76223

NO SPEC

FROM SNEEDEN, INC.
Air Conditioning & Refrigeration

P. O. BOX 3548 WILMINGTON, NORTH CAROLINA 28401

RETURN REQUESTED - THIRD OR FOURTH CLASS

TO

OPERATION, MAINTENANCE AND PARTS MANUAL

FOR

BACHELOR ENLISTED QUARTERS III
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

McQuay Group McQuay-Perfex Inc.
P.O. Box 1551, Minneapolis, Mn. 55440

SEASONPAK
AIR COOLED WATER CHILLER

CERTIFIED DRAWING 327099Y

TYPE ALR 060A THRU 130A

McQuay certifies that it will furnish equipment in accordance with this drawing and specifications, and subject to its published warranty. Purchaser's approval of this drawing signifies that the equipment is acceptable under the provisions of the job specifications. Any change made hereon by any person whomsoever is subject acceptance by McQuay at its home office.

GENERAL SPECIFICATIONS

CABINET CONSTRUCTION—Galvanized steel cabinet with baked enamel finish. Continuous galvanized steel channel base.

COMPRESSORS—Accessible hermetic with suction and discharge service valves, force feed lubrication, crankcase heater, inherent motor protection, and initial oil charge. Mounted on rubber-in-shear isolators.

CONDENSER COIL—Copper tube, aluminum fin with integral subcooler section.

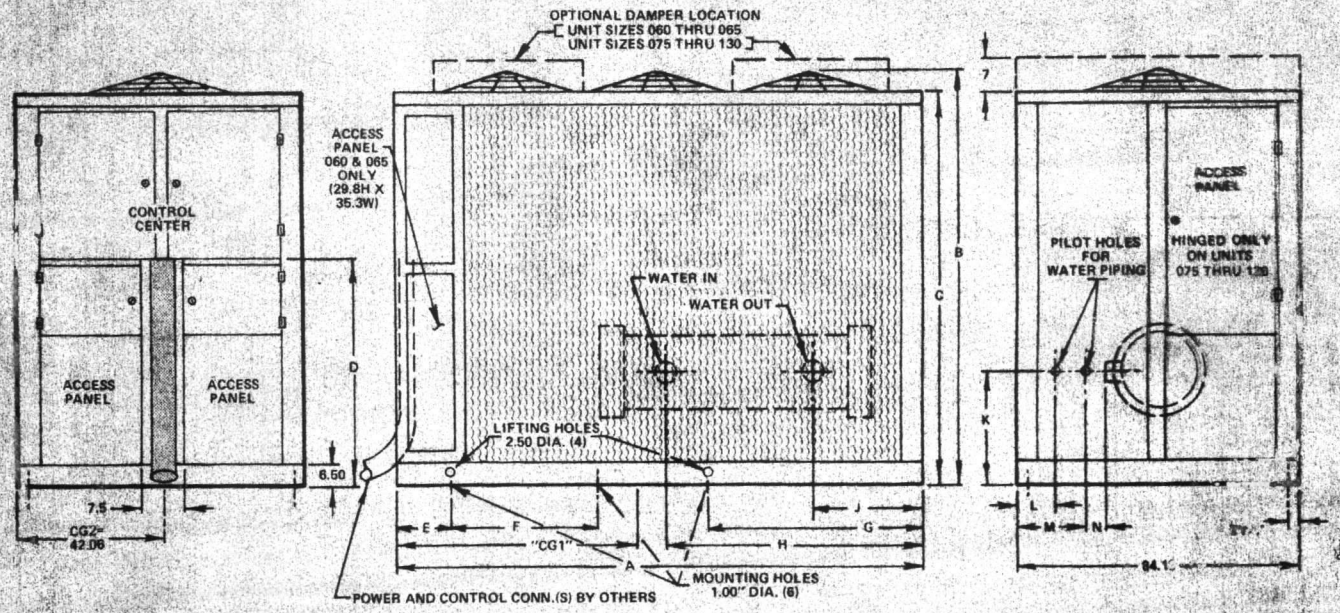
CONDENSER FANS—Propeller type with heavy gauge close mesh guard, belt drive, steel construction with zinc plating and iridite finish. Sealed pillow block type ball bearings.

CONDENSER FAN MOTORS—Three phase, open dripproof ball bearing type with inherent overload protection in all three legs. Positioned within unit cabinet for weather protection.

COOLER—Shell and thru tube with removable heads and internally finned tubes. ASME constructed and stamped. Dual refrigerant circuits. Insulated and protected by a sheet metal enclosure. Resistance type heating cable and ambient thermostat for freeze protection to -20 F with separate 115 volt power supply (may tap control circuit power supply at field option). Drain connections at each end. Vent connection on leaving water end.

PIPING AND ACCESSORIES—Manual liquid line shutoff valve, filter drier with replaceable core, liquid line solenoid valve, sight glass/moisture indicator, thermal expansion valve and suction line insulation. Spring loaded 425 psig relief valve and purge valve.

CONTROL CENTER—Weatherproof enclosure and completely wired. Includes: system emergency stop switch, dual pumpdown switches, oil safety control, high and low pressure cutouts, water temperature controller with sensor factory installed on models ALR-075 – 130, water freeze protection, FANTROL fan cycling pressure switches, compressor and fan motor contactors, time delay fuses for each compressor and fan motor, control circuit and cooler heater fusing, compressor sequence-start timers, COPS pumpdown control. A separate 115 volt control circuit power supply is required as standard.



NOTE: 1. CG1 & CG2 ARE CENTERS OF GRAVITY.
2. THE FAN SHOWN FARTHEST FROM THE CONTROL CENTER ONLY APPLIES TO UNITS ALR-075 THRU 130.

ALR MODEL	DIMENSIONS (INCHES)														COOLER CONNECTIONS* BAFFLE OPTION No.				
	A	B	C	D	E	F	G	CG1	H	J	K	L	M	N	1	2	3	4	5
060 AD	192	80.0	73.8	36.1	20.0	–	66.0	73.0	109.9	24.6	14.5	13.7	23.0	5.0	3		4	4	5
065 AD	192	80.0	73.8	36.1	20.0	–	66.0	85.1	109.9	12.6	14.5	13.7	23.0	5.0	3	4	4	5	
075 AD	228	98.8	92.5	47.0	30.0	54.0	84.0	91.4	140.5	69.3	19.5	14.0	22.5	5.5	5	5	5	7	8
085 AD	228	98.8	92.5	47.0	30.0	54.0	84.0	89.2	140.5	69.3	19.5	14.0	22.5	5.5	5	6	5	5	7
105 AD	228	98.8	92.5	47.0	30.0	54.0	84.0	85.9	140.5	33.3	19.5	14.0	22.5	5.5	5	5	5	–	–
110 AD	228	98.8	92.5	47.0	30.0	54.0	84.0	94.1	140.0	45.8	19.5	14.0	22.5	6.5	5	6	5	5	–
130 AD	228	98.8	92.5	47.0	30.0	54.0	84.0	96.6	140.0	45.8	19.5	14.0	22.5	6.5	6	6	6	6	–
130 AD	228	98.8	92.5	47.0	30.0	54.0	84.0	95.9	140.0	33.8	19.5	14.0	22.5	6.5	6	6	6	–	–

*COOLER CONNECTIONS – Baffle option No. 3 is standard, other baffle options available. All connections are NPS steel pipe. 3-inch pipe connections are threaded MPT. 4 thru 6-inch pipe connections are furnished with grooves for victaulic couplings by others.

McQuay International
P.O. Box 1551, Minneapolis, Mn. 55440

McQuay certifies that it will furnish equipment in accordance with this drawing and specifications, and subject to its published warranty. Purchasers approval of this drawing signifies that the equip

GENERAL SPECIFICATIONS

CABINET CONSTRUCTION –Galvanized steel cabinet with baked enamel finish. Continuous galvanized steel channel base.

COMPRESSORS –Accessible hermetic with suction and discharge service valves, force-feed lubrication, crankcase heater, inherent motor protection, and initial oil charge. Mounted on rubber in shear isolators.

CONDENSER COIL –Copper tube, aluminum fin with integral subcooler section.

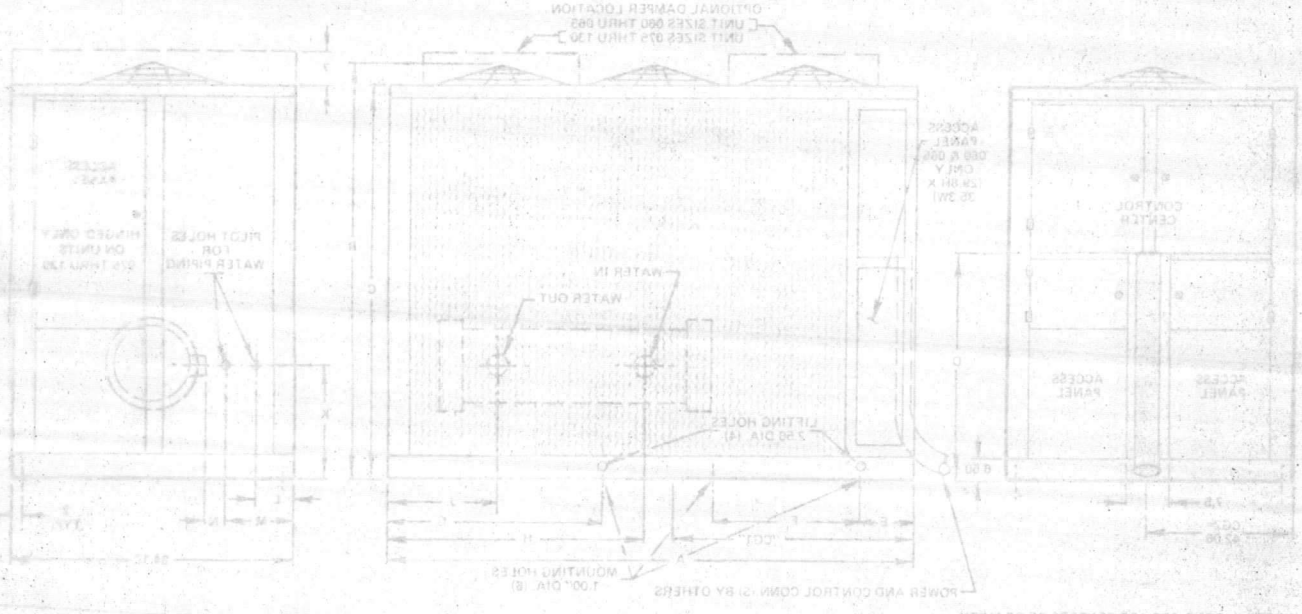
CONDENSER FANS –Propeller type with heavy gauge close mesh guard, belt drive, steel construction with zinc plating and inlet/t finish. Sealed pillow block type ball bearings.

CONDENSER FAN MOTORS –Three phase, open drippproof ball bearing type with inherent overload protection in all three legs. Positioned within unit cabinet for weather protection.

COOLER Shell and tube type, [illegible] fabricated and stamped. Dual refrigerant circuits. Insulated and protected by a steel jacketed, flexible type heating cable and suitable for 20 F with separate 115volt power supply at field control circuit. Drain connections at each end. Vent connection on leaving water end.

PIPING AND ACCESSORIES –Manual flow switch, water strainer, filter drier with replaceable core, liquid line solenoid valve, sight glass/moisture indicator, thermal expansion valve and suction line insulation. Spring loaded 425 psig relief valve and purge valve.

CONTROL CENTER –Weatherproof enclosure and completely wired, including system emergency stop switch, safety control, high and low pressure controls, temperature controller with sensor, factory installed on models ALR-075 – 130, water freeze protection, FANTROL fan cycling pressure switches, compressor [illegible] and fan motor contactors, [illegible] compressor sequence start, [illegible] compressor time delay (one each compressor), CCPS pumpdown control. A separate 115 volt control circuit power supply is required as standard



NOTE: CG1 & CG2 ARE CENTERS OF GRAVITY
2. THE RAM SHOWN PARTIALLY FROM THE CONTROL CENTER ONLY APPLIES TO UNITS ALR 075 THRU 130

ALR MODEL	DIMENSIONS (INCHES)														COOLER CONNECTIONS BAFFLE OPTION No.				
	A	B	C	D	E	F	G	CG1	H	J	K	L	M	N	1	2	3	4	5
060 AD	182	80.0	73.8	36.1	20.0	—	66.0	73.0	109.8	24.6	14.5	13.7	23.0	5.0	3	3	4	4	5
065 AD	182	80.0	73.8	36.1	20.0		66.0	85.1	109.8	12.6	14.5	13.7	23.0	5.0	3	4	4	4	—
075 AD	228	98.8	92.5	47.0	30.0	54.0	84.0	91.4	140.5	59.3	19.5	14.0	22.5	5.5	6	6	6	6	6
095 AD	228	98.8	92.5	47.0	30.0	54.0	84.0	89.2	140.5	69.3	19.5	14.0	22.5	5.5	6	6	6	6	6
105 AD	228	98.8	92.5	47.0	30.0	54.0	84.0	80.0	140.5	33.3	19.5	14.0	22.5	5.5	6	6	6	6	—
110 AD	228	98.8	92.5	47.0	30.0	54.0	84.0	94.1	140.0	45.9	19.5	14.0	22.5	5.5	6	6	6	6	—
120 AD	228	98.8	92.5	47.0	30.0	54.0	84.0	96.6	140.0	45.9	19.5	14.0	22.5	5.5	6	6	6	6	—
130 AD	228	98.8	92.5	47.0	30.0	54.0	84.0	95.9	140.0	33.8	19.5	14.0	22.5	5.5	6	6	6	—	—

COOLER CONNECTIONS – Baffle option No. 3 is standard, other baffle options available. All connections are NPS steel pipe. Victaulic connections are threaded MPT, 4 thru 6-inch pipe connections are furnished with grooves for victaulic couplings by others.

ELECTRICAL DATA

ALR MODEL	NAMEPLATE AMPS						UNIT AMPACITY		
	208V-60Hz-3P		230V-60Hz-3P		460V-60Hz-3P				
	COMPRESSORS	FANS (1)	COMPRESSORS	FANS (1)	COMPRESSORS	FANS (1)	208V	230V	460V
060 AD	(1) 98, (1) 116	(1) 10.6, (1) 16.7	(1) 98, (1) 116	(1) 9.6, (1) 15.2	(1) 45, (1) 58	(1) 4.8, (1) 7.6	272	268	134
065 AD	(1) 116, (1) 147	(2) 16.7	(1) 116, (1) 138	(2) 15.2	(1) 58, (1) 69	(2) 7.6	335	319	160
075 AD	(1) 116, (2) 76	(3) 16.7	(1) 116, (2) 76	(3) 15.2	(1) 58, (2) 38	(3) 7.6	339	343	172
085 AD	(3) 116	(3) 10.6	(3) 116	(3) 9.6	(3) 58	(3) 4.8	410	406	203
105 AD	(2) 76, (2) 116	(3) 16.7	(2) 76, (2) 116	(3) 15.2	(2) 38, (2) 58	(3) 7.6	466	439	239
110 AD	(1) 76, (2) 116	(3) 16.7	(1) 76, (3) 116	(3) 15.2	(1) 38, (3) 58	(3) 7.6	5[illegible]6	499	250
120 AD	(4) 116	(3) 16.7	(4) 116	(3) 15.2	(4) 58	(3) 7.6	546	539	270
130 AD	(4) 147	(3) 16.7	(4) 138	(3) 15.2	(4) 69	(3) 7.6	678	633	317

ALR MODEL	LOCKED ROTOR AMPS								
	208V-60Hz-3P			230V60Hz-3P			460V-60Hz-3P		
	COMPRESSORS		FANS	COMPRESSORS		FANS	COMPRESSORS		FANS
	A.L. START	P.W. START		A.L. START	P.W. START		A.L. START	P.W. START	
060 AD	(1) 470, (1) 565	(1) 296, (1) 340	(1) 59, (1) 99	(1) 470, (1) 565	(1) 292, (1) 340	(1) 54, (1) 90	(1) 235, (1) 283	(1) 121, (1) 150	(1) 27, (1) 45
065 AD	(1) 565, (1) 625	(1) 340, (1) 388	(2) 99	(1) 565, (1) 594	(2) 340	(2) 90	(1) 283, (1) 297	(1) 150, (1) 147	(2) 45
075 AD	(1) 565, (2) 428	(1) 340, (2) 250	(3) 99	(1) 565, (2) 428	(1) 340, (2) 250	(3) 90	(1) 283, (2) 214	(1) 150, (2) 100	(3) 45
085 AD	(3) 565	(3) 340	(3) 99	(3) 565	(3) 340	(3) 54	(3) 283	(3) 150	(3) 27
105 AD	(2) 428, (2) 565	(2) 250, (2) 340	(3) 99	(2) 428, (2) 565	(2) 250, (2) 340	(3) 90	(2) 214, (2) 283	(2) 100, (2) 150	(3) 45
110 AD	(1) 428, (3) 565	(1) 250, (3) 340	(3) 99	(1) 428, (3) 565	(1) 250, (3) 340	(3) 90	(1) 214, (3) 283	(1) 100, (3) 150	(3) 45
120 AD	(4) 565	(4) 340	(3) 99	(4) 565	(4) 340	(3) 90	(4) 283	(4) 150	(3) 45
130 AD	(4) 625	(4) 388	(3) 99	(4) 594	(4) 340	(3) 90	(4) 297	(4) 147	(3) 45

NOTES: (1) Fan Nameplate and Locked Rotor Amps are from 1975 National Electric Code Tables 430-150 and 430-151.

(2) Compressor Nameplate and LRA are at extreme operating conditions.

(3) Unit ampacity is 125% of the Nameplate Amps of the largest motor plus 100% of the Nameplate Amps of all other motors. Unit Ampacity does not include ampacity of control circuit and cooler heater -10A (208 or 230V Units) or 5A (460V Units).

(4) Allowable Voltage Tolerances: Nameplate 208: Max. 229V. Min. 187V.
Nameplate 230: Max. 253V. Min. 207V.
Nameplate 460: Max. 506V. Min. 414V.

PHYSICAL DATA

ALR MODEL	FAN HP EACH	APPROXIMATE OPERATING WT.--LBS.	OPERATING REGRIG. CHARGE--LBS. (R-22)
060 AD	(1) 3, (1) 5	5226	58-80
065 AD	(2) 5	5906	70-74
075 AD	(3) 5	6240	51-88
085 AD	(3) 3	6433	51-88
105 AD	(3) 5	7758	116-116
110 AD	(3) 5	8018	116-133
120 AD	(3) 5	8987	170-170
130 AD	(3) 5	9264	185-185

ELECTRICAL DATA

ALR MODEL	NAMEPLATE AMPS				UNIT AMPACITY (3)			
	208V-60Hz-3P		230V-60Hz-3P		208V-60Hz-3P		230V-60Hz-3P	460V-60Hz-3P
	COMPRESSORS	FANS (1)	COMPRESSORS	FANS (1)	FANS (1)	COMPRESSORS		
060 AD	(1) 8.5, (1) 11.6	(1) 10.6, (1) 16.2	(1) 9.8, (1) 11.6	(1) 9.6, (1) 16.2	(1) 4.8, (1) 7.6	(1) 44, (1) 58	272	134
085 AD	(1) 11.6, (1) 14.7	(2) 16.2	(1) 11.6, (1) 13.6	(2) 15.2	(1) 7.6	(1) 58, (1) 58	335	160
075 AD	(1) 11.6, (1) 14.7	(3) 16.2	(1) 11.6, (1) 13.6	(3) 15.2	(1) 7.6, (2) 7.6	(1) 58, (2) 38	390	172
085 AD	(3) 11.6	(3) 10.6	(3) 11.6	(3) 9.6	(3) 4.8	(3) 58	410	203
105 AD	(2) 11.6, (1) 14.7	(3) 16.2	(2) 11.6, (1) 13.6	(3) 15.2	(3) 7.6	(2) 38, (2) 58	466	230
110 AD	(1) 11.6, (2) 14.7	(3) 16.2	(1) 11.6, (2) 13.6	(3) 15.2	(3) 7.6	(1) 38, (3) 58	506	250
120 AD	(4) 11.6	(3) 16.2	(4) 11.6	(3) 15.2	(3) 7.6	(4) 58	546	270
130 AD	(4) 14.7	(3) 16.2	(4) 13.6	(3) 15.2	(3) 7.6	(4) 69	578	317

ALR MODEL	LOCKED ROTOR AMPS							
	208V-60Hz-3P				230V-60Hz-3P			
	COMPRESSORS		FANS	FANS	COMPRESSORS		FANS	FANS
	A.L. START	P.W. START			A.L. START	P.W. START		
060 AD	(1) 470, (1) 565	(1) 290, (1) 340	(1) 59, (1) 99	(1) 59, (1) 90	(1) 470, (1) 565	(1) 292, (1) 340	(1) 59, (1) 99	(1) 59, (1) 90
085 AD	(1) 565, (1) 625	(1) 340, (1) 388	(2) 99	(2) 90	(1) 565, (1) 594	(1) 340	(2) 99	(2) 90
075 AD	(1) 565, (2) 428	(1) 340, (2) 250	(3) 99	(3) 90	(1) 565, (2) 428	(1) 340, (2) 260	(3) 99	(3) 90
085 AD	(3) 565	(3) 340	(3) 99	(3) 94	(3) 565	(3) 340	(3) 99	(3) 94
105 AD	(2) 428, (2) 565	(2) 250, (2) 340	(3) 99	(3) 90	(2) 428, (2) 565	(2) 250, (2) 340	(3) 99	(3) 90
110 AD	(1) 428, (3) 565	(1) 250, (3) 340	(3) 99	(3) 90	(1) 428, (3) 565	(1) 250, (3) 340	(3) 99	(3) 90
120 AD	(4) 565	(4) 340	(3) 99	(3) 90	(4) 565	(4) 340	(3) 99	(3) 90
130 AD	(4) 565	(4) 388	(3) 99	(3) 90	(4) 594	(4) 340	(4) 207	(3) 90

ALR MODEL	460V-60Hz-3P			
	COMPRESSORS		FANS	
	A.L. START	P.W. START		
060 AD	(1) 235, (1) 283	(1) 127, (1) 150	(1) 27, (1) 45	
085 AD	(1) 283, (1) 297	(1) 150, (1) 147	(2) 45	
075 AD	(1) 283, (2) 214	(1) 150, (2) 100	(3) 45	
085 AD	(3) 283	(3) 150	(3) 27	
105 AD	(2) 214, (2) 283	(2) 100, (2) 150	(3) 45	
110 AD	(1) 214, (3) 283	(1) 100, (3) 150	(3) 45	
120 AD	(4) 283	(4) 150	(3) 45	
130 AD	(4) 297	(4) 147	(3) 45	

NOTES: (1) Fan Nameplate and Locked Rotor Amps are from 1975 National Electric Code Tables 430-150 and 430-151.

(2) Compressor Nameplate and LRA are at extreme operating conditions.

(3) Unit ampacity is 125% of the Nameplate Amps of the largest motor plus 100% of the Nameplate Amps of all other motors. Unit Ampacity does not include ampacity of control circuit and cooler heater -10A (208 or 230V Units) or 5A (460V Units).

(4) Allowable Voltage Tolerances: Nameplate 208: Max. 229V, Min. 187V
Nameplate 230: Max. 253V, Min. 207V
Nameplate 460: Max. 506V, Min. 414V

PHYSICAL DATA

ALR MODEL	FAN HP EACH	APPROXIMATE OPERATING WT.–LBS	OPERATING REFRIG. CHARGE–LBS (R-22)
060 AD	(1) 1.5	5229	60
085 AD	(1) 1.5	5508	70
075 AD	(1) 1.5	6240	84
085 AD	(2) 1.5	6633	87
105 AD	(2) 1.5	7158	116
110 AD	(2) 1.5	8018	116
120 AD	(2) 1.5	8297	116
130 AD	(2) 1.5	8297	116

McQUAY GROUP

McQUAY-PERFEX INC.
13600 INDUSTRIAL PARK BLVD.
P.O. BOX 1551
MINNEAPOLIS, MINNESOTA 55440

CERTIFIED PERFORMANCE DATA

REFER TO FOR CERTIFIED DIMENSIONS

SEASON[illegible] Air Cooled Condensing Units
TYPE ALR | DRAWING NUMBER 327100Y

SEASONPA[illegible] Air Cooled Chiller
TYPE ALR | DRAWING NUMBER 327099Y

SEASONPAK Packaged Water Chiller
TYPE WHR | ARRG'T. 1 DRAWING NUMBER 281165Y
ARRG'T. 2 DRAWING NUMBER 281166Y
ARRG'T. 3 DRAWING NUMBER 281167Y

DIRECT EXPANSION COOLER
TYPE CDE | DRAWING NUMBER 265527Y

SOLD TO: Sneeden, Inc.
Wilmington, North Carolina

McQUAY ORDER NO. GO.

DATE DR. 1/25/78

CUST. P.O. 6343

REP. Hoffman & Hoffman, Inc.

REP P.O. 22-35-178

10 COPIES | XX FOR APPR'L | FOR RECORD

JOB: Bachelor Enlisted Quarters
Marine Corps Base
Camp LeJeune, North Carolina

CONSULTING ENGINEER:
J. E. Sirrine Company
Greenville, South Carolina

REV. NO.	BY	DATE	WAS

TAG	McQUAY ITEM NO.	MODEL NUMBER	QTY.	ELECTRICAL CHARACTERISTICS V - Hz - P	KW INPUT (1)	CAPACITY TONS	COOLER GPM	COOLER EWT	COOLER LWT	COOLER P.D.	CONDENSER GPM	CONDENSER EWT	CONDENSER LWT	CONDENSER P.D.	AMB. AIR	REFR. R–	NO. OF CONTROL STEPS
ACC-1	010	ALR-105	1	460-60-3	117.5	100	255	51.4	42	20	–	–	–	–	90°F	R-22	4
ACC-2	010	ALR-105	1	460-60-3	117.5	100	255	51.4	42	20	–	–	–	–	90°F	R-22	4

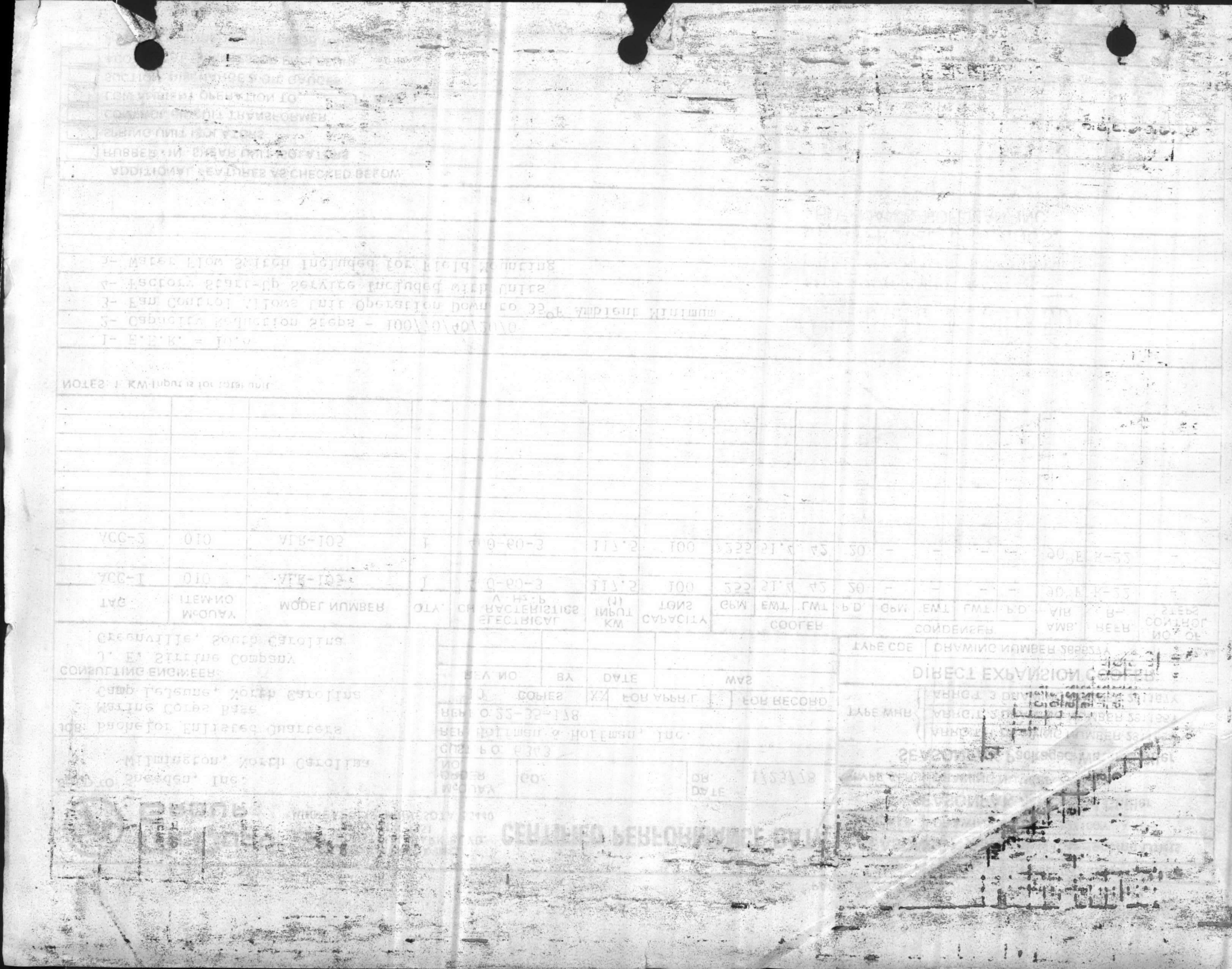
NOTES: 1. KW Input is for total unit.

1- E.E.R. = 10.6
2- Capacity Reduction Steps - 100/70/40/20/0
3- Fan Control Allows Unit Operation Down to 35°F Ambient Minimum
4- Factory Start-Up Service Included with Units
5- Water Flow Switch Included for Field Mounting

APPROVAL REQUIRED
MATERIAL WILL NOT BE ORDERED UNTIL RECEIPT OF APPROVED DRAWINGS.
HOFFMAN & HOFFMAN, INC.

ADDITIONAL FEATURES AS CHECKED BELOW:

- [ ] RUBBER-IN-SHEAR UNIT ISOLATORS
- [ ] SPRING UNIT ISOLATORS
- [ ] CONTROL CIRCUIT TRANSFORMER
- [ ] LO. AMBIENT OPERATION TO ____F. AMB.
- [ ] SUCTION, DISCHARGE & OIL GAUGES
- [ ] ACOUSTICAL COMPRESSOR ENCLOSURE
- [ ] 4 YR. EXTENDED COMPRESSOR WARRANTY



BULLETIN NO. IM 172-2
JULY, 1979
INSTALLATION AND
MAINTENANCE DATA
FORM NO. 339274Y REV. B

McQUAY

Seasonpak®

PACKAGED AIR COOLED WATER CHILLER
MODELS ALR-035A THRU 050A & 075A THRU 130A
MODELS ALR-060B & 065B

McQUAY
GROUP McQUAY-PERFEX Inc. 13600 Industrial Park Blvd., P.O. Box 1551, Minneapolis, Mn. 55440

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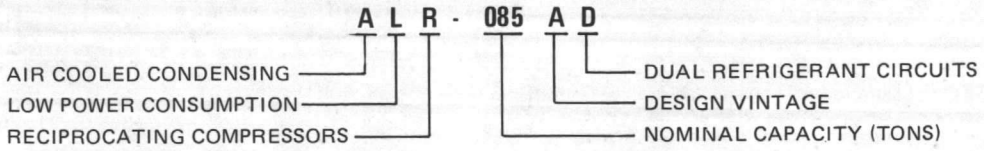
INTRODUCTION

GENERAL DESCRIPTION

McQuay type ALR SEASONPAK air cooled water chillers are complete, self-contained automatic refrigerating units that include the latest in engineered components arranged to provide a compact and efficient unit. Each unit is completely assembled and factory wired before evacuation, charging and testing, and comes complete and ready for installation. Each unit consists of: twin air cooled condensers with integral subcooler sections, multiple accessible hermetic compressors, replaceable tube dual circuit shell-and-tube evaporator, and complete refrigerant piping. Liquid line components that are included are: manual liquid line shut-off valves, replaceable core filter-driers, liquid line solenoid valves, sightglass/moisture indicators, and double diaphragm hydraulic element thermal expansion valves. Other features include: compressor crankcase heaters, an evaporator heater for chilled water freeze protection, recycling pumpdown during "on" or "off" seasons, compressor lead lag switch to alternate the compressor starting sequence, and sequenced starting of compressors.

The electrical control center includes all safety and operating controls necessary for dependable automatic operation. Compressors and fan motors are fused in all three conductor legs and started by their own three-pole contactor.

NOMENCLATURE



INSPECTION

When the equipment is received, all items should be carefully checked against the bill of lading to insure a complete shipment. All units should be carefully inspected for damage upon arrival. All shipping damage should be reported to the carrier and a claim should be filed. The unit serial plate should be checked before unloading the unit to be sure that it agrees with the power supply available.

INSTALLATION

NOTE: Installation and maintenance are to be performed only by qualified personnel who are familiar with local codes and regulations, and experienced with this type of equipment. CAUTION: Sharp edges and coil surfaces are a potential injury hazard. Avoid contact with them.

HANDLING

Care should be taken to avoid rough handling or shock due to dropping the unit. Do not push or pull the unit from anything other than the base, and block the pushing vehicle away from the unit to prevent damage to the sheet metal cabinet and end frame. (See Figure 1.)

Never allow any part of the unit to fall during unloading or moving as this may result in serious damage.

To lift the unit, 2½" diameter lifting holes are provided in the base of the unit. Spreader bars and cables should be arranged to prevent damage to the condenser coils or unit cabinet. (See Figure 2.)

LOCATION

Due to the vertical condenser design, it is recommended that certain precautions be taken before installation to orient the unit so that prevailing winds blow parallel to the unit length, thus minimizing effects on condensing pressure. If it is not practical to orient the unit in this manner, a wind deflecting fence should be considered.

SERVICE ACCESS

Each end of the unit must be accessible after installation for periodic service work. Compressors, filter-driers, and manual liquid line shut-off valves are accessible from the control center end of the unit through removable access panels on unit sizes 075 thru 130 and hinged side access doors on unit sizes 035 thru 065. All operational, safety, and starting controls are located in the unit control center. Capped connections for field service gauges are also located inside these enclosures.

FIGURE 1. SUGGESTED PUSHING ARRANGEMENT

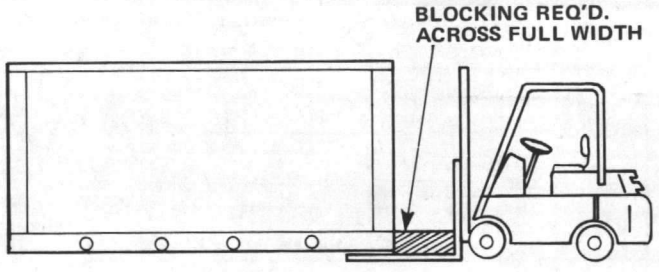
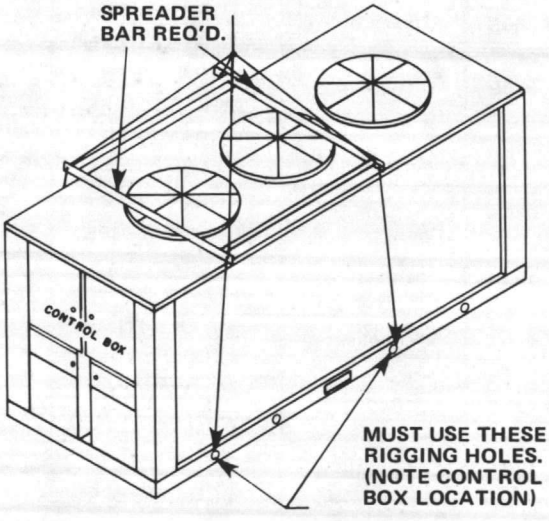


FIGURE 2. SUGGESTED LIFTING ARRANGEMENT



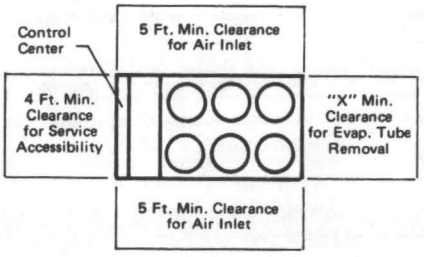
CAUTION: *Disconnect all power to the unit while servicing condenser fan drives.*

The condenser fans, motors and drives are accessible through a walk-in, keylocked access door on units ALR-075 thru 130. The access door on units ALR-075A thru 130A is located at the end of the unit opposite the control center. Expansion valves are accessible from the same access door on unit sizes 075A thru 130A and from side access doors at the control center end on unit sizes 035A thru 065A.

An internal fan guard is located below the condenser fans and drives on units 075 thru 130. This guard must be removed to service the fan drives but must always be reinstalled when service work is complete.

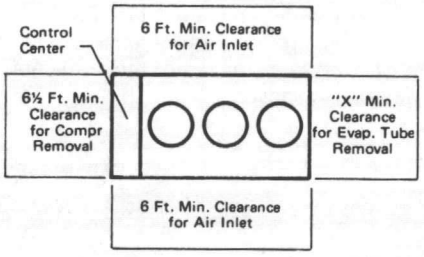
FIGURE 3. CLEARANCE AROUND UNIT

ALR-035A THRU 065B



UNIT SIZE	"X" DIM. (FT.)
ALR-035A	6
ALR-040A	9
ALR-050A	7
ALR-060B	8
ALR-065B	9

ALR-075A THRU 130A



UNIT SIZE	"X" DIM. (FT.)
ALR-075A	4
ALR-085A	4
ALR-105A	9
ALR-110A	7
ALR-120A	7
ALR-130A	9

NOTES: (1) Minimum vertical clearance above unit should be 10 feet.
(2) Clearance to condenser coil must be doubled if more than one side is obstructed or between adjacent units. Consult your McQuay sales representative.

VIBRATION ISOLATORS

Vibration isolators are recommended for all roof mounted installations or wherever vibration transmission is a consideration. Table 1 lists spring isolators for all ALR unit sizes. Figure 4 shows isolator locations in relation to the unit control center. Figure 5 gives dimensions that are required to secure each McQuay isolator selection to the mounting surface.

Table 2 shows the isolator loads at each location shown in Figure 4, and the maximum loads for each McQuay selection.

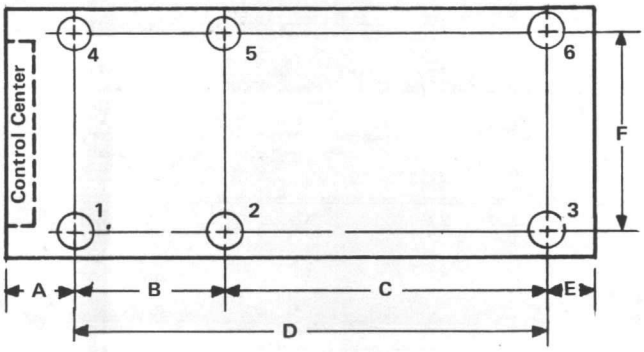
TABLE 1. VIBRATION ISOLATORS

ALR UNIT SIZE	SPRING ISOLATORS					
	LOCATIONS 1 & 4		LOCATIONS 2 & 5		LOCATIONS 3 & 6	
	ORDERING NO. 877-	SPRING COLOR CODE	ORDERING NO. 877-	SPRING COLOR CODE	ORDERING NO. 877-	SPRING COLOR CODE
035A	(1)216403B-31	GRAY WITH 2 YELLOW STRIPES	(2)216403B-28	GRAY WITH GREEN STRIPE	216403B-26	GRAY WITH 2 WHITE STRIPES
	(4)216403B-27	GRAY WITH ORANGE STRIPE	(5)216403B-27	GRAY WITH ORANGE STRIPE		
040A	216403B-31	GRAY WITH 2 YELLOW STRIPES	216403B-31	GRAY WITH 2 YELLOW STRIPES	216403B-31	GRAY WITH 2 YELLOW STRIPES
050A	216403B-31	GRAY WITH 2 YELLOW STRIPES	216403B-31	GRAY WITH 2 YELLOW STRIPES	216403B-31	GRAY WITH 2 YELLOW STRIPES
060B	216403B-32	GRAY WITH WHITE STRIPE	216403B-32	GRAY WITH WHITE STRIPE	216403B-32	GRAY WITH WHITE STRIPE
065B	216403B-32	GRAY WITH WHITE STRIPE	216403B-32	GRAY WITH WHITE STRIPE	216403B-32	GRAY WITH WHITE STRIPE
075A	216404B-28	GRAY WITH GREEN STRIPE	216404B-28	GRAY WITH GREEN STRIPE	216404B-27	GRAY WITH ORANGE STRIPE
085A	216404B-28	GRAY WITH GREEN STRIPE	216404B-28	GRAY WITH GREEN STRIPE	216404B-27	GRAY WITH ORANGE STRIPE
105A	216404B-31	GRAY WITH 2 YELLOW STRIPES	216404B-31	GRAY WITH 2 YELLOW STRIPES	216404B-31	GRAY WITH 2 YELLOW STRIPES
110A	216404B-31	GRAY WITH 2 YELLOW STRIPES	216404B-31	GRAY WITH 2 YELLOW STRIPES	216404B-31	GRAY WITH 2 YELLOW STRIPES
120A	216404B-32	GRAY WITH WHITE STRIPE	216404B-32	GRAY WITH WHITE STRIPE	216404B-32	GRAY WITH WHITE STRIPE
130A	216404B-32	GRAY WITH WHITE STRIPE	216404B-32	GRAY WITH WHITE STRIPE	216404B-32	GRAY WITH WHITE STRIPE

TABLE 2. ISOLATOR LOADS

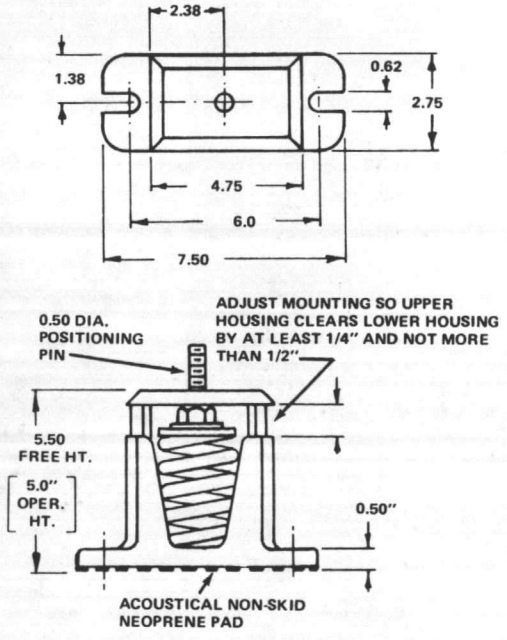
ALR UNIT SIZE	ISOLATOR LOADS AT EACH MOUNTING LOCATION (LBS.)			MAXIMUM LOADS ALLOWABLE FOR EACH McQUAY ISOLATOR SELECTION (LBS.)		
	1 & 4	2 & 5	3 & 6	1 & 4	2 & 5	3 & 6
035A	(1) 787 (4) 569	(2) 541 (5) 459	466	(1) 1100 (4) 750	(2) 900 (5) 750	600
040A	684	705	750	1100	1100	1100
050A	789	813	867	1100	1100	1100
060B	894	916	984	1300	1300	1300
065B	924	958	1066	1300	1300	1300
075A	1095	1095	930	1800	1800	1500
085A	1150	1150	915	1800	1800	1500
105A	1310	1310	1258	2200	2200	2200
110A	1370	1370	1270	2200	2200	2200
120A	1480	1480	1480	2600	2600	2600
130A	1570	1570	1540	2600	2600	2600

FIGURE 4. ISOLATOR LOCATIONS

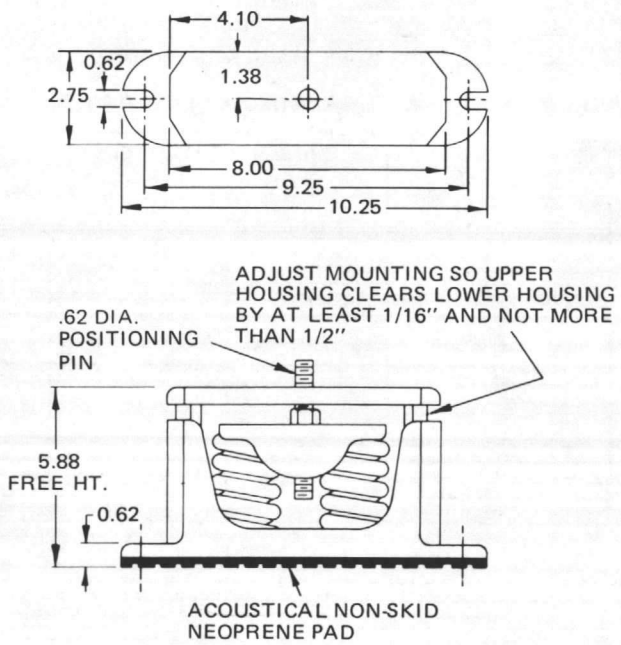


ALR UNIT SIZE	VIBRATION MOUNT LOCATION DIMENSIONS (INCHES)					
	"A"	"B"	"C"	"D"	"E"	"F"
035A	8.5	41.5	69.5	111.0	8.5	78
040A	8.5	41.5	98.0	139.5	20.0	78
050A	8.5	41.5	98.0	139.5	20.0	78
060B	8.5	41.5	138.0	179.5	20.0	78
065B	8.5	41.5	138.0	179.5	20.0	78
075A	8.0	76.0	114.0	190.0	30.0	80
085A	8.0	76.0	114.0	190.0	30.0	80
105A	8.0	76.0	114.0	190.0	30.0	80
110A	8.0	76.0	114.0	190.0	30.0	80
120A	8.0	76.0	114.0	190.0	30.0	80
130A	8.0	76.0	114.0	190.0	30.0	80

FIGURE 5. SPRING ISOLATORS



ORDERING NO. 877-216403B-28 THRU -32



ORDERING NO. 877-216404B-27 THRU -31

WATER PIPING

Due to the variety of piping practices, it is advisable to follow the recommendations of local authorities. They can supply the installer with the proper building and safety codes required for a safe and proper installation.

Basically, the piping should be designed with a minimum number of bends and changes in elevation to keep system cost down and performance up. It should contain:

1. Vibration eliminators to reduce vibration and noise transmission to the building.
2. Shut-off valves to isolate the unit from the piping system during unit servicing.
3. Manual or automatic air vent valves at the high points of the system.
4. Some means of maintaining adequate system water pressure (e.g., expansion tank or regulating valve).
5. Temperature and pressure indicators located at the unit to aid in unit servicing.
6. A strainer or some means of removing foreign matter from the water before it enters the pump. It should be placed far enough upstream to prevent cavitation at the pump inlet (consult pump manufacturer for recommendations). The use of a strainer will prolong pump life and thus keep system performance up.

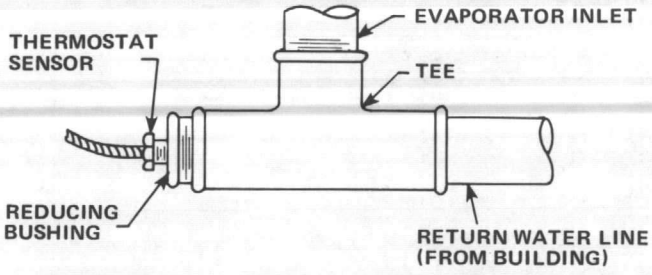
Prior to insulating the piping and filling the system, a preliminary leak check should be made.

Piping insulation should include a vapor barrier to prevent moisture condensation and possible damage to the building structure. It is important to have the vapor barrier on the outside of the insulation to prevent condensation within the insulation on the cold surface of the pipe.

CHILLED WATER THERMOSTAT

The chilled water thermostat is mounted inside the unit control center. On models ALR-075A thru 130A, the thermostat sensor is factory mounted in the return water connection of the evaporator. On models ALR-035A thru 065B, the sensor must be installed in the return water line as shown in Figure 6. The thermostat sensor should be insulated after installation.

FIGURE 6. THERMOSTAT SENSOR INSTALLATION



FLOW SWITCH

A WATER FLOW SWITCH MUST BE MOUNTED in either the entering or leaving water line to insure that there will be adequate water flow and cooling load to the evaporator before the unit can start. This will safeguard against slugging the compressors on start-up. It also serves to shut down the unit in the event that water flow is interrupted to guard against evaporator freeze-up.

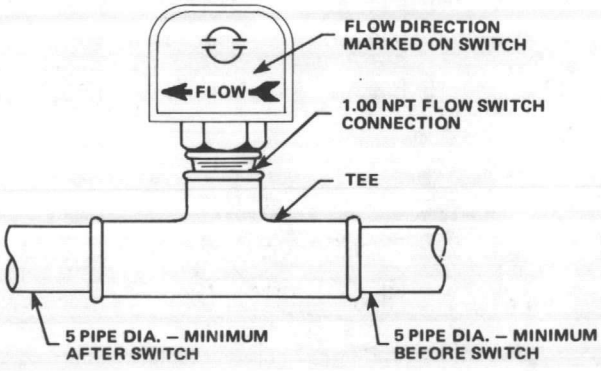
A flow switch is available from McQuay under ordering number 860-175033X-00. It is a "paddle" type switch and adaptable to any pipe size from 1" to 6" nominal. Certain minimum flow rates are required to close the switch and are listed in Table 3. Installation should be as shown in Figure 7.

Electrical connections in the unit control center should be made at terminals 3 and 4 on the ALR-035A thru 065B and terminals 14 and 15 on the ALR-075A thru 130A. The normally open contacts of the flow switch should be wired between these two terminals. There is also a set of normally closed contacts on the switch that could be used for an indicator light or an alarm to indicate when a "no flow" condition exists.

TABLE 3. FLOW SWITCH MINIMUM FLOW RATES

NOMINAL PIPE SIZE (INCHES)	MINIMUM REQUIRED FLOW TO ACTIVATE SWITCH (GPM)
1	6.00
1 1/4	9.80
1 1/2	12.70
2	18.80
2 1/2	24.30
3	30.00
4	39.70
5	58.70
6	79,20

FIGURE 7



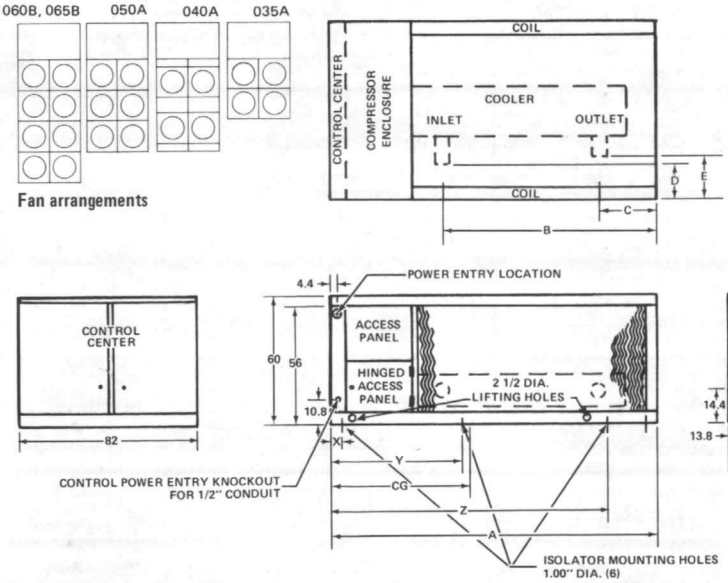
WATER CONNECTIONS

Water piping connections at the unit vary in size and style depending on the baffle option ordered. These connection variations are shown in the table with Figure 8.

Piping through the unit cabinet can be through the end or bottom of the unit as the application dictates. Models ALR-035A thru 065B have holes at the back of the unit as shown in Figure 8. Pilot holes on models ALR-075A thru 130A locate the proper hole centers for piping through the end of the unit. Figure 8 gives the necessary dimensions for either piping method.

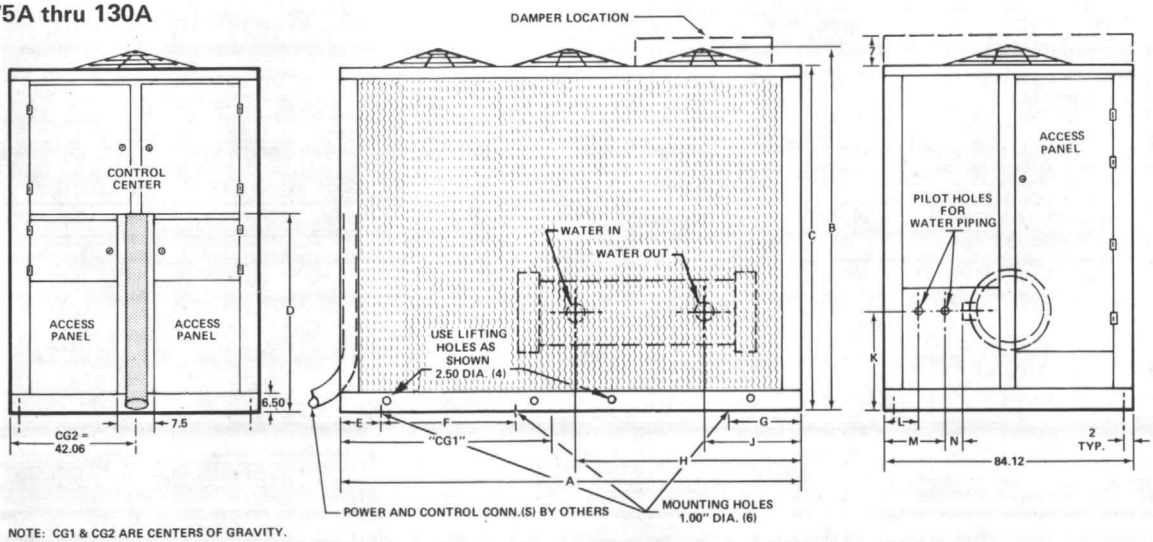
FIGURE 8. ALR DIMENSIONAL DRAWINGS

ALR-035A thru 065B



ALR UNIT SIZE	LENGTH A	CENTER OF GRAVITY CG	WATER CONNECTIONS					ISOLATOR LOCATIONS		
			SIZE	B	C	D	E	X	Y	Z
035A	128	58	3 NPT	72.5	7.6	15.9	23.9	8.5	50	119.5
040A	168	71	3 NPT	112.5	11.6	15.9	23.9	8.5	50	148.0
050A	168	71	3 NPT	109.4	36.1	15.9	23.9	8.5	50	148.0
060B	208	85	4 NPS	149.4	64.1	18.9	26.9	8.5	50	188.0
065B	208	87	4 NPS	149.4	52.1	18.9	26.9	8.5	50	188.0

ALR-075A thru 130A



NOTE: CG1 & CG2 ARE CENTERS OF GRAVITY.

ALR UNIT SIZE	DIMENSIONS (INCHES)														COOLER CONN'S.*
	A	B	C	D	E	F	G	CG1	H	J	K	L	M	N	
075A-D	228	98.8	92.5	47.0	8.0	76.0	30.0	91.4	140.5	69.3	19.5	14.0	22.5	5.5	5
085A-D	228	98.8	92.5	47.0	8.0	76.0	30.0	89.2	140.5	69.3	19.5	14.0	22.5	5.5	5
105A-D	228	98.8	92.5	47.0	8.0	76.0	30.0	95.3	140.5	33.3	19.5	14.0	22.5	5.5	5
110A-D	228	98.8	92.5	47.0	8.0	76.0	30.0	94.1	140.5	45.8	19.5	14.0	22.5	6.5	6
120A-D	228	98.8	92.5	47.0	8.0	76.0	30.0	96.6	140.5	45.8	19.5	14.0	22.5	6.5	6
130A-D	228	98.8	92.5	47.0	8.0	76.0	30.0	95.9	140.5	33.8	19.5	14.0	22.5	6.5	6

*COOLER CONNECTIONS: All connections are NPS steel pipe. Pipe connections are furnished with grooves for Victaulic couplings by others.

TABLE 4. R-22 OPERATING CHARGE

ALR UNIT SIZE	R-22 REFRIGERANT CHARGE (LBS.)	
	CIRCUIT 1	CIRCUIT 2
035A	35	–
040A	25	25
050A	35	35
060B	35	35
065B	44	44
075A	50	60
085A	45	65
105A	90	90
110A	90	90
120A	100	100
130A	110	110

REFRIGERANT CHARGE

All units are designed for use with refrigerant 22 and are shipped with an operating charge. Table 4 gives the operating charge for each unit.

FIELD WIRING

Wiring should be done in accordance with all applicable codes and ordinances.

Warranty is voided if wiring is not in accordance with specifications. An open fuse indicates a short, ground, or overload. Before replacing a fuse or restarting a compressor or fan motor, the trouble must be found and corrected.

Copper wire is required for all power lead terminations at the unit while either aluminum or copper can be used for all other wiring.

TABLE 5. WIRE SIZING AMPACITIES & RECOMMENDED POWER LEAD WIRE SIZES

ALR UNIT SIZE	3 PHASE, 60 HZ ELECTRICAL SUPPLY (1)	WIRE SIZING AMPS (2)	RECOMMENDED COPPER POWER LEAD WIRE SIZES (3)			MAXIMUM RECOMMENDED FUSE SIZES (6)
			3 WIRES 1 CONDUIT	6 WIRES 1 CONDUIT	6 WIRES 2 CONDUITS	
035A	208	172	00	–	–	200
	230	172	00	–	–	200
	460	87	3	–	–	100
040A	208	185	000	1	–	200
	230	185	000	1	–	200
	460	94	3	–	–	100
050A	208	252	250	00	–	300
	230	252	250	00	–	300
	460	135	0	–	–	150
060B	208	291	350	000	–	350
	230	291	350	000	–	350
	460	150	00	3	–	175
065B	208	354	500	0000	–	400
	230	335	500	0000	–	400
	460	170	00	2	–	200
075A	208/230	361/357	500	0000	000	400/400
	460	181	00	–	–	200
085A	208/230	443/439	600	300	0000	500/500
	460	221	0000	–	–	250
105A	208/230	482/478	–	350	250	600/600
	460	242	250	0	–	300
110A	208/230	532/519	–	400	300	600/600
	460	262	250	00	–	300
120A	208/230	564/560	–	500	300	600/600
	460	282	300	00	0	300
130A	208	700	–	–	500	800
	230	632	–	600	400	700
	460	316	400	000	00	350

NOTES:

1. Separate terminals provide for the field connection of a separate 115/60/1 power supply to the control circuit.
2. Wire sizing amps are equal to 125% of the RLA of the largest motor plus 100% of the RLA of all other loads in the circuit (the control circuit is not included). To include the control circuit, add 10 amps to 208 or 230 volt units and 5 amps to 460 volt units (models ALR-075A thru 130A); to include the control circuit, add 7 amps to 208 or 230 volt units and 4 amps to 460 volt units (models ALR-035A thru 065B). Recommended power lead wire and maximum fuse sizes are not affected.
3. Recommended power lead wire sizes for three conductors per conduit are based on 100% conductor ampacity at 86F ambient for no more than 3 conductors per conduit. Wire sizes for six conductors per conduit are based on 80% of the above mentioned conductor ampacity in accordance with NEC. Voltage drop has not been included. Therefore, it is recommended that power leads be kept short. All terminal block connections must be made with copper wire.
4. The unit power terminal block has two lugs per phase. Single or parallel conductors per phase may be used for power hook-up as listed under "Recommended Power Lead Wire Size."
5. The cooler heater cable current draw is 3.5 amps and power draw is 400W.
6. "Maximum Recommended Fuse Sizes" are selected at approximately 150% of the largest compressor RLA, plus 100% of all other loads in the circuit. (Control circuit not included.)

All unit sizes are set up as standard for separate 115 volt power supply circuits for the control circuit and cooler heater. The control circuit only or both the control circuit and cooler heater can be powered off of the main unit power supply if the optional control circuit transformer is ordered. It may be desirable, however, to have the unit cooler heater on a separate disconnect switch from the main unit power supply so that the unit may be shut down without defeating the freeze protection provided by the cooler heater.

A standard feature on all ALR units is COPS (Controlled Override of Pump Shutdown), a system for interlocking the field supplied chilled water pump into the chiller control system. A relay (R19) is wired into the unit control circuit so that a time clock and/or ambient thermostat can be connected to a pair of terminals (6 and 11) inside the unit control center. The time clock can energize a pump starter. Once the pump starts, the flow switch and/or pump interlock will close and energize that part of the control circuit that will allow the unit to start.

This feature makes it possible to start the chilled water pump and the chiller simultaneously only when cooling is required. For recycling pumpdown without a demand for cooling, a pair of relays (energized by low pressure controls) are also wired into this circuit to start the pump, close the flow switch and pump down the unit.

NOTE: *If a time clock, ambient thermostat and/or remote on-off switch are not used, terminals 6 and 11 must be jumpered together before the unit will start.*

Figure 9 shows typical field wiring that is required for unit installation.

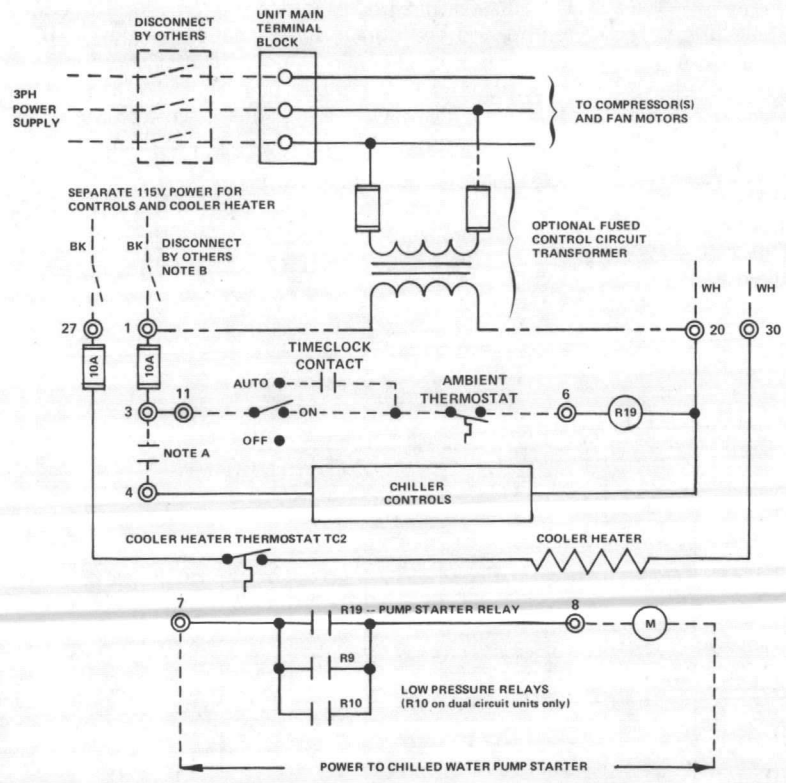
TABLE 6. COMPRESSOR AND CONDENSER FAN MOTORS (1)

ALR UNIT SIZE	ELEC. SUPPLY (1)	RATED LOAD AMPS (2)					NO. OF FAN MTRS.	LOCKED ROTOR AMPS (3)							
		COMPRESSOR				FAN MTRS. (EA.)		FAN MTRS. (EA.)	ACROSS-THE-LINE START COMPRESSOR				PART WINDING START COMPRESSOR			
		NO.1	NO.2	NO.3	NO.4				NO.1	NO.2	NO.3	NO.4	NO.1	NO.2	NO.3	NO.4
035A	208	121	–	–	–	5.2	4	40	565	–	–	–	340	–	–	–
	230	121	–	–	–	5.2	4	40	565	–	–	–	340	–	–	–
	460	61	–	–	–	2.6	4	20	283	–	–	–	150	–	–	–
040A	208	64	80	–	–	5.2	4	40	308	428	–	–	188	250	–	–
	230	64	80	–	–	5.2	4	40	308	428	–	–	188	250	–	–
	460	32	41	–	–	2.6	4	20	154	214	–	–	82	100	–	–
050A	208	98	98	–	–	5.2	6	40	470	470	–	–	292	292	–	–
	230	98	98	–	–	5.2	6	40	470	470	–	–	292	292	–	–
	460	53	53	–	–	2.6	6	20	235	235	–	–	121	121	–	–
060B	208	98	121	–	–	5.2	8	40	470	565	–	–	292	340	–	–
	230	98	121	–	–	5.2	8	40	470	565	–	–	292	340	–	–
	460	53	61	–	–	2.6	8	20	235	283	–	–	121	150	–	–
065B	208	121	153	–	–	5.2	8	40	565	625	–	–	340	388	–	–
	230	121	153	–	–	5.2	8	40	565	625	–	–	340	388	–	–
	460	61	69	–	–	2.6	8	20	283	297	–	–	150	147	–	–
075A	208	121	80	–	80	16.7	3	99	565	428	–	428	340	250	–	250
	230	121	80	–	80	15.2	3	90	565	428	–	428	340	250	–	250
	460	61	41	–	41	7.6	3	45	283	214	–	214	150	100	–	100
085A	208	121	121	–	121	16.7	3	99	565	565	–	565	340	340	–	340
	230	121	121	–	121	15.2	3	90	565	565	–	565	340	340	–	340
	460	61	61	–	61	7.6	3	45	283	283	–	283	150	150	–	150
105A	208	80	121	80	121	16.7	3	99	428	565	428	565	250	340	250	340
	230	80	121	80	121	15.2	3	90	428	565	428	565	250	340	250	340
	460	41	61	41	61	7.6	3	45	214	283	214	283	100	150	100	150
110A	208	80	121	121	121	16.7	3	99	428	565	565	565	250	340	340	340
	230	80	121	121	121	15.2	3	90	428	565	565	565	250	340	340	340
	460	41	61	61	61	7.6	3	45	214	283	283	283	100	150	150	150
120A	208	121	121	121	121	16.7	3	99	565	565	565	565	340	340	340	340
	230	121	121	121	121	15.2	3	90	565	565	565	565	340	340	340	340
	460	61	61	61	61	7.6	3	45	283	283	283	283	150	150	150	150
130A	208	153	153	153	153	16.7	3	99	625	625	625	625	388	388	388	388
	230	138	138	138	138	15.2	3	90	594	594	594	594	340	340	340	340
	460	69	69	69	69	7.6	3	45	297	297	297	297	147	147	147	147

NOTES: (1) Voltage limits: Nameplate 208-Max. 229V, Min. 187V.
Nameplate 230-Max. 253V, Min. 207V.
Nameplate 460-Max. 506V, Min. 414V.
Nameplate 380-Max. 418V, Min. 360V.
(2) Compressor nameplate and locked rotor amps are at extreme operating conditions.
(3) ALR-075A thru 159A fan motor nameplate and locked rotor amps from 1975 NEC tables 430-150 and 430-151.
(4) Compressor locked rotor amps for part winding start are for the first winding.

FIGURE 9. TYPICAL FIELD WIRING DIAGRAMS

ALR-035A THRU 065B



LEGEND:

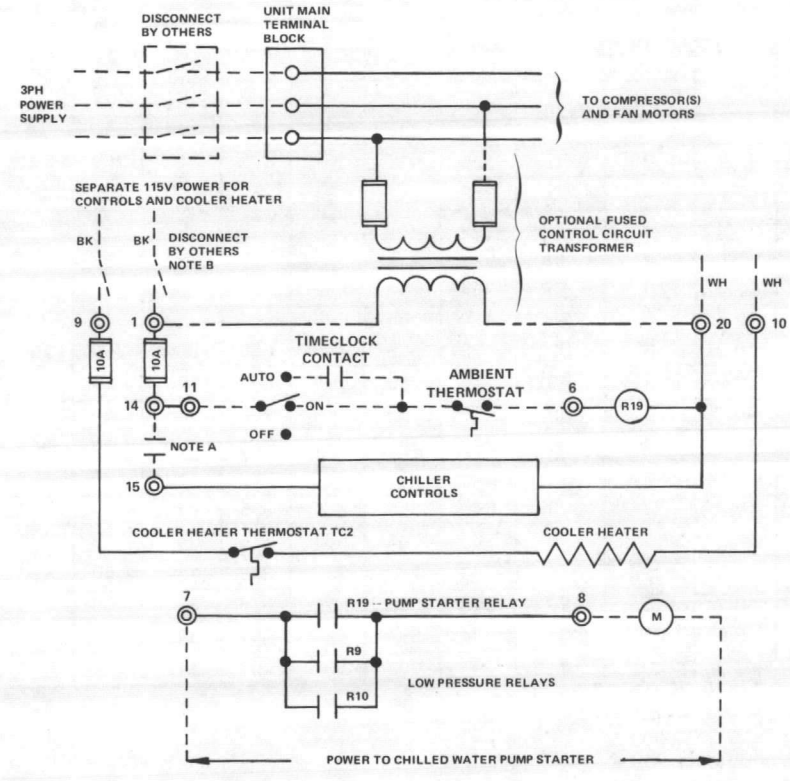
- ◎ FIELD WIRING TERMINAL
- – – – FIELD WIRING
- ——— FACTORY WIRING
- —·—·— OPTIONAL FACTORY WIRING
- BK BLACK WIRING (LINE)
- WH WHITE WIRING (NEUTRAL)

NOTE A:
Chilled water flow switch and/or starter interlock.

NOTE B:
Standard is separate power supply circuits for controls and cooler heater. These circuits can be combined by installing jumpers from 1 to 27 and 20 to 30.

NOTE C:
Pump starter contacts of R9, R10, and R19 between terminals 7 and 8 are limited to 250 volts maximum.

ALR-075A THRU 130A



LEGEND:

- ◎ FIELD WIRING TERMINAL
- – – – FIELD WIRING
- ——— FACTORY WIRING
- —·—·— OPTIONAL FACTORY WIRING
- BK BLACK WIRING (LINE)
- WH WHITE WIRING (NEUTRAL)

NOTE A:
Chilled water flow switch and/or starter interlock.

NOTE B:
Standard is separate power supply circuits for controls and cooler heater. These circuits may be combined by installing jumpers from terminals 1 to 9 and 10 to 20.

NOTE C:
Pump starter contacts of R9, R10, and R19 between terminals 7 and 8 are limited to 250 volts maximum.

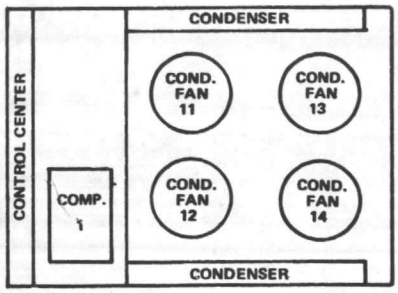
UNIT LAYOUT & PRINCIPLES OF OPERATION

MAJOR COMPONENT LOCATIONS

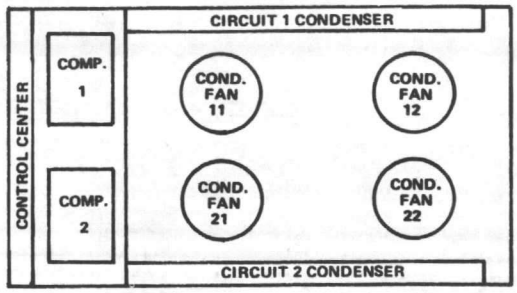
The figures below illustrate component locations within the unit and compressor and condenser fan motor horsepower values for each unit size.

