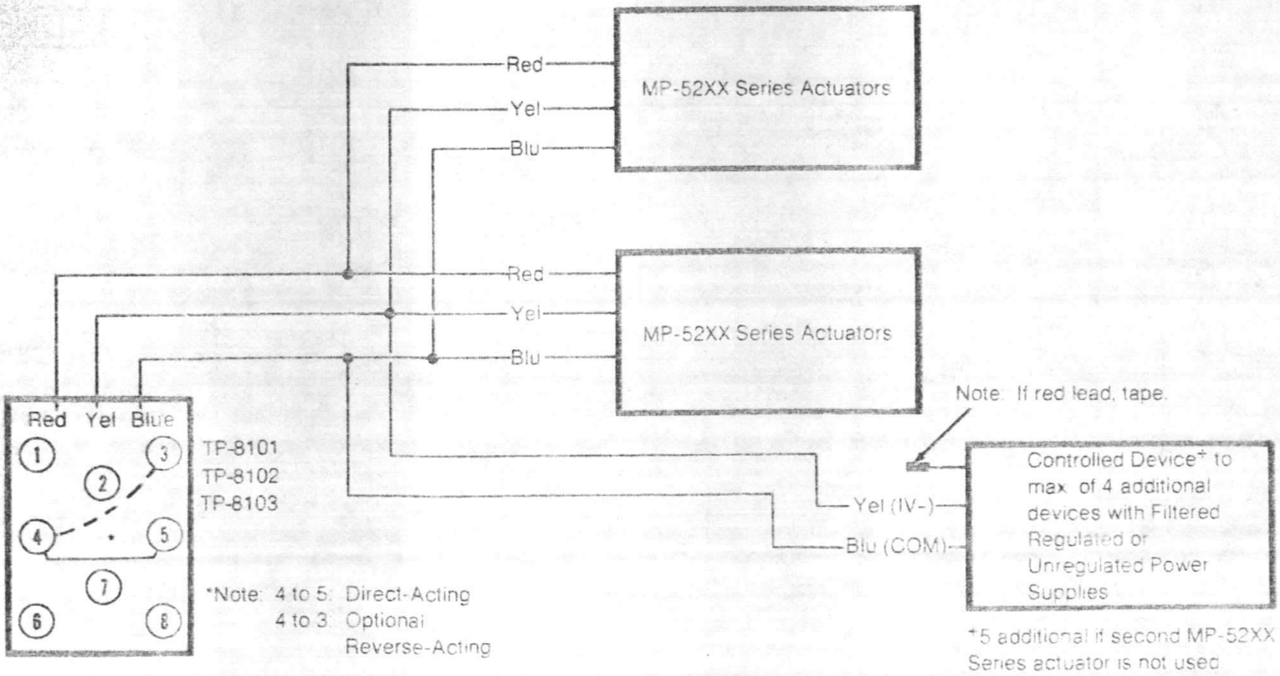
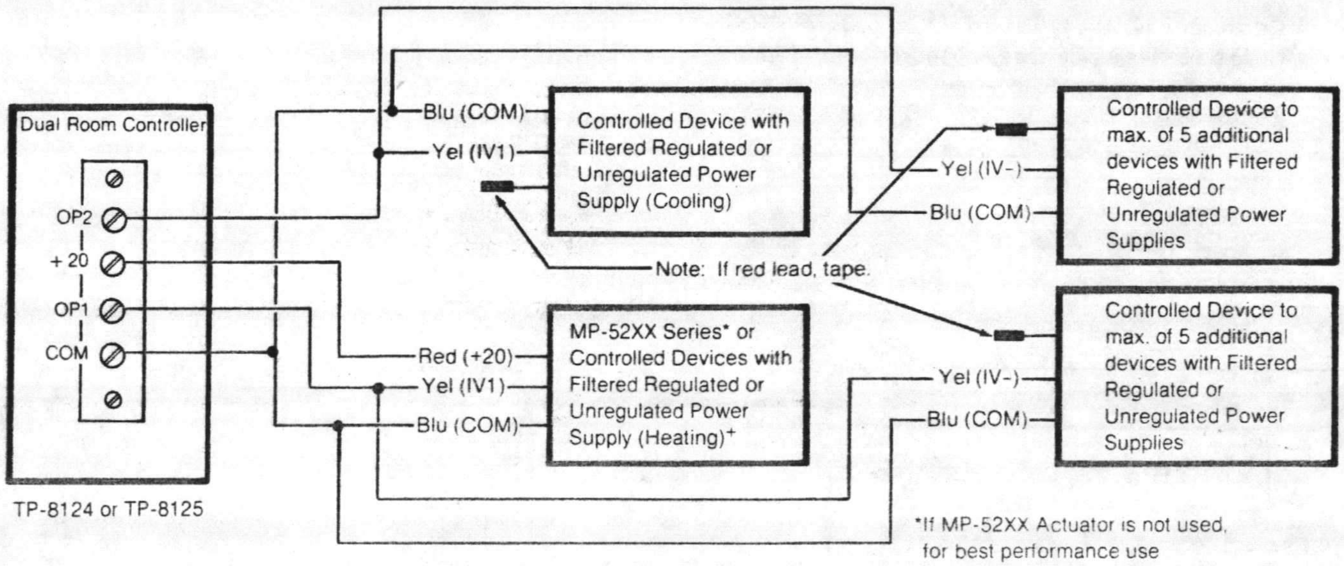


Figure 5
TP-8101, TP-8102 and TP-8103
Typical Wiring *with* MP-52XX Actuators



*If MP-52XX Actuator is not used, for best performance use Regulated and Filtered Power Supply if one is present.

+The MP-52XX Series also may be used as the cooling device.

Figure 6
TP-8124 and TP-8125
Typical Wiring with *One or No* MP-52XX Actuators

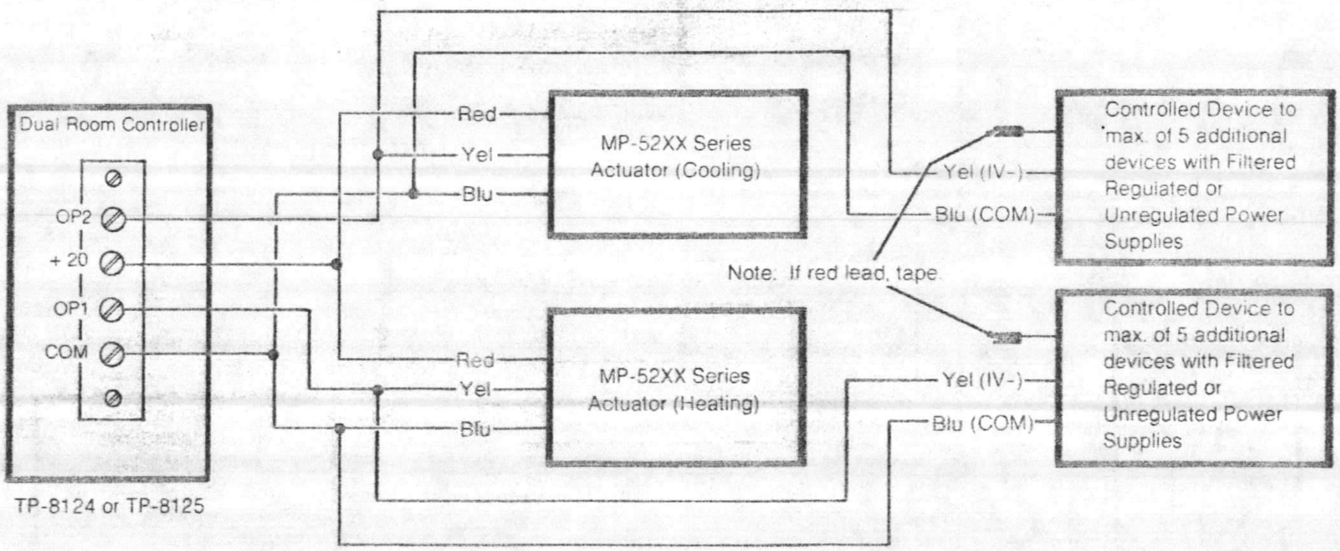


Figure 7
TP-8124 and TP-8125
Typical Wiring with *Two* MP-52XX Actuators

ADJUSTMENTS

TP-8101, TP-8102, TP-8103

1. Turn the setpoint adjuster to the required temperature setting. Normally, no further adjustments are required.

2. Throttling range settings of 2, 3, 6 and 20° are available by placing the T.R. jumper on the proper selector pin. See Figure 8. For other throttling ranges (1 through 60°) add a resistor to the auxiliary pins. Select the resistor from the chart below. Place the T.R. jumper on the auxiliary pin nearest the center of the controller.

Table 2. Throttling Range Resistor Values

°F T.R.	Auxiliary Resistor	Barber-Colman Part Number
1	4.3 Meg. ±5%	E19-23-562
1.5	3.0 Meg. ±5%	
2.0	2.2 Meg. ±5%	CYZR-481-860
2.5	1.8 Meg. ±5%	CYZR-481-580
3.0	1.5 Meg. ±5%	CYZR-481-680
3.5	1.2 Meg. ±5%	CYZR-481-450
4.0	1 Meg. ±5%	CYZR-481-610
4.5	975K, ±1%	CYZR-862-496
5.0	866K, ±1%	
6.0	732K, ±1%	
7.0	619K, ±1%	CYZR-862-477
8.0	549K, ±1%	
9.0	487K, ±1%	
10.0	432K, ±1%	CYZR-862-462
15.0	287K, ±1%	CYZR-862-445
20.0	215K, ±1%	
25.0	174K, ±1%	CYZR-837-913
30.0	143K, ±1%	CYZR-837-130
40.0	107K, ±1%	
50.0	84.5K, ±1%	E19-64-390
60.0	69.8K, ±1%	CYZR-837-890

TP-8124 and TP-8125

1. Remove the cover and turn the setpoint adjuster (SPA) to the required temperature for the heating mode (typically 65°F).

   Turn the setpoint adjuster (SPB) to the required temperature for the cooling mode (typically 78°F).

   The cooling signal is direct-acting, and stages cooling or proportionally opens a normally closed chilled water valve with a temperature increase.

   The heating signal is factory set for reverse-acting. With a temperature decrease, the signal stages electric heat or proportionally increases the electric heat output controlled by a Barber-Colman CP-8400 or CP-80000 Series SCR controller.

2. For applications that require a direct-acting signal in the heating mode, such as a normally open heating valve, move jumper J7 to pin "B".

3. The Temperature Deadband between heating and cooling is the difference in SPB and SPA settings. For example, the deadband is 13°F with SPA at 65°F and SPB at 78°F.

4. The throttling ranges are factory set at 3°F for heating and cooling. These settings should not be changed for normal applications. Increase the throttling range only to achieve control stability (adjustable 2 to 10°F).

   To adjust, turn the T.R. dial to position the required T.R. value closest to the thermostat cover.

5. Replace the cover.

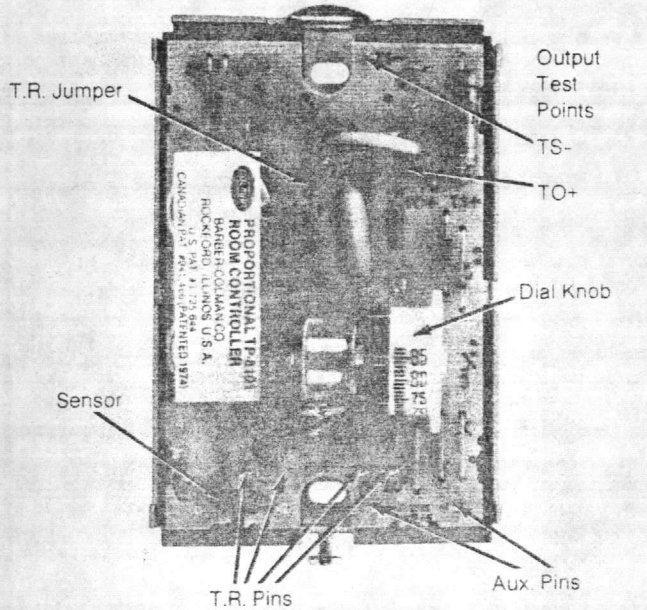


Figure 8
TP-8101, TP-8102 and TP-8103

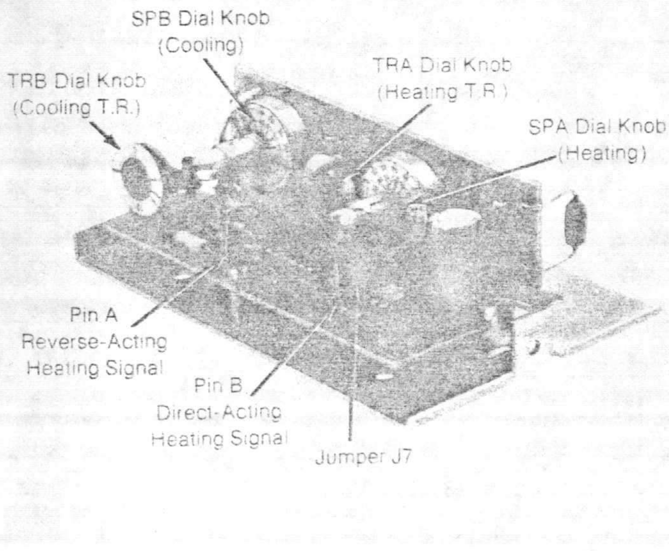


Figure 9a
TP-8124 or TP-8125

SERVICE

TP-8101, TP-8102, TP-8103

NOTE

The TP-8101, TP-8102 and TP-8103 have been factory calibrated to produce a 7.5 Vdc output signal at the yellow and blue leads (TO+ and TS-) when the setpoint and the temperature at the sensing element agree.

1. Verify wiring per job wiring diagram.
2. Measure with a 20,000 ohm per Vdc VOM.
   a. Power supply 20 Vdc: Red (+) to blue (-) wires or test point pins TS- and TS+ (+ end of the 47 μf capacitor).
   b. Output 2 to 15 Vdc: Yellow (+) to blue (-) wires or TO+ and TS- test pins. The voltage varies between 2-15 as the dial knob is rotated.
3. Consult EN 111 for additional service information.
4. Replace the controller if it is defective.

If calibration is necessary, proceed as follows:

1. Connect a 20,000 ohm per Vdc VOM between the yellow (+) and blue (-) leads or TO+ and TS- pins on the thermostat.
2. With the thermostat cover on, insert a 5/64" Allen wrench through the hole on the right-hand side of the thermostat into the setpoint potentiometer shaft.
3. Measure the temperature at the thermostat.
4. Adjust the thermostat setpoint by rotating the Allen wrench until the setpoint dial reading equals the temperature measured in step 3 above.
5. Using the thumb of your left hand, hold the knob in place. Avoid touching the lower left-hand corner of the thermostat where the sensor is located.
6. Rotate the Allen wrench until VOM reads 7.5 ±.3 Vdc.
7. The thermostat is calibrated.

TP-8142 and TP-8125

NOTE

The TP-8124 and TP-8125 have been factory calibrated to produce 6.0 Vdc output signals at OP1 and OP2 to COM terminals when the setpoints and the temperatures at the sensing element agree.

Test the power supply and output as follows:

1. Verify the wiring per the job wiring diagram.
2. Measure with a 20,000 ohm per Vdc VOM:
   a. Power supply 20 Vdc: +20 (+) to COM (-).
   b. Heating output: OP1 (+) to COM (-). Vdc varies between 2-15 as SPA is rotated.
   c. Cooling output: OP2 (+) to COM (-). Vdc varies between 2-15 as SPB is rotated.
3. Replace the controller if it is defective.

If calibration is necessary, proceed as follows:

1. Remove the thermostat cover. Note room temperature.
2. If room temperature is 75°F or greater:
   a. Connect VOM internally to OP2 (+) and COM (-). See Figure 9B for details.
   b. Rotate SPB until VOM reads 6.0 ±.3 Vdc. SPB pointer must indicate the temperature measured. If not, hold SPB shaft and rotate pointer (CCW) until it indicates the temperature measured.

      SPB is calibrated.
   c. Disconnect VOM lead from OP2 and reconnect to OP1. Connect Jumper J7 to Pin A.
   d. Connect 1 MEG ±1% resistor (SYZE-13512 test kit) between AB1 and 6.2 connections.
   e. Rotate SPA until VOM reads 6.0 ±.3 Vdc. SPA should read temperature measured minus 10°F. If not, hold SPA shaft and rotate pointer (CCW) until it indicates temperature measured minus 10°F.

      SPA is calibrated.
3. If room temperature is 74°F or less:
   a. Connect VOM internally to OP1 (+) and COM (-). See Figure 9B for details.
   b. Rotate SPA until VOM reads 6.0 ±.3 Vdc. SPA must indicate the temperature measured. If not, hold SPA shaft and rotate the pointer (CCW) until it indicates the measured temperature.

      SPA is calibrated.
   c. Disconnect VOM lead from OP1 and re-connect to OP2. Connect Jumper J7 to Pin A.
   d. Connect 1 MEG, ±1% resistor (SYZE-13512 test kit) between AB2 and COM connections.
   e. Rotate SPB until VOM reads 6.0 ±.3 Vdc. SPB should read the measured temperature plus 10°F. If not, hold SPB shaft and rotate pointer (CCW) until it indicates the measured temperature plus 10°F.

      SPB is calibrated.

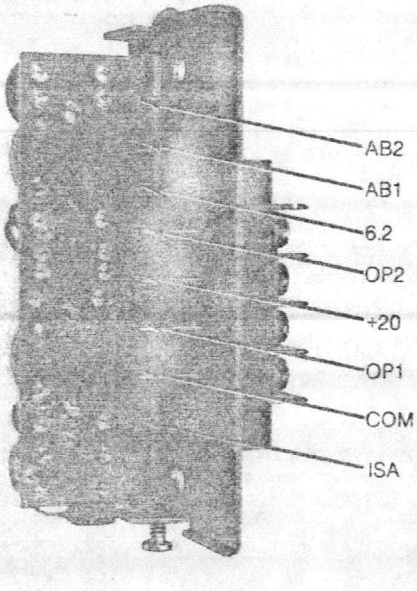


Figure 9b

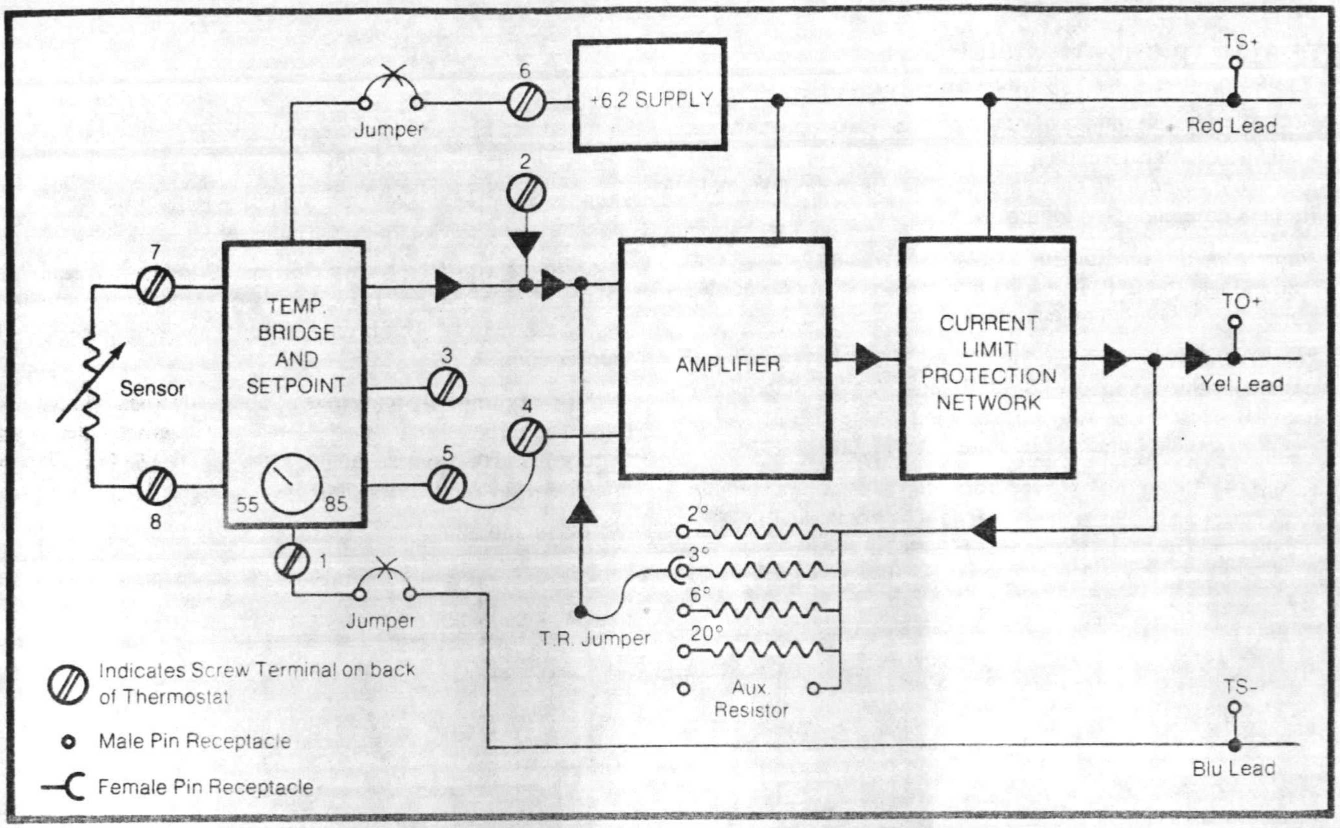


Figure 10
TP-8101, TP-8102 and TP-8103 Block Diagram

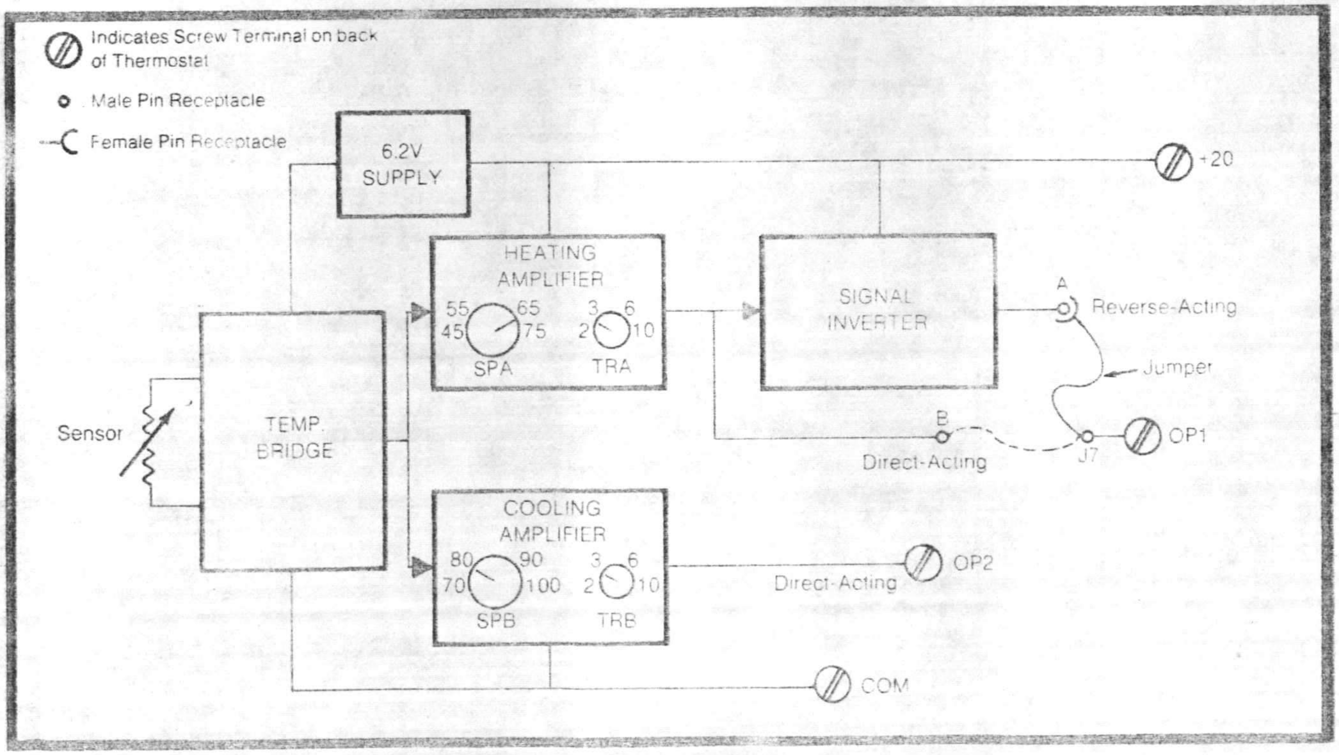


Figure 11
TP-8124 and TP-8125 Block Diagram

OPTIONS

TP-8101, TP-8102, TP-8103
(TP-8124 and TP-8125 have no options.)