TOP VIEW OF UNIT

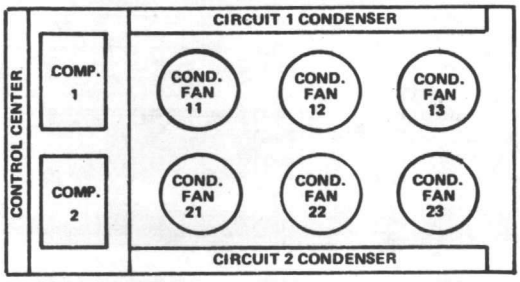
ALR-035A



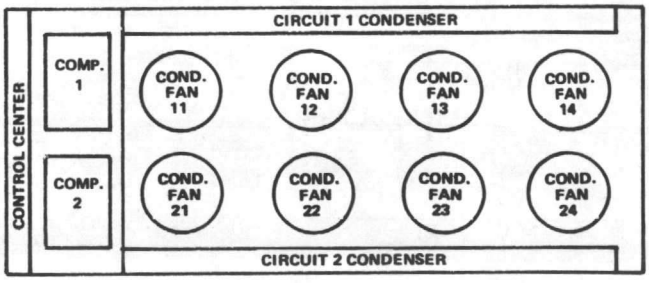
ALR-040A



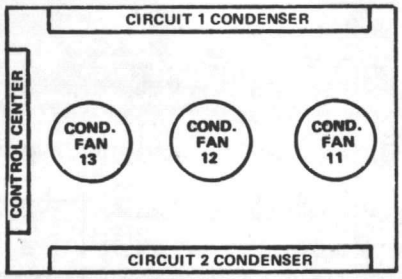
ALR-050A

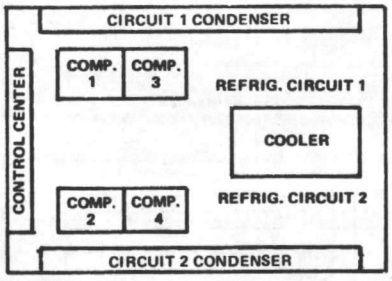


ALR-060B, ALR 065B



ALR-075A THRU 130A





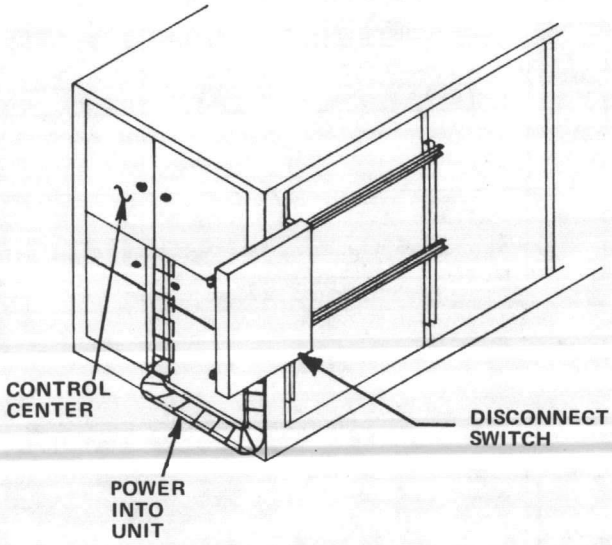
UNIT SIZE	COMPRESSOR HP				FAN HP (EACH)
	1	3	2	4	
ALR-035A-D	35	–	–	–	1.5
ALR-040A-D	20	–	25	–	1.5
ALR-050A-D	30	–	30	–	1.5
ALR-060B-D	30	–	35	–	1.5
ALR-065B-D	35	–	40	–	1.5
ALR-075A-D	35	–	25	25	5.0
ALR-085A-D	35	–	35	35	5.0
ALR-105A-D	25	35	25	35	5.0
ALR-110A-D	25	35	35	35	5.0
ALR-120A-D	35	35	35	35	5.0
ALR-130A-D	40	40	40	40	5.0

CONTROL CENTER

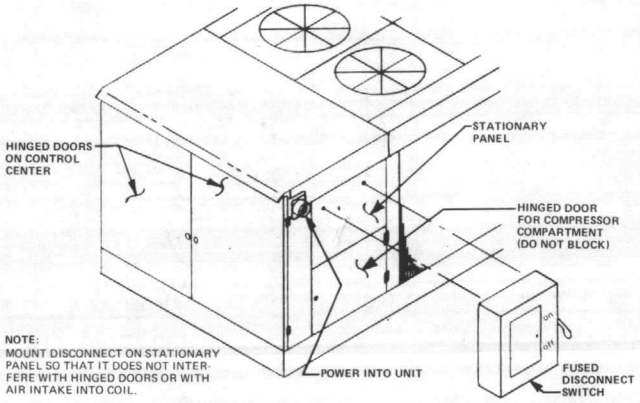
All electrical controls are enclosed in a weatherproof control center with keylocked, hinged access doors.

Power supply conduits are intended to come into the bottom of the upper enclosure and between the two lower enclosures. It is recommended that the unit disconnect switch be mounted away from the unit; however, Figure 10 recommends unit mounting arrangements if the disconnect must be unit mounted.

FIGURE 10. UNIT MOUNTED DISCONNECT



ALR-075A THRU 130A



ALR-035A THRU 065B

FIGURE 11. CONTROL CENTER LAYOUT ALR-035A

(Left Side, 110 Volt Controls)

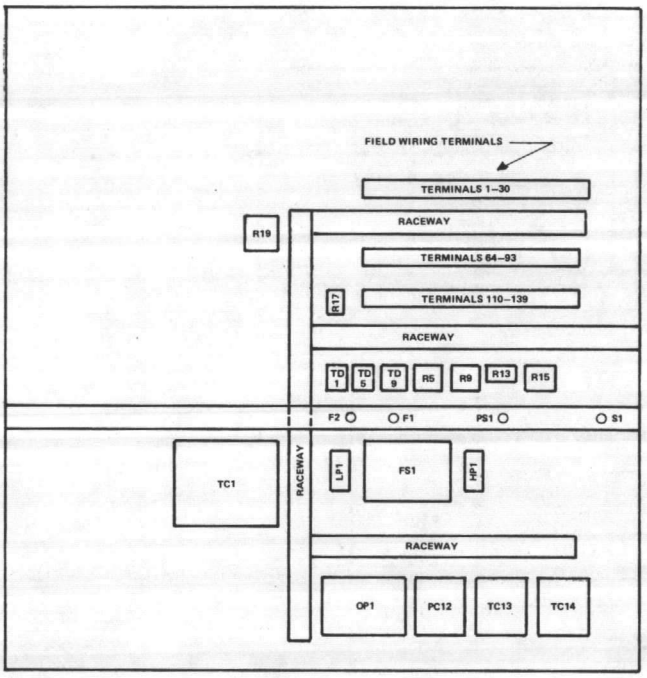


FIGURE 12. CONTROL CENTER LAYOUT ALR-040A THRU 065B

(Left Side, 110 Volt Controls)

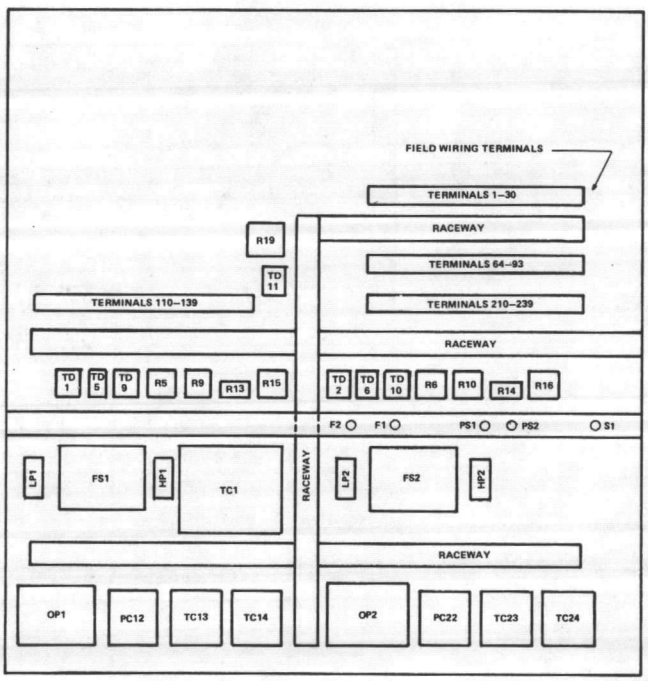


FIGURE 13. CONTROL CENTER LAYOUT ALR-035A THRU 065B

(Right Side, High Voltage Power Section)

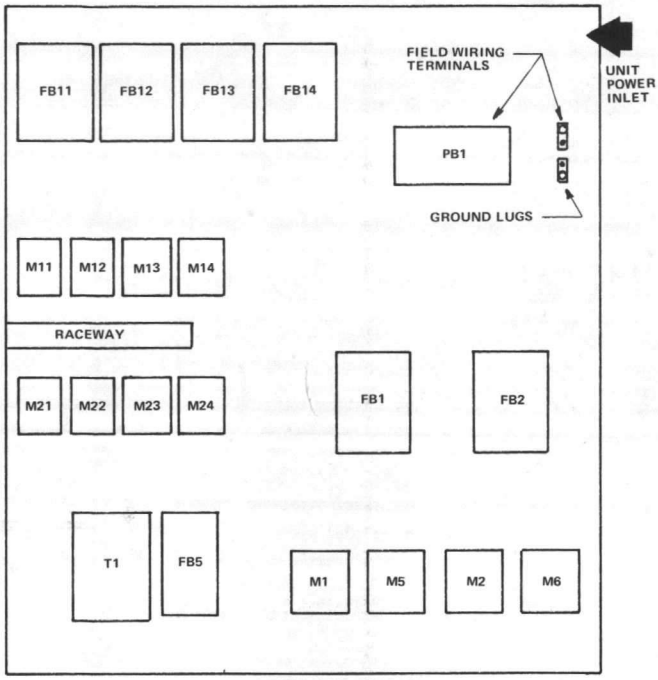
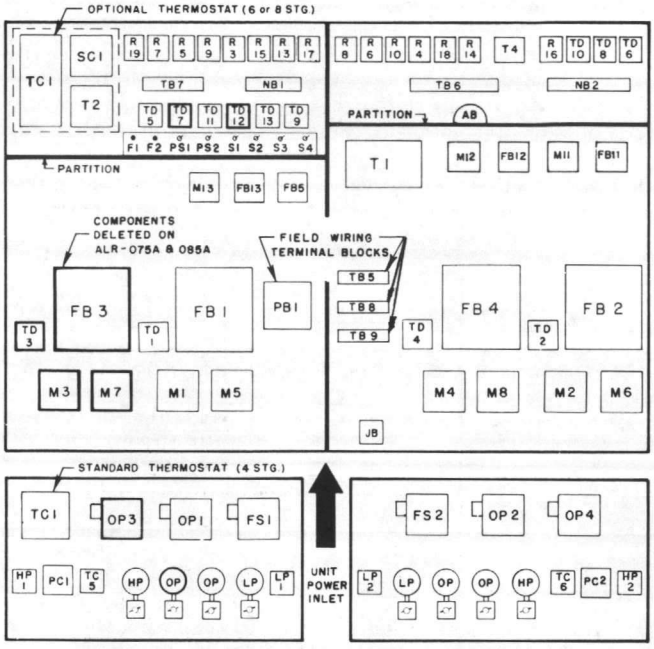


FIGURE 14. CONTROL CENTER LAYOUT ALR-075A THRU 130A



NOTE: On units ordered with optional capacity reduction and a unit mounted thermostat, the temperature adjustment for the thermostat is located where the 4 stage TC1 appears above.

SEQUENCE OF OPERATION

For Models ALR-035A thru 065B:

The components for a 2-compressor unit, models ALR-040A, -050A, -060B, and -065B, are given in parentheses ().

The following sequence of operation is for ALR SEASONPAK air cooled water chiller operation. With control circuit power on, control stop switch S1 closed, and manual pumpdown switch PS1 (PS2) closed ("auto" position), 115 volt power is applied through control circuit fuse F1 to the compressor crankcase heater HTR1 (HTR2), and also to the contacts of low pressure switch LP1 (LP2).

When the remote time clock or manual shutdown switch turns on, pump starter relay R19 holding coil is energized, closing contacts 1 and 3 to start the chilled water pump. Relay R19 contacts 4 and 6 in the thermostatic circuit also close. With the flow switch closed, if freeze control FS1 (FS2), high pressure control HP1 (HP2), and motor protector MP1 (MP2) do not sense an alarm condition, safety relay R5 (R6) is energized closed, applying power to the water temperature control thermostat TC1. The unit will operate automatically in response to TC1.

On a call for cooling, TC1, stage 1, energizes liquid line solenoid SV1, opening the valve and allowing refrigerant to flow into the evaporator. As refrigerant pressure builds up, low pressure control LP1 closes, energizing low pressure relay R9 which closes to energize compressor contactor M1, starting the compressor. Closing relay R9 contacts also energizes condenser fan relay M11, closing its contacts and providing power to condenser fan motor 11 and condenser fan motor controls PC12, TC13 and TC14. (TC14 on ALR-035, 060 and 065.)

On two-compressor units, if additional stages of cooling are required, temperature control thermostat TC1 energizes liquid line solenoid valve SV2 after time delay relay TD11 has sequenced closed, to initiate the same starting sequence in refrigerant circuit number 2.

On units with compressor unloading, if additional stages of cooling are required the unloader U1 (U2) is de-energized and the compressor is loaded.

For Models ALR-075A thru 130A:

The following sequence of operation is typical for ALR SEASONPAK air cooled water chiller operation. It is written for a 4-compressor unit. Components referred to in the sequence, but not used in a 3-compressor unit, are: HTR3, MP3, R7, TD12, M3 and M7.

With the control circuit power on, control stop switch S1 closed, and manual pumpdown switches PS1 and PS2 closed ("auto position), 115 volt power is applied through control circuit fuse F1 to the compressor crankcase heaters HTR1 through HTR4, and also to the contacts of low pressure switches LP1 and LP2.

When the remote time clock or manual shutdown switch turns on, pump starter relay R19 holding coil is energized, closing contacts 1 and 3 to start the chilled water pump. Relay R19 contacts 4, 6, 7 and 9 in the thermostatic circuit also close. With the flow switch closed, if freeze controls FS1 and FS2, high pressure controls HP1 and HP2, and compressor motor protectors MP1 through MP4 do not sense an alarm condition, safety relays R5 through R8 are energized closed, applying power to the water temperature control thermostat TC1. The unit will operate automatically in response to TC1.

On a call for cooling, TC1 energizes liquid line solenoid SV1, opening the valve and allowing refrigerant to flow into the evaporator. As refrigerant pressure builds up, low pressure control LP1 closes, energizing low pressure relay R9 which closes to energize compressor contactor M1, starting the compressor. Closing relay R9 contacts also energizes condenser fan relay R17, closing its contacts and providing power to condenser fan motor contactors M11, M12, and M13.

If additional stages of cooling are required, temperature control thermostat TC1 energizes liquid line solenoid valve SV2 after time delay relay TD11 has sequenced closed, to initiate the same starting sequence in refrigerant circuit number 2.

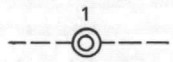
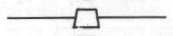
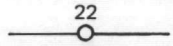
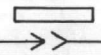
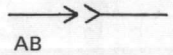
If additional cooling is still required, the 3rd and 4th stages of TC1 energize the 3rd and 4th compressors, after time delay relays TD12 and TD13 have sequenced closed.

PUMPDOWN CYCLE

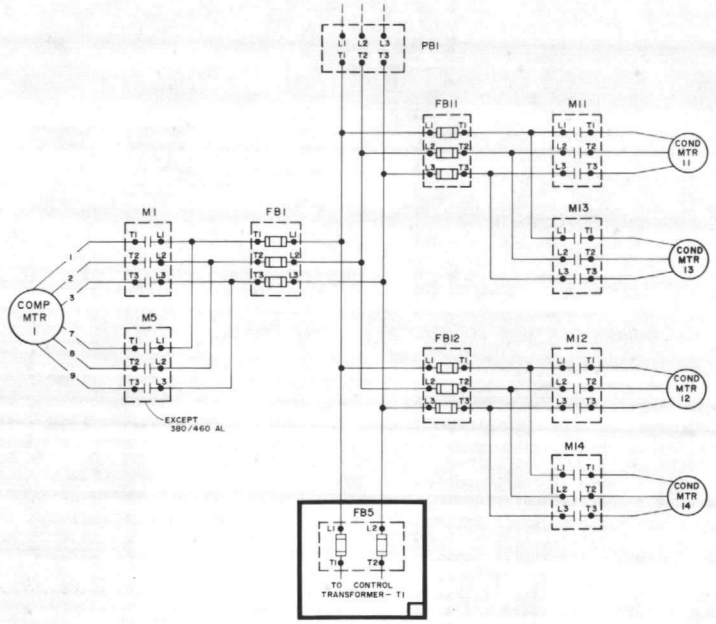
As temperature control thermostat TC1 is satisfied, it opens its contacts, de-energizing liquid line solenoid valve SV1, causing the valve to close. When the compressor has pumped most of the refrigerant from the evaporator to the condenser, the low pressure control LP1 opens, shutting down the compressor and condenser fan motors.

In the event a closed solenoid valve allows refrigerant to leak to the low side of the refrigerant circuit during either unit "on" or "off" time, the buildup in pressure will close the low pressure control, energizing the low pressure relay and starting the compressor for pumpdown.

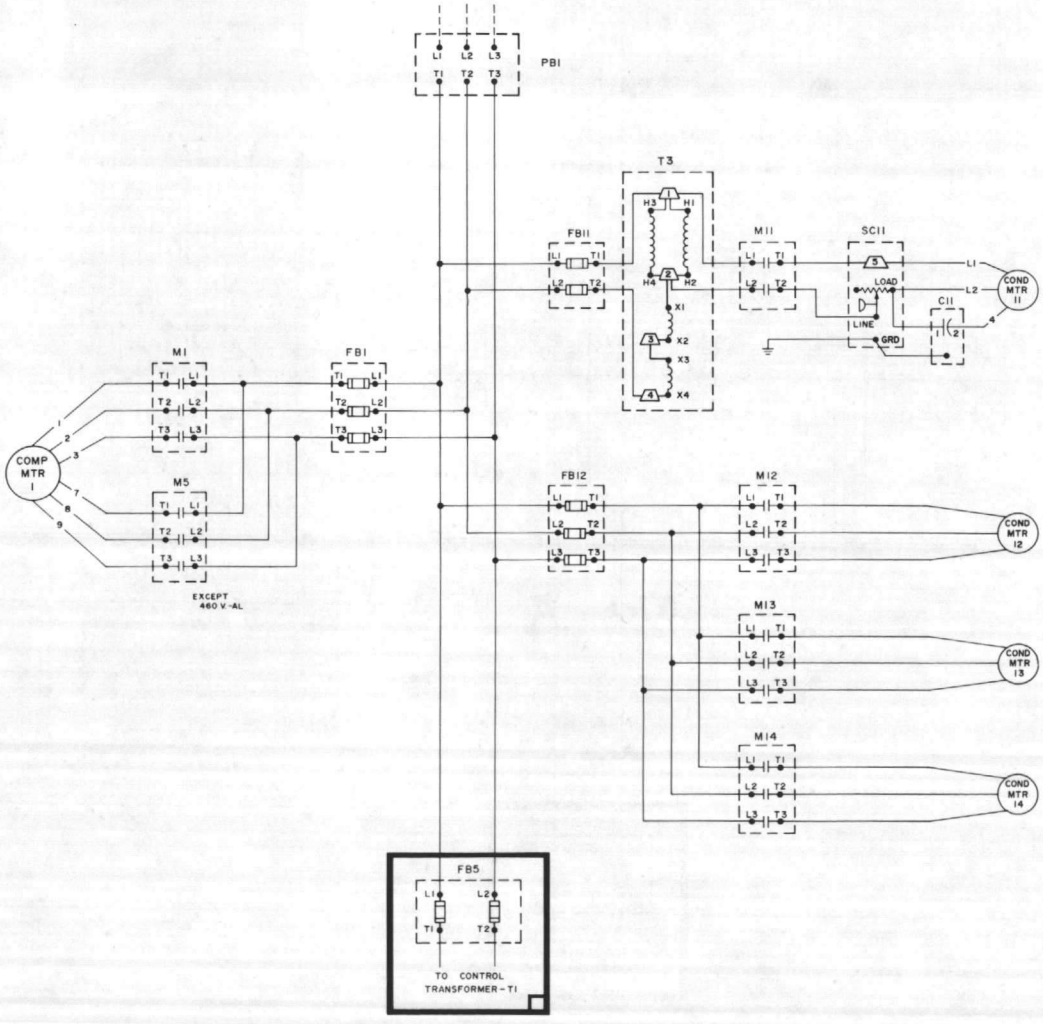
ELECTRICAL LEGEND

	FIELD WIRING AND NUMBERED TERMINAL
	WIRE NUT
	FACTORY WIRING AND NUMBERED TERMINAL
200	WIRE NUMBER
	OPTIONAL CONTROL – SEE WIRING DIAGRAMS
	CONNECTOR
AB	ALARM BELL
F1	CONTROL CIRCUIT FUSE
F2	EVAPORATOR HEATER FUSE
FB1,2,3,4	FUSE BLOCKS (COMP. 1,2,3,4)
FB5	CONTROL CIRCUIT TRANSFORMER FUSE BLOCK – OPTIONAL
FB11,12,13	FUSE BLOCKS (COND. FAN 11,12,13)
FS1,2	FREEZE CONTROLS (REF. CIRCUIT 1,2)
HP1,2	HIGH PRESSURE CONTROLS (REF. CIRCUIT 1,2)
HP	HIGH PRESSURE GAUGE – OPTIONAL
HTR1 thru 4	CRANKCASE HEATERS (COMP. 1,2,3,4)
HTR5	EVAPORATOR HEATER
JB	JUNCTION BOX (FOR ALARM BELL) – OPTIONAL
LP1,2	LOW PRESSURE CONTROLS (REF. CIRCUIT 1,2)
LP	LOW PRESSURE GAUGE – OPTIONAL
M1 thru 8	CONTACTORS (COMP. 1,2,3,4)
M11,12,13,14	CONTACTORS (COND. FAN 11,12,13,14)
M21,22,23,24	CONTACTORS (COND. FAN 21,22,23,24 – ALR-040 thru 065, CIRCUIT 2)
MP1 thru 4	MOTOR PROTECTORS (COMP. 1,2,3,4)
OP1,2,3,4	OIL PRESSURE CONTROLS (COMP. 1,2,3,4)
OP	OIL PRESSURE GAUGE – OPTIONAL
PB1	MAIN POWER TERMINAL BLOCK
PC1 and PC2	FANTROL PRESSURE CONTROLS (ALR-075 thru 130)
PC12,22	FANTROL PRESSURE CONTROLS (ALR-035 thru 065)
TC5 and TC6	FANTROL TEMPERATURE CONTROLS (ALR-075 thru 130)
TC13,14	FANTROL TEMPERATURE CONTROLS (ALR-035 thru 065, Circuit 1)
TC23,24	FANTROL TEMPERATURE CONTROLS (ALR-040 thru 065, Circuit 2)
PS1,2	PUMPDOWN SWITCHES (REF. CIRCUIT 1,2)
R3,4	STARTER RELAYS (COMP. 3,4)
R5,6,7,8	SAFETY RELAYS (COMP. 1,2,3,4)
R9,10	LOW PRESSURE RELAYS (REF. CIRCUIT 1,2)
R13,14	LOW AMBIENT START RELAYS (REF. CIRCUIT 1,2) – OPTIONAL
R15,16	COMPRESSOR LOCKOUT RELAYS – OPTIONAL
R17,18	CONDENSER FAN RELAY (ALR-075 thru 130)
R19	PUMP STARTER RELAY
S1	CONTROL STOP SWITCH
S2,3,4	LEAD-LAG SWITCHES
T1	CONTROL CIRCUIT TRANSFORMER – OPTIONAL
T3	SPEEDTROL TRANSFORMER – OPTIONAL
TD1,2,3,4	PART WINDING TIME DELAYS (COMP. 1,2,3,4) – OPTIONAL
TD5,6,7,8	COMP. LOCKOUT TIME DELAYS (COMP. 1,2,3,4) – OPTIONAL
TD9,10	LOW AMBIENT START TIME DELAYS (CIRCUIT 1,2) – OPTIONAL
TD11,12,13	COMP. SEQUENCING TIME DELAYS (STAGES 2,3,4)
NB1,2	TERMINAL BLOCKS (NEUTRAL-FACTORY WIRING)
TB6,7	TERMINAL BLOCKS (HOT-FACTORY WIRING)
TB5,8,9	TERMINAL BLOCKS (FIELD WIRING)
TC1	WATER TEMP. CONTROL THERMOSTAT
SC1	OPTIONAL WATER TEMP. CONTROL THERMOSTAT SIGNAL CENTER
T2	OPTIONAL WATER TEMP. CONTROL THERMOSTAT TRANSFORMER
T4	ALARM BELL TRANSFORMER – OPTIONAL
TC2	COOLER HEATER THERMOSTAT

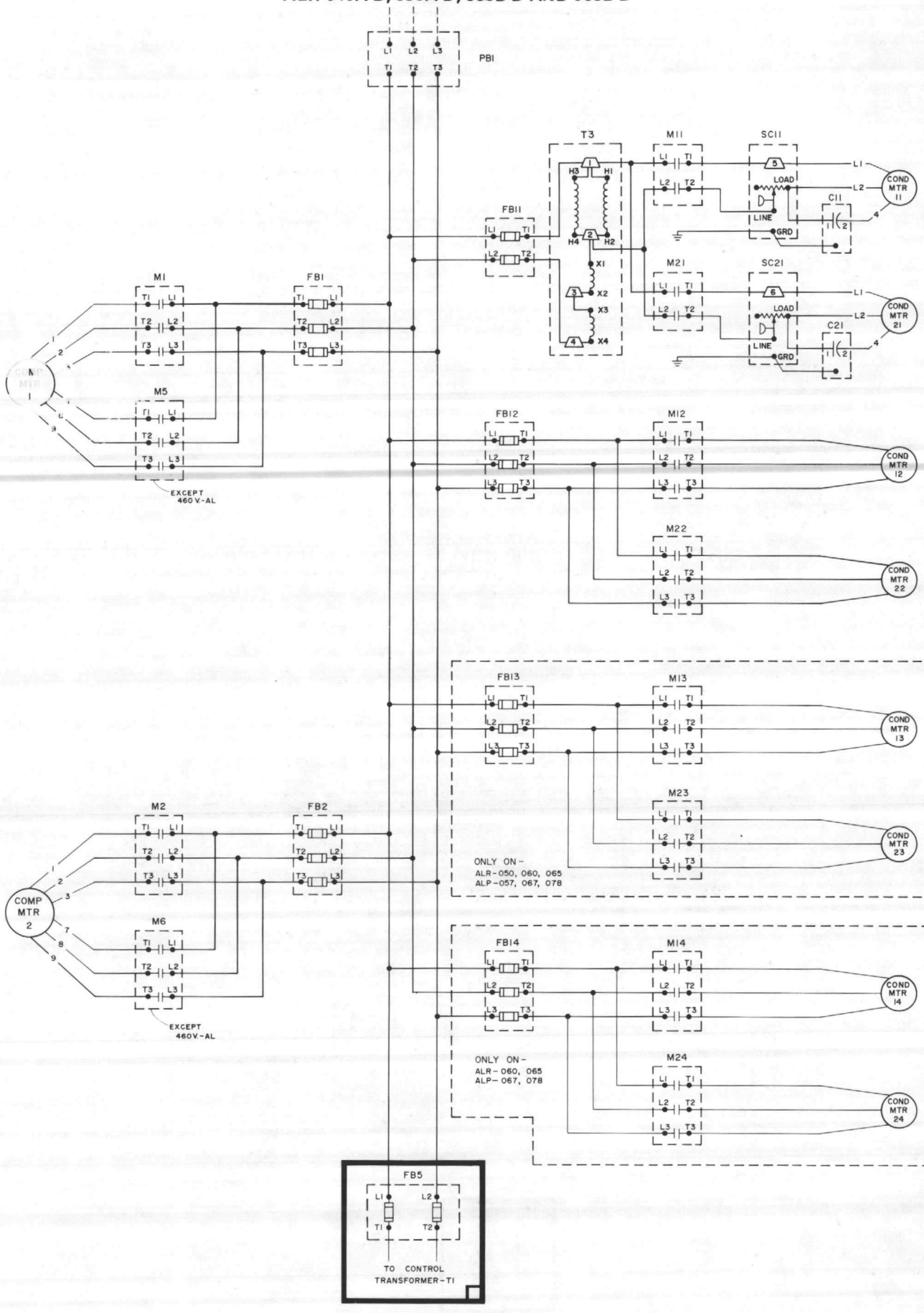
POWER SCHEMATIC
COMPRESSOR AND CONDENSER FAN MOTORS (WITHOUT SPEEDTROL)
ALR-035A-S



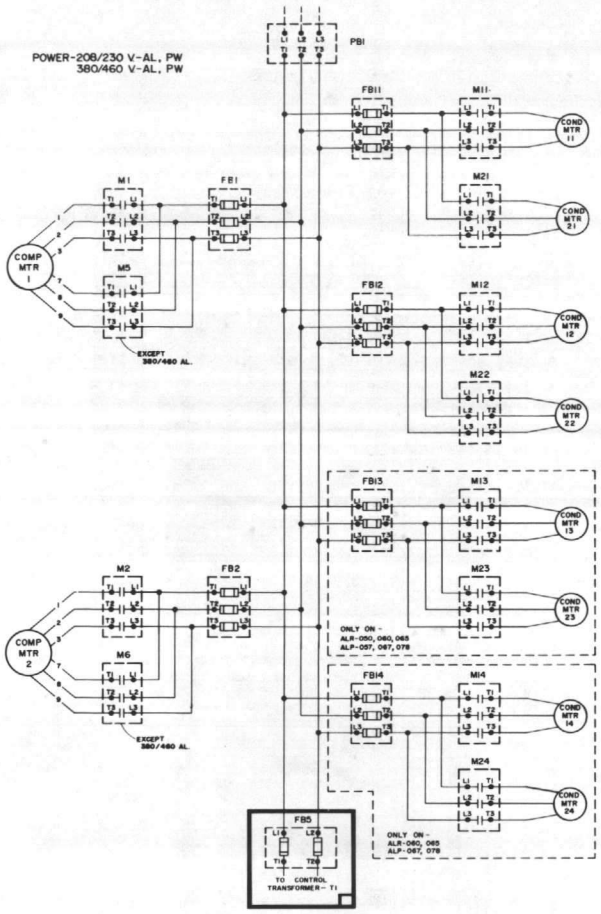
POWER SCHEMATIC
COMPRESSOR AND CONDENSER FAN MOTORS (WITH SPEEDTROL)
ALR-035A-S



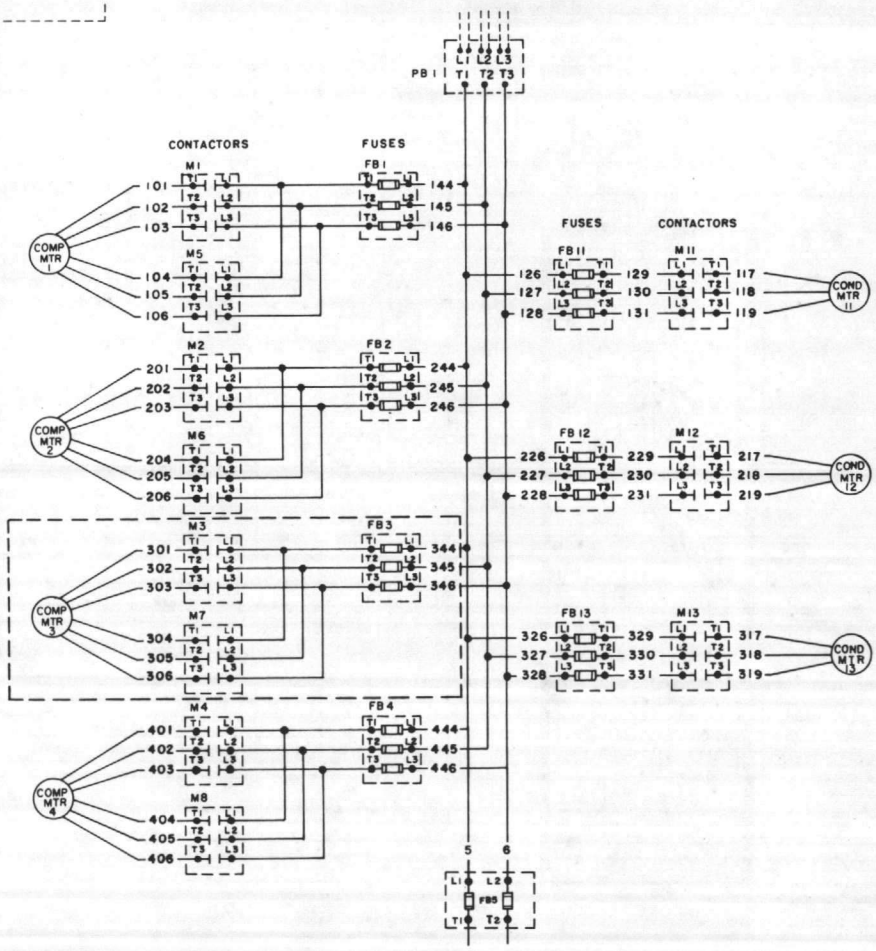
POWER SCHEMATIC
COMPRESSOR AND CONDENSER FAN MOTORS (WITH SPEEDTROL)
ALR-040A-D, 050A-D, 060B-D AND 065B-D



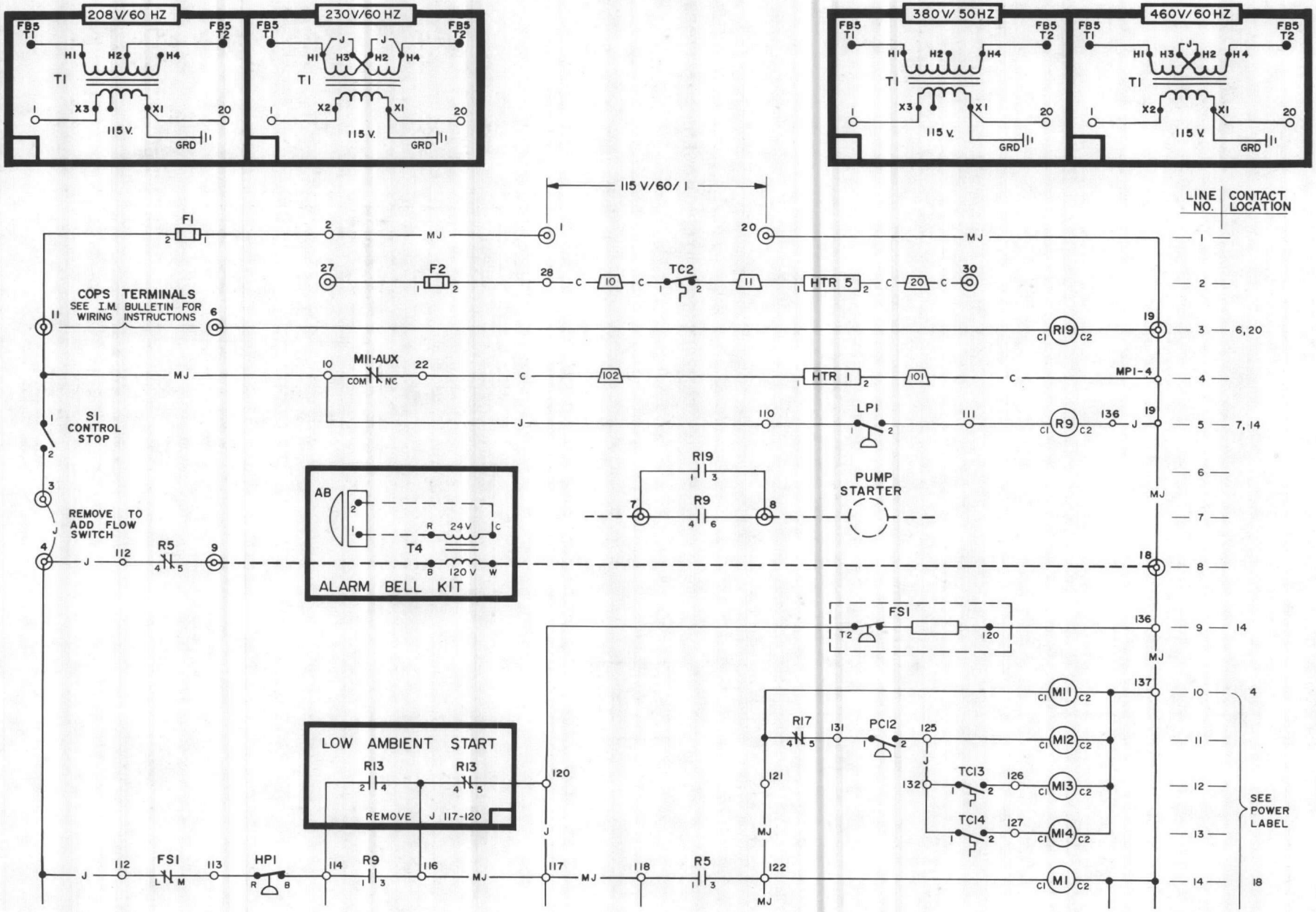
POWER SCHEMATIC
COMPRESSOR AND CONDENSER FAN MOTORS
(WITHOUT SPEEDTROL)
ALR-040A-D, 050A-D, 060B-D AND 065B-D

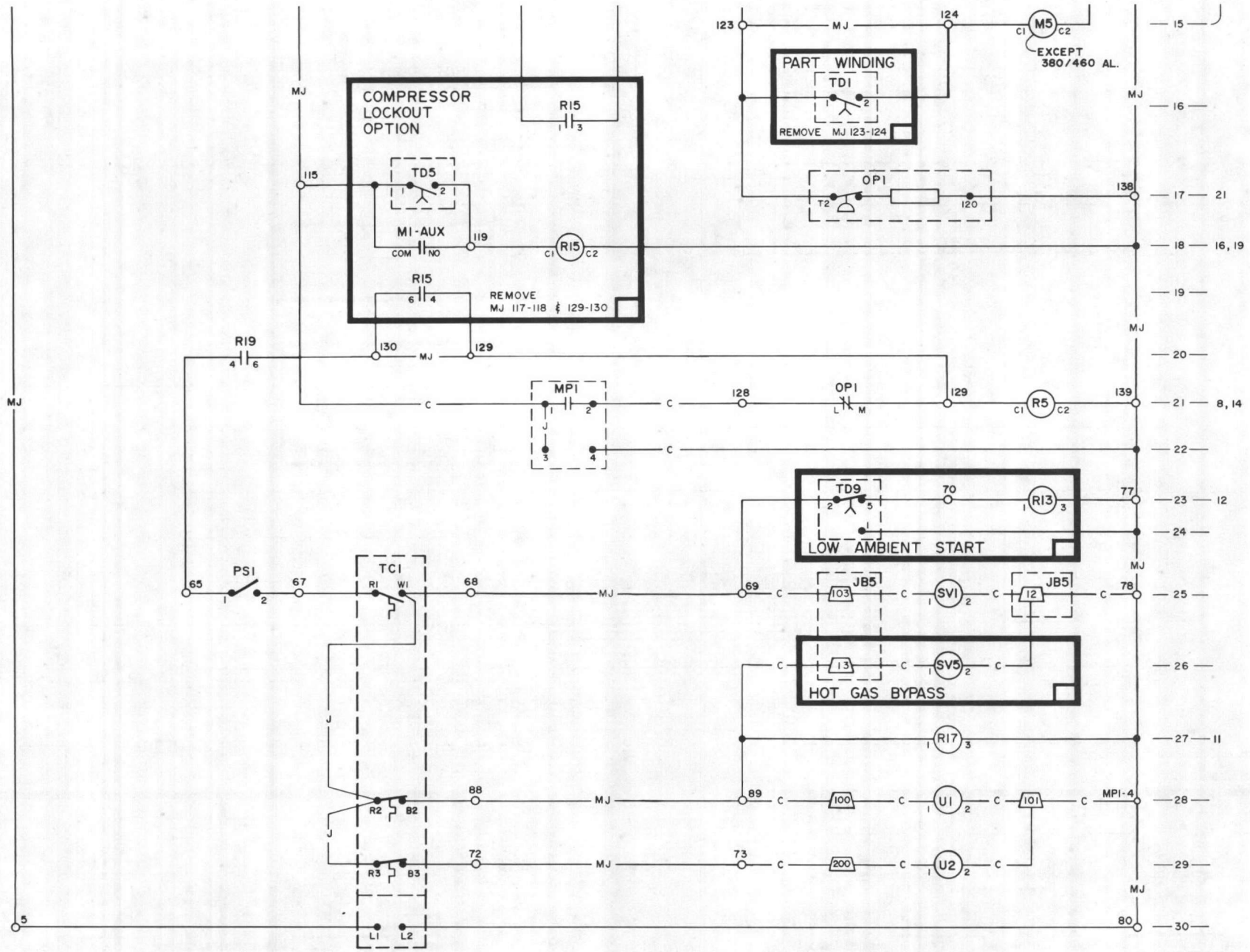


POWER SCHEMATIC
COMPRESSOR AND CONDENSER FAN MOTORS
ALR-075A THRU 130A



COMPRESSOR CONTROL SCHEMATIC
ALR-035A-S
LABEL 377753E REV. O




MJ
COMPRESSOR LOCKOUT OPTION
R15
TD5
MI-AUX
COM NO
REMOVE MJ 117-118 & 129-130
R19
MP1
OP1
PART WINDING
TD1
REMOVE MJ 123-124
M5
EXCEPT 380/460 AL.
TD9
LOW AMBIENT START
R13
R17
JB5
SV1
SV5
HOT GAS BYPASS
PS1
TC1
R2
B2
R3
B3
U1
U2
L1
L2
115
119
123
124
129
130
138
139
65
67
68
69
70
72
73
77
78
80
88
89
100
101
103
12
13
200
MPI-4
15
16
17
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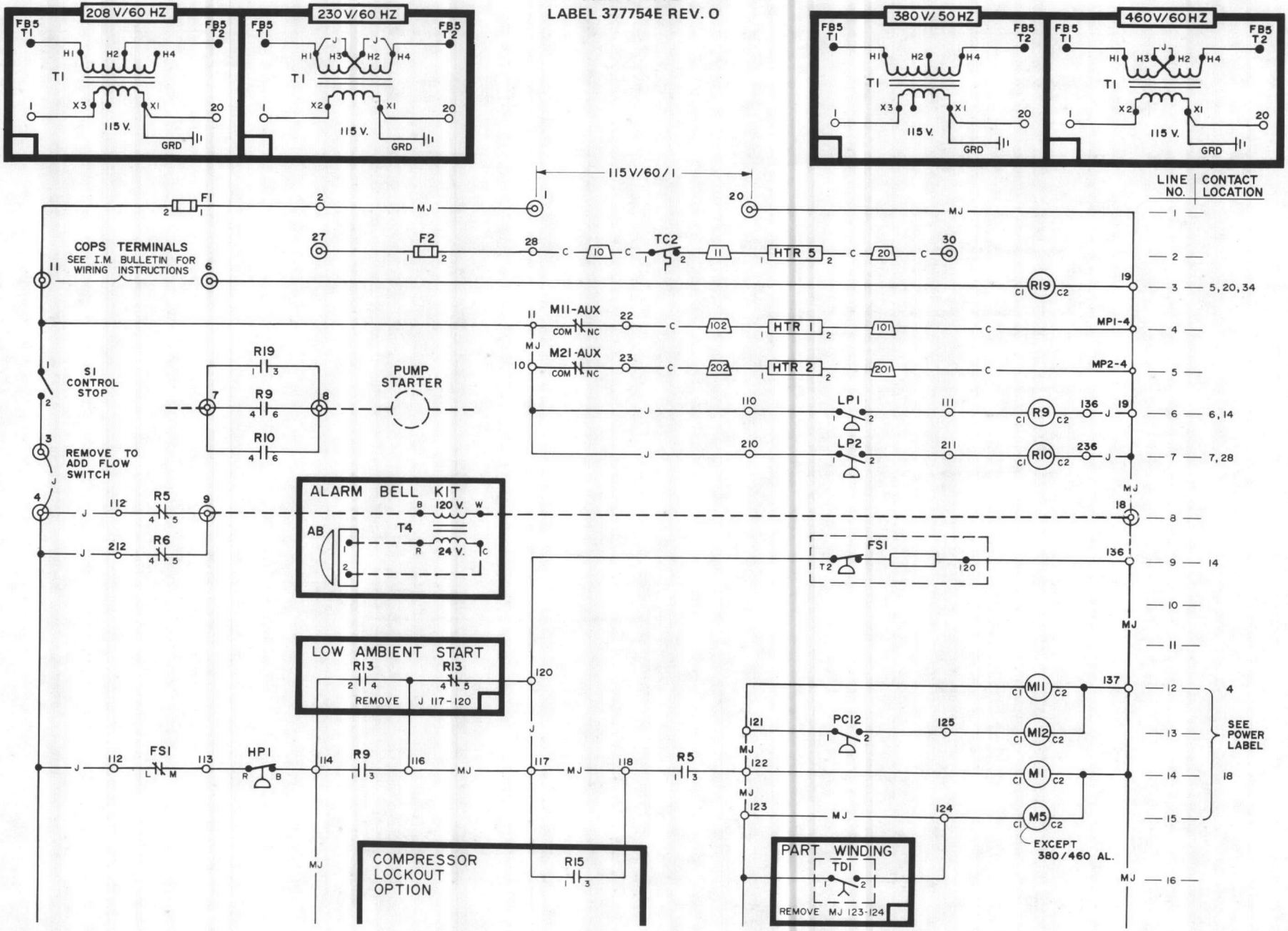
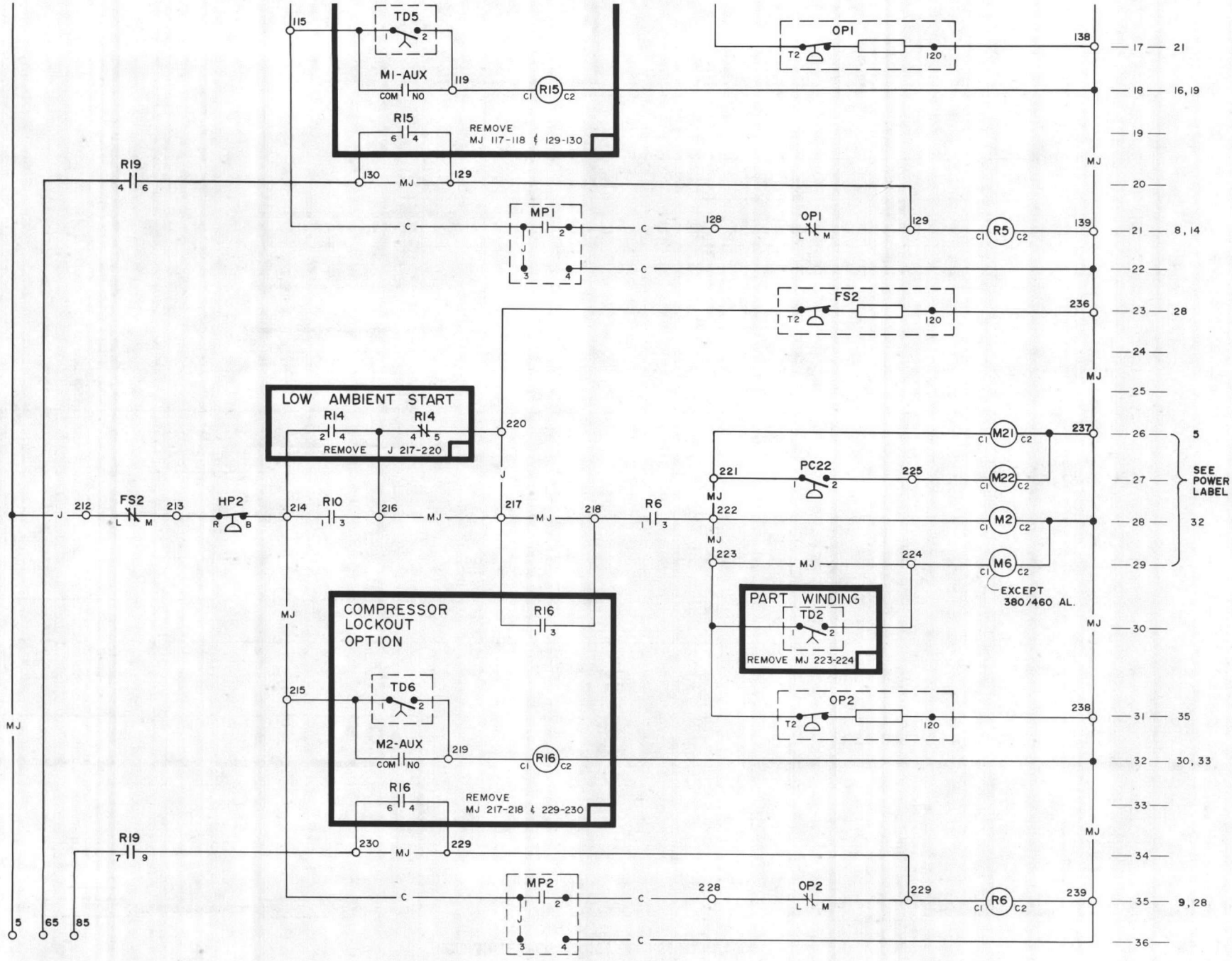
COMPRESSOR CONTROL SCHEMATIC
ALR-040A-D
LABEL 377754E REV. O

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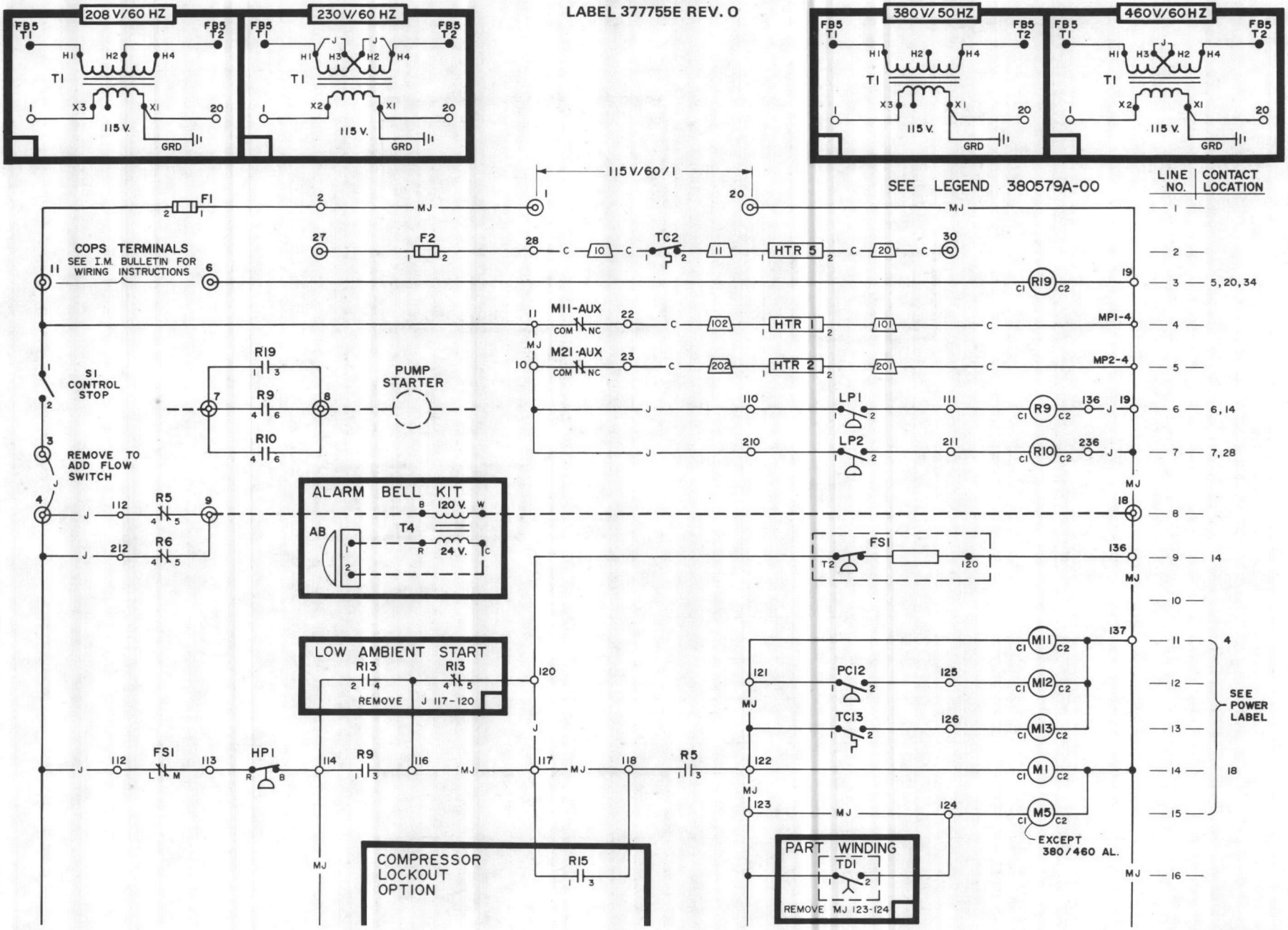
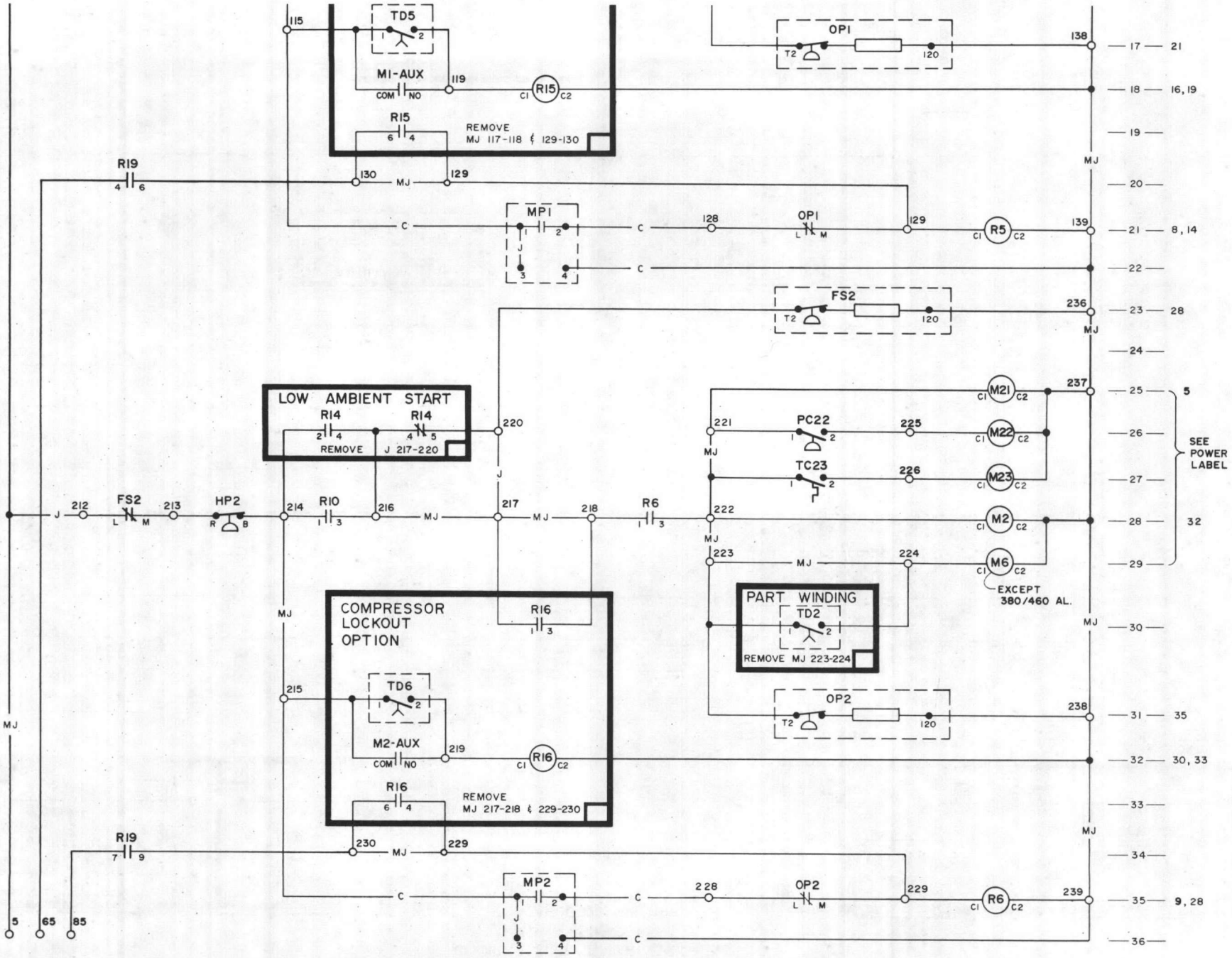
M1-AUX
COM NO
119
R15 C1 C2
R15
6 4
REMOVE MJ 117-118 & 129-130
OP1
T2
120
138
17 21
18 16, 19
19
MJ
R19
4 6
130
MJ
129
20
MP1
C
128
OP1
L M
129
R5 C1 C2
139
21 8, 14
J
3 4
22
FS2
T2
120
236
23 28
24
MJ
25
LOW AMBIENT START
R14
2 4
R14
4 5
REMOVE J 217-220
220
J
M21 C1 C2
237
26
5
SEE POWER LABEL
221
PC22
225
M22 C1 C2
27
J
212
FS2
L M
213
HP2
R B
214
R10
1 3
216
MJ
217
MJ
218
R6
1 3
MJ
222
M2 C1 C2
28
32
MJ
223
MJ
224
M6 C1 C2
29
EXCEPT 380/460 AL.
PART WINDING
TD2
REMOVE MJ 223-224
MJ
COMPRESSOR LOCKOUT OPTION
R16
1 3
MJ
30
215
TD6
M2-AUX
COM NO
219
R16 C1 C2
R16
6 4
REMOVE MJ 217-218 & 229-230
OP2
T2
120
238
31 35
32 30, 33
33
MJ
R19
7 9
230
MJ
229
34
MP2
C
228
OP2
L M
229
R6 C1 C2
239
35 9, 28
J
3 4
36
MJ
5
65
85

COMPRESSOR CONTROL SCHEMATIC
ALR-050A-D
LABEL 377755E REV. O

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COM NO
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R15 C1 C2
R15
6 4
REMOVE
MJ 117-118 & 129-130
R19
4 6
130
MJ
129
MP1
C
128
OP1
L M
T2
120
138
17 21
18 16, 19
19
MJ
20
129
R5 C1 C2
139
21 8, 14
22
FS2
236
23 28
MJ
24
LOW AMBIENT START
R14
2 4
R14
4 5
REMOVE J 217-220
220
M21 C1 C2
237
25
5
221
PC22
225
M22 C1 C2
26
SEE POWER LABEL
MJ
TC23
226
M23 C1 C2
27
212
FS2
L M
213
HP2
R B
214
R10
1 3
216
MJ
217
MJ
218
R6
1 3
222
M2 C1 C2
28
32
MJ
223
MJ
224
M6 C1 C2
29
EXCEPT 380/460 AL.
PART WINDING
TD2
REMOVE MJ 223-224
MJ
30
COMPRESSOR LOCKOUT OPTION
R16
1 3
215
TD6
M2-AUX
COM NO
219
R16 C1 C2
OP2
238
31 35
32 30, 33
R16
6 4
REMOVE
MJ 217-218 & 229-230
33
MJ
R19
7 9
230
MJ
229
34
MP2
C
228
OP2
L M
229
R6 C1 C2
239
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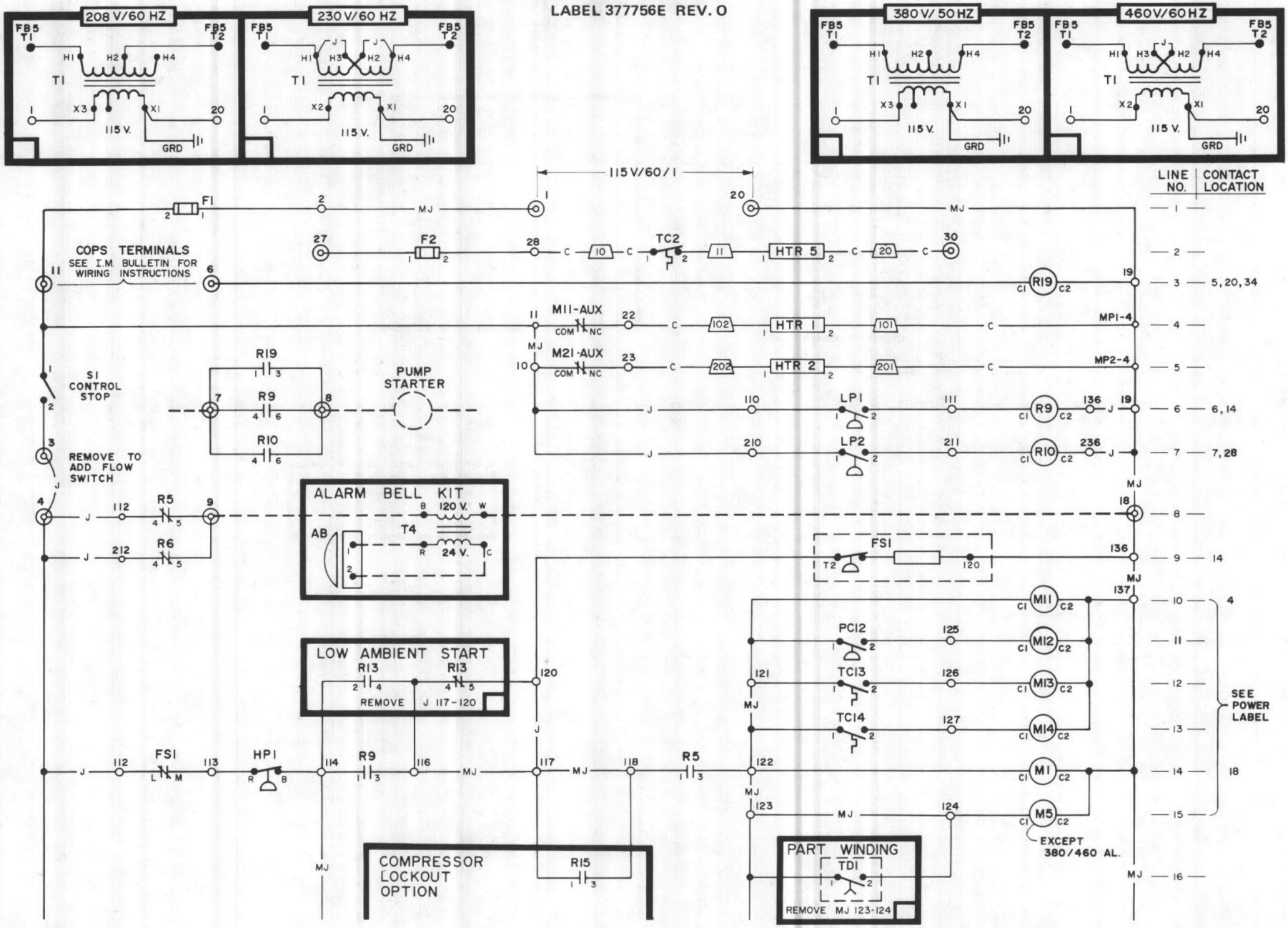
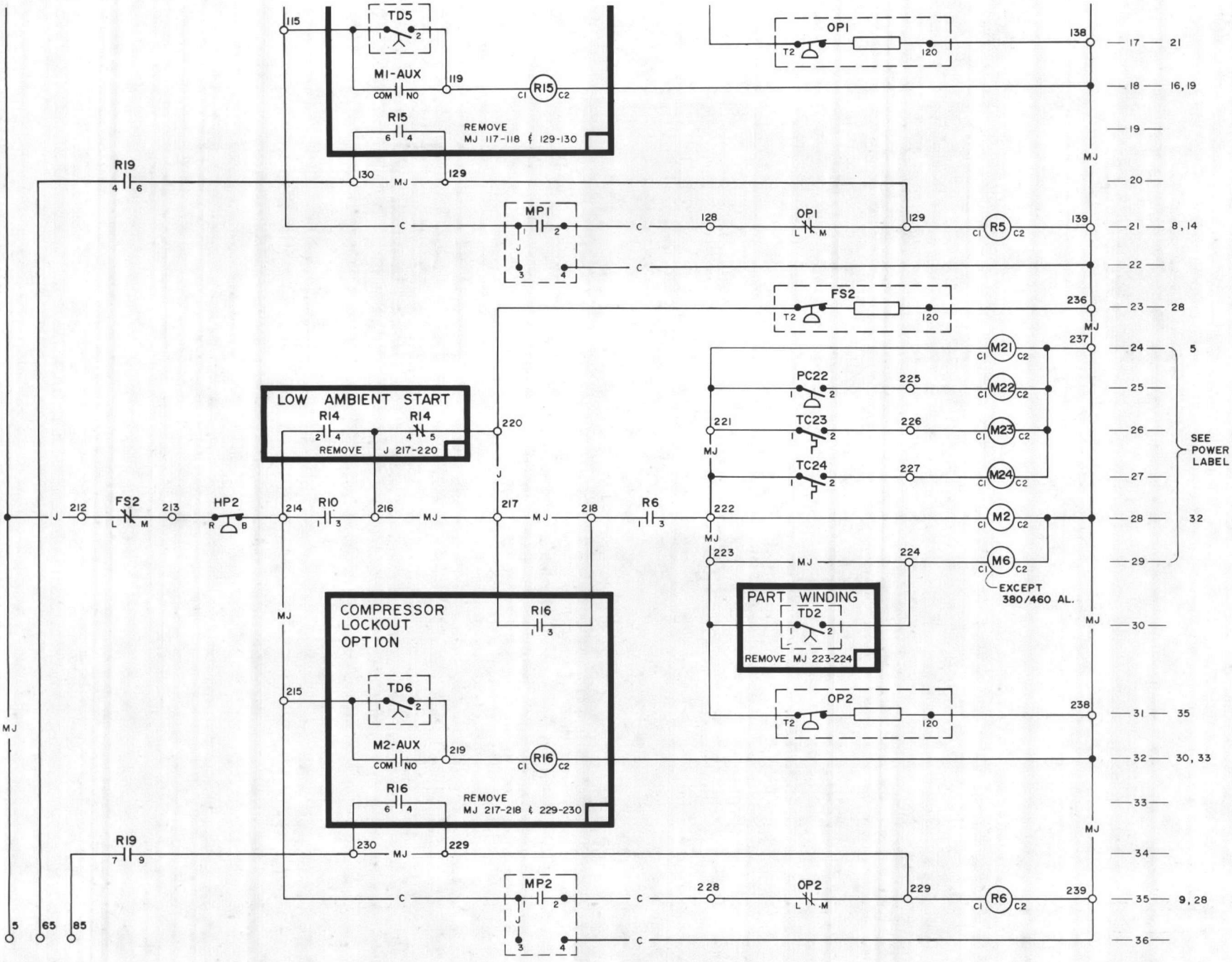
36
5
65
85

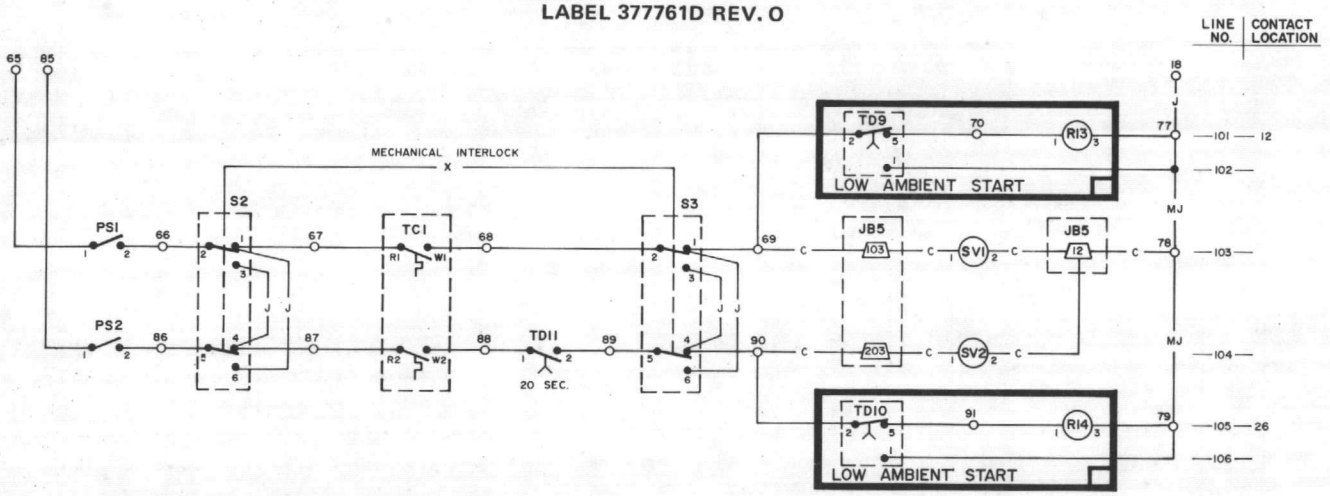
COMPRESSOR CONTROL SCHEMATIC
ALR-060B-D, 065B-D
LABEL 377756E REV. O




TD5
115
M1-AUX
COM NO
119
R15
C1 C2
R15
6 4
REMOVE
MJ 117-118 & 129-130
OP1
T2
120
138
17 21
18 16, 19
19
MJ
R19
4 6
130
MJ
129
20
MP1
C
128
OP1
L M
129
R5
C1 C2
139
21 8, 14
22
FS2
T2
120
236
23 28
MJ
237
M21
C1 C2
24
5
PC22
225
M22
C1 C2
25
LOW AMBIENT START
R14
2 4
R14
4 5
REMOVE J 217-220
220
221
TC23
226
M23
C1 C2
26
SEE POWER LABEL
MJ
TC24
227
M24
C1 C2
27
J
212
FS2
L M
213
HP2
R B
214
R10
1 3
216
MJ
217
MJ
218
R6
1 3
222
M2
C1 C2
28
32
MJ
223
MJ
224
M6
C1 C2
29
EXCEPT 380/460 AL.
PART WINDING
TD2
REMOVE MJ 223-224
MJ
30
COMPRESSOR LOCKOUT OPTION
R16
1 3
215
TD6
M2-AUX
COM NO
219
R16
C1 C2
OP2
T2
120
238
31 35
32 30, 33
R16
6 4
REMOVE
MJ 217-218 & 229-230
33
MJ
R19
7 9
230
MJ
229
34
MP2
C
228
OP2
L M
229
R6
C1 C2
239
35 9, 28
36
5
65
85
MJ

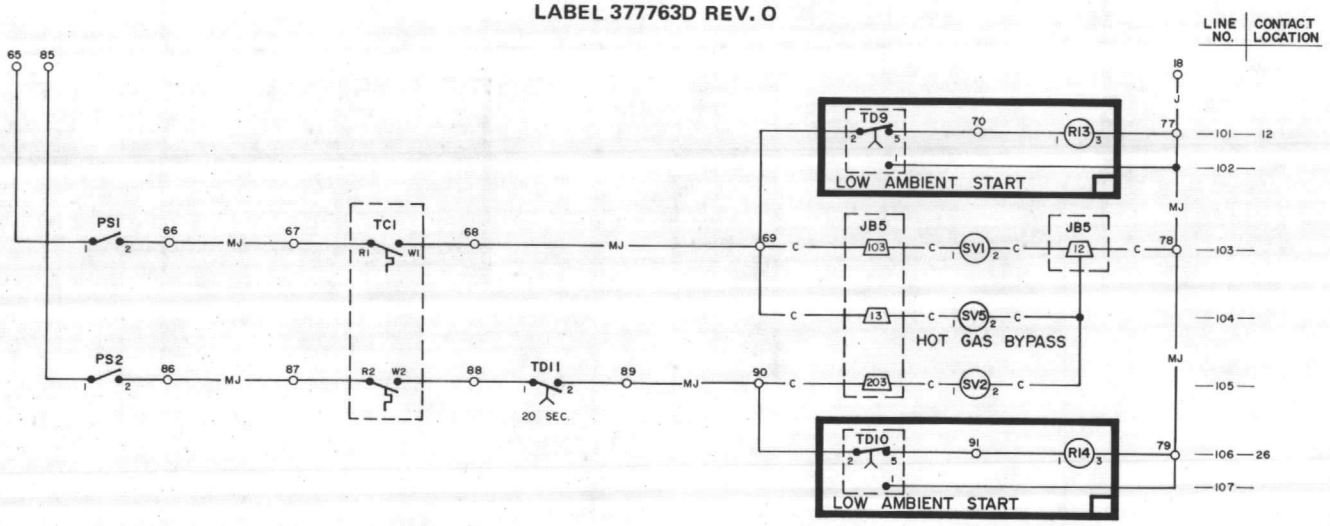
THERMOSTAT CIRCUIT SCHEMATIC – ALR-040A-D, 050A-D, 060B-D, 065B-D
(No Unloading, With Lead Lag)