Remote Setpoint Install the AT-8100 Series remote setpoint adjuster between terminals 1, 2 and 7. These are used for applications where the setpoint adjustment is mounted remote from the controller. See Figure 14, 15 or 16.

Remove the dial rim from the setpoint knob using wire cutters. Turn the dial to 70°F. The AT-11-404 blank cover is recommended to prevent dust infiltration.

Remote Sensing Remove the internal 1000 ohm sensor and install the remote sensor (TS-8000 Series) between terminals 7 and 8. This is used for applications where the sensor is mounted remote from the controller. See Figure 13.

Summer-Winter Changeover is accomplished without remote setpoints or selective ratio discharge. The controller operates in either the DA or RA mode. See Figure 12.

Jumper 4 to 5 — DA (direct-acting): A temperature increase causes an output voltage increase.

Jumper 3 to 4 — RA (reverse-acting): A temperature increase causes an output voltage decrease.

Selective Ratio Discharge Control Connect the ratio discharge sensor (Figure 19) to the room controller as shown in Figure 14, 15 or 16. This is used for room and discharge control applications.

Winter-Summer Operation is accomplished using selective ratio discharge and/or remote setpoints. For direct-acting, see Figure 14. For reverse-acting, see Figure 15. For winter-summer switching, see Figure 16.

For panel mounting, see Figure 18.

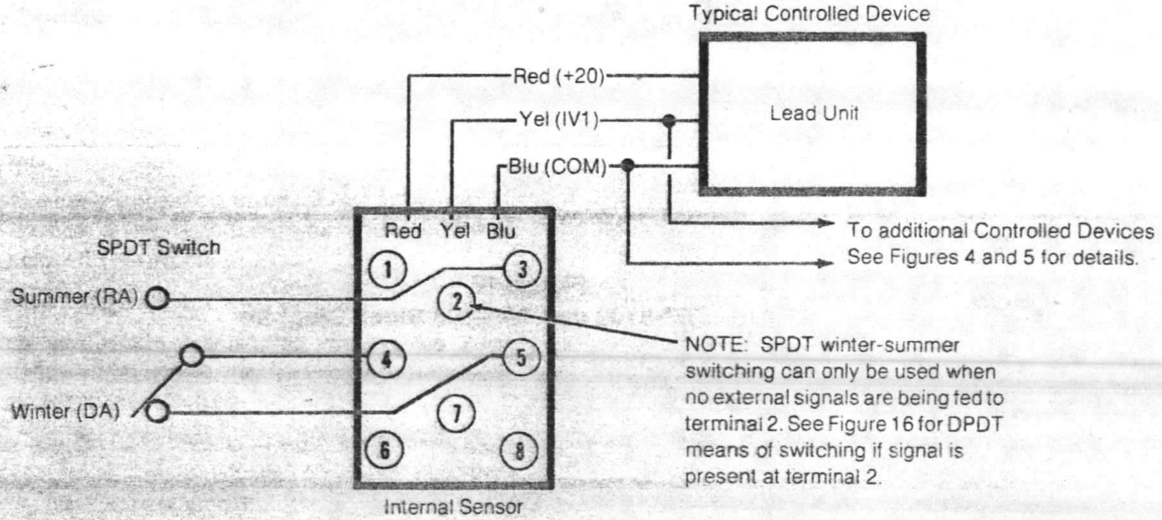


Figure 12. TP-8101, TP-8102 and TP-8103 with Single Pole Double Throw (SPDT) Winter-Summer Switching

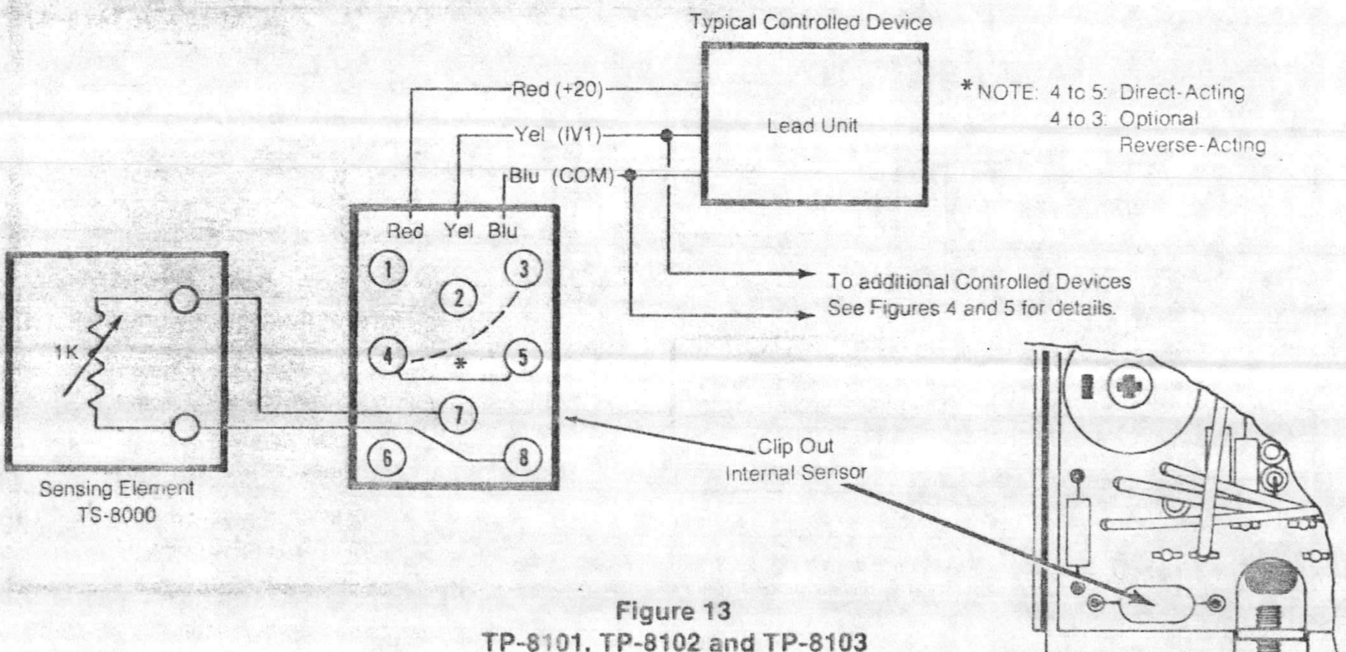
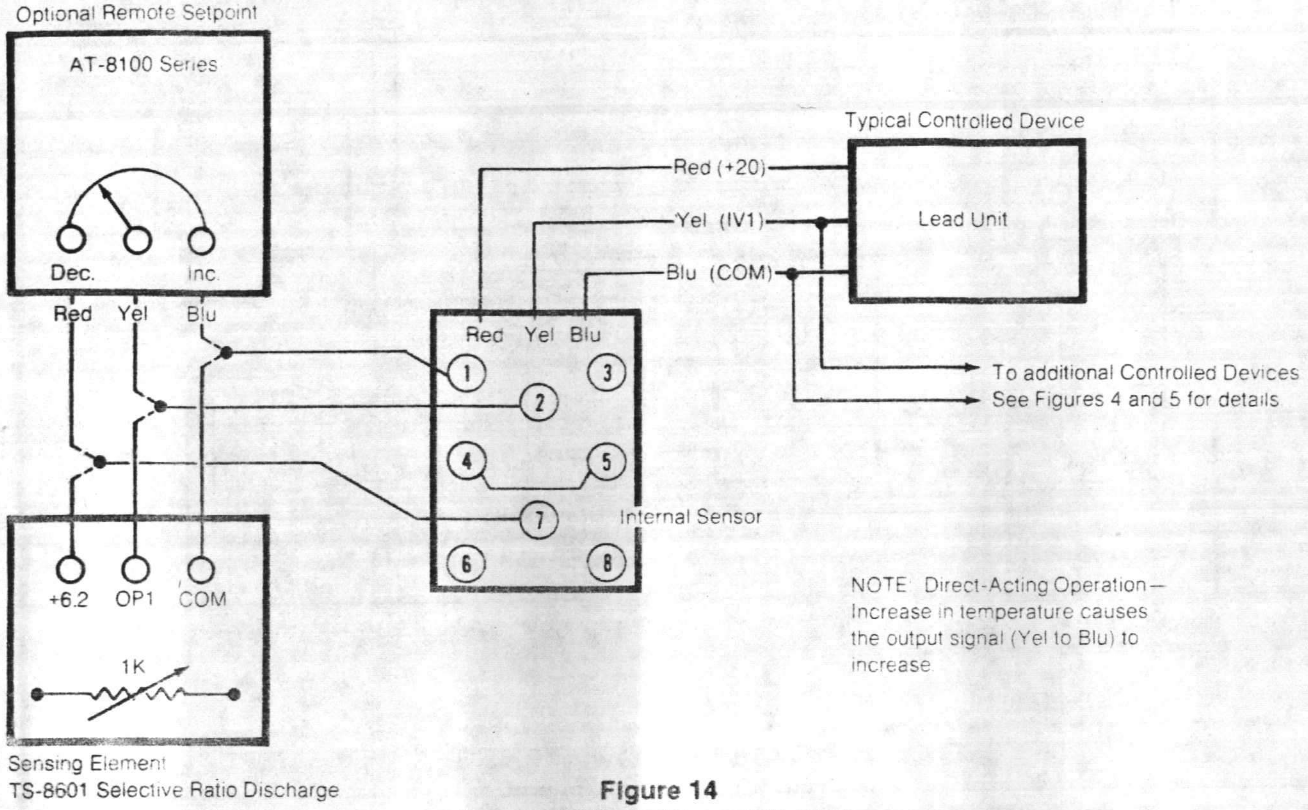
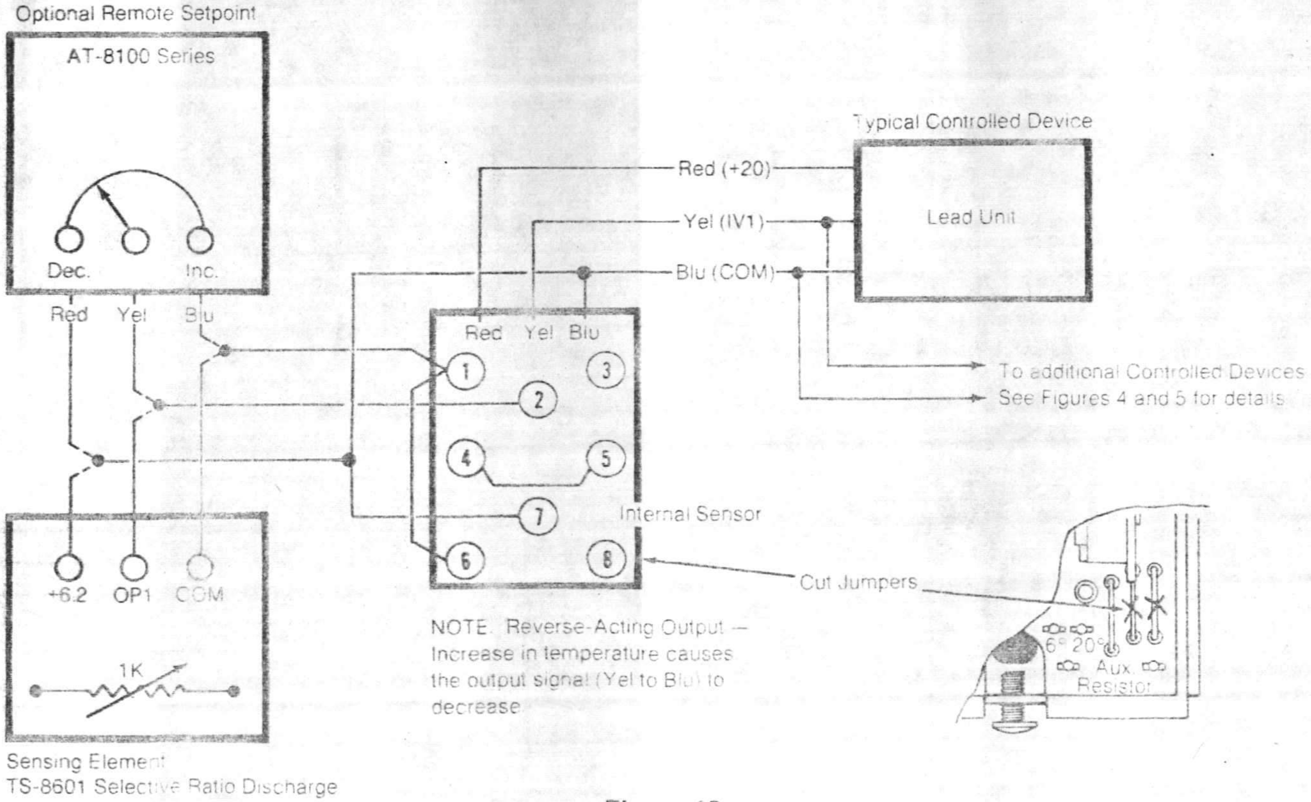


Figure 13
TP-8101, TP-8102 and TP-8103
with Remote Sensor



NOTE: Direct-Acting Operation—Increase in temperature causes the output signal (Yel to Blu) to increase.

Figure 14
TP-8101, TP-8102 and TP-8103 with Remote Setpoint and/or Selective Ratio Discharge Sensor
Direct-Acting Output Only



NOTE: Reverse-Acting Output—Increase in temperature causes the output signal (Yel to Blu) to decrease.

Figure 15
TP-8101, TP-8102 and TP-8103 with Remote Setpoint and/or Selective Ratio Discharge Sensor
Reverse-Acting Output Only

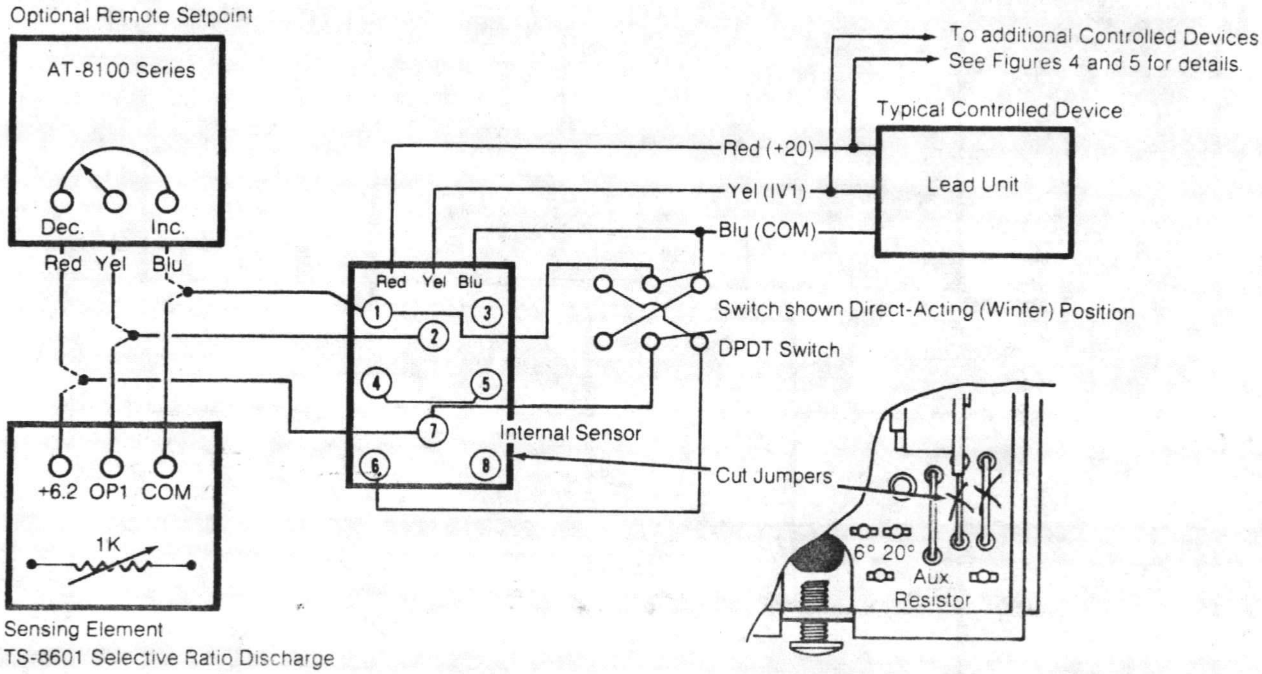
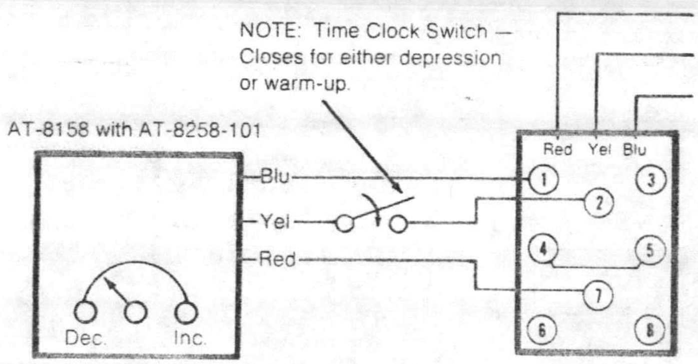
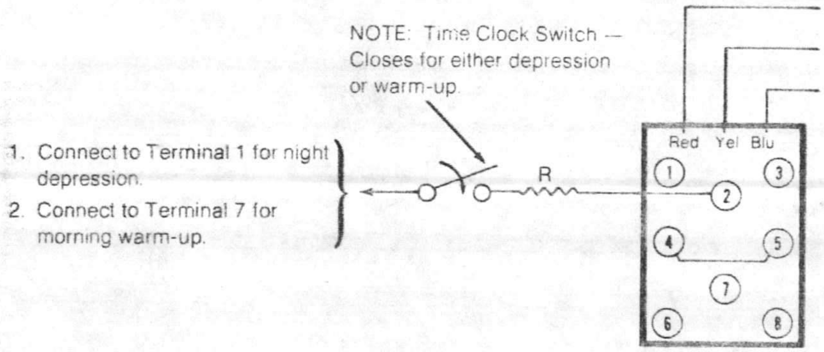


Figure 16
TP-8101, TP-8102 and TP-8103
with Remote Setpoint and/or
Selective Ratio Discharge Sensor
with Double Pole Double Throw (DPDT)
Winter-Summer Switching





RESISTORS		
Degrees	**Resistance**	**B-C Part No.**
5	2.0 MEG. ±5%	CYZR-481-530
10	1.0 MEG. ±1%	CYZR-862-501
15	681K, ±1%, 1/8W	E19-64-481
20	499K, ±1%, 1/8W	CYZR-862-468

Figure 17
TP-8101, TP-8102 and TP-8103
with Night Depression and/or
Morning Warm-Up