LABEL 377761D REV. O

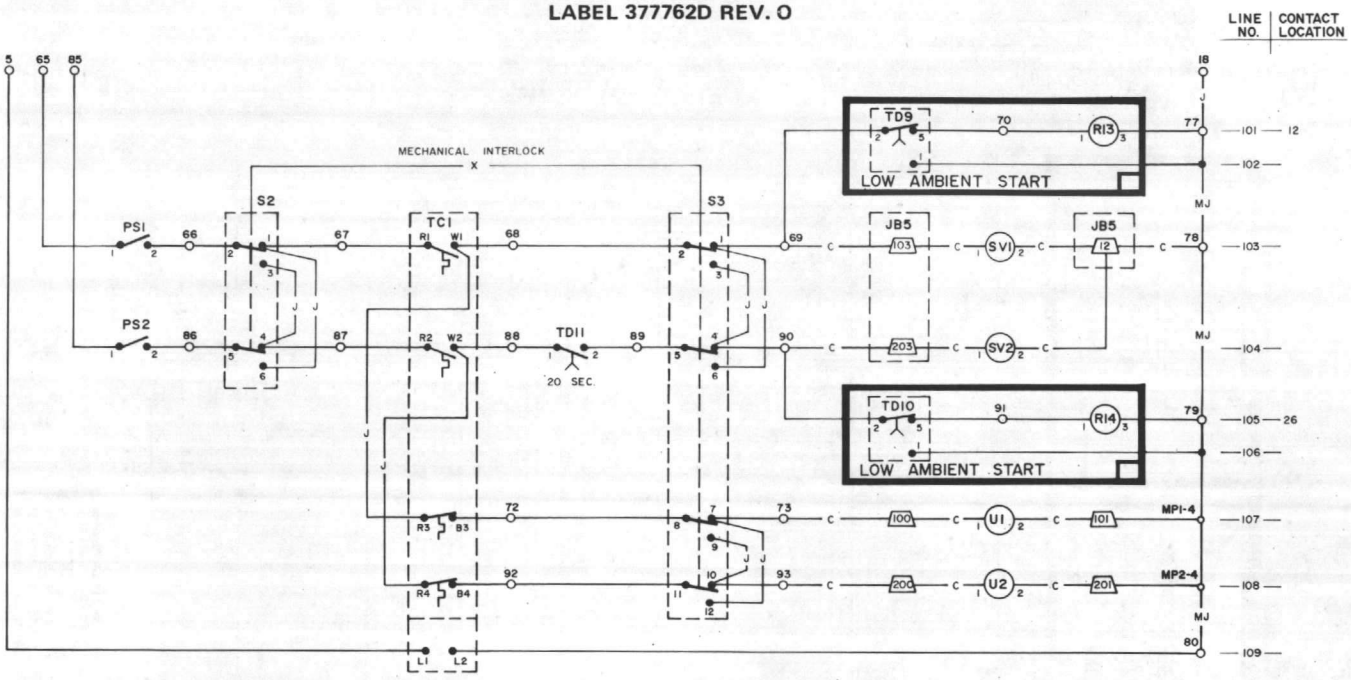


THERMOSTAT CIRCUIT SCHEMATIC – ALR-040A-D, 050A-D, 060B-D, 065B-D
(No Unloading, With Hot Gas Bypass)

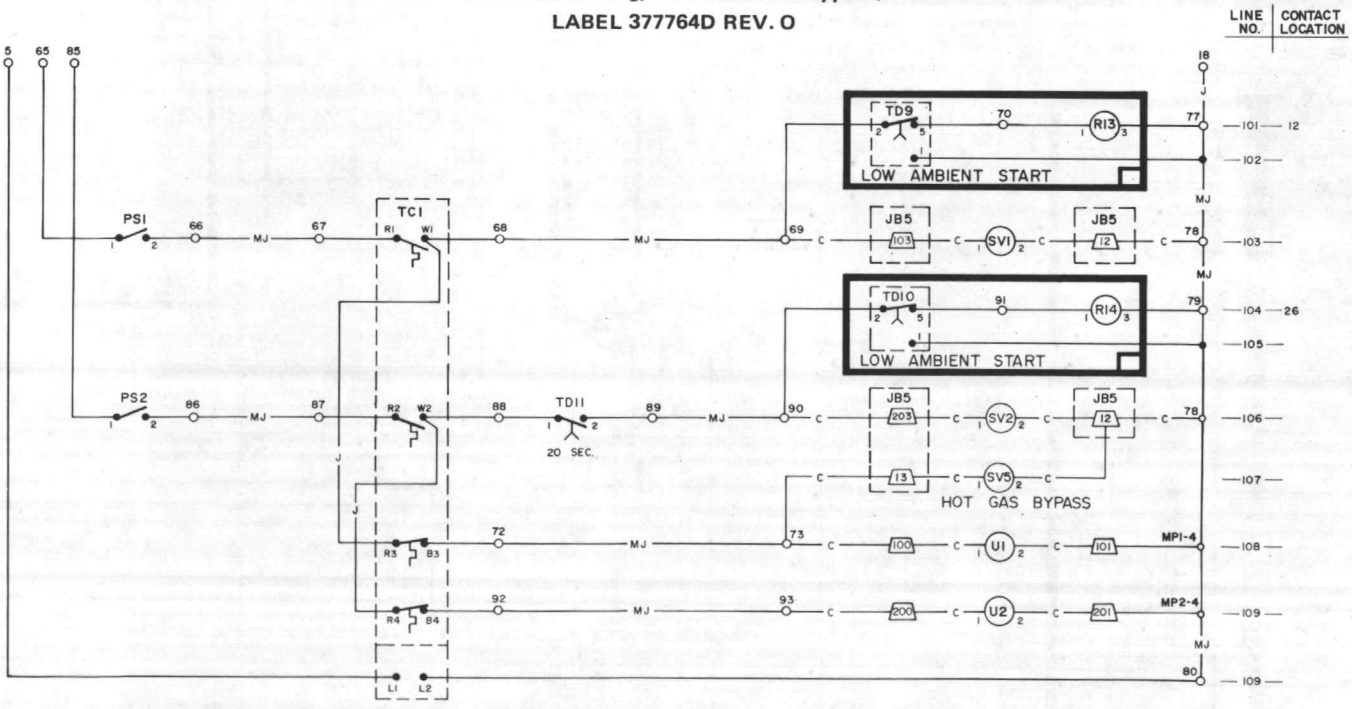
LABEL 377763D REV. O



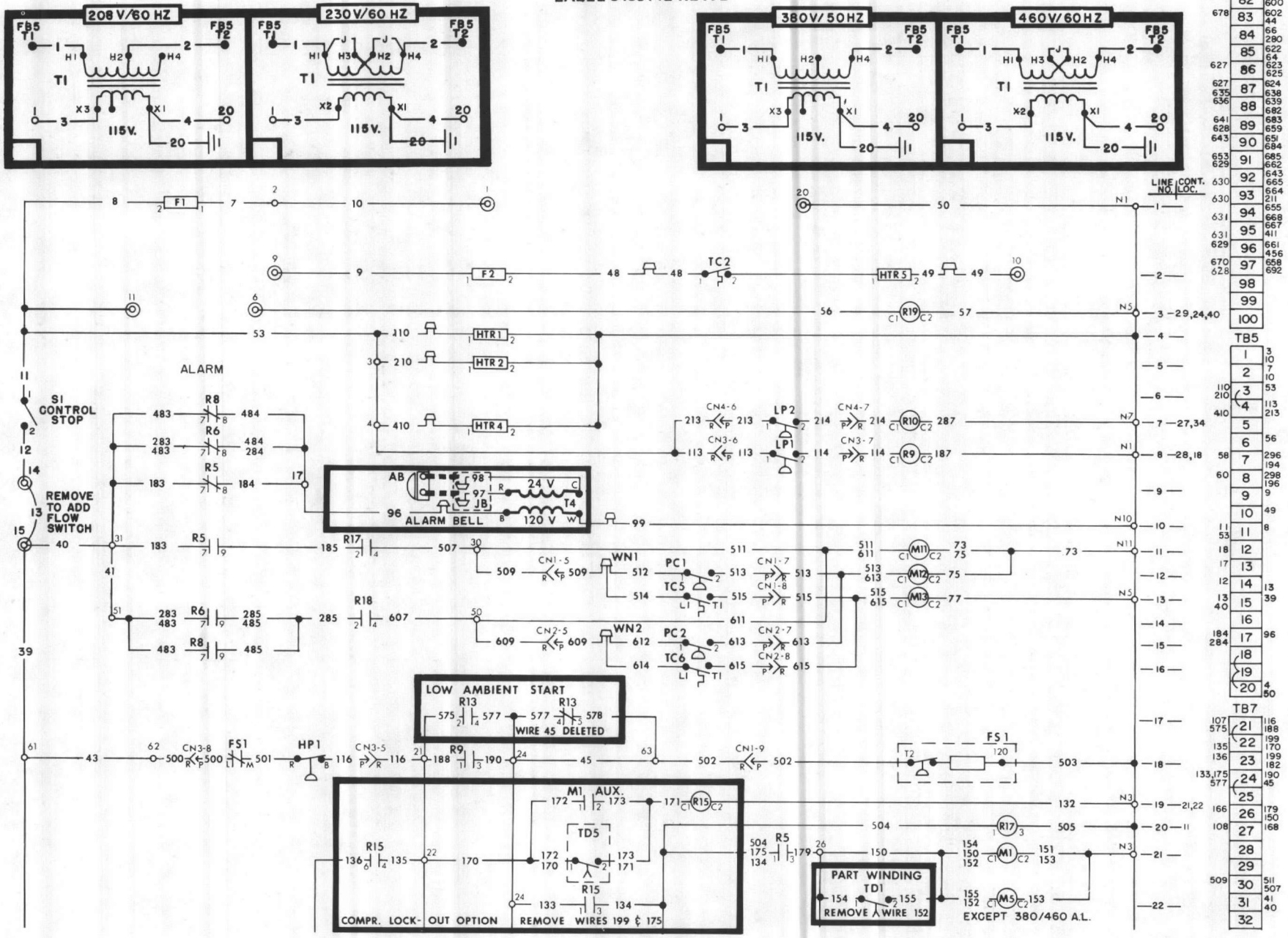
THERMOSTAT CIRCUIT SCHEMATIC – ALR-040A-D, 050A-D, 060B-D, 065B-D
(With Unloading, With Lead Lag)
LABEL 377762D REV. O

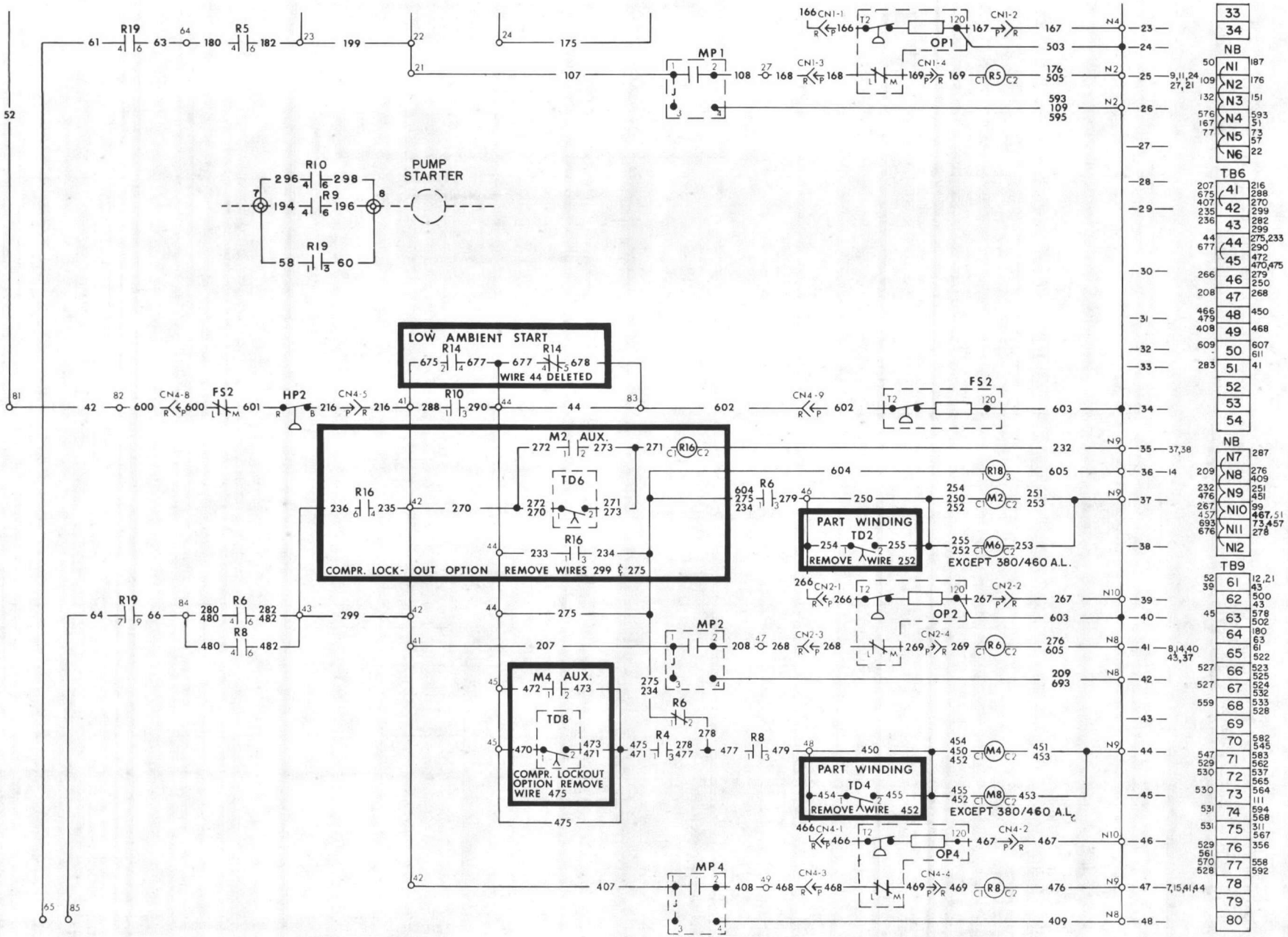


THERMOSTAT CIRCUIT SCHEMATIC – ALR-040A-D, 050A-D, 060B-D, 065B-D
(With Unloading, With Hot Gas Bypass)
LABEL 377764D REV. O

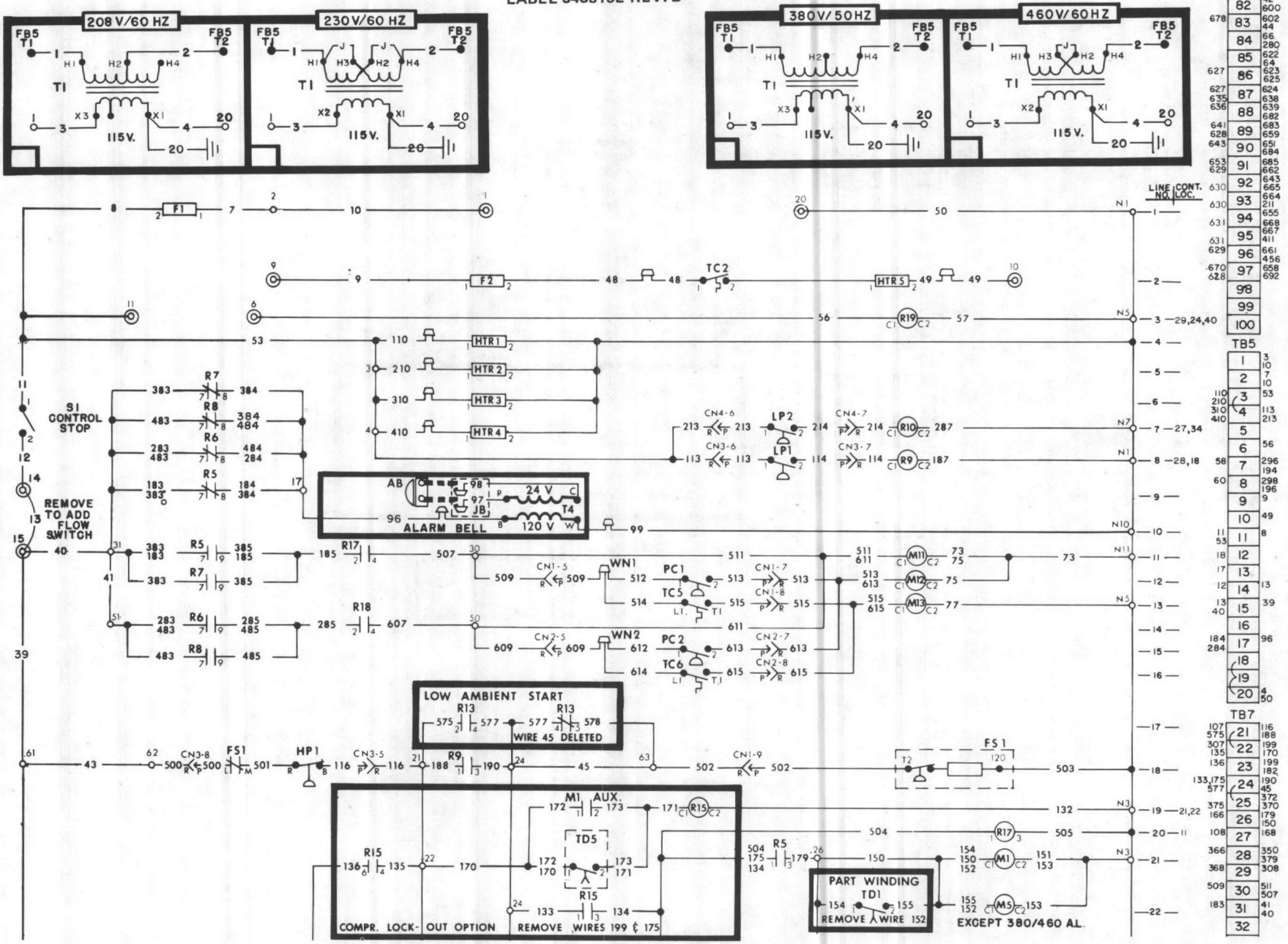


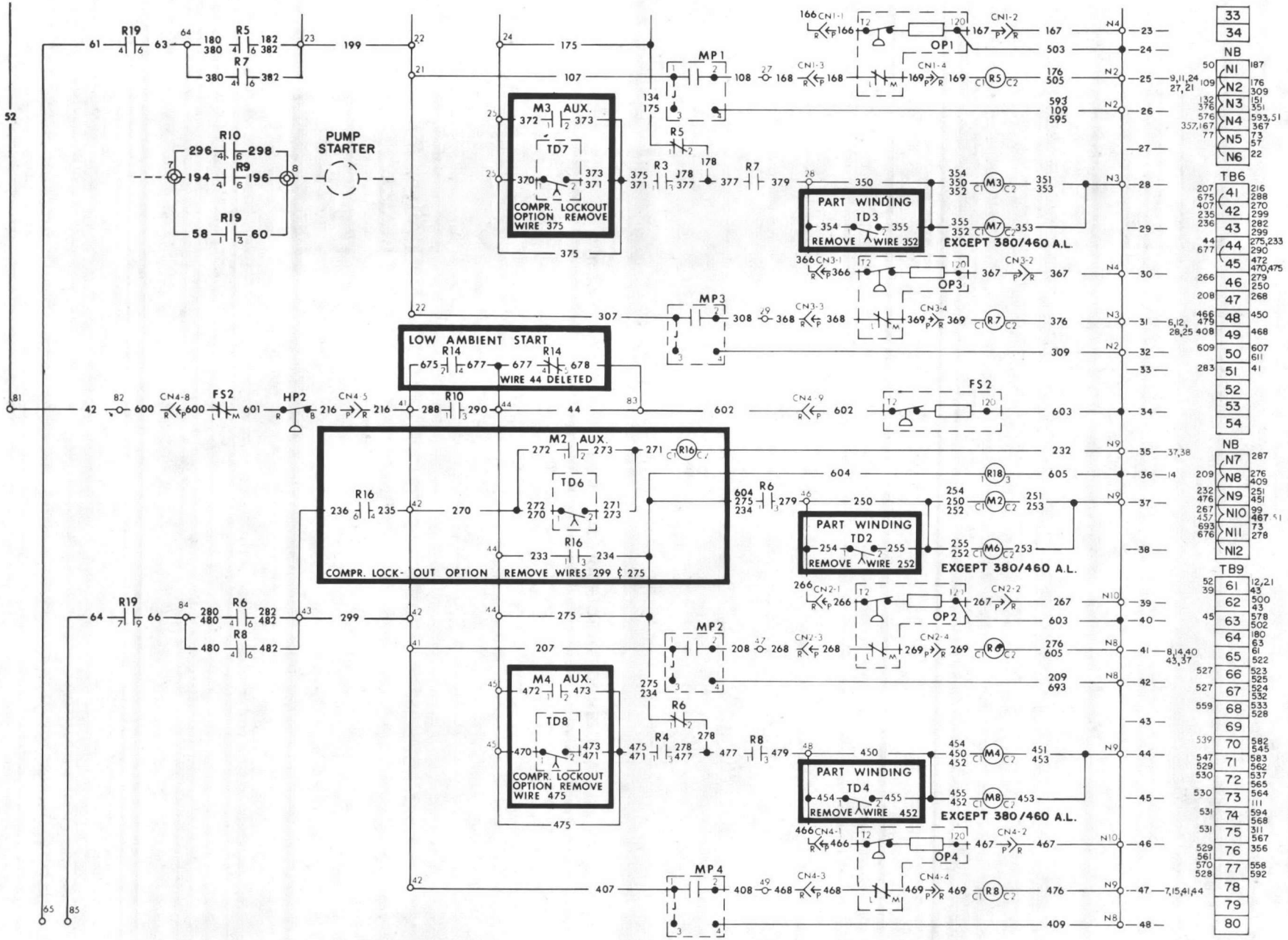
COMPRESSOR CONTROL SCHEMATIC
ALR-075A-D, 085A-D
LABEL 343514E REV. B



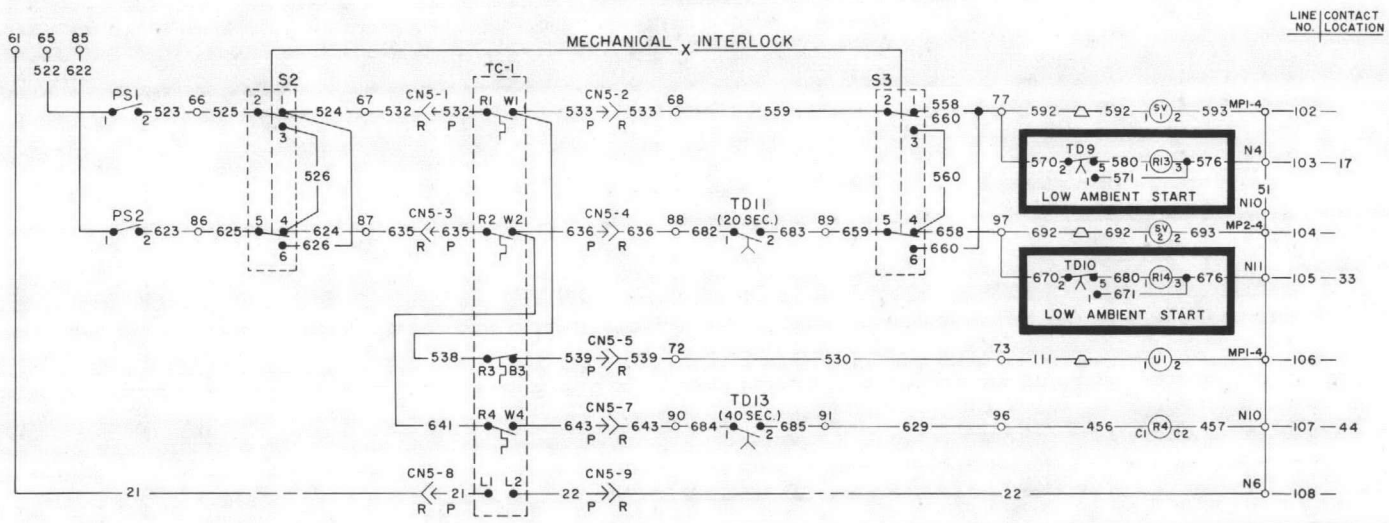

LOW AMBIENT START
WIRE 44 DELETED
M2 AUX.
TD6
COMPR. LOCK- OUT OPTION
REMOVE WIRES 299 & 275
PART WINDING
TD2
REMOVE WIRE 252
EXCEPT 380/460 A.L.
M4 AUX.
TD8
COMPR. LOCKOUT OPTION REMOVE WIRE 475
PART WINDING
TD4
REMOVE WIRE 452
EXCEPT 380/460 A.L.
PUMP STARTER
OP1
OP2
OP4
MP1
MP2
MP4
FS2
HP2
TB6
TB9
NB

COMPRESSOR CONTROL SCHEMATIC
ALR-105A-D THRU 130A-D
LABEL 343515E REV. B

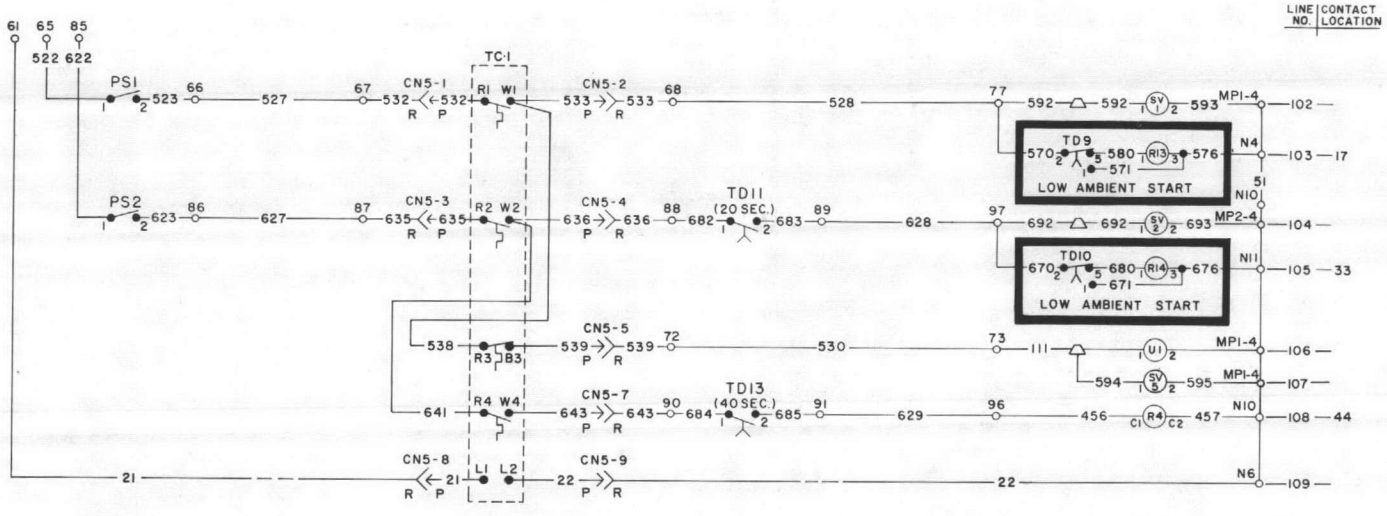



R19
R5
R7
R10
R9
R19
PUMP STARTER
M3 AUX.
TD7
COMPR. LOCKOUT OPTION REMOVE WIRE 375
MP1
CN1-1
CN1-2
OP1
CN1-3
CN1-4
R5
PART WINDING
TD3
REMOVE WIRE 352
EXCEPT 380/460 A.L.
CN3-1
CN3-2
OP3
MP3
CN3-3
CN3-4
R7
LOW AMBIENT START
R14
WIRE 44 DELETED
FS2
HP2
CN4-8
CN4-5
CN4-9
M2 AUX.
TD6
R16
COMPR. LOCK-OUT OPTION
REMOVE WIRES 299 & 275
R6
R18
PART WINDING
TD2
REMOVE WIRE 252
EXCEPT 380/460 A.L.
CN2-1
CN2-2
OP2
MP2
CN2-3
CN2-4
M4 AUX.
TD8
COMPR. LOCKOUT OPTION REMOVE WIRE 475
R4
R8
PART WINDING
TD4
REMOVE WIRE 452
EXCEPT 380/460 A.L.
CN4-1
CN4-2
OP4
MP4
CN4-3
CN4-4
TB6
NB
TB9

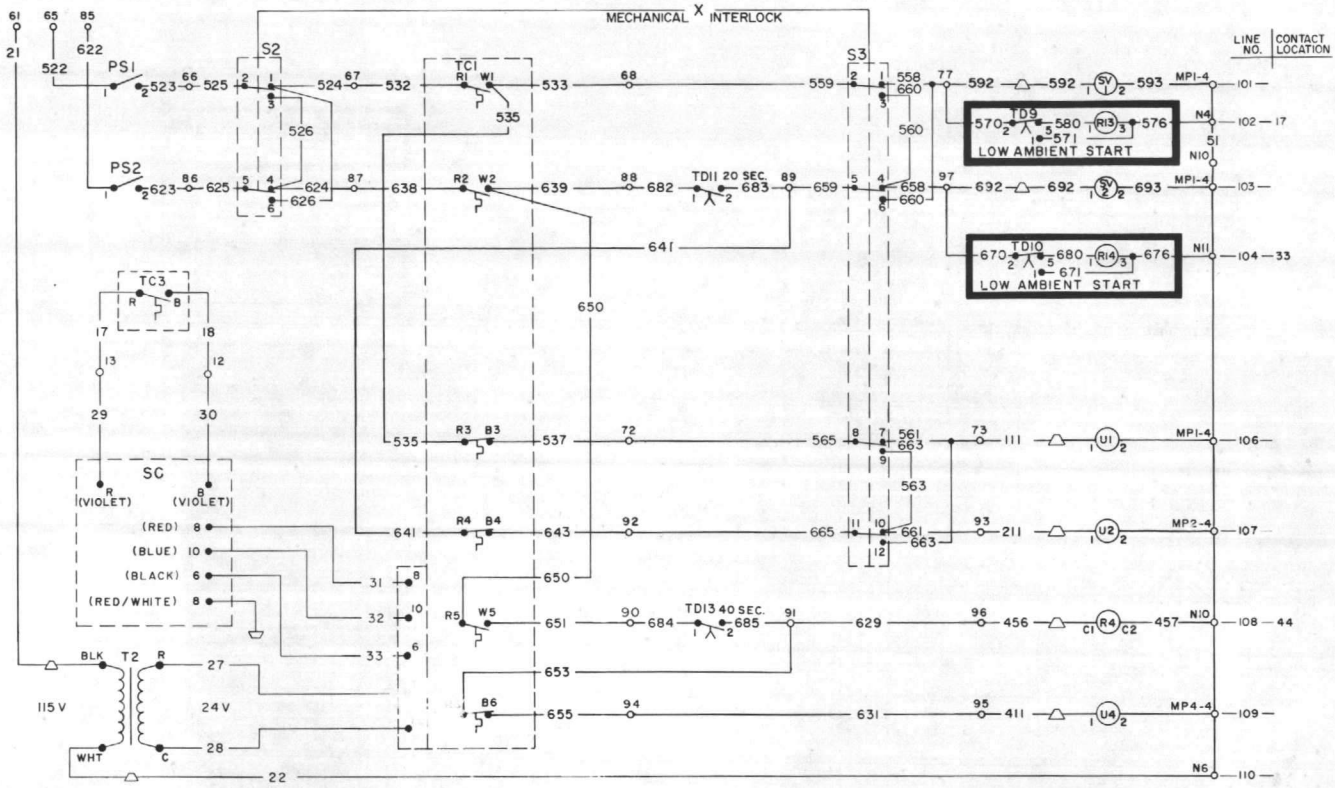
THERMOSTAT CIRCUIT SCHEMATIC – ALR-075A-D, 085A-D
(With Lead Lag)
LABEL 343520D REV. A



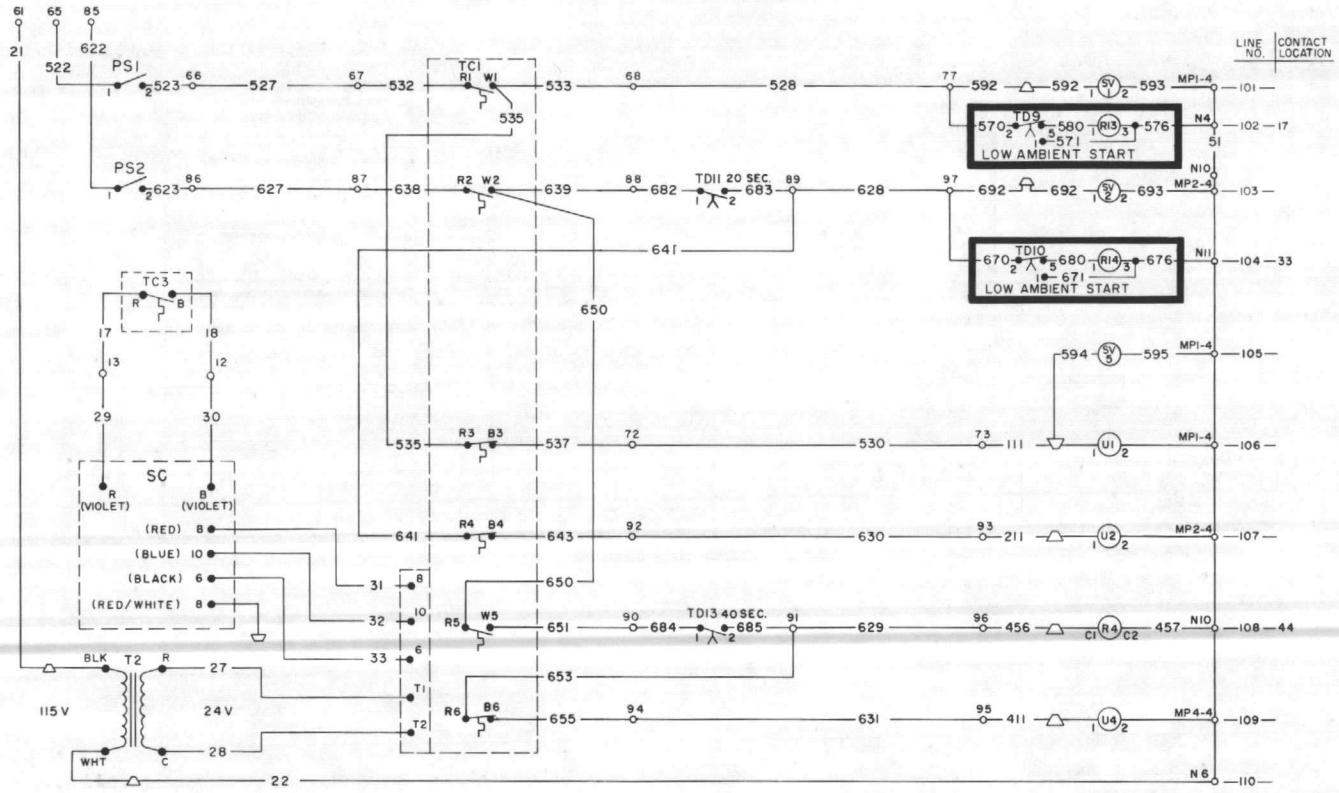
THERMOSTAT CIRCUIT SCHEMATIC – ALR-075A-D, 085A-D
(With Hot Gas Bypass)
LABEL 343522D REV. A



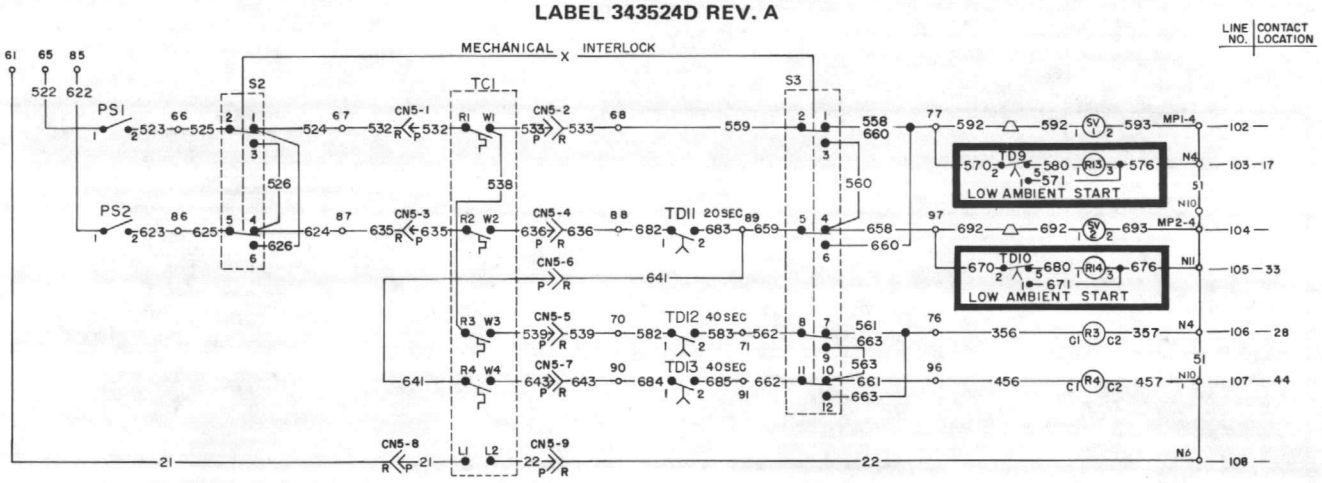
THERMOSTAT CIRCUIT SCHEMATIC – ALR-075A-D, 085A-D
(With Unloading, With Lead Lag)
LABEL 343521D REV. A



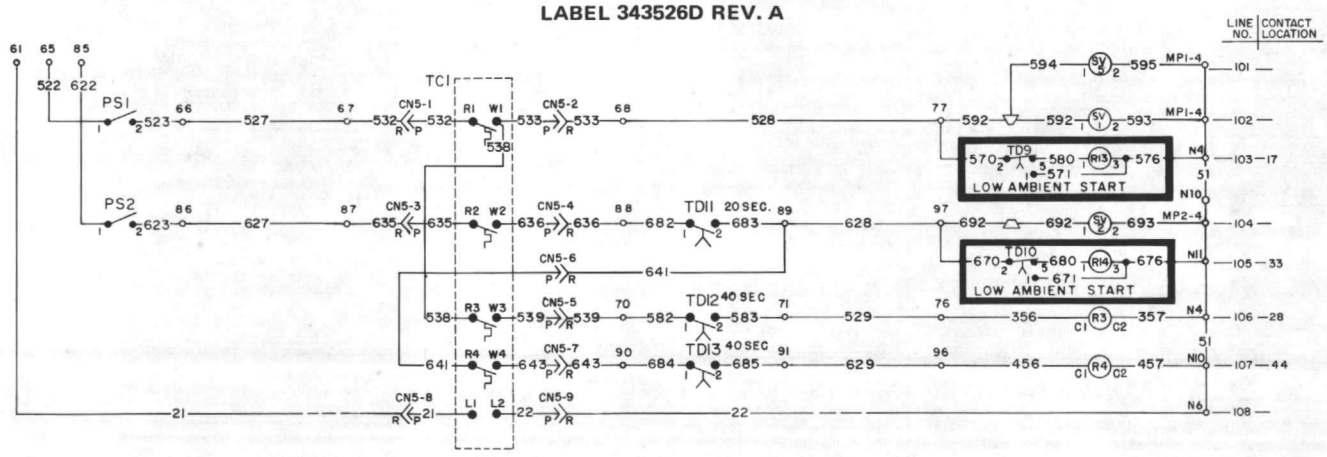
THERMOSTAT CIRCUIT SCHEMATIC – ALR-075A-D, 085A-D
(With Unloading, With Hot Gas Bypass)
LABEL 343523D REV. A



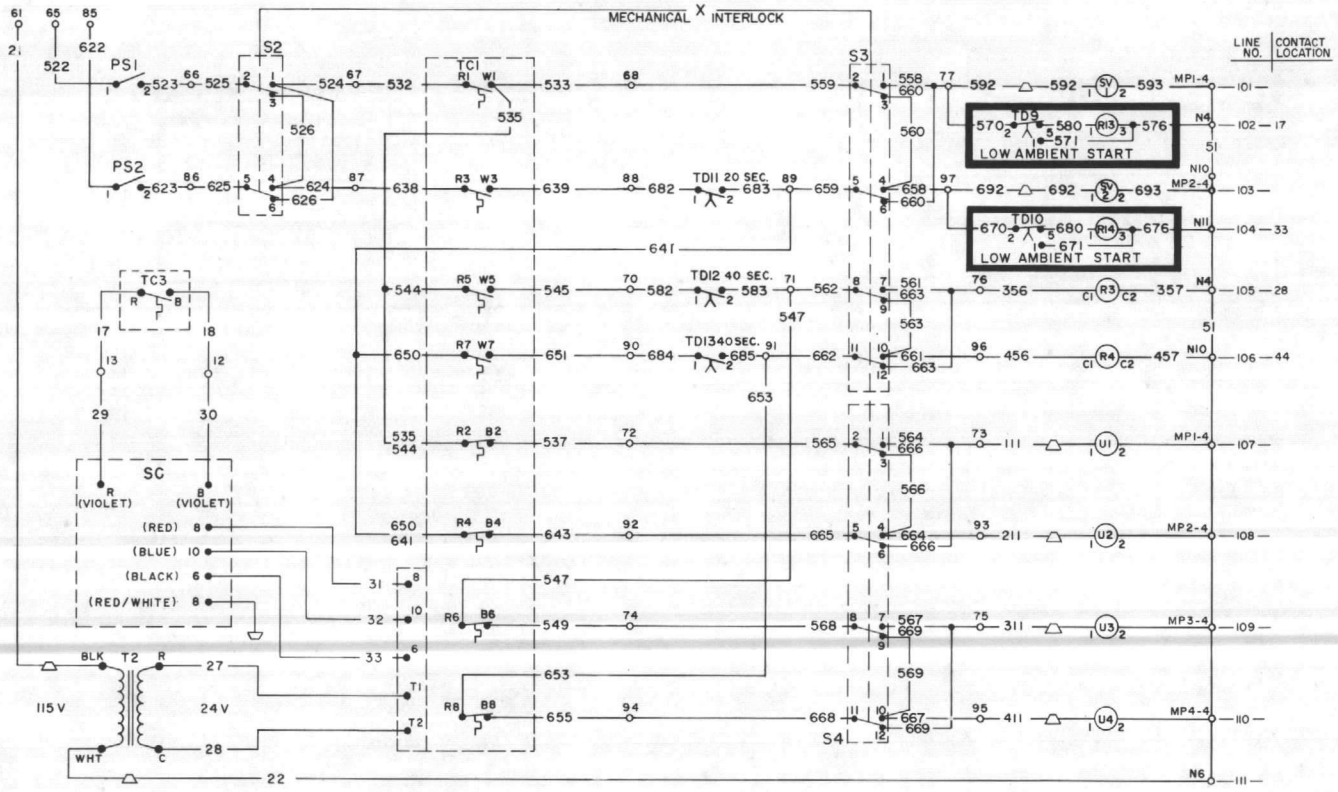
THERMOSTAT CIRCUIT SCHEMATIC – ALR-105A-D THRU 130A-D
(No Unloading, With Lead Lag)
LABEL 343524D REV. A



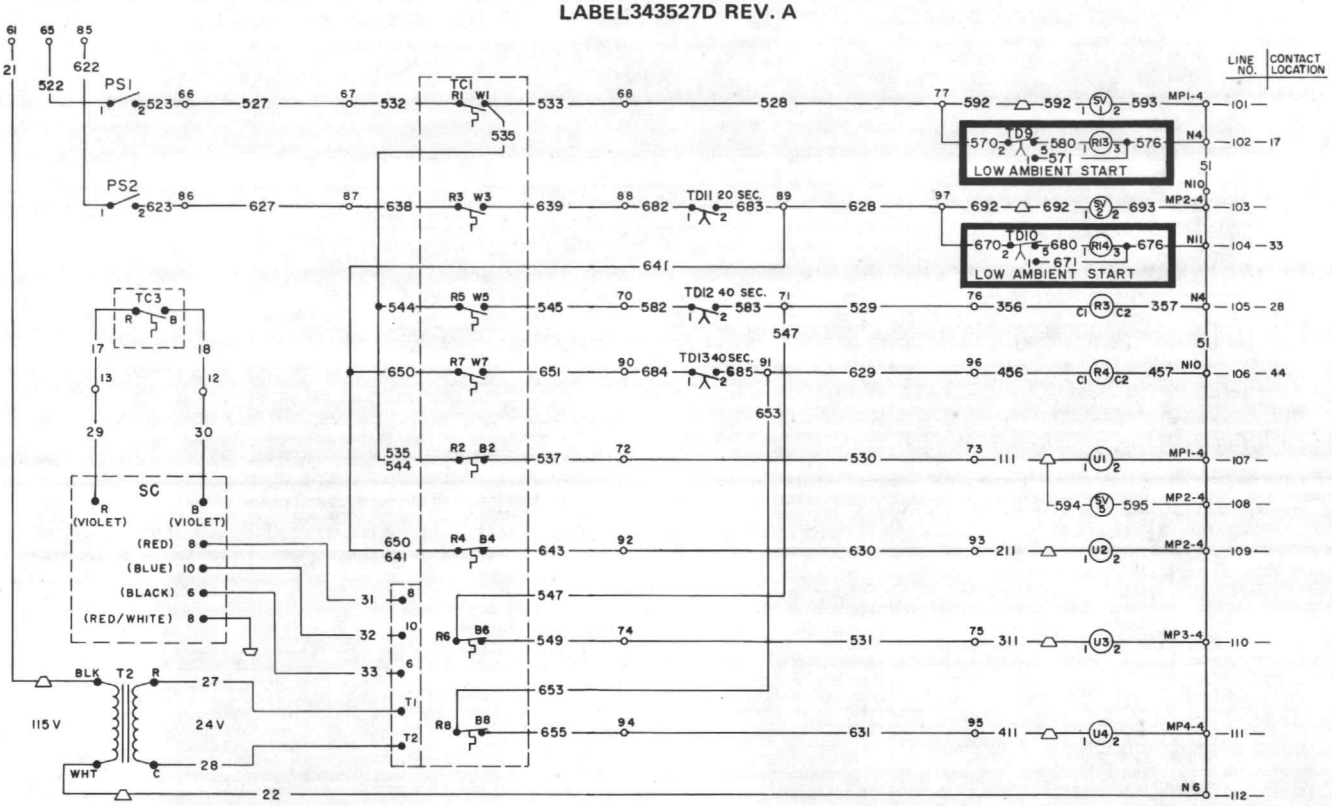
THERMOSTAT CIRCUIT SCHEMATIC – ALR-105A-D THRU 130A-D
(No Unloading, With Hot Gas Bypass)
LABEL 343526D REV. A



THERMOSTAT CIRCUIT SCHEMATIC – ALR-105A-D THRU 130A-D
(With Unloading, With Lead Lag)
LABEL 343525D REV. A



THERMOSTAT CIRCUIT SCHEMATIC – ALR-105A-D THRU 130A-D
(With Unloading, With Hot Gas Bypass)
LABEL343527D REV. A



START-UP AND SHUTDOWN

PRE START-UP

1. With all electric disconnects open, check all screw or lug type electrical connections to be sure they are tight for good electrical contact. Although all factory connections are tight before shipment, some loosening may have resulted from shipping vibration.
2. Inspect all water piping for flow direction and correct connections at the evaporator.
3. Open all water flow valves and start the chilled water pump. Check all piping for leaks and vent the air from the evaporator as well as from the system piping. Flush the evaporator and system piping to obtain clean, non-corrosive water in the evaporator circuit.
4. Check to see that the thermostat water temperature sensor is installed in the return water line (return to chiller). On ALR-075A thru 130A units with standard capacity reduction, or ALR-035A and 065B units with standard or optional capacity reduction, the sensor well should be full of heat conducting compound and the sensor should be secured in the well with the retaining clip provided. On ALR-075A thru 130A units with optional capacity reduction, the sensor is installed directly into the return water line; i.e., no well or heat conducting compound is required.
5. Check the compressor oil level. Prior to start-up, the oil level should cover at least one-third of the oil sightglass.
6. Remove the compressor shipping blocks located beneath the compressor rails for each compressor and attached to the base of the unit.
7. Check the voltage of the unit power supply and see that it is within the ± 10% tolerance that is allowed. Phase voltage unbalance must be within ± 2%.
8. Check the unit power supply wiring for adequate ampacity and a minimum insulation temperature rating of 75C.
9. Verify that all mechanical and electrical inspections have been completed per local codes.
10. See that all auxiliary control equipment is operative and that an adequate cooling load is available for initial start-up.
11. Open the compressor suction and discharge shut-off valves until back seated. Always replace valve seal caps.
12. Energize the crankcase heaters for a minimum of 12 hours prior to start-up.

START-UP

1. Open the compressor suction and discharge shut-off valves until back seated. Always replace valve seal caps.
2. Open the manual liquid line shut-off valve at the outlet of the subcooler.
3. Check to see that pumpdown switches (PS1 and PS2) are in the "manual pumpdown" position and the emergency stop switch (S1) is in the "on" position.
4. Adjust the dial on temperature controller TC1 to the desired chilled water temperature.
5. Throw the main power and control circuit disconnects to the "on" position.

CAUTION: *Most relays and terminals in the unit control center are hot with S1 and the control circuit disconnect on.*

6. Start the auxiliary equipment for the installation by turning on the time clock, ambient thermostat and/or remote on/off switch if the unit and chilled water pump are electrically interlocked by using the COPS method discussed in "Field Wiring."
7. Start the system by moving pumpdown switches (PS1 and PS2) to the "auto. pumpdown" position.
8. After system performance has stabilized, it is necessary that the "Compressorized Equipment Warranty Form" (Form No. 206036A) be completed to obtain full warranty benefits. This form is shipped with the unit and after completion should be returned to McQuay's Service Department through your sales representative.

TEMPORARY SHUTDOWN

Move pumpdown switches (PS1 and PS2) to the "manual pumpdown" position. After the compressors have pumped down, turn off the chilled water pump.

NOTE: *With the unit left in this condition, it is capable of recycling pumpdown operation. To defeat this mode of operation, simply move control stop switch S1 to the "off" position.*

It is important that the compressors pump down before the water flow to the unit is interrupted to avoid freeze-up in the evaporator.

START-UP AFTER TEMPORARY SHUTDOWN

1. Start the chilled water pump.
2. With emergency stop switch S1 in the "on" position, move pumpdown switches (PS1 and PS2) to the "auto. pumpdown" position.
3. Observe the unit operation for a short time to be sure that the compressors do not cut out on low oil pressure.

EXTENDED SHUTDOWN

1. Close the manual liquid line shut-off valves.
2. After the compressors have pumped down, turn off the chilled water pump.
3. Turn off all power to the unit and to the chilled water pump.
4. Move the emergency stop switch S1 to the "off" position.
5. Close the compressor suction and discharge valves.
6. Tag all opened disconnect switches to warn against start-up before opening the compressor suction and discharge valves.
7. Drain all water from the unit evaporator and chilled water piping if the unit is to be shut down during winter.

START-UP AFTER EXTENDED SHUTDOWN

1. Inspect all auxiliary equipment to see that it is in satisfactory operating condition.
2. Remove all debris that has collected on the surface of the condenser coils.
3. Open the compressor suction and discharge valves.
4. Open the manual liquid line shut-off valves.
5. Check to see that pumpdown switches (PS1 and PS2) are in the manual pumpdown position.
6. Turn on the electric power to the unit and other parts of the system.
7. Allow the crankcase heaters to operate for at least 12 hours prior to start-up.
8. Start the chilled water pump and purge the water piping as well as the evaporator in the unit.
9. Check to see that the emergency stop switch S1 is in the "on" position.

CAUTION: *Most relays and terminals in the unit control center are hot with S1 and the control circuit disconnect on.*

10. Start the unit by moving pumpdown switches (PS1 and PS2) to the "auto. pumpdown" position.
11. After running the unit for a short time, check the oil level in each compressor crankcase and check for flashing in the refrigerant sightglass (see "Maintenance" on page 39).

SYSTEM MAINTENANCE

GENERAL

On initial start-up and periodically during operation, it will be necessary to perform certain routine service checks. Among these are checking the compressor oil level and taking condensing, suction and oil pressure readings. During operation, the oil level should be visible in the oil sightglass with the compressor running. On units ordered with gauges, condensing, suction and oil pressures can be read from the unit control center. The gauges are factory installed with a manual shut-off valve on each gauge line. The valves should be closed at all times except when gauge readings are being taken. On units ordered without gauges, the gauge shut-off valves come factory installed inside the unit control center for convenient connection of service gauges from outside the unit.

FAN SHAFT BEARINGS (ALR-075A-D thru 130A-D)

The fan shaft bearings do not require lubrication at the time the unit is put into service. The fan shaft bearings should be greased once a year using Standard Oil Company Amco Multi-Purpose Lithium Grease. *DO NOT OVERLUBRICATE.*

ELECTRICAL TERMINALS

CAUTION: ELECTRIC SHOCK HAZARD. TURN OFF ALL POWER BEFORE CONTINUING WITH FOLLOWING SERVICE.

All power electrical terminals should be retightened every six months, as they tend to loosen in service due to normal heating and cooling of the wire.

COMPRESSOR OIL LEVEL

Because of the large refrigerant charge required in an air cooled condensing unit, it is usually necessary to put additional oil into the system. The oil level should be watched carefully upon initial start-up and for sometime thereafter.

At the present time, Suniso No. 3GS oil is the only oil approved by Copeland for use in these compressors. The oil level should be maintained at about one-third of the sightglass on the compressor body.

CONDENSERS

Condensers are air cooled and constructed with 3/8 O.D. copper tubes bonded in a staggered pattern into rippled aluminum fins. No maintenance is ordinarily required except the occasional removal of dirt and debris from the outside surface of the fins. Care should be taken not to damage the fins during cleaning. Periodic use of the purge valve on the condenser will prevent the buildup of non-condensables.

REFRIGERANT SIGHTGLASS

The refrigerant sightglasses should be observed periodically. (A monthly observation should be adequate.) A clear glass of liquid indicates that there is adequate refrigerant charge in the system to insure proper feed through the expansion valve. Bubbling refrigerant in the sightglass indicates that the system is short of refrigerant charge. An element inside the sightglass indicates what moisture condition corresponds to a given element color. If the sightglass does not indicate a dry condition after a few hours of operation, the unit should be pumped down and the cores in the filter-driers changed.

LEAD-LAG

A standard feature on all McQuay ALR air cooled chillers is a system for reversing the sequence that compressors start in. (Chillers with the hot gas bypass option do not have lead-lag.) For example, on a 4-compressor unit with the lead-lag switches in the "circuit 1 leads" position, the normal starting sequence is 1, 2, 3, 4. With the lead-lag switches in the "circuit 2 leads" position, the reversed starting sequence is 2, 1, 4, 3. It is achieved electrically by a multi-pole switching arrangement (see "Control Schematics" on pages 16 through 37). It is suggested that the lead-lag switches in the unit control center be switched annually to provide even compressor life.

SERVICE

NOTE: Service on this equipment is to be performed by qualified refrigeration personnel. Causes for repeated tripping of safety controls must be investigated and corrected. CAUTION: Disconnect all power before doing any service inside the unit.

FILTER-DRIERS

To change the filter-drier core(s), pump the unit down by moving pumpdown switches (PS1 and PS2) to the "manual pumpdown" position. Turn off all power to the unit and install jumpers across the terminals shown in the table.

UNIT SIZE	CIRCUIT NO.	JUMPER ACROSS TERMINALS
ALR-035A thru 065B	1	110 to 111
ALR-040A thru 065B	2	210 to 211
ALR-075A thru 130A	1	21 to 24
ALR-075A thru 130A	2	41 to 44

Turn power to the unit back on and re-start the unit by moving pumpdown switches (PS1 and PS2) to the "auto. pumpdown" position. Close the manual liquid line shut-off valve(s) and when evaporator pressure reaches 0 PSIG, move the control stop switch S1 to the "off" position. This will close the liquid line solenoid valve(s) and isolate the short section of refrigerant piping containing the filter-drier(s). Remove the cover plate from the filter-drier shell and replace the core(s).

After core replacement, replace the cover plate. A leak check around the flange of the filter-drier shell is recommended after the cores have been changed.

LIQUID LINE SOLENOID VALVE

The liquid line solenoid valves, which are responsible for automatic pumpdown during normal unit operation, do not normally require any maintenance. They may, however, require replacement of the solenoid coil or of the entire valve assembly.

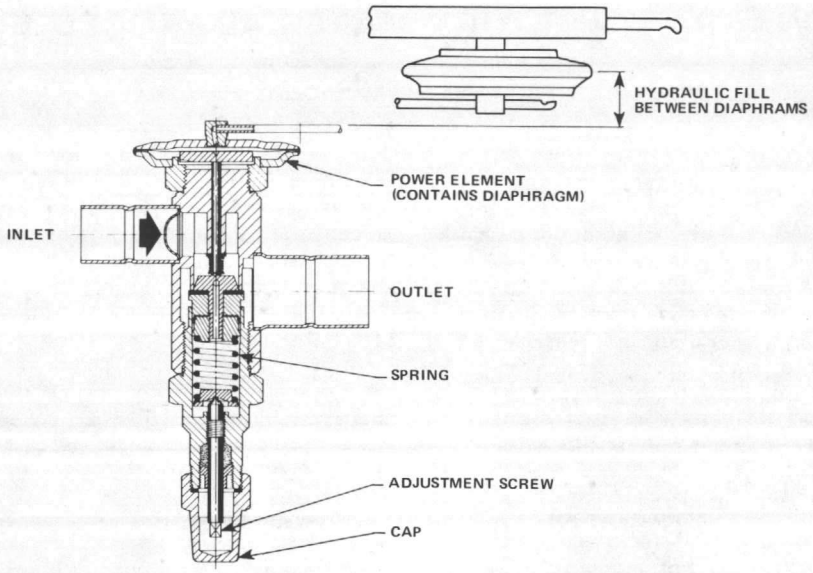
The solenoid coil may be removed from the valve body without opening the refrigerant piping by moving pumpdown switches (PS1 and PS2) to the "manual pumpdown" position. The coil can then be removed from the valve body by simply removing a nut or snap-ring located at the top of the coil. The coil can then be slipped off its mounting stud for replacement. Be sure to replace the coil on its mounting stud before returning pumpdown switches (PS1 and PS2) to the "auto. pumpdown" position.

To replace the entire solenoid valve, the unit must be pumped down by use of the manual liquid line shut-off valve.

THERMOSTATIC EXPANSION VALVE

The expansion valve is responsible for allowing the proper amount of refrigerant to enter the evaporator regardless of cooling load. It does this by maintaining a constant superheat. (Superheat is the difference between refrigerant temperature as it leaves the evaporator and the saturation temperature corresponding to the evaporator pressure.) All ALR chillers are factory set for between 8F and 12F superheat. If it is necessary to increase the superheat setting of the valve, remove the cap at the bottom of the valve to expose the adjustment screw. Turn the screw clockwise (when viewed from the adjustment screw end) to increase the superheat setting and counterclockwise to reduce superheat. Allow time for system rebalance after each superheat adjustment.

The expansion valve, like the solenoid valve, should not normally require replacement, but if it does, the unit must be pumped down by using the manual liquid line shut-off valve. If the problem can be traced to the power element only, it can be unscrewed from the valve body without removing the valve, but only after pumping the unit down with the manual liquid line shut-off valves.



EVAPORATOR

The evaporator is of the direct expansion, shell-and-tube type with refrigerant flowing through the tubes and water flowing through the shell over the tubes. The tubes are internally finned to provide extended surface as well as turbulent flow of refrigerant through the tubes. Normally no service work is required on the evaporator. There may be instances where a tube will leak refrigerant into the water side of the system. In the cases where only one or two tubes leak, the problem can best be solved by plugging the tube at both ends. When the tube must be replaced, the old tube can be removed and replaced.

To remove a tube, the unit should be temporarily pumped down by moving pumpdown switches (PS1 and PS2) to the "manual pumpdown" position. Power to the unit should be shut off to install jumpers. (See table in filter-drier section for terminal numbers.) Turn power to the unit back on, then pumpdown both refrigerant circuits until evaporator pressure is at or near 0 PSIG by closing the manual liquid line shut-off valves at the outlet of each condenser. Close both compressor suction valves and the manual liquid line valves. These steps will insure a minimum amount of refrigerant loss when the evaporator is opened up. The tubes are mechanically expanded into the tube sheets (see figure below) at each end of the cooler. In order to remove the tubes, it is necessary to break this bond by collapsing the tube. After doing this at both ends of the shell, the tube can be removed for replacement. The new tube can then be inserted and re-expanded into the tube sheet.

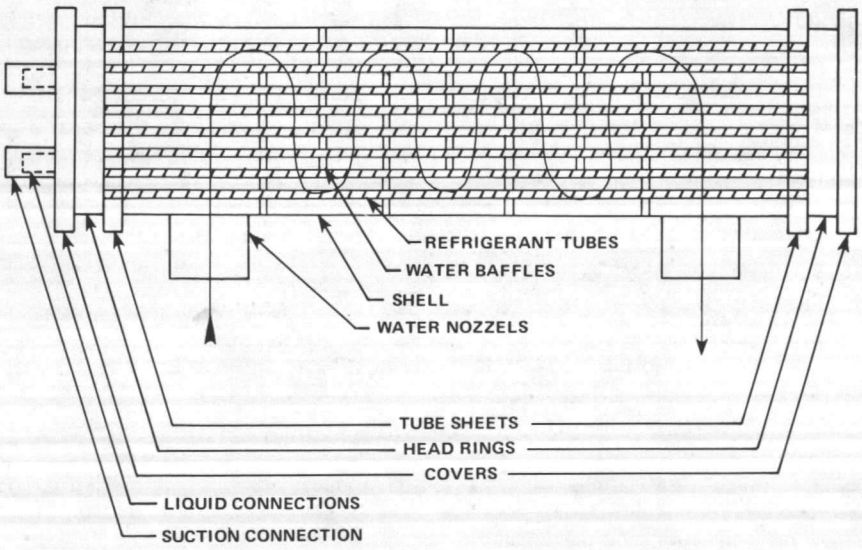
NOTE: *The bond produced by expansion must be refrigerant tight. This bond must be produced by rolling the tube into the tube sheet.*

After re-assembling the evaporator, a small amount of refrigerant should be introduced by momentarily opening the manual liquid line valve. A leak check should then be performed on the evaporator.

Tube removal can only take place after the leaking tube is located. This aspect depends on the ingenuity of the serviceman. One method that would work would be to subject each tube to air pressure by plugging each end, and with a pressure gauge attached to one of the end plugs, observe to see if there is a loss of air pressure over a period of a minute or two.

NOTE: *The evaporator should always be supplied with clean water to minimize scale buildup on the refrigerant tubes.*

TOP VIEW OF TYPICAL DUAL CIRCUIT SHELL-AND-TUBE EVAPORATOR



IN-WARRANTY RETURN MATERIAL PROCEDURE

COMPRESSOR

Copeland Refrigeration Corporation has stocking wholesalers who maintain a stock of replacement compressors and service parts to serve refrigeration contractors and servicemen.

When a compressor fails in warranty, contact your local sales representative, or McQuay Warranty Claims Department at the address on the cover of this bulletin. You will be authorized to exchange the defective compressor at a Copeland Wholesaler, or an advance replacement can be obtained. A credit is issued to you by the wholesaler for the returned compressor after Copeland factory inspection of the inoperative compressor. If that compressor is out of Copeland's warranty, a salvage credit only is allowed. Provide McQuay with full details: McQuay unit model and unit serial numbers. Include the invoice and the salvage value credit memo copies and we will reimburse the difference. In this transaction, be certain that the compressor is definitely defective. If a compressor is received from the field that tests satisfactorily, a service charge plus a transportation charge will be charged against its original credit value.

On all out-of-warranty compressor failures, Copeland offers the same field facilities for service and/or replacement as described above. The credit issued by Copeland on the returned compressor will be determined by the repair charge established for that particular unit.

COMPONENTS OTHER THAN COMPRESSORS

Material may not be returned except by permission of authorized factory service personnel of McQuay Inc. at Minneapolis, Minnesota. A "Return Goods" tag will be sent to be included with the returned material. Enter the information as called for on the tag in order to expedite handling at our factories and prompt issuance of credits.

The return of the part does not constitute an order for replacement. Therefore, a purchase order must be entered through your nearest McQuay Representative. The order should include part name, part number, model number and serial number of the unit involved.

Following our personal inspection of the returned part, and if it is determined that the failure is due to faulty material or workmanship, and in warranty, credit will be issued on customer's purchase order.

All parts shall be returned to the pre-designated McQuay factory, transportation charges prepaid.

APPENDIX

STANDARD CONTROLS

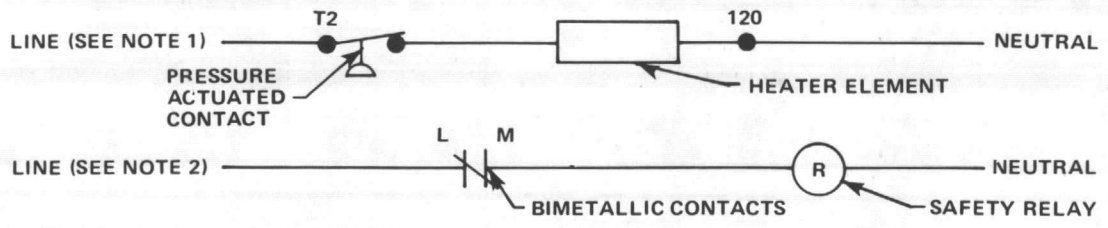
OIL PRESSURE SAFETY CONTROL

The oil pressure safety control is a manually resettable device which senses the differential between oil pressure at the discharge of the compressor oil pump and suction pressure inside the compressor crankcase. When the oil pressure reaches approximately 15 PSI above the crankcase suction pressure, the pressure actuated contact of the control opens from its normally closed position. If this pressure differential cannot be developed, the contact will remain closed and energize a heater element within the control. The heater element warms a normally closed bimetallic contact and causes the contact to open, de-energizing a safety relay and breaking power to the compressor.

It takes about 120 seconds to warm the heater element enough to open the bimetallic contact, thus allowing time for the pressure differential to develop.

If during operation, the differential drops below 10 PSI, the heater element will be energized and the compressor will stop. The control can be reset by pushing the reset button on the control. If the compressor does not restart, allow a few minutes for the heater element and bimetallic contacts to cool and reset the control again.

To check the control, pump down and shut off all power to the unit. Remove the compressor fuses, and install a voltmeter between terminals "L" and "M" of the oil pressure control. Turn on power to the unit control circuit (separate disconnect or main unit disconnect depending on the type of installation). Check to see that the control stop switch S1 is in the "on" position. The control circuit should now be energized, but with the absence of the compressor fuses, no oil pressure differential can develop and thus the pressure actuated contacts of the control will energize the heater element and open the bimetallic contacts of the control within 120 seconds. When this happens, the safety relay is de-energized, the voltmeter reading will rise to 115V, and the compressor contactor should open. Repeated operations of the control will cause a slight heat buildup in the bimetallic contacts, resulting in a slightly longer time for reset with each successive operation.



NOTES: 1. Hot only when the unit thermostat calls for compressor to run.
2. Hot only when other safety control contacts are closed.

HIGH PRESSURE CONTROL

The high pressure control is a single pole pressure activated switch that opens on a pressure rise to de-energize the entire control circuit except for compressor crankcase heaters. It senses condenser pressure and is factory set to open at 380 PSIG and can be manually reset closed at 315 PSIG. To check the control, either block off condenser surface or start the unit with fuses in only one fan fuse block (FB11) and observe the cut-out point of the control by watching condenser pressure rise. The highest point reached before cut-out is the cut-out setting of the control.

CAUTION: *Although there is an additional pressure relief device in the system set at 450 PSIG , it is highly recommended that the "control stop" switch S1 be close at hand in case the high pressure control should malfunction.*

LOW PRESSURE CONTROL

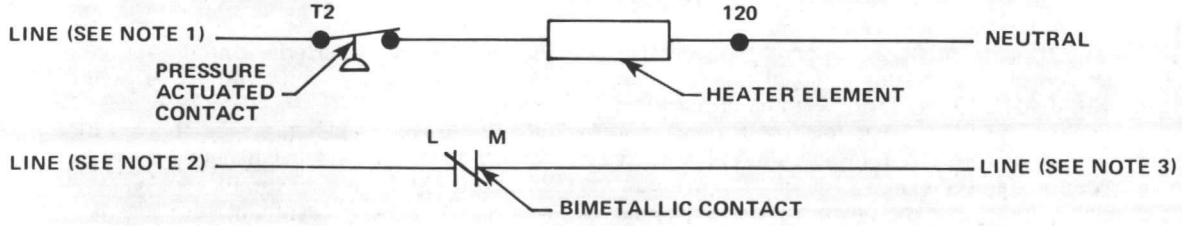
The low pressure control is a single pole pressure switch that closes on a pressure rise. It senses evaporator pressure and is factory set to close at 60 PSIG and automatically open at 35 PSIG. To check the control (unit must be running), move the pumpdown switch(es) PS1 and PS2 to the "manual pumpdown" position. As the compressor pumps down, condenser pressure will rise and evaporator pressure will drop. The lowest evaporator pressure reached before cut-out is the cut-out setting of the control. By moving the pumpdown switch(es) PS1 and PS2 to the "auto. pumpdown" position, evaporator pressure will rise. The highest evaporator pressure reached before compressor re-start is the cut-in setting of the control.

FREEZE CONTROL

The freeze control is very similar to the oil pressure control in operation except that it senses evaporator pressure only, rather than a pressure differential. It contains a pressure actuated contact that upon a fall in evaporator pressure energizes a heater element that in turn opens a normally closed bimetallic contact. When the bimetallic contact opens, it de-energizes the entire control circuit except for the compressor crankcase heaters and cooler heater. The control is factory set to close at 52 PSIG and open at 54 to 57 PSIG. It takes approximately 60 seconds to warm the heater element enough to open the bimetallic contact. This time delay period prevents nuisance cut-outs due to a momentary drop in suction pressure, but since the control senses pressure rather than temperature, it still provides quicker response for protection than a temperature sensing control.

To check the control, the system must be operating. A voltmeter should be connected across terminals of the pressure activated contact. With the unit running, there should be a 115 volt potential across these terminals. Observing evaporator pressure, move the pumpdown switch(es) PS1 and PS2 to the "manual pumpdown" position. Evaporator pressure will begin to drop. When the voltmeter goes to zero, the pressure activated contacts of the control will have closed. Note the evaporator pressure at which this happens. Because the unit will have pumped down before the 60-second delay period, bimetallic contacts "L" and "M" will not open before the unit shuts down. This part of the control operation may be checked after the pumpdown cycle is complete by connecting a jumper from terminal 1 in the control center to terminal T2 of the control. This will energize the heater element of the control, provided that evaporator pressure is sufficiently low. Within about 60 seconds, the bimetallic contacts of the control should open.

Should the control(s) cause the unit to shut down during normal operation, a period of about 2 minutes will be required before the bimetallic contacts of the control will have cooled enough to allow the control to be manually reset. Similar to the oil pressure safety control, repeated successive operations of the freeze control will prolong the time required before reset.



NOTES: 1. Hot whenever unit compressor(s) is running.
2. Hot whenever control circuit flow switch and control stop switch (S1) are closed.
3. Provides power to energize compressor contactors through low pressure relay (R9 or R10).

FANTROL – HEAD PRESSURE CONTROL

FANTROL is a method of head pressure control which automatically cycles the condenser fans in response to condenser pressure and ambient air temperature. This maintains head pressure and allows the unit to run at low ambient air temperatures.

For ALR-035A thru 065B:
The 040A thru 065B units have dual independent circuits with the fans for circuit 1 (11, 12, 13, 14) and circuit 2 (21, 22, 23, 24) being controlled independently by the condensing pressure and ambient air of each circuit. Fans 11 and 21 start with each compressor and fans 12 and 22 cycle on and off in response to condenser pressure. The cut-out and cut-in pressures are given in Table 13. Fans 13 and 14 (circuit 1) and fans 23 and 24 (circuit 2) are controlled by ambient temperature and are factory set at the values given in Table 13. Note that the number of fans on each unit varies.

For ALR-075A thru 130A:
The first fan (11) is started when the first compressor in the unit starts. Fan 12 is controlled by parallel wired pressure switches which sense condenser pressure in circuits 1 and 2. The third fan (13) is controlled by parallel wired temperature switches, one of which senses condenser inlet air for circuit 1 and the other senses condenser inlet air for circuit 2. Refer to Table 7 for cut-out and cut-in settings of these controls.

TABLE 7. FACTORY FANTROL SETTINGS

COND FAN / UNIT SIZE	PC12		PC22		TC13		TC23		TC14		TC24	
	Cut-In	Cut-Out	Cut-In	Cut-Out	Cut-In	Cut-Out	Cut-In	Cut-Out	Cut-In	Cut-Out	Cut-In	Cut-Out
ALR-035A	250 PSI	150 PSI	–	–	74F	69F	–	–	69F	64F	–	–
ALR-040A	225 PSI	155 PSI	225 PSI	155 PSI	–	–	–	–	–	–	–	–
ALR-050A	255 PSI	170 PSI	255 PSI	170 PSI	74F	69F	74F	69F	–	–	–	–
ALR-060B	270 PSI	170 PSI	270 PSI	170 PSI	74F	69F	74F	69F	69F	64F	69F	64F
ALR-065B	280 PSI	170 PSI	280 PSI	170 PSI	74F	69F	74F	69F	66F	61F	66F	61F
ALR-075A thru ALR-130A	270 PSI*	170 PSI*	–	–	80F†	70F†	–	–	–	–	–	–

*PC1 & PC2 †TC5 & TC6

OPTIONAL CONTROLS

SPEEDTROL – HEAD PRESSURE CONTROL
ALR-035A thru 065B

The SPEEDTROL system of head pressure control operates in conjunction with FANTROL by modulating the motor speed on fans 11 and 21 in response to condensing pressure. By reducing the speed of the last fan as the condensing pressure falls, the unit can operate at lower ambient temperatures.

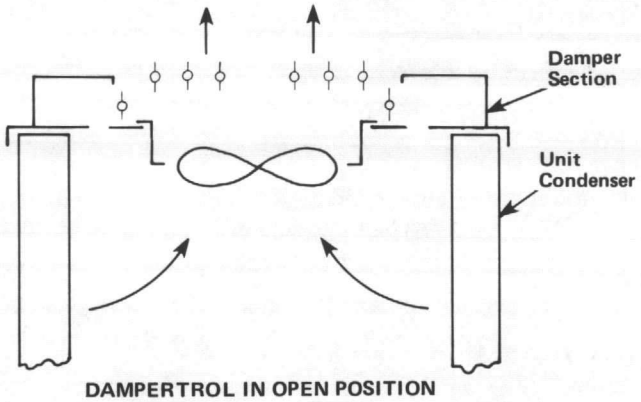
The SPEEDTROL fan motor is a single-phase, 208/240 volt, thermally protected motor specially designed for variable speed application. The solid state speed controls SC11 and SC21 are mounted inside the compressor compartment near the top of the condenser coils. Units with 460 volt power have a transformer mounted on the back of the control box to step the voltage down to 230 volts for the SPEEDTROL motor.

The SPEEDTROL control starts to modulate the motor speed at approximately 230 PSIG and maintains a minimum condensing pressure of 170 to 180 PSIG.

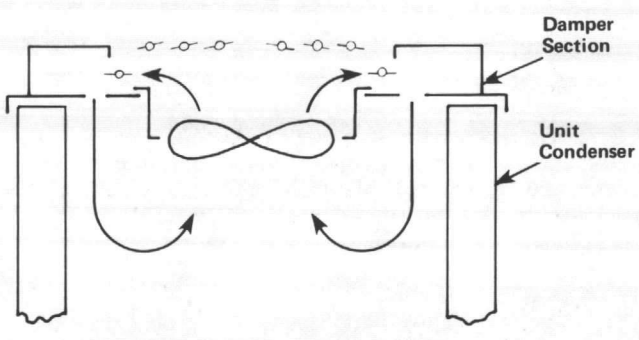
DAMPERTROL – HEAD PRESSURE CONTROL
ALR-075A thru 130A

DAMPERTROL is an optional system for reducing condenser capacity. It consists of an assembly of damper blades, linkages and blade operators installed over the first fan turned on by FANTROL (fan no. 11) and arranged to operate as shown. The blade operators sense condenser pressure and extend or contract in response to the pressure to open or close the damper blades as required to maintain adequate condenser pressure. The operators are factory set to begin opening the damper blades at 170 ± 5 PSIG and to be fully open at 250 ± 10 PSIG.

To check the damper blade operator pressure settings, the unit should be started with the fuses removed from fans 11 and 13 (on 3-fan units only). At condenser pressures below 170 ± 5 PSIG, the damper blades should be completely closed. As pressure rises above 170 ± 5 PSIG, the damper blades should begin opening and be fully open at 250 ± 10 PSIG. Leaving the fuses in on fan 12 will prevent head pressure from becoming excessive since this fan will start after the fully open setting of the damper operators has been observed.



DAMPERTROL IN OPEN POSITION

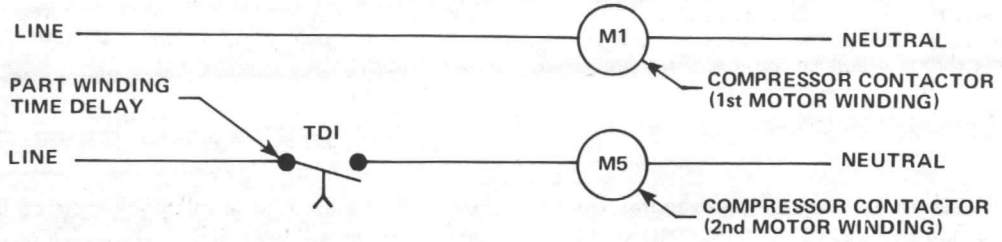


DAMPERTROL IN CLOSED POSITION

PART WINDING START (OPTIONAL)

Part winding start is available on all voltage units and consists of a solid state time delay wired in series with the contactor that energizes the second winding of each compressor motor. Its purpose is to limit current in-rush to the compressors upon start-up. As each compressor starts, the contactor for the first motor winding is delayed for 1 second.

Control checkout is best accomplished by observation as each contactor is pulled in to see that the 1 second delay occurs before the second contactor pulls in.



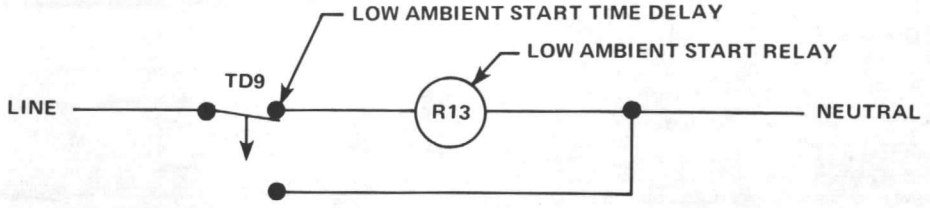
NOTE: Line is only hot when the unit thermostat calls for compressor to run.

LOW AMBIENT START (OPTIONAL)

Low ambient start is available on all units as an option with FANTROL and included automatically with optional DAMPERTROL or SPEEDTROL. It consists of a solid state, normally closed time delay wired in series with a relay. These are both wired in parallel to the liquid line solenoid valve so that when the solenoid valve is energized by the unit thermostat, the low ambient start relay is also energized through the time delay. The relay has contacts that essentially short-circuit the low pressure control and freezestat and allow the compressor to start with the low pressure control open.

After about 2-3/4 minutes, the time delay will open and de-energize the relay. If the system has not built up enough evaporator pressure to close the low pressure control, the compressor will stop. The time delay can be reset to its original normally closed position by moving the pumpdown switch(es) PS1 or PS2 to the "manual pumpdown" position. Moving the pumpdown switch back to the "auto. pumpdown" position will again energize the relay for another attempt at start-up. If the system has built up enough evaporator pressure, the compressor will continue to run.

To check the control, turn off all power to the unit and remove the wire(s) leading to the terminals of the low pressure control(s) LP1 and LP2. Remove the compressor fuses and jumper across terminals "L" and "M" of the freeze control(s) and oil pressure safety control(s). Energize the control circuit by turning on the control circuit disconnect or main power disconnect (depending on the installation) and the control stop switch S1. The compressor contactors should pull in instantly.



NOTE: Line is only hot when the unit thermostat calls for compressor to run.

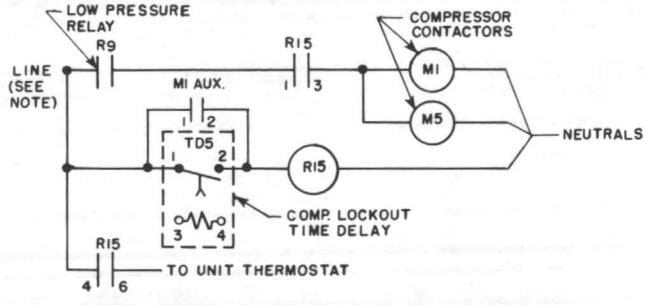
COMPRESSOR LOCKOUT (OPTIONAL)

Compressor lockout consists of a solid state time delay wired in series with the compressor contactor(s). Its purpose is to prevent rapid compressor cycling when cooling demands are erratic. The circuit illustrated above is for the lead compressor in each refrigerant circuit. The circuit for the second compressor(s) performs the same function but is wired differently (see unit wiring diagram).

When the unit thermostat no longer calls for cooling and the compressor contactor(s) have opened, the lockout time delay breaks open the circuit, preventing compressor re-start.

The circuit remains open for a period of 5 minutes so that, if the unit thermostat should call for cooling before the delay period has expired, the compressor will not re-start. After 5 minutes, the time delay will close its contacts to complete the circuit and be ready for start-up. The time delay opens its contacts whenever power to terminal 4 is interrupted and resets closed automatically after the time delay period.

To check the control, the compressor(s) must be running initially. Move the pumpdown switch (PS1 or PS2) to the "manual pumpdown" position. Immediately after the compressor(s) have stopped running, move the pumpdown switch back to the "auto. pumpdown" position. The lead compressor should not re-start for 5 minutes. The second compressor in the refrigerant circuit should start approximately 20 seconds after the lead compressor, provided that the cooling load is high enough to require it. Each refrigerant circuit can be checked the same way.



NOTE: Hot whenever freeze control and high pressure control permit safe operation

ALARM BELL (OPTIONAL)

Models ALR-075A thru 130A:
The 24-volt alarm bell is mounted inside the control center but not wired to the control circuit. It is expected that in most cases, the customer will want to relocate the bell where it will be more easily heard in the event of a safety failure. There are leads for connection of the bell inside a junction box which is located in the unit control center. All that is necessary is that the bell be mounted in a preferred location and wired to the leads in the junction box.

The bell is wired into the control circuit so that it will sound whenever there is a failure due to low oil pressure, motor overload, an evaporator freeze condition, or excessive condenser pressure.

An alarm bell kit is available on unit sizes ALR-035A thru 065B.

HOT GAS BYPASS (OPTIONAL)

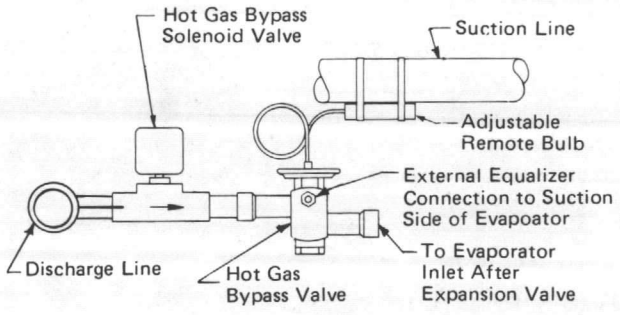
Hot gas bypass is a system for maintaining evaporator pressure at or above a minimum value. The purpose for doing this is to keep the velocity of the refrigerant as it passes through the evaporator high enough for proper oil return to the compressor when cooling load conditions are light.

The system consists of a solenoid valve piped in series with a pressure regulating valve as shown below. The solenoid valve is factory wired to open whenever the unit thermostat calls for the first stage of cooling. The pressure regulating valve is factory set to begin opening at 58 PSIG (32F for R-22) when the air charged bulb is in an 80F ambient temperature. Since the bulb is factory mounted on the suction line, and suction line temperatures are usually in the 50F to 60F range, the chart above indicates that for ALR chillers, the valve is factory set to begin opening at 54 to 56 PSIG. This setting can be changed as indicated above by changing the pressure of the air charge in the adjustable bulb. To raise the pressure setting, remove the cap on the bulb and turn the adjustment screw clockwise. To lower the setting, turn the screw counterclockwise. Do not force the adjustment beyond the range it is designed for, as this will damage the adjustment assembly.

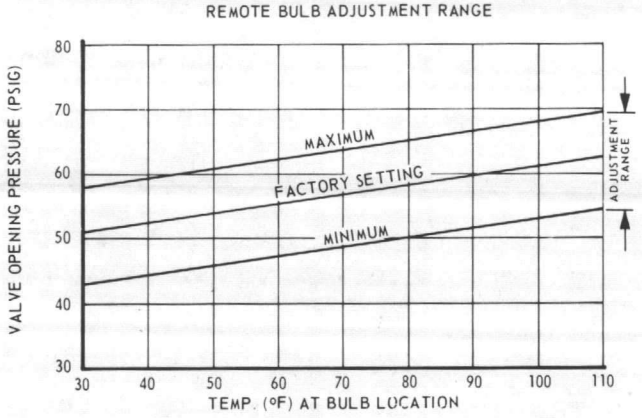
The regulating valve opening point can be determined by slowly reducing the system load (or increasing the required chilled water temperature setting indicated on the unit thermostat), while observing the suction pressure. When the bypass valve starts to open, the refrigerant line on the evaporator side of the valve will begin to feel warm to the touch.

CAUTION: *The hot gas line may become hot enough to cause injury in a very short time, so care should be taken during valve checkout.*

HOT GAS BYPASS PIPING DIAGRAM



HOT GAS BYPASS ADJUSTMENT RANGE



TROUBLE SHOOTING CHART

PROBLEM	POSSIBLE CAUSES	POSSIBLE CORRECTIVE STEPS
Compressor will not run	1. Main switch open. 2. Fuse blown. Circuit breakers open. 3. Thermal overloads tripped. 4. Defective contactor or coil. 5. System shut down by safety devices. 6. No cooling required. 7. Liquid line solenoid will not open. 8. Motor electrical trouble 9. Loose wiring.	1. Close switch. 2. Check electrical circuits and motor winding for shorts or grounds. Investigate for possible overloading. Replace fuse or reset breakers after fault is corrected. 3. Overloads are auto. reset. Check unit closely when unit comes back on line. 4. Repair or replace. 5. Determine type and cause of shut-down and correct it before resetting safety switch. 6. None. Wait until unit calls for cooling. 7. Repair or replace coil. 8. Check motor for opens, short circuit, or burn out. 9. Check all wire junctions. Tighten all terminal screws.
Compressor noisy or vibrating	1. Flooding of refrigerant into crankcase. 2. Improper piping support on suction or liquid line. 3. Worn compressor	1. Check setting of expansion valve. 2. Relocate, add or remove hangers. 3. Replace.
High Discharge Pressure	1. Non-condensibles in system. 2. System overcharged with refrigerant. 3. Discharge shut off valve partially closed. 4. Seasontrol out of adjustment 5. Fan not running.	1. Purge the non-condensibles. 2. Remove excess. 3. Open valve. 4. Adjust Seasontrol valves. 5. Check belts and electrical circuit.
Low Discharge Pressure	1. Faulty condenser temperature regulation. 2. Suction shut-off valve partially closed. 3. Insufficient refrigerant in system. 4. Low suction pressure. 5. Compressor operating unloaded.	1. Check condenser control operation. 2. Open valve. 3. Check for leaks. Repair and add charge. 4. See Corrective Steps for low suction pressure below. 5. See Corrective Steps for failure of compressor to load up below.
High Suction Pressure	1. Excessive load. 2. Expansion valve overfeeding. 3. Compressor unloaders open.	1. Reduce load or add additional equipment. 2. Check remote bulb. Regulate superheat. 3. See Corrective Steps below for failure of compressor to load up.
Low Suction Pressure	1. Lack of refrigerant. 2. Evaporator dirty. 3. Clogged liquid line filter-drier. 4. Clogged suction line or compressor suction. gas strainers. 5. Expansion valve malfunctioning. 6. Condensing temperature too low. 7. Compressor will not unload.	1. Check for leaks. Repair and add charge. 2. Clean chemically. 3. Replace cartridge(s). 4. Clean strainers. 5. Check and reset for proper superheat. 6. Check means for regulating condensing temperature. 7. See Corrective Steps for failure of compressor to unload.
Compressor will not unload or load up.	1. Defective capacity control. 2. Pressurestat not set for application.	1. Replace. 2. Reset pressurestat setting to fit application.
Little or no oil pressure	1. Clogged suction oil strainer. 2. Excessive liquid in crankcase. 3. Oil pressure gauge defective. 4. Low oil pressure safety switch defective. 5. Worn oil pump. 6. Oil pump reversing gear stuck in wrong position. 7. Worn bearings. 8. Low oil level. 9. Loose fitting on oil lines. 10. Pump housing gasket leaks. 11. Flooding of refrigerant into crankcase.	1. Clean. 2. Check crankcase heater. Reset expansion valve for higher superheat. Check liquid line solenoid valve operation. 3. Repair or replace. Keep valve closed except when taking readings. 4. Replace. 5. Replace. 6. Reverse direction of compressor rotation. 7. Replace compressor. 8. Add oil. 9. Check and tighten system. 10. Replace gasket. 11. Adjust thermal expansion valve.
Compressor loses oil	1. Lack of refrigerant. 2. Excessive compression ring blow-by.	1. Check for leaks and repair Add refrigerant. 2. Replace compressor.
Motor overload relays open or blown fuses	1. Low voltage during high load conditions. 2. Defective or grounded wiring in motor. 3. Loose power wiring. 4. High condensing temperature. 5. Power line fault causing unbalanced voltage. 6. High ambient temperature around the overload relay. 7. Failure of second starter to pull in on part-winding start systems.	1. Check supply voltage for excessive line drip. 2. Replace compressor - motor. 3. Check all connections and tighten. 4. See Corrective Steps for high discharge pressure. 5. Check supply voltage. Notify power compnay. Do not start until fault is corrected. 6. Provide ventilation to reduce heat. 7. Repair or replace starter or time delay mechanism.
Compressor thermal protector switch open.	1. Operating beyond design conditions. 2. Discharge valve partially shut. 3. Blown valve plate gasket.	1. Add facilities so that conditions are within allowable limits. 2. Open valve. 3. Replace gasket.

HEAT TRANSFER SALES, INC.

P. O. BOX 11103
GREENSBORO, NORTH CAROLINA 27409
03-03-03

SUBMITTAL NO. 1631

DATE FEBRUARY 14, 1978

[X] THIS ORDER IS BEING HELD FOR APPROVAL AND WILL NOT BE RELEASED UNTIL APPROVED.

[ ] THESE PRINTS ARE FOR YOUR RECORDS. ORDER HAS BEEN RELEASED PER PRINTS.

CONTRACTOR: SNEEDEN, INC.
BOX 3548
WILMINGTON, N.C. 28401

JOB: B.E.Q. 05-76-6223
CAMP LEJEUNE, N.C.

ENGINEER:

QUAN.	EQUIPMENT LIST AND DESCRIPTION	ACTION TAKEN
	"400 AIRTHERM FAN COIL UNITS WITH: PSC MOTORS 1" THROWAWAY FILTERS 4 WAY DEFLECTION OUTLET GRILLE CEILING UNITS MODEL C-B WITH BOTTOM RETURN AIR. FREE STANDING UNITS MODEL F WITH OUTSIDE AIR INTAKE WITH MANUAL DAMPER AND ANODIZED ALUMINUM WALL BOX ON B-1 UNITS ONLY.	

10 SETS OF SUBMITTAL DATA FOR YOUR APPROVAL.

AIRTHERM UNITAIRE II — CAPACITY DATA

MARK	QUANTITY	UNIT SIZE	COIL NUMBER	HAND OF PIPING	MODEL	CFM	OUTSIDE AIR - CFM	COOLING CAPACITIES							HEATING CAPACITIES							
											ENT AIR °F				HOT WATER						ELECTRIC	
								GPM	PRESSURE DROP FT. H_2O	ENTERING WATER °F	DB	WB	TOTAL MBH	SENSIBLE MBH	HAND OF PIPING	GPM	PRESSURE DROP FT. H_2O	ENTERING WATER °F	ENT AIR °F	MBH	KW	AMPS
A-1	203	02	1	R	C-B	230	0	1.1	.8'	42	75	62.5	6.42	4.91	–	1.1	.8'	180°	70°	8.63	—	—
A-2	5	02	1	R	C-B	230	0	1.3	1.1'	42	75	62.5	6.63	5.17	–	1.3	1.1'	180°	70°	6.51	—	—
A-3	43	03	1	R	C-B	305	0	1.2	1.0'	42	75	62.5	7.17	5.53	–	1.2	1.0'	180°	70°	5.82	—	—
A-4	43	03	1	R	C-B	305	0	1.5	1.5'	42	75	62.5	7.42	5.78	–	1.5	1.5'	180°	70°	6.46	—	—
A-5	39	06	1	R	C-B	600	0	1.6	.6'	42	75	62.5	7.75	6.20	–	1.6	.6'	180°	70°	6.55	—	—
A-6	10	06	1	R	C-B	600	0	2.0	.8'	42	75	62.5	8.37	6.52	–	2.0	.8'	180°	70°	6.91	—	—
A-7	4	03	1	R	C-B	305	0	2.1	2.5'	42	75	62.5	8.27	6.72	–	2.1	2.5'	180°	70°	6.36	—	—
A-8	29	06	1	R	C-B	600	0	1.1	.3'	42	75	62.5	8.53	6.96	–	1.1	.3'	180°	70°	5.82	—	—
A-9	4	06	1	R	C-B	600	0	1.3	.4'	42	75	62.5	9.33	7.47	–	1.3	.4'	180°	70°	6.91	—	—
A-10	2	06	1	R	C-B	600	0	1.4	.5'	42	75	62.5	9.36	7.73	–	1.4	.5'	180°	70°	6.91	—	—
A-11	2	06	1	R	C-B	600	0	2.0	.8'	42	75	62.5	9.71	8.33	–	2.0	.8'	180°	70°	7.20	—	—

ACCESSORIES

ACCESSORY NO.	DESCRIPTION
F-1	1" THROWAWAY FILTERS
M-1	PSC MOTOR
G-9	4 WAY DEFLECTION OUTLET GRILLE
VP-B	MOUNT CONTROL, FURNISHED BY CONTROL CONTRACTOR, AT FACTORY WITH VALVING.

NOTES

ELECTRICAL DATA

ELECTRIC HEATING COIL ____ /60/1

MOTOR PSC 115 /60/1

MOTOR TYPE ☐ SHADED POLE ☒ PSC

THERMOSTAT ____ /60/1

CONTROLS ____ /60/1

HYDRONIC VALVE ____ /60/1

PROJECT B.E.Q. 05-76-6223

LOCATION CAMP LEJEUNE, N.C.

CUSTOMER SNEEDEN, INC.

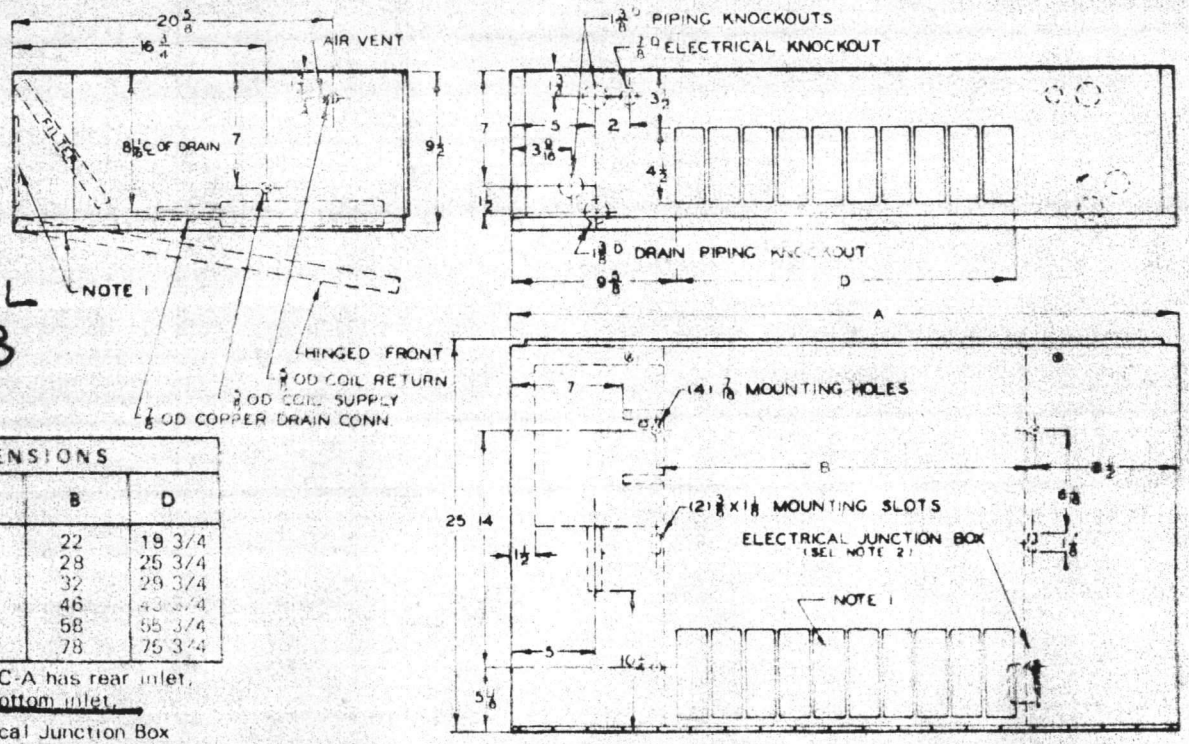
ORDER NO ____ DATE 2/10/78

ARCHITECT ____

ENGINEER ____

PREPARED BY L.F.

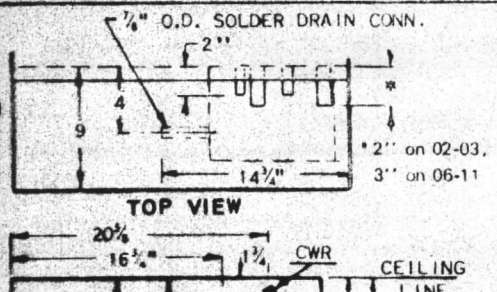
AIRTHERM UNITAIRE II MODELS C-A C-B

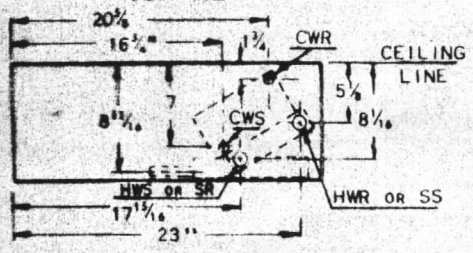


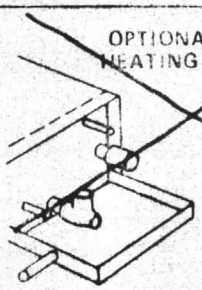
DIMENSIONS			
UNIT SIZE	A	B	D
02	39	22	19 3/4
03	45	28	25 3/4
04	49	32	29 3/4
06	63	46	43 3/4
08	75	58	55 3/4
11	95	78	75 3/4

NOTE 1 - Model C-A has rear inlet, Model C-B has bottom inlet.

NOTE 2 - Electrical Junction Box located on piping side, if specified, or when electrical valve packages are factory mounted.







For 06, 08 & 11 Units with Hot Water Aux. Coil Conns. on same end as 3 Row Coil Conns., the Aux. Supp. Conn. is teed to vertical position as shown.

COIL CONNECTIONS

Cooling Coil — 5/8" O.D. Solder
Aux. Sizes 02 - 04 — 7/8" O.D. Solder
Aux. Sizes 06 - 11 — 3/4" F.P.T.

One Row Aux. Water Coil Conns. may be "Same As" or "Opposite" Cooling Coil Piping. One Row Aux. Steam Coil Conns. must be "Opposite" Cooling Coil Piping. When Factory Mounted Controls are supplied, the Auxiliary Coil Piping will be opposite Cooling Coil Piping.

LEGEND CWS CWR – Chilled Water Supply - Return
HWS HWR – Hot Water Supply - Return
SS SR – Steam Supply - Return

MOTOR DATA

UNIT SIZE	NO. PER UNIT	CFM AT MOTOR SPEED HIGH	MED	LOW	RUNNING AMPS. SHADED POLE MOTOR	PSC MOTOR	WATTS INPUT SHADED POLE MOTOR	PSC MOTOR	POWER FACTOR SHADED POLE MOTOR	PSC MOTOR	HIGH SPEED RPM SHADED POLE MOTOR	PSC MOTOR
02	1	230	195	150	1.20	0.59	92	59	.67	.93	1060	1070
03	1	305	260	200	1.90	0.92	123	95	.56	.90	1040	1040
04	1	400	340	265	1.40	0.76	108	86	.67	.98	1050	1020
06	1	600	515	400	2.80	1.59	160	146	.50	.85	1080	1085
08	2	800	685	530	4.70	2.40	280	249	.52	.86	1080	1080
11	2	1100	940	730	5.60	3.00	314	285	.49	.83	1090	1095

Medium Speed - 900 RPM, Low Speed - 700 RPM.

STANDARD SPECIFICATIONS

UNIT SIZE			02	03	04	06	08	11
FILTER	Throw away - 3/4" Thick, 9" Wide - Length In.		20 7/8	26 7/8	30 7/8	44 7/8	56 7/8	76 7/8
	Number per Unit		1	1	1	1	1	1
FANS	WHEEL	Diameter - In.	5.72	5.72	5.72	5.72	5.72	5.72
		Width - In.	7.875	7.875	7.875	7.875	7.875	7.875
		Number per Unit	1	1	2	2	3	4
		Type	Double Width Double Inlet Forward Curved					
		Construction	Tube Filled Polypropelene - Dynamically Balanced					
	HOUSING	Width - In.	9 3/16					
		Construction	Galvanized Steel					
COIL THREE ROWS DEEP	Face Area - Sq. Ft.		0.83	1.20	1.41	2.08	2.71	3.75
	Connections		5/8" O.D. Sweat					
	Air Vent		Manual					
	FINS	Material and No. per Inch	Aluminum Spaced 10.5 per In.					
	TUBES	Diameter - Material	5/8" O.D. Seamless Copper					
		Test Pressure - Maximum Working Pressure	Tested at 300 PSI - 200 PSIG Max. W.P.					
MOTORBOARD	Galvanized Steel	Metal Gauge	16	16	16	16	14	14
DECORATIVE CABINET	CONSTRUCTION	18 Gauge Steel						
	STANDARD FINISH	Phosphatized and Painted with Baked-On Blue-Gray Semi Gloss Enamel.						
	INSULATION	1/2" 2 lb. Density Glass Fiber, Installed on Front Panel and Discharge Panel.						
BASIC UNIT CHASSIS	CONSTRUCTION	Heavy Gauge Galvanized Steel Reinforced for Maximum Rigidity.						
	INSULATION	1/2" 2 lb. Density Glass Fiber, Installed in Conditioned Air Passages.						
	PIPING CONNECTIONS	Left Hand or Right Hand - Specify.						
DRAIN PAN	PRIMARY AND AUXILIARY	18 Gauge Steel Insulated						
MOTOR	Shaded Pole, Tap Wound for 115/60/1, with Built-In Thermal Overload Protection and Automatic Reset.							
SPEED CONTROL	Three Speed Switch with Off Position Furnished for Remote Mounting.							

AIRTHERM UNITAIRE II — CAPACITY DATA

MARK	QUANTITY	UNIT SIZE	COIL NUMBER	HAND OF PIPING	MODEL	CFM	OUTSIDE AIR - CFM	COOLING CAPACITIES							HEATING CAPACITIES							
											ENT AIR °F				HOT WATER						ELECTRIC	
								GPM	PRESSURE DROP FT. H_2O	ENTERING WATER °F	DB	WB	TOTAL MBH	SENSIBLE MBH	HAND OF PIPING	GPM	PRESSURE DROP FT. H_2O	ENTERING WATER °F	ENT AIR °F	MBH	KW	AMPS
B-1	12	08	1	R	F	800	320	1.9	.9'	42	82.6	71	15.2	11.9	-	1.9	.9'	180°	47.1	23.6	—	—
B-2	4	03	1	R	F	305	0	1.5	1.5'	42	75	62.5	7.43	5.81	-	1.5	1.5'	180°	70	5.97	—	—

ACCESSORIES

ACCESSORY NO.	DESCRIPTION
F-1	1" THROWAWAY FILTERS
M-1	PSC MOTOR
G-8	4 WAY DEFLECTION OUTLET GRILLE
VP-8	MOUNT CONTROL VALVE, FURNISHED BY CONTROL CONTRACTOR, AT FACTORY WITH VALVING.
B-1 UNITS ONLY	
D-1	BACK INLET O.A. WITH MANUAL DAMPER
G-23	ANODIZED ALUMINUM O.A. WALL BOX

NOTES

ELECTRICAL DATA

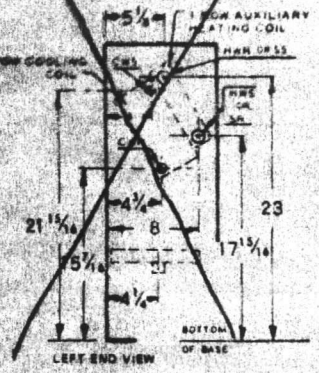
ELECTRIC HEATING COIL ..... /60/1
MOTOR PSC 115 /60/1
MOTOR TYPE ☐ SHADED POLE ☒ PSC

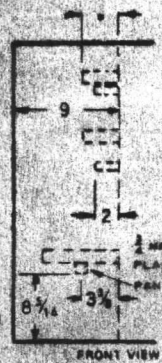
THERMOSTAT ..... /60/1
CONTROLS ..... /60/1
HYDRONIC VALVE ..... /60/1

PROJECT B.E.Q 05-76-6223
LOCATION CAMP LEJEUNE, N.C.
CUSTOMER SNEEDEN, INC.
ORDER NO. _____ DATE 2/10/78
ARCHITECT _____
ENGINEER _____
PREPARED BY L.E.

AIRTHERM UNITAIRE II MODELS F AND PF

OPTIONAL AUXILIARY HEATING COIL - 1 ROW





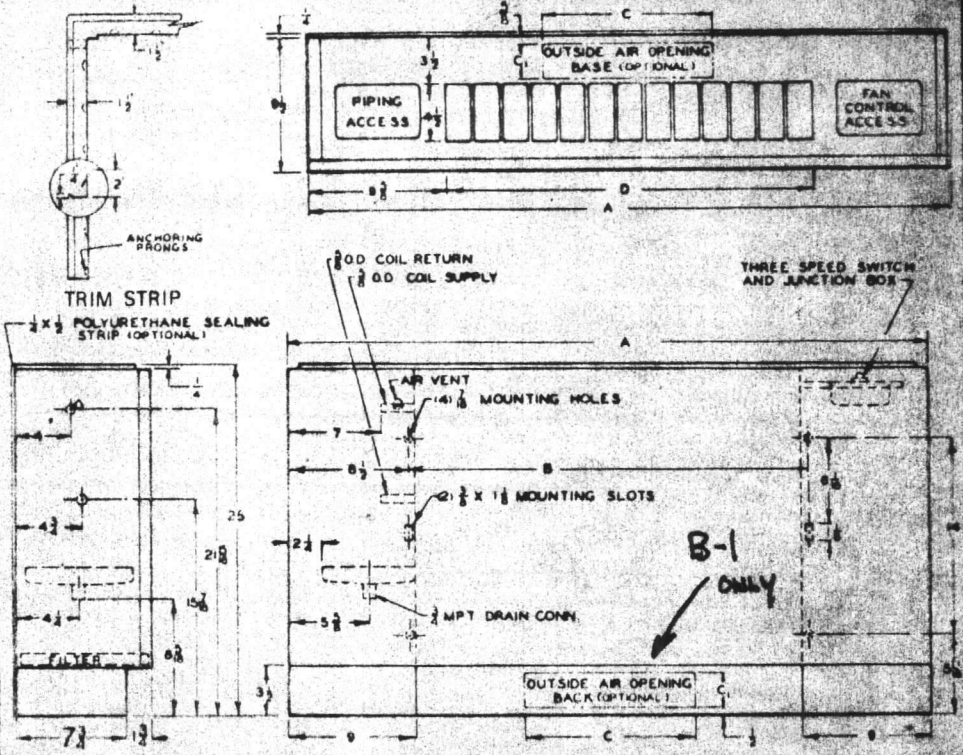
"2" on 02-04
3" on 06-11

LEGEND
CWS - CWR - Chilled Water Supply - Return
HWS - HWR - Hot Water Supply - Return
SS - SR - Steam Supply - Return

COIL CONNECTIONS

Cooling Coil – 5/8" O.D. Solder
Aux. Sizes 02-04 – 5/8" O.D. Solder
Aux. Sizes 06-11 – 3/4" F.P.T.

One Row Aux. Steam or Water Coil Conns. may be "Same As" or "Opposite" Cooling Coil Piping. If "Opposite" is selected, Fan Speed Control must be located on chilled water side or located remote from Unit. When Factory Mounted Controls are supplied, the Auxiliary Coil Piping will be opposite Cooling Coil Piping.



Model F shown, Model PF is furnished with trim strip for recessing 3-1/4 inches.

DIMENSIONS

UNIT SIZE	A	B	25% O.A. INTAKE C	25% O.A. INTAKE C_1	100% O.A. INTAKE C	100% O.A. INTAKE C_1	D
02	39	22	9	2 1/2	21	3	19 3/4
03	45	28	9	2 1/2	27	3	25 3/4
04	49	32	15	2 1/2	31	3	29 3/4
06	63	46	15	2 1/2	45	3	43 3/4
08	75	58	27	2 1/2	57	3	55 3/4
11	95	78	27	2 1/2	77	3	75 3/4

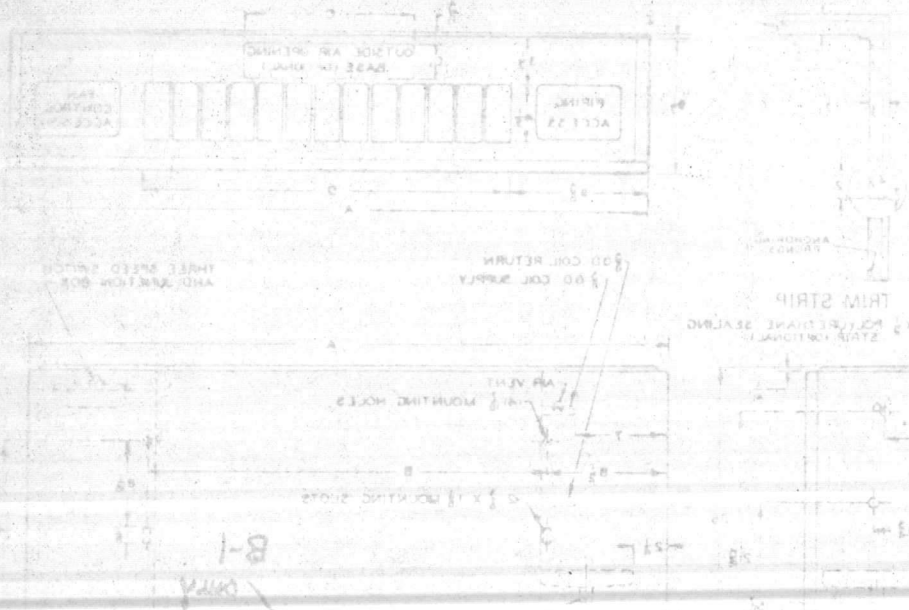
MOTOR DATA

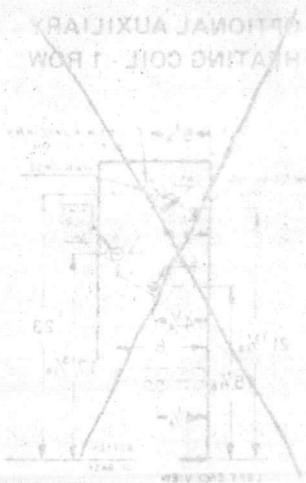
UNIT SIZE	NO. PER UNIT	CFM AT MOTOR SPEED HIGH	MED	LOW	RUNNING AMPS SHADED POLE MOTOR	RUNNING AMPS PSC MOTOR	WATTS INPUT SHADED POLE MOTOR	WATTS INPUT PSC MOTOR	POWER FACTOR SHADED POLE MOTOR	POWER FACTOR PSC MOTOR	HIGH SPEED RPM SHADED POLE MOTOR	HIGH SPEED RPM PSC MOTOR
02	1	230	195	150	1.20	0.55	92	59	.67	.93	1060	1070
03	1	305	260	200	1.90	0.92	123	95	.56	.90	1040	1040
04	1	400	340	265	1.40	0.76	108	86	.67	.98	1050	1020
06	1	600	515	400	2.80	1.50	160	146	.50	.85	1080	1085
08	2	800	685	530	4.70	2.40	280	240	.52	.86	1080	1080
11	2	1100	940	730	5.60	3.00	314	285	.49	.83	1090	1085

Medium Speed - 900 RPM, Low Speed - 700 RPM.

STANDARD SPECIFICATIONS

UNIT SIZE			02	03	04	06	08	11
FILTER	Throw away - 3/4" Thick, 9" Wide - Length In.		20 7/8	26 7/8	30 7/8	44 7/8	56 7/8	76 7/8
	Number per Unit		1	1	1	1	1	1
FANS	WHEEL	Diameter - In.	5.72	5.72	5.72	5.72	5.72	5.72
		Width - In.	7.875	7.875	7.875	7.875	7.875	7.875
		Number per Unit	1	1	2	2	3	4
		Type	Double Width Double Inlet Forward Curved					
		Construction	Talc Filled Polypropelene - Dynamically Balanced					
	HOUSING	Width - In.	9 3/16	10	9 3/16	10	10	10
		Construction	Galvanized Steel					
COIL THREE ROWS DEEP	Face Area - Sq. Ft.		0.83	1.20	1.41	2.08	2.71	3.75
	Connections		5/8" O.D. Sweat					
	Air Vent		Manual					
	FINS	Material and No. per Inch	Aluminum Spaced 10.5 per In.					
	TUBES	Diameter - Material	5/8" O.D. Seamless Copper					
		Test Pressure - Maximum Working Pressure	Tested at 300 PSI - 200 PSIG Max. W.P.					
MOTORBOARD	Galvanized Steel	Metal Gauge	16	16	16	16	14	14
DECORATIVE CABINET	CONSTRUCTION	18 Gauge Steel						
	STANDARD FINISH	Phosphatized and Painted with Baked-on Blue-Gray Semi Gloss Enamel.						
	INSULATION	1/2" 2 lb. Density Glass Fiber, Installed on Front Panel and Discharge Panel.						
BASIC UNIT CHASSIS	CONSTRUCTION	Heavy Gauge Galvanized Steel Reinforced for Maximum Rigidity.						
	INSULATION	1/2" 2 lb. Density Glass Fiber, Installed in Conditioned Air Passages.						
	PIPING CONNECTIONS	Left Hand or Right Hand - Specify.						
DRAIN PAN	PRIMARY	18 Gauge Galvanized Steel. Bottom Insulated with 2 lb. Density Polyurethane.						
	AUXILIARY	Plastic						
MOTOR	Shaded Pole, Tap Wound for 115/60/1, with Built-In Thermal Overload Protection and Automatic Reset.							
SPEED CONTROL	Three Speed Switch with Off Position Mounted on Unit on End Opposite Piping.							





DIMENSIONS

UNIT SIZE	A	B	25% O.A. INTAKE C	C1	100% O.A. INTAKE C	C1	D
02	39	22	3	2 1/2	21	3	19 3/4
03	45	28	9	2 1/2	27	3	25 3/4
04	49	32	15	2 1/2	31	3	29 3/4
06	53	46	15	2 1/2	45	3	43 3/4
08	75	64	27	2 1/2	57	3	55 3/4
11	105	78	27	2 1/2	77	3	75 3/4

MOTOR DATA

UNIT SIZE	NO. PER UNIT	CFM AT MOTOR SPEED HIGH	CFM AT MOTOR SPEED LOW	RUNNING AMPS SHADED POLE MOTOR	RUNNING AMPS PSC MOTOR	INPUT WATTS SHADED POLE MOTOR	INPUT WATTS PSC MOTOR	POWER FACTOR SHADED POLE MOTOR	POWER FACTOR PSC MOTOR	HIGH SPEED SHADED POLE MOTOR	HIGH SPEED PSC MOTOR
02	1	1200	1000	1.70	.90	190	95	.97	.93	1000	1000
03	1	1600	1200	2.20	1.20	250	142	.96	.96	1140	1140
04	1	2000	1600	2.80	1.40	320	168	.96	.97	1400	1400
06	1	2800	2400	4.20	2.20	480	260	.96	.97	2100	2100
08	1	4000	3200	6.20	3.20	700	380	.96	.97	2800	2800
11	1	5600	4800	8.70	4.70	980	560	.96	.97	3900	3900

Medium Speed - 900 RPM Low Speed - 700 RPM

PUBLICATION 12

AIRTHERM

THE CARE AND MAINTENANCE OF STEAM AND HOT WATER UNIT HEATERS

AIR # 52

THE CARE AND MAINTENANCE OF STEAM AND HOT WATER UNIT HEATERS

Heating system design is not covered here for it is assumed that this work has been carried out in accordance with the established engineering principles. Some matters will be touched on however, for their omission can cause persistent trouble in unit heater operation.

BRANCHES FROM STEAM SUPPLY MAIN

The branch connecting the unit heater to the steam supply main should utilize swing connections and be pitched down from the heater. Connection should be taken off the top of the main. Do not drip the main through the heater since entrained condensate will reduce its capacity. The return should utilize swing connections and must be pitched down from the unit so that condensate will drain freely.

LOW PRESSURE GRAVITY SYSTEMS

Each unit must be provided with a swing check valve on the return connection. The check valves require a head of water above them before they will operate. If they are not placed well below the bottom of the heater, condensate will back up into the heating element and trouble as well as a drop in capacity will result. Place the trap or check valve at least 12" below the outlet of the heater and extend a dirt pocket 6" below this. Do not bush the heater but run full size to the strainer. The usual practice is to size the strainer the same size as the trap tapping. Make sure that there is an adequate air vent valve installed in closed-return systems. Float type traps may be used in place of check valve in which case a strainer is required ahead of the trap.

VACUUM SYSTEMS

The precautions listed above apply equally to a vacuum system except that vent valves are omitted. If a plain thermostatic trap (one containing a thermal element which will operate on but a few degrees below steam temperature) instead of float and thermostatic trap is used, a run of bare pipe used as a cooling leg, the same size as condensate outlet of heater to strainer inlet, must be provided ahead of the trap.

HIGH PRESSURE SYSTEMS

Each heater should be provided with a high pressure bucket or float type trap and a dirt strainer the same size as the trap inlet, and of sufficient size and capacity to pass two times the normal condensate released by the unit at the minimum differential pressure in the system. A check valve at the outlet of each trap is necessary to protect each heater from the effects of back pressure. The bucket or high pressure float trap should be installed at least 12" below the bottom of the unit together with a 6" dirt pocket.

Proper air venting, the key to efficient high pressure unit heaters, can be achieved by use of a steam trap with an internal air vent, or a steam trap with an externally piped high pressure thermostatic trap as an air vent or by use of a petcock with a scored seat.

TREATMENT OF HIGH EXIT AIR TEMPERATURES IN HIGH PRESSURE SYSTEMS

Where exit air temperatures on high steam pressures are excessive, pressure reducing valves are recommended so that the units may operate at lower pressures and hence lower final air temperatures.

TRAPS

When traps are used on low pressure unit heaters, consult the standard ratings for traps as established by the Steam Heating Equipment Manufacturers Association (SHEMA). These ratings may be applied directly to the capacities of unit heaters as the safety factors have already been applied to arrive at catalog ratings.

A bypass should be installed around a trap when continuous service is essential. Trap capacities should be based upon the actual anticipated difference in pressure between the supply line and the back pressure in the return line.

Consult with trap manufacturer for his specific recommendations.

STRAINERS

It is advisable to use a pipe line strainer before each steam trap draining a unit heater. This protection will reduce the maintenance of the steam trap. When strainers are used they should be installed between the unit heater and the trap, or between heater and check valve if the latter is used in lieu of a trap. In order to catch dirt and scale, the strainer should have a screen perforation size smaller than the trap orifices.

NEW UNIT HEATERS

Inspect carefully before operating. Normally, no attention is needed, but it is a wise precaution. Check to see that the fan wheel is in the proper position and tight on the shaft. Tighten any loose nuts, bolts and screws. Remove and carefully store operating instructions. If necessary, lubricate motor as directed, being careful not to over-lubricate. Be sure that the line voltage agrees with that of the motor nameplate rating.

MAINTENANCE

The most important factor in trouble-free and economical operation is regular inspection. Make a simple check sheet showing the date of inspection for each heater. In normal operation, inspection every four months should be sufficient. If the atmosphere is extremely dirty, more frequent inspections are needed. Check for dirty heating elements, loose electrical or piping connections and excessive vibration; clean the fan and the outside of the motor.

MOTORS

Follow the motor manufacturer's instructions. Different types of motors are applied to unit heaters and general rules are difficult to establish. Save the tags or instructions supplied with the unit, and if they are missing, it is suggested that you write to the unit heater manufacturer or the motor manufacturer for information. Be sure to give the complete motor nameplate data. Thermal-overload protection is recommended for all motors and if not built into the motor, a separate thermal-overload switch should be provided.

Lubricate motors in accordance with the manufacturer's instructions. If the motors are furnished with pressure relief plugs, they should be removed before lubricating motor. Motors with sealed-in lifetime lubrication systems are not equipped with visible oiling provisions. Should reoiling be required it is suggested that the motor manufacturer by contacted for instructions.

Units may be equipped with either sleeve bearing or ball bearing motors and attached motor manufacturer's recommendations are to be followed for lubrication. These instructions should be carefully preserved.

Open type motors should be blown out with compressed air at regular inspection periods.

HEATING ELEMENTS

Clean the heating element as often as required to maintain maximum efficiency, at least once a year, and more often if the unit is operating in a dirty or corrosive atmosphere. Dirt can seriously reduce the heating capacity of the unit.

To protect open type motors, when cleaning element, a bag should be placed over the motor. Dirt may then be removed by brushing the fins on the side where the air enters the unit and turning on the fan, after removing the bag. It is recommended that a second bag be placed over the face of the unit to catch this dirt. Be sure to brush along the fins to avoid bending which could reduce unit capacity. The element can also be cleaned by blowing high pressure air at the air leaving side of the heating element.

Oil and dirt accumulations on leading edge of fins can be removed with a mild alkali solution or detergent to cut oil or grease. Be sure to rinse thoroughly to remove any trace of this solution. If a very thorough cleaning is needed, dismount the unit and spray the heating element, being careful to rinse well afterwards. A steam gun can be used for this cleaning and rinsing.

FAN

Clean at periodic intervals. A dirty fan will get out of balance and cause noise and excessive vibration that may damage the bearings, and will certainly overload the motor. Check to see that the fan is in the proper position, the set screws tight, and that the fan blades have a uniform setting.

DIMENSIONS
HORIZONTAL UNIT HEATERS

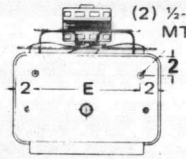
STANDARD MODELS
LOW OUTLET TEMPERATURE MODELS

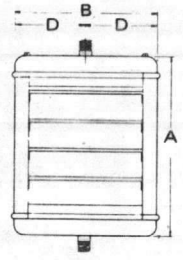
DIMENSIONS

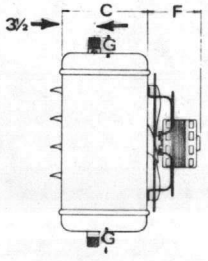
MODEL		A	B	C	D	E	F*	G	Supply & Return M P T
HR-27	HRL-27	18-1/2	15-1/8	9-1/8	7-9/16	11-1/8	5-1/4	1-11/16	1
HR-39	HRL-39	18-1/2	15-1/8	9-1/8	7-9/16	11-1/8	6	1-11/16	1
HR-45	HRL-45	18-1/2	15-1/8	9-1/8	7-9/16	11-1/8	5-1/2	1-11/16	1
HR-55	HRL-55	22	18-3/4	9-1/8	9-3/8	14-3/4	5-1/2	1-3/8	1-1/2
HR-65	HRL-65	22	18-3/4	9-1/8	9-3/8	14-3/4	5-3/4	1-3/8	1-1/2
HR-76	HRL-76	22	18-3/4	9-1/8	9-3/8	14-3/4	6-1/2	1-3/8	1-1/2
HR-92	HRL-92	23-7/8	21-1/8	9-1/8	10-9/16	17-1/8	10-5/8	1-3/8	1-1/2
HR-110	HRL-110	23-7/8	21-1/8	9-1/8	10-9/16	17-1/8	10-3/4	1-3/8	1-1/2
HR-125	HRL-125	26	23-1/2	10-1/8	11-3/4	19-1/2	10-1/8	1-1/2	2
HR-146	HRL-146	26	23-1/2	10-1/8	11-3/4	19-1/2	10-1/8	1-1/2	2
HR-180	HRL-180	30-1/4	26	10-1/8	13	22	10-3/4	1-1/2	2
HR-209	HRL-209	30-1/4	26	10-1/8	13	22	10-1/8	1-1/2	2
HR-250	HRL-250	37-3/4	30-3/4	10-1/8	15-3/8	26-3/4	11-7/8	2-3/8	2-1/2
HR-300	HRL-300	37-3/4	30-3/4	10-1/8	15-3/8	26-3/4	13	2-3/8	2-1/2

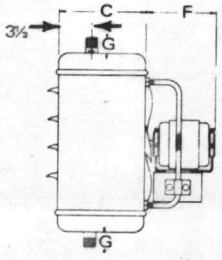
*Approximate Dimensions

ALL DIMENSIONS IN INCHES









MODELS
HR-27 – HR-76
HRL-27 – HRL-76

MODELS
HR-92 – HR-300
HRL-92 – HRL-300

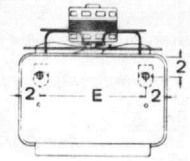
HRW HOT WATER MODELS

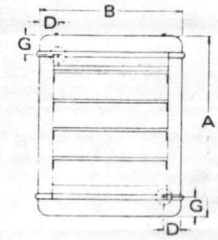
DIMENSIONS

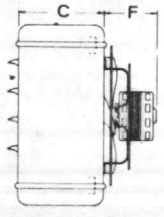
MODEL	A	B	C	D	E	F*	G	Supply & Return M P T
HRW-27	18-5/8	15-1/8	9-1/8	2	11-1/8	5-1/4	2	3/4
HRW-39	18-5/8	15-1/8	9-1/8	2	11-1/8	6	2	3/4
HRW-45	18-5/8	15-1/8	9-1/8	2	11-1/8	5-1/2	2	3/4
HRW-55	22	18-3/4	9-1/8	2	14-3/4	5-1/2	2-5/8	1
HRW-65	22	18-3/4	9-1/8	2	14-3/4	5-3/4	2-5/8	1
HRW-76	22	18-3/4	9-1/8	2	14-3/4	6-1/2	2-5/8	1
HRW-92	23-7/8	21-1/8	9-1/8	2	17-1/8	10-5/8	3-1/2	1
HRW-110	23-7/8	21-1/8	9-1/8	2	17-1/8	10-3/4	3-1/2	1
HRW-125	26	23-1/2	10-1/8	2-1/4	19-1/2	10-1/8	3-1/4	1-1/4
HRW-146	26	23-1/2	10-1/8	2-1/4	19-1/2	10-1/8	3-1/4	1-1/4
HRW-180	30-1/4	26	10-1/8	2-1/4	22	10-1/8	3-1/2	1-1/4
HRW-209	30-1/4	26	10-1/8	2-1/4	22	10-1/8	3-1/2	1-1/4
HRW-250	37-3/4	30-3/4	10-1/8	2-1/4	26-3/4	11-7/8	3-1/2	1-1/2
HRW-300	37-3/4	30-3/4	10-1/8	2-1/4	26-3/4	13	3-1/2	1-1/2

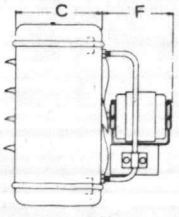
*Approximate Dimensions

ALL DIMENSIONS IN INCHES







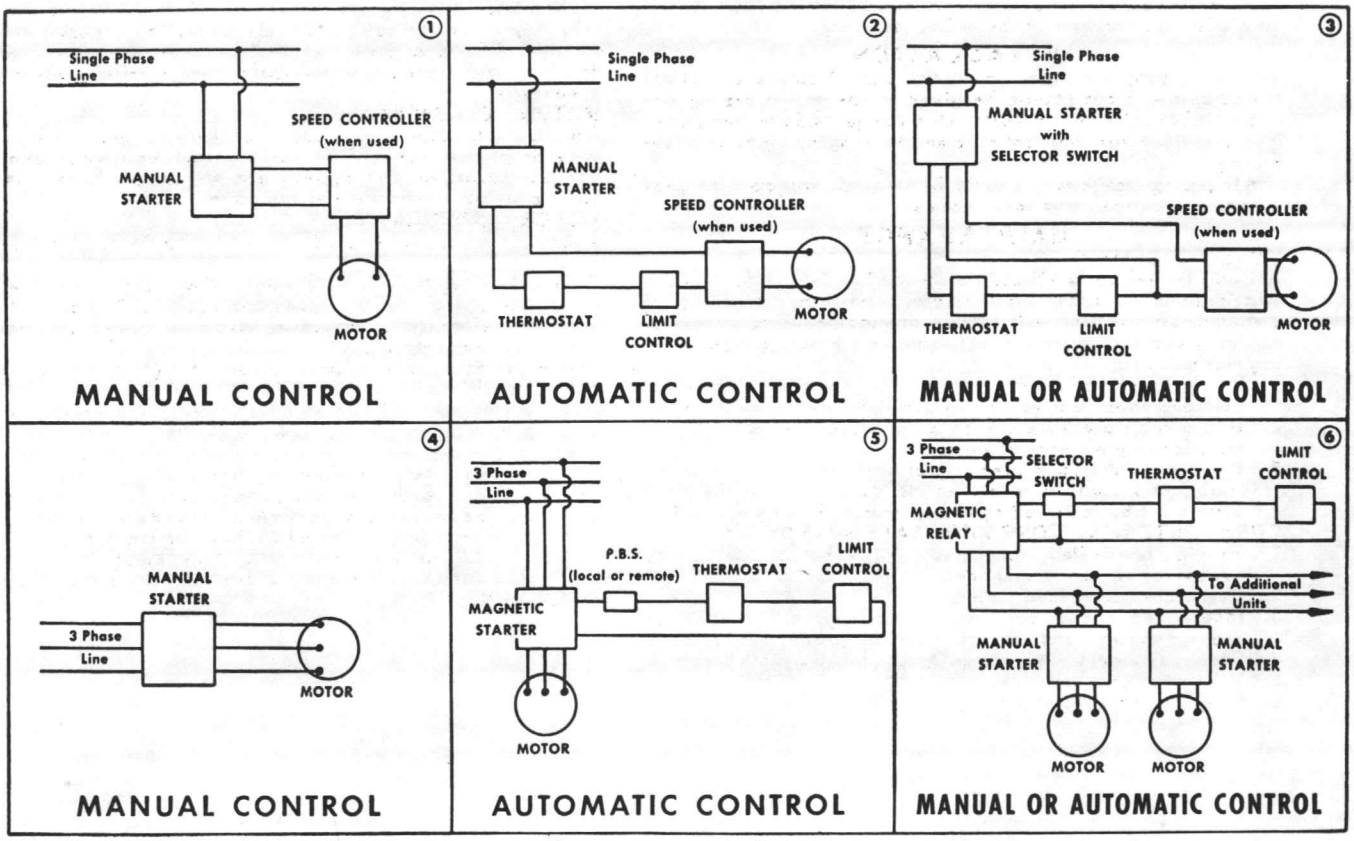


MODELS
HRW-27 – HRW-76

MODELS
HRW-92 – HRW-300

Horizontal Unit Heater
INSTALLATION AND MAINTENANCE DATA
BULLETIN NO. IM 77-2

TYPICAL WIRING DIAGRAMS



As proper control is a vital part of any heating system, the manufacturer offers the typical wiring diagrams shown above as suggestions of what may be accomplished by control.

It will be noted that each diagram includes a manual or magnetic starter because the manufacturer recommends that each unit be provided with thermal overload protection. In addition, single phase diagrams show where speed controllers are installed in relation to other controls. However, as the actual wiring of the speed controller varies with the type of controller and the make of motor, this detail wiring is not shown in these diagrams. However, the manufacturer supplies the proper wiring diagram with each speed controller when shipped.

Diagram 1 and 4. Although unit heaters are usually thermostatically controlled, there are some installations where manual "on-off" control is sufficient. These diagrams show this type of control. The single phase manual starter shown in Diagram No. 1 may be of the single pole or double pole type. Typical installations would be on loading docks, in process work, etc.

Diagram 2 and 5. Here is shown the most common method of controlling unit heaters. Each unit is controlled by a space thermostat and, in addition, a limit control (temperature or pressure type) is connected in the circuit so that the unit cannot operate when the heating medium is inadequate. Typical installations would be warehouses, etc.

Diagram 3 and 6. Here is shown the most flexible method of control providing both automatic and manual operation. The automatic operation will be the same as in Diagram 2 and 5. However, in addition, provision is made for operating the unit manually. This permits the unit being used as an air circulator during the non-heating season.

Typical installations would be offices, restaurants, etc.

Although Diagram No. 6 shows a multiple application, this same type of control may be applied to individual units by substituting a magnetic starter for the magnetic relay and omitting the manual starter.

MOTOR NAME PLATE AMP. RATINGS FOR SIZING OVERLOAD HEATER COILS

MODEL NUMBER	MOTOR		SINGLE PHASE	THREE PHASE		
	HP	RPM	115V	200 V	230 V	460 V
UHH-016A	1/55	1550	.7	1.0*	0.9*	0.4*
UHH-022A	1/25	1550	1.1	1.0*	0.9*	0.4*
UHH-028A	1/25	1550	1.1	1.0*	0.9*	0.4*
UHH-034A	1/20	1550	1.7	1.0*	0.9*	0.4*
UHH-044A	1/20	1550	1.7	1.0*	0.9*	0.4*
UHH-052A	1/20	1550	1.7	1.0*	0.9*	0.4*
UHH-056A	1/15	1050	2.6	1.3+	1.1+	0.6+
UHH-062A	1/5	1050	6.2	1.3+	1.1+	0.6+
UHH-068A	1/5	1050	6.2	1.3+	1.1+	0.6+
UHH-074A	1/5	1050	6.2	1.3+	1.1+	0.6+
UHH-080A	1/3	1140	5.6	1.8	1.6	0.8
UHH-086A	1/4	1100	4.0	1.5	1.4	0.7
UHH-094A	1/2	1140	7.5	2.2	1.9	1.0

*1/6 HP 1725 RPM Motor
+1/6 HP 1140 RPM Motor

MOTOR: OVERLOAD PROTECTION

Wide variation in voltage or a change to a lower or higher voltage or excessively high prevailing ambient temperatures may cause motor over-heating and serious motor damage. To prevent such an occurrence, all single phase motors are provided with inherent thermal overload protection. However, the manufacturer strongly recommends that a separate starter with thermal overload protection be provided for each unit. The amperage ratings of motors vary somewhat depending upon the manufacturer. The amperage ratings given above can be considered as average for the various makes used on these units. The table above is provided for use in selecting the thermal overload elements. Before putting the unit heater in operation, check the motor nameplate amperage and overload heater coil to be sure that there is adequate motor protection.

INSTALLATION and MAINTENANCE INSTRUCTIONS

GENERAL

A Unit Heater is a mechanical device which requires a normal amount of maintenance to insure trouble-free operation. Outlined below are recommendations for the installation, care and maintenance of these Unit Heaters.

INSTALLATION

Typical piping diagrams for these Unit Heaters are illustrated below. Care should be given to the entire piping layout to insure the best results. Use hanger rods to hang unit. The manufacturer does not recommend hanging units from the piping.

All piping and wiring should be in conformance with good standard practices and local codes.

MAINTENANCE

CORE: CLEANING

All unit heater coils should be cleaned at least once a year, and more often under unfavorable conditions. Build-up of dirt, grease and lint will reduce original heating capacity, and may overload motor. The following are suggested cleaning methods.

1. Use a brush to loosen dirt on side where air enters the coil and then turn fan on to blow the dirt from the unit.
2. Use a high pressure air hose to loosen dirt by blowing from leaving air side of unit.
3. For a more thorough cleaning of coil, remove the fan and motor, and spray a mild alkaline solution over the coil. This must be followed by a very thorough hot water rinse.

CORE: INTERNAL CORROSION SAFEGUARDS

1. Provide controlled water treatment – but do not use an excess of boiler compounds.
2. De-aerate boiler feed-water.
3. Insure rapid and continuous condensate drainage by proper sizing and installation of traps and piping.
4. Clean strainers and check traps for proper operation.
5. Vent each unit properly.
6. Use low pressure steam whenever possible.

CASING:

Casings should be periodically cleaned to remove dirt, grease and corrosive substances which might injure the finish. Any rusted or corroded spots should be cleaned and repainted. Check accessories and motor mount. Also, check fan for tight connection to shaft, free rotation and proper clearance.

MOTOR: CLEANING

During each inspection, remove all grease and dirt from the outside of the motor. This is important as grease and dirt act as insulation and thereby prevent proper heat dissipation, causing overheating of the motor.

MOTOR: LUBRICATION

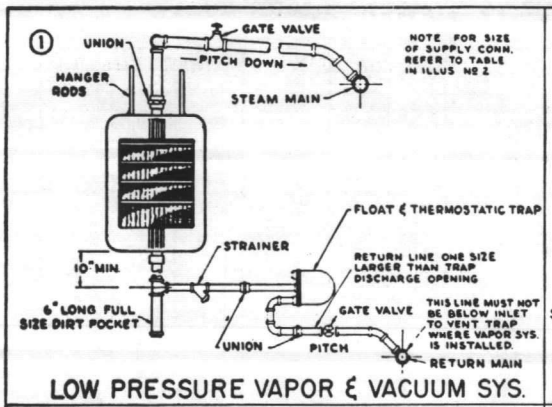
Lubricate motors in accordance with manufacturer's instructions.

Sleeve bearing motors with oilers–For normal service, re-oil at the end of the first year and each 2,000 hours of service thereafter. The amount of oil to be added depends on the motor temperature and the conditions of service. For normal service, use a good grade of light (SAE 20) non-detergent lubricating oil. DO NOT OVER-LUBRICATE.

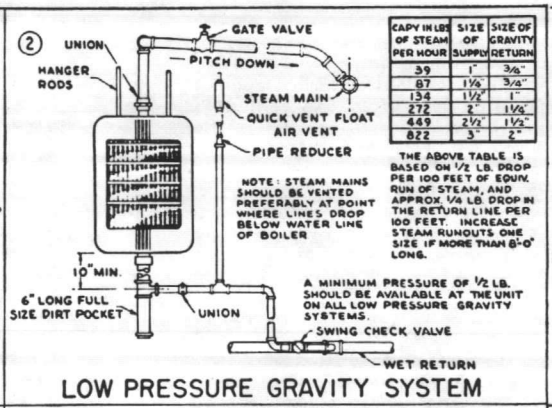
Ball bearing motors–The standard motors are pre-lubricated bearing motors and do not require further lubrication. However, on special applications, a motor with other types of bearings might be furnished. In this case, lubricate motors in accordance with the motor manufacturer's instructions, which will be included separately or on a decal on the motor.

Where motors are operated in high ambient temperatures and/or under severe conditions, they must be serviced, lubricated and repacked at more frequent intervals. DO NOT OVER-LUBRICATE.

PIPING DIAGRAMS



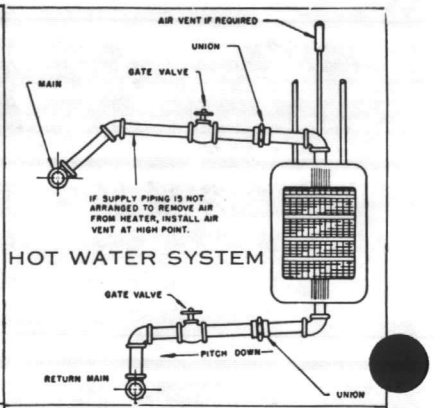
LOW PRESSURE VAPOR & VACUUM SYS.



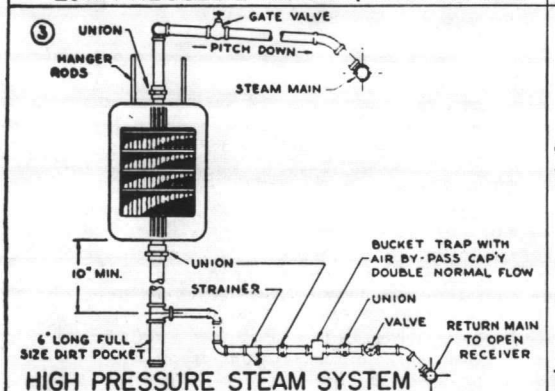
CAPY IN LBS OF STEAM PER HOUR	SIZE OF SUPPLY	SIZE OF GRAVITY RETURN
39	1"	3/4"
87	1¼"	3/4"
134	1½"	1"
272	2"	1¼"
449	2½"	1½"
822	3"	2"

THE ABOVE TABLE IS BASED ON ½ LB. DROP PER 100 FEET OF EQUIV. RUN OF STEAM, AND APPROX. ¼ LB. DROP IN THE RETURN LINE PER 100 FEET. INCREASE STEAM RUNOUTS ONE SIZE IF MORE THAN 8'-0" LONG.

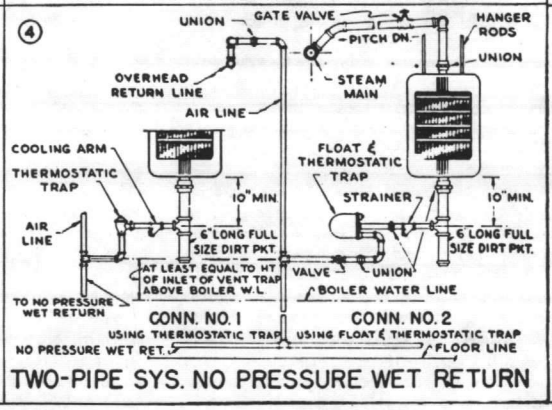
LOW PRESSURE GRAVITY SYSTEM



HOT WATER SYSTEM



HIGH PRESSURE STEAM SYSTEM



TWO-PIPE SYS. NO PRESSURE WET RETURN

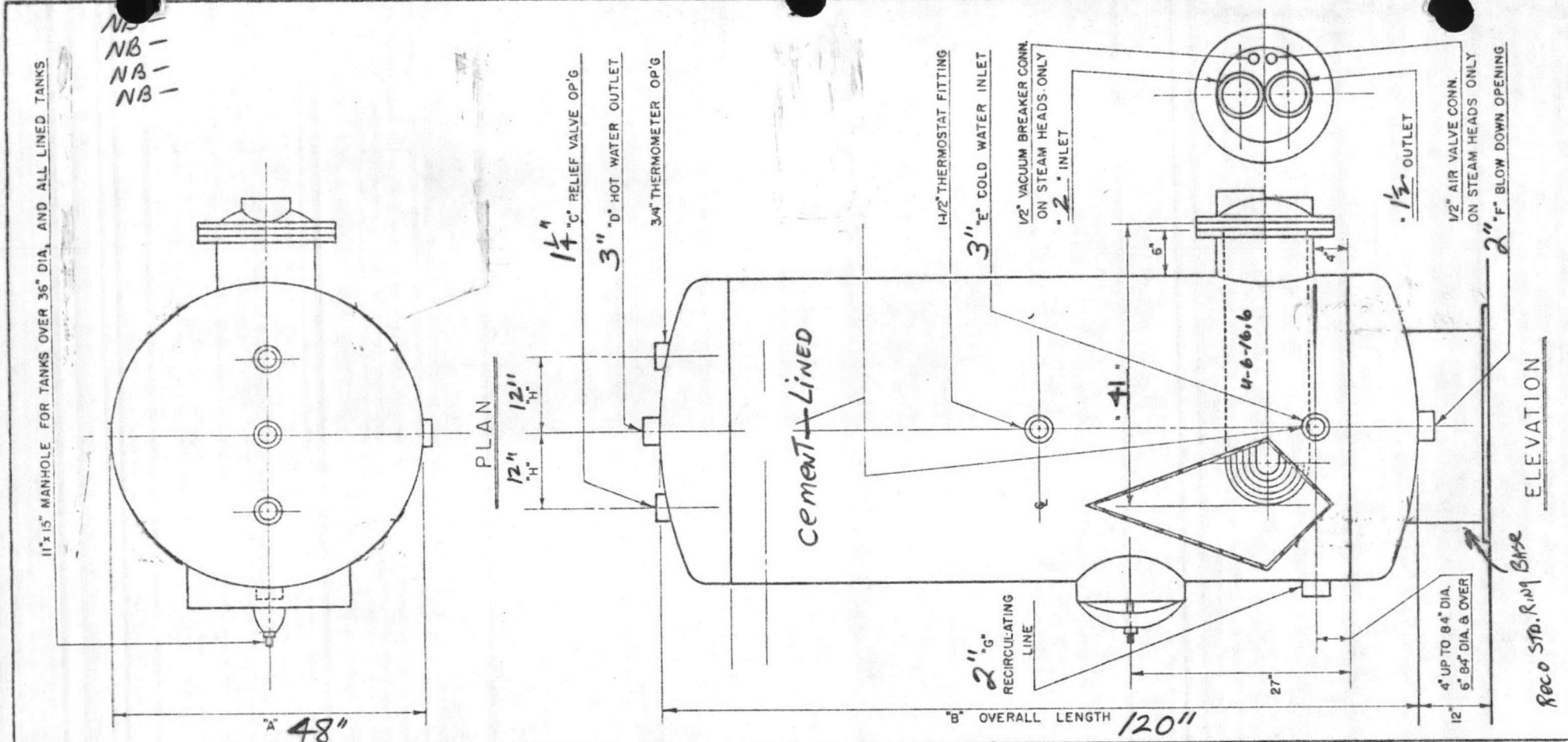
Pipe sizing is based on the type of heating system, pressure, and flow rate. Consult the ASHRAE guide for complete data. On hot water installations, the hot water supply and return lines must be of the same size.