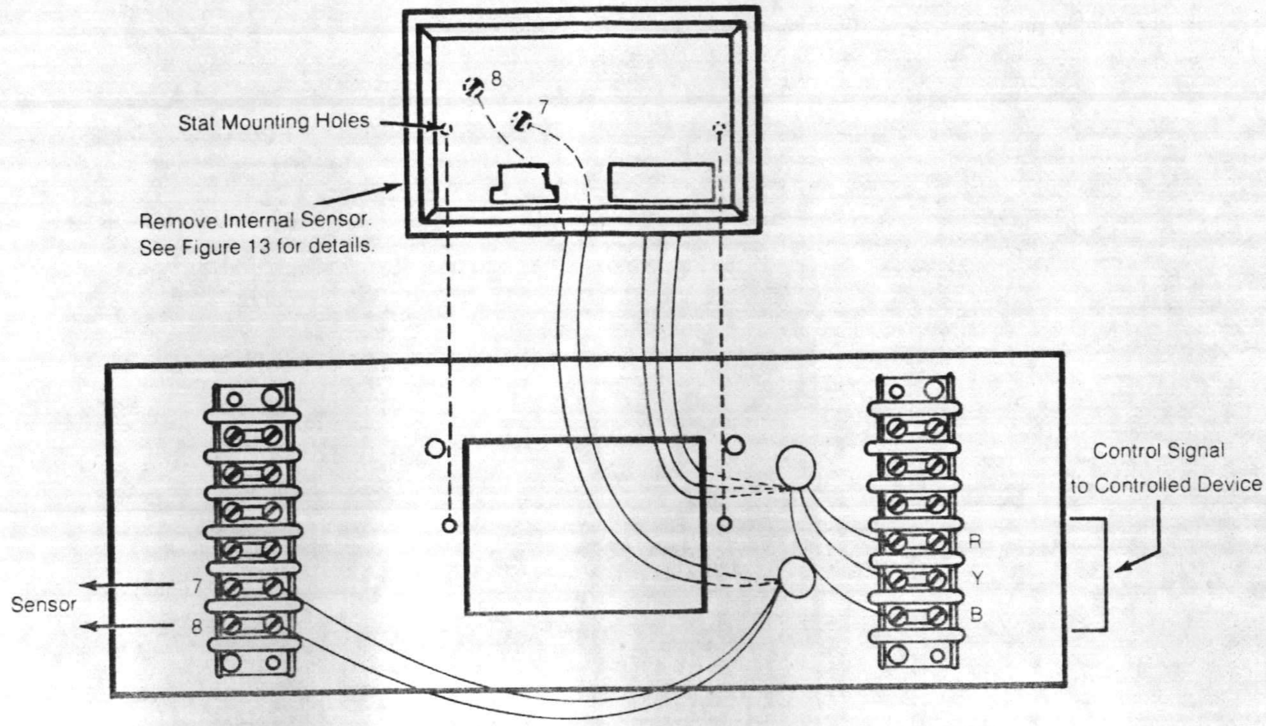
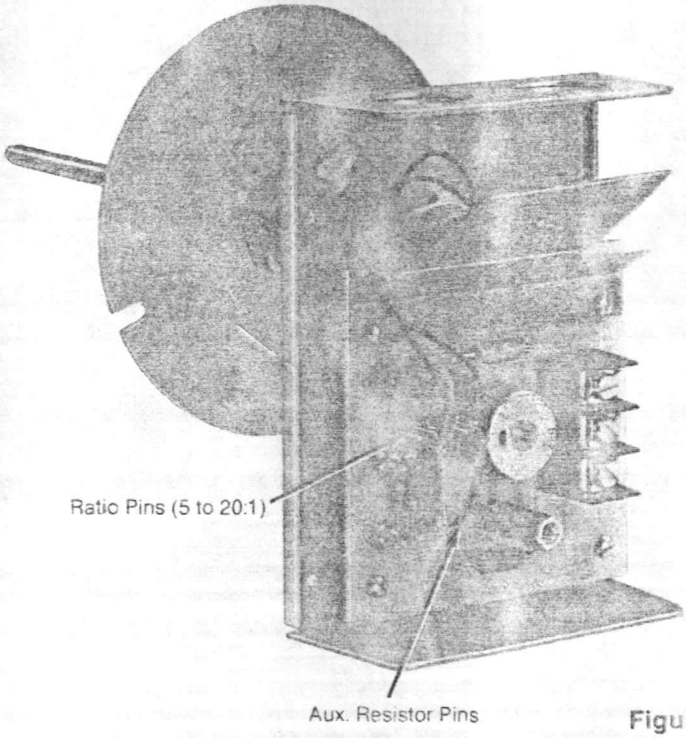


Figure 18
TP-8101, TP-8102 and TP-8103
Mounted on AD-8951



AUXILIARY RESISTORS		
Ratio	**Resistance**	**B-C Part No.**
25:1	59K ±1%, 1/8W	CYZR-932-66
30:1	71.5K ±1%, 1/8W	CYZR-868-19
40:1	95.3K ±1%, 1/8W	E19-29-395
50:1	121K ±1%, 1/8W	CYZR-788-12

Figure 19
TS-8601 Ratio Discharge Sensor
for use with
TP-8101, TP-8102 and TP-8103

MAINTENANCE

This is a quality product. Regular maintenance of the total system is recommended to assure optimum performance.

Barber-Colman Company
ENVIRONMENTAL CONTROLS DIVISION

1354 Clifford Avenue
P.O. Box 2940
Loves Park, IL U.S.A. 61132-2940

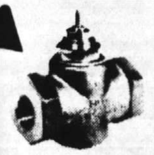
LITHO IN U.S.A.

2-WAY VALVES, SCREWED (1/2" TO 2") AND FLANGED (2-1/2" TO 4") WITH HYDRAULIC ACTUATORS

Para. 6.2.8
2.2.2.9

V-2,6

TABLE 1. Select **Valve Body** including **P Code** (Valve Size, Cv Rating, Port Code) or select **Valve Assembly** with correct Input Signal (see Table 3 also) less Actuator Code (XXX) including the **P Code** (Size, Cv Rating, Port Code). (See Pages 331-335 for Valve Sizing.)



		APPLICATION			
		Chilled or Hot Water 281°F Max. 35 psig Steam		Hot Water 300°F Max. 100 psig Steam	Hot Water 366°F Max. 150 psig Steam
		Screwed	Flanged	Screwed	
	Size	1/2"—2"	2-1/2"—4"	1/2"—2"	1/2"—2"
Normally Open Valves	Valve Body	VB-9213-0-4-P	VB-9213-0-5-P	VB-9253-0-4-P	VB-9273-0-4-P
	Valve Assembly 2-15 Vdc Input, System 8000	VS-9213-XXX-4-P	VS-9213-35X-5-P	VS-9253-XXX-4-P	VS-9273-XXX-4-P
	Valve Assembly, Built-in System 8000 Controller	VS-9213-35X-4-P	VS-9213-35X-5-P	VS-9253-35X-4-P	VS-9273-35X-4-P
	2-Position SPST Valve Assembly	VA-9213-2XX-4-P	—	VA-9253-2XX-4-P	VA-9273-2XX-4-P
Normally Closed Valves	Valve Body	VB-9223-0-4-P	VB-9223-0-5-P	VB-9263-0-4-	VB-9283-0-4-P
	Valve Assembly 2-15 Vdc Input, System 8000	VS-9223-XXX-4-P	VS-9223-35X-5-P	VS-9263-XXX-4-P	VS-9283-XXX-4-P
	Valve Assembly, Built-in System 8000 Controller	VS-9223-35X-4-P	VS-9223-35X-5-P	VS-9263-35X-4-P	VS-9283-35X-4-P
	2-Position SPST Valve Assembly	VA-9223-2XX-4-P	—	VA-9263-2XX-4-P	VA-9283-2XX-4-P
Flow Type		Equal %	Equal %	Equal %	Equal %
Material	Body	Bronze	Cast Iron	Bronze	Bronze
	Seat	Bronze	Bronze	Stainless Steel	Stainless Steel
	Stem	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
	Plug	Brass	Brass	Stainless Steel	Stainless Steel
	Packing	Spring Loaded Teflon Cone	Spring Loaded Teflon Cone	Spring Loaded Teflon Cone	Spring Loaded Teflon Cone
	Disc	Composition	Composition	Teflon	None
STEAM					
Pressure (psig)	Static	250	125	250	250
	Inlet	35	35	100	150
	Recom. Diff.*	20	20	35	50
Fluid Temp. °F (°C)	Max.	281° (138°)	281° (138°)	340° (171°)	366° (180°)
WATER					
Pressure (psig)	Static	250	125	250	250
	Recom. Diff.*	35	35	35	50
Fluid Temp. °F (°C)	Min	40° (4°)	40° (4°)	40° (4°)	40° (4°)
	Max	281° (138°)	281° (138°)	300° (149°)	366° (180°)

NOTE: These charts are color coded as shown below to assist valve selection. Note it is possible to select either a valve assembly or component parts (actuator, valve linkage, valve body).

ORDERING EXAMPLES:

1. **Valve Assembly** **VS-9223-212-4-8**
2. **Valve Body** **VB-9223-0-4-8**
   Actuator **MP-5210-500**
   Linkage **AV-600**

■ **Valve Body** Data less P Code (Size, Cv Rating, Port Code) or **Valve Assembly** less Actuator Code (XXX) and less P Code (Size, Cv Rating, Port Code)

■ P Code (Size, Cv Rating, Port Code)

■ **Actuator** or Actuator Code (XXX) for Valve Assemblies.

□ **Valve Linkage**

VALVES

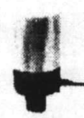
TO SELECT A PORT CODE (P)

P Code	Valve Size	Cv			
1**	1/2"	0.4		0.4	0.4
2**		1.3		1.3	1.3
3**		2.2		2.2	2.2
4		3.6		3.6	3.6
5**	3/4"	5.0		5.0	5.0
6		6.2		6.2	6.2
7**	1"	8.2		8.2	8.2
8		11.0		11.0	11.0
9	1 1/4"	16.0		16.0	16.0
10	1 1/2"	25.0		25.0	25.0
11	2"	40.0		40.0	40.0
12	2 1/2"		56		
13	3"		85		
14	4"		145		

*Maximum recommended differential pressure in full open position. Do not exceed recommended differential pressure (pressure drop) or integrity of parts may be affected.
NOTE: Do not exceed close-off rating.
**NOTE: Factory assemblies are not available for 2-position applications using reduced port valve bodies.

2-WAY VALVES, SCREWED (1/2" TO 2") AND FLANGED (2-1/2" TO 4") WITH HYDRAULIC ACTUATORS

TABLE 2. Select **Actuator Type** or **Actuator Code (XXX)** series with correct Input Signal having sufficient close-off for the application. If selecting Component Parts, select **Valve Linkage.**

							
Input Signal					Two-Position SPST	2-15 Vdc System 8000	2-15 Vdc System 8000**
Valve Linkage 1/2" — 1-1/4" Valve					AV-600	AV-600	—
Valve Linkage 1/2" — 2" Valve					—	—	AV-430
Valve Linkage 2-1/2" — 4" Valve					—	—	AV-495
Actuator Code (XXX)					2XX	2XX	35X
Actuator Code					MA-521X-XXX	MP-5X1X	MS-8XX1X-XXX
Normal Position	**Factory Avail. Valve Assembly**	**Valve Body**	**P Code**	**Size**	**CLOSE-OFF PRESSURE RATING***		
Normally Open	VA-9213-2XX-4-P VA-9253-2XX-4-P VA-9273-2XX-4-P VS-9213-XXX-4-P VS-9253-XXX-4-P VS-9273-XXX-4-P	VB-9213-0-4-P VB-9253-0-4-P VB-9273-0-4-P	-1-2-3-4	1/2"	180	190	
			-5-6	3/4"	75	85	
			-7-8	1"	40	45	
			-9	1-1/4"	25	30	
			-10	1-1/2"			65
			-11	2"			35
Normally Open	VS-9213-35X-5-P	VB-9213-0-5-P	-12	2-1/2"			20
			-13	3"			12
			-14	4"			6
Normally Closed	VA-9223-2XX-4-P VA-9263-2XX-4-P VA-9283-2XX-4-P VS-9223-XXX-4-P VS-9263-XXX-4-P VS-9283-XXX-4-P	VB-9223-0-4-P VB-9263-0-4-P VB-9283-0-4-P	-1-2-3-4	1/2"	250	220	
			-5-6	3/4"	140	90	
			-7-8	1"	75	50	
			-9	1-1/4"	45	30	
			-10	1-1/2"			65
			-11	2"			35
Normally Closed	VS-9223-35X-5-P	VB-9223-0-5-P	-12	2-1/2"			20
			-13	3"			12
			-14	4"			6

*Close-off pressure ratings apply when valves are installed with pressure under the seat. **Certain models have built-in controller.

TABLE 3. Select exact **Actuator** or **Actuator Code (XXX)** if Factory Assembly is available.

Input Signal	Wiring Figure No.	Voltage Vac 50/60 Hz	VA	Aux. Switch	Actuator Part No.	Actuator Code (XXX) For Factory Available Assy
Two-position SPST	See Figure 1 on Page 336	24	18	No	MA-5213	201
		24		Yes	MA-5213-500	202
		120		No	MA-5210	211
		120		Yes	MA-5210-500	212
		208		No	MA-5212	
		208		Yes	MA-5212-500	
		240		No	MA-5211	221
		240		Yes	MA-5211-500	222
2-15 Vdc, System 8000, Stroke occurs 6-9 Vdc approx., Non-positive positioning	See Figure 12 on Page 339	24	18	No	MP-5213	201
		24		Yes	MP-5213-500	202
		120		No	MP-5210	211
		120		Yes	MP-5210-500	212
		208		No	MP-5212	
		208		Yes	MP-5212-500	
		240		No	MP-5211	221
		240		Yes	MP-5211-500	222
2-15 Vdc, System 8000, start 6 Vdc factory set, Adjustable 2-12 Vdc, 3 Vdc span, Positive positioning	See Figure 12 on Page 339	24	18	No	MP-5413	243
		120		No	MP-5410	240
		208		No	MP-5412	
		240		No	MP-5411	241
	See Figure 12 on Page 339	24	36	No	MS-83013	351
		120	37	No	MS-83010	353
		120	37	Yes	MS-83010-500	
		240	39	No	MS-83011	
		240	39	Yes	MS-83011-500	
Built-in System 8000 controller, Uses TS-8XXX sensor	See Figure 19 on Page 343	120	37	No	MS-84110	354
		120	37	No	MS-84110-011*	
		120	37	Yes	MS-84110-500	

VALVES

2-WAY VALVES, SCREWED (1/2" TO 2") AND FLANGED (2-1/2" TO 4") WITH HYDRAULIC ACTUATORS

TABLE 4. Dimensions

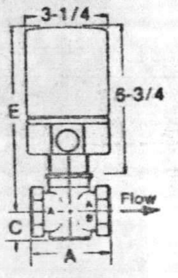
	DIMENSIONS (Inches)					
	Valve Body				Actuator Series	
					200*	350
Part Number	Size	A	B	C	E	E
VA-9213-2XX-4-P VA-9253-2XX-4-P VA-9273-2XX-4-P VS-9213-XXX-4-P VS-9253-XXX-4-P VS-9273-XXX-4-P	1/2"	3		1	8-3/16	
	3/4"	3-5/8		1-3/8	8-11/16	
	1"	4-5/8		1-1/2	9	
	1-1/4"	4-5/8		1-5/8	9	
	1-1/2"	6-1/8		2-1/2		19-1/8
	2"	6-1/8		2-1/2		19-1/8
VS-9213-35X-5-P	2-1/2"	8-1/2		3-1/2		19-13/16
	3"	9-1/2		3-3/4		20-3/16
	4"	11-1/2		4-1/2		21-7/16
VA-9223-2XX-4-P VA-9263-2XX-4-P VA-9283-2XX-4-P VS-9223-XXX-4-P VS-9263-XXX-4-P VS-9283-XXX-4-P	1/2"	3		1-7/16	8-3/16	
	3/4"	3-5/8		1-3/4	8-11/16	
	1"	4-5/8		2	9	
	1-1/4"	4-5/8		2	9	
	1-1/2"	6-1/8		3-3/16		18-5/8
	2"	6-1/8		3-3/16		18-5/8
VS-9223-35X-5-P	2-1/2"	8-1/2		4-1/8		19-7/16
	3"	9-1/2		4-1/8		19-13/16
	4"	11-1/2		5-1/16		20-7/16

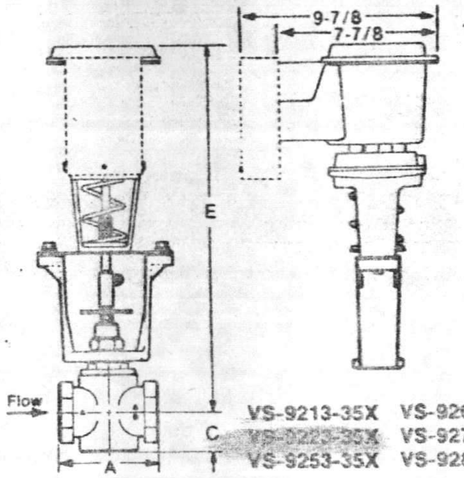
*Add 21/32" (52 mm) to the "E" dimension for a valve assembly using an AV-601 linkage extension that must be purchased separately.

Dimensions in inches (metric conversion 25.4 mm = 1 inch)

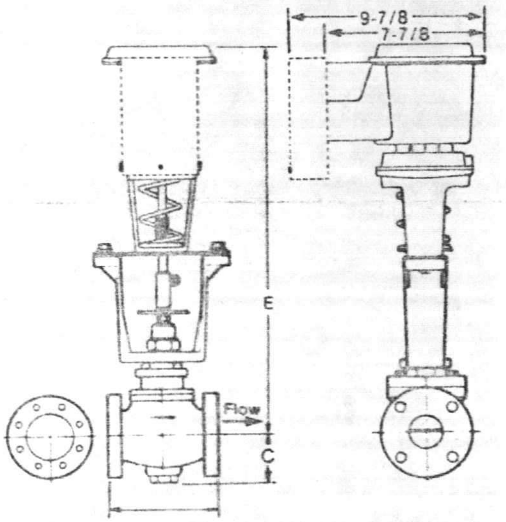
NOTE: Allow 3 inches clearance above actuator for removal. Mount MA/MP-5XXX actuators above the valve body at 45° from vertical on steam applications.

VS-9213-2XX VA-9213-2XX
VS-9223-2XX VA-9223-2XX
VS-9253-2XX VA-9253-2XX
VS-9263-2XX VA-9263-2XX
VS-9273-2XX VA-9273-2XX
VS-9283-2XX VA-9283-2XX

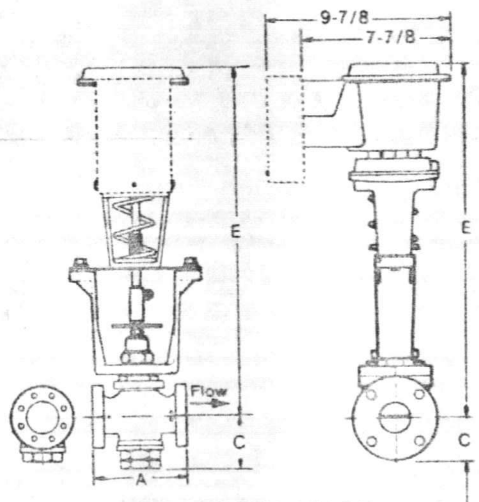




VS-9213-35X VS-9263-35X
VS-9223-35X VS-9273-35X
VS-9253-35X VS-9283-35X



VS-9213-35X-5-P



VS-9223-35X-5-P

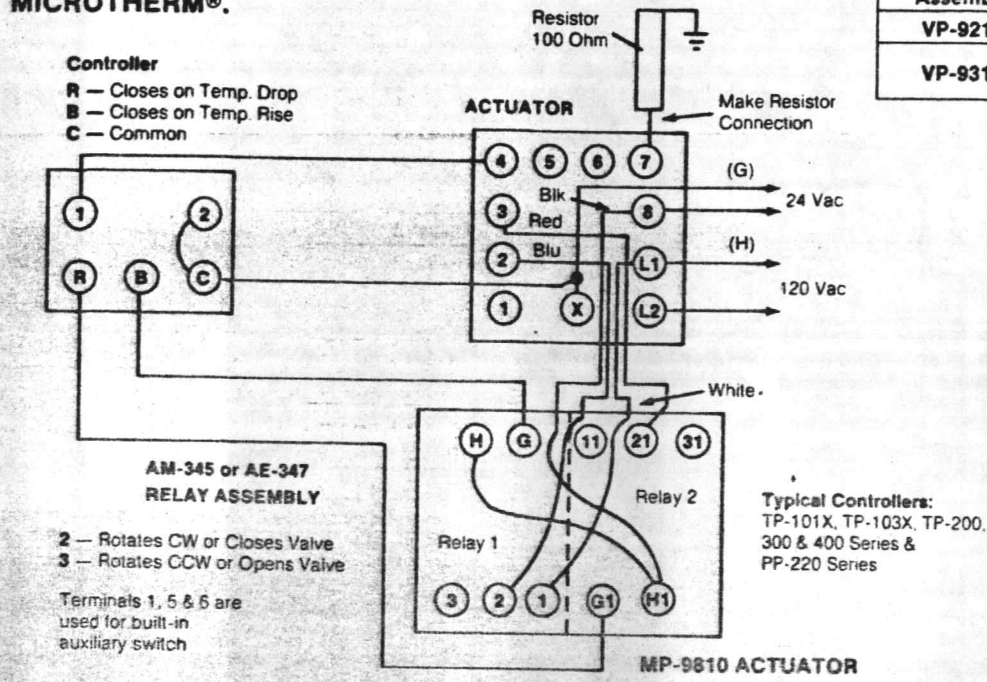
See Flange Detail Table on following page

VALVES

Wiring Figure No. 11

MICROTHERM®.

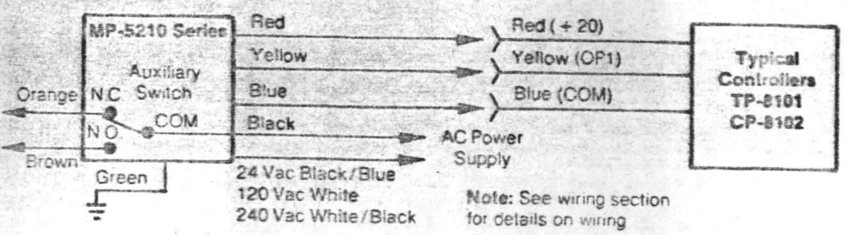
Valve Assembly	"L_1" to "2" on Actuator	"L_1" to "3" on Actuator
VP-9213	Closed	Open
VP-9313	Flow "A" to "AB"	Flow "B" to "AB"

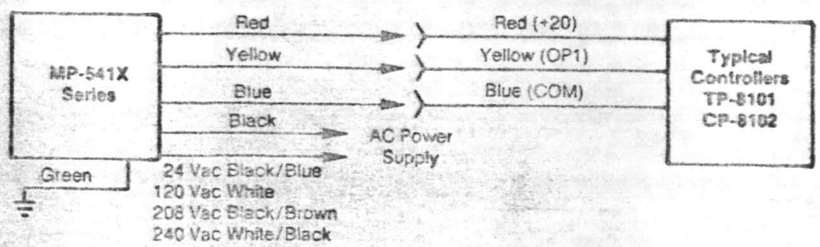


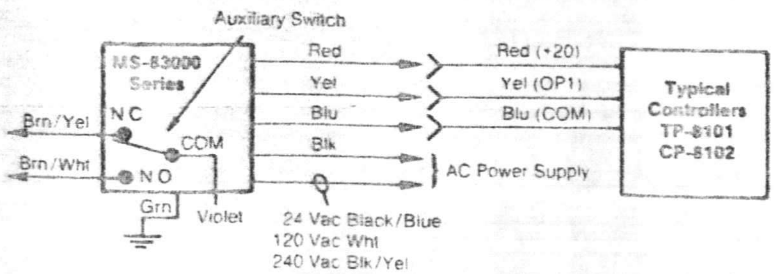
Wiring Figure No. 12

SYSTEM 8000
2-15 VDC INPUT

Valve Assembly	Increasing Vdc Input Signal	Normal Position Decreasing Vdc
VP-1112	Closed	Open
VS-9211		
VS-9212		
VS-9213		
VS-9253		
VS-9273		
VS-9221	Open	Closed
VS-9222		
VS-9223		
VS-9263		
VS-9283		
VS-9313	Flow "A" to "AB"	Flow "B" to "AB"
VS-9323-XXX-4	Flow "B" to "A"	Flow "B" to "AB"
VS-9323-XXX-5	Flow "C" to "U"	Flow "C" to "L"







Auxiliary switch shown with actuator retracted field adjusted 0-100% of stroke

VALVES

para. 2.2.2.q

BARBER COLMAN COMPANY

General Instructions

AT-602, 603, 607, 608 & 609-XXX Selector Switch Sub-Bases and Legend Plates

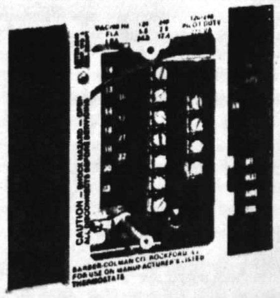
For use at the room thermostat to accommodate switching functions such as heating to cooling, day to night control, etc. **Device:** Rugged one piece molded beige plastic housing. One or two slide switches are double-pole, double throw (DPDT) or double pole-4 position (DP4T) allowing numerous control possibilities. DP4T can be used as two or three position by installing switch legend plates that limit switch travel. Coded screw terminals for the switch contacts are accessible for up to two No. 14 gauge wire connections. See Figure 2.