The selection of proper traps and air vents is very important. Traps must be properly sized and orificed for the pressure involved and should be sized for a minimum of two times the maximum condensing rate of the unit heater. In case of doubt, consult the trap manufacturer.

VERTICAL HEATER-CODE

HEADS-5/16" SHELL-5/16" JE-70%

NB-
NB-
NB-
NB-



TANK DIMENSIONS IN INCHES

SYMBOL	A	B	C	D&E	F	G	H	ANGLE	BASE PL
RV18	18		3/4	1-1/4	1-1/4	1-1/4	6	2 x 2 x 1/4	4x4x5/16
RV24	24		3/4	1-1/4	1-1/4	1-1/4	6	2 x 2 x 1/4	4x4x5/16
RV30	30		3/4	2	1-1/4	1-1/4	8	2-1/2x2-1/2x1/4	6x6x3/8
RV36	36		1	2	1-1/2	1-1/2	8	2-1/2x2-1/2x1/4	6x6x3/8
~~RV42~~	~~42~~		~~1-1/4~~	~~3~~	~~2~~	~~2~~	~~12~~	~~3 x 3 x 3/8~~	~~6x6x3/8~~
RV48	48	120	1-1/4	3	2	2	12	3 x 3 x 3/8	6x6x3/8
~~RV54~~	~~54~~		~~1-1/2~~	~~4~~	~~2~~	~~2~~	~~12~~	~~3 x 3 x 3/8~~	~~6x6x3/8~~
RV60	60		1-1/2	4	3	3	12	4 x 4 x 1/2	6x6x1/2
RV66	66		1-1/2	4	3	3	12	4 x 4 x 1/2	6x6x1/2
RV72	72		1-1/2	4	3	3	12	4 x 4 x 1/2	6x6x1/2
RV78	78		1-1/2	4	3	3	12	4 x 4 x 1/2	6x6x1/2
RV84	84		2	6	4	4	12	4 x 4 x 1/2	6x6x1/2
RV90	90		2	6	4	4	12	5 x 5 x 1/2	6x6x1/2
RV96	96		2	6	4	4	12	5 x 5 x 1/2	6x6x1/2
RV									

REV:

1. NUMBER REQUIRED FOUR (4)
2. DESIGN PRESSURE 150#@200°F P. S. I.
3. TEST PRESSURE 225# P. S. I.
4. A.S.M.E. INSPECTED AND STAMPED VIII Div.1 WIN. 76
5. MATERIAL A515-70 CARBON STEEL
6. PAINT STEEL TANK EXTERIOR ONE COAT METAL PRIMER
7. INTERIOR LINING Cement
8. [redacted] OFFSET

REV:

ENGINEER

1. ELEMENT U-6-16.6 [3/4 O.D. & 18 BWG] SEAMLESS CU. TUBES. 2. HEATING SURFACE 16.6 SQ. FT.
3. HEATING CAPACITY 960 G. P. H.
4. TEMPERATURE RANGE 40 °F TO 140 °F
5. HEATING MEDIUM 25# STEAM

NOTE: A.S.M.E. CODE REQUIRES THAT FOR PRESSURES EXCEEDING 125 P.S.I., ALL CONNECTIONS OVER 3" I.P.S. [STATE OF CALIF., ALL OVER 2" I.P.S.] MUST HAVE FLANGED NOZZLES

REV:

RECO RICHMOND ENGINEERING CO.
Richmond, Virginia

VERTICAL STORAGE HEATER

CUSTOMER NOLAND CO. P.O. NO. 2601-E-58319
JOB SNEEDEN — CAMP LEJEUNE, N C
REPRESENTATIVE DOZIER CITY

JOB NO. S-0753 | DRAWN BY MLC
DATE 2-23-78 | APP'D BY

DRAWING NO. A-78-7531

C-59-395

HEAT TRANSFER SALES, INC.

P. O. BOX 11103
GREENSBORO, NORTH CAROLINA 27409
03-03-03

RE-- SUBMITTAL NO. 1360-3398

DATE MAY 3, 1978

[X] THIS ORDER IS BEING HELD FOR APPROVAL AND WILL NOT BE RELEASED UNTIL APPROVED.

[ ] THESE PRINTS ARE FOR YOUR RECORDS. ORDER HAS BEEN RELEASED PER PRINTS.

CONTRACTOR: SNEEDEN, INC.
BOX 3548
WILMINGTON, N.C. 28401

JOB: (4) 3 STORY B.E.Q'S
CAMP LEJEUNE, N.C.

ENGINEER:

QUAN.	EQUIPMENT LIST AND DESCRIPTION	ACTION TAKEN
	SECTION 15654-7	
	AIR CONTROL SYSTEM (1 REQUIRED)	
2	220 GALLON ASME EXPANSION TANKS	
2	1" TANK FITTINGS	
2	440 TANK DRAINERS	
1	AC-6F AIR SEPARATOR WITH STRAINER	
1	335 3/4" BRONZE PRV	
1	2" X 2" ASME RELIEF VALVE, 3,850,000 BTUH, SET 30 PSI	
1	489 3/4" VACUUM BREAKER.	
	SECTION 15654-4	
	PUMPS	
	P-1 CH.W. (1 REQUIRED)	
	TACO BB-4008, 4" BASE MOUNTED BALL BEARING PUMP.	
	510 GPM @ 155' HD, 30 HP, 460/3/60, 3500 RPM	
	74.5% EFFICIENCY.	
	P-2 H.W. (1 REQUIRED)	
	TACO BB-4006, 4" BASE MOUNTED BALL BEARING PUMP.	
	215 GPM @ 30' HD, 3 HP, 460/3/60, 1750 RPM,	
	72% EFFICIENCY.	
	CONDENSATE PUMPS	
	CP-1 (1 REQUIRED)	
	WEINMAN D20C-4AEV20 DUPLEX CONDENSATE PUMP.	
	4 GPM @ 60 PSI DISCHARGE 2 HP, 208/3/60, 3500 RPM.	
	20 GALLON CAST IRON RECEIVER FLOAT SWITCHES MECH.	
	ALTERNATOR, LESS STARTERS.	
	CP-2 (4 REQUIRED)	
	WEINMAN D20-4AEV30 DUPLEX CONDENSATE PUMP. 17 GPM	
	@ 60 PSI DISCHARGE, 3 HP, 460/3/60, 3500 RPM, 20	
	GALLON CAST IRON RECEIVER FLOAT SWITCHES MECH.	
	ALTERNATOR, LESS STARTER.	
	G.E. STARTER FOR ALL PUMPS.	
	SUCTION DIFFUSERS	
	FOR P-1 (1 REQUIRED)	
	TACO 355, 6" SYSTEM CONNECTION 4" PUMP CONNECTION.	
	FOR P-2 (1 REQUIRED)	
	TACO 354, 4" SYSTEM CONNECTION, 4" PUMP CONNECTION.	

HEAT TRANSFER SALES, INC.

P. O. BOX 11103
GREENSBORO, NORTH CAROLINA 27409
03-02-03

RE-SUBMITTAL NO. 1360-3398 PAGE 2

DATE MAY 3, 1978

☒ THIS ORDER IS BEING HELD FOR APPROVAL AND WILL NOT BE RELEASED UNTIL APPROVED.

☐ THESE PRINTS ARE FOR YOUR RECORDS. ORDER HAS BEEN RELEASED PER PRINTS.

CONTRACTOR: SNEEDEN, INC.
BOX 3548
WILMINGTON, N.C. 28401

JOB: (4) 3 STORY B.E.Q'S
CAMP LEJEUNE, N.C.

ENGINEER:

QUAN.	EQUIPMENT LIST AND DESCRIPTION	ACTION TAKEN

HEAT EXCHANGER
C-1 (1 REQUIRED)
TACO B12408SN HEAT EXCHANGER, 125 PSI ASME. 215 GPM 148° TO 180° WITH 2691 LBS/HR. OF 25 PSI STEAM. .0005 FOULING FACTOR. 3.7 FPS TUBE VELOCITY 1.0 P.D., 12" DIAMTER 4 PASS 5' LONG. LESS SADDLES 105.3 SQ.FT. HEATING SURFACE.

SOLAR PUMPS
P-5 (4 REQUIRED)
TACO 1641-C, 2" IN-LINE PUMP. 120 GPM @ 45' HD, 3 HP, 208/3/60, 1750 RPM.

CIRCUIT SETTERS

790	1/2"
791	3/4"
792	1"
793	1-1/4"
794	1-1/2"
795	2"

TRERICE BX93403-1/2, 9" SCALE ORGANIC RED READING " EVERYANGLE" THERMOMETER. 3-1/2" STEM WITH BRASS WELL. 30° TO 240° RANGE.

TRERICE NO. 601, 4-1/2" DIAL PRESSURE GAUGE, 1/4" BOTTOM CONNECTION. RANGES AS REQUIRED.

1/4" BRASS HEAVY DUTY, "T" HANDLE GAUGE COCKS

1/4" IRON PIGTAIL SIPHON.

10 SETS OF SUBMITTAL DATA FOR YOUR APPROVAL.

SUBMITTAL DATA

ASME EXPANSION TANKS

NUMBER
SD 400-3

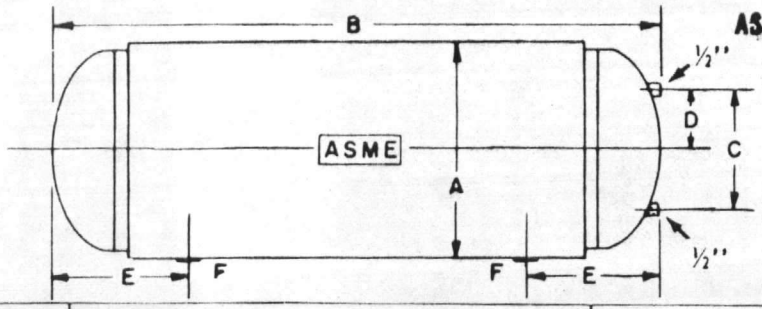
Effective: May 2, 1977
Supersedes: SD 400-3
dated 11/10/72

Taco ASME Tanks are ASME and National Board Stamped.

FINISH: Std. Finish Red Oxide Paint.
OPTIONAL: Hot Dipped Galvanized.
Gauge Glass Tappings – Std. Equipment.

JOB: (4) 3 STORY B.E.Q.'S
CAMP LEJEUNE, N.C.
DATE SUBMITTED: 5-3-78 BY: M.J.
Location
Size
220 GAL.
AIR CONTROL SYSTEM

ASME-STAMPED WITH NAT. BD. NO.



CAP. IN GALS.	DIMENSION IN INCHES						WEIGHT IN LBS.	
	A	B	C	D	E	F	PAINTED	GALVANIZED
15	12	33	8	4	7 3/4	1	45	50
18	12	39	8	4	7 3/4	1	50	60
24	12	52	8	4	7 3/4	1	63	70
30	14	48	10	5	8 1/2	1	65	73
40	14	63	10	5	8 1/2	1	83	93
60	16	72	12	6	9 1/4	1	113	127
80	20	63	16	8	10	1	130	145
100	20	78	16	8	10	1	162	181
120	24	65	20	10	11 1/8	1	195	215
135	24	72	20	10	11 1/8	1	215	235
180	30	62 1/4	22	11	13 1/2	1 1/2	295	318
220	30	77	22	11	13 1/2	1 1/2	355	383
240	30	81	22	11	13 1/2	1 1/2	385	415
310	30	105 3/4	22	11	13 1/2	1 1/2	480	517
300	36	71 1/4	28	14	15	1 1/2	485	515
400	36	93 1/2	28	14	15	1 1/2	634	675
515	36	120 3/4	28	14	15	1 1/2	789	840
550	42	97	17		16 3/8	2	834	882

Specifications

Taco ASME Tanks are constructed to the ASME Code for Unfired Pressure Vessels

Working Pressure ..... 125 PSI
Maximum Recommended Temperature ..... 375 F
Tanks are inspected and labeled by Authorized Insurance and Inspection Service
Gauge Glass Tappings — Standard Equipment

TACO, Inc., 1160 Cranston Street, Cranston, Rhode Island 02920 U.S.A. Tel: (401) 942 8000 Telex: 92 7627
Taco Heaters of Canada, Ltd., 3090 Lenworth Drive, Mississauga, Ontario Tel: (416) 625-2160 Telex: 06-961179

ARMSTRONG

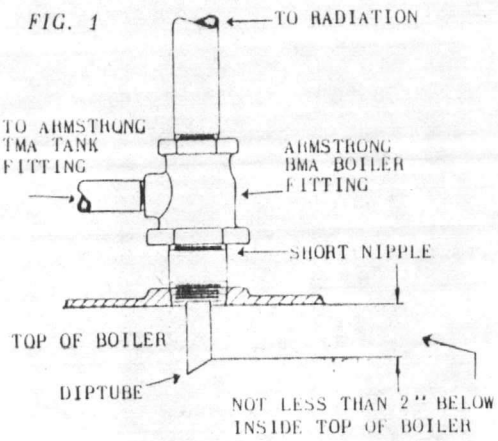
AIR CONTROL DEVICES FOR HYDRONIC SYSTEMS

FILE NO.: 5011.90
DATE: Feb. 28/69
SUPERSEDES: 5011.90
DATE: Oct. 24/66

ARMSTRONG BMA BOILER FITTING

Armstrong BMA Boiler Fittings are made in sizes 1" through 4". The size selected should be the same as the supply main at the boiler. The Armstrong Boiler Fitting is designed to remove the air at the point of release - the boiler.

FIG. 1



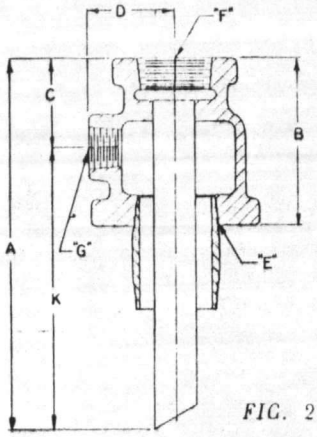


FIG. 2

All dimensions in inches

UNIT NO.	A	B	C	D	PIPE THREAD E	PIPE THREAD F	PIPE THREAD G	K
BMA 1	10½	4	2⅛	1 5/16	2	1	¾	7
BMA 1¼	10½	4	2⅛	1 5/16	2	1¼	¾	7
BMA 1½	10½	4	2⅛	1 5/16	2	1½	¾	7
BMA 2	12½	4½	2½	2½	3	2	¾	8¼
BMA 2½	12½	4½	2½	2½	3	2½	¾	8¾
BMA 3	14½	4⅝	2¾	3	4	3	¾	10¼
BMA 4	15⅝	4¾	2½	4⅛	6	4	1¼	11¾

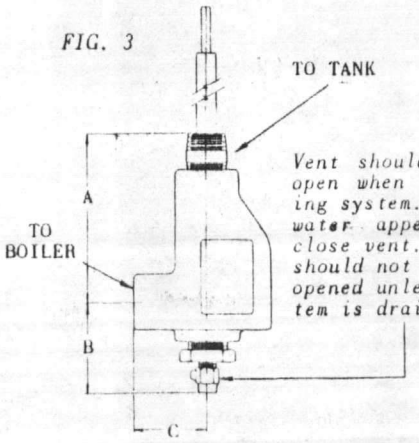
INSTALLATION NOTE

When installing Armstrong BMA Boiler Fittings, care should be taken to ensure that diptube does not strike any obstruction in boiler. If standard diptube is too long for insertion in boiler, diptube may be cut to suit. Diptube must always be installed below inside top of boiler. See Fig. 1.

ARMSTRONG TMA TANK FITTING

The Armstrong Tank Fitting is designed to maintain the correct amount of air in the expansion tank. When selecting the Armstrong Tank Fitting it is important that the diameter of the expansion tank be known and a Tank Fitting be selected to suit as follows: -

FIG. 3



SIZE	TANK DIAMETER	CONNECTIONS - NPT TO TANK	CONNECTIONS - NPT TO BOILER	A	B	C
TMA-9	9"					
TMA-12	12, 13 or 14"					
TMA-16	16"					
TMA-18	18"	1/2"	3/4"	3-1/2"	2"	1-5/8"
TMA-20	20"					
TMA-24	24"					
TMA-L	48*	1"	1-1/4"	4-1/2"	2-3/4"	2"

* *TMA-L may be used for smaller diameter tanks. Cut tubing on installation to length equal to 2/3 diameter of tank.*

PIPE SIZING FROM BOILER TO TMA TANK FITTING		
DISTANCE OF HORIZONTAL PIPE FROM BOILER TO FURTHEST TANK		
UNDER 7 FT.	OVER 7 FT. UNDER 20 FT.	OVER 20 FT. UNDER 40 FT.
¾"	1"	1¼"

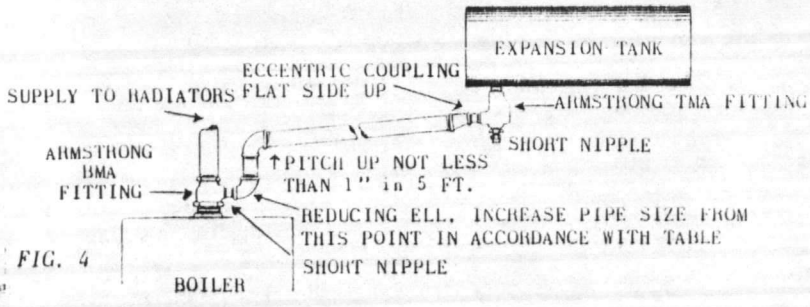


FIG. 4

CAUTION:- When using several Armstrong Boiler Fittings on one boiler, only one Boiler Fitting should be connected to a Tank Fitting. Expansion tank connections on remaining Boiler Fittings must be plugged.

FORM NO. 6132A

Taco

SUBMITTAL DATA

NUMBER

SD 100-8

TANK DRAINER

EFFECTIVE: JUNE 1, 1967

Supersedes: SD100-8 dated 4/10/62

Purpose

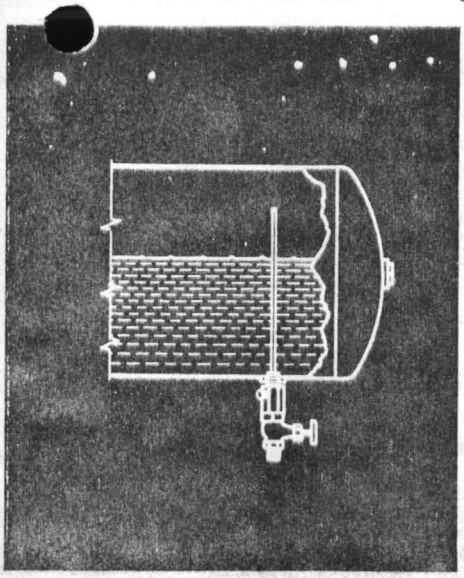
Designed for fast draining of water from water - logged Expansion Tanks.

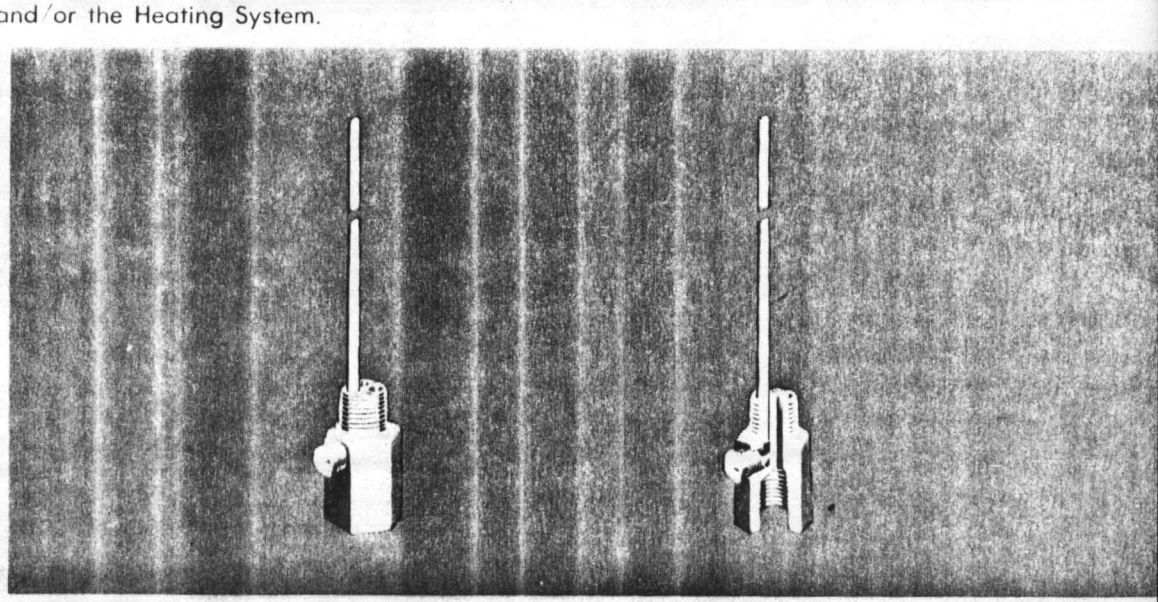
Features

- **Low Cost**
- **Quick Air Charging**
- **Easily installed**
- **All brass body**
- **11" 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.





Specification, Size & Dimensions

PRODUCT NUMBER	SIZE. CONN'S.	APPROX. SHIP WHT. LBS.		DIA. INS.	LGTH. INS.
		EACH	12 PCS.		
440	N.P.T.	10 Oz.	8	1⅛"	13

TACO, INC.

1160 Cranston Street
Cranston
Rhode Island 02920

Taco Heaters of Canada, Ltd.
3090 Lenworth Drive
Cooksville, Ontario

Taco

SUBMITTAL DATA

AIR CONTROL

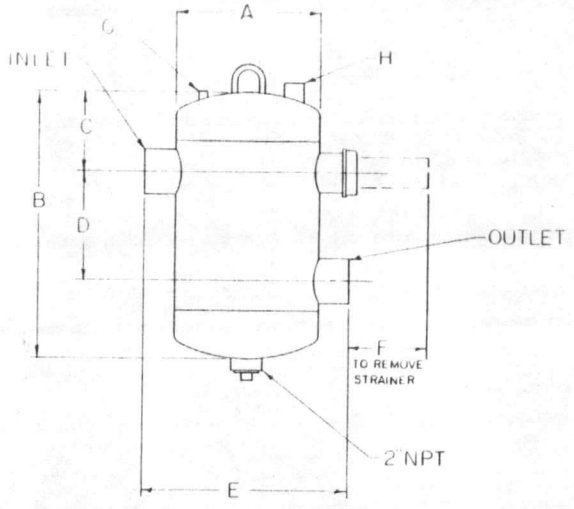
NUMBER
SD 400-2

Effective: March 15, 1977
Supersedes: SD400-2
dated 4/1/1975

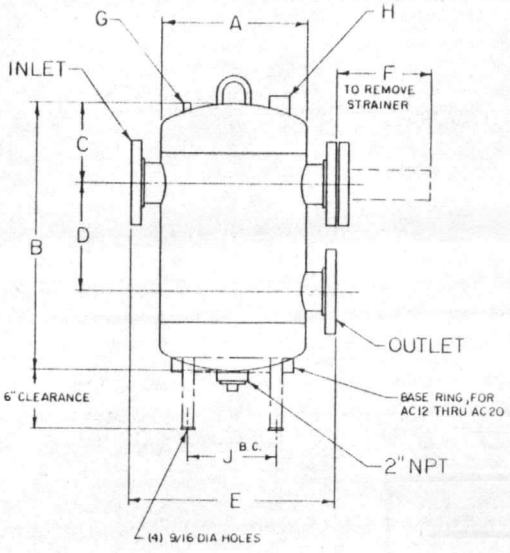
FOR: SNEEDEN, INC.
WILMINGTON, N.C.
JOB: (4) 3 STORY B.E.Q's
CAMP LEJEUNE, N.C.

LOCATION:	PRODUCT NO.	SIZE:
AIR CONTROL SYS.	AC-6F	6"

PURPOSE: THE TACO AIR CONTROL CONTINUOUSLY REMOVES EXCESS AIR FROM LARGE HYDRONIC HEATING AND COOLING SYSTEMS.



AC2F-AC25F



AC3F-AC20F

ASME-STAMPED WITH NAT. BD. NO.

PIPE SIZE inches	PRODUCT NO. less strainer	PRODUCT NO. with strainer	A	B Max	C	D	E	F	G	H	J	MAX FLOW (gpm)	STRAINER FREE AREA (sq.in.)	NO STRAINER C_v FACTOR	STRAINER C_v FACTOR	APPROX. SHIPPING WT. less strainer	APPROX. SHIPPING WT. with strainer
2	AC2	AC2F	8.625	18	6	5.38	12.75	13	¼"NPT	¾"NPT		80	22	86	72	46	48
2½	AC25	AC25F	10.750	20	7	5.88	15.75	16	¼"NPT	¾"NPT		130	34	122	102	72	78
3	AC3	AC3F	12.750	27	8	10.50	18.00	18	¼"NPT	1¼"NPT		190	51	190	162	100	122
4	AC4	AC4F	14	29	8	12.00	20.00	19	¼"NPT	1¼"NPT		330	80	325	272	110	141
5	AC5	AC5F	16	32	9.5	13.00	23.00	22	¼"NPT	1¼"NPT		550	112	510	422	162	200
6	~~AC6~~	AC6F	20	37	11	14.00	27.00	26	¼"NPT	1¼"NPT		900	180	740	618	200	243
8	AC8	AC8F	20	41	12.4	16.50	31.00	28	¼"NPT	1¼"NPT		1500	246	1260	1060	290	358
10	AC10	AC10F	26	45	13	19.00	34.00	32	¼"NPT	1¼"NPT		2600	392	2000	1670	425	520
12	AC12	AC12F	30	54	16	22.00	40.50	37	½"NPT	1½"NPT	22	3400	548	2900	2400	825	1050
14	AC14	AC14F	36	63	19½	24.00	46.50	43	½"NPT	1½"NPT	24	4700	732	3500	2850	950	1230
16	AC16	AC16F	36	67	20½	26.50	49.00	44	½"NPT	1½"NPT	24	6000	845	4600	3800	1210	1570
18	AC18	AC18F	42	76	24	28.00	55.50	51	½"NPT	1½"NPT	30	8000	1125	5900	4900	1775	2200
20	AC20	AC20F	48	87	28	30.50	62.00	58	½"NPT	1½"NPT	36	10,000	1435	7400	6200	2600	3200

TACO HEATERS OF CANADA, LTD.
3090 Lenworth Drive
Mississauga, Ontario

Taco, Incorporated, 1160 Cranston Street, Cranston, Rhode Island 02920

printed in U.S.A.

Taco

SUBMITTAL DATA

NUMBER
SD 100-1

Effective: June 15, 1976
Supersedes: SD 100-1
dated 10/31/73

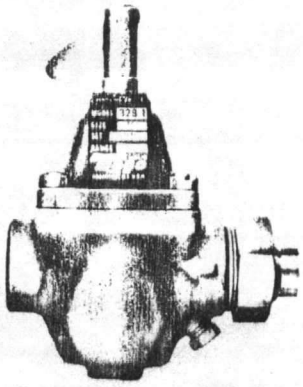
REDUCING VALVES RELIEF VALVE DUAL CONTROL

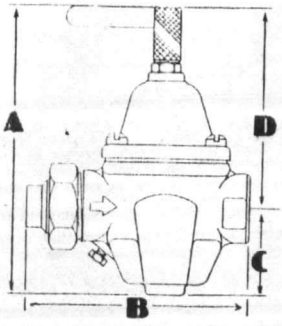
Nos. 329 & 335 REDUCING VALVES

PURPOSE: Automatically feeds water to a hot water heating system whenever pressure in the system drops below the pressure setting of the valve.

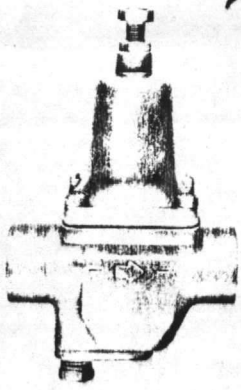
FEATURES:
- Fast fill rate on model 329
- Built-in check to prevent emptying system if incoming pressure fails. Also permits strainer cleaning without emptying system.
- Non-sticking, hi-temp discs.
- Hi-temp, reinforced diaphragms

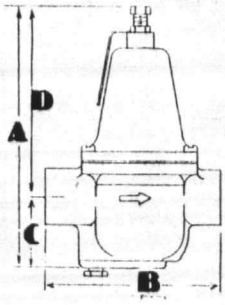
No. 329





No. 335





Product No.	Material	Size & Type Connections	Maximum Pressure	Maximum Temperature	Dimensions A	B	C	D	Shipping Wt/lb Ea.	Ctn.
3	Cast Iron	½"NPT & Sweat	200 psig	200°F	5 15/16	4 1/16	1 5/8	4 5/16	2 1/4	27
335	Brz.	¾" NPT	200 psig	200°F	6 1/2	3 29/32	1 5/8	4 7/8	3 1/8	22

Incorporated 1160 Cranston Street, Cranston, Rhode Island 02920 Telephone [401] 942-8000 Telex: 92-7627

Litho in U.S.A.

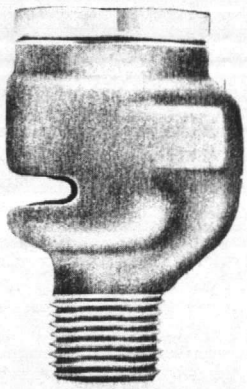
Taco Heaters of Canada, Ltd. 3090 Lenworth Drive, Mississauga, Ontario Telephone [416] 625-2160 Telex: 06-961179

SUBMITTAL DATA

NUMBER
SD-100-11

Effective: June 15, 1976
Supersedes: NEW

STEAM & HOT WATER VACUUM RELIEF VALVE



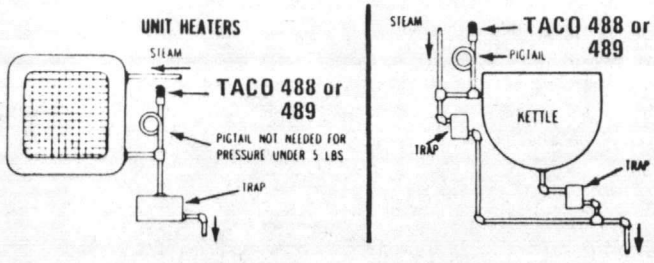
FOR LOW PRESSURE STEAM SERVICE –

An effective control for preventing excessive vacuum conditions in steam heating and steam processing systems. When the supply line is shut off, steam condenses and a vacuum can be created which not only affects system operation, but can also cause damage to the equipment. Taco 488 & 489 Vacuum Relief Valves protect against this hazard by automatically admitting air to the system, thereby breaking the vacuum. Used on jacketed kettles, unit heaters and low pressure steam heating systems,

MAXIMUM TEMPERATURE – 250°F

MAXIMUM PRESSURE – 15 psi (steam)

VENTING CAPACITY – No. 488 = 13.5 cfm
No. 489 = 21.5 cfm

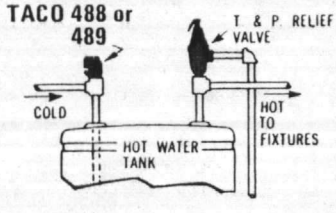


FOR HOT WATER SERVICE –

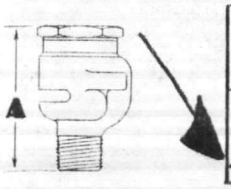
Automatically vents a system if vacuum occurs. Opens at less than ½" vacuum. Design features a dry guide which is located out of the water and away from corrosion. Construction is bronze body with silicone disc.

MAXIMUM WATER PRESSURE – 200 psig

MAXIMUM TEMPERATURE – 250°F



NOTE: Vacuum relief valves are not designed or approved for use as back-siphonage backflow preventers.



Product No.	Size	Shipping Wt. lb.	Venting Capacity	Dimensions		Maximum Pressure H_2O	Maximum Temp. H_2O	Maximum Press. Steam
				A	Width			
488	½"	3/8 lb.	13.5 cfm	2½"	1¾"	200 lb.	250°F	15 psig
489	¾"	3/4 lb.	21.5 cfm	2	1¾"	200 lb.	250°F	15 psig

Taco, Incorporated 1160 Cranston Street, Cranston, Rhode Island 02920 Telephone [401] 942-8000 Telex: 92-7627

Litho in U.S.A.

Taco Heaters of Canada, Ltd. 3090 Lenworth Drive, Mississauga, Ontario Telephone [416] 625-2160 Telex: 06-961179

BASE MOUNTED and CLOSE COUPLED PUMPS 4008 1750-3450 RPM

SD 300-3-21

EFFECTIVE: JULY 31, 1974 SUPERSEDES: SD 300-3-21 dated 10/31/72

JOB: (4) 3 STORY B.E.Q.'S CAMP LEJEUNE, N.C.

DATE SUBMITTED: 5-3-78 BY: M.J.

Location	Model No.	Pumpsize	Impeller Size	GPM	Head	Voltage	Phase
CH.W.	BB-4008	4"		510	155'	460/3/60	

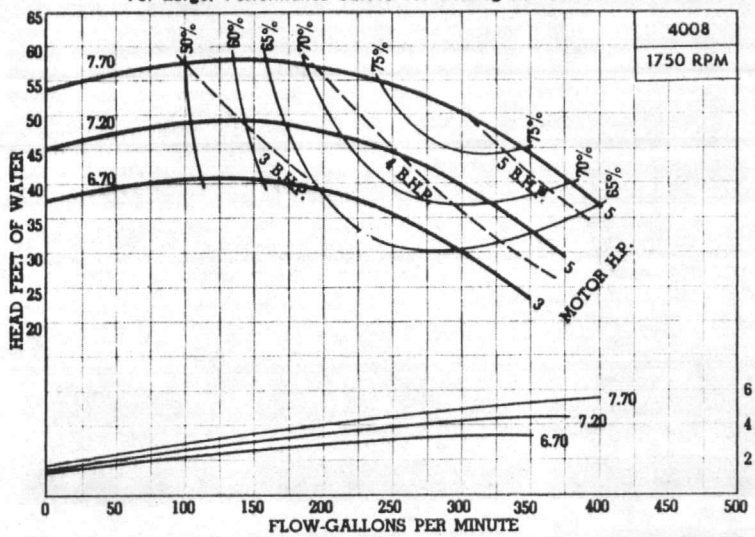
SPECIFICATIONS

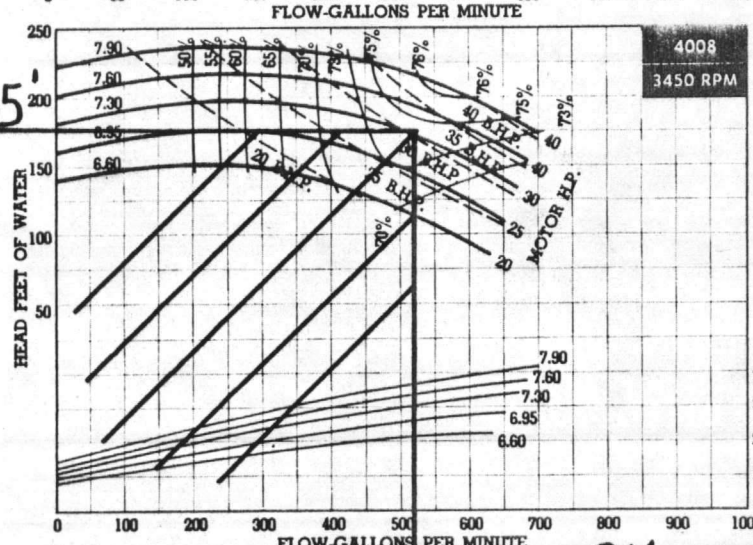
Description	STANDARD CONSTRUCTION: Ball Bearing	Sleeve Bearing	Close Coupled	OPTIONS
Frame	Ball Bearing	Sleeve Brng.	———	———
Coupler	4 Way Flex	4 Way Flex	———	———
Baseplate	Structural Steel	Structural Steel	———	———
Shaft-Pump	Alloy Stl	Alloy Stl	Alloy Stl (Mtr. Shaft)	☐ Stainless* Steel
Mech. Seal	Permalife 1 (250F)	Permalife 1 (250F)	Permalife 1 (250F)	Permalife 2* ☐ (300F)
Stuffing Box	250F	———	250F	☐ Yes
Bronze Gland w/ S.S. Studs & Nuts	with Stuff Box	with Stuff Box	with Stuff Box	———
Shaft Sleeve	Cupro Nickle	Cupro Nickle	Cupro Nickle	☐ St. Steel w/Stuff Box
Impeller	Cast Iron	Cast Iron	Cast Iron	☒ Cast Brz.
Special Imp. Cut	———	———	———	☐ Yes .....
Motor, O.D.P. 60 cycle, 3 phase 230/460	☐ 1750 BB ☒ 3450 BB	1750 SB	☐ 1750 BB ☐ 3450 BB	☐
Purocell Filter	———	———	———	☐ YES*
Coupler Guard	———	———	———	☐ YES*
Brz. Const.	———	———	———	☐ YES*
Comp. Flanges ASA	———	———	———	☐ YES*
Bronze Wear Ring	———	———	———	☐ YES*
Working Pressure / Test Pressure	175PSI** 250 PSI	175PSI** 250 PSI	175PSI** 250 PSI	———

*Not Included in Standard Cost

**In accordance with ASA B16.1

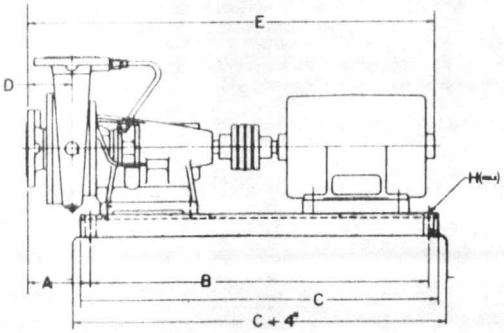
For Larger Performance Curves See Catalog No. 300-3-1

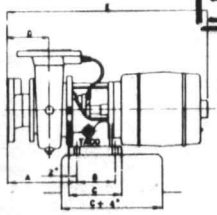


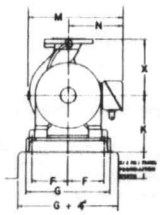


155

SIZES AND DIMENSIONS







510 GPM

	Product No.	Motor RPM	Motor HP	Suction & Dis. Conn.	G	C	K	F	B	J	H	A	D	N	M	E
Base Mounted	SB 4008 BB 4008	1750	3 5	4	18	33	11⅞	7¹⁵⁄₁₆	31	4	⅝	9¹⁵⁄₁₆	6	9½	7²⁷⁄₃₂ 7³¹⁄₃₂	16²⁷⁄₃₂ 16³¹⁄₃₂	42
	BB4008	3500 3450	20 25 30 40	4	18	41	11⅞	7¹⁵⁄₁₆	39	4	⅝	9¹⁵⁄₁₆	6	9½	10¼ 10¼ 10¹³⁄₁₆ 10¹³⁄₁₆	16¾ 19¹³⁄₁₆ 19¹³⁄₁₆ 19¹³⁄₁₆	50 50 50 51⅜
CLOSED COUPLED	CC4008	1750	3 5	4	12	6¼	7⅞	5¼	4½	1¼	⅝	9¾	6	9½	7	13⅞	25¼ 26¼
	CC4008	3450	20 25 30 40	4	14	13	10	6	10¾	1¼	⅝	9¾	6	9½	10¼ 10¼ 10¹³⁄₁₆ 10¹³⁄₁₆	16¹³⁄₁₆ 16¹³⁄₁₆ 17¹¹⁄₁₆ 17¹¹⁄₁₆	31¾ 32½ 33¼ 34¾

TACO HEATERS OF CANADA, LTD.
3090 Lenworth Drive, Mississauga, Ontario

TACO, Inc., 1160 Cranston St., Cranston, R.I. 02920

printed in U.S.A.

BASE MOUNTED and CLOSE COUPLED PUMPS

4006

1750-3450 RPM

SUBMITTAL DATA

SD 300-3-20

EFFECTIVE: JULY 31, 1974 SUPERSEDES: SD 300-3-20 dated 10/31/72

JOB: (4) 3 STORY B.E.Q.'s CAMP LEJEUNE, N.C.

DATE SUBMITTED: 5-3-78 BY: M.J.

Location	Model No.	Pumpsize	Impeller Size	GPM	Head	Voltage	Phase
H.W.	BB-4006	4"		215	30'	460	3/60

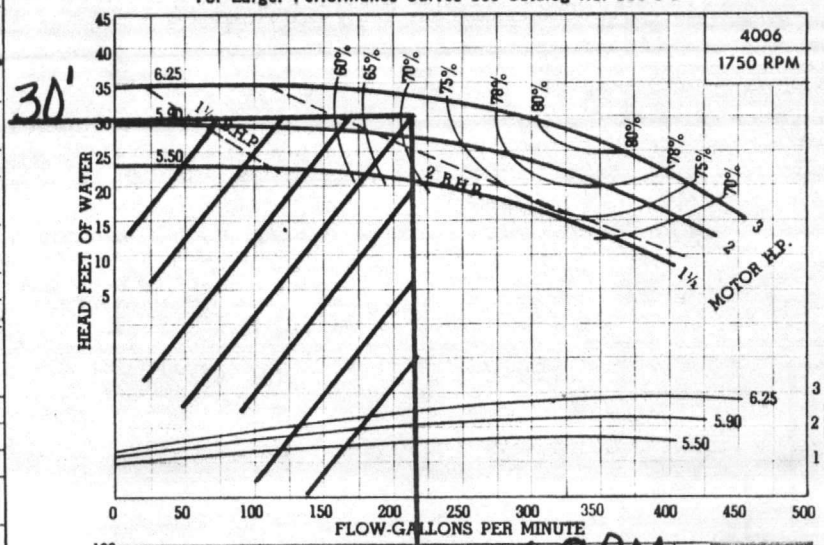
SPECIFICATIONS

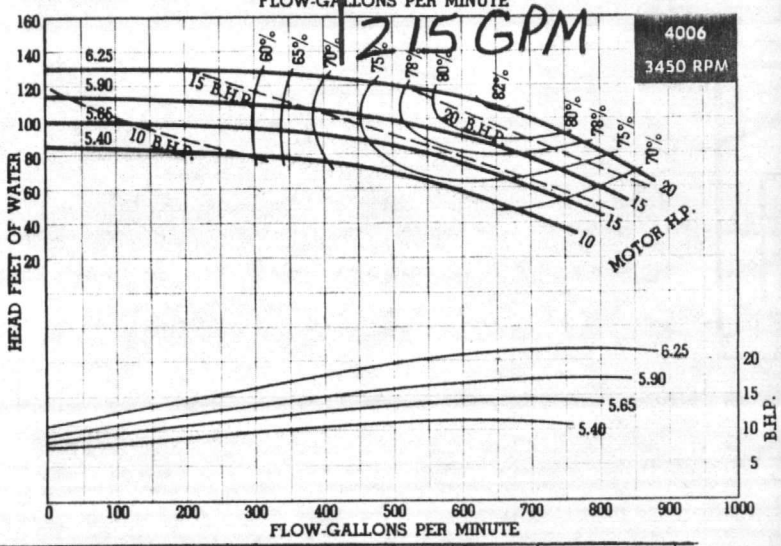
Description	STANDARD CONSTRUCTION: Ball Bearing	Sleeve Bearing	Close Coupled	OPTIONS
Frame	Ball Bearing	Sleeve Brng.	———	———
Coupler	4 Way Flex	4 Way Flex	———	———
Baseplate	Structural Steel	Structural Steel	———	———
Shaft-Pump	Alloy Stl	Alloy Stl	Alloy Stl (Mtr. Shaft)	☐ Stainless* Steel
Mech. Seal	Permalife 1 (250F)	Permalife 1 (250F)	Permalife 1 (250F)	Permalife 2* ☐ (300F)
Stuffing Box	250F	———	250F	☐ Yes
Bronze Gland w/ S.S. Studs & Nuts	with Stuff Box	with Stuff Box	with Stuff Box	———
Shaft Sleeve	Cupro Nickle	Cupro Nickle	Cupro Nickle	☐ St. Steel w/Stuff Box
Impeller	Cast Iron	Cast Iron	Cast Iron	☒ Cast Brz.
Special Imp. Cut	———	———	———	☐ Yes .....
Motor, O.D.P. 60 cycle, 3 phase 230/460	☒ 1750 BB ☐ 3450 BB	1750 SB	☐ 1750 BB ☐ 3450 BB	☐
Purocell Filter	———	———	———	☐ YES*
Coupler Guard	———	———	———	☐ YES*
Brz. Const.	———	———	———	☐ YES*
Comp. Flanges ASA	———	———	———	☐ YES*
Bronze Wear Ring	———	———	———	☐ YES*
Working Pressure Test Pressure	175PSI** 250 PSI	175PSI** 250 PSI	175PSI** 250 PSI	——— ———

*Not included in Standard Cost

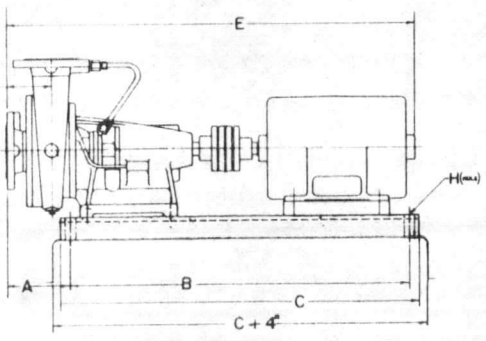
**In accordance with ASA B16.1

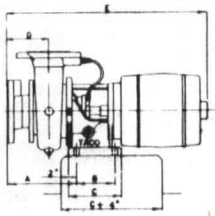
For Larger Performance Curves See Catalog No. 300-3-1

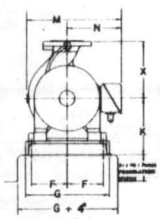




SIZES AND DIMENSIONS







	Product No.	Motor RPM	Motor HP	Suction & Dis. Conn.	G	C	K	F	B	J	H	A	D	X	N	M	E
Base Mounted	SB 4006 BB 4006	1750	1½ 2 3	4	12	27¾	9½	4¾	26²⁄₃₂	3	⅝	8¾	5½	8½	6¹³⁄₁₆ 6¹³⁄₁₆ 7²²⁄₃₂	12¹³⁄₁₆ 12¹³⁄₁₆ 13²⁷⁄₃₂	35¾ 35¾ 36⅞
	BB4006	3450	10 15 20	4	13	35⅜	10½	5¼	33⅞	4	⅝	8¾	5½	8½	8½ 8½ 10¼₆	15 15 16⁹⁄₁₆	43⅜
CLOSED COUPLED	CC4006	1750	1½ 2 3	4	12	6¼	6½	5¼	4½	1	⅝	9¼₆	5½	8½	6 6 7	12³⁵⁄₆₄ 12³⁵⁄₆₄ 13³⁵⁄₆₄	24³⁄₃₂ 24³⁄₃₂ 25³⁄₃₂
	CC4006	3450	10 15 20	4	12 12 14	6¼ 6¼ 13	6½ 6½ 10	5¼ 5¼ 6	4½ 4½ 10¾	1 1 1¼	⅝ ⅝ ¾	8¹⁵⁄₁₆	5½	8½	8¹³⁄₁₆ 8¹³⁄₁₆ 10¼₆	15¾ 15¾ 16¹⁹⁄₃₂	27⁴¹⁄₆₄ 29⁹⁄₆₄ 31²³⁄₆₄

TACO HEATERS OF CANADA, LTD.
3090 Lenworth Drive, Mississauga, Ontario

TACO, Inc., 1160 Cranston St., Cranston, R.I. 02920

printed in U.S.A.

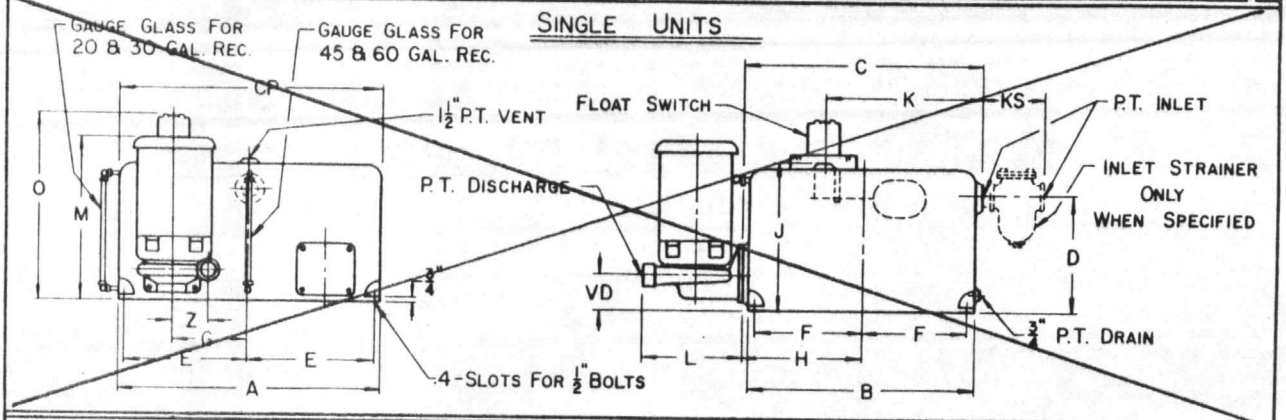
weinman pump company
290 Spruce Street Columbus, Ohio 43215 (614) 221-6351

Types "ACV, ADV, AEV, AFV" Condensate Units With Cast Iron Receivers

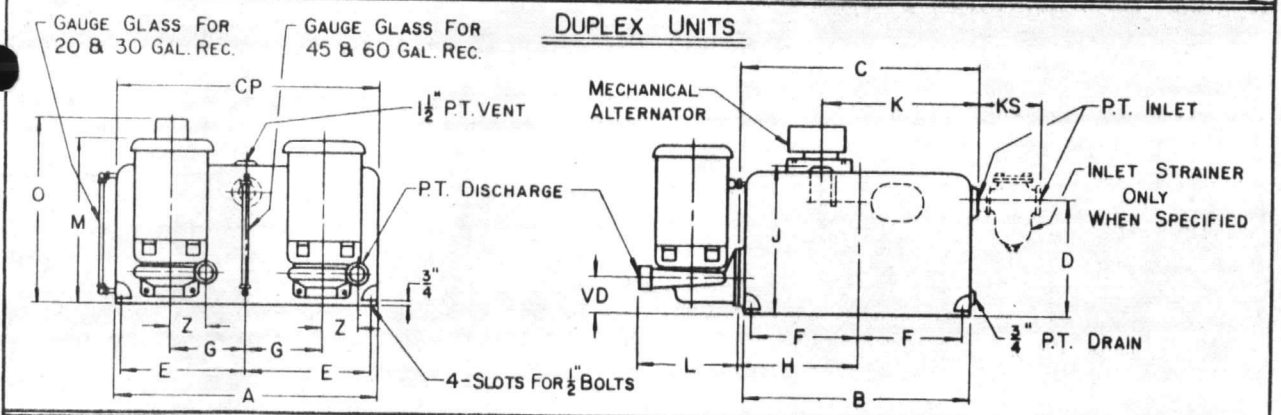
MODEL NO. D20C-4AEV20 SINGLE OR DUPLEX
PUMP RECEIVER SIZE 20 GAL.
EDR 60 PSI 2 HP
3500 RPM PH. CY. VOLTS

PUMP NO. CP-1 D20C-4AEV20
FOR: (4) 3 STORY B.E.Q'S
CERT. BY DATE

SINGLE UNITS



DUPLEX UNITS



REC. GAL.	INLET	A	B	C	CP	D	E	F	G	H	J	K	KS	O
* 20C	2	24	16¾	18	24	10	10½	7½	6	9	13⅜	13⅜	6½	19¼
* 30C	2½	24	25½	26¾	24	10	10½	11⅞	6	13⅜	13⅜	13⅜	7¾	19¼
45C	3	36	25	26¼	36	10	16½	11⅝	8	13⅛	13⅞	18⅝	8¾	19¾
67C	3	36	36	37¼	36	10	16½	17⅛	8	18⅝	13⅞	18⅝	8¾	19¾

PUMP	DIS.	M	L	VD	Z
4ACV	1	16¾	9¼	2⅝	3¼
4AEV	1	22¾	11	3½	4
6ACV	1½	23⅛	11	3⅜	3¾
6ADV	1½	26⅞	12¾	3⅜	5¼
6AFV	1½	28⅝	16	4¾	6¾

* 6AFV DUPLEX UNITS NOT AVAILBLE ON 20 & 30 GAL. RECEIVERS

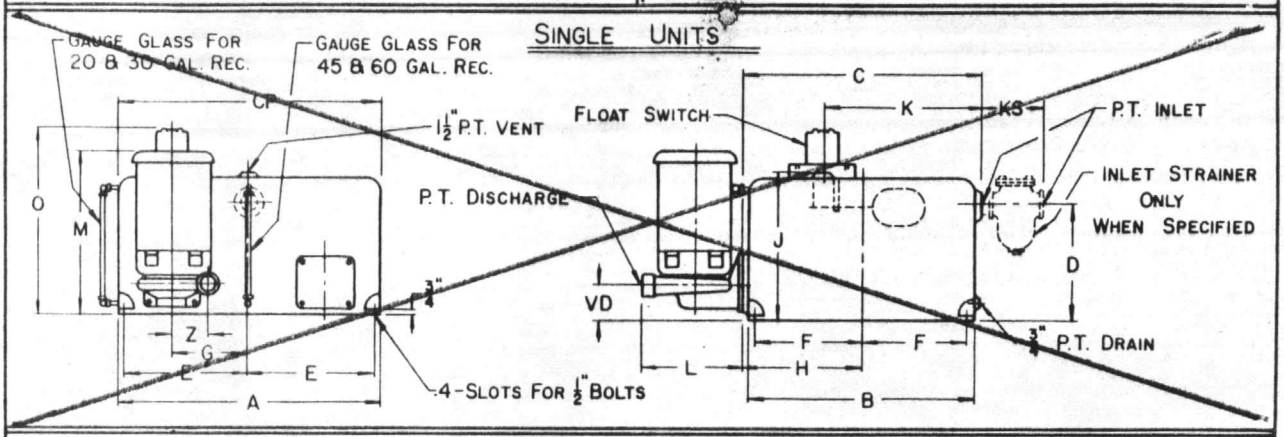
weinman pump company
290 Spruce Street Columbus, Ohio 43215 (614) 221-6351

Types "ACV, ADV, AEV, AFV" Condensate Units With Cast Iron Receivers

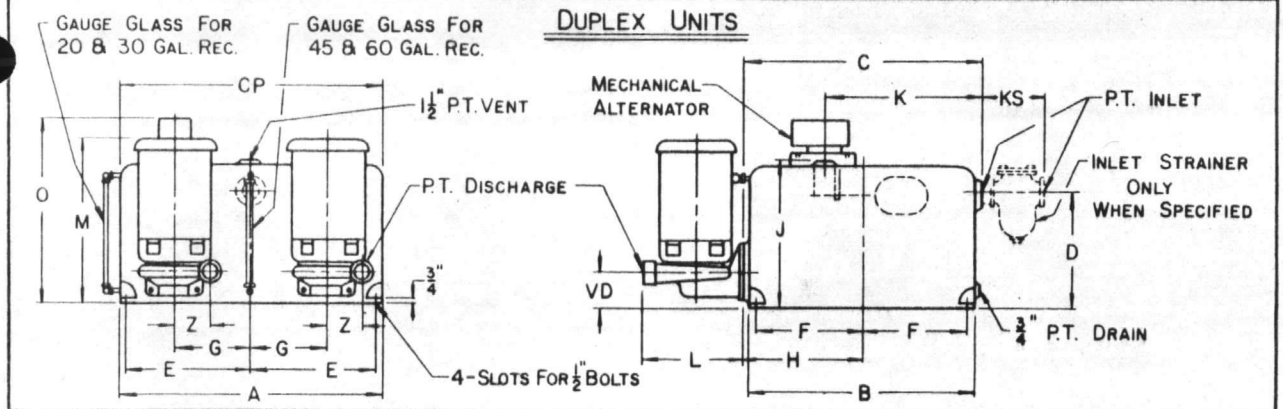
MODEL NO. D20-4AEV30 SINGLE OR DUPLEX
PUMP RECEIVER SIZE 20 GAL.
EDR 60 PSI 3 HP
3500 RPM PH. CY. VOLTS

PUMP NO. CP.Z D20-4AEV30
FOR: (4) 3 STORY B.E.Q'S
CERT. BY DATE

SINGLE UNITS



DUPLEX UNITS



REC. GAL.	INLET	A	B	C	CP	D	E	F	G	H	J	K	KS	O
* 20C	2	24	16¾	18	24	10	10½	7½	6	9	13⅜	13⅜	6½	19¼
* 30C	2½	24	25½	26¾	24	10	10½	11⅞	6	13⅜	13⅜	13⅜	7¾	19¼
45C	3	36	25	26¼	36	10	16½	11⅜	8	13⅛	13⅞	18⅜	8¾	19¾
67C	3	36	36	37¼	36	10	16½	17⅛	8	18⅜	13⅞	18⅜	8¾	19¾

PUMP	DIS.	M	L	VD	Z
4ACV	1	16¾	9¼	2⅜	3¼
4AEV	1	22¾	11	3½	4
6ACV	1½	23⅛	11	3⅜	3¾
6ADV	1½	26⅞	12¾	3⅜	5¼
6AFV	1½	28⅝	16	4¾	6¾

* 6AFV DUPLEX UNITS NOT AVAILBLE ON 20 & 30 GAL. RECEIVERS

Taco

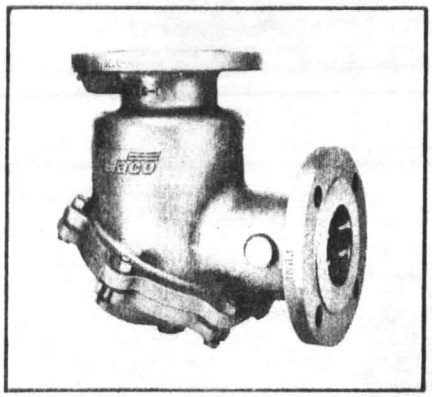
SUBMITTAL DATA

SUCTION DIFFUSER

NUMBER

SD-400-5

Effective: April 10, 1975
Supersedes: SD 400-5
dated 3/9/73



FEATURES

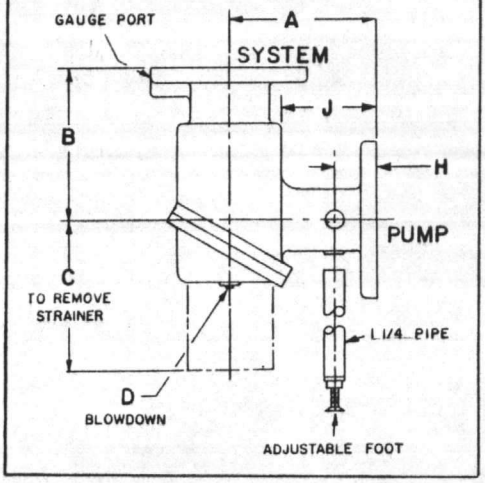
DIFFUSER - Provides ideal flow conditions for pump inlet. Protects the pump with minimum pressure loss.

START UP STRAINER - A disposable fine mesh strainer can be specified that is removable without loss of protection of the larger perforations in the suction diffuser.

FLOW - Direction is such that foreign material is trapped inside the strainer for easy cleaning and removal.

PIPE SUPPORT - Just cut a piece of pipe (without threads) to the approximate length; insert support foot and adjust the load for greater pump alignment and protection.

DIMENSION DRAWING



MODEL	SYSTEM	PUMP	C.V. Factor	Free Area Sq. In.	DIMENSIONS						Ship. Wgt. Lbs.
					A	B	C	D	H	J	
350	3 Flg.	2 Flg.	110	40	7 1/16"	7 3/8"	8 1/4"	3/4"	2 3/8"	4 5/8"	45
351	3 Flg.	2 1/2 Flg.	110	40	7 1/16	7 3/8	8 3/4	3/4	2 3/8	4 5/8	45
352	3 Flg.	3 Flg.	200	50	7 1/8	7 3/8	8 1/4	1	2 1/16	4 1/8	57
353	4 Flg.	3 Flg.	200	50	7 1/8	7 3/8	8 1/4	1	2 1/16	4 1/8	62
354	4 Flg.	4 Flg.	350	80	9 5/16	7 1/4	9 1/2	1	3 1/2	5 3/8	95
348	5 Flg.	4 Flg.	350	80	9 5/16	7 1/4	9 1/2	1	3 1/2	5 3/8	112
349	5 Flg.	5 Flg.	520	125	10	9 1/16	11 7/8	1	3	5 3/8	150
355	6 Flg.	4 Flg.	350	80	9 5/16	7 1/4	9 1/2	1	3 1/2	5 3/8	125
356	6 Flg.	5 Flg.	520	125	10	9 1/16	11 7/8	1	3	5 3/8	160
357	6 Flg.	6 Flg.	760	150	11	8 3/4	11 7/8	1	3	5 5/16	180
358	8 Flg.	6 Flg.	760	150	11	8 3/4	11 7/8	1	3	5 5/16	205
359	8 Flg.	8 Flg.	1000	275	11 3/4	13 1/16	16	1 1/4	2 3/4	5 1/4	280
370	10 Flg.	8 Flg.	1000	275	11 3/4	13 1/16	16	1 1/4	2 3/4	5 1/4	298

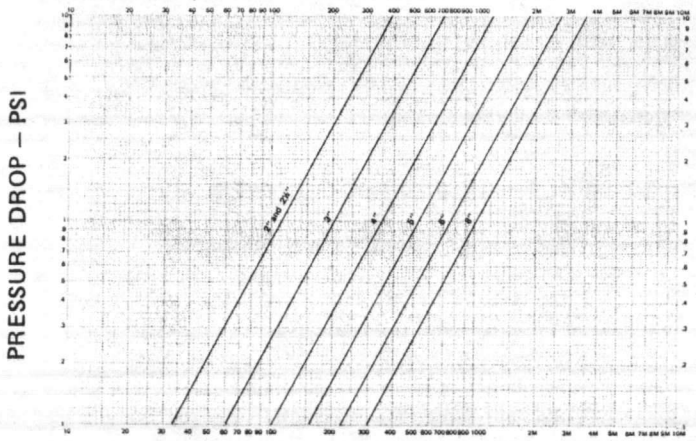
Note: C.V. = Flow rate in GPM with 1.0 PSI pressure drop through Suction Diffuser.

Therefore: $\Delta P = \left(\frac{Q}{C_v}\right)^2$ Where ΔP = Pressure Drop
C_v = From Table
Q = Design GPM

Pressure - up to 175 PSI in accordance with ASA B16.1

Temperature - up to 250° F.

PRESSURE DROP CURVE



TYPICAL SPECIFICATIONS

Provide at each pump a Suction Diffuser of size and type noted on drawings. Units shall consist of angle type body with inlet vanes and combination Diffuser-Strainer-Orifice Cylinder with 3/16" diameter openings for pump protection. (Unit shall be equipped with disposable fine mesh start-up strainer which shall be removed after thirty days of operation.) Design shall be such that foreign particles are trapped inside the strainer. Body shall fit pump and connecting pipe size. Unit shall be provided with adjustable support foot to relieve piping strains from pump suction. Mechanical Contractor shall provide valved gauged connections to Diffuser inlet and pump suction to indicate when cleaning is needed.

TACO HEATERS OF CANADA, LTD.
3090 Lenworth Drive
Mississauga, Ontario

TACO, INC. 1160 Cranston Street, Cranston, Rhode Island 02920

Printed In U.S.A.

Laco

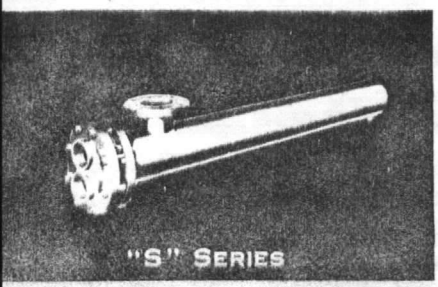
NUMBER

SD 200-1-3

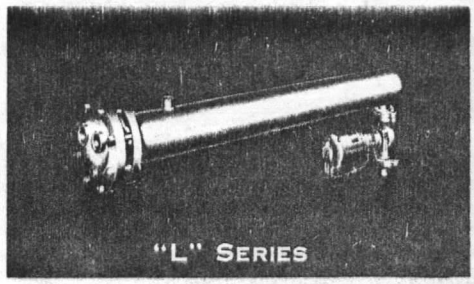
"S" AND "L" SERIES

HEAT EXCHANGERS

EFFECTIVE: JANUARY 17, 1975
SUPERSEDES: SD 200-1-3 dated 9/7/73



For SNEEDEN INC.
WILMINGTON, N.C.
Job (4) 3 STORY B.E.Q's
CAMP LEJEUNE, N.C.



• ALL UNITS ARE REGULARLY CONSTRUCTED TO THE ASME AND ASA CODES •

STANDARD TUBE PITCH IS 15/16" TRIANGULAR

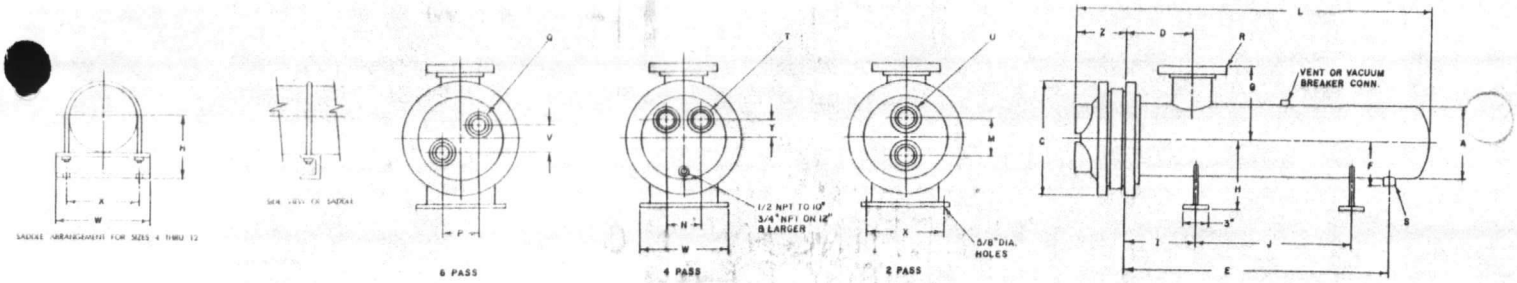
	LOCATION	LOCATION	LOCATION
Heater Number	B12408SN		
No. of Passes	4		
Tube Capacity —	215 GPM		
Tube Temperature — In	148° F		
Tube Temperature — Out	180° F		
Steam Pressure — PSI	25 PSI		
Shell Capacity —	2691 lbs/hr.		
Shell Temperature — In	242° F		
Shell Temperature — Out	242° F		
Press. Drop — Tubes	1.0 FT		
Press. Drop — Shell	—		
Head Material	CAST IRON		
Tube Plate Material	STEEL		
Tubing —	COPPER		
ASME Stamp & Certificate	Yes ☒ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Saddles	Yes ☐ No ☒	Yes ☐ No ☐	Yes ☐ No ☐

MATERIALS AND PRESSURES

UNIT DIA.	(1) TUBING (Copper)	SHELLS	(2) TUBE PLATES	(2) HEADS	TEST	PRESSURES — PSI WORKING				MAX. OPER. TEMP.
							ASME			
							2 PASS	4 PASS	6 PASS	
3"	5/8"—	Steel	Cast Iron	Cast Iron	225		....	150	....	375°F
4"	3/4"—	Steel	Cast Iron	Cast Iron	225		150	150	....	375°F
6"	3/4"—	Steel	Cast Iron	Cast Iron	225		150	150	150	375°F
8"	3/4"—	Steel	Cast Iron	Cast Iron	225		150	150	150	375°F
10"	3/4"—	Steel	Cast Iron	Cast Iron	225		125[3]	150	150	375°F
12"	3/4"—	Steel	Cast Iron	Cast Iron	225		125[3]	125[3]	150	375°F
14"	3/4"—	Steel	Steel	Cast Iron	225		125[3]	125[3]	150	375°F
16"	3/4"—	Steel	Steel	Cast Iron	225		125[3]	125[3]	....	375°F
18"	3/4"—	Steel	Steel	Cast Iron	225		125[3]	125[3]	....	375°F
20"	3/4"—	Steel	Steel	Cast Iron	225		125[3]	125[3]	....	375°F

(1) Available in other materials — some at same cost — others at extra cost.
(2) Available in bronze at extra cost.
(3) These sizes available with fabricated steel heads to meet ASME Code for 150 PSI working pressure at extra cost.

Printed In U.S.A.



PRODUCT NO.			DIMENSIONS IN INCHES																											APPROX. SHIP WT.
2 PASS	4 PASS	6 PASS	A	C	D	E		F		G		H	I	J	L	M	N	P	Q	R		S		T	U	V	W	X	Y	Z	
						"S" SERIES	"L" SERIES	"S" SERIES	"L" SERIES	"S" SERIES	"L" SERIES									"S" SERIES	"L" SERIES	"S" SERIES	"L" SERIES								
B4204	B4404		4.5	9	5	19.5	19.5	4	3.875	4	3.875				27	2.5	2.4			1.25	1.5T	1.25T	1.5T	1T	1.5T				.875	2.5	65
B4206	B4406					31.5	31.5								39																75
B4208	B4408					43.5	43.5								51																84
B4210	B4410					55.5	55.5								63																94
B4212	B4412					67.5	67.5			3.875					75					1.5T											104
B4214	B4414					79.5	79.5			3.75					87					2T											123
B6204	B6404	B6604	6.6	11	5	18.5	18	4.875	4.875	4.875	4.875				28	4	3.8	4.8	1.25T	1.5T	2T	1T	2T	1.5T	2T	2			1.25	3	120
B6206	B6406	B6606				30.5	30								40				2T	2T											148
B6208	B6408	B6608				42.5	42			4.125					52				2.5T	2.5T											182
B6210	B6410	B6610				54.5	54								64																207
B6212	B6412	B6612				66.5	66			3.875					76				3T	3T											235
B6214	B6414	B6614				78.5	78								88																262
B6216	B6416					90.5	90								100																290
B8204	B8404	B8604	8.6	13.5	6" FOR "L" SERIES 8" FOR "S" SERIES	18	17	6	5.125	6	5.125				28	5	4	6	2T	2T	3T	1T	3T	2T	3T	2.8			2	4	192
B8206	B8406	B8606				30	29			5.25					40					2.5T											234
B8208	B8408	B8608				42	41			5.125					52					3T											283
B8210	B8410	B8610				54	53			8.875					64					4F											326
B8212	B8412	B8612				66	65								76							1.25T									369
B8214	B8414	B8614				78	77								88																390
B8216	B8416	B8616				90	89								100					6F											453
B8218	B8418	B8618				102	101								112																496
B10204	B10404	B10604	10.8	16	8" FOR "L" SERIES 10" FOR "S" SERIES	17	16	7.125	6.25	6.25	6.25		LOOSE SADDLES		28.5	6.3	5.5	7.2	2.5T	3T	3T	1T	3T	3T	4T	3.5			2.25	4.5	285
B10206	B10406	B10606				29	28			10					40.5					4F		1.25T									353
B10208	B10408	B10608				41	40								52.5					6F		1.5T									415
B10210	B10410	B10610				53	52								64.5							2T									476
B10212	B10412	B10612				65	64								76.5																537
B10214	B10414	B10614				77	76								88.5																598
B10216	B10416					88.5	88								100.5																660
B10218	B10418					100.5	100								112.5																721
B10220	B10420					112.5	112								124.5																782
B12206	B12406	B12606	12.8	19	10" FOR "S" SERIES 8" FOR "L" SERIES	29	28	8.125	7.375	11	7.375		LOOSE SADDLES		41	8	5.8	8.4	3T	4F	3T	1.25T	3T	4T	4T	4.2			2.5	5	510
B12208	B12408	B12608				41	40								53					6F		1.5T									596
B12210	B12410	B12610				53	52								65							2T									681
B12212	B12412	B12612				65	64								77					8F											772
B12214	B12414	B12614				77	76								89							2.5T									857
B12216	B12416					88	88	7.375							101																941
B12218	B12418					100	100								113																1027
B12220	B12420					112	112								125																1111
B14206	B14406	B14606	14	21	10" FOR "S" SERIES 8" FOR "L" SERIES	29	27	8.75	10	12	12	12	8	10	42	8	6.5	8	3T	6F	4T	1.25T	4F	4T	6T	5	14	12	3.25	5	568
B14208	B14408	B14608				40.5	39							22	54					8F		2T									664
B14210	B14410	B14610				52.5	51							34	66																756
B14212	B14412	B14612				64.5	63							46	78							2.5T									847
B14214	B14414	B14614				76	75	8						58	90																937
B14216	B14416					88	87							70	102					10F											1029
B14218	B14418					100	99							82	114							3T									1120
B14220	B14420					112	111							94	126																1212
B16206	B16406		16	23.5	10" FOR "S" SERIES 8" FOR "L" SERIES	28.5	26	9.75	11	13	13	13	6	10	43	9.2	7.8			6F	6F	1.5T	6F	4T	6T		15	13	3.5	5.8	745
B16208	B16408					40	38							22	55							2T									863
B16210	B16410					52	50	9						34	67							2.5T									981
B16212	B16412					64	62							46	79					8F											1105
B16214	B16414					76	74							58	91					10F		3T									1187
B16216	B16416					87.5	86							70	103																1305
B16218	B16418					99.5	98							82	115																1424
B16220	B16420					111.5	110							94	127																1541
B18206	B18406		18	25	10" FOR "S" SERIES 8" FOR "L" SERIES	27.5	25	10.75	12	14	14	14	6	9	42.5	10.7	8.3			6F	6F	2T	6F	4T	6T		16	14		6.3	902
B18208	B18408					39.5	37							21	54.5					8F											1044
B18210	B18410					51	49	10						33	66.5							2.5T									1183
B18212	B18412					62.5	61							45	78.5					10F		3T									1326
B18214	B18414					74.5	73							57	90.5																1446
B18216	B18416					86.5	85							69	102.5																1586
B18218	B18418					98.5	97							81	114.5					12F		4T									1732
B18220	B18420					110.5	109	12						93	126.5																1871
B20206	B20406		20	27.5	10" FOR "S" SERIES 8" FOR "L" SERIES	27.5	25	11.75	13	15	15	15	6	9	43	11.2	8.8			8F	6F	2T	6F	6T	8T		16	14	4.25	6.5	1060
B20208	B20408					39	37	11						21	55					10F		2.5T									1226
B20210	B20410					50.5	49							33	67							3T									1386
B20212	B20412					62.5	61							45	79					12F											1547
B20214	B20414					74.5	73							57	91							4T									1706
B20216	B20416					86.5	85	13						69	103																1867
B20218	B20418					98.5	97							81	115																2041
B20220	B20420					110.5	109							93	127					14F											2202

Taco Heaters Of Canada, Ltd.
3090 Lenworth Drive
Mississauga, Ontario

Taco, Inc. 1160 Cranston Street, Cranston, R.I. 02920 U.S.A.

Taco

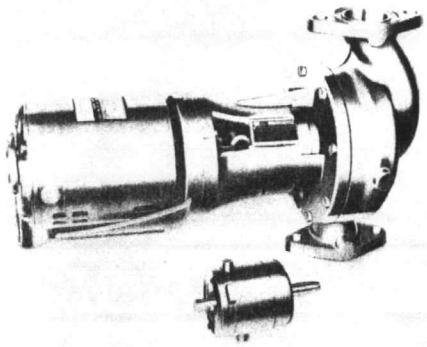
SUBMITTAL DATA

NUMBER
SD 300-1-17

NO. 1641 CARTRIDGE TYPE CUSTOM IN-LINE PUMP

EFFECTIVE: APRIL 1, 1974
SUPERSEDES: NEW

NOTE: TACO Submittal Data Sheets SD 300-1-5 SD 300-1-8 SD 300-1-9 SD 300-1-10 are OBSOLETE and are NO LONGER VALID.



JOB: (4) 3 STORY B.E.Q.'S CAMP LEJEUNE, N.C.

Date Submitted: 5-3-78 By: M.J.

LOCATION	PUMP SIZE	GPM	HEAD	PHASE
P-5 1641-C	2"	120	45'	208/3/60

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.

BODY
Cast Iron or Bronze with flanged in-line connections. Companion Flanges are included.

IMPELLER
Cast Bronze, Closed, Dynamically Balanced.

DRIVE COUPLING
Non-Metallic / Vibration Dampening

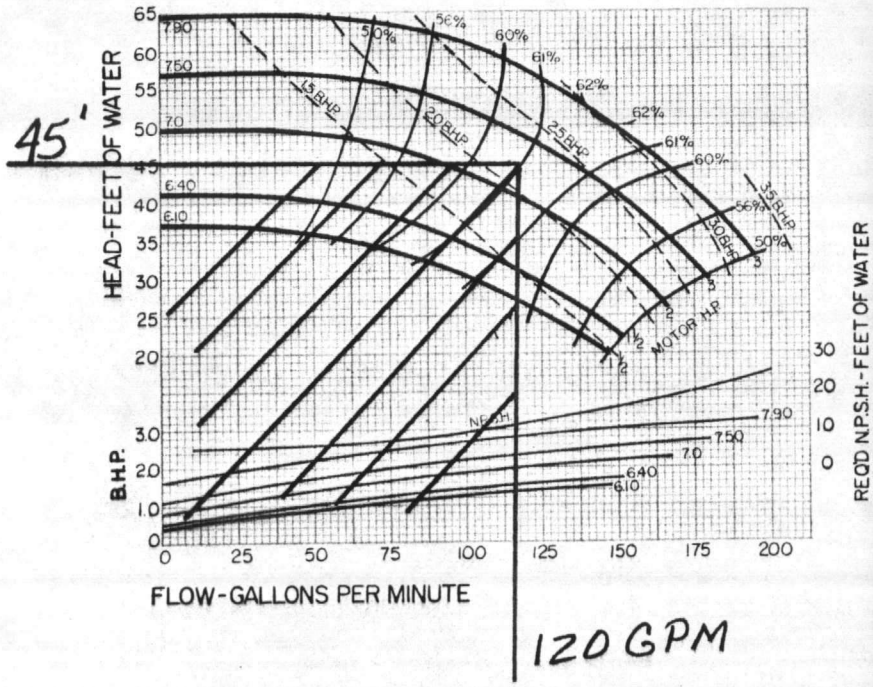
SHAFT
Stainless Steel with Cupro-Nickel Sleeve.

FRAME
Sleeve Bearing, Disc Type, Oil lubricated. REMOVABLE BEARING CARTRIDGE FITS ALL MODELS. Dip Stick to measure oil level.

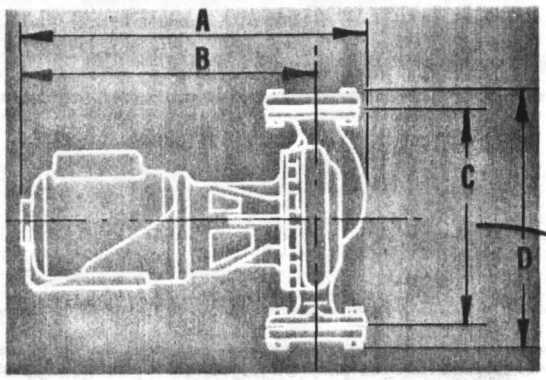
MECHANICAL SEAL
2 Piece Standard–250°F Operating Temp.
Hi-Temp –Extra Cost
300°F Operating Temp.

WORKING PRESSURE
175 PSI... in accordance with ASA B16.1

NOTE: Flanges are tapped for gauges



SIZES & DIMENSIONS:



MODEL	Flange Size	H.P.	A	B	C	D
1641-C	2	1½	24½	21	16½	19½
		2	26½	23		
		3	27	24		

Dimensions apply to Single & Three Phase Motors

Taco Heaters of Canada, Ltd.
3090 Lenworth Drive
Mississauga, Ontario

Taco, Inc. 1160 Cranston Street, Cranston, Rhode Island 02920 U.S.A.

printed in U.S.A.

Taco

SUBMITTAL DATA

NUMBER

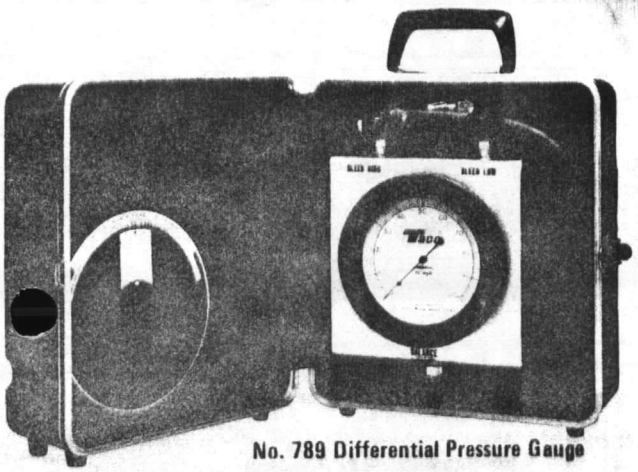
SD 400-4-2

Effective: June 30, 1976
Supersedes: SD 400-4-2 dtd. 2/14/75

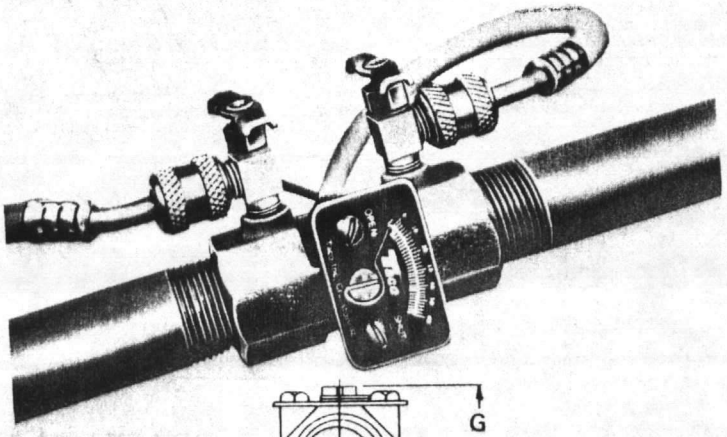
Taco circuit setter

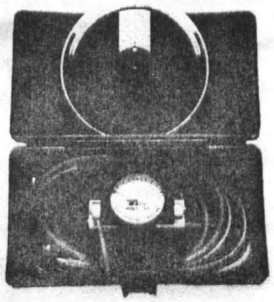
FEATURES

BALL VALVE CONSTRUCTION: Allows smooth, quiet, dependable operation.
NEEDLE VALVE CONNECTIONS: Assure leakproof connection of readout instrument.
PRECISION MACHINED ORIFICE: Insures accuracy.
CALIBRATED NAMEPLATE: Easy to read; easy to make setting adjustments.
INTERNAL SEALS: Prevent leakage.
URETHANE PACKING: Protects and insulates Taco circuit setter when not in use.
READOUT METER: Includes rugged carrying case and necessary hoses and valves.



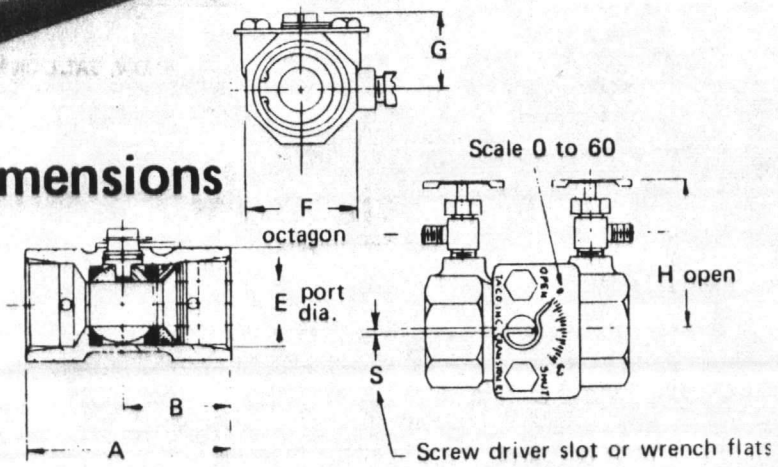
No. 789 Differential Pressure Gauge





No. 788 Differential Pressure Gauge

Dimensions

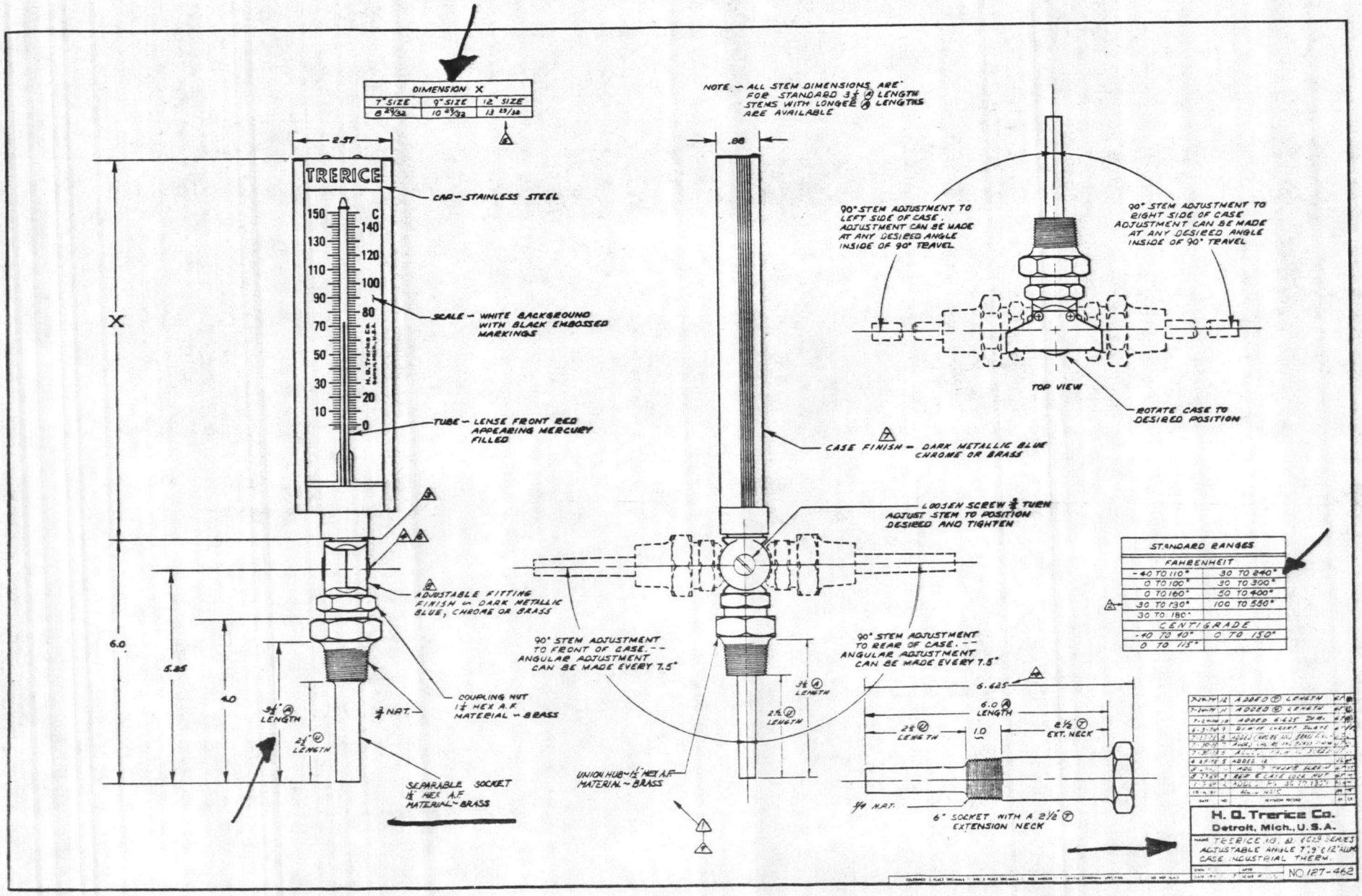


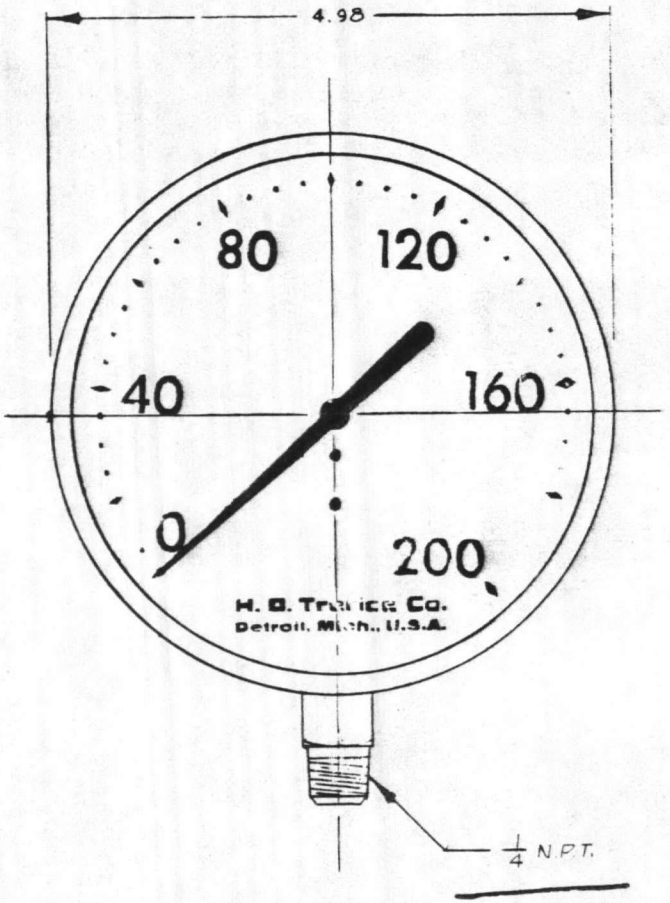
MODEL	SIZE	A	B	E	F	G	H	S	WEIGHT
790	1/2"	2-13/16"	1-1/2"	3/8"	1-1/8"	23/32"	2-5/16"	3/64"	3/4 lb.
791	3/4	3	1-9/16	1/2	1-5/16	29/32	2-3/8	3/64	1 lb.
792	1	3-1/2	1-13/16	5/8	1-5/8	1-1/8	2-9/16	3/64	1-1/2
793	1-1/4	4	2-1/16	13/16	2	1-5/16	2-3/4	3/64	2-1/2
794	1-1/2	4-3/16	2-3/16	15/16	2-5/16	1-9/16	2-15/16	3/8	4
795	2	4-3/4	2-7/16	1-1/4	2-3/4	1-3/4	3-1/8	3/8	5-1/4
796	2-1/2	5-5/8	2-15/16	1-1/2	3-1/8	2-1/16	3-5/16	3/8	7
797	3	7-1/4	3-1/4	1-13/16	4	2-13/32	3-3/4	3/8	8-1/2

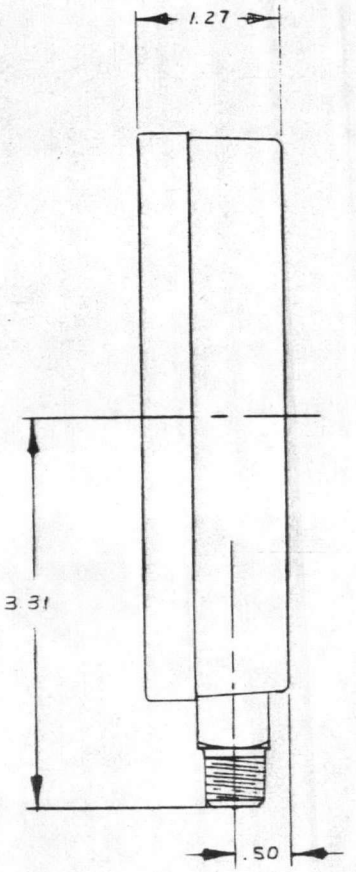
Dimensions for Readout Meter and case on back of page.

TACO, Inc. 1160 Cranston Street, Cranston, Rhode Island 02920 U.S.A. Telephone (401) 942-8000 Telex: 92-7627

TACO HEATERS OF CANADA, Ltd., 3090 Lenworth Drive, Mississauga, Ontario. Telephone: (416) 625-2160 Telex: 06961179


DIMENSION X
7" SIZE | 9" SIZE | 12" SIZE
8 29/32 | 10 29/32 | 13 29/32
NOTE – ALL STEM DIMENSIONS ARE FOR STANDARD 3½ (A) LENGTH STEMS WITH LONGER (A) LENGTHS ARE AVAILABLE
2.57
.88
TRERICE
CAP – STAINLESS STEEL
SCALE – WHITE BACKGROUND WITH BLACK EMBOSSED MARKINGS
TUBE – LENSE FRONT RED APPEARING MERCURY FILLED
X
6.0
5.85
4.0
3½" (A) LENGTH
2½" (2) LENGTH
¾ N.P.T.
COUPLING NUT 1¼ HEX A.F. MATERIAL – BRASS
SEPARABLE SOCKET 1¼ HEX A.F. MATERIAL – BRASS
ADJUSTABLE FITTING FINISH – DARK METALLIC BLUE, CHROME OR BRASS
90° STEM ADJUSTMENT TO LEFT SIDE OF CASE. ADJUSTMENT CAN BE MADE AT ANY DESIRED ANGLE INSIDE OF 90° TRAVEL
90° STEM ADJUSTMENT TO RIGHT SIDE OF CASE ADJUSTMENT CAN BE MADE AT ANY DESIRED ANGLE INSIDE OF 90° TRAVEL
TOP VIEW
ROTATE CASE TO DESIRED POSITION
CASE FINISH – DARK METALLIC BLUE CHROME OR BRASS
LOOSEN SCREW ¼ TURN ADJUST STEM TO POSITION DESIRED AND TIGHTEN
90° STEM ADJUSTMENT TO FRONT OF CASE. – ANGULAR ADJUSTMENT CAN BE MADE EVERY 7.5°
90° STEM ADJUSTMENT TO REAR OF CASE. – ANGULAR ADJUSTMENT CAN BE MADE EVERY 7.5°
3½ (A) LENGTH
2½ (2) LENGTH
UNION HUB 1¼" HEX A.F. MATERIAL – BRASS
STANDARD RANGES
FAHRENHEIT
-40 TO 110° | 30 TO 240°
0 TO 100° | 30 TO 300°
0 TO 160° | 50 TO 400°
30 TO 130° | 100 TO 550°
30 TO 180°
CENTIGRADE
-40 TO 40° | 0 TO 150°
0 TO 115°
6.625
6.0 (A) LENGTH
2½ (2) LENGTH
1.0
2½ (7) EXT. NECK
¾ N.P.T.
6" SOCKET WITH A 2½" (7) EXTENSION NECK
H. O. Trerice Co.
Detroit, Mich., U.S.A.
NAME TRERICE 10, 40, 60 & 80 SERIES ADJUSTABLE ANGLE 7", 9" & 12" ALUM. CASE INDUSTRIAL THERM.
NO 127-462





CASE — BLACK FINISHED CAST ALUMINUM
RING — BLACK FINISHED OR OPTIONAL EXTRA POLISHED CHROME PLATED
DIAL — WHITE FINISHED WITH BLACK EMBOSSED FIGURES AND MARKINGS.
POINTER — BLACK FINISHED ALUMINUM OR OPTIONAL EXTRA BLACK FINISHED, RED TIPPED, ADJUSTABLE.
MOVEMENT — BRASS, MILLED TEETH
BOURDON TUBE — PHOSPHER BRONZE
SOCKET — BRASS, 1/4" NPT
LENS — CLEAR GLASS

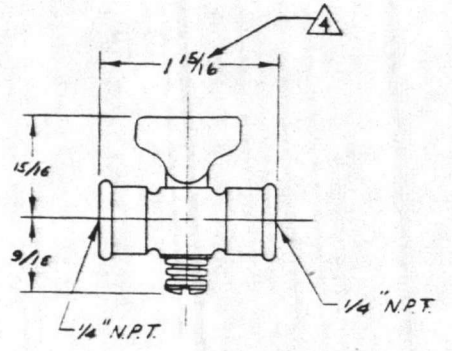
STANDARD RANGES	
30"VAC. – 0	0 – 60 PSI
30"VAC. – 15 PSI	0 – 100 PSI
30" VAC. – 30 PSI	0 – 160 PSI
30"VAC. – 60 PSI	0 – 200 PSI
30"VAC. – 150 PSI	0 – 300 PSI
30"VAC. – 300 PSI	0 – 400 PSI
0 – 15 PSI	0 – 600 PSI
0 – 30 PSI	0 – 1000 PSI

DATE	NO.	REVISION RECORD	BY	CK
1-6-69	1	REDRAWN		

H. O. Trerice Co.
Detroit, Mich., U.S.A.

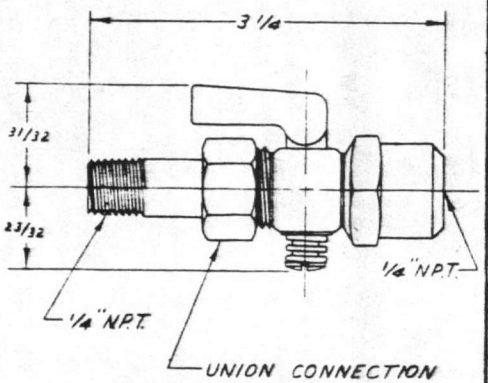
NAME TRERICE SERIES NO. 601
4½" PRESSURE GAUGE

DWN. | APVD. | NO. 127-486
DATE 7-11-66 | SCALE
DO NOT SCALE



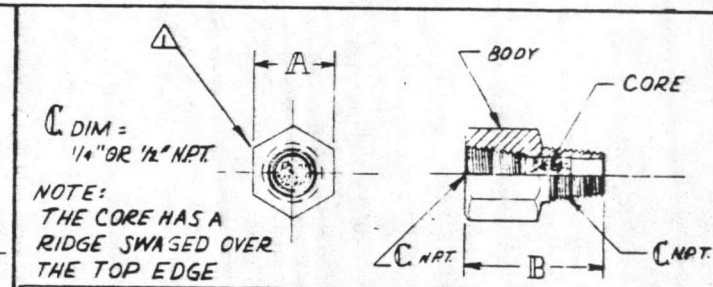
MATERIAL - BRASS
MAX. PRESS - 125 P.S.I.

NO. 865 TRERICE 'T' HANDLE GAUGE COCK



MATERIAL - BRASS
MAX. PRESS. - 125 P.S.I.

NO. 880 TRERICE LEVER HANDLE GAUGE COCK



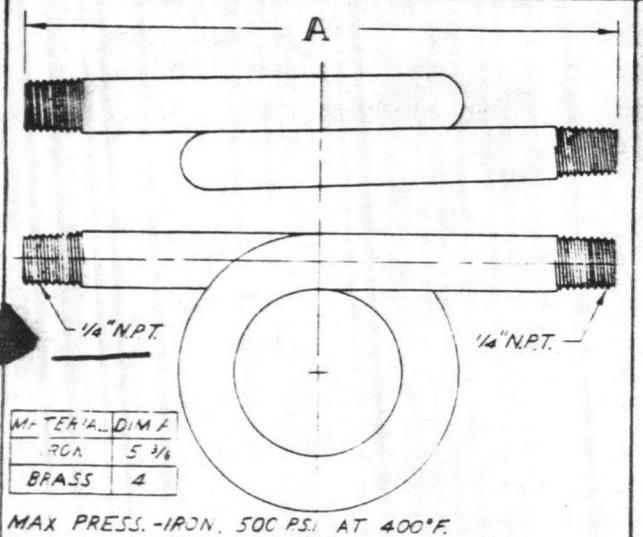
NOTE:
THE CORE HAS A RIDGE SWAGED OVER THE TOP EDGE

NO. 872 TRERICE PRESSURE SNUBBER

PART NO.	MATERIAL		DIMENSIONS 1/4 N.P.T.		1/2 N.P.T.		MAX. PRESS.	SERVICE RECOMMENDATION
	BODY	CORE	A	B	A	B		
872-1	BRASS	BRONZE	3/4	1 1/16	1 1/16	1 3/8	5,000 P.S.I.	AIR, GASES, GASOLINE, LIGHT OILS, STEAM, WATER
872-2								
872-3								LUBRICATING & HEAVY OILS
872-4	STAINLESS STEEL	STAINLESS STEEL	3/4	1 1/16	1 1/16	1 7/8	10,000 P.S.I.	AIR, GASES
872-5								GASOLINE, LIGHT OILS, STEAM, WATER
872-6								LUBRICATING & HEAVY OILS

NO. 870 TRERICE IMPULSE DAMPENER

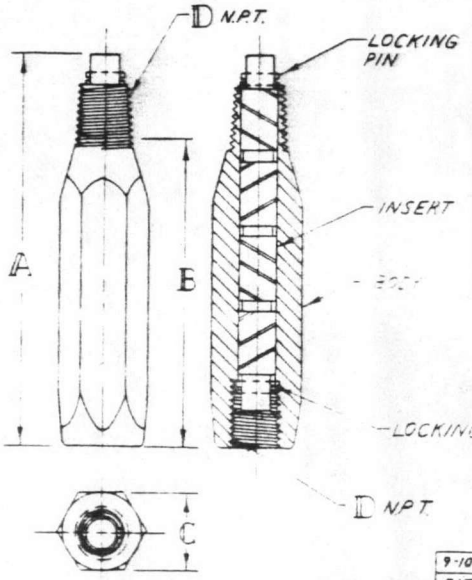
PART NO.	"D" N.P.T.	MATERIAL BODY	MATERIAL INSERT	DIMENSIONS A	B	C	MAX. PRESS.	SERVICE RECOMMENDATION
870-1	1/4	BRASS	BRASS	3 15/16	3 3/16	3/4	12,000 P.S.I.	AIR, WATER, STEAM, GASES
870-2								GASOLINE & LIGHT OILS
870-3								LUBRICATING & HEAVY OILS
870-7	1/4	STAINLESS STEEL	STAINLESS STEEL	4 1/2	3 1/16	1	25,000 P.S.I.	AIR, WATER, STEAM, GASES
870-8								GASOLINE, LIGHT OILS, AMMONIA
870-9								LUBRICATING & HEAVY OILS
870-10	1/2						50,000 P.S.I.	AIR, WATER, STEAM, GASES
870-11								GASOLINE, LIGHT OILS, AMMONIA
870-12								LUBRICATING & HEAVY OILS



MATERIAL	DIM A
IRON	5 3/16
BRASS	4

MAX PRESS. - IRON, 500 P.S.I. AT 400°F.
BRASS, 250 P.S.I. AT 400°F.

N.C. 685 TRERICE COIL SYPHON



DATE	NO.	REVISION	BY	CK
8-31-71	4	WAS 15/32	W	MKD
12-12-68	3	ADDED STEAM TO #E72-2 & #872-5	T.	
11-22-68	2	ADDED H, CH #870-8 & #870-5	JKK	
6-19-68	1	REDRAWN TO NC 672.	JKK	

9-10-74	5	WAS 150# AIR, STEAM, 300# WHO.		
DATE	NO.	REVISION	BY	CK

.X FRACT. .X PLACE DECIMALS ± .010 .XX PLACE DECIMALS ± .005 ANGLES ± 1° UNLESS OTHERWISE SPECIFIED — DO NOT SCALE

H. O. Trerice Co.
Detroit, Mich., U.S.A.

NAME
PRESSURE GAUGE ACCESSORIES

DWN J. LEESE	APVD
DATE 3-17-66	SCALE —

NO. 127-444

HEAT TRANSFER SALES, INC.

RE--SUBMITTAL NO. 1360-3398

P. O. BOX 11103
GREENSBORO, NORTH CAROLINA 27409
03-02-03

DATE MAY 3, 1978

☒ THIS ORDER IS BEING HELD FOR APPROVAL AND WILL NOT BE RELEASED UNTIL APPROVED.

☐ THESE PRINTS ARE FOR YOUR RECORDS. ORDER HAS BEEN RELEASED PER PRINTS.

CONTRACTOR: SNEEDEN, INC.
BOX 3548
WILMINGTON, N.C. 28401

JOB: (4) STORY B.E.Q'S
CAMP LEJEUNE, N.C.

ENGINEER:

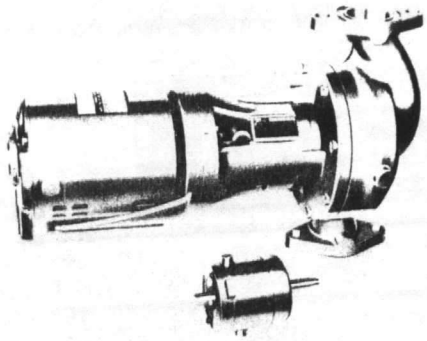
QUAN.	EQUIPMENT LIST AND DESCRIPTION	ACTION TAKEN
	SECTION 15654-4	
	P-3 DOM. H.W. (4 REQUIRED) TACO 1600-C 1-1/2" BRONZE FITTED IN-LINE SLEEVE BEARING PUMP. 13 GPM @ 16'HD. 1/4 HP, 115/1/60.	
	G.E. STARTER FOR ALL PUMPS.	
	10 SETS OF SUBMITTAL DATA FOR YOUR APPROVAL.	

STANDARD 1600 SERIES CARTRIDGE TYPE IN-LINE PUMPS

NUMBER
SD 300-1-12

EFFECTIVE: APRIL 1, 1974
SUPERSEDES: NEW

NOTE: TACO Submittal Data Sheets SD 300-1-5 SD 300-1-8 SD 300-1-9 SD 300-1-10 are OBSOLETE and are NO LONGER VALID.



JOB: (4) STORY B.E.Q'S
CAMP LEJEUNE, N.C.

Date Submitted: 5.3.78 By: M.J.

LOCATION	PUMP SIZE	GPM	HEAD	PHASE
P-3				
1600-C	1/2"	13	16'	115/1/60

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.

BODY
Cast Iron with flanged in-line connections. Companion flanges are included

IMPELLER
Cast Bronze, Closed, Dynamically Balanced.

DRIVE COUPLING
Non-Metallic / Vibration Dampening

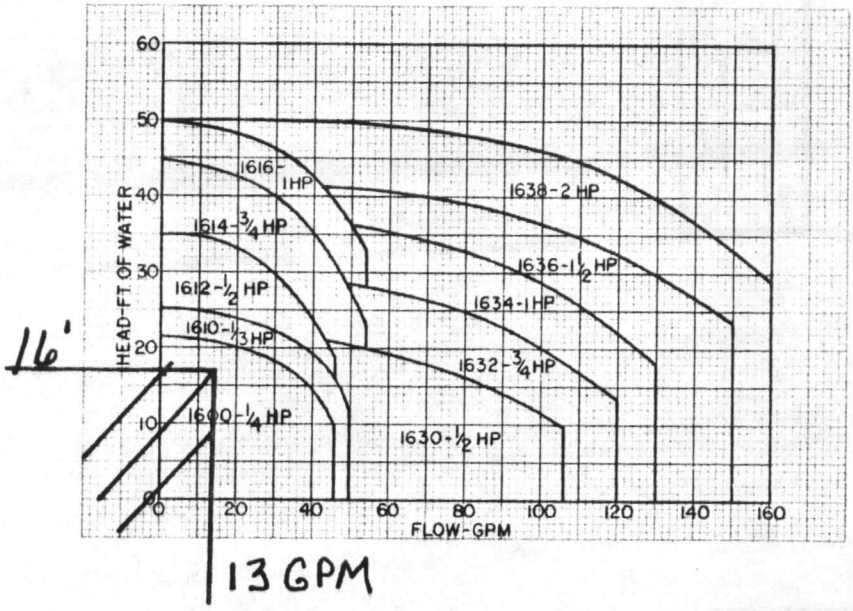
SHAFT
Stainless Steel with Cupro-Nickel Sleeve.

FRAME
Sleeve Bearing, Disc Type, Oil lubricated. REMOVABLE BEARING CARTRIDGE FITS ALL MODELS. Dip Stick to measure oil level.

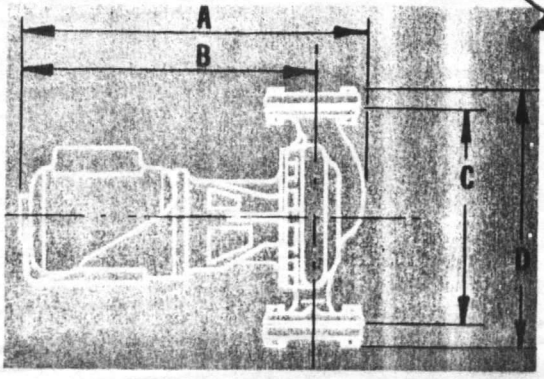
MECHANICAL SEAL
Standard–250°F Operating Temp.

WORKING PRESSURE
175 PSI... in accordance with ASA B16.1

NOTE: Flanges are tapped for gauges



SIZES & DIMENSIONS:



MODEL NO.	Flg. Size	MOTOR DATA HP	60 Hz 1 Ph.	60 Hz 3 Ph.	DIMENSIONS A	B	C	D
1600-C	1½	¼	115V	NOT AVAILABLE	19	16½	10¼	12⅞
1610		⅓	115V		19	16½	10¼	12⅞
1612		½	115/230	200 or 230/460	21	18½	13½	16⅛
1614		¾			21½	19	13½	16⅛
1616	2"	1			22	19	14½	17⅜
1630		½			21½	18	13½	16⅛
1632		¾			22	18½	13½	16⅛
1634		1			22½	19	13½	16⅛
1636		1½			24½	21	16½	19½
1638		2			26½	23	16½	19½

Taco Heaters of Canada, Ltd.
3090 Lenworth Drive
Mississauga, Ontario

Taco, Inc. 1160 Cranston Street, Cranston, Rhode Island 02920 U.S.A.

printed in U.S.A.

Taco

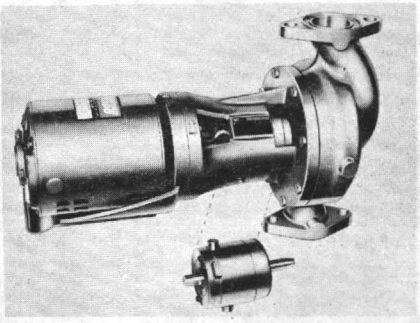
INSTRUCTION SHEET

INSTRUCTION SHEET NUMBER
IS-300-1-12

ALL CARTRIDGE-TYPE CIRCULATORS:
2½", 3", AND 1600 SERIES (-9 AND UP)

EFFECTIVE: FEB. 1, 1968
Supersedes: IS-300-1-12 Dated Sept. 11, 1967
REVISED: August 15, 1971

Plant ID. No. 001-329



APPLICATION:

All pumps covered by this instruction sheet are designed for pumping water.

Working Pressure:	Up to 175 PSIG in accordance with ASA B16.1.
Temperature:	250° F Standard 300° F with Hi-Temp Seal

INSTALLATION:

Install *horizontally only* and with the *longer of the two bracket ribs pointing to the ceiling.*

The casing can be rotated relative to the bracket for installation in vertical or horizontal pipe.

The pump must be installed far enough away from ceiling and walls to permit lubrication of bracket and motor.

"CAUTION": UNDER NO CIRCUMSTANCES SHOULD ANY PART OF BRACKET OR MOTOR BE COVERED WITH INSULATION.

START UP:

Before operating the pump for the first time check the following:

1. Is motor correctly wired for voltage in use?
   Warranty is void if motor is damaged due to improper electrical hook-up.
2. If a magnetic starter is used see that the heater element is sized for the Service Factor load of the motor otherwise nuisance tripouts may occur.
3. Motor and pump are properly oiled at the factory. However, as a matter of precaution it is recommended that the oil level in the pump bracket be checked as specified on pump nameplate. An oil level slightly above the "full" mark on the dip stick can be tolerated.
4. Motors are properly aligned with pump at the factory and normally require no attention. If due to rough handling the motor base becomes bent, realign by shimming between cast iron and steel section of motor base.
5. Before starting motor, ascertain that pump is filled with water to lubricate the seal. *Do not operate pump dry for motor checkout.*

LUBRICATION:

Pump must never be operated with oil level in bracket below low limit on dip stick.

For replenishing, use premium grade SAE No. 30 oil only (see pump nameplate).

Lubricate motor per instruction label attached to motor.

Taco Heaters of Canada, Ltd.
3090 Lenworth Drive
Cooksville, Ontario

TACO, INC. 1160 Cranston Street, Cranston, Rhode Island 02920

Printed In U.S.A

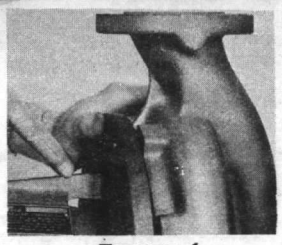


FIGURE 1

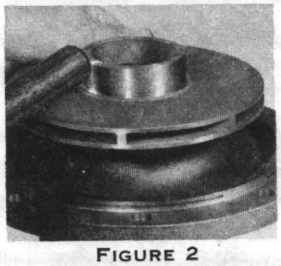


FIGURE 2

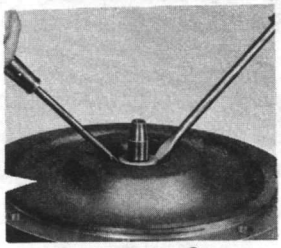


FIGURE 3

FIGURE 4

FIGURE 5

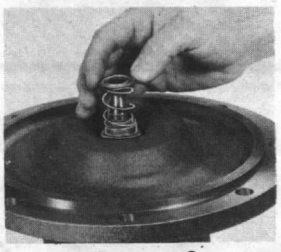


FIGURE 6

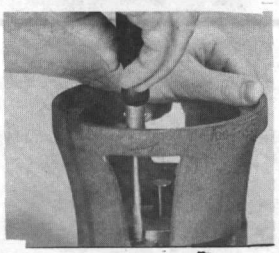


FIGURE 7

SEAL REPLACEMENT:

To replace the water seal, the following steps must be observed:

1. Disconnect electrical connections. Relieve system pressure and drain water from body.
2. Remove motor assembly from bracket and bracket from pump body.
3. Place bracket in vertical position, impeller up and loosen screw at center of impeller two turns. (7/16 Hex Head) *This screw has a left-hand thread.* Tap impeller at its outside diameter with handle of hammer to free tapered fit between shaft and impeller and completely remove screw, washer and impeller. (see Figure 2)
4. Remove carbon assembly and ceramic seal by prying them loose with a screwdriver. (see Figure 3)
5. If necessary, thoroughly clean shaft and seat cavity.
6. Insert new seal seat. For easy assembly coat OD of seal rubber (either a cup or an O-ring) with special grease provided in small container. Do not use any other oil or grease. Push seat *all the way down into cavity. Seat must not be cocked relative to shaft. Be sure face of seal stays absolutely clean — wipe surface with with soft clean cloth if necessary.* (see Figure 4)
7. Install new carbon assembly. Coat inside of rubber bellows with special grease provided (do not use any other oil or grease) and slide assembly (carbon first) over shaft until carbon meets seat. Push on rubber insert on very end of assembly and not on outside diameter of carbon retainer. *Be sure carbon face stays absolutely clean* (see Figure 5)
8. Install spring and spring retainer with raised face inside spring. (see Figure 6)
9. Replace impeller using new impeller screw and washer provided. Make sure cones of both impeller and shaft are clean.
10. Reassemble bracket into pump casing using new gasket provided. Clean gasket surface of both casing and bracket if necessary. *Be sure that the longer of the two outside bracket ribs is on top.* (see Figure 1)
11. Reinstall coupler and motor.
12. Follow procedure outlined under section Start Up where required.

IMPELLER REPLACEMENT:

Follow steps 1 through 3 and 8 through 12 outlined under section Seal Replacement.

BEARING (CARTRIDGE) REPLACEMENT:

If for some reason the bracket bearings should fail, it is not necessary to replace the entire bracket.

A pre-lubricated cartridge containing bearings and shaft is available. To change the cartridge, follow this procedure:

—Follow steps 1 through 4 as outlined under section Seal Replacement.

—Flip bracket around so that moter end is on top.

—Remove the two outermost socket head screws. (see Figure 7)

—Pull out old cartridge. If necessary tap cone end of shaft with a hammer to accomplish this.

—Insert new cartridge and refasten with socket head screws.

—Follow steps 5 through 12 outlined under section Seal Replacement.

Note: If you plan to re-use the water seal it is not necessary to remove the seal seat. The carbon assembly may be lubricated with water to make reinstallation easy It is recommended that when changing the cartridge the water seal be replace also.

Taco

REPLACEMENT PARTS LIST

NUMBER

300PL3

Effective: December 1, 1976
Supersedes: 300PL3, 7/30/75

FOR FOLLOWING MODEL NUMBERS:

BM or CC: 2 - 8 2½ - 8 2½ - 10 3 - 8 & 4 - 6
BM or CC: 2008 2010 2012 2508 2510 3008 & 4006
SB or BB: 2008 2010 2012 2508 2510 3008 & 4006

WHEN SELECTING AND ORDERING PARTS, ALWAYS REFER TO SERIAL NUMBER ON NAME PLATE

—Example—

p. 1 ACTUAL IMPELLER DIAMETER
NOMINAL IMPELLER DIAMETER
FRAME SIZE & STYLE p. 2

2 - 8 - 7.9 — B1B1

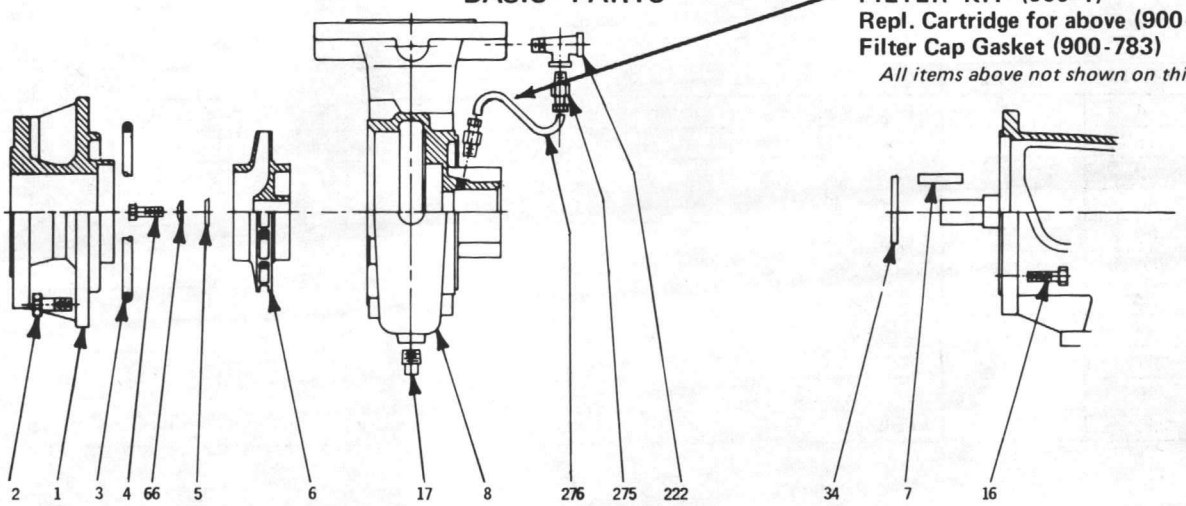
OR

2008 - 7.9 — B6B1

p. 2 FRAME SIZE & STYLE
SEAL OR PACKING DESIGN p. 3

BASIC PARTS

FILTER KIT (900-1)
Repl. Cartridge for above (900-439)
Filter Cap Gasket (900-783)
All items above not shown on this sheet.



Item No.	No. Reqd.	DESCRIPTION	PART NO. PER PUMP SIZE						
			2 - 8 2008	2 - 10 2010	2 - 12 2012	2½ - 8 2508	2½ - 10 2510	3 - 8 3008	4 - 6 4006
1	1	Suction Cover (1)	920-003	883-003	884-003	928-003	922-003	934-003	938-003
2	8	Suction Cover Bolts	10-216	10-211	10-211	10-216	10-211	10-216	10-230
3	1	Suction Cover 'O' Ring	912-005	862-005	868-004	912-005	862-005	912-005	918-005
4	1	Impeller Bolt (SS)	10-257A	10-259A	10-259A	10-257A	10-257A	10-257A	10-257A
5	1	Impeller Washer	926-004	926-004	926-004	926-004	926-004	926-004	926-004
6	1	Impeller (1)	920-002	883-002	884-002	928-002	922-002	934-005	938-002
7	1	Impeller Key (SS)	13-104A	13-105A	13-105A	13-104A	13-104A	13-104A	13-104A
8	1	Casing (1) (2)	920-001	883-001	884-001	928-001	922-001	934-001	938-001
16	4	Casing Bolt	10-201	10-201	10-201	10-201	10-201	10-201	10-201
17	1	Drain Plug	16-102	16-104	16-104	16-102	16-102	16-102	16-102
34	1	Slinger Ring (3)	900-040	N/A	N/A	900-040	900-040	900-040	900-040
34	1	Slinger Ring (4)	900-044	900-044	900-044	900-044	900-044	900-044	900-044
66	1	Belleville Washer	900-053	900-053	900-053	900-053	900-053	900-053	900-053
222	1	Fitting	900-566	900-566	900-566	900-566	900-566	900-566	900-566
275	2	Fitting	900-798	900-798	900-798	900-798	900-798	900-798	900-798
276	1	Tube	900-728	900-728	900-728	900-728	900-728	900-728	900-728

(1) Add "B" after No. for Bronze.
(2) Throttle Bushing (Item 10), found in Seal Section, must be ordered with each casing.
(3) For Close Coupled Only.
(4) For Base Mounted Only.

TACO, Inc., 1160 Cranston Street, Cranston, Rhode Island 02920 U.S.A. Tel: (401) 942-8000 Telex: 92-7627

Litho in USA

Taco Heaters of Canada, Ltd., 3090 Lenworth Drive, Mississauga, Ontario Tel: (416) 625-2160 Telex: 06-961179

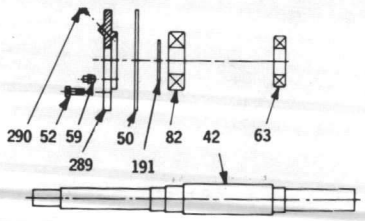
FRAME SIZE & STYLE – 0000-00-XX00

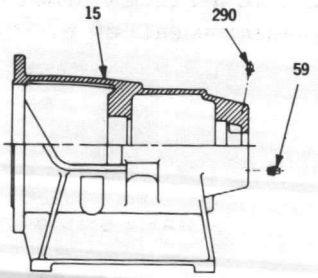
B1 **BALL BEARING DESIGN:** Update pump with 840-124RP Complete Frame Assembly. Please furnish all nameplate data to insure proper updated nameplate.

B2 **SLEEVE BEARING DESIGN:** Update pump with 840-110RP Complete Frame Assembly. Please furnish all nameplate data to insure proper updated nameplate.

B3 **SLEEVE BEARING DESIGN:** *Same as B2 design.*

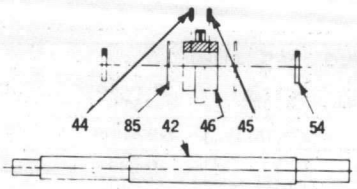
B5 BALL BEARING DESIGN:

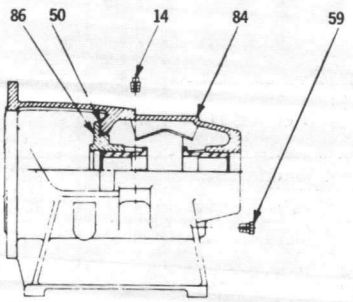




Item No.	No. Req.	DESCRIPTION	PART NO.	REMARKS
74	1	Frame Assembly (complete)	840-124RP	
15	1	Frame	840-111	
42	1	Shaft	840-113	Add SS for Stainless Steel
50	1	Bearing Plate Gasket	840-123	
52	4	Bearing Plate Bolt	10-230	3/8 - 16 x 1
59	2	Drain Plug	16-111C	1/8 NPT Brass
63	1	Ball Bearing	840-114	
82	1	Ball Bearing	840-071	
191	1	Retainer Ring	15-105	
289	1	Bearing Cover Plate Assembly	840-120	
290	2	Lubrication Fitting	15-200	

B6 SLEEVE BEARING DESIGN:

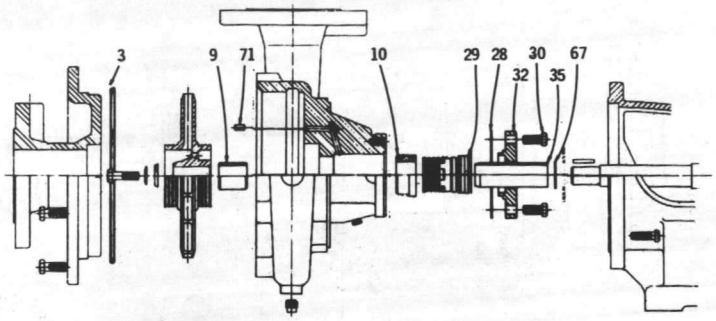




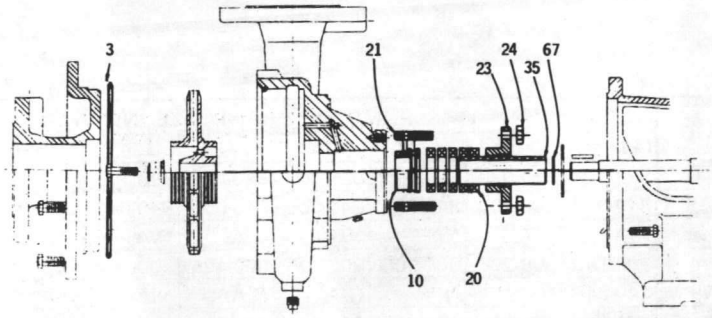
Item No.	No. Req.	DESCRIPTION	PART NO.	REMARKS
74	1	Frame Assembly (complete)	840-110RP	
14	1	Pipe Plug	16-102	3/8 NPT Steel
42	1	Shaft	820-048	Add SS for Stainless Steel
44	1	Cone Point Set Screw	10-310	5/16 - 18 x 3/8 Steel
45	1	Cup Point Set Screw	10-301	5/16 - 18 x 5/16 Steel
46	1	Thrust Collar	820-423	
50	1	Bearing Plate Gasket	840-123	
54	1	Oil Seal	840-129	
59	1	Drain Plug	16-111C	1/8 NPT Brass
84	1	Frame Sub Assembly	840-126	
85	2	Thrust Washers	820-052	
86	1	Bearing Sub Assembly	840-069	

SEAL OR PACKING DESIGN – 0000-00-00X0

MECHANICAL SEAL



PACKING

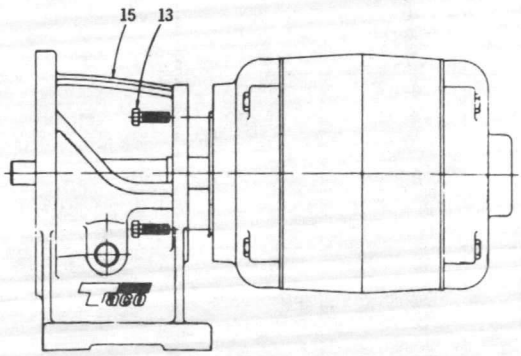


TYPE B STANDARD. TYPE D HI-TEMP. TYPE P PACKED. TYPE E CERAMIC.

Item No.	No. Reqd.	DESCRIPTION	SEAL OR PACKING DESIGN			REMARKS
			Type 'B'	Type 'D'	Type 'P'	
3	1	'O' Ring	*See Page 1*			
9	1	Impeller Spacer	900-026	900-026	Not Used	
10	1	Throttle Bushing	920-016	920-016	920-008	
20	1	Packing Set			900-241	
21	2	Studs			900-029	
22	1	Filler Ring (Not shown)	Not Used	Not Used	900-030	
23	1	Gland			920-015	Add "B" after No. for Bronze
24	2	Hex Nuts			12-129	3/8 - 16
28	1	Retainer Cap Gasket	920-014	920-014		
29	1	Water Seal (1)	900-024	900-087		
91	1	WATER SEAL KIT (1)	830-128BRP	840-128DRP	Not Used	Includes Items 28, 29, 35 & 67
30	4	Retainer Cap Bolts	10-208	10-208		3/8 - 16 x 7/8
32	1	Seal Retainer Cap	920-020	920-020		
35	1	Sleeve	900-027B	900-027B	920-006	
67	1	Sleeve Gasket	920-007	920-007	920-007	

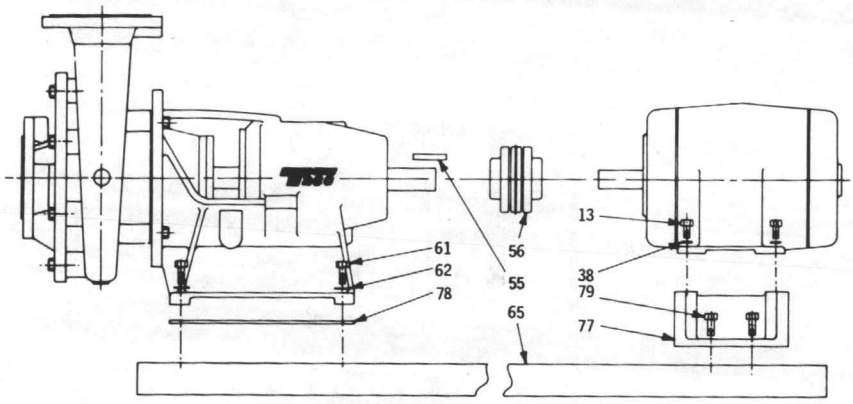
(1) For Ceramic Seal, order 900-215 or 840-128 ERP Kit.

CLOSE COUPLED (CC) FRAMES ---------- B4



NEMA FRAME Size "T"	NEMA FRAME Size "U"	ITEM 13 FR. BOLT Part No.	ITEM 13 FRAME BOLT Size	ITEM 15 PUMP FRAME
	48	10-223	(4) 1/2 - 13 x 1¼	920-004
	56	10-223	(4) 1/2 - 13 x 1¼	920-004
143	182	10-223	(4) 1/2 - 13 x 1¼	920-004
145	184	10-223	(4) 1/2 - 13 x 1¼	920-004
182	213	10-223	(4) 1/2 - 13 x 1¼	928-004
184	215	10-223	(4) 1/2 - 13 x 1¼	928-004
213	254	10-223	(4) 1/2 - 13 x 1¼	928-004
215	256	10-223	(4) 1/2 - 13 x 1¼	928-004
254	285	10-223	(4) 1/2 - 13 x 1¼	928-004T 900-126U
256	286	10-223	(4) 1/2 - 13 x 1¼	928-004T 900-126U
284		10-223	(4) 1/2 - 13 x 1¼	900-126

MOTOR PARTS – NOT PART OF SERIAL NUMBER
–Motor Frame Sizes Must be Specified When Ordering Parts Shown Below–



Item No.	No. Reqd.	DESCRIPTION	MOTOR FRAME SIZE (NEMA STD.) 'T'										REMARKS
			143-145T	182T	184T	213T	215T	254T	256T	284T	284TS	286TS	
65	1	Base Plate (1)	820-090	820-090	820-090	820-109	820-109	820-109	820-109	820-790	820-790	820-790	
77	2	Spacer	840-098	840-003	840-004	840-005	840-006	840-041	840-040	N/A	N/A	N/A	
78	2	Frame Spacer	N/A	N/A	N/A	N/A	N/A	N/A	N/A	840-106	840-106	840-106	
56	1	Coupler	900-193	900-206	900-206	900-195	900-195	900-197	900-197	900-538	900-197	900-199	
38	4	Mtr. Lck. Wshr.	14-104	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5/16
38	4	Mtr. Lck. Wshr.	N/A	14-101	14-101	14-101	14-101	N/A	N/A	N/A	N/A	N/A	3/8
38	4	Mtr. Lck. Wshr.	N/A	N/A	N/A	N/A	N/A	14-100	14-100	14-100	14-100	14-100	7/16
62	4	Frm. Lck. Wshr.	14-102	14-102	14-102	14-102	14-102	14-102	14-102	14-102	14-102	14-102	1/2
13	4	Mtr. Hx. Hd. Blt.	10-254	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5/16-18x1¼
13	4	Mtr. Hx. Hd. Blt.	N/A	10-221	10-221	10-221	10-221	N/A	N/A	N/A	N/A	N/A	3/8-16x1¼
13	4	Mtr. Hx. Hd. Blt.	N/A	N/A	N/A	N/A	N/A	10-209	N/A	N/A	N/A	N/A	7/16-14x1½
13	4	Mtr. Hx. Hd. Blt.	N/A	N/A	N/A	N/A	N/A	N/A	10-202	10-202	10-202	10-202	7/16-14x1¼
61	4	Fr. Hex. Hd. Blt.	10-238	10-238	10-238	10-238	10-238	10-238	10-238	N/A	N/A	N/A	1/2-13x1-5/8
61	4	Fr. Hex. Hd. Blt.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10-217	10-217	10-217	1/2-13x2½
79	4	Spr. Hx. Hd. Blt.	10-230	10-230	10-230	10-230	10-230	N/A	N/A	N/A	N/A	N/A	3/8-16x1
55	1	Coupler Key	13-100	13-100	13-100	13-100	13-100	13-100	13-100	13-100	13-100	13-100	1/4x1/4x1½
47	1	Coupler Guard	820-796	820-796	820-796	820-796	820-796	820-796	820-796	820-796	820-796	820-796	
48	4	CG. RdHd. Scw.	10-400	10-400	10-400	10-400	10-400	10-400	10-400	10-400	10-400	10-400	1/4-20x3/8
111		Coup. Insert	900-512	900-512	900-512	900-513	900-513	900-514	900-514	900-515	900-514	900-515	

(1) Add "A" to base plate number when coupler guard is to be used.

Item No.	No. Reqd.	DESCRIPTION	MOTOR FRAME SIZE (NEMA STD.) 'U'						REMARKS
			182U	184U	213U	215U	254U	256U	
65	1	Base Plate (1)	820-090	820-090	820-109	820-109	820-109	820-109	
77	2	Spacer	840-003	840-004	840-005	840-006	840-041	840-040	
78	2	Frame Spacer	N/A	N/A	N/A	N/A	N/A	N/A	
56	1	Coupler	900-193	900-193	900-206	900-206	900-195	900-195	
38	4	Motor Lock Wshr.	14-101	14-101	14-101	14-101	N/A	N/A	3/8
38	4	Motor Lock Wshr.	N/A	N/A	N/A	N/A	14-100	14-100	7/16
62	4	Frame Lock Wshr.	14-102	14-102	14-102	14-102	14-102	14-102	1/2
13	4	Mtr. Hx. Hd. Bolt	10-221	10-221	10-221	10-221	N/A	N/A	3/8 - 16 x 1¼
13	4	Mtr. Hx. Hd. Bolt	N/A	N/A	N/A	N/A	10-209	10-209	7/16 - 14 x 1½
61	4	Frm. Hx. Hd. Bolt	10-238	10-238	10-238	10-238	10-238	10-238	1/2 - 13 x 1-5/8
79	4	Spcr. Hx. Hd. Bolt	10-230	10-230	10-230	10-230	N/A	N/A	3/8 - 16 x 1
55	1	Coupler Key	13-100	13-100	13-100	13-100	13-100	13-100	1/4 x 1/4 x 1½
47	1	Coupler Guard	820-796	820-796	820-796	820-796	820-796	820-796	
48	4	C.G. Rd. Hd. Scrw.	10-400	10-400	10-400	10-400	10-400	10-400	1/4 - 20 x 3/8
111	1	Coupler Insert	900-512	900-512	900-513	900-513	900-514	900-514	

(1) Add "A" to base plate number when coupler guard is to be used.

Taco

MAINTENANCE AND SERVICING INSTRUCTIONS

NUMBER

IS 300-3-1

TACO "LP" SERIES

BALL & SLEEVE BEARING BASEMOUNTED AND CLOSE COUPLED

EFFECTIVE: 2/1/73
SUPERSEDES: IS 300-3-1 dtd. 3/31/68

MAINTENANCE AND SERVICING

Plant ID. No. 001-359

C1-GENERAL

Before undertaking any service work on the pump, read these instructions carefully to be readily prepared for the job. For your convenience TACO encloses with these instructions a list of replacement parts for each pump. Order parts required for maintenance work by listing item number, number required, description, and part number. Before taking pump apart, flange gaskets for pipe connections and a pump gasket kit should be available.

A step by step procedure of the most common maintenance jobs is given below. Follow it on the exploded views in the replacement parts list. In the description and on the drawings all parts are referred to by item numbers. To start any maintenance work stop pump and close suction and discharge lines. To gain access to internal parts of pump remove flanged nipple (spool piece) that has been provided on suction side of the pump.

If no freely removable piece is provided on suction side of pump, you can service the pump by disconnecting both suction and discharge flanges and removing the frame hold down bolts. The whole pump can now be moved for convenient servicing.

C2-REPLACING IMPELLER

Required replacement parts

Item No. 6	Impeller
Item No. 3	Suction Cover "O" Ring
1 Pair of	Pipe flange gaskets

DISASSEMBLY

Disconnect suction cover (1) by removing suction cover bolts (2).

Remove impeller bolt (4) with a socket or offset box wrench. Bolt has right hand thread. Place wrench over bolt head, hold wrench handle horizontally and hit handle end sharply with a plastic hammer. This should loosen bolt (Fig. 2). If this method is unsuccessful hold exposed section of motor shaft with a pipe wrench.

Remove Belleville Washer (66), impeller washer (5) and impeller spacer (18) (where used) together with impeller bolt (4).

Pull out impeller (6) and impeller key (7). The use of a wheel puller may be helpful in removing the impeller. If no wheel puller is available, insert impeller bolt (4) in shaft (42) and bring bolt head down on it. Hold a drift against the bolt head and hit it 2 or 3 times sharply with a hammer. This will normally loosen impeller from shaft (Fig 3). Next insert two screwdrivers, one on each side in the grooving of the impeller wear rings and pry out, taking care not to damage the wear rings (Fig. 4). If any burrs develop smooth out with emery cloth.

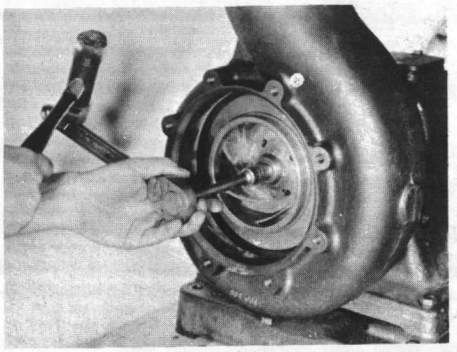
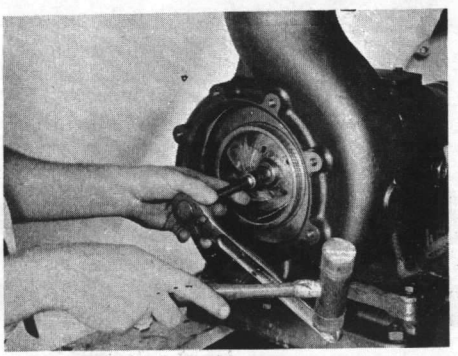


Fig. 1 — Disassembly



Reassembly

Fig. 2 – Removing and Replacing Impeller Bolt

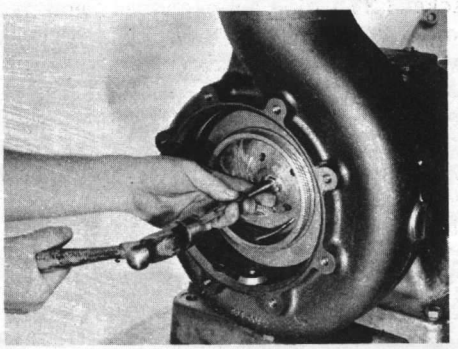


Fig. 3—Hitting on Drift—Impeller Bolt

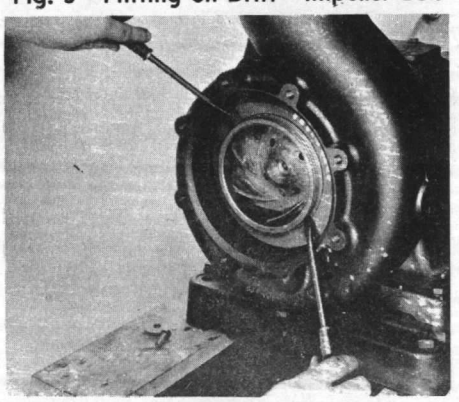


Fig. 4 — Prying Out of Impeller

C2-REPLACING IMPELLER -Continued

REASSEMBLY

Clean shaft end (42) and key slot. Apply some grease or oil and insert key in key way.

Apply grease to wear rings on both sides of replacement impeller (6) and slide over shaft end.

Apply grease or oil to the threads of impeller bolt (4), slide Belleville washer (66), impeller washer (5) and spacer (18) (where used) over it. Insert bolt (4) into shaft (42) and tighten firmly down by hitting sharply with a hammer on wrench handle end (Fig. 2).

Replace suction cover "O" ring (3) on suction cover (1).

Reassemble suction cover (1) to casing (8) and tighten cover bolts (2) evenly.

C3-REPLACING SEAL

Required replacement parts

Item No. 29	Waterseal
Item No. 90	Gasket Kit
Item No. 9	Impeller Spacer (if badly worn)
Item No. 35	Sleeve (if badly worn)
1 pair of	Pipe flange gaskets
Item No. 26	Cooling jacket "O" ring (where applicable)
Item No. 33	Casing "O"ring (where applicable)

It is difficult to determine which concealed parts are worn so it is recommended that if the pump has been in operation for some length of time that these concealed parts (item 9 & item 35) are also available before dismantling pump.

DISASSEMBLY

Follow disassembling steps of impeller replacement, paragraph C 2. Disconnect (where applicable) cooling jacket (27) pipe connections. Remove seal retainer cap bolts (30) with a ratchet type socket wrench. On larger models a 12 point box wrench may also be used. Tap seal retainer cap (32) to loosen it and slide it back on the shaft.

Remove casing (8) from frame (15) by taking casing bolts (16) out. Cooling jacket (27) (where used) will slide out with casing (8). Pry cooling jacket (27) off casing (8) by inserting screwdrivers in the casing "O" ring (33) slot. Slide impeller spacer (9), sleeve (35) with waterseal (29) on it, sleeve gasket (67) and seal retainer cap (32) off the shaft (42).

Remove spring retainer ring and spring of the seal from sleeve (35). To remove rotating seal part from sleeve, place sleeve (35) chamfered side down on a horizontal surface, slide seal retainer cap (32) over top of sleeve (35) and push down with both hands (Fig. 5).

Remove stationary seal seat from seal retainer cap (32). cap (32).