Installation

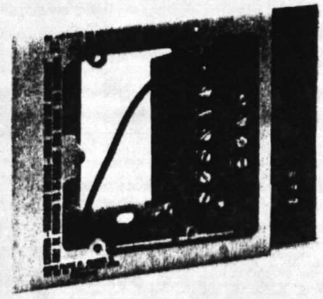
Use Class I wiring for all connections to switch subbases and to room thermostat unless all circuits are powered from a Class II source. Make all connections in accordance with national and local codes.

Install subbases on a flush switch box, a surface switch box or directly on a wall (for 24V applications only).

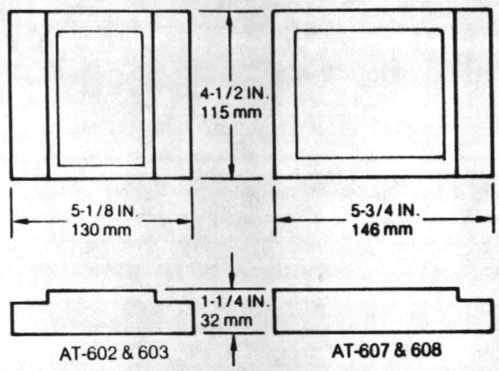
1. Pull the required wires.
2. If plastic conduit box is used, connect green wire from subbase to system ground, otherwise clip out the green wire.
3. Mount the subbase (see Figure 1). Screws are provided for switch box mounting.
4. Connect proper wires to subbase screw terminals. Push excess wire into conduit box, allowing field wires (if any) for room thermostat to project through opening in subbase.
5. Make all electrical connections to thermostats and install any jumpers as required. Refer to job wiring diagram and/or General Instruction Sheet for thermostat.
6. Install thermostat on subbase (see Figure 1).
7. To install switch legend plate on subbase strip the paper backing off and press plate into subbase. Note: Legend plates must be ordered separately.

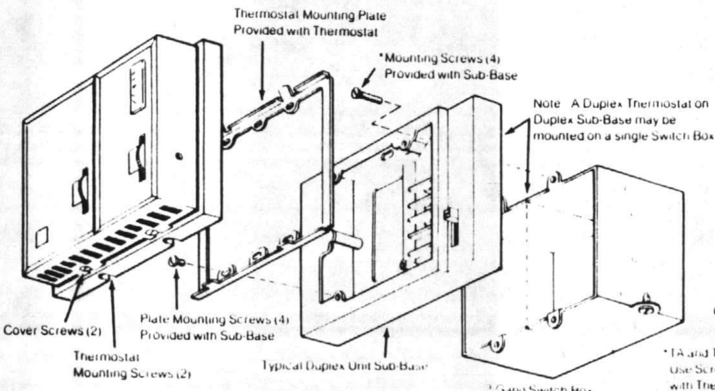


UL **Typical Single Unit Sub-Base**

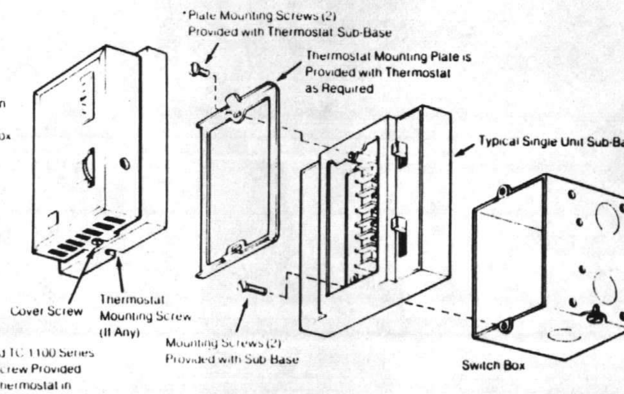


UL **Typical Duplex Unit Sub-base**





Duplex Thermostat on Duplex Sub-Base



Single Thermostat on Single Sub-Base

Figure 1

Part Number	Switch Description		Used With
	Upper Right	Lower Right	
AT-602		DP4T	All Single Room Thermostats Except TK's, TA-115, TA-121, TA-133, TA-134, TC-114, and TC-142.
AT-603	DPDT	DP4T	
AT-607		DP4T	TA-151, 115X, TC-154, 114X, 115X, 116X, 2-Stage and Duplex Thermostats.
AT-608	DPDT	DP4T	

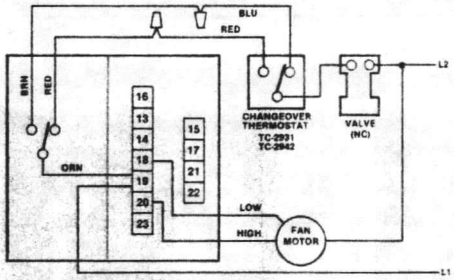
Total Electrical Rating of Each Sub-Base Switch*

Volts (AC)	Inductive		Non-Inductive Amps	Pilot Duty (VA)
	Full Load Amps	Locked Rotor Amps		
24	5.8	34.8	6	125
120	5.8	34.8	6	125
240	2.9	17.4	3	125

*The total load on both poles of a switch must not exceed the total electrical rating.

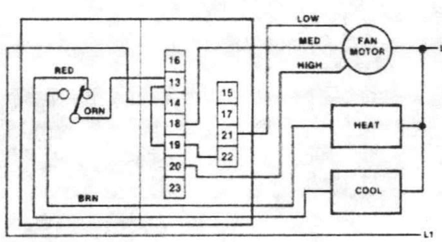
TYPICAL APPLICATIONS

THERMOSTAT CYCLES VALVE, SUMMER/WINTER CHANGEOVER THERMOSTAT, OFF-LOW-HIGH FAN SWITCH



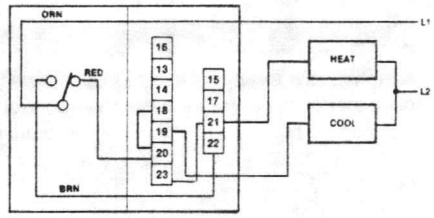
ITEMS: TC-1101, AT-602, AT-609-302

THERMOSTAT PROVIDES SEQUENCED HEAT & COOL, ON-OFF SWITCH, OFF LOCKS OFF SYSTEM & FAN, LOW-MED-HIGH FAN SWITCH



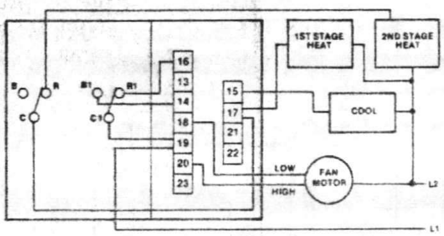
ITEMS: TC-1191; AT-603; AT-609-353

THERMOSTAT PROVIDES SEQUENCED HEAT & COOL OFF-HEAT-AUTO-COOL SWITCH



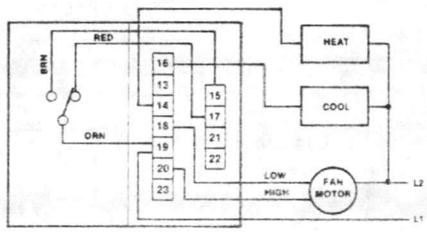
ITEMS: TC-1191, AT-602, AT-609-402

THERMOSTAT CYCLES 2 STAGES HEAT AND 1 STAGE COOL, HEAT-COOL SWITCH, OFF-LOW-HIGH FAN SWITCH



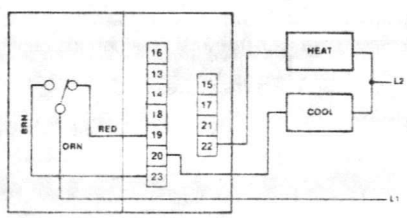
ITEMS: TC-154, AT-608, AT-609-352

THERMOSTAT CYCLES HEAT & COOL, HEAT-COOL SWITCH, OFF-LOW-HIGH FAN SWITCH



ITEMS: TC-1101; AT-603; AT-609-352

THERMOSTAT CYCLES HEAT AND COOL, HEAT-COOL SYSTEM SWITCH



ITEMS: TC-1101, AT-602, AT-609-204

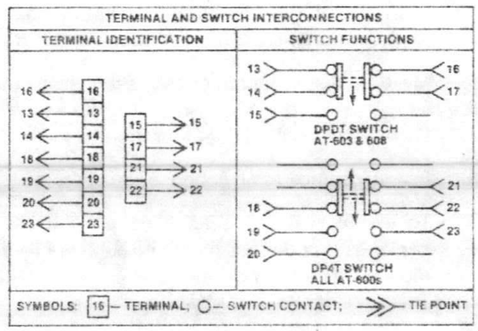


Figure 2

AT-609-XXX

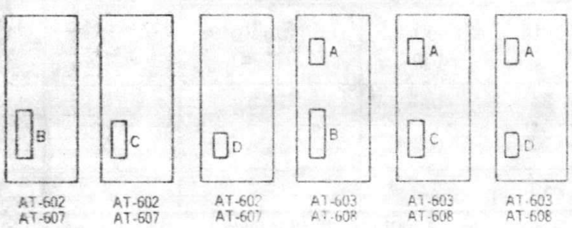
Legend Plates for Switch Sub-Bases

Various switch indicating plates are available and must be ordered separately. These have a brown simulated leather finish with bright letters and pressure sensitive backing for simplified field installation. Blank plate on left side of AT-602 & 603 is factory installed.

Switch Position	Switch Action	AT-609-XXX SWITCH LEGEND PLATES																								
		Blank Plates*						Plates With Legends																		
		201	301	401	250	350	450	202	203	204	205	206	251	252	253†	302	303	305	306	307	351	352	353	402	403	452
A	DPDT												On Off	On Off	On Auto						On Auto Fan	Heat Cool	On Off			On Auto Fan
B	DP4T																							Off Heat Auto Cool	Off Low Med High	Off Heat Auto Cool
C	** DP3T															Off Low High	Heat Off Cool	Occu Off Unoccu	Night Off Day	Off On Auto	Heat Off Cool	Off Low High	Low Med High			
D	** DPDT							On Off	Occu Unoccu	Heat Cool	Night Day	Auto On	Low High	High Low	High Low											

*Special lettering can usually be provided by local nameplate engravers.
**Legend Plate limits travel of DP4T Switch to provide DPDT or DP3T.
†"Fan Operation" legend placed between switches.

SWITCH POSITIONS



Barber-Colman Company
ENVIRONMENTAL CONTROLS DIVISION

1354 Clifford Avenue
P.O. Box 2940
Loves Park, IL U.S.A. 61132-2940

LITHO IN U.S.A.

Para. 2.2.2.9 O.A. T'STAT

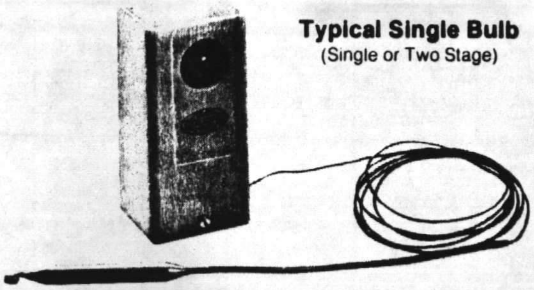
General Instructions

TC-4100 Series
TC-4200 Series
Bulb Thermostats
Return Air Thermostats

For on-off control of media temperature in ducts, tanks, liquid lines, etc.

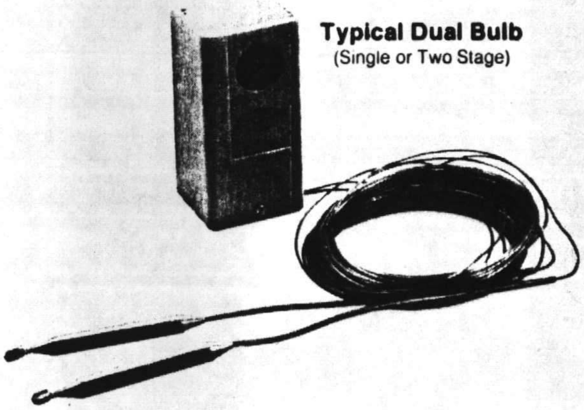
TC-4100 Series **one stage** units control one electrical circuit. Available in single or dual bulb configurations. (See Performance Table.)

TC-4200 Series **two stage** units control two electrical circuits in sequence. Available in single or dual bulb configurations. (See Performance Table.)



Typical Single Bulb
(Single or Two Stage)

Dual bulb units are used to vary the control point of the controlled media as a function of outside air temperature. The ratio specified is outdoor to indoor. A unit with a 1 to 1-1/2 ratio will increase the water temperature 1-1/2°F for a 1°F decrease in outdoor temperature.



Typical Dual Bulb
(Single or Two Stage)

Air bulb units feature a coiled, fast responding air bulb. Used in return air control applications.

Device: Liquid filled thermal element actuates one snap acting SPDT switch per stage. Large color coded terminals. Setpoint adjustment dial plate is marked in °F on one side and °C on the other. The thermal differential is adjustable within the limits shown in the performance table. The mechanism is enclosed in a metal case and the cover, and has 1/2-inch to 3/4-inch conduit opening in the bottom of the case. Remote bulbs are suitable for immersion, duct, or outside air mounting.

Dimensions

Bulb Units: 2-1/4" (57 mm) Wide × 4-5/8" (117 mm) High × 2" (51 mm) Deep.

Air Bulb Units: 2-1/4" (57 mm) Wide × 9" (229 mm) High × 2" (51 mm) Deep.

Typical Air Bulb
(Single or Two Stage)

Electrical Rating: All Units Except TC-4115*

Switch Rating (50/60 Hz)	24V	120V	240V
Full Load Amps	9.8	9.8	8.0
Locked Rotor Amps	58.8	58.8	48.0
Pilot Duty VA	60	360	360
Non-Inductive Amps (Resistive)	—	—	—
Single Stage	22	22	22
Two Stage	16	16	8.0

*TC-4115 for System 8000 and dry circuit switching
Electrical Rating: 1.0 amp at 24 Vac; 25 amp at 24 Vdc.

Performance and Selection Table

Type	Part Number	Setpoint Adjustment Range	Dual† Bulb Ratio	Dimensions: Capillary (Copper)	Dimensions: Bulb (Copper)		Differential: Factory Set	Differential: Adjustable	Maximum Safe Bulb Temperature	Case Ambient Temperature
Single Stage Single Bulb	TC-4111	-40 to 120°F		6′	3/8 × 4″		3°F	3 to 16°F	170°F	-40 to 150°F
	TC-4111-020			20′						
	TC-4112	100 to 260°F		6′					310°F	
	TC-4115*	-40 to 120°F							170°F	
	TC-4121			10′ Armored						
	TC-4122	100 to 260°F							310°F	
	TC-4123	190 to 350°F							400°F	
					Indoor	Outdoor				
Single Stage Dual Bulb	TC-4151	70 to 120°F	1:1-1/2 **	30′ Each Bulb	3/8 × 4″	3/8 × 5-1/2″	3°F	1.5 to 10°F	Total of indoor and outdoor temperatures must not exceed 280°F	-40 to 150°F
	TC-4152		1:1		3/8 × 4″	3/8 × 4″		3 to 16°F		
One Stage Air Bulb	TC-4166	50 to 90°F		None	Coiled 2-1/2 × 2″		2°F Fixed		-40 to 145°F Safe Bulb Range	-40 to 150°F
Two Stage Single Bulb	TC-4211	-40 to 120°F		6′	3/8 × 4″		3°F	Per Stage Fixed Between Stages 2 to 10°F	170°F	-40 to 150°F
	TC-4221			10′ Armored						
	TC-4222	100 to 260°F							310°F	
	TC-4223	190 to 350°F							400°F	
					Indoor	Outdoor				
Two Stage Dual Bulb	TC-4251	70 to 120°F	1:1-1/2 **	30′ Each Bulb	3/8 × 5-1/2″	3/8 × 4″	3°F	Per Stage Fixed Between Stages 1.5 to 6.5°F	Total of indoor and outdoor temperatures must not exceed 280°F	-40 to 150°F
	TC-4252		1:1		3/8 × 4″	3/8 × 4″		2 to 10°F		
Two Stage Air Bulb	TC-4266	50 to 90°F		None	Coiled 2-1/2 × 2″		3°F	Per Stage Fixed 2°F Between Stage Adj. 1 to 5°F	-40 to 145°F Safe Bulb Range	-40 to 150°F

*TC-4115 for System 8000 and dry circuit switching. Electrical Rating: 1.0 amp at 24 Vac; .25 amp at 24 Vdc.

**TC-4151 and TC-4251 — For 1-1/2:1 ratio reverse bulbs and use extra dial supplied with unit.

†First number of reset ratio typically indicates outdoor air temperature change required to increase the setpoint by the second number.

Ratio Selection Table

Outdoor Temperature (°F)	Ratio	Change in Water Temperature for Different Ratios as Outdoor Temperature Drops from 70°F to Design Temperature: Dial Set at 70°F	Dial Set at 80°F	Dial Set at 90°F	Dial Set at 100°F	Dial Set at 110°F	Dial Set at 120°F
-30	1 to 1-1/2	70 to 220	80 to 230	90 to 240	100 to 250	110 to 260	120 to 270
	1 to 1	70 to 170	80 to 180	90 to 190	100 to 200	110 to 210	120 to 220
	1-1/2 to 1	70 to 137	80 to 147	90 to 157	100 to 167	—	—
-20	1 to 1-1/2	70 to 205	80 to 215	90 to 225	100 to 235	110 to 245	120 to 255
	1 to 1	70 to 160	80 to 170	90 to 180	100 to 190	110 to 200	120 to 210
	1-1/2 to 1	70 to 130	80 to 140	90 to 150	100 to 160	—	—
-10	1 to 1-1/2	70 to 190	80 to 200	90 to 210	100 to 220	110 to 230	120 to 240
	1 to 1	70 to 150	80 to 160	90 to 170	100 to 180	110 to 190	120 to 200
	1-1/2 to 1	70 to 123	80 to 133	90 to 143	100 to 153	—	—
0	1 to 1-1/2	70 to 175	80 to 185	90 to 195	100 to 205	110 to 215	120 to 225
	1 to 1	70 to 140	80 to 150	90 to 160	100 to 170	110 to 180	120 to 190
	1-1/2 to 1	70 to 117	80 to 127	90 to 137	100 to 147	—	—
+10	1 to 1-1/2	70 to 160	80 to 170	90 to 180	100 to 190	110 to 200	120 to 210
	1 to 1	70 to 130	80 to 140	90 to 150	100 to 160	110 to 170	120 to 180
	1-1/2 to 1	70 to 110	80 to 120	90 to 130	100 to 140	—	—
+20	1 to 1-1/2	70 to 145	80 to 155	90 to 165	100 to 175	110 to 185	120 to 195
	1 to 1	70 to 120	80 to 130	90 to 140	100 to 150	110 to 160	120 to 170
	1-1/2 to 1	70 to 103	80 to 113	90 to 123	100 to 133	—	—
+30	1 to 1-1/2	70 to 130	80 to 140	90 to 150	100 to 160	110 to 170	120 to 180
	1 to 1	70 to 110	80 to 120	90 to 130	100 to 140	110 to 150	120 to 160
	1-1/2 to 1	70 to 97	80 to 107	90 to 117	100 to 127	—	—

Dual Bulb Selection

On the dual bulb units, indoor and outdoor bulbs are determined by the ratio selected. See Performance and Selection Table. Ratio refers to the outdoor air temperature change compared to the water temperature change. The dial setpoint is the water temperature setpoint when the outdoor temperature is 70°F.

To select ratio it is necessary to know only: (1) outdoor design temperature, (2) maximum water temperature at outdoor design temperature, and (3) desired water temperature at 70°F outdoors. Use the Ratio Selection Table to determine the required ratio based on this information and set the dial per item (3). NOTE: If a 1-1/2:1 ratio is selected, the extra dial supplied with the unit must be used.

Options

Single bulb units are available with optional capillary lengths of 20' or 45'.

Accessories: (Order Separately)

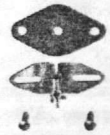
Part No.	Description	
AT-201*	Bulb Well	Copper, 3/4" MNPT 9-1/2"
AT-203*		Stainless, 3/4" MNPT 9-1/2"
AT-206		Copper, 1/2" MNPT 4-1/2"
AT-208	Duct Mounting Kit for Bulb	
AT-209	Liquid Line, or Tank, Bulb Mounting Kit. A Bulb Well is recommended. (Required with AT-201 or AT-203.)	
AT-210	Concealed Adjustment Kit. Includes plate to conceal setpoint adjustment and lock cover screw.	
AT-211	Outside Bulb Shield	

*Requires AT-209 Bulb Mounting Kit

Example: Select ratio for an installation with a -10°F design temperature and estimated supply water temperatures of 75°F at 70°F outdoors and 125°F at -10°F outdoors. From Ratio Selection Table, -10°F for 1-1/2:1 ratio, note by interpolation (70°F to 123°F with dial at 70°F, 80°F to 133°F with dial at 80°F) that water temperature varies from 75°F to 128°F as outdoor temperature drops from 70°F to -10°F.

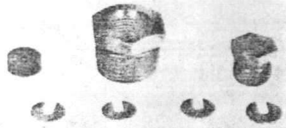
For this application, the 1-1/2:1 ratio should be selected. The extra dial supplied with the unit would be used, and the dial set at 75°F.