Discard old seal parts (29), sleeve gasket (67) and paper cap gasket (28). Discard also impeller spacer (9) and sleeve (35) if badly worn. Where cooling jacket is used, replace casing—and cooling jacket "O" rings (26,33).

REASSEMBLY

Clean, if necessary, with fine emery cloth, exposed shaft end (42), sleeve (35), impeller spacer (9) and seal retainer cap (32). Clean also portions of casing (8) which came in contact with seal (29) and throttle bushing (10) which is pressed into casing.

Place new seal seat in seal retainer cap (32). For ease of assembly, wet O.D. of seat with water. Hold the seal retainer cap (32) with both hands and press down on the seat with thumbs. Push alternately left and right hand side (Fig.6). Another method of placing the seat is to put the cardboard disc of the seal packaging on the top of the seal seat and then push down on it with a hammer handle (Fig.7). After the seat is placed on the seal retainer cap (32), check on the back side to see that the seal seat is properly seated against the seal retainer cap shoulder.

Apply some grease or oil to exposed shaft end (42). Slide sleeve gasket (67) and sleeve (35) over shaft. Chamfered side of sleeve should point toward impeller end (Fig.8). Place cap gasket (28) on seat retainer cap (32) and accurately line up bolt holes. Two drops of oil or grease on the contact face of the cap and gasket will hold these parts temporarily together. Slide seal retainer cap (32) with seal seat and cap gasket (28) over the sleeve (35) as far as it will go. Be careful not to damage seal seat.

Wet I.D. of rotating seal part (29 rubber) with water. Slide it, carbon washer facing seal seat, over sleeve. (35) Push seal (29) all the way back until it gently touches the seat. Slide the seal spring over the sleeve followed by the spring retainer ring with the raised portion toward the spring (Fig.8),

Clean—where applicable—cooling jacket (27) and replace "O" rings (26 & 33). Place cooling jacket over back of casing (8).

Assemble casing (8) to frame (15) and firmly tighten casing bolts (16) alternately.

Fig. 5 — PRESSING SEAL OFF SLEEVE

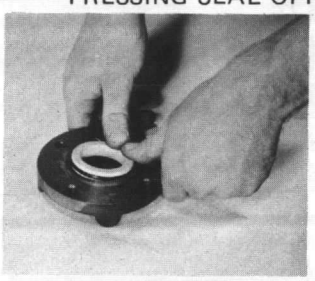


Fig. 6— PRESSING IN SEAL SEAT

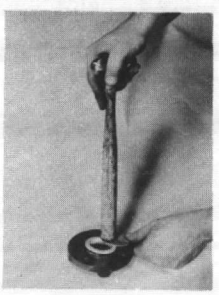


Fig. 7—PRESSING IN SEAL SEAT WITH HAMMER HANDLE

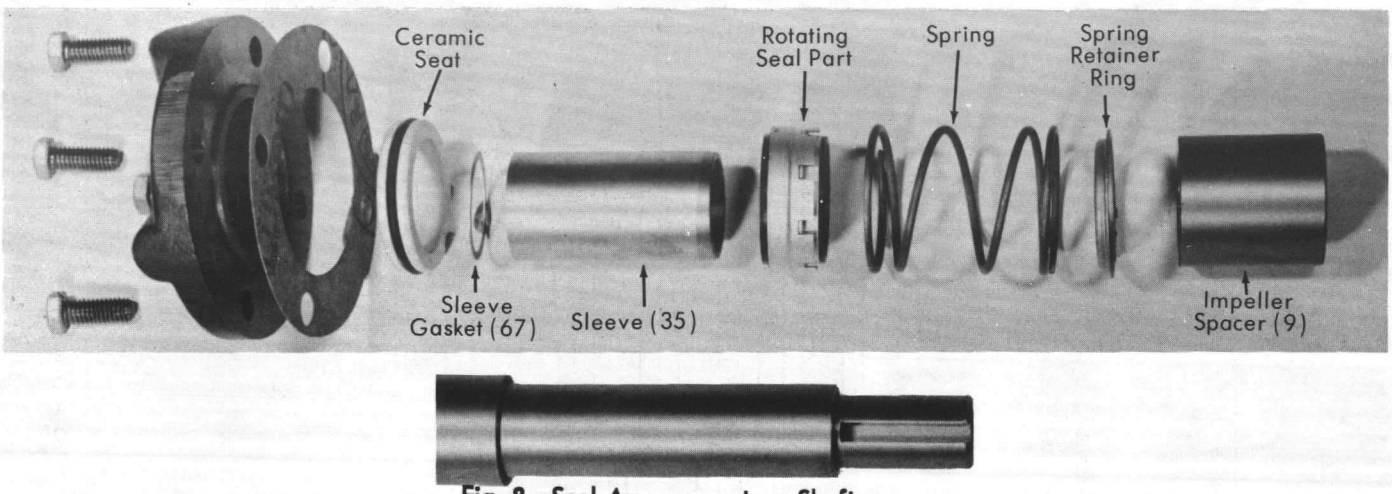


Fig. 8—Seal Arrangement on Shaft

C3—REPLACING SEAL-Continued

Place impeller spacer (9) on shaft (42) it will fit the space between throttle bushing (10) and shaft. Next follow reassembly directions for impeller.

Before reassembling suction cover (1) insert the two side cap bolts (30) through seal retainer cap (32) and cap gasket (28) and slide them towards rear end of casing (8) (Fig. 9). Start bolts in threaded holes and take up cap evenly by turning bolt (30) alternately on each side. Do this operation very carefully in order not to break seal. When cap reaches casing (8) insert also top and bottom bolt (30) and tighten all four alternately and evenly.

Reconnect (where applicable) cooling jacket (27) pipe connections.

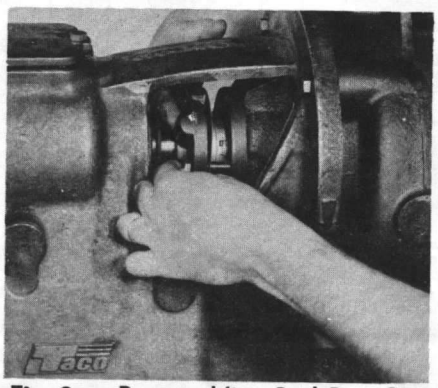


Fig. 9 — Reassembling Seal Ret. Cap

C4-REPLACING PACKING

Remove packing gland nuts (24) and slide gland (23) back as far as it will go.

Remove all old packing rings (20) with a flexible packing hook or one made from a piano wire with a short sharp hook.

Replace with graphite impregnated asbestos rings by a reliable packing manufacturer. Packing ring sizes are as follows:

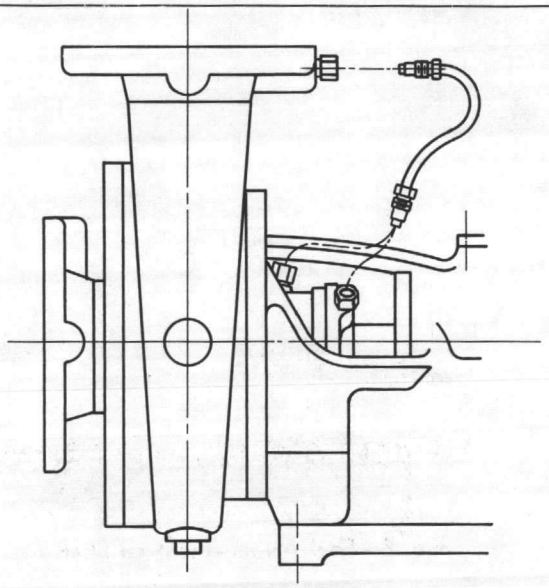
PUMP SIZE	NO. OF RINGS	RING SIZE I.D. O.D. Thickness
1¼-5, 1¼-6, 1½-5 1½-6, 1½-8, 2-5,2-6 2½-5, 2½-6, 3-5, 3-6	4	1¼"x1¾"x⅜"
2-8, 2½-8, 2½-10, 3-8 4-6	5	1¼"x2" x ⅜"
3-10, 4-8, 4-10, 4-12, 5-8 5-10, 5-12, 6-10	6	1½"x2¼"x ⅜"
6-12	5	2" x 3" x ½"

Solid rings should be split diagonally on one side. If a length of spiral packing is used, rings should be cut to ID's as shown above. Butts at joints should be made diagonally.

After rings (20) are ready to use, open first ring sufficiently to place around shaft (42) with opening at bottom and push into stuffing box chamber with the packing gland (23). Next, pull gland (23) back and insert next ring (20) with opening on top and again push into place with gland (23). Repeat this operation. alternating cuts in rings for the required number.

Slide gland (23) squarely up to the last packing ring (20) and hand tighten nuts (24) (Do not use a wrench at this time). Open discharge and suction valves. If packing does not leak or leaks slightly, pump may be started. If packing leaks excessively, tighten nuts (24) with a short wrench one or two turns, before starting pump. Permit more than normal (1 to 3 drops, per minute) leakage while pump is running for approximately 30 to 60 minutes. During this running in period, take up on the nuts (24) equally about one half (1/2) turn every five (5) minutes or so until at the end of the period you are getting a normal leak of 1 to 3 drops per minute. While pulling up on the nuts (24), make certain the gland (23) is being pulled up evenly.

INSTALLATION OF EXTERNAL CIRCULATION TUBE

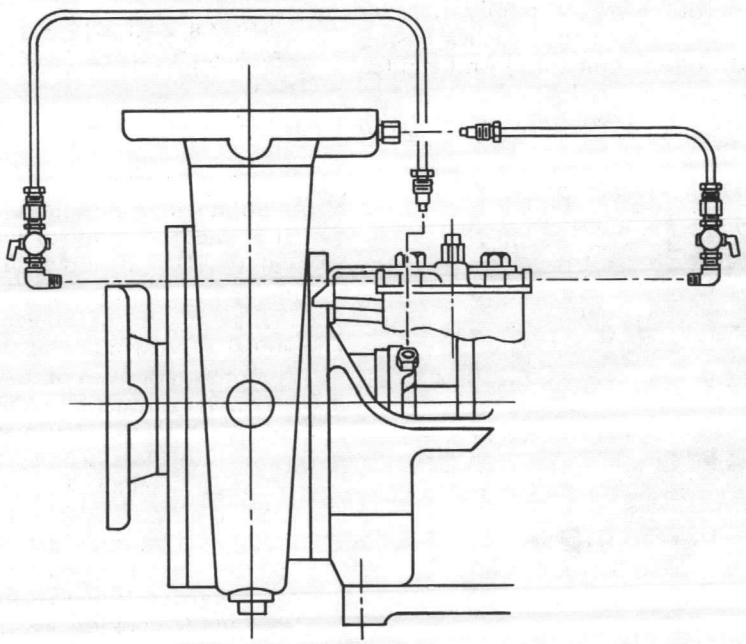


IMPORTANT

Before filling system with water, assemble external circulation tube to pump casing as follows:

1. Screw nut into body until hand tight.
2. With a wrench continue tightening for about one and one-half full additional turns. (It is not necessary to tighten nut all the way down)

INSTALLATION OF PUROCELL FILTER



IMPORTANT

1. Attach Filter to the pump by loosening the top bolt on the frame and casing and slip bracket under bolt and tighten.
2. If Recirculating line is installed — remove from frame and insert this end into inlet of Filter.
3. Attach line from outlet of the filter to seal retainer cap.

TACO, INC.
1160 Cranston Street, Cranston, Rhode Island 02920

Printed in U.S.A.

Taco

REPLACEMENT PARTS LIST

NUMBER
300PL3

Effective: December 1, 1976
Supersedes: 300PL3, 7/30/75

FOR FOLLOWING MODEL NUMBERS:

BM or CC: 2 - 8 2½ - 8 2½ - 10 3 - 8 & 4 - 6
BM or CC: 2008 2010 2012 2508 2510 3008 & 4006
SB or BB: 2008 2010 2012 2508 2510 3008 & 4006

WHEN SELECTING AND ORDERING PARTS, ALWAYS REFER TO SERIAL NUMBER ON NAME PLATE

—Example—

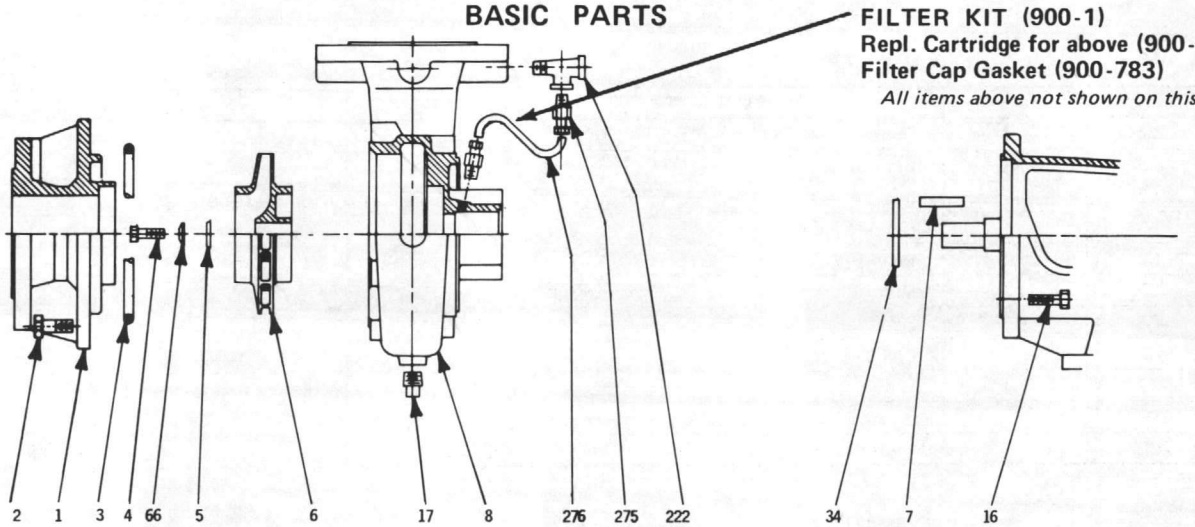
p. 1 ACTUAL IMPELLER DIAMETER
NOMINAL IMPELLER DIAMETER
FRAME SIZE & STYLE p. 2

2 - 8 - 7.9 — B1B1
OR
2008 - 7.9 — B6B1

p. 2 FRAME SIZE & STYLE
SEAL OR PACKING DESIGN p. 3

BASIC PARTS

FILTER KIT (900-1)
Repl. Cartridge for above (900-439)
Filter Cap Gasket (900-783)
All items above not shown on this sheet.



Item No.	No. Reqd.	DESCRIPTION	PART NO. PER PUMP SIZE						
			2 - 8 2008	2 - 10 2010	2 - 12 2012	2½ - 8 2508	2½ - 10 2510	3 - 8 3008	4 - 6 4006
1	1	Suction Cover (1)	920-003	883-003	884-003	928-003	922-003	934-003	938-003
2	8	Suction Cover Bolts	10-216	10-211	10-211	10-216	10-211	10-216	10-230
3	1	Suction Cover 'O' Ring	912-005	862-005	868-004	912-005	862-005	912-005	918-005
4	1	Impeller Bolt (SS)	10-257A	10-259A	10-259A	10-257A	10-257A	10-257A	10-257A
5	1	Impeller Washer	926-004	926-004	926-004	926-004	926-004	926-004	926-004
6	1	Impeller (1)	920-002	883-002	884-002	928-002	922-002	934-005	938-002
7	1	Impeller Key (SS)	13-104A	13-105A	13-105A	13-104A	13-104A	13-104A	13-104A
8	1	Casing (1) (2)	920-001	883-001	884-001	928-001	922-001	934-001	938-001
16	4	Casing Bolt	10-201	10-201	10-201	10-201	10-201	10-201	10-201
17	1	Drain Plug	16-102	16-104	16-104	16-102	16-102	16-102	16-102
34	1	Slinger Ring (3)	900-040	N/A	N/A	900-040	900-040	900-040	900-040
34	1	Slinger Ring (4)	900-044	900-044	900-044	900-044	900-044	900-044	900-044
66	1	Belleville Washer	900-053	900-053	900-053	900-053	900-053	900-053	900-053
222	1	Fitting	900-566	900-566	900-566	900-566	900-566	900-566	900-566
275	2	Fitting	900-798	900-798	900-798	900-798	900-798	900-798	900-798
276	1	Tube	900-728	900-728	900-728	900-728	900-728	900-728	900-728

(1) Add "B" after No. for Bronze.
(2) Throttle Bushing (Item 10), found in Seal Section, must be ordered with each casing.
(3) For Close Coupled Only.
(4) For Base Mounted Only.

TACO, Inc., 1160 Cranston Street, Cranston, Rhode Island 02920 U.S.A. Tel: (401) 942-8000 Telex: 92-7627

Litho in USA

Taco Heaters of Canada, Ltd., 3090 Lenworth Drive, Mississauga, Ontario Tel: (416) 625-2160 Telex: 06-961179

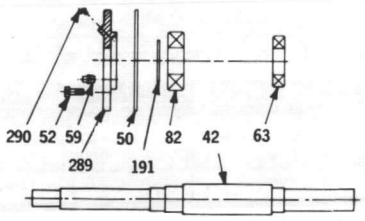
FRAME SIZE & STYLE – 0000-00-XX00

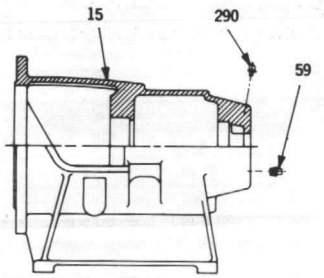
B1 **BALL BEARING DESIGN:** Update pump with 840-124RP Complete Frame Assembly. Please furnish all nameplate data to insure proper updated nameplate.

B2 **SLEEVE BEARING DESIGN:** Update pump with 840-110RP Complete Frame Assembly. Please furnish all nameplate data to insure proper updated nameplate.

B3 **SLEEVE BEARING DESIGN:** *Same as B2 design.*

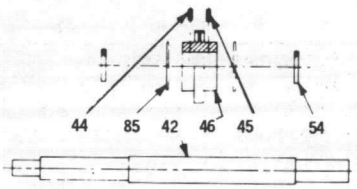
B5 BALL BEARING DESIGN:

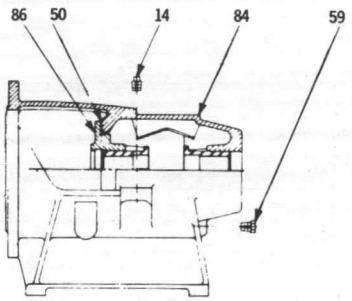




Item No.	No. Req.	DESCRIPTION	PART NO.	REMARKS
74	1	Frame Assembly (complete)	840-124RP	
15	1	Frame	840-111	
42	1	Shaft	840-113	Add SS for Stainless Steel
50	1	Bearing Plate Gasket	840-123	
52	4	Bearing Plate Bolt	10-230	3/8 - 16 x 1
59	2	Drain Plug	16-111C	1/8 NPT Brass
63	1	Ball Bearing	840-114	
82	1	Ball Bearing	840-071	
191	1	Retainer Ring	15-105	
289	1	Bearing Cover Plate Assembly	840-120	
290	2	Lubrication Fitting	15-200	

B6 SLEEVE BEARING DESIGN:

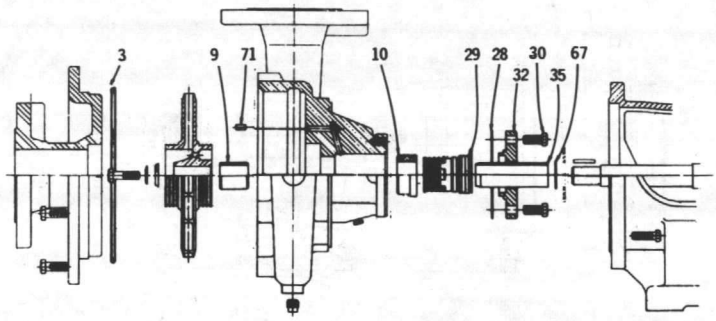




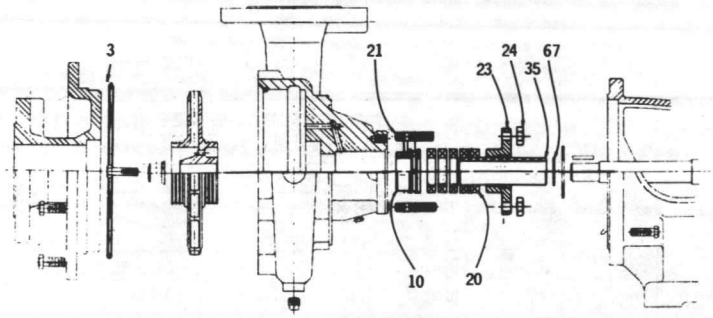
Item No.	No. Req.	DESCRIPTION	PART NO.	REMARKS
74	1	Frame Assembly (complete)	840-110RP	
14	1	Pipe Plug	16-102	3/8 NPT Steel
42	1	Shaft	820-048	Add SS for Stainless Steel
44	1	Cone Point Set Screw	10-310	5/16 - 18 x 3/8 Steel
45	1	Cup Point Set Screw	10-301	5/16 - 18 x 5/16 Steel
46	1	Thrust Collar	820-423	
50	1	Bearing Plate Gasket	840-123	
54	1	Oil Seal	840-129	
59	1	Drain Plug	16-111C	1/8 NPT Brass
84	1	Frame Sub Assembly	840-126	
85	2	Thrust Washers	820-052	
86	1	Bearing Sub Assembly	840-069	

SEAL OR PACKING DESIGN – 0000-00-00X0

MECHANICAL SEAL



PACKING

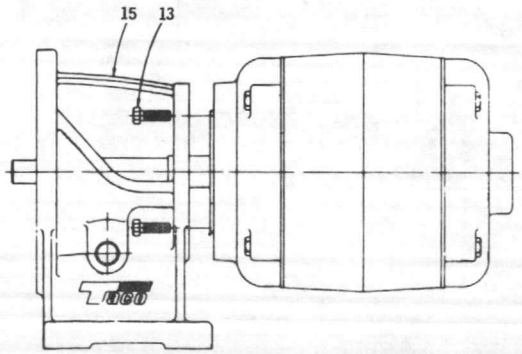


TYPE B STANDARD. TYPE D HI-TEMP. TYPE P PACKED. TYPE E CERAMIC.

Item No.	No. Reqd.	DESCRIPTION	SEAL OR PACKING DESIGN			REMARKS
			Type 'B'	Type 'D'	Type 'P'	
3	1	'O' Ring	*See Page 1*			
9	1	Impeller Spacer	900-026	900-026	Not Used	
10	1	Throttle Bushing	920-016	920-016	920-008	
20	1	Packing Set			900-241	
21	2	Studs			900-029	
22	1	Filler Ring (Not shown)	Not Used	Not Used	900-030	
23	1	Gland			920-015	Add "B" after No. for Bronze
24	2	Hex Nuts			12-129	3/8 - 16
28	1	Retainer Cap Gasket	920-014	920-014		
29	1	Water Seal (1)	900-024	900-087		
91	1	WATER SEAL KIT (1)	830-128BRP	840-128DRP	Not Used	Includes Items 28, 29, 35 & 67
30	4	Retainer Cap Bolts	10-208	10-208		3/8 - 16 x 7/8
32	1	Seal Retainer Cap	920-020	920-020		
35	1	Sleeve	900-027B	900-027B	920-006	
67	1	Sleeve Gasket	920-007	920-007	920-007	

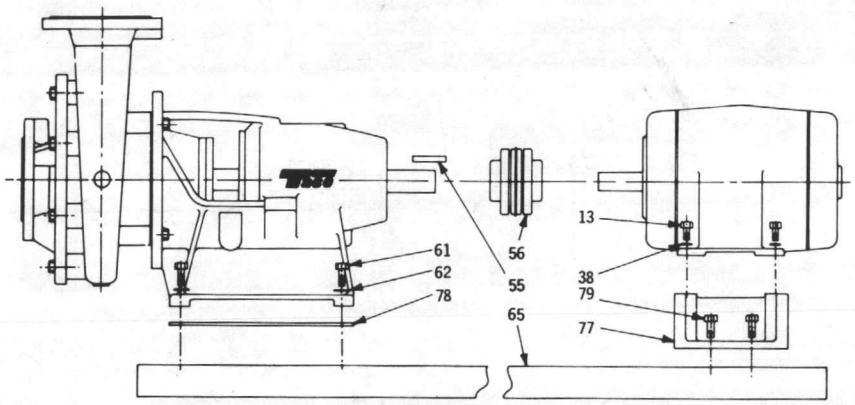
(1) For Ceramic Seal, order 900-215 or 840-128 ERP Kit.

CLOSE COUPLED (CC) FRAMES ---------- B4



NEMA FRAME Size "T"	NEMA FRAME Size "U"	ITEM 13 FR. BOLT Part No.	ITEM 13 FRAME BOLT Size	ITEM 15 PUMP FRAME
	48	10-223	(4) 1/2 - 13 x 1¼	920-004
	56	10-223	(4) 1/2 - 13 x 1¼	920-004
143	182	10-223	(4) 1/2 - 13 x 1¼	920-004
145	184	10-223	(4) 1/2 - 13 x 1¼	920-004
182	213	10-223	(4) 1/2 - 13 x 1¼	928-004
184	215	10-223	(4) 1/2 - 13 x 1¼	928-004
213	254	10-223	(4) 1/2 - 13 x 1¼	928-004
215	256	10-223	(4) 1/2 - 13 x 1¼	928-004
254	285	10-223	(4) 1/2 - 13 x 1¼	928-004T 900-126U
256	286	10-223	(4) 1/2 - 13 x 1¼	928-004T 900-126U
284		10-223	(4) 1/2 - 13 x 1¼	900-126

MOTOR PARTS – NOT PART OF SERIAL NUMBER
–Motor Frame Sizes Must be Specified When Ordering Parts Shown Below–



Item No.	No. Reqd.	DESCRIPTION	MOTOR FRAME SIZE (NEMA STD.) 'T'										REMARKS
			143-145T	182T	184T	213T	215T	254T	256T	284T	284TS	286TS	
65	1	Base Plate (1)	820-090	820-090	820-090	820-109	820-109	820-109	820-109	820-790	820-790	820-790	
77	2	Spacer	840-098	840-003	840-004	840-005	840-006	840-041	840-040	N/A	N/A	N/A	
78	2	Frame Spacer	N/A	N/A	N/A	N/A	N/A	N/A	N/A	840-106	840-106	840-106	
56	1	Coupler	900-193	900-206	900-206	900-195	900-195	900-197	900-197	900-538	900-197	900-199	
38	4	Mtr. Lck. Wshr.	14-104	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5/16
38	4	Mtr. Lck. Wshr.	N/A	14-101	14-101	14-101	14-101	N/A	N/A	N/A	N/A	N/A	3/8
38	4	Mtr. Lck. Wshr.	N/A	N/A	N/A	N/A	N/A	14-100	14-100	14-100	14-100	14-100	7/16
62	4	Frm. Lck. Wshr.	14-102	14-102	14-102	14-102	14-102	14-102	14-102	14-102	14-102	14-102	1/2
13	4	Mtr. Hx. Hd. Blt.	10-254	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5/16-18x1¼
13	4	Mtr. Hx. Hd. Blt.	N/A	10-221	10-221	10-221	10-221	N/A	N/A	N/A	N/A	N/A	3/8-16x1¼
13	4	Mtr. Hx. Hd. Blt.	N/A	N/A	N/A	N/A	N/A	10-209	N/A	N/A	N/A	N/A	7/16-14x1½
13	4	Mtr. Hx. Hd. Blt.	N/A	N/A	N/A	N/A	N/A	N/A	10-202	10-202	10-202	10-202	7/16-14x1¼
61	4	Fr. Hex. Hd. Blt.	10-238	10-238	10-238	10-238	10-238	10-238	10-238	N/A	N/A	N/A	1/2-13x1-5/8
61	4	Fr. Hex. Hd. Blt.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10-217	10-217	10-217	1/2-13x2½
79	4	Spr. Hx. Hd. Blt.	10-230	10-230	10-230	10-230	10-230	N/A	N/A	N/A	N/A	N/A	3/8-16x1
55	1	Coupler Key	13-100	13-100	13-100	13-100	13-100	13-100	13-100	13-100	13-100	13-100	1/4x1/4x1½
47	1	Coupler Guard	820-796	820-796	820-796	820-796	820-796	820-796	820-796	820-796	820-796	820-796	
48	4	CG. RdHd. Scw.	10-400	10-400	10-400	10-400	10-400	10-400	10-400	10-400	10-400	10-400	1/4-20x3/8
111		Coup. Insert	900-512	900-512	900-512	900-513	900-513	900-514	900-514	900-515	900-514	900-515	

(1) Add "A" to base plate number when coupler guard is to be used.

Item No.	No. Reqd.	DESCRIPTION	MOTOR FRAME SIZE (NEMA STD.) 'U'						REMARKS
			182U	184U	213U	215U	254U	256U	
65	1	Base Plate (1)	820-090	820-090	820-109	820-109	820-109	820-109	
77	2	Spacer	840-003	840-004	840-005	840-006	840-041	840-040	
78	2	Frame Spacer	N/A	N/A	N/A	N/A	N/A	N/A	
56	1	Coupler	900-193	900-193	900-206	900-206	900-195	900-195	
38	4	Motor Lock Wshr.	14-101	14-101	14-101	14-101	N/A	N/A	3/8
38	4	Motor Lock Wshr.	N/A	N/A	N/A	N/A	14-100	14-100	7/16
62	4	Frame Lock Wshr.	14-102	14-102	14-102	14-102	14-102	14-102	1/2
13	4	Mtr. Hx. Hd. Bolt	10-221	10-221	10-221	10-221	N/A	N/A	3/8 - 16 x 1¼
13	4	Mtr. Hx. Hd. Bolt	N/A	N/A	N/A	N/A	10-209	10-209	7/16 - 14 x 1½
61	4	Frm. Hx. Hd. Bolt	10-238	10-238	10-238	10-238	10-238	10-238	1/2 - 13 x 1-5/8
79	4	Spcr. Hx. Hd. Bolt	10-230	10-230	10-230	10-230	N/A	N/A	3/8 - 16 x 1
55	1	Coupler Key	13-100	13-100	13-100	13-100	13-100	13-100	1/4 x 1/4 x 1½
47	1	Coupler Guard	820-796	820-796	820-796	820-796	820-796	820-796	
48	4	C.G. Rd. Hd. Scrw.	10-400	10-400	10-400	10-400	10-400	10-400	1/4 - 20 x 3/8
111	1	Coupler Insert	900-512	900-512	900-513	900-513	900-514	900-514	

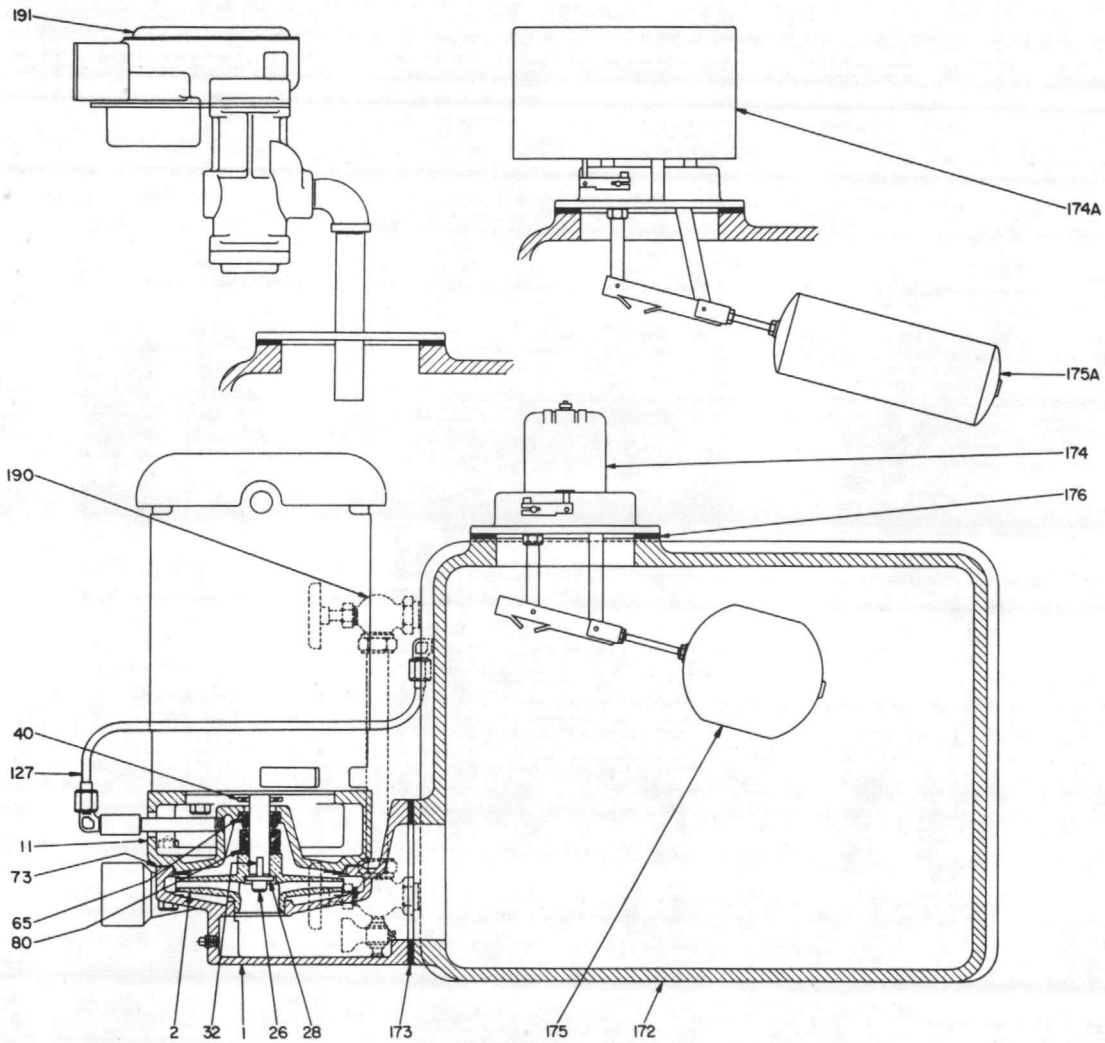
(1) Add "A" to base plate number when coupler guard is to be used.

LFE CORPORATION
Fluids Control Division
EASTERN • MIDLAND • WEINMAN
100 Skiff Street • Hamden, Connecticut 06514
TEL. (203) 248-3841 TELEX 963425

WEINMAN

REPAIR PARTS LIST

TYPES "ACV & AEV" VERTICAL CONDENSATE UNIT
CAST IRON RECEIVERS
(With Type 6 Mechanical Shaft Seal)



Item No.	Name	Material of Construction (St'd Fitted)	Item No.	Name	Material of Construction (St'd Fitted)
1	CASING	CAST IRON	127	SEAL VENT PIPING	COPPER
* 2	IMPELLER	BRONZE	172	RECEIVER	CAST IRON
11	CASING COVER	CAST IRON	*173	RECEIVER GASKET	RUBBER
*26	IMPELLER SCREW	STAINLESS	174	FLOAT SWITCH	Sq. D. #9037
*28	IMPELLER SCREW WASHER	STAINLESS	174A	MECHANICAL ALTERNATOR	Sq. D. #9038
*32	IMPELLER KEY	STAINLESS	175	FLOAT (Float Switch)	COPPER
40	DEFLECTOR (Liquid)	NEOPRENE	175A	FLOAT (Alternator)	COPPER
† *65	MECHANICAL SHAFT SEAL (Stationary Element)	CERAMIC	176	FLOAT SWITCH GASKET	RUBBER
*73	CASING GASKET	ASBESTOS	190	WATER GAUGE	BRASS
† *80	MECHANICAL SHAFT SEAL (Rotating Element)	CARBON	191	MAKE-UP VALVE (When Specified)	McDonnell #101

* FOR DOMESTIC SERVICE WE RECOMMEND THESE PARTS BE CARRIED IN STOCK AS SPARES.

† FURNISHED ONLY IN PAIRS AS COMPLETE UNIT.

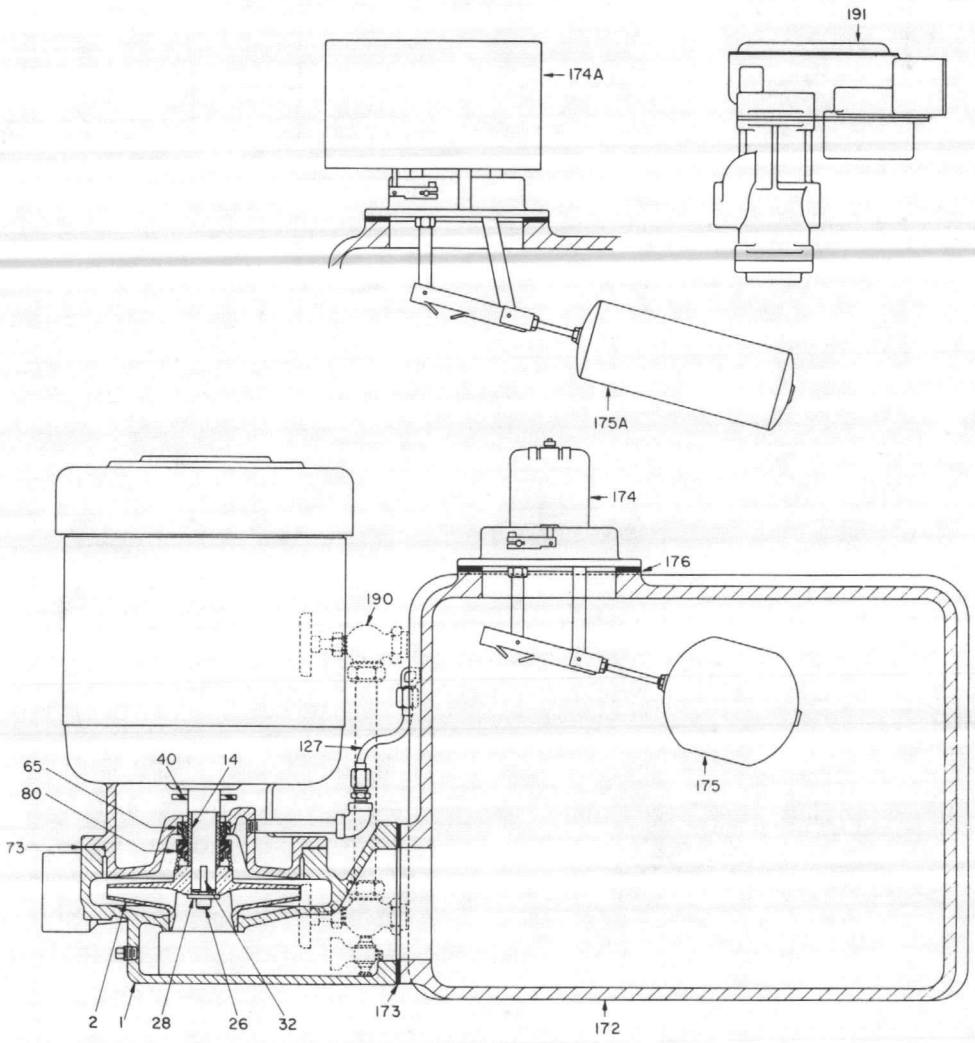
WHEN WRITING THE FACTORY REGARDING YOUR PUMP – ALWAYS INCLUDE SERIAL NUMBER

LFE CORPORATION
Fluids Control Division
EASTERN • MIDLAND • WEINMAN
100 Skiff Street • Hamden, Connecticut 06514
TEL. (203) 248-3841 TELEX 963425

WEINMAN

REPAIR PARTS LIST

TYPES "ACV & AEV" VERTICAL CONDENSATE UNIT
CAST IRON RECEIVERS
(With Type 21 Mechanical Shaft Seal)



Item No.	Name	Material of Construction (St'd Fitted)	Item No.	Name	Material of Construction (St'd Fitted)
1	CASING	CAST IRON	127	SEAL VENT PIPING	COPPER
* 2	IMPELLER	BRONZE	172	RECEIVER	CAST IRON
*14	SHAFT SLEEVE	BRONZE	*173	RECEIVER GASKET	RUBBER
*26	IMPELLER SCREW	STAINLESS	174	FLOAT SWITCH	Sq. D. #9037
*28	IMPELLER SCREW WASHER	STAINLESS	174A	MECHANICAL ALTERNATOR	Sq. D. #9038
*32	IMPELLER KEY	STAINLESS	175	FLOAT (Float Switch)	COPPER
40	DEFLECTOR (Liquid)	NEOPRENE	175A	FLOAT (Alternator)	COPPER
† *65	MECHANICAL SHAFT SEAL (Stationary Element)	CERAMIC	176	FLOAT SWITCH GASKET	RUBBER
*73	CASING GASKET	ASBESTOS	190	WATER GAUGE	BRASS
† *80	MECHANICAL SHAFT SEAL (Rotating Element)	CARBON	191	MAKE-UP VALVE (When Specified)	McDonnell #101

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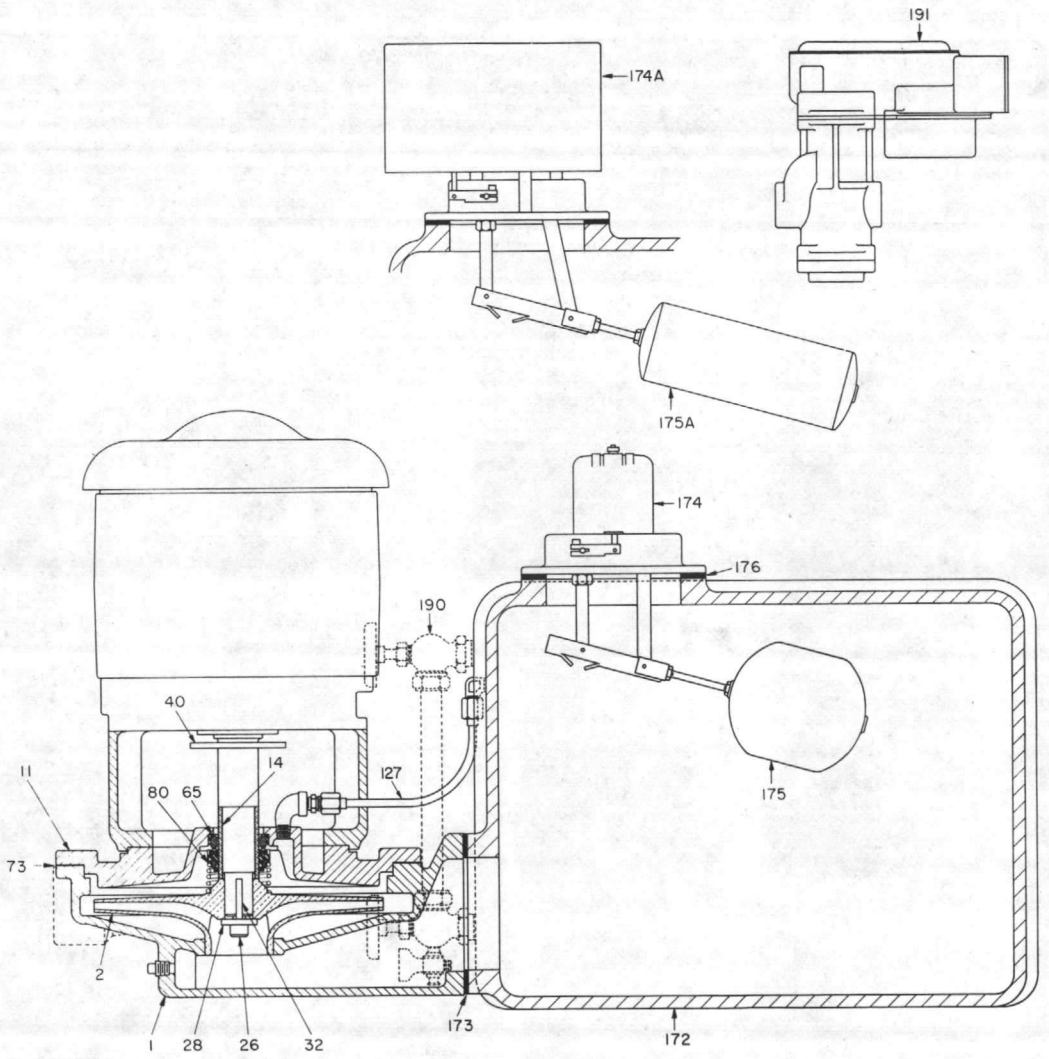
WHEN WRITING THE FACTORY REGARDING YOUR PUMP – ALWAYS INCLUDE SERIAL NUMBER

Supersedes March 26, 1962 Issue

LFE CORPORATION weinman pump company
290 Spruce Street Columbus, Ohio 43215 (614) 221-6351

REPAIR PARTS LIST

TYPES "6 ADV & 6 AFV" VERTICAL CONDENSATE UNIT
CAST IRON RECEIVERS
(With Type 21 Mechanical Shaft Seal)



Item No.	Name	Material of Construction (St'd Fitted)
1	CASING	CAST IRON
* 2	IMPELLER	BRONZE
11	CASING COVER	CAST IRON
*14	SHAFT SLEEVE	BRONZE
*26	IMPELLER SCREW	STAINLESS
*28	IMPELLER SCREW WASHER	STAINLESS
*32	IMPELLER KEY	STAINLESS
40	DEFLECTOR (Liquid)	NEOPRENE
† *65	MECHANICAL SHAFT SEAL (Stationary Element)	CERAMIC
*73	CASING GASKET	ASBESTOS
† *80	MECHANICAL SHAFT SEAL (Rotating Element)	CARBON
127	SEAL VENT PIPING	COPPER
172	RECEIVER	CAST IRON
*173	RECEIVER GASKET	RUBBER
174	FLOAT SWITCH	Sq. D. #9037
174A	MECHANICAL ALTERNATOR	Sq. D. #9038
175	FLOAT (Float Switch)	COPPER
175A	FLOAT (Alternator)	COPPER
176	FLOAT SWITCH GASKET	RUBBER
190	WATER GAUGE	BRASS
191	MAKE-UP VALVE (When Specified)	McDonnell #101

* FOR DOMESTIC SERVICE WE RECOMMEND THESE PARTS BE CARRIED IN STOCK AS SPARES.

† FURNISHED ONLY IN PAIRS AS COMPLETE UNIT.

WHEN WRITING THE FACTORY REGARDING YOUR PUMP — ALWAYS INCLUDE SERIAL NUMBER

Supersedes March 26, 1962 Issue

Taco

INSTRUCTION SHEET

INSTRUCTION SHEET NUMBER

IS-200-1-1

HEAT EXCHANGERS

Effective: March 15, 1965
Supersedes: NEW

INSTALLATION

1. Allow sufficient clearance for removal of tube bundle.
2. After initial start and run at operating temperatures and pressures, shut down and tighten head bolts.
3. Make certain that tubing is full of water before introducing steam or hot water into shell, otherwise flashing or noise may occur.

CLEANING

Shell and tube bundle should be flushed out periodically. If cleaning is necessary, remove head and bundle to clean inside of shell and outside of tubes. Replace gaskets if necessary.

If unit is installed in a hard water area, inside of tubing can be cleaned as follows: -

1. - Break water connections and plug bottom opening.
2. - Fill the tubes with a solution of 1 part muriatic acid to 10 parts of water and allow to stand for 2 hours.
   CAUTION: A longer period may cause damage to the copper tubing.
3. - Drain off and flush thoroughly with clean water.
4. - Re-Assemble unit.

NOTE

Commercially available cleaners may also be used.

REPLACEMENT PARTS

When ordering Replacement Parts specify complete model number from nameplate.

Normally, the only Replacement Parts required would be:

1 - Tube Bundle
1 - Set of Gaskets

Replacement Heads are also available if required.

Taco Heaters of Canada, Ltd.
3090 Lenworth Drive
Cooksville, Ontario

TACO, INC. 1160 Cranston Street, Cranston, Rhode Island 02920

Printed In U.S.A.

REPLACEMENT PARTS

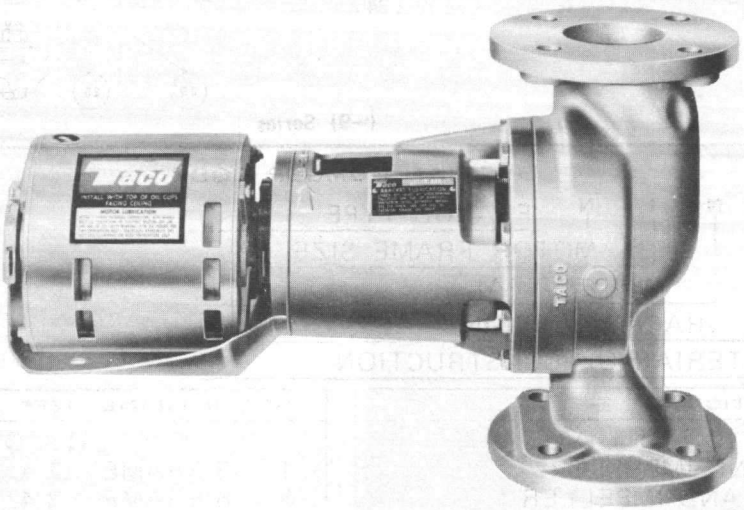
NUMBER
300-1PL-1

Effective: 12/1/76
Supersedes: 100-PL-15 and 300-1PL-1, both dated 2/11/74

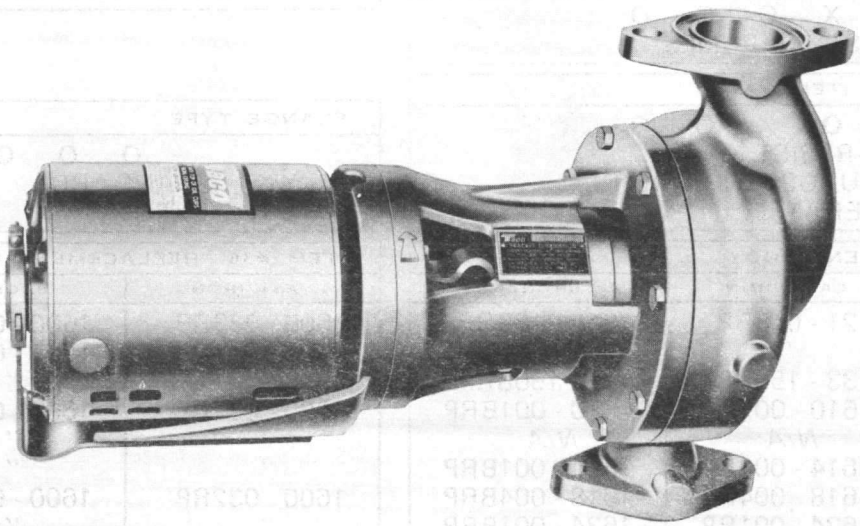
121 THRU 138 PUMPS
1600 SERIES PUMPS

IMPORTANT: When ordering, always specify part number, part name, and complete model number of pump.

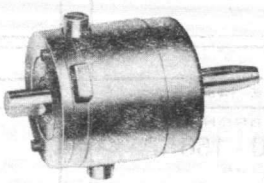
CARTRIDGE DESIGN PUMPS



121 — 138 SERIES PUMPS



1600 SERIES PUMPS

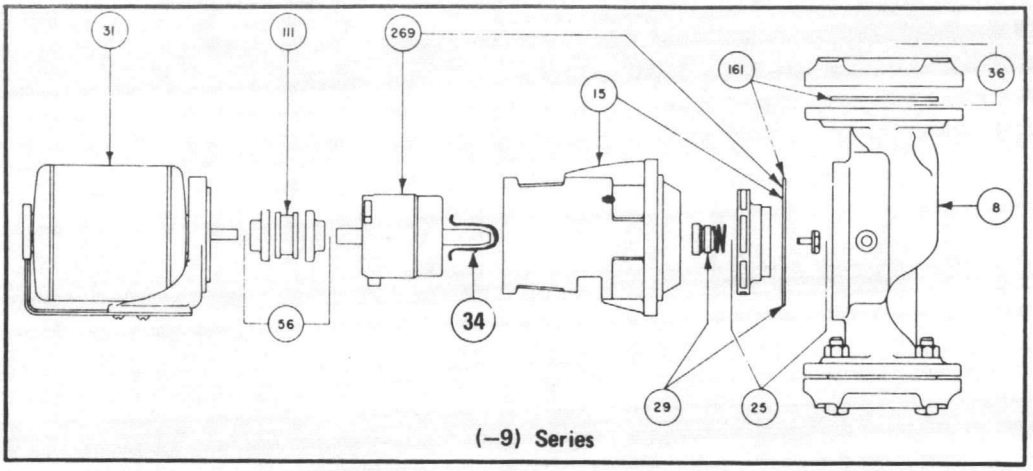


Taco, Incorporated 1160 Cranston Street, Cranston, Rhode Island 02920 Telephone [401] 942-8000 Telex: 92-7627

Litho in U.S.A.

Taco Heaters of Canada, Ltd. 3090 Lenworth Drive, Mississauga, Ontario Telephone [416] 625-2160 Telex: 06-961179

REPLACEMENT PARTS FOR (–9) AND SERIAL NUMBER CARTRIDGE DESIGN PUMPS



(–9) Series

SERIAL NUMBER CODE

1600C - - - 4.25 C 1 N 1 N

- N — FLANGE TYPE
- 1 — MOTOR FRAME SIZE
- N — WATER SEAL
- 1 — BRACKET DESIGN
- C — MATERIAL OF CONSTRUCTION

MATERIAL OF CONSTRUCTION

X O O O O

A CAST IRON PUMP AND IMPELLER
B ALL BRONZE PUMP AND IMPELLER
C CAST IRON PUMP AND BRONZE IMPELLER

BRACKET DESIGN

O X O O O

1 ALL CURRENT STYLE PUMPS

WATER SEAL TYPE, ITEM #29

O O X O O

N 1600 - 170RP NI-RESIST
H 1600 - 170HRP TUNGSTEN CARBIDE
E 1600 - 170ERP CERAMIC

MOTOR FRAME SIZE*

O O O X O

1 48 FRAME (1/4, 1/3, 1/2 HP)
2 56 FRAME (3/4, 1 HP)
3 56 FRAME (1½, & 2 HP)
4 56 FRAME (3 HP)

*Refer to standard motors only. See nameplate for other motors.

FLANGE TYPE

O O O O X

N NPT (STANDARD)
D DIN (EXPORT)

ITEM #8 REPLACEMENT BODY

PUMP MOD. NO.	CAST IRON	BRONZE
121	121 - 018RP	121 - 018BRP
122	"	"
131, 32, 33 & 38[1]	133 - 150RP	133 - 150BRP
1600, 10, 11[1]	1610 - 001RP	1610 - 001BRP
1602, 1604[2]	*N/A*	*N/A*
1612, 14, 15	1614 - 001RP	1614 - 001BRP
1616, 18, 19	1618 - 004RP	1618 - 004BRP
1620, 22, 24	1634 - 001RP	1634 - 001BRP
1630, 1632	"	"
1634, 1635	"	"
1636, 1638	1640 - 002RP	1640 - 002BRP
1640, 1641	"	"

ITEM #36 REPLACEMENT FLANGE SET

CAST IRON	BRONZE	
1600 - 033RP	1600 - 033BRP	
1600 - 034RP	1600 - 034BRP	
"	"	
1600 - 031RP	1600 - 031BRP	
"	"	
"	"	
1600 - 032RP	1600 - 032BRP	
"	"	
"	"	
"	"	
1600 - 174RP	1600 - 174BRP	
"	"	

ITEM #15 REPLACEMENT BRACKET

PUMP MOD. NO.	MOTOR FRAME SIZE (48)	
	CAST IRON	BRONZE
121, 122	1600 - 155RP	1600 - 156RP
1600, 10, 11	"	"
1602, 1604	1600 - 175RP	1600 - 176BRP
1612, 20, 30	"	"
131, 132, 1615	"	"
133, 138	"	"
1614, 22, 24	"	"

MOTOR FRAME SIZE (56)		ITEM #161 GASKET KIT
CAST IRON	BRONZE	
		1600 - 050RP
		"
		"
		"
1624 - 023RP	1624 - 024RP	"
1624 - 023RP	1624 - 024RP	"
"	"	"

ITEM #15 REPLACEMENT BRACKET (CONT.)					ITEM #161 GASKET KIT
PUMP MOD. NO.	MOTOR FRAME SIZE (48)		MOTOR FRAME SIZE (56)		
	CAST IRON	BRONZE	CAST IRON	BRONZE	
1632, 34, 35	1600 - 175RP	1600 - 176RP	1604 - 023RP	1604 - 024RP	1600 - 050RP
1635			1604 - 025RP	1604 - 026RP	"
1616, 19, 36			"	"	1618 - 006RP
1619			1604 - 023RP	1604 - 024RP	"
1638, 40, 41			1604 - 025RP	1604 - 026RP	"

ITEM #25 REPLACEMENT IMPELLER ASSEMBLY							
PUMP NO.	(-9) PUMPS	CURRENT	DIA.	PUMP NO.	(-9) PUMPS	CURRENT	DIA.
121, 122	121 - 142BRP	SAME	4.300	1618	1618 - 001BRP	*N/A*	7.900
131	131 - 075BRP	1630 - 023BRP	4.5	1619*	*N/A*	1619 - 001BRP	7.885
132	132 - 063BRP	1630 - 022BRP	4.90	1620	1620 - 022BRP	*N/A*	5.100
133	133 - 075BRP	1632 - 022BRP	5.60	1622	1622 - 020BRP	*N/A*	5.800
138	138 - 037BRP	1634 - 023BRP	6.15	1624	1624 - 040BRP	*N/A*	6.500
1600	1600 - 079BRP	1610 - 020BRP	4.25	1630	1630 - 022BRP	SAME	4.900
1610	1610 - 019BRP	SAME	4.75	1632	1632 - 022BRP	SAME	5.600
1611*	*N/A*	1611 - 001BRP	4.73	1634	1634 - 023BRP	SAME	6.150
1612	1612 - 019BRP	SAME	5.50	1635*	*N/AS*	1635 - 001BRP	6.135
1614	1614 - 018BRP	SAME	6.10	1636	1636 - 001BRP	SAME	6.250
1615*	*N/A*	1615 - 001BRP	6.08	1638	1638 - 001BRP	SAME	7.000
1616	1616 - 002BRP	SAME	6.60	1640	1640 - 001BRP	*N/A*	7.900
				1641*	*N/A*	1641 - 001BRP	7.88

*When ordering, please advise diameter of impeller.

ITEM #31 REPLACEMENT MOTOR ASSEMBLY*				
HP	115/60/1	115/230/60/1	200/60/3	230/460/60/3
1/4	121 - 151RP	*N/A*	121 - 148RP	121 - 137RP
1/3	131 - 143RP	*N/A*	131 - 115RP	131 - 137RP
1/2	*N/A*	132 - 096RP	132 - 066RP	132 - 097RP
3/4	*N/A*	133 - 119RP	133 - 140RP	133 - 134RP
1	*N/A*	138 - 119RP	138 - 148RP	138 - 142RP
1½	*N/A*	1636 - 013RP	1636 - 019RP	1636 - 010RP
2	*N/A*	1638 - 012RP	1638 - 015RP	1638 - 010RP
3	*N/A*	*N/A*	1640 - 013RP	1640 - 010RP

*When ordering other than standard, refer to nameplate, then consult factory.

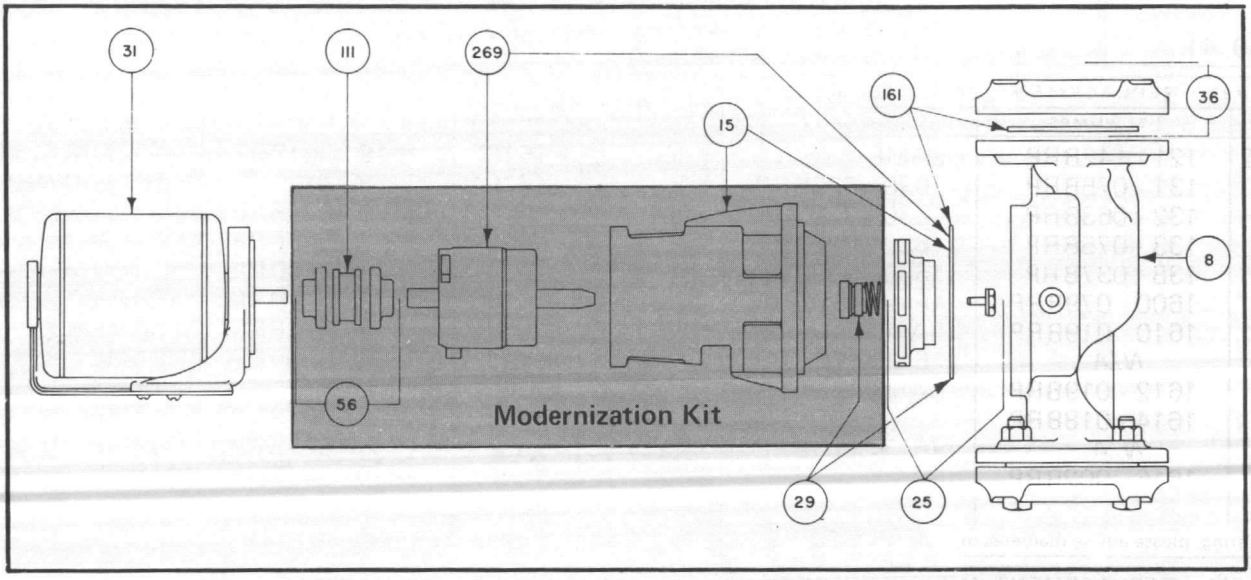
ITEM #34 SHAFT SLEEVE	1600 - 205RP	All –9 and Serial Number Pumps.
ITEM #56 COUPLER	1624 - 053RP	All Inline Pumps.
ITEM #111 RUBBER INSERT	1624 - 004RP	All Pumps with 1/4 thru 1 HP.
ITEM #111 RUBBER INSERT	1624 - 047RP	All Pumps with 1½ thru 3 HP.
ITEM #269 CARTRIDGE ASSY.	1600 - 160RP	All –9 and Serial Number Pumps.

Note (1) When replacing Item #8 body on 131, 132, 133, 138 and 1600C - 1 & - 9, you must also order current style impeller.

Note (2) Body for the 1602 & 1604 are no longer available. Consult factory.

REPLACEMENT PARTS FOR OLD STYLE PUMPS AND CIRCULATORS

121, 122, 131, 132, 138, 1600, 1602, 1604, 1610, 1612, 1614, 1620, 1622, 1624, 1630, 1632 AND 1634



ITEM #8	BODY	Same as –9 and Serial Number Pumps.
ITEM #25	IMPELLER AND SHAFT ASSEMBLY	No longer available. Must purchase Item #74 Modernization Kit listed below.
ITEM #29	SEAL KIT	Part No. 1600-055RP
ITEM #31	MOTOR ASSEMBLY[1]	Same as –9 and Serial Number Pumps.
ITEM #36	FLANGE SET	Same as –9 and Serial Number Pumps.
ITEM #56	COUPLER	Same as –9 and Serial Number Pumps.
ITEM #111	RUBBER INSERT	Same as –9 and Serial Number Pumps.
ITEM #161	GASKET KIT	Same as –9 and Serial Number Pumps.

ITEM #74 MODERNIZATION KIT*

PUMP NO.	MOTOR FRAME SIZE (48)		MOTOR FRAME SIZE (56)		
	CAST IRON	BRONZE	CAST IRON	BRONZE	
121, 122	121 - 154RP	122 - 002RP			
131, 132[2]	131 - 144RP	132 - 145RP	133 - 147RP	138 - 153RP	
133, 138			"	"	
1600, 1610	121 - 154RP	122 - 002RP			
1602, 1604[2]	131 - 144RP	132 - 145RP			
1612, 1620[2]	"	"	133 - 147RP	138 - 153RP	
1630[2]	"	"	"	"	
1614, 1622			"	"	
1624, 1632			"	"	
1634			"	"	

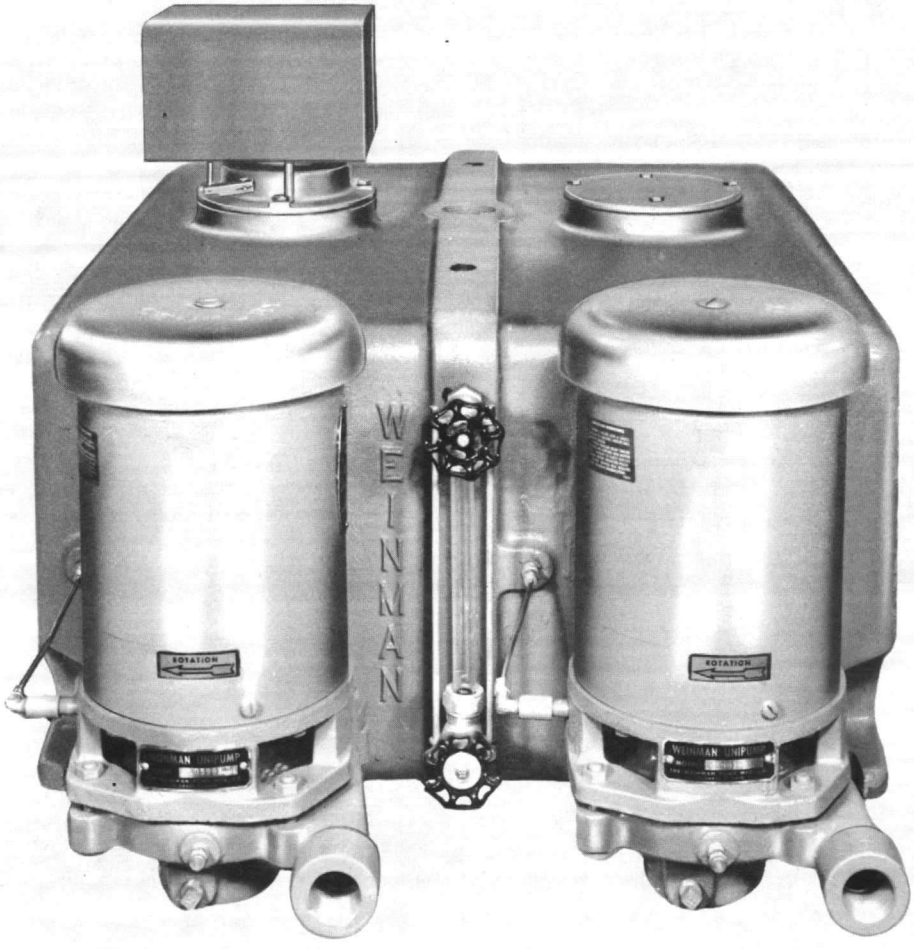
Note (1) When replacing 1/3 or 1/2 HP 56 Frame (old) motor with a new 48 Frame motor, adapter kit #1600 - 194RP must be ordered.

Note (2) Select modernization kit per motor frame size. Select impellers per selection chart on previous page.

for quality, efficiency, dependability...

WEINMAN

CONDENSATE RETURN AND BOILER FEED UNITS
TYPES ACV, ACKV, AEV, AEKV, ADV and AFV



INSTALLATION and OPERATING
INSTRUCTIONS

These instructions are important. Please read them thoroughly before installing your Weinman Unit. Quiet, trouble-free operation depends on proper installation and operation procedure. By carefully following the procedure outlined you will insure top performance from your Weinman equipment over a long period of time.

Keep these instructions on hand for future reference, along with the enclosed parts list which will be of help to you should you need replacement parts.

LFE CORPORATION
Fluids Control Division
EASTERN • MIDLAND • WEINMAN
100 Skiff Street • Hamden, Connecticut 06514
TEL. (203) 248-3841 TELEX 963425

WEINMAN
INSTALLATION and OPERATING INSTRUCTIONS for CONDENSATE RETURN and BOILER FEED UNITS
TYPES ACV, ACKV, AEV AEKV, ADV and AFV

How to install, maintain and operate WEINMAN Condensate Return and Boiler Feed Units

Your Weinman Condensate Return and Boiler Feed Units are precision designed and built with quality materials and fine workmanship to warrant superior performance under the toughest operating conditions. To insure continued successful operation it is essential the following installation, maintenance and operation instructions be followed in every detail.

INSTALLATION

STEP 1: Choose a clean, dry, well ventilated area in which to install your unit. This not only assures proper operation and increased service life, but speeds maintenance.

STEP 2: Install the unit in a position that will permit the condensate to flow by gravity into the receiver. This eliminates the possibility of the return lines becoming moisture laden, thus preventing the system from freeing itself of air.

STEP 3: After installation, be certain the unit is perfectly level. Shim it when necessary to level.

STEP 4: Connect the discharge piping carefully. Be sure that it is supported independently to prevent pipe strain from being transferred to the pump casing. It's good to install a union, gate valve, and check valve in the discharge line.

STEP 5: Hook up the return piping making certain that it slopes slightly toward condensate receiver.

STEP 6: Install the vent piping. Be sure it is open to the atmosphere at all times.

WIRING

Check the motor nameplate for specific wiring requirements. For safe and proper operation, fuses installed in the safety switches and all wiring must conform to recommendations of the National Electrical Code.

PUMP ROTATION

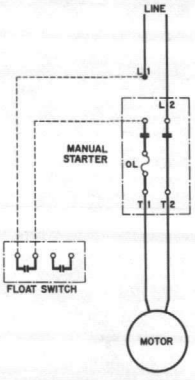
Pump rotation is clockwise as you look down on the pump. Single phase motors are wired so that they rotate clockwise automatically. Three phase motors, however, should be checked carefully for proper rotation prior to operation. To do this:

1. Connect wiring leads to pump motor in the usual manner.
2. Start the motor the first time by just touching the starter button and then stopping the motor immediately. When you do this check the pump shaft for proper clockwise rotation.
3. If pump rotation is counter-clockwise, switch any two of the motor wires to obtain proper rotation.

TYPICAL WIRING DIAGRAMS

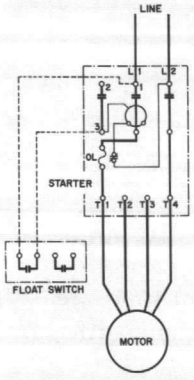
FLOAT SWITCH

SINGLE PHASE MANUAL STARTER



When using manual starter with three position selector switch (Hand-Off-Auto), connect line L1 to "Hand" terminal of switch, and float switch in series to "Auto" terminal and to line L1.

SINGLE PHASE MAGNETIC STARTER

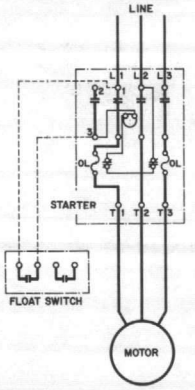


When using magnetic starter with three position selector switch (Hand-Off-Auto), connect float switch to terminals 1 and 2.

For low voltage, connect terminals T1 to T2, and T3 to T4.

For high voltage, connect terminal T2 to T3.

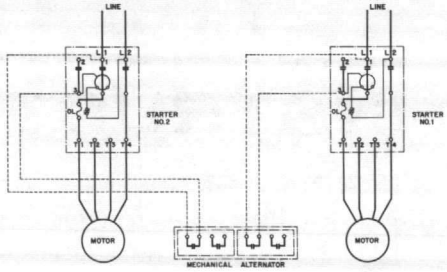
THREE PHASE MAGNETIC STARTER



When using magnetic starter with three position selector switch (Hand-Off-Auto), connect float switch to terminals 1 and 2.

MECHANICAL ALTERNATOR

SINGLE PHASE MAGNETIC STARTER

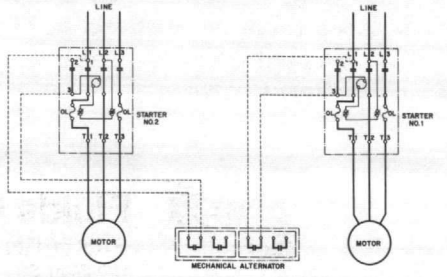


When using magnetic starter with three position selector switch (Hand-Off-Auto), connect alternator to terminals 1 and 2.

For low voltage, connect terminals T1 to T2 and T3 to T4.

For high voltage, connect terminal T2 to T3.

THREE PHASE MAGNETIC STARTER



When using magnetic starter with three position selector switch (Hand-Off-Auto), connect alternator to terminals 1 and 2.