Immersion Well AT-20X



Bulb Duct Mounting Kit AT-208

Concealed Adjustment Kit AT-210



Liquid Line or Tank Bulb Mounting Kit AT-209 (Also Required with AT-201 or AT-203 Well)

Pre-Installation

Refer to the INSTALLATION and Performance Data applicable to the part number of the device being installed. Make a visual inspection of the device for obvious signs of damage. Avoid locations where excessive moisture, corrosive fumes, vibration or high ambient exists.

Installation

Location

Locate the device allowing proper distance to the bulb location. The case can be mounted in any position. Refer to Figure 1 for case dimensions.

Procedure

Remote Bulb Models
Air Bulb Models — Mounting in Return Air Duct

1. Remove cover and provide 2 holes for #10 round head screws using the housing as the template or by using the dimensions shown in Figure 1.
2. Partially insert the mounting screws in the screw holes. Fit the housing over the screws, slide housing down on the screws and tighten the screws.

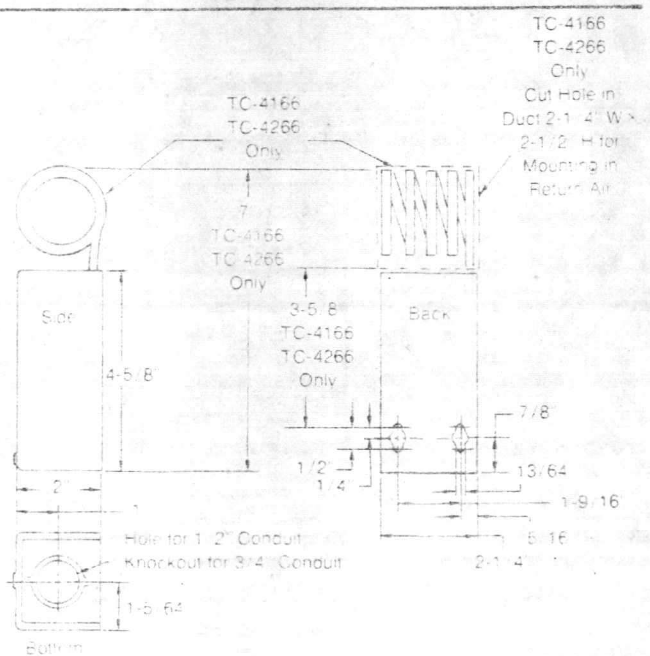


Figure 1. Case Dimensions

Air Bulb Models

Mounting Outside of Return Air Duct

1. Prepare duct for mounting by cutting hole and providing mounting screw holes per Figure 1.
2. Fabricate a cover as shown in Figure 2.
3. Carefully roll bulbs toward back of unit and insert through 2-1/4" × 2-1/2" hole.
4. Remove cover and attach unit to duct with #10 screws.
5. Attach cover over 2-1/4" × 2-1/2" hole.

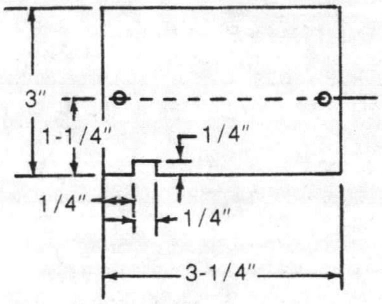


Figure 2. Field Supplied Duct Hole Cover Plate

Remote Bulb Mounting — Duct and Outdoor

Maximum insertion length (6 inches). Maximum safe bulb temperature above scale range. For dual bulbs, total of indoor and outdoor bulb temperatures must not exceed (280°F).

Duct: Install bulb with AT-208 kit as shown in Figure 3.

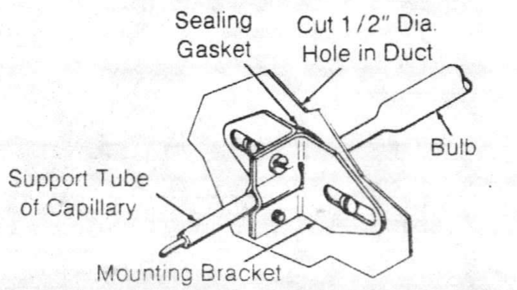


Figure 3. Duct Mounting with AT-208

Outdoor: Install with AT-211 kit as shown in Figure 4.

1. Mount bulb to outside wall or surface with bulb clip.
2. Place shield over bulb and fasten to mounting surface.

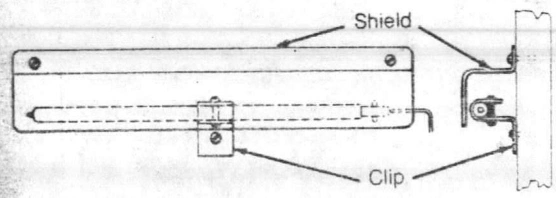
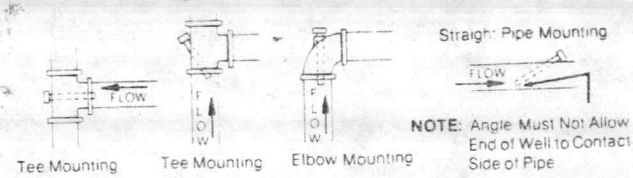


Figure 4. Outdoor Mounting with AT-211

Bulb Mounting — Liquid Line and Tank



Installation Hardware and Application Limitations

Part No.	Description	Mtg. Fitting	Insertion Size	Applications Limitations at 250°F Fluid Temp.*		Installation Per Figure
				Max. Recommended Velocity (FPS)	Max. Recommended Static Press. (PSIG)	
AT-201	Copper Bulb Well**	3/4" MNPT	1/2" Dia. O.D. 9-1/2" Long	11	250	5
AT-203	Stainless Steel Bulb Well**			20	500	
AT-206	Copper Bulb Well	1/2" MNPT	1/2" Dia. O.D. 4-1/2" Long	11	250	5A
AT-209†	Bulb Mounting Kit	3/4" MNPT	Length of Bulb	4	150	5

*Max. Recommended Fluid Temperature is 350°F.
**Requires AT-209
†Recommended Installation is with a Bulb Well.

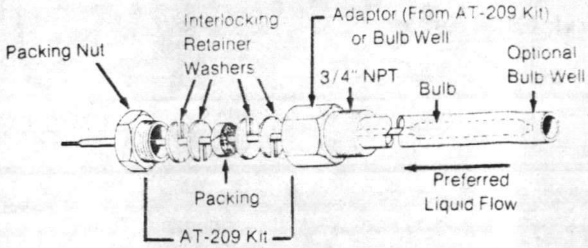


Figure 5. AT-201 or AT-203 Installation

Install bulb well or adaptor from AT-209 into 3/4" FNPT opening. Place packing nut, washers, and packing from AT-209 over bulb support section and insert bulb into well or AT-209 adaptor. Push interlocking washers and packing into well or adaptor and tighten packing nut until firmly seated.

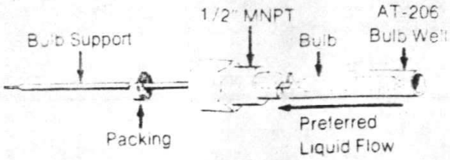


Figure 5A. AT-206 Installation

Install AT-206 bulb well into 1/2" FNPT opening. Place packing (included with AT-206) over bulb support section and insert bulb into well. Push packing into nut on well using a screwdriver.

Concealed Setpoint and Lock Cover Screw

Order AT-210 Concealed Adjustment Kit separately.

1. Peel off adhesive film from the concealed adjustment plate and place into the recess of cover.
2. Remove screw from cover.
3. Install lock cover screw provided with AT-210.

Wiring

The thermostat has one 1/2-inch to 3/4-inch conduit opening in bottom of housing. Make all electrical connections in accordance with the job wiring diagram and in compliance with national and local electrical codes. Terminal coding and switch action is shown in Figure 6, and Figure 7 shows two stage switching sequence.

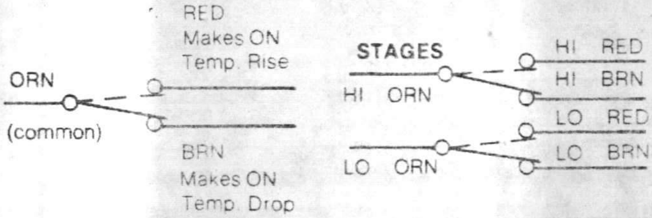


Figure 6. Terminal Coding and Switch Action

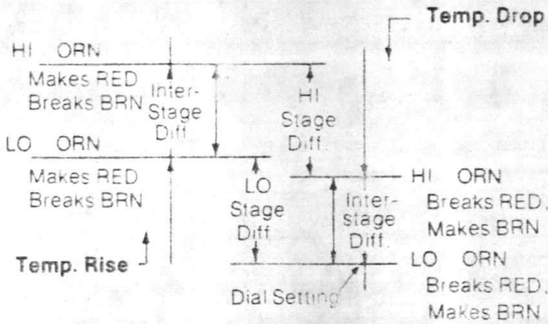


Figure 7. Two Stage Switch Sequence

Typical Applications

Figure 8 shows a typical heating or cooling application for single stage units. Figure 9 shows typical heating and cooling applications for two stage units.

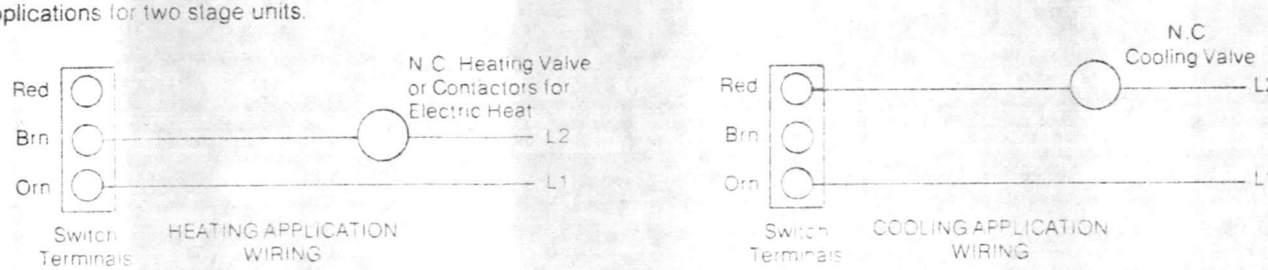
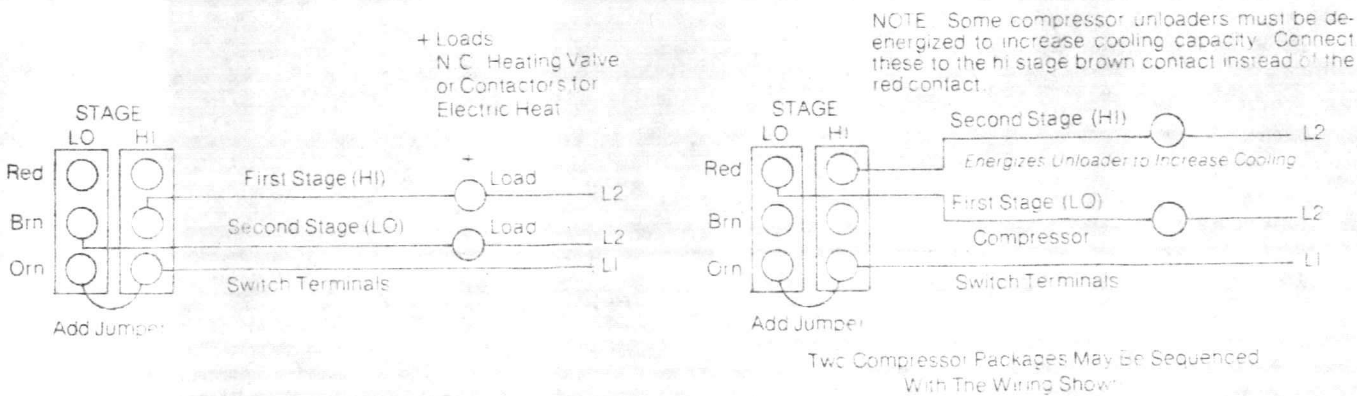


Figure 8. Typical Heating or Cooling Application for Single-Stage Units



TYPICAL HEATING APPLICATION WIRING FOR TWO-STAGE UNITS

TYPICAL COOLING APPLICATION WIRING FOR TWO-STAGE UNITS

Figure 9

Checkout

After installing a thermostat, make an initial check of the switching action. Verify the switch action by listening to the switch contacts.

1. Turn the setpoint dial to a temperature above ambient. This should cause the thermostat to switch, making orange to brown.
2. Turn the setpoint dial setting down gradually. Orange to brown must break, making orange to red.
3. Compare the differential of the device to the differential shown on the performance charts by turning the dial. The differential of the devices is the difference in dial reading between the make of orange to brown and the make of orange to red on single switch units.

Run/Adjust

Setpoint

Screwdriver adjustment. Scales dual marked °F on front and °C on back. To change scale, remove spring retaining ring, select scale and replace retaining ring.

Differential Adjustment

The differential is adjustable by turning the adjustor located on side of device (see Figure 10).

Single stage: Each line represents approximately 3°F change.

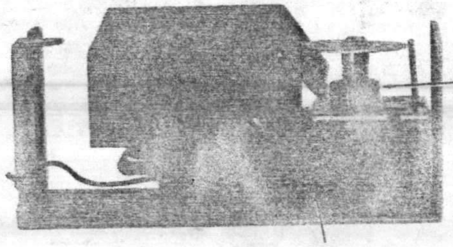


Figure 10

Two stage: Each notch represents approximately 2°F change between stages. (Differential per switch is fixed.)

To adjust differential:

1. Disconnect power to unit.
2. Remove cover.
3. Turn adjustor to approximately desired position.
4. Check out by turning dial and noting dial readings where switch contacts make.
5. After changing differential, recalibrate. See Service and Repair.

Service and Repair

Calibration

1. With all power disconnected, soak bulb(s) for 10 minutes at known temperature (must be 70°F for dual bulb).
2. Turn dial and note where switch contacts make.
3. Turn dial midway between click points.
4. Turn the calibration nut (located under dial) until the temperature of the bulb is indicated on the dial. (See Figure 10.)

NOTE

On two-stage units follow above procedure. "LO" switch is first stage on cooling applications. "HI" switch is first stage on heating applications.

Repair

Field repair is not recommended. Replace defective device.

Barber-Colman Company
ENVIRONMENTAL CONTROLS DIVISION

1354 Clifford Avenue
P.O. Box 2940
Loves Park, IL U.S.A. 61132-2940

LITHO IN U.S.A.

para. 2.2.2.9

TS-1, TS-2

General Instructions

Solid State Sensing
Temperature and Humidity
Series TS-8000 and HS-8000

Temperature Sensing

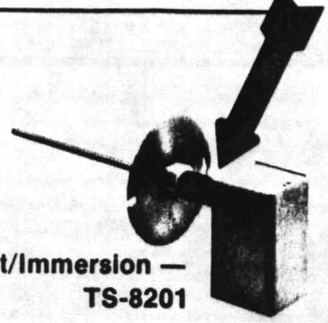
GENERAL INFORMATION

Sensing is accomplished by the use of a temperature sensitive Balco resistance wire packaged in the form of room, duct, averaging and outdoor type configurations. The design of the entire system is around a 1000 Ω sensing element at 70°F.

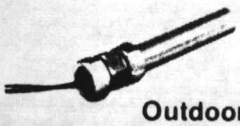
WIRING

Make all electrical connections to the element in accordance with the installation and wiring diagram for the job. Comply with national and local electrical codes. Do not use the element box as a junction box for other control circuits. It is generally advisable to use flexible conduit for connecting box to rigid conduit. Restrict element leads to shortest length practical. Barber-Colman twisted cable or factory approved cable should be used.

Room — TS-8100 Series

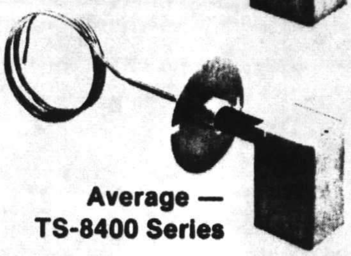


Duct/Immersion — TS-8201

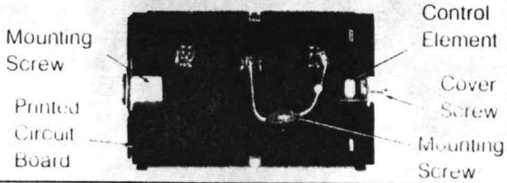
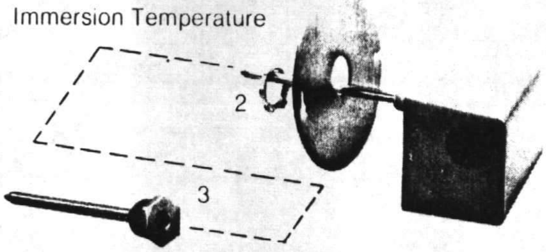
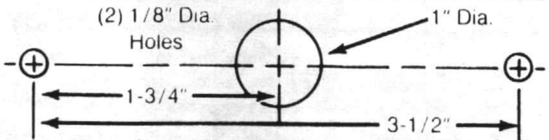


Outdoor — TS-8501

Immersion — TS-8201-106



Average — TS-8400 Series

Part No.	Use	Location	Mounting	Terminal Code Wiring
TS-8101	Room Sensor w/o Setpoint	Wall		⑦ ⑧ } Output Terminals
TS-8111	Room Sensor w/Setpoint	Wall		
TS-8201	Duct Immersion 7" Immersion Length	Duct or Well AT-215 3/4" NPT	AT-215 Thermowell Immersion Temperature 	Pigtails: Black Black } (C) Controlling; Black Black } (L)* Controlling; *Found only on the TS-8331
TS-8201 -106	Immersion 4" Insertion Length	Well AT-225 1/2" NPT		
TS-8331	Lagged Sensor	Duct		
TS-8405	5' Average	Duct		
TS-8422	22' Average	Duct	Duct Mounting Dimensions	
TS-8241	Diffuser	Ceiling	Mount on Face of Ceiling Diffuser. See Instructions for B-C Models PB, PS or SFS, SFB. Pg. 2	Pigtails: Black Black
TS-8261	Light Fixture	Light Fixture	Mount in Return Grill of Light Fixture	Pigtails: Black Black
TS-8501	Outdoor Air	Outside of Building	Use Conduit Connectors	Pigtails: Black Black } Controlling
TS-8531	Solar	Outside of Building		Orange Orange } Element (Solar)
TS-8533	Econostat	Outside of Building		Red Red } Heater (Econostat)

Para. 2.2.2.9

BARBER COLMAN COMPANY

a Siebe company

General Instructions

Solid State Sensing Temperature and Humidity Series TS-8000 and HS-8000

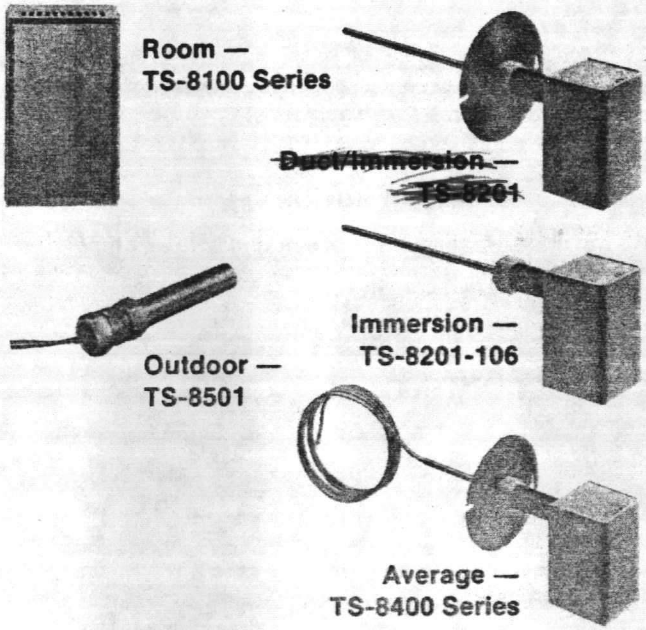
Temperature Sensing

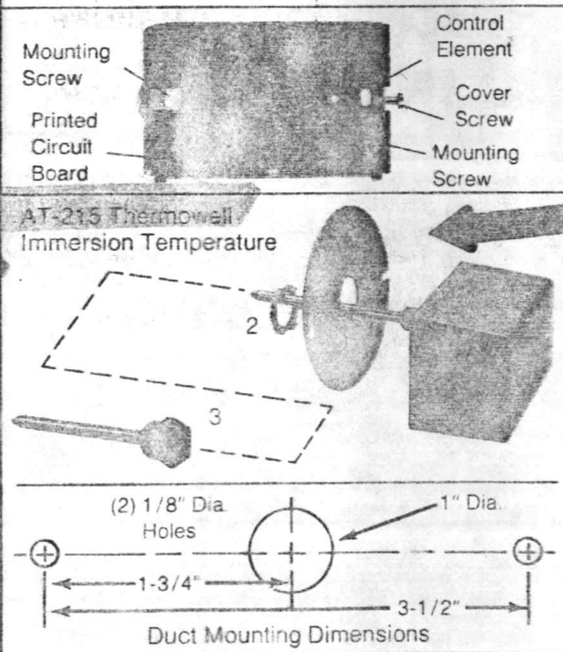
GENERAL INFORMATION

Sensing is accomplished by the use of a temperature sensitive Balco resistance wire packaged in the form of room, duct, averaging and outdoor type configurations. The design of the entire system is around a 1000 Ω sensing element at 70°F.

WIRING

Make all electrical connections to the element in accordance with the installation and wiring diagram for the job. Comply with national and local electrical codes. Do not use the element box as a junction box for other control circuits. It is generally advisable to use flexible conduit for connecting box to rigid conduit. Restrict element leads to shortest length practical. Barber-Colman twisted cable or factory approved cable should be used.

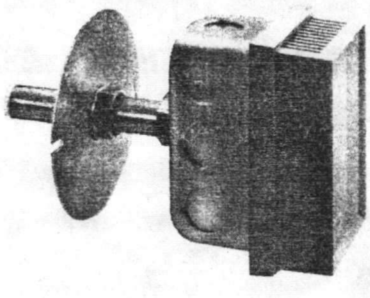


<table>
<tr><th>Part No.</th><th>Use</th><th>Location</th><th>Mounting</th><th>Terminal Code Wiring</th></tr>
<tr><td>TS-8101</td><td>Room Sensor w/o Setpoint</td><td>Wall</td><td rowspan="7"></td><td rowspan="2">⑦ } Output
⑧ } Terminals</td></tr>
<tr><td>TS-8111</td><td>Room Sensor w/Setpoint</td><td>Wall</td></tr>
<tr><td>TS-8201</td><td>Duct Immersion 7" Immersion Length</td><td>Duct or Wall AT-215 3/4" NPT</td><td rowspan="5">Pigtails:
Black } (C) Controlling
Black
Black } (L)* Controlling
Black
*Found only on the TS-8331</td></tr>
<tr><td>TS-8201 -106</td><td>Immersion 4" Insertion Length</td><td>Well AT-225 1/2" NPT</td></tr>
<tr><td>TS-8331</td><td>Lagged Sensor</td><td>Duct</td></tr>
<tr><td>TS-8405</td><td>5' Average</td><td>Duct</td></tr>
<tr><td>TS-8422</td><td>22' Average</td><td>Duct</td></tr>
<tr><td>TS-8241</td><td>Diffuser</td><td>Ceiling</td><td>Mount on Face of Ceiling Diffuser. See Instructions for B-C Models PB, PS or SFS, SFB. Pg. 2</td><td>Pigtails: Black
Black</td></tr>
<tr><td>TS-8261</td><td>Light Fixture</td><td>Light Fixture</td><td>Mount in Return Grill of Light Fixture</td><td>Pigtails: Black
Black</td></tr>
<tr><td>TS-8501</td><td>Outdoor Air</td><td>Outside of Building</td><td rowspan="3">Use Conduit Connectors</td><td>Pigtails: Black } Controlling
Black</td></tr>
<tr><td>TS-8531</td><td>Solar</td><td>Outside of Building</td><td>Orange } Element
Orange } (Solar)</td></tr>
<tr><td>TS-8533</td><td>Econostat</td><td>Outside of Building</td><td>Red } Heater
Red } (Econostat)</td></tr>
</table>

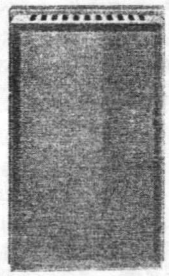
Solid State Humidity Sensing

Sensing is accomplished by the use of a nonorganic resistance type material which will be housed either in a room or duct type mounting base. Selection of the proper AH-100 series element will provide the capability of control over a 15% range. Elements are available through the span of 5% to 95% R.H.

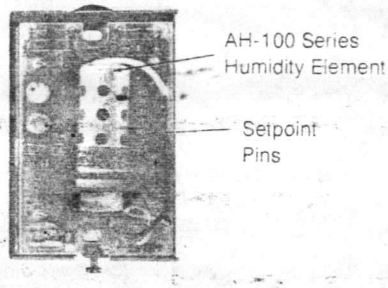
The average resistance of each element at midrange is approximately 22,000 ohms; except the violet element, which is 50,000 ohms. A resistor of appropriate value may be substituted in the bridge circuit to verify the element resistance.



Duct — HS-8200 Series



Room — HS-8100 Series



CAUTION

Do not measure resistance of element with an ohmmeter, as DC voltage across the element will cause polarization and a new element will be required. Basic element is not repairable. Order a replacement from the factory or local branch office.

CARE OF ELEMENT

The elements are wrapped with a moisture pervious cellophane, which actually is an air filter. On installations using duct elements, where air velocities are reasonably high **do not remove cellophane.** Always install element with wrapping so that perforations in cellophane are on downstream side of air currents. Punch more holes (only in downstream side of cellophane) to increase element sensitivity.

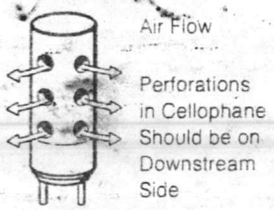


TABLE 1.

Part Number	Sensing Element Color	Relative Humidity Range
AH-100	Violet	85% to 95%
AH-101	Blue	70% to 85%
AH-102	Green	50% to 70%
AH-103	Yellow	40% to 55%
AH-104	Orange	30% to 45%
AH-105	Brown	10% to 30%

WIRING

Make all electrical connections to the device in accordance with the installation wiring diagram for the job. Comply with national and local electrical codes. Restrict element leads to shortest length practical, using three conductor twisted cable, 18 gauge minimum.

CAUTION

Power wiring must never be installed in the same conduit.

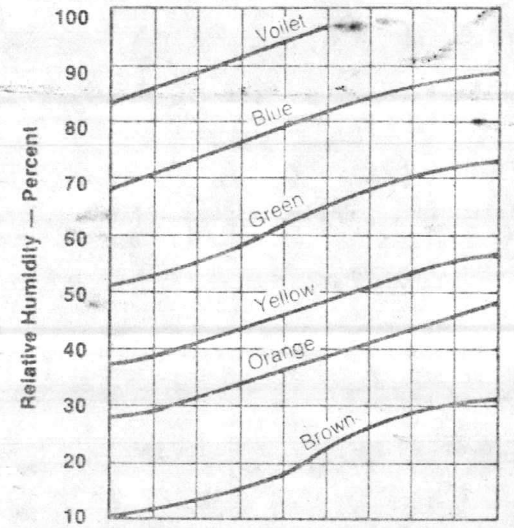
LOCATION

Locate the sensing element where it will be exposed to unrestricted natural air circulation and to the average conditions of the controlled space. Do not locate it near extreme sources of heat, cold, or moisture.

CALIBRATION

1. Place DC-VOM on output of CP-8102 controller, OP1 (+) and COM (-).
2. Read humidity at the sensor.
3. Place jumper on proper pin, per chart below.
4. Adjust the controller (CAL A) to 7.5 Vdc output.
5. Refer to CP-8102 literature if further details are required.

GENERAL INFORMATION



MOUNTING OF DIFFUSER SENSOR TS-8241

Sensor should be mounted to the face of the ceiling diffuser so that it projects downward into the room. See Figure 1. If the diffuser has an adjustable pattern, the discharge air direction must be adjusted to a horizontal pattern. This will insure a representative sample of room air over the element (Figure 2). The transmitter will not perform satisfactorily if the discharge is adjusted to a vertical pattern.

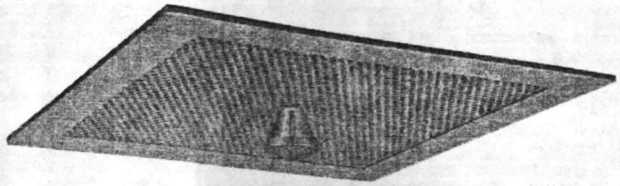


Figure 1.
Sensor Mounted in Perforated Face Ceiling Diffuser Model PB or PS

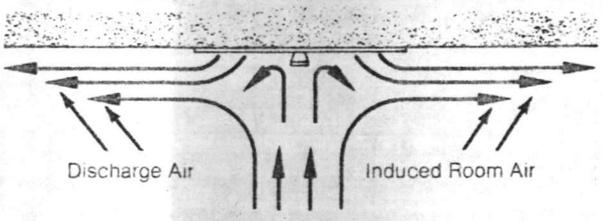


Figure 2.
Room Air Induced over Sensor by Discharged Air

A 7/16-inch hole is required in the diffuser face for mounting.

The SFS and SFB louver faced diffusers are available in nine air patterns, both in the square and rectangular design. For proper installation, use Table 2 which shows sensor location and the mounting figure referred to in the installation procedure. APNS-107 must be ordered separately.

SENSOR MOUNTING PROCEDURE ON SFS AND SFB USING APNS-107 KIT

1. Drill a 5/16" hole for sensor leads.
   a. Fig. 3. Locate hole center on an angled surface about 5/16" from an edge of the 1/2" square so as to avoid drill contact with the welded center plate mounting brackets.
   b. Fig. 4. Locate the hole center on one louver about 5/16" from junction of two center back to back louvers.
   c. Fig. 5. Locate hole center on an end louver about 1/2" from the junction of the louver and the mounting flange.
2. Bring field leads through the 5/16" hole. If required, remove the louver assembly from the mounting flange.
3. Center the APNS-107 bracket over the 5/16" hole (use as a template) and drill 1/8" holes for the mounting screws.
   a. Fig. 3. Drill two holes near edges of square center plate.
   b. Fig. 4. Drill two holes, one each on bottom edge of back to back louvers.
   c. Fig. 5. Drill one hole on end louver.
4. Assemble the sensor to APNS-107 bracket as shown in Figs. 3, 4, and 5.

   Fig. 5. Cut off one side of APNS-107 as shown.
5. Make field connections to sensor leads and push leads up through the 5/16" hole.

   Wrap friction or electrical tape around the leads and fill the 5/16" hole, preventing direct primary air passage over the sensor.
6. Attach APNS-107 as shown in Figs. 3, 4, and 5 using #6 screws.

   Fig. 5. Cover the crack between the end louver and mounting flange at least 12" on each side of the sensor. A 24" length of 3/4" tape stuck to mounting flange can be used.
7. The sensor installation is complete.

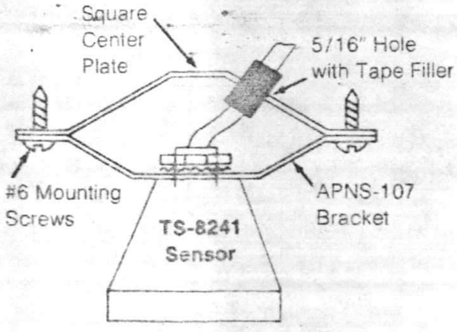


Figure 3

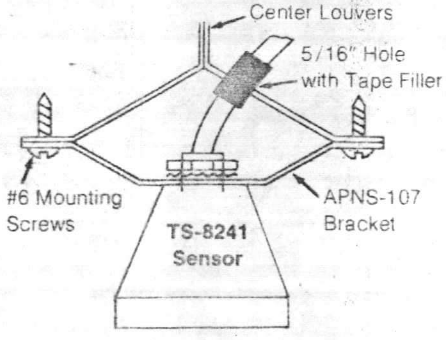


Figure 4

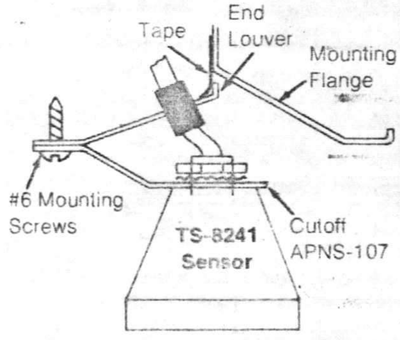


Figure 5

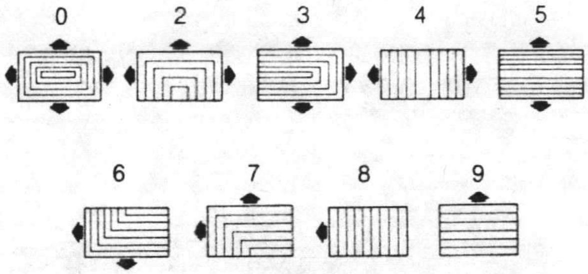
TABLE 2. SENSOR LOCATION AND FIGURE SHOWING MOUNTING DETAILS

Air Pattern	Sensor Location: Center of Diffuser — Sq.	Rect.	Center of Side with No Air Throw — Sq.	Rect.	Corner Opposite Air Throw — Sq.	Rect.	End Opposite Air Throw — Sq.	Rect.
0	Fig. 3	Fig. 4						
2			Fig. 4					
3								
4	Fig. 4							
5								
6					Fig. 3	Fig. 5		
7								
8							Fig. 5	
9								

TS-8241 must not be located nearer than 18" from a wall or corner of a room when used on air patterns 2, 6, 7, 8, or 9. This allows space for induced air to pass over TS-8241.

AIR PATTERNS (As Viewed from Diffuser Face)

Number is air pattern designation when ordering.



Specifications			Temperature Sensors: Room Light Fixture Diffuser*	Duct/ Immersion	Averaging	Selective Ratio Discharge	Humidity Sensors (Sensors must be ordered separately. Refer to Sensor Range Table 1.): Room	Duct
Package		Size**	4⅜×2¾×1⅝	4¾×3½×9⅛	4¾ × 3½ × †	4¾×3½×9⅛	4⅜×2¾×1⅝	4⅜×3½×9⅛
		Mounting	Wall	Duct/ Immersion	Duct	Duct	Wall	Duct
		Mounting Position	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical
		Connection	Terminals	Pigtails	Pigtails	Terminals	Pigtails	Pigtails
		Ambient Temp. Limits	-40 to 250°	-40 to 250°	-40 to 250°	-40 to 250°	35 to 135°	35 to 135°
Sensor		Resistance	1000 Ω	1000 Ω	1000 Ω	1000 Ω		
		Sensitivity	2.2 Ω/°F	2.2 Ω/°F	2.2 Ω/°F	2.2 Ω/°F		
		Length		6"	5' or 22'	6"		6"
Input	Control Range							
	Impedance							
	Adjust	Setpoint Range	55 to 85°				Up to 20% R.H.	Up to 20% R.H.
		Calibration Range					±5%	±5%
		Throttling Range						
		Ratio				5 to 20/1		
Output	Voltage	Impedance						
		Range						
		Reference				Negative	Negative	Negative
	Power Supply	Voltage						
		Current						
		Regulation						
Load		Voltage						
		Current						
Power		Voltage				6.2 Vdc ±.4	24Vac±10%	24Vac±10%
		Current				1 mA	25 mA	25 mA

Barber-Colman Company

ENVIRONMENTAL CONTROLS DIVISION

1354 Clifford Avenue
P.O. Box 2940
Loves Park, IL U.S.A. 61132-2940

Para. 2.2.2.9 RC-1

General Instructions

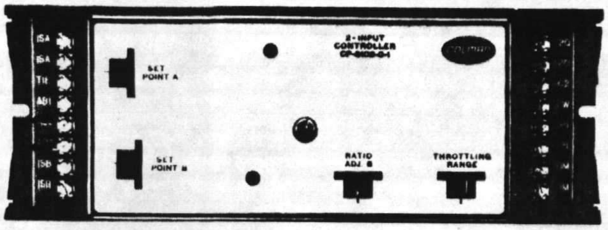
CP-8102 Electronic Two Input Temperature or Humidity Controller

FUNCTIONS

Electronic controller receives temperature or humidity sensor inputs and sends a variable electronic signal, 1 to 15 Vdc, to up to six System 8000® actuators or relays (controlled devices). Additional devices can be controlled with the use of adapters. These actuators or relays operate heating, cooling, humidification or dehumidification equipment in HVAC systems.

FEATURES AND BENEFITS

The reliable, easy to install CP-8102 electronic controller incorporates an amplifier with inputs for 1000ohm Balco® temperature sensors, humidity sensors or remote setpoint adjustor. Two setpoint dials, ratio authority dials, throttling range dials and calibration potentiometers are visable and accessible without removing controller cover allow for easy field adjustment. Coded screw terminals make sensor, remote setpoint, power supply and output signal wiring easy to install and change. The CP-8102 controller is used with other System 8000 devices.



CP-8102

Wiring Connections: Coded screw terminals for all control inputs and outputs.

Safe Ambient Temperature Limits:

Operation: 40 to 135°F (4.4 to 57°C)
Storage: -40 to 160°F (-40 to 71°C)

Dimensions: 4" (102 mm) high × 11" (279 mm) wide × 2-1/2" (64 mm) deep

Table 1. Specifications

Part Number	Control Dial Range Setpoint "A"	Control Dial Range Setpoint "B"	Throttling Range for 3 Vdc Output Change	Authority Ratio Adjustment Setpoint "A" Setpoint "B"	Control Output Voltage†	Power Required	Power Supply Available
CP-8102	20 to 120°F	20 to 120°F	Adjustable 2 to 10°F by Dial*	.5:1 to 25:1 Adjustable by Dial	1 to 15 Vdc 10 mA Max. Factory Set for D.A.	20 Vdc 23 mA	6.2 Vdc 7 mA Max.
CP-8102-116	-6 to 48°C	-6 to 48°C	Adjustable 1 to 6°C by Dial*				

* See ADJUSTMENTS for additional throttling ranges.
† Units factory calibrated for 7.5 Vdc output with sensor at setpoint temperature.

Options: None.

ACCESSORIES:

AD-8122	Signal adaptor for dual outputs (two direct acting)
AD-8123	Signal adaptor for dual outputs (one direct, one reverse acting)
AD-8124	Signal adaptor for dual outputs (one reverse, one direct acting)
AD-8912	12" enclosure
AD-8969-201	Off set resistor kit: 5, 10, 15 & 20°F
AD-8969-901	Extended throttling range jumper
ASP-301	Power supply required for HSP-6X81 humidity transmitter
ASP-581	Indication meter 20 to 80% RH
AT-8122	Remote setpoint adjuster, dual scale 20 to 120°F (-6 to 49°C)
AT-8155	Remote setpoint adjuster, dual scale 50 to 250°F (10 to 121°C)
AT-8158	Remote setpoint adjuster, dual scale 55 to 85°F (13 to 29°C)
AT-8222-101	Setpoint scale for humidity 20% to 100%
AT-8435	Remote setpoint adjuster, dual scale 50 to 450°F (10 to 232°C) for use with TS-8204 only
CN-8101	Multi-purpose bridge
HS-8101	Room humidity sensor
HS-8201	Duct humidity sensor
TS-8101	Room sensor
TS-8111	Room sensor with setpoint
TS-8131	Room button type sensor
TS-8201	Duct/immersion sensor
TS-8204	High temp. duct/immersion sensor requires AT-8435 remote setpoint for all applications except differential control
TS-8241	Diffuser sensor
TS-8261	Light fixture sensor
TS-8331	Lagged sensor (CN-8101 is required)
TS-8405	5' averaging sensor
TS-8422	22' averaging sensor
TS-8501	Outdoor sensor
TS-8531	Solar sensor (CN-8101 is required)
TS-8533	Econostat sensor
Tool-201	Calibration kit for system 8000

DEFINITIONS

Mode of Operation: Either direct-acting or reverse-acting.

Direct-acting (D.A.) means that an increase in temperature at the sensor(s) causes the voltage output (OP1) to increase.

Reverse-acting (R.A.) means that an increase in temperature at the sensor(s) causes the voltage output (OP1) to decrease.

Reset Control Action: The direction of reset determines whether input A setpoint is reset upward or downward on a temperature decrease at input B.

Direct reset: (D.R.) A temperature decrease on input B resets input A setpoint downward.

Reverse reset: (R.R.) A temperature decrease on input B resets input A setpoint upward.

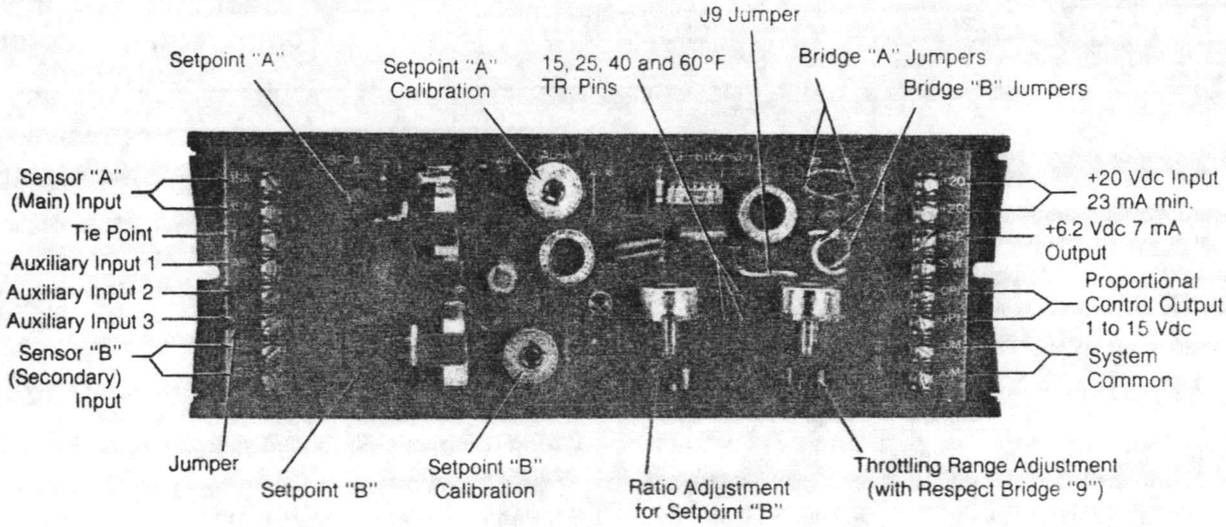


Figure 1. CP-8102

CONTROL TERMINAL INPUTS (See Figure 1)

ISA: Any TS-8000 Temperature Sensor (1000 ohm Balco)

ISB: Any TS-8000 Temperature Sensor (1000 ohm Balco)

AB1, AB2, AB3: Auxiliary inputs; any remote setpoint adjuster AT-8000 series, HS-8X01 humidity sensor, CN-8101 multi-purpose bridge

CONTROL TERMINAL OUTPUT (See Figure 1)

OP1: 1 to 15 Vdc (10 mA maximum). Units factory calibration for 7.5 Vdc output with sensor at setpoint temperature.

ADJUSTMENTS: (See figure 1)

Temperature Setpoint "A": By dial 20 to 120°F (-6 to 48°C), or by remote setpoint adjuster (See Accessories).

Temperature Setpoint "B": By dial 20 to 120°F (-6 to 48°C), or by remote setpoint adjuster (See Accessories).

Setpoint "A" Calibration: By potentiometer.

Setpoint "B" Calibration: By potentiometer. For reset control, set Setpoint "B" at value where Setopint "A" will be reset. Adjust Setpoint "A" at control point required with no reset from sensor "B".

THOTTLING RANGE: By dial 2 to 10°F, 1 to 6°C. By pin selection 15, 25, 40 and 60°F (8, 14, 22, 33°C). Remove J9 jumper from JC9 and attach to required throttling range pin. By extended throttling range adjuster, AD8969-901 (order separately), 55, 65, 75, 85, 100, 115, 125 and 140°F (31, 36, 42, 47, 56, 64, 69 and 78°C). The throttling range is the sum of the T.R. pins connected.

AUTHORITY RATIO
ADJUSTMENT: By dial .5 to 25:1. Ratio is the number of degrees change at Sensor "B" required to reset Setpoint "A" one (1) degree. Example: 25:1 means a 25°F (14°C) change at Sensor "B" will reset Setpoint "A" 1°F (.5°C).

Table 2

Controller Function	Jumper Connections Required	
	Bridge "A"	**Bridge "B"**
Direct Acting*	J4 to JC6 J3 to JC5	J5 to JC5 J6 to JC6
Reverse Acting	J4 to JC5 J3 to JC6	J5 to JC6 J6 to JC5
Internal Setpoint Active*	J1 to JC1	J2 to JC3
Internal Setpoint Inactive for Remote Setpoint	J1 to JC2	J2 to JC4
Disable Bridge "B" for Single Sensor Input	Remove Jumper from AB2 to AB3	

* As supplied from factory.

To Obtain Reverse Reset: Both bridges should have the same action. Example: both direct acting, or both reverse acting.

To Obtain Direct Reset: Bridges should have different action. Example: one direct and one reverse acting.

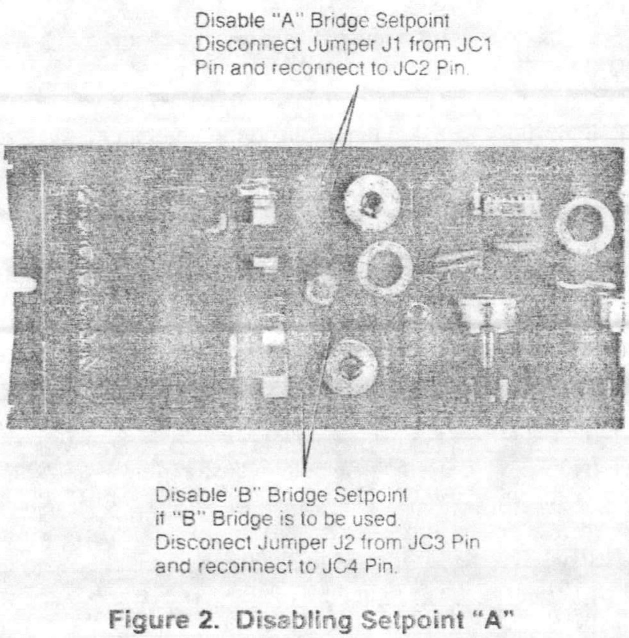


Figure 2. Disabling Setpoint "A" and/or Setpoint "B"

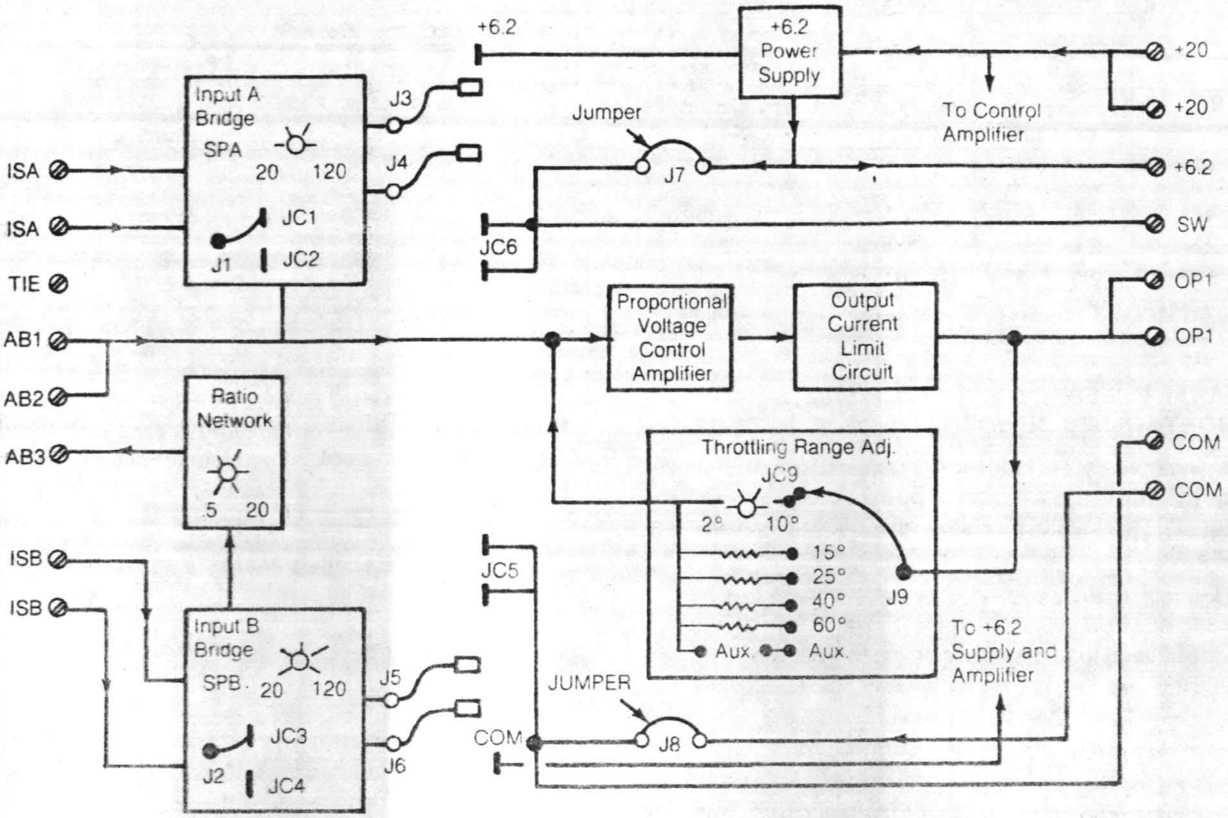


Figure 3. CP-8102 Controller Block Diagram

PRE-INSTALLATION: Open the carton and visually inspect the device for part number and obvious defects before proceeding with the installation.

NOTE

Mounting screws are not provided.

INSTALLATION: Device may be mounted, in any position, in an inside location near the controlled equipment using the two slots in the track. AD-8912 enclosures can be ordered separately for remote installations.

CAUTION

Avoid locations where excessive vibration, moisture, corrosive fumes or vapors are present, or where high radio frequency or electro-magnetic interference generating devices are near.

See Figure 4 for mounting dimensions.

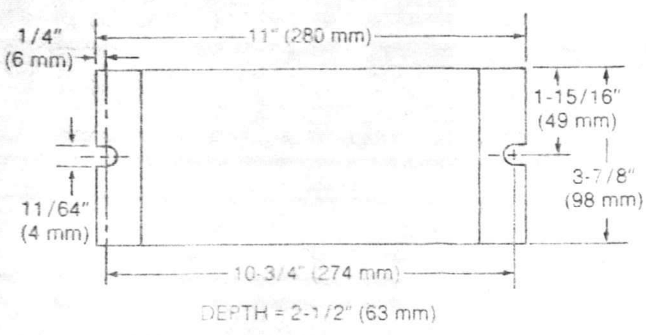


Figure 4. Mounting Dimensions

GENERAL WIRING INFORMATION

Make all connections according to job wiring diagrams and in compliance with national and local codes.

Two separate No. 18 twisted pair wires (six turns per foot [.3m]).
Class II, low voltage, are suitable for up to 1000 feet (300 m) for the sensor leads. See table 3 for longer runs.

CAUTION

Never run line voltage in the same conduit with unshielded sensing element leads. Use copper conductors only.

Shielded cable (Belden No. 8422 or equivalent) must be used when it is necessary to install the DC signal leads in the same conduit with power wiring, or when it is known that high RFI/EMI generating devices are near. Ground the shield at the controller only on the COM (-) terminal.

Table 3. Wiring Lengths

Wire Gauge	LENGTH OF RUN IN FEET**						
	"HS" Sensor To CP-8102	"TS" Sensor To CP-8102	CN-8101, AT-81X4 TS-8601 To CP-8102	"HSP" Transmitter To CP-8102	TSP-8101 To CP-8102	CP-8102 To Controlled Device	CP-8102 To Adaptor*
22	125	—	—	—	Should be in Same Panel as Controller	—	—
18	300	1,000	1,000	250		1,000	1,000
16	—	2,250	—	—		2,250	2,250
14	—	4,000	—	—		4,000	4,000

* AD-8101, AD-812X, AD-8201, AD-8301, AD-8501

**1 Ft. approx. .3 meter

GENERAL RULES FOR WIRING CP-8102 TO CONTROLLED DEVICE(S)

1. Never connect red lead (or +20 terminal) of any controlled device which has a regulated power supply to the red lead (or +20 terminal) of any other controlled device (see Figure 5).
2. Controlled devices (MP-52XX) with unfiltered and unregulated power supplies must be filtered. CP-8102 will provide filtering for a maximum of two MP-52XX by connecting the two red leads together at the controller's +20 terminal (see Figure 6).
3. Controlled devices with filtered and unregulated supplies: Up to six controlled devices with the red leads (+20 terminals) can be connected together. Number of units paralleled depends on the current (mADC) requirements of the controller or adaptor.

Table 4. Controlled Device Power Supply Characteristics

Filtered & Regulated	Filtered & Unregulated	Unfiltered & Unregulated
CC-8101 CC-8102 CC-8103 CC-8111 Series CC-8118 Series CC-8218 Series CP-8161 Series CP-8301 Series* CP-8425 Series CP-8501 Series CP-8502 Series	MP-54XX MS-8XXX Actuators	MP-52XX Actuators

* Except CP-8301-101 which does not have a power supply.

FIELD CHECKOUT

Units are factory calibrated and tested and should not require field checkout. If required, proceed as follows (see Figure 1):

NOTE

The following procedures can be used for either reverse or direct acting connected CP-8102 controllers.

1. Initial Conditions for CP-8102
   A. Jumper between AB2 and AB3 disconnected.
   B. 20 Vdc +1 - 1.5 Vdc (23 mA) applied to the +20 and common terminals. This power is normally supplied by the controlled device.
2. Connect a 20,000 ohm/volt DC VOM meter between the OP1 (+) terminal and COM (-) terminal of the CP-8102. Use a 20 Vdc or less range.
3. Disconnect the temperature sensing element "A" from the ISA terminals of the CP-8102. Short ISA terminals together and VOM reading should be 1 Vdc or less if bridge "A" is direct acting and more than 15 Vdc if bridge A is reverse acting.
4. Open ISA terminals and VOM reading should be greater than 15 Vdc if bridge "A" is direct acting and less than 1 Vdc if bridge "A" is reverse acting.
5. The CP-8102 is a good unit if it passes tests in steps 3 and 4. Replace the unit if tests 3 and 4 are not met.

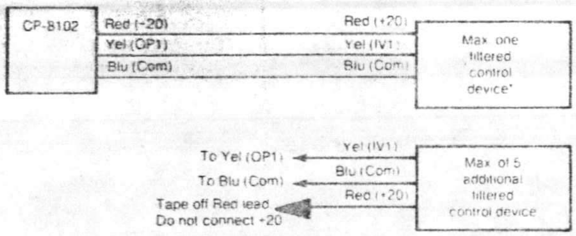


Figure 5. Controlled Devices All Filtered

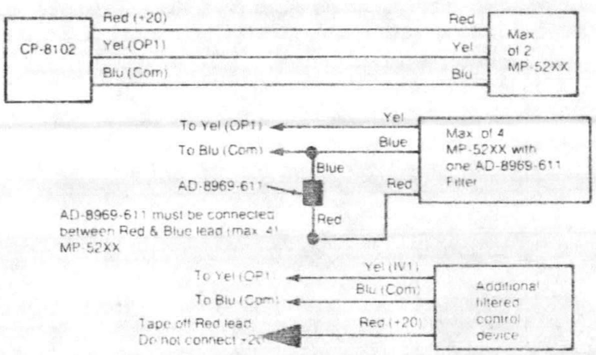


Figure 6. At Least One of the Controlled Devices in MP-52XX (Unfiltered)

FIELD CALIBRATION PROCEDURES FOR CONTROLLERS WITH ONE AND TWO INPUTS

(See Figures 7 and 9):

The following procedures can be used for either reverse or direct acting connected CP-8102 controllers.

The CP-8102 is factory calibrated and shipped with both inputs connected for direct acting output.

Normally, the CP-8102 (connected for either direct or reverse acting) requires no field calibration but if a field calibration check or recalibration becomes necessary, then proceed as follows:

1. Initial Conditions for CP-8102:

   A. Setpoint "A" set for: 70°F.

   B. Setpoint "B" set for: 70°F.

   C. Ratio adjustment set for: 1:1.

   D. Throttling range adjustment set for: 3°F.

   E. Jumper between AB2 and AB3 disconnected.

   F. 20 Vdc (23 mA) applied to the +20 and common terminals. This power is normally supplied by the controlled device.

2. Connect a 20,000 ohm/volt DC VOM meter between the OP1 (+) terminal and COM (-) terminal of the CP-8102. Use a 20 Vdc or less range.

3. Calibration of "A" input. Use one of the following two methods.

   A. Temperature measurement methods:

      Accurately measure the temperature at the temperature sensing element "A". Adjust setpoint "A" until the dial reading agrees with the temperature measured. Rotate setpoint "A" calibration potentiometer (located just to the right of setpoint "A" dial) until a VOM reading of 7.5±.2 Vdc is obtained.

   B. Sensing element substitution method:

      Disconnect the temperature sensing element "A" from the ISA terminals of the CP-8102. Reconnect a 1000 ohm ±.1% wire wound resistor (TOOL-203) to the ISA terminals. Adjust setpoint "A" for 70°F. Rotate setpoint "A" calibration potentiometer (located just to the right of setpoint "A" dial) until a VOM reading of 7.5±.2 Vdc is obtained.

NOTE

Method B above does not calibrate out any errors due to sensing element tolerances or wire lead resistance.

4. Calibration of "A" input complete.

   If "B" input is not being used (jumper between AB2 and AB3 removed) then proceed to step 7 below.

5. Reconnect jumper between AB2 and AB3.

6. Calibration of "B" input. Use one of the following two methods.

   A. Temperature measurement method:

      Accurately measure the temperature at the temperature sensing element "B". Adjust setpoint "B" until the dial reading agrees with the temperature measured. Rotate setpoint "B" calibration potentiometer (located just to the right of setpoint "B" dial) until a VOM reading of 7.5±.2 Vdc is obtained.

   B. Sensing element substitution method:

      Disconnect the temperature sensing element "B" from ISB terminals of the CP-8102. Reconnect a 1000 ohm ±.1%, wire wound resistor (TOOL-203) to the ISB terminals. Adjust setpoint "B" for 70°F. Rotate setpoint "B" calibration potentiometer (located just to the right of setpoint "A" dial) unti a VOM reading of 7.5±.2 Vdc is obtained.

NOTE

Method B above does not calibrate out any errors due to sensing element tolerances or wire lead resistance.

7. CP-8102 calibration is complete. Remove all test meters, test resistor, etc. Reconnect all elements, place setpoints, throttling range and ratio adjustments as required for the application.

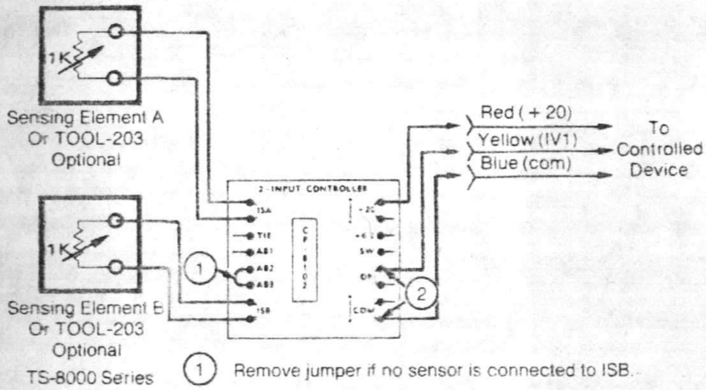


Figure 7. One or Two sensor Application

FIELD SERVICE

Units are factory calibrated and tested for direct acting control (D.A.) and reverse reset (R.R.) and should not require service. If required, proceed as follows (see Figure 8):

Power Supply

Apply +20; +1, -1.5 Vdc (23 mA) to the +20 and common terminals. Proper power supply is always required for unit to function properly. The +6.2 (±.3) Vdc should be available from the controller, if required.

Test

Connect a 20,000 ohm/volt DC VOM meter between +20 and common terminals. Controller power supply +20, +1 -1.5 Vdc (indicated by M1 in Figure 8) should be measured. Power supply is normally supplied by controlled device. Check +6.2 (±.3) Vdc power supply of controller with VOM.

Service

If the +20 Vdc level is not measured, service the (lead) controlled device, power supply or installation wiring as necessary to insure proper power supply.

Controller Output

See Field Calibration Procedures on this page, for calibration of "A" setpoint using sensor element substitutes.

Test

With signal output measured between OP1 and COM at 7.5 ± .2 Vdc, rotate setpoint "A" dial several degrees (in increments of 1°F) each way from 70° setting to vary the M2 reading from 1 to 15 Vdc. The number of degrees that setpoint dial "A" is changed to vary the reading on M2 3 Vdc should be approximately 3°F (if T.R. is set at 5°F, 3 Vdc will change over 5°F).

Service

See Field Calibration Procedures, on page 5, for calibration of "B" setpoint using sensor element substitutes. (Make certain that jumper is connected to AB2 and AB3.)

Adjusting setpoint "B" several degrees from 70°F setting will cause the M2 reading to vary from 1 to 15 Vdc.

If output voltage cannot be made to vary over a 1 to 15 Vdc range, then replace the CP-8102 as defective.

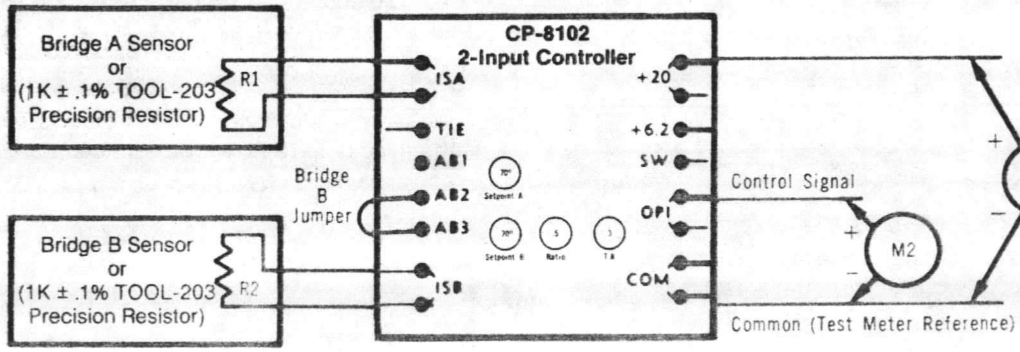


Figure 8.

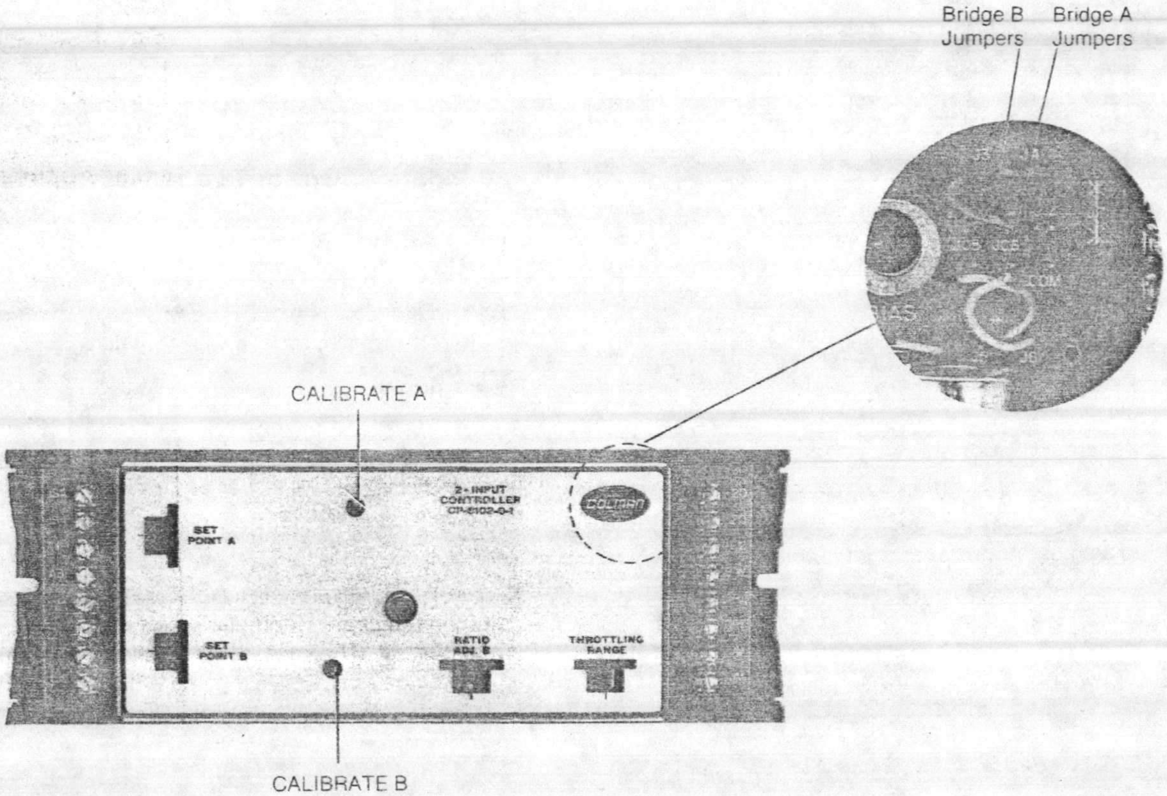


Figure 9.

MAINTENANCE

This is a quality product. Regular maintenance of the total system is recommended to assure sustained optimum performance.

TYPICAL APPLICATIONS

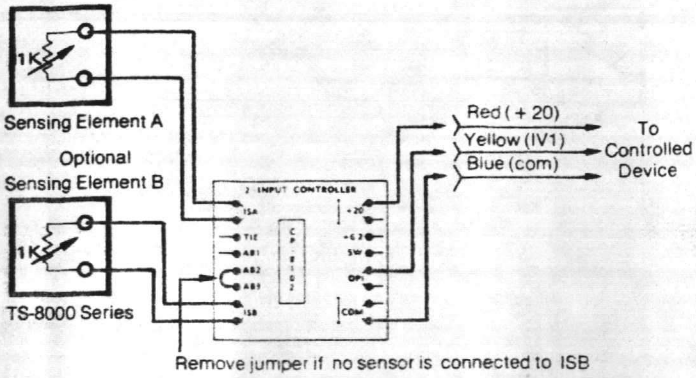


Figure 10. One or Two Temperature Sensor Application

Hot water reset is typical application for a two sensor application of the CP-8102. For example, perimeter radiation temperature, with hot water as a heating medium, is increased as the temperature of the outside air decreases. This method of control is known as reverse reset. A reset schedule shown below in table requires the hot water temperature to increase from 100° to 170°F, a change of 60°F, as the outside air temperature decreases from 60° to 0°F. If the throttling range of the CP-8102 controller is 10°F the setting of the CP-8102 will be as follows:

Setpoint "A": 110°
Setpoint "B": 60°
Ratio Adjustment: 1 (change in outside air temperature/change in hot water temperature)
Throttling Range: 10°F
Note: Controller function is Direct Acting * (see table 2)
* Factory setting

Table 5. Reset Schedule

Outside Air Temp. (°F)	Water Temperature (°F)
60	110
0	170

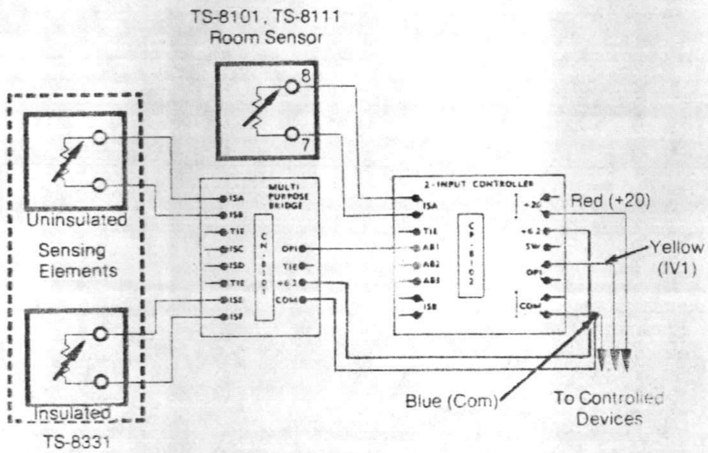
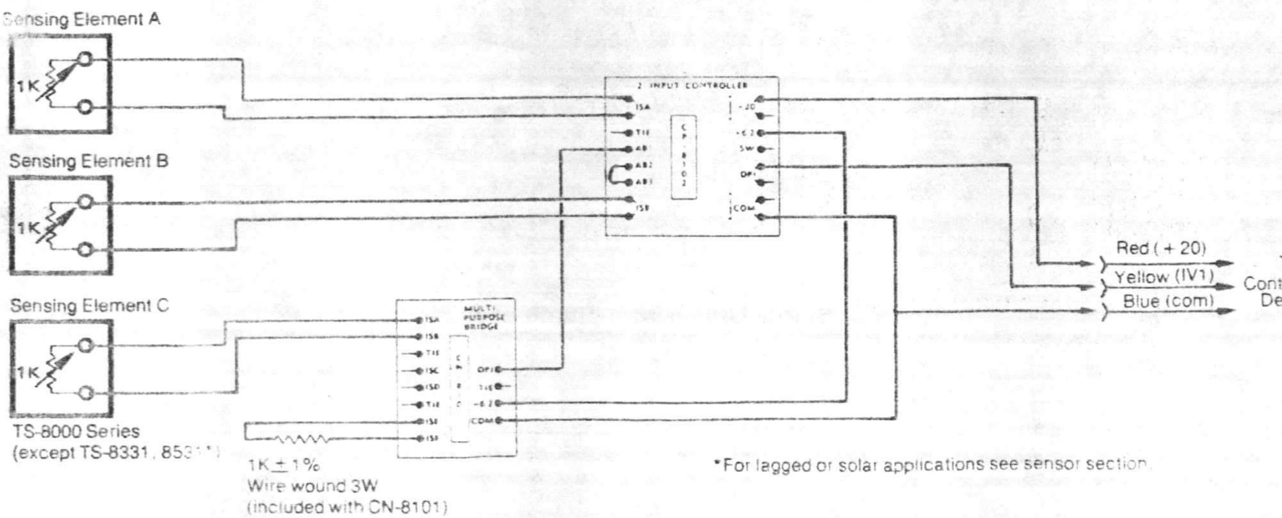


Figure 11. Derivative (Lagged) Sensor



*For lagged or solar applications see sensor section.

Figure 12. Three Temperature Sensor Application*

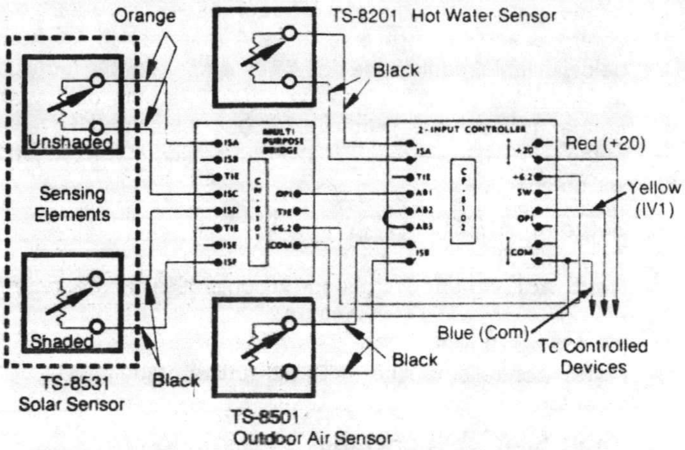
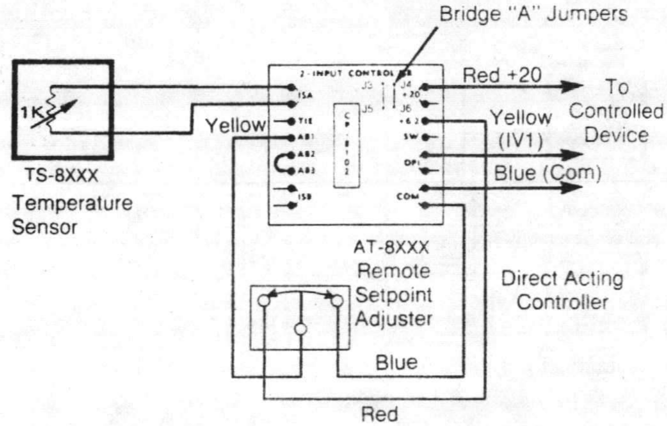


Figure 13. Solar and Outdoor Air Reset of Hot Water (Direct Acting Output)



NOTE: If the controller bridge is reverse acting, the red and blue wires at the AT-8XXX Series must be reversed (red to common, blue to +6.2).

Figure 14. Single Input with Remote Setpoint

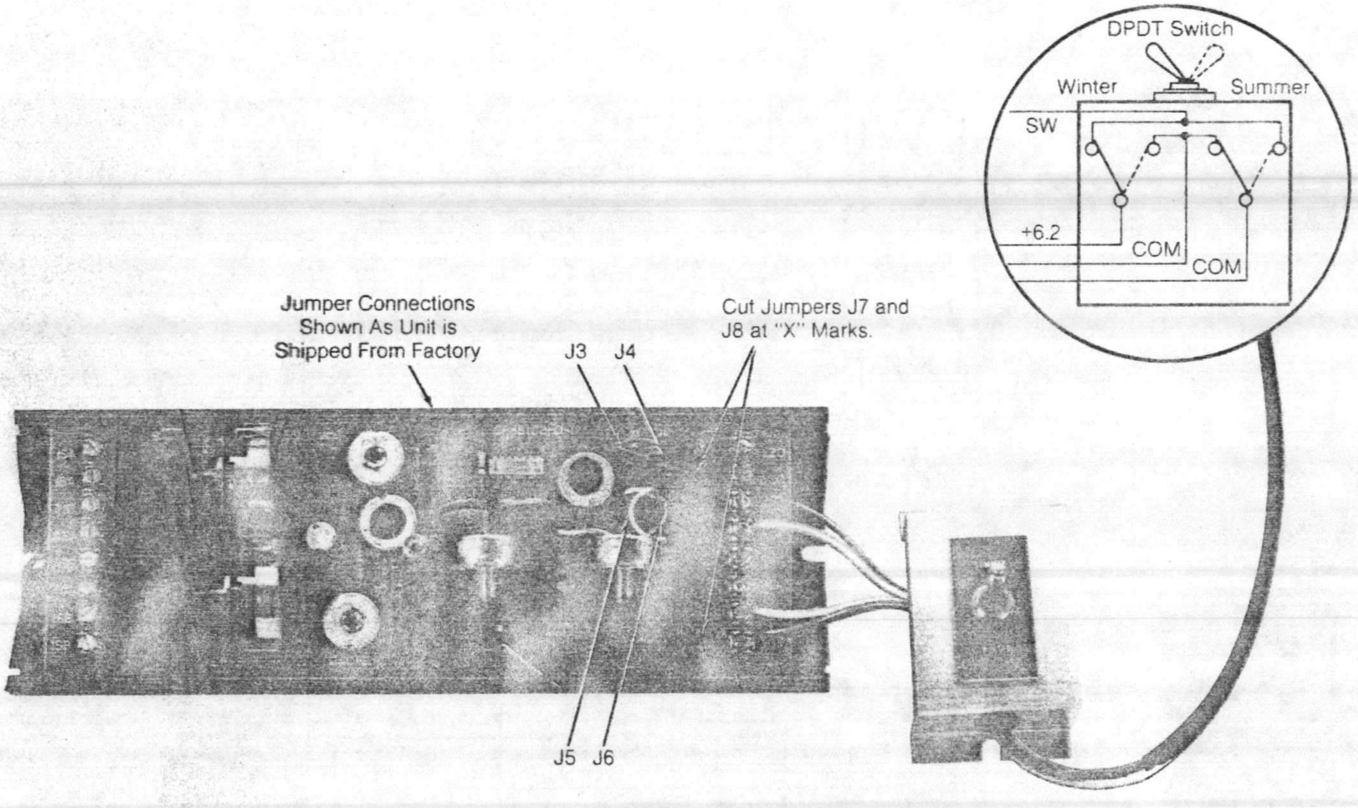


Figure 15. Single Unit Winter-Summer Switching

1. Cut both jumpers that are located between the terminal strip and cover on the left hand side of the device. (See Figure 15).
2. Connect D.P.D.T. Switch (CYZP-11 or equivalent) according to Figure 15.

NOTE

Switch contacts should have pilot duty ratings and maintain a 1 ohm or less contact rating over its normal life.

3. No recalibration of CP-8102 is required.

SINGLE UNIT SUMMER/WINTER SWITCHING (Continued):

Table 6. Bridge Connections for Summer/Winter (See Figure 15.)

BRIDGE "A" (MAIN SENSOR)		BRIDGE "B" (RESET SENSOR)		RESET OF SETPOINT "A"		JUMPER TO PIN CONNECTIONS			
Winter	Summer	Winter	Summer	Winter	Summer	J3	J4	J5	J6
D.A.	R.A.	D.A.		Reverse	Direct	JC5	JC6	COM	+6.2
R.A.	D.A.	D.A.		Direct	Reverse	JC6	JC5	COM	+6.2
D.A.	R.A.	R.A.		Direct	Reverse	JC5	JC6	+6.2	COM
R.A.	D.A.	R.A.		Reverse	Direct	JC6	JC5	+6.2	COM
D.A.		D.A.	R.A.	Reverse	Direct	COM	+6.2	JC5	JC6
R.A.		D.A.	R.A.	Direct	Reverse	+6.2	COM	JC5	JC6
D.A.		R.A.	D.A.	Direct	Reverse	COM	+6.2	JC6	JC5
R.A.		R.A.	D.A.	Reverse	Direct	+6.2	COM	JC6	JC5

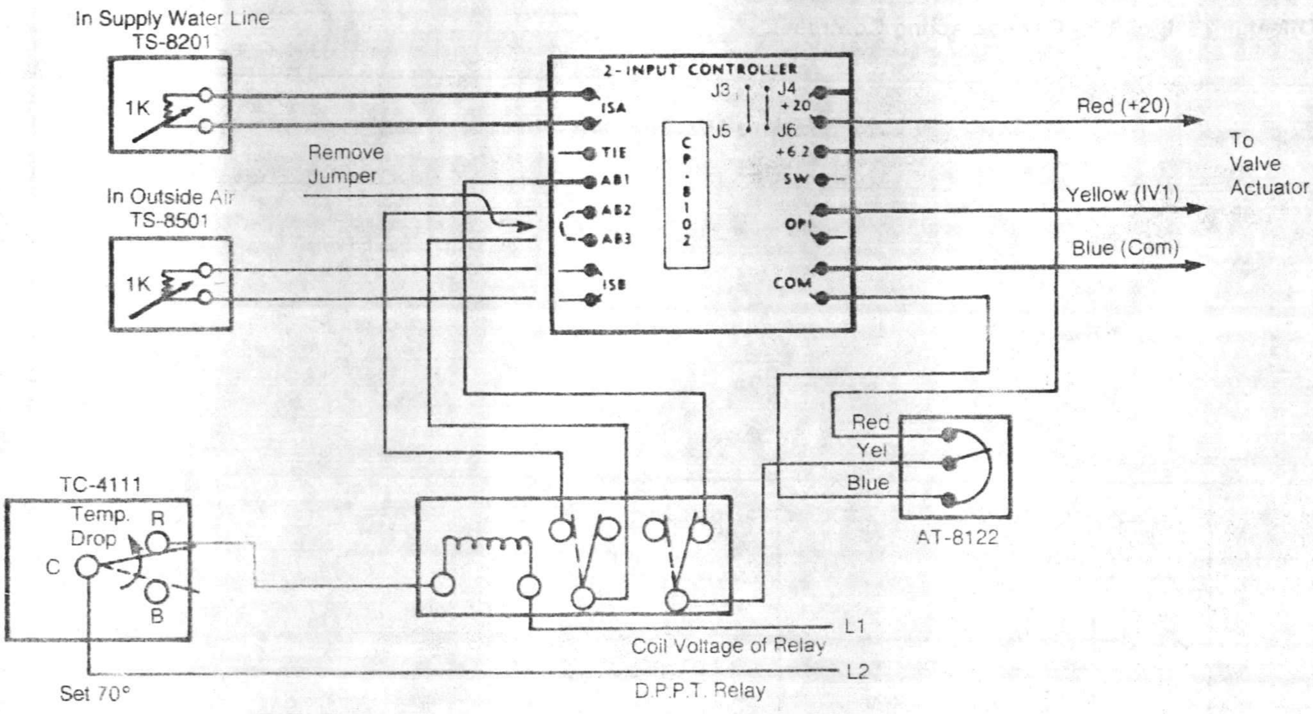


Table 7. Typical Reset Schedule

Outside Air Temp. (°F)	Water Temperature (°F)
70°	110°
0°	140°
Above 70°	85°

Outside air temperature reset of supply water temperature with fixed temperature of 85°F with outside air temperature of 70°F.

Setpoint "A": 110°F

Setpoint "B": 70°F

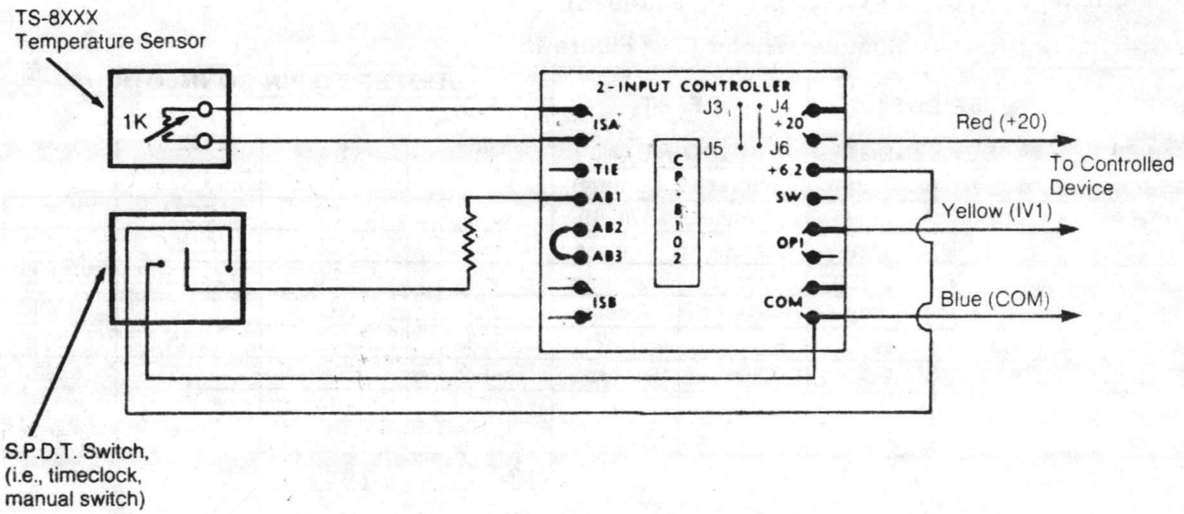
Ratio Adjustment: 2.33

Throttling Range: 10°F

AT-8122: Set 45°F for S.P. of 85 where O.A. is above 70°F.

Relay is energized with outside air temperature below 70°.

Figure 15. Outside Air Temperature Reset of Hot Water with Fixed Temperature with Outside Air Temperature Above Selected Value



Resistor (5, 10, 15, 20°F offset) use AD-8969-201 kit.

Offsetting setpoint for Direct Acting Controller:

Raise, connector resistor to +6.2 terminal.

Lower, connect resistor to COM terminal.

Offsetting setpoint for Reverse Acting Controller:

Raise, connect resistor to COM terminal.

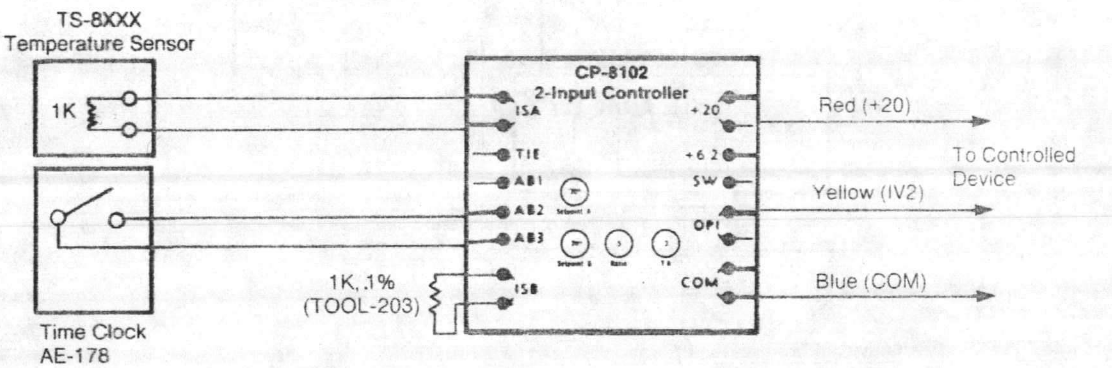
Lower, connect resistor to +6.2 terminal.

NOTE

Standard two conductor twisted wire should be used if remote switching is employed.

Resistor must always be located at stat.

Figure 16. Setpoint Offset

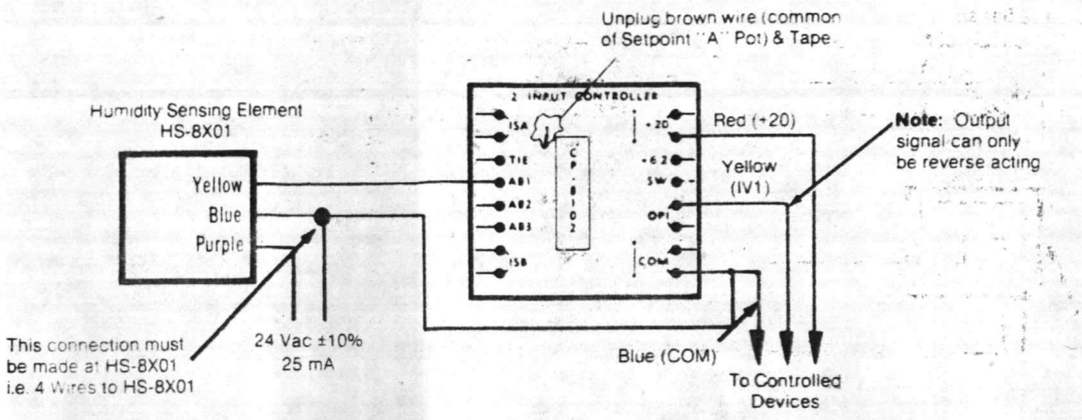


Install 1000 ohm 1% (TOOL-203) resistor in ISB. Install AE-178 7 day time clock. Set setpoint "B" as desired for night setback.

Table 8.

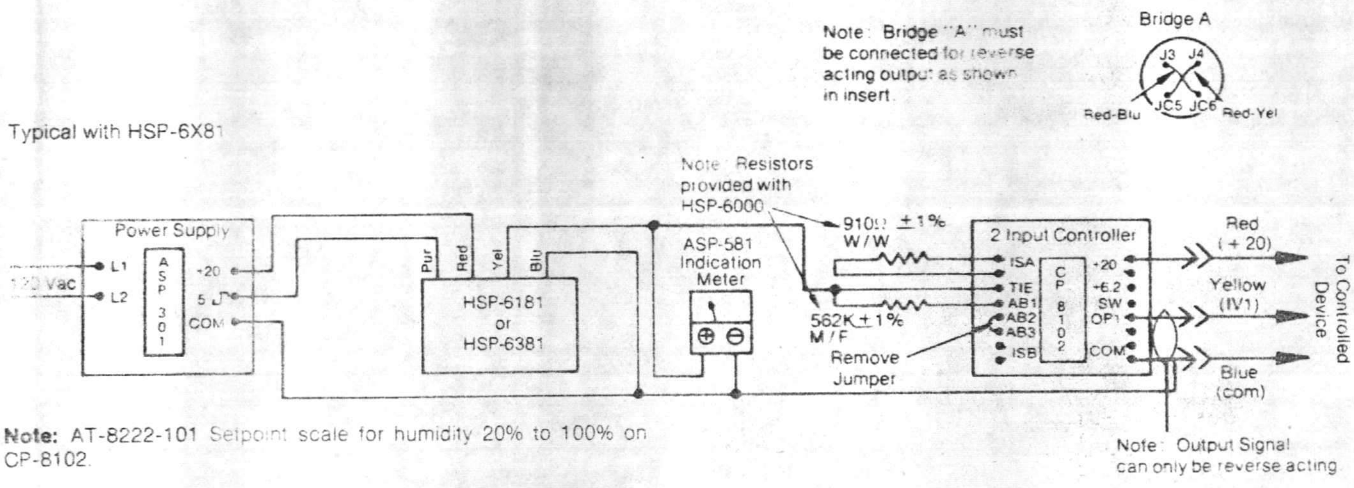
Setpoint "B"	Night Setback
70°F (21.1°C)	No Setback
65°F (18.3°C)	5°F (2.8°C) Setback
60°F (15.6°C)	10°F (5.6°C)Setback
55°F (12.8°C)	15°F (8.3°C) Setback

Figure 17. Night Setback



Note: Settings of 2-6 throttling range result in 2-6% RH throttling range for 3 Vdc output change. 6 TR is maximum setting.

Figure 18. Humidity Control



Note: AT-8222-101 Setpoint scale for humidity 20% to 100% on CP-8102.

Figure 19. Humidity Control & Indication

Barber-Colman Company
ENVIRONMENTAL CONTROLS DIVISION

1354 Clifford Avenue
P.O. Box 2940
Loves Park, IL U.S.A. 61132-2940