LUBRICATION

Under normal condensate service requirements, lubricate motor bearings about once a year. WARNING! EXCESSIVE GREASING DAMAGES BEARINGS JUST AS QUICKLY AS INSUFFICIENT GREASING. It is essential to use a good grade of grease. Any of the following brands are acceptable for Weinman Pumps:

American Oil Company	Amolith No. 2
Cities Service Oil Company	Trojan H2
Humble Oil & Refining Company	Nebula EP No. 2
Shell Oil Company	Alvania No. 2
Sinclair Refining Company	Litholine 2
Texaco Inc.	Multifak 2
Union Oil Company	UNOBA No. 2

OPERATION

Operation of Weinman Condensate Return and Boiler Feed Units is simple and easy, if you observe these rules in keeping them in proper condition.

New or repaired water systems must be flushed for several days to eliminate all impurities and make sure the entire system is clean. This simple precaution will give you years more of maintenance-free service.

Heating systems should be flushed thoroughly at the start of each heating season for the same reason.

To flush your Weinman Unit . . . remove the drain plug at the receiver and drain the system water into the sewer. If the system water remains dirty after flushing . . . operate it for several days, draining the water into the sewer until it becomes clean.

DISASSEMBLY

Whenever it is necessary to repair the motor or replace the mechanical seal, the pump can be removed from its casing quickly and easily without disturbing the piping.

INSTALLING A NEW MECHANICAL SEAL

CAUTION: This seal is a precision product and should be handled accordingly. Be especially careful not to scratch or chip the lapped sealing faces of the washer and floating seat. If reinstalling a used seal, both sealing faces should be relapped.

INSTALLING STATIONARY ELEMENT

The seat must be seated securely in the seat ring with the lapped face out. The *unlapped* face is marked and correctly assembled when shipped. Oil the seat ring with *light oil* and seat it firmly and squarely. If this cannot be done with the fingers, use a sleeve as shown in Fig. 1, inserting the cardboard shipping disc between the sleeve and the lapped face to prevent scratching sealing face.

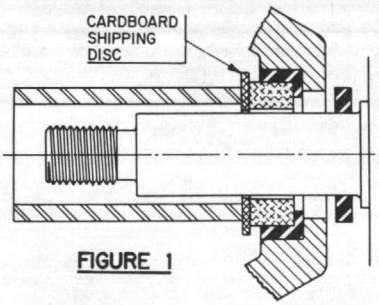


FIGURE 1

INSTALLING ROTATING ELEMENT

Oil shaft with *light oil*. Shaft should be clean and polished smooth. Slide seal body on shaft (washer end *first*) and seat firmly. A sleeve as shown in Fig. 2 will facilitate this operation and prevent the rubber driving ring from pulling out of place as the seal body is slid along the shaft. Assembly of impeller automatically sets seal in proper position.

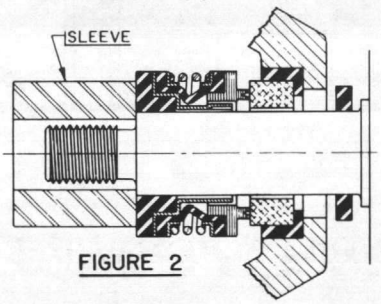
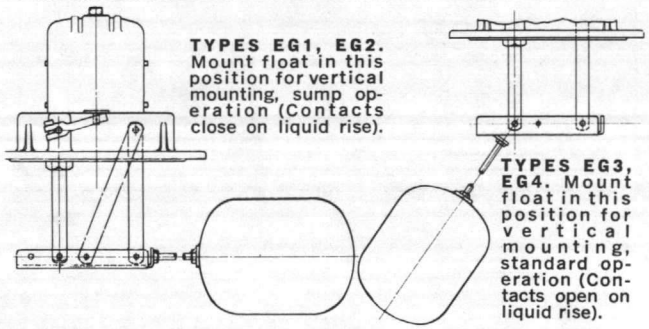


FIGURE 2

Make sure at all times, and particularly before final assembly, that both sealing faces are absolutely clean. Sealing faces should be oiled with clean, light oil.

NEVER RUN THE SEALING FACES DRY. The liquid being handled insures proper lubrication unless other methods of lubrication have been specified. In some cases a short period of operation is required to clear up slight leakage.

REVERSING FLOAT POSITION WHEN USING MECHANICAL ALTERNATOR



TYPES EG1, EG2. Mount float in this position for vertical mounting, sump operation (Contacts close on liquid rise).

TYPES EG3, EG4. Mount float in this position for vertical mounting, standard operation (Contacts open on liquid rise).

PUMP TROUBLES AND THEIR CAUSES

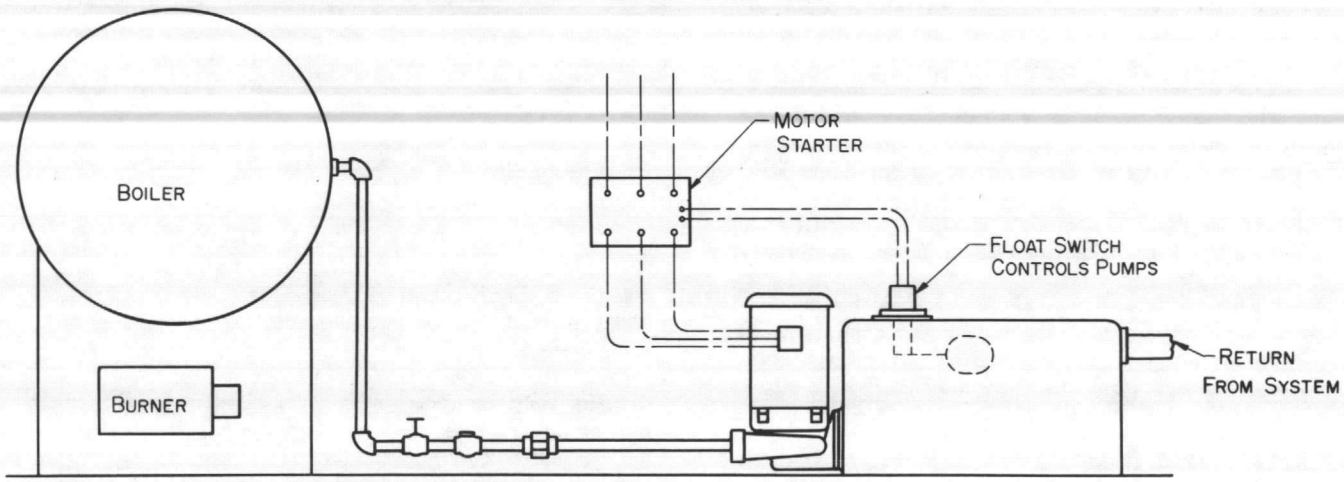
A. Failure to Pump

1. No water in the receiver
2. Rotation in wrong direction
3. Speed too low
4. Return water too hot
5. Total head too high

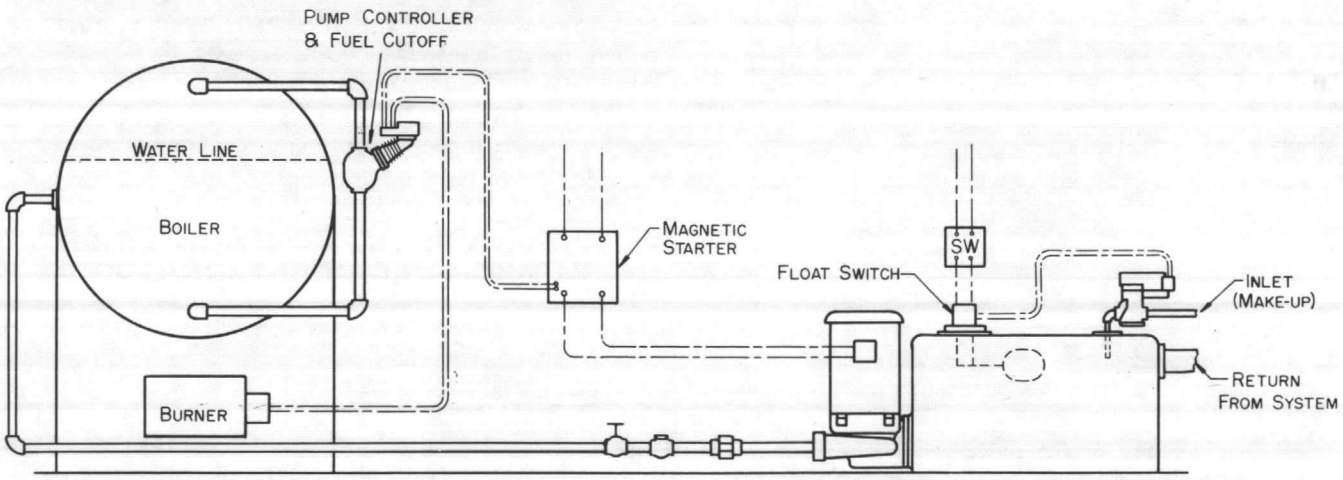
B. Overloaded Driving Unit

1. Total head too low
2. Unit misalignment (check for piping strains)

CONDENSATE RETURN UNIT CIRCUIT



BOILER FEED UNIT CIRCUIT



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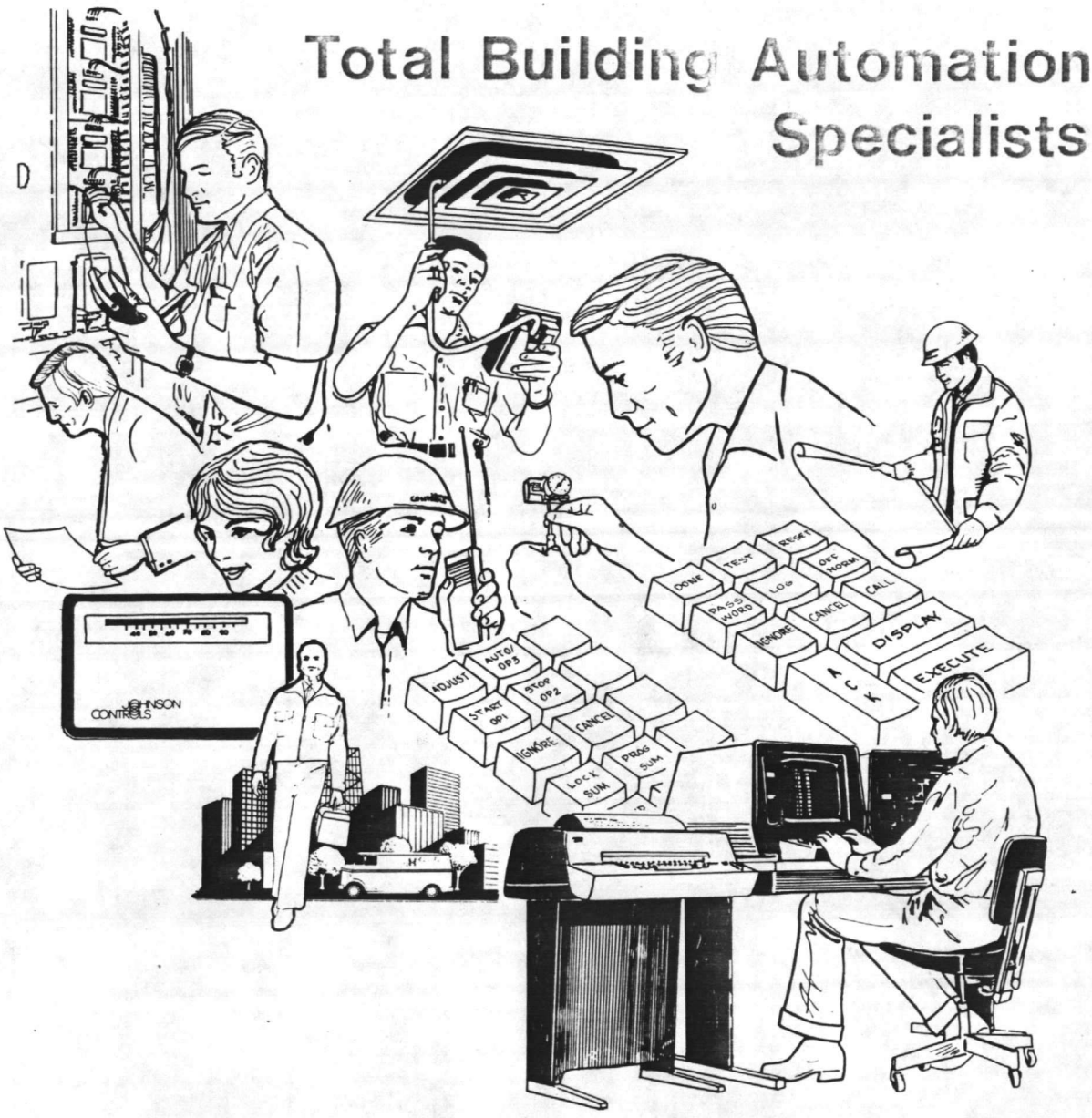

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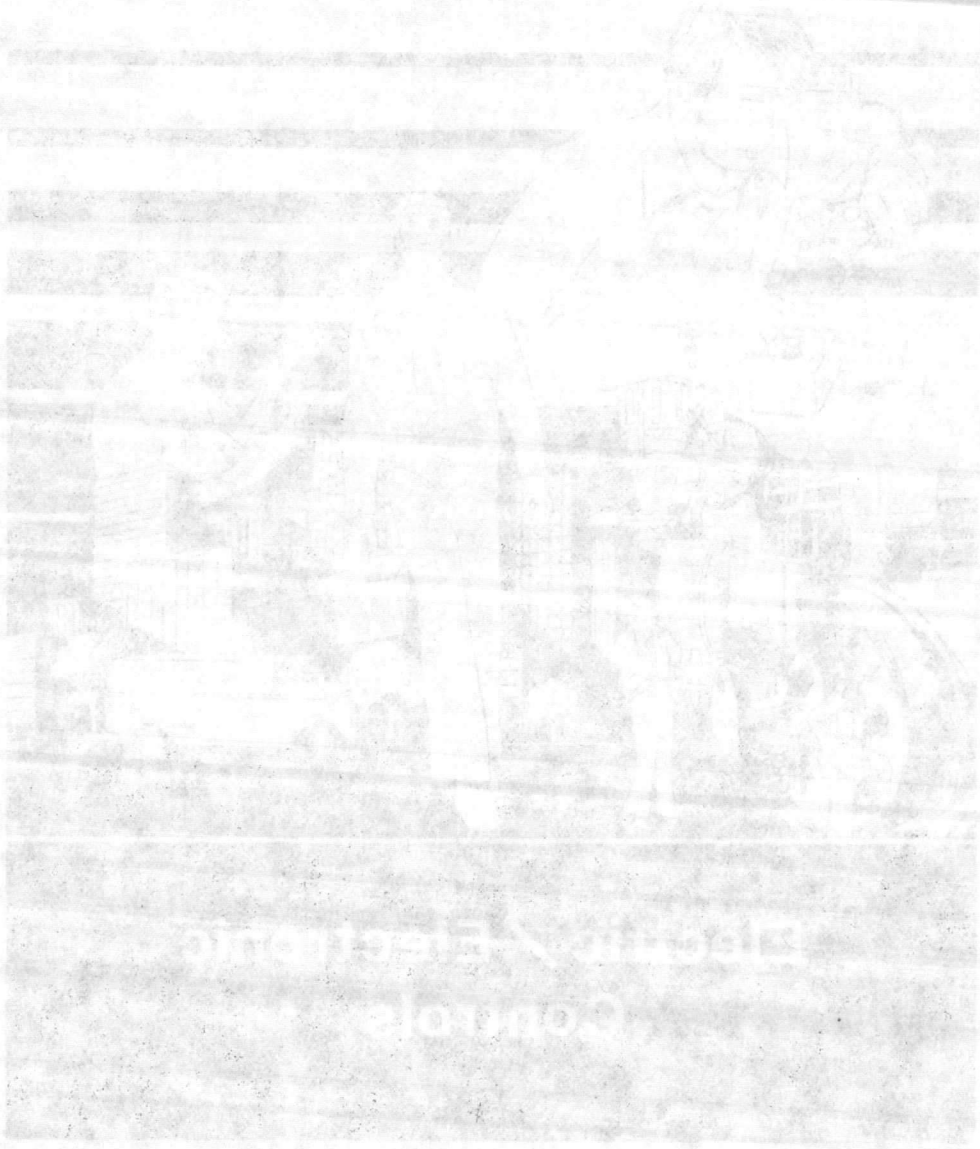
JOHNSON CONTROLS

JOHNSON CONTROLS

OPERATOR'S MANUAL

Electric / Electronic Controls



JOHNSON CONTROLS

FOREWORD

Since 1885, Johnson Controls, Inc. has pioneered the development of automatic control systems to meet the exacting needs of heating, ventilating and air conditioning installations.

Your Johnson Control System is a precision system carefully constructed and installed to provide the highest degree of accuracy possible. It is the result of the work of highly skilled engineers and experienced trade craftsmen. It has been installed for you by Johnson Controls, Inc., a company with nearly 100 years experience in all phases of automatic control design, installation and service. Today's Johnson building automation systems capabilities include heating, ventilating and air conditioning (HVAC) controls, Integrated Control Centers, Energy Conservation Controls, lighting controls, fire alarm, security, sound and communications, clock systems, water treatment and computerized automation systems.

There are certain suggestions which, if followed, will protect your building, improve operating efficiency, and add years of life to your control and mechanical systems. Careful regular maintenance is important if you wish to obtain the best possible results from your control system. Brief inspections are outlined to help you prevent any serious difficulties from occurring.

Many service calls result from insufficient knowledge of the operation and limitations of the control system and the heating, ventilating and air conditioning (HVAC) system. The objective of this Operator's Manual, in conjunction with the "as-built" control drawings and Product Directory(s), is to help you better understand your system. The control drawings show the control system "as-built" in your installation. The Product Directory(s) gives you a general description of the different type of controls available from Johnson Controls, Inc. The Operator's Manual will give you specific information on the operation, maintenance and adjustment of the various kinds of equipment.

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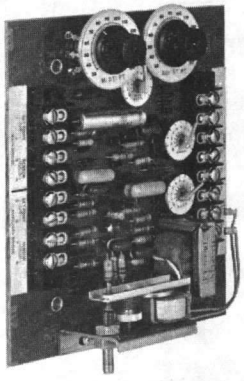
MAINTENANCE

Prior to performing any work on an electrical apparatus, care must be taken to ensure that the equipment is completely isolated. Electric and electronic equipment are comparatively maintenance free, however, for most efficient operation, the following preventive maintenance should be performed:

CONTROLLERS

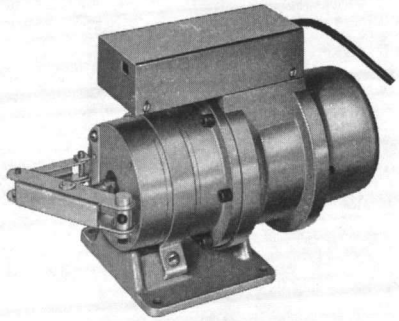
Check and clean the circuit board and its terminals periodically to prevent buildup of dust and dirt.



TC-4100 Temperature Controller

VALVE AND DAMPER ACTUATORS

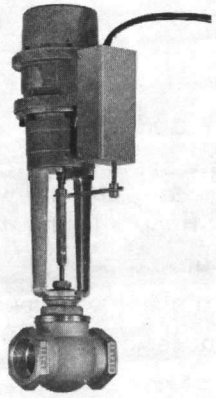
The actuator shaft should be lubricated periodically with high-temperature lubricant which can be obtained through your local Johnson office. On damper actuators, the friction points in linkage should also be lubricated with the same lubricant.



DA-3200 Actuator

VALVES

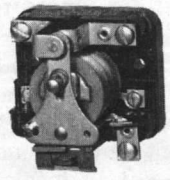
Control valves should be visually checked monthly for leaks and sticking stems. Loss of the valve's ability to close tightly will require inspection of valve seats and discs for wear and system contaminant buildup. Valve disassembly and repair may require special tools. Contact your local Johnson branch office for specific recommendations and instructions.



Valve and VA-3200 Actuator

OPEN CONTACT DEVICES

Contacts on relays, switches and thermostats that are exposed to the surrounding atmosphere should be checked periodically to prevent a buildup of dust and dirt. If an excess of dust is allowed to collect on contacts, arcing may occur which would cause the contact surface to pit and corrode. The result will be premature failure of the contact.



KZ-4000 Relay

Never use a file or sandpaper to clean contacts. This removes a special plating which leads to pitting. Clean the contacts by any of the following methods:

1) blow contacts clean with forced air stream (CAUTION – air must be clean and dry)
2) brush with soft brush
3) spray with contact cleaner

PRIMARY CONTROLS

The following equipment and associated control should be checked periodically. They should always be checked before extremely cold weather and before starting up the air handling system.

1. Hot water and steam supply
2. Chilled water (drained or protected with anti-freeze)
3. All pumps, including hot water, chilled water, condensate, etc.
4. Safety controls.

SECONDARY CONTROLS

On secondary systems, periodic checks should be made to the following whenever they are applicable to the individual system.

1. Outside air dampers
2. Preheat discharge temperature
3. Dew point temperature
4. Hot and cold duct temperature
5. Return air temperature
6. Humidity
7. Local safety controls, such as low limit, high limit, and fire detectors.

HVAC SYSTEM

A control system cannot maintain proper conditions within a building unless the heating, ventilating, and air conditioning system is functioning as designed. It is therefore essential that the maintenance recommended by the manufacturer of such equipment be performed. By the same token, a control system cannot function properly if maintenance is not performed on it. In consideration of this requirement, a sample list of recommended maintenance tasks is listed below showing typical tasks considered essential for the continued efficient operation of the control system(s).

MAINTENANCE CHECK LIST

1. HVAC UNITS
   a) review cycle and sequence of operation
   b) check controllers and recalibrate as required
   c) repair controllers as required
   d) check operation of panel devices
   e) clean control panel
   f) check damper operation
   g) clean and lubricate dampers
   h) check operation and sequence of damper actuators
   i) repair damper actuators as required
   j) check operating range of sequencing networks
   k) check operation and spring range of valves
   l) repair valves as required
   m) check operation of safety limits and minimum positioning devices
   n) clean all instruments, covers, terminals, etc.

2. ROOM AND ZONE CONTROL
   a) check operation of controllers
   b) recalibrate controllers as required
   c) repair controllers as required
   d) check operation of unit valves or dampers
   e) repair unit valves or dampers as required
   f) clean all instruments, covers, terminals, etc.

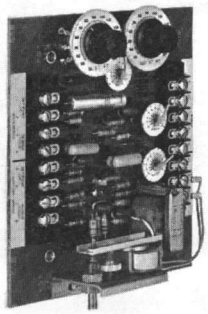
ADJUSTING INSTRUCTIONS

There are two basic types of controls in heating, ventilation and air conditioning systems, proportional and two-position. Proportional controls typically produce a variable 0–16 V.D.C. output signal, which is used to modulate or proportionally stroke a valve or damper. In an electric/electronic system, the majority of the controllers are proportional electronic which produce the above mentioned variable 0–16 V.D.C. output signal. The remaining electric controllers function in a two-position manner, that is to either start or stop fans or pumps, open or close valves or dampers, or interrupt the variable 0–16 V.D.C. signals of a proportional controller.

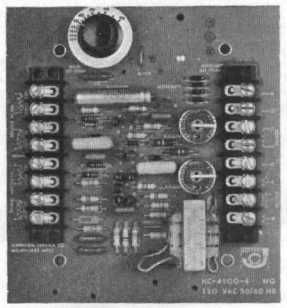
ADJUSTING PROPORTIONAL CONTROLS

A proportional controller is in control of the temperature it is measuring when its output signal is within the spring range of the controlled device. This is determined by measuring the output signal with a D.C. meter across the output terminals or wires of the controller. If a signal between 0 and 16 V.D.C. is read, the temperature measured at the controller's sensing element can then be read and compared to the setting of the controller. Complete check-out procedures are given in individual controller installation data sheets available from your local Johnson branch office.

TC-4550 Temperature Controller



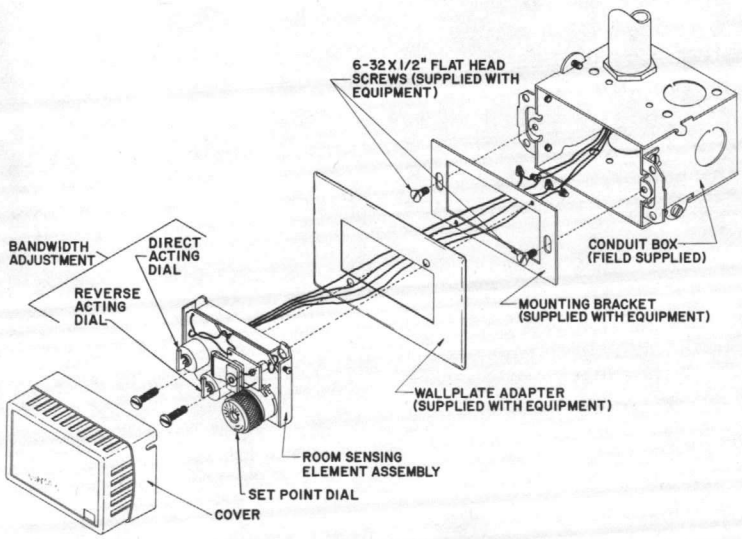
TC-4100 Temperature Controller



HC-4100 Humidity Controller

Bandwidth

The dial labeled 'bandwidth' should be positioned as far toward the lower end of its 0–10 scale as possible without causing 'hunting' or cycling to occur in the control system.



HC-4550 Exploded View

Troubleshooting

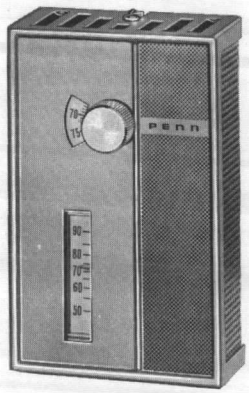
Whenever the controller output signal is at a minimum (0) or maximum (16) value the controller is not in control and the reason for this must be determined and corrected. It must be determined whether the problem lies in the control loop (room) or in the system loop (HVAC equipment). First determine the action of the controller. Then rotate the set point dial slowly toward the temperature at the element to see if the output signal changes. If the voltage changed, the controller also recognized there is a problem and **should not be readjusted.** Return controller set point dial to its previous set point. The problem then is in the system loop. When the problem is found and corrected, the controller will automatically return the control loop to the correct temperature.

responds. The differential setting of these controllers is factory set, but if caution is exercised, the differential can be readjusted in the field.

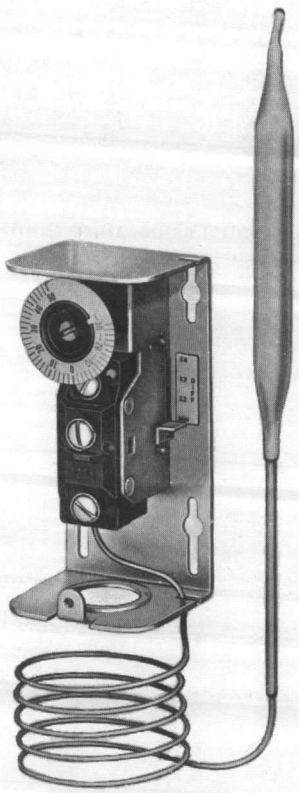
The controller set point position is indicated by the value on the dial. The second position is determined by either adding or subtracting the differential from the set point value. To establish the set point and differential, slowly rotate the set point dial toward the temperature as measured at its element until the contacts close or open. Read the dial value. Slowly rotate the dial in the opposite direction until the contacts open or close. Read the dial value. The difference between these two values is the differential, and the value of the dial that matches the measured temperature at the switchover point is the controller set point. Then turn the dial to the desired value.

ADJUSTING TWO-POSITION CONTROLS

A two-position controller has a point at which the contacts open and a point at which the contacts close. These two points are at different temperature values. The difference is referred to as the "controller differential". Some two-position electric thermostats have an adjustable differential which is established according to the requirements of the control loop to which the electric controller



T26A Controller



A19ABC Controller

LOW LIMIT PROTECTION

The importance of taking every precaution against freeze-up of equipment cannot be over-emphasized. Regardless of the automatic low limit devices furnished, the following procedures should generally be followed when there is any indication that the outside temperature will drop to the predetermined low limit setting.

PUMPS

All hot water pumps and/or condensate or vacuum pumps should be operational.

BOILERS

Boilers and/or converters should be allowed to cycle on a demand basis.

SUPPLY AND EXHAUST FANS

Supply fans should be allowed to operate on their normal occupied or unoccupied cycles. When on the unoccupied cycle, the outside air and exhaust dampers should be closed and the return air damper open.

LOW LIMIT THERMOSTAT OPERATION

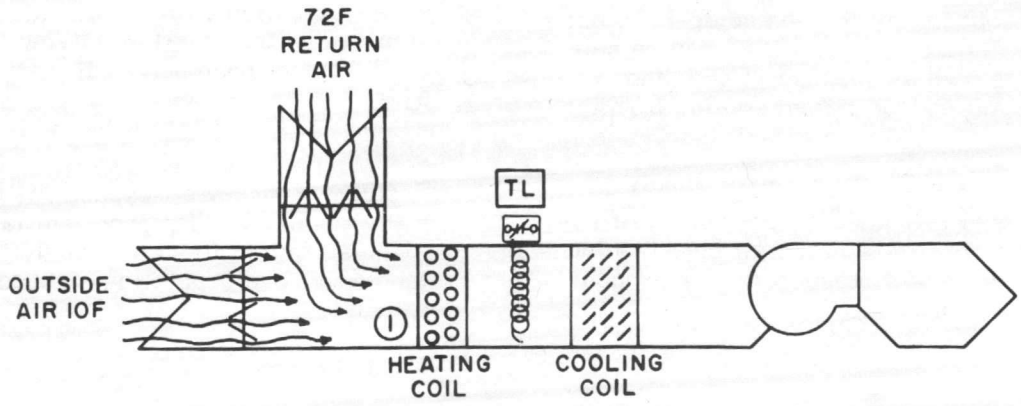
The low temperature limit protection device located at the heating coil discharge senses the lowest temperature along any portion of its sensing element. When one foot or more of any portion of the element senses a temperature as low as the thermostat set point, the instrument will open the circuit. Since the thermostat responds to a "spot" type condition, it is essential that stratification of air in the mixing chamber entering the coil be eliminated if proper operation is to be expected.

Where repeated shut-downs occur as a result of this condition, a greater tendency exists for the operating personnel to override or bypass the low limit protection device in order to keep the unit running. This is a dangerous practice and should be avoided. Further investigation as to the cause of shut-down should take place to determine the cause of the problem with appropriate remedial action.

Low limit protection devices should be checked prior to the arrival of cold weather. This can be done by turning the dial to a warmer setting until the low limit protection device operates. The setting should equal the temperature of the entering air or water. Do not forget to turn the device back to the original setting called for on the control diagram.

SPECIAL PRECAUTIONS

In extremely cold weather, the following added precautions should be taken: Before air supply systems are started, check steam traps and steam pressure and/or water temperature at the air supply system. After supply systems are started, check operation of the control system thermostats and observe for correct functioning with respect to the temperatures being sensed.



Example of Temperature Stratification
(A Stratified condition Could Occur at Point (1) in above Illustration)

OCCUPANT DISCOMFORT

The first evidence of trouble with the heating, ventilation or cooling system is very often a complaint from an individual who is too hot, too cold or is bothered with drafts. Go to the person complaining and personally check the complaint. Experience has shown that in the majority of cases the problem behind the complaint is not a malfunction of the control system. To assist in determining this, the various factors, other than automatic control, that can create comfort problems are listed:

1. Zone Control

   A person outside of the controlled zone may feel too hot or too cold. A zone control thermostat can only sense the temperature at its particular location. Temperatures in all other areas of the zone are dependent on proper balance of the heating/cooling distribution system.

2. Sun Load

   Direct sunlight on the thermostat will cause over-cooling of a zone while direct sunlight on the individual will cause over-heating.

3. Covering of Grills

   Frequently occupants will cover part or all of a discharge grill causing improper heating or cooling. Whenever a grill is covered, the heating or cooling medium is not permitted to enter the space to correct for variances from the set point.

4. Occupant Location

   If occupants are located adjacent to outside walls or windows they may be subject to cold air leakage through the windows and/or radiant cooling from the wall.

5. Insufficient Conditioned Air Supply

   This can be caused by poor air distribution, dirty filters in the air conditioning unit, or lack of proper return or exhaust air outlets.

6. People and Equipment

   Over-heating will result if more people or equipment occupy an area than was intended in the original design concept. This can occur when a meeting is held in an area not designed for this type of function.

7. Heating and Cooling System

   A malfunction, or lack of capacity in extreme weather, of the primary or secondary mechanical heating or cooling equipment will result in insufficient heating or cooling.

8. Psychological Adjustment

   Many complaints are purely psychological. Once a person understands the limitations of a HVAC system, he is more likely to accept the conditions that prevail.

9. Drafts

   In systems using air as a means of heating and cooling, there must be movement of air. To many people, even a slight air motion is uncomfortable. This can be a problem when an unbalanced system causes excessive drafts. Minor problems can sometimes be solved by relocation of work stations, however, it is always best to have a balanced system. i.e. proper size, spacing and delivery of air distribution equipment (fans, diffusers, grills, registers, etc.)

10. Wide Fluctuation of Air Temperature

    Wide fluctuation of air temperature in an area can be the result of varying load conditions or improperly adjusted controls.

11. Stuffiness

    A stuffy or smoky atmosphere will normally result from improper ventilation, i.e. insufficient fresh air supply, air too humid, overpopulation, or inadequate exhaust.

TROUBLESHOOTING – DIAGNOSING THE PROBLEM

HVAC EQUIPMENT

Depending on whether the area is too cold or too warm, and the time of year, check the heating, ventilating and air conditioning equipment that could be involved. This can involve any or all of the following:

1. Boiler
2. Refrigeration Compressor and/or Chilled Water System.
3. Pumps
4. Secondary Heating and Air Conditioning Supply Systems.

AUTOMATIC CONTROLS

When a complaint of improper temperatures has been received, a review of the mechanical system should be made to assure proper operation of the HVAC equipment. If the cause of trouble is not due to the mechanical system, conduct the following check of the control system. (A multi-purpose meter is necessary to make a thorough check, however, a limited check can be made visually).

Disconnect Switch

Check the disconnect switch that switches the power to the control system to make certain that it has not been switched to the "OFF" position.

Fuses and Circuit Breakers

Check the fuses or circuit breakers to make certain they are not blown or tripped. The circuit breaker may be part of the disconnect switch and will throw the switch to the "OFF" position if it trips. On 24 volt A.C. systems, the Johnson transformer is of the energy limiting type. When the maximum current rating is reached, the voltage will begin to decrease. When the overcurrent condition is remedied, voltage will automatically return to its correct level. If a fuse has been replaced or a circuit breaker reset and it opens again the local Johnson service department should be contacted.

Controlled Devices

Check the automatic valve, damper actuator, etc., to see if they are in the proper position as called for by the controller. If they are not, check the actuator along with the controller to see if the actuator responds to the controller.

Controllers

If the actuator is not in the proper position, check the controller which controls that actuator as follows:

1. Check to see if the controller is at the desired set point value.
2. If the condition at the sensor of the controller has deviated from the controller set point, turn the controller set point slowly to match this condition.
3. Check the actuator again. If it is in the proper position to provide the heating or cooling, chances are the controller is only out of adjustment.
4. If the controller is out of adjustment, it should be readjusted by a qualified serviceman. Call your Johnson service department for adjusting, or parts replacement.
5. If the actuator does not change position when the controller set point is changed, the actuator or controller could be defective. To proceed further requires the use of a multi-purpose meter and a basic knowledge of electronics.
6. If the owner's personnel have a basic knowledge of electronics and wish to troubleshoot malfunctions, a multi-purpose meter with a sensitivity of 20,000 ohms per volt, capable of reading A.C. and D.C. voltage and resistance in ohms is required.

TROUBLESHOOTING PROCEDURE

By following the troubleshooting procedure outlined below, specific malfunctions, such as loose connections, broken wires, defective transformers, sensing elements, controllers, or actuators can be determined. Where maintenance is to be performed by the owner's personnel, replacement equipment should be stocked or ordered from the service department of the local Johnson office.

Controllers

The following procedures will assist in finding minor control problems:

1. The reverse acting and direct acting output signals of the controller should vary from 0 to 16 V.D.C. as the set point is varied.
2. Controller should give either a reverse or direct acting signal. If both signals are present at the same time, the controller is defective.
3. Make certain that elements are in good condition before conducting this test (see next section). Manually change the controller set point. If either output signal remains at a maximum or at "0" while the set point is varied, the controller may be defective. If both outputs are "0", make certain that the controller is getting A.C. power.
4. If either the direct acting or reverse acting output is a constant 16 V.D.C. while the other is "0", the problem may be in the sensing element, remote set point control, or faulty wiring.

Sensing Elements

If it is suspected that a sensing element in a system is faulty, it can be checked using the following procedure:

1. Disconnect leads from sensing element to controller.
2. Using an ohmmeter, check for opens (above 2000 ohms) or shorts through the sensing element.
3. If either of these conditions are detected, the element should be replaced.

Actuators

If the controller is functioning properly, and the actuator is still not responding properly, check the following at the actuator.

1. Check the control signal at the red (+) and blue (-) wires at the actuator. If there is no signal there may be a broken wire or loose connection between the controller and actuator.
2. If the proper signal is getting to the actuator, and it still does not function properly, measure the power supply voltage to the actuator. This reading should be 24 V.A.C. across the yellow and white wires or 120 V.A.C. across the black and black/red wires depending on voltage used. If the power supply voltage is correct, the actuator is defective.
3. If the control signal at the actuator remains at a constant voltage while varying the controller set point, any of the auxiliary devices between the controller and the actuator should be checked for proper operation.

Contact your nearest Johnson branch office if a more complete check-out procedure is required.

REPAIR

Adjustment and repair tool kits can be ordered from the local Johnson office. They can also supply you with repair and replacement equipment. In a majority of cases, it is less expensive to replace equipment under the Johnson exchange policy. Recommendations on proper replacement equipment should be obtained from the local branch office. When requesting replacements, give the equipment code number shown on the control drawings.

PROGRAMMED MAINTENANCE

Programmed maintenance becomes more important every year. Today's mechanical and electrical systems are designed with closer tolerances than in the past. And they are more interdependent. If one system deteriorates, chances are that other systems will be affected. Therefore, every system must be careully maintained to operate as closely as possible to design efficiency.

CUT COSTS TWO WAYS

Maintenance becomes more specialized under these conditions. And that's where Johnson can help. Our programmed maintenance plans match your scheduled needs while saving you money two ways. First, we eliminate your expense of hiring and training maintenance personnel. Second, we provide you with trained specialists who are experts in their field. There is no time wasted isolating problems or overcomplicating maintenance procedures. No need to pay full time for part-time services.

PARTS AVAILABILITY WITHOUT INVENTORY EXPENSE

What happens when a critical component failure shuts down part of your system? Do you have to wait for days or weeks before a replacement can be located? And then pay premium prices and expensive shipping charges? Not with programmed maintenance by Johnson. In the first place, preventive maintenance eliminates most failures. But where a rare disruptive failure does occur, our emergency service minimizes expensive downtime. And you're assured of an adequate supply of the necessary replacement parts.

SAVES TEST EQUIPMENT AND TOOL EXPENSE

Servicing building controls for mechanical and electrical systems today requires a wide range of specialized tools and test equipment. This is a sizable investment for a building owner. And the equipment is usually used only part time. Johnson programmed maintenance eliminates this investment while assuring availability of the latest test equipment and tools.

LONGER EQUIPMENT LIFE

A regularly-followed maintenance program extends equipment life by catching minor problems before they become serious. And by replacing worn parts before they can cause serious damage.

HELPS PREVENT MAJOR BREAKDOWNS

Often a serious system breakdown is triggered by failure of a minor system component. This touches off a series of failures that ultimately leads to complete system failure. With a planned maintenance program, no component, no matter how small, is neglected.

UNINTERRUPTED COMFORT, ENERGY CONSERVATION

A programmed maintenance schedule eliminates costly downtime. Uninterrupted, efficient productivity and fewer occupant complaints result. A preventive maintenance program provides you with assurance that these systems are always functioning properly. Efficient operation conserves energy.

PROGRAMMED MAINTENANCE BUDGET

Johnson's wide experience in maintaining controls for electrical and mechanical systems permits establishing a program of preventive maintenance with predetermined costs. You can accurately predict and budget all your maintenance costs. Systematized checklists spell out everything covered in your program. So you know beforehand exactly what is to be done and when, with no surprises, no chances for omissions. It is recommended that you plan and start a maintenance program at the start of your system's guarantee period.

Johnson is ready to handle your needs on any basis you wish, from taking total responsibility for your entire building to simply changing filters regularly.

For a customized programmed maintenance plan for your building, including complete cost information, contact the Johnson office nearest you for full details.

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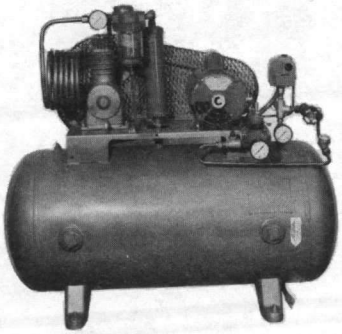
Johnson Controls, Inc.
Milwaukee, Wisconsin 53201

Air Compressors and Aftercoolers — Section A

A-3000 Series Air Compressors

Durable and reliable, the A-3000 Series Air Compressors have been specifically designed to provide supply air for pneumatic control systems. All A-3000 compressor motors are 40°C rise NEMA, B, L, or N design. Single-phase, 115/230 volt, 60 Hz motors have built-in overload protection and a DPST disconnect switch. Three-phase, 208-230/460 volt, 60 Hz motors require a manual or magnetic starter and overload switches that must be field supplied. Horsepowers range from 1/4 to 1-1/2 and have corresponding outputs (1/3 run) of 472 to 2708 SCIM (129 to 739 mL/s). Factory-calibrated, snap-acting DPST pressure-electric switches provide automatic cut-in at 70 PSIG (482 kPa) and cut-out at 90 PSIG (620 kPa). Over-pressure protection is provided by an ASME pop safety valve, set and sealed at 110 PSIG (758 kPa). Two models are available with a single-tower dessicant dryer system: 1/4 HP, 260 SCIM (71 mL/s), and 1/2 HP, 440 SCIM (120 mL/s) (1/3 run—both single phase).

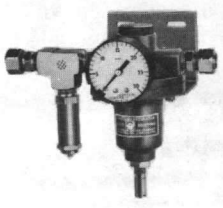


A-3000 Compressor with Desiccant Dryer System

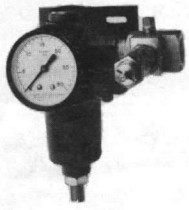
A-4000 Series Air Compressor Accessories

Pressure Reducing Stations

For installations where air pressure must be reduced, Pressure Reducing Stations with 1/2-in. O.D. compression fittings or 1/2-in. NPT connections are available. Output pressure is factory set for 15 to 20 PSIG (103 to 138 kPa) but easily field adjusted between 0 and 50 PSIG (0 to 345 kPa). However, a safety valve relieves over-pressures exceeding 25 PSIG (172 kPa). A mounting bracket is provided.



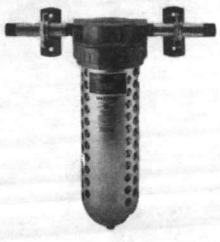
Reducing Station with 1/2-in. O.D. Compression Fitting



Reducing Station with 1/2-in. NPT Connection

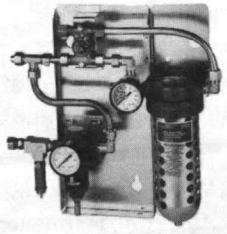
Filter Assembly

For installations requiring a large amount of filtered air, a 60 SCFM (28 L/s) [at 80 PSIG (551 kPa) for 1 PSI (7 kPa) pressure differential] Filter Assembly with 1/2-in. NPT connections is available. Maximum input pressure is 150 PSIG (1034 kPa). The filter removes 99% of entrained oil, particles as small as 0.03 microns, and will also coalesce aerosols. For use with a 1/2-in. NPT Pressure Reducing Station.



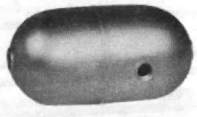
Filter and Reducing Station Assembly

The 1/2-in. O.D. compression fitting Pressure Reducing Stations are available with a factory-mounted 15 or 36 SCFM (7 or 17 L/s) capacity [at 80 PSIG (551 kPa) for 1 PSI (7 kPa) pressure differential] oil filter. The filter has a maximum input pressure rating of 200 PSIG (1378 kPa). It removes 99% of entrained oil, particulates as small as 0.03 microns, and will also coalesce aerosols. A bypass valve assures an uninterrupted air supply—even if servicing of the oil filter is required. Output pressure is factory set for 15 to 20 PSIG (103 to 138 kPa); assemblies are easily field adjusted between 0 and 50 PSIG (0 and 345 kPa). However, a safety valve relieves over-pressures exceeding 25 PSIG (172 kPa). All units are furnished with a metal bowl guard and mounting base.



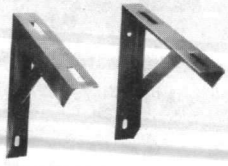
Pulsation Chamber

Minimizes compressor output pulsations and/or air surge noise through the check valve. The chamber has a 37 cubic inch (606 cm^3) capacity and a 300 PSIG (2067 kPa) maximum working pressure.



Wall Brackets for Horizontal Tanks ☐

Rugged, 1/8-in. (3 mm) angle iron brackets may be used to mount a compressor on a wall where floor space is limited. These brackets may be used for single compressors with up to 30-gallon (114 L) tanks.



Floor Legs for Horizontal Tanks ☐

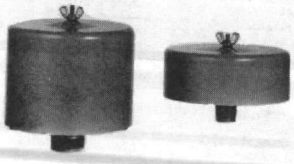
Provide 12 inches (305 mm) of floor clearance to meet building code requirements and facilitate cleaning under the compressor.

Vibration Dampening and Leveling Legs ☐

For use on single or duplex compressors on an uneven floor. One set will hold a 1200-lb. (545 kg.) compressor.

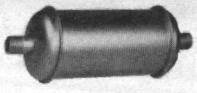
Intake Air Filter ☐

A dry-type filter with a replaceable cartridge. The filter is 99% efficient at a 10-micron rating, regardless of air demands or temperature variations. Available in 5, 10, and 30 SCFM (2.4, 4.7, and 14.2 L/s, respectively) capacities.



Intake Silencer ☐

An absorption-type silencer with minimal flow restriction. Installed directly before the intake of a compressor head.



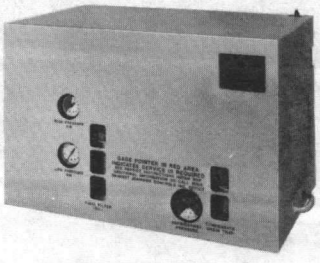
A-4001 Oil Indicator ☐

A calibrated measuring instrument for detecting entrained oil in compressed air output at any point in a system. The indicator is sensitive enough to measure a concentration as low as 0.01 PPM (0.012 mg/m³). It can be used in systems with line pressures between 50 and 125 PSIG (345 and 861 kPa).

A-4001 Installed in an Air Line

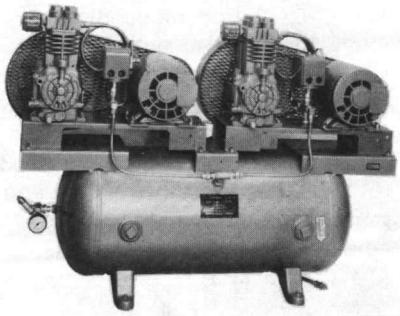
A-4210 Refrigerated Air Dryer ☐

The A-4210 Refrigerated Air Dryer is designed to provide continuous, dry, oil-free air for pneumatic control systems. Appropriate bypass valves insure an uninterrupted air supply—even when servicing. Single-phase, 115 volt 60 Hz or 240/220 volt 50 Hz units are available. There are two variations of each. Both are wall mounting and feature a hermetically sealed refrigerant compressor/motor unit, heat exchanger, automatic drain trap with manual override, and a bypass valve on the heat exchanger. Besides these and other features, one model has an oil filter and pressure reducing station and an additional valve to bypass this assembly. Special 115 volt 50 Hz units with or without the oil filter and pressure reducing station, CSA Approved, are available for Canadian use. At 80 PSIG (551 kPa) inlet pressure, A-4210 Air Dryers have a 20 SCFM (9.4 L/s) capacity; maximum inlet pressure is 125 PSIG (861 kPa).



A-5000 Duplex Air Compressors ☐

For instrumentation systems requiring maximum reliability of supply air, the A-5000 Duplex Air Compressor Series provides two equally rated motor-compressor assemblies mounted on a single, 30-gallon ASME tank. All compressor motors are 40°C rise NEMA, B, L, or N design. Single-phase, 115/230 volt, 60 Hz motors have built-in overload protection and a DPST disconnect switch. Three-phase, 208-230/460 volt, 60 Hz motors require a manual or magnetic starter and overload heaters that must be field supplied. Horsepowers range from 1/4 to 1-1/2 and have corresponding outputs (1/3 run) of 467 to 2679 SCIM (127 to 731 mL/s). Snap-acting DPST pressure switches, factory calibrated to close at 70 PSIG (482 kPa) and open at 90 PSIG (620 kPa), are provided on all models. Over-pressure protection is provided by an ASME pop safety valve, set and sealed at 110 PSIG (760 kPa).



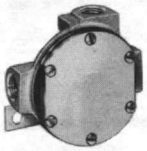
Clocks and Cumulators — Section C

C-130 Comparator ☐

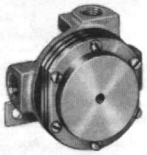
The C-130 Comparator applies its output pressure to pilot a controller or operate a controlled device in accordance with pressure signals received from two other sources. It "compares" the two signal pressures to determine its output or control pressure. When both signal pressures are equal, an output pressure of 9 PSIG (62 kPa) is maintained. An increase in signal "1" produces an equal output increase; an increase in signal "2" produces an equal output decrease.

C-202 2:1 Ratio Cumulator ☐

The C-202 Cumulator is used singly or in groups to accumulate the outputs of two or more controllers regulating a single device. Direct or reverse acting, it varies its output pressure in proportion to pilot air changes at a 2:1 ratio.



Direct

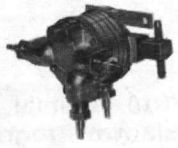


Reverse

C-204 Averaging Cumulator ☐

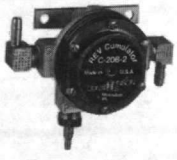
The C-204 produces a proportional output signal equal to the average of the input signals from two, three, or four pneumatic controllers or transmitters. This output signal operates a control device or receiver-controller. Available in 3- or 4-point models.

4-Point Model



C-208 Reverse Acting Cumulator ☐

Proportionally changes the output of a controller from direct to reverse acting or vice versa at a 1:1 ratio. The C-208 can also be used in "Direct-Reverse" applications. Factory set for 10 PSIG (69 kPa) output with 10 PSIG pilot pressure, the cumulator can be field adjusted ± 9 PSI (62 kPa).

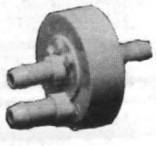


C-2220 High-Low Pressure Selector ☐

The C-2220 High-Low Pressure Selector selects and transmits the highest and lowest control pressure signals from a group of thermostats or controllers. It is available in either master or slave modules for use with high-volume (relay) and low-volume (non-relay) thermostats or controllers.

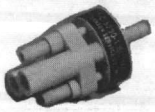
C-5226 Pneumatic Signal Transmitter ☐

The C-5226 is used to repeat pneumatic transmission signals or select the higher or lower of two signals directly from the output of a controller. It operates at a 1:1 ratio to compensate for pressure drops and time lags inherent in long transmission lines.



C-5230 Pneumatic Signal Limiter ☐

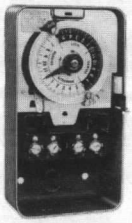
The C-5230 Pneumatic Signal Limiter is used to adjust a high signal limit or a low signal limit or both. With an 18 to 22 PSIG (124 to 152 kPa) supply, the high-limit restrictor can be adjusted from 3 to 15 PSIG (21 to 103 kPa), and the low-limit restrictor can be adjusted from 0.5 to 15 PSIG (3.4 to 103 kPa).



C-7351 Time Controls ☐

C-7351 Time Controls provide 24-hour or 7-day automatic switching of electrical equipment. A feature on the 24-hour, 4-pole model allows up to 6 days to be skipped from the daily switching schedule. The 7-day model is available with a battery that will maintain a switching schedule for up to eight hours during a power failure. Three bridges are supplied with the 24-hour and 7-day, 4-pole models, for various switching arrangements. CSA Approved and UL Listed.

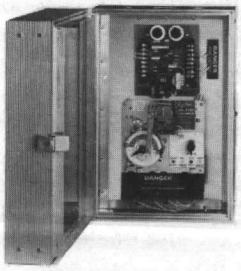
7-Day Model in Surface Mounted Case



24-Hour SPDT Model

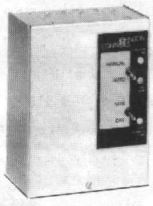
C-7500 Optimal Start Programmer ☐

The C-7500 Optimal Start Programmer is an electric-electronic device that automatically delays the morning start-up of heating and ventilating systems until they are actually needed for proper conditioning prior to occupancy. It operates similarly to the 7-day Time Control except that the start-up time is dependent not only on the time of day but also on outside air temperature and the heat transfer coefficient of the building. Delay of the start-up time saves energy.



C-7510 Optimal Start Controller ☐

The C-7510 Optimal Start Controller is a pneumatic-electric device that performs the same function as the C-7500.

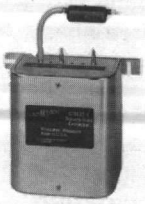


C-7610 Optimal Start Cooldown Programmer ☐

The C-7610 Optimal Start Cooldown Programmer is a pneumatic-electric device designed to start a building cooling system at the optimum time for minimum energy consumption. It anticipates the morning cooldown and ventilating lead time requirements for comfort at occupancy time and automatically actuates the appropriate "Occupied" cycle circuits. The C-7610 is used with a C-7351 Time Control.

C-9115 Square Root Extractor ☐

The C-9115 Square Root Extractor is a direct acting, low-volume pneumatic device designed primarily for use in variable air volume system applications. It can also be used in water flow applications. The C-9115 converts the input from a velocity pressure transmitter to an output signal which is linear to the controlled variable velocity (FPM).



C-9200 Sequencing Cumulator ☐

The C-9200 provides sequential operation of controlled devices that may have similar spring ranges and are operated by the same control signal. It may also be used to correct changes in spring ranges of controlled devices caused by pressure or other external forces. The output of the C-9200 can be reduced below the input from 3.5 to 9 PSIG (24 to 62 kPa). However, until the input exceeds the set point, the output will be zero.

C-9500 Two-Position Pilot Cumulator

The C-9500 Two-Position Pilot Cumulator switches its output from zero to full pressure at a preselected pressure. The C-9500 can be used for two-position action from a proportional control signal. Factory set at 9 PSIG (62 kPa), the set point is adjustable from 4 to 20 PSIG (28 to 138 kPa).

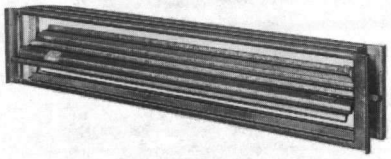
C-9506 Air Switching Cumulator

The C-9506 Air Switching Cumulator switches from zero pressure to full supply pressure when the pilot pressure reaches the preselected switch-point pressure. The set point, or switching point, is adjustable between 2 and 12 PSIG (14 and 83 kPa).

Dampers and Actuators — Section D

Proportion/Aire Dampers D-1100, D-1200, and D-1300

Single, parallel, and opposed blade dampers (D-1100, D-1200, and D-1300, respectively) control air flow in heating, ventilating, and air conditioning systems. The single-blade D-1100 is 6 in. (152 mm) high and is available in standard widths from 12 to 96 inches (305 to 2438 mm). D-1200 and D-1300 dampers are available in standard widths from 12 to 96 inches and standard heights from 12 to 96 inches. Proportion/Aire Dampers are modular in concept. Sizes larger than the standard units are obtained by bolting or riveting two or more modules together. Frames are made of 13-gauge, galvanized sheet steel, formed into channels and welded together for maximum strength. Blades consist of two formed sheets of 22-gauge, galvanized sheet steel, spot welded together for extra strength in withstanding high velocities and static pressures. Stainless steel end seals assure minimum leakage between the blade ends and the damper frame. Bearings are oil impregnated for constant lubrication. The dampers are suitable for temperatures between -40 and 200F (-40 and 93°C).



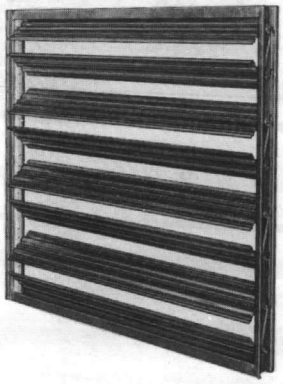
D-1100 Single Blade Damper

D-1200 Parallel Blade Damper

D-1300 Opposed Blade Damper

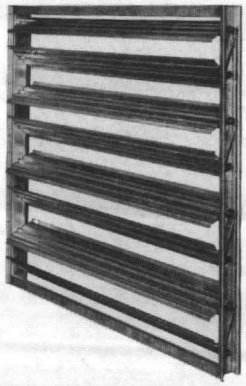
SD-1300 Smoke Damper ☐

The SD-1300 Smoke Damper is an opposed blade damper that automatically interrupts air flow to restrict the passage of smoke from one area to another. When no smoke is present, the damper can be modulated to perform the automatic control functions. When a detector "senses" smoke, the control signal to the actuator is interrupted, and the SD-1300 closes tightly. If fire should damage the control wiring or piping to the actuator, a fail-safe feature closes the damper. SD-1300 dampers are constructed the same as Proportion/Aire Dampers. They are available in standard widths from 12 to 96 inches (305 to 2438 mm) and standard heights from 12 to 96 inches. Smoke Dampers are modular in concept. Sizes larger than the standard units are obtained by bolting or riveting two or more modules together. The dampers are designed for temperatures between -40 and 200F (-40 and 93°C). A single-blade model—the SD-1100—is available. Smoke Dampers meet the requirements of NFPA Bulletin 90A and other specifying agencies having applications for tight-closing dampers to prevent the passage of smoke and other noxious gasses through air-handling systems.



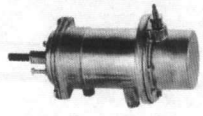
D-2300 Proportioning Damper ☐

An economical, high-quality unit for controlling air flow in heating, ventilating, and air conditioning systems. Dampers are available in standard widths from 12 to 96 inches (305 to 2438 mm) and standard heights from 6 to 96 inches (152 to 2438 mm). Proportioning Dampers are modular in concept. Sizes larger than the standard units are obtained by bolting or riveting two or more modules together. Frames are made of 13-gauge, galvanized sheet steel, formed into channels and welded. Blades consist of two formed sheets of 22-gauge, galvanized sheet steel, spot welded together. Bearings are oil impregnated for constant lubrication. Proportioning Dampers are for temperatures between -40 and 200F (-40 and 93°C).



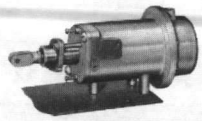
D-251 Pneumatic Piston Damper Actuator ☐

D-251 Actuators accurately position N.O. or N.C. dampers in response to the output signals of pneumatic controllers. Two models are available that vary in stroke and positioning power. Adjustable external stops are provided to limit the stroke of the actuator in either direction. Various mounting arrangements, brackets, and linkages are available.



D-255 Two-Stage Piston Actuator ☐

The D-255 Two-Stage Piston Actuator is designed primarily for unit ventilator applications to admit a minimum amount of outside air during heating cycles. Its total stroke is 2-3/4 in. (70 mm) with the first stage adjustable from 0 to 50 percent of the total stroke. Adjustable stops are provided to limit the total stroke in either direction. The nominal spring ranges are 3 to 6 PSIG (21 to 41 kPa) for the first stage of operation and 9 to 12 PSIG (62 to 83 kPa) for the second stage.



D-3000 Piston Top Damper Actuator ☐

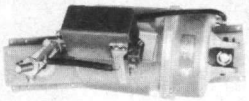
The D-3000 Piston Top Damper Actuator is a multipurpose positioning device designed primarily for use in damper controlled fan coil and induction-type heating units, and for face-and-bypass dampers in unit ventilators. The D-3000 is available in three different spring ranges. It is furnished with an integral mounting bracket.

D-3031 Pneumatic Actuator ☐

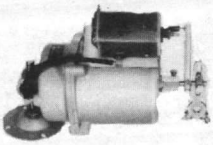
The D-3031 is designed primarily for damper positioning on small terminal units. It is furnished with a maximum stroke of 1 in. (25 mm) without stops. Two stroke-adjustment stops are provided with some models for limiting the stroke in 1/8-in. (3.2 mm) increments from 7/8 to 1/2 in. (22 to 13 mm). D-3031 actuators are designed for either swivel or rigid face mounting to operate N.O. or N.C. dampers.

D-3153 Pneumatic Piston Actuator ☐

The D-3153 Pneumatic Piston Actuator is a multipurpose positioning device used primarily for operating a ventilating damper in response to the output signal of a pneumatic controller. The D-3153 has a 3-in. (76 mm) stroke and is available in three standard spring ranges.



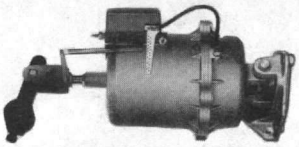
D-3153 with Universal Mounting Bracket



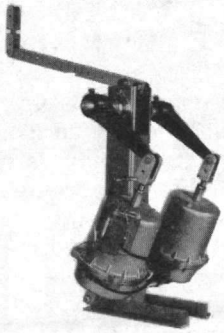
D-3153 with Auxiliary Mounting Bracket

D-3240 Series Pneumatic Piston Actuators ☐

D-3240 Series Actuators are multipurpose, high-torque positioning devices used for operating inlet vanes on centrifugal fans and compressors in response to the output signal of a pneumatic controller. These actuators can also be used on other applications that require a great amount of positioning power from a single actuator, such as large dampers. D-3240 Series Actuators are furnished with an 8 to 13 PSIG (55 to 90 kPa) spring range and in two basic mounting configurations: swivel and pedestal floor (single or duplex). D-3244 Actuators have a 4-in. (102 mm) stroke; D-3246 Actuators have a 6-in. (152 mm) stroke.



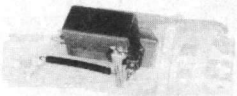
Swivel Mounted Actuator



Duplex Pedestal Mounted Actuators

D-9502 Pneumatic Positioner ☐

D-9502 Positioners are precision pneumatic relay devices used to adjust and maintain damper actuators in exact positions on those applications requiring precise or otherwise special damper positioning. The basic positioner provides dynamic stabilization and/or sequential control of damper actuators. It is available factory installed on most D-3000 Series Damper Actuators. The D-9502 is furnished with a mounting bracket for attachment directly onto the actuator body.

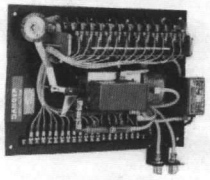


D-9502 Installed on a D-3153 Pneumatic Actuator

Gages and Step Controllers — Section G

G-180 Pneumatic Step Controller

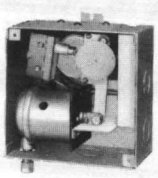
The G-180 Pneumatic Step Controller sequentially controls a group of electrically operated devices in accordance with a proportional signal from a pneumatic controller. Three basic models are available consisting of 6, 8, or 12 snap-acting SPDT switches. All models are furnished with a recycler solenoid air valve fail-safe feature and a time delay restrictor mechanism. A manual sequence changer and a mounting cabinet are also available.



12-Point Step Controller

G-182 Time Proportioning Switch

The G-182 Time Proportioning Switch provides accurate and simple pneumatic proportional control for electric heating systems. It automatically controls the "ON" time of electric heaters in proportion to the heat demand of the controller. The G-182 consists of a specially designed pneumatic piston actuator; a nylon cam driven by a 115 volt, 50/60 Hz synchronous motor; and a positive acting electrical switch rated at 345 volt amperes. UL Listed and CSA Approved.



G-201 Air Pressure Gages

G-201 Air Pressure Gages are easily read and understood. Gages are stem, flush, or surface mounted. They are available in 1-1/2, 2, 2-1/2, and 3-1/2 in. dial sizes and in 0-30, 0-100, and 0-160 PSIG ranges. Refer to appropriate gage literature for available combinations. Some 0-30 PSIG range gages have a corresponding metric 0-200 kPa scale. Breakoff notches are stamped into all "U" clamps to speed flush mounting into various panel thicknesses.

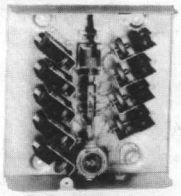
3-1/2 in. Flush or Surface Mounted

G-202 Target Gage for On-Off Operation Indication

The G-202 Target Gage is designed for use in any application where an indication of equipment operation is needed. The dial is divided into bright fluorescent segments which change from red to green or vice versa as the pressure changes from zero to maximum. The gage may be used with either a 0 to 15 or 0 to 20 PSIG (0 to 103 or 0 to 138 kPa) supply. Breakoff notches are stamped into all "U" clamps to speed flush mounting into various panel thicknessess.

G-7185 Step Controller

The G-7185 Pneumatic Step Controller regulates electric heating elements according to the demands of a direct acting, single or dual pneumatic temperature thermostat. It is available with six or nine pressure electric switches adjusted for sequential operation within a nominal operating range of pilot pressure. Each switch is rated at 20 amperes, 480 volts A.C. (non-inductive); 360 V.A., 120-480 volts A.C. pilot duty. The 6-switch unit is available with either a 120 or 208 volt exhaust valve; the 9-switch unit has a 120 volt exhaust valve.

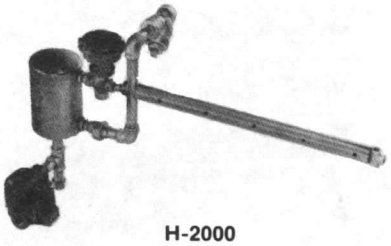


9-Switch Unit

Humidostats and Humidifiers — Section H

H-2000 and H-2010 Dri-Steem Humidifiers

The H-2000 Humidifier emits controlled amounts of dry steam directly into an air stream by means of a single, stainless steel, steam-jacketed dispersion tube to humidify a forced air system. The H-2010 is a multiple tube model. Because of the unique design of the dispersion tube and stainless steel separator, only dry steam enters the air stream. The design of the steam discharge openings of the dispersion tube provides for quiet and uniform distribution. Models are available for either vertical or horizontal mounting in both the single tube and multiple tube humidifiers. The capacity of the H-2000 is from 3.3 to 1900 pounds per hour, while the capacity of the H-2010 is between 3.3 and 3120 pounds per hour. All models include a V-3970 or V-3974 normally closed steam valve.



H-2000

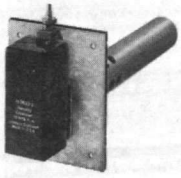
H-2010

H-2025 Area Type Dri-Steem Humidifier

The H-2025 discharges controlled amounts of dry steam directly into the space to be humidified. Units are available with air-operated or electric fans and without fans for use in conjunction with heaters. The capacity of the H-2025 is from 3.3 to 335 pounds of moisture per hour. Humidifiers are supplied with V-3970 or V-3974 N.C. steam valves. An electric, N.C., two-position solenoid valve is optional.

H-3610 Duct-Mounted Humidity Instrument

The H-3610 is a reverse acting pneumatic instrument used as a humidity controller or high limit. Both models have an adjustable sensitivity and set point which allows them to be used for other applications. The H-3610 requires a 0.007-in. restricted 20 PSIG (138 kPa) air supply.



H-4100 Series Pneumatic Room Humidostats

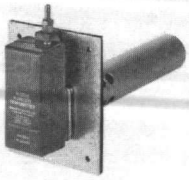
H-4100 Series Humidostats provide individual space humidity control. They produce a proportional output which is used to modulate controlled devices in response to load changes. The humidostats have a CAB (cellulose acetate butyrate) sensing element and a volume amplifier. H-4100 Humidostats are direct or reverse acting and have pneumatic feedback to insure accurate proportional response. Model H-4103 is a submaster-type humidostat with local and/or remote set point readjustment. It is reverse acting with reverse readjustment.

H-5100 Room Humidity Pneumatic Transmitter

The H-5100 measures room or space relative humidity and transmits a proportional pneumatic signal to a remote receiver. It has a CAB (cellulose acetate butyrate) sensing element and is direct acting. Pneumatic feedback assures that the transmitted signal will accurately follow any variation in space humidity. Models with ranges of 30 to 80% RH and 10 to 60% RH are available.

H-5210 Duct Humidity Pneumatic Transmitter ☐

The H-5210 senses duct humidity and transmits a proportional signal to a receiver. The transmitter incorporates pneumatic feedback and has a CAB (cellulose acetate butyrate) sensing element. The H-5210 is a low-volume instrument installed with a 0.007-in. (0.18 mm) external restrictor. It is mounted directly on a duct with an integral bracket.



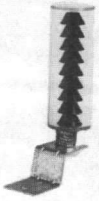
H-5500 Series Pneumatic Humidity Indicators ☐

Humidity Indicators provide continuous visual indication of relative humidity measured by a transmitter with a 3 to 15 PSIG (21 to 103 kPa) pneumatic output range. They are available in 2-1/2 and 3-1/2 in. dial sizes. Indicators are flush or surface mounting. Breakoff notches are stamped into all "U" clamps to speed flush mounting into various panel thicknesses. There is a recalibration screw on the face of the dial.

Miscellaneous — Section M

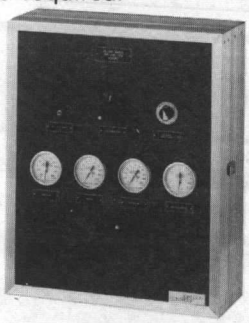
M-2500 Solar Compensator ☐

The M-2500 Solar Compensator is a non-directional device used to compensate for the sun's effect on buildings having air conditioning or heating systems employing exposure zoning.



M-8100 Control Cabinets ☐

M-8100 Control Cabinets are general purpose utility enclosures designed for grouping and protecting various pneumatic, electric and/or electronic control system components. All cabinets are UL Listed for line voltage applications. M-8100 Cabinets have extruded aluminum alloy frames and removable face and back panels made of aluminum bonded on both sides of a plywood core. The cabinets can be inverted so that the doors swing from right to left or left to right as required.



Typical M-8100 (Pre-mounted and Pre-connected by the Panel Unit)

Networks

Section N

N-1000 Logic Network

The N-1000 Logic Network is a multipurpose pneumatic device which provides a sequence of logic functions to an outside air damper and mechanical cooling coil. N-1000 outputs are based on cooling demand, outside air temperature, outside air switchover adjustment, and an overriding input such as fan status. The device also incorporates a minimum percent override protection (temperature low limit) and an auxiliary 1 to 20 PSIG (7 to 138 kPa) switch-line output. The versatility of the N-1000 will allow its use on every air handling unit that has outside and return air dampers.

N-2000 Humidity Logic Network for D.X. or N.C. Dehumidification Apparatus

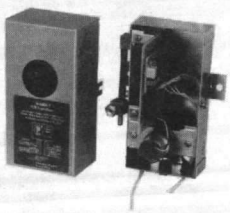
The N-2000 Humidity Logic Network provides a sequence of logic functions for humidification and dehumidification as required. It is designed to provide energy efficient humidity requirements as described in ASHRAE 90-75, i.e., a low % RH set point is established during the Winter mode with no energy usage to humidify or dehumidify above this value, and a high % RH set point is established during the Summer mode with no energy usage to dehumidify or humidify below this value. The N-2000 can also be connected to provide the required logic for constant RH (single set point) applications.

N-2010 Humidity Logic Network for N.O. Dehumidification Equipment

The N-2010 performs the same functions as the N-2000 but is used with normally open dehumidification equipment.

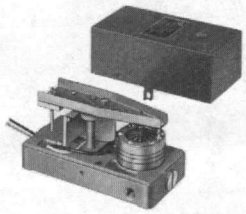
N-6600 Pressure Electric Transducer Linear Current and/or Voltage Output

The N-6600 is a LVDT-(Linear Variable Differential Transformer) type pressure to electric transducer used with an S-6600 Power Supply. The N-6600-1 is designed so that both 4 to 20 mA D.C. current and 40 to 200 mV D.C. voltage outputs can be used simultaneously or individually depending on the application. The N-6600-2 is designed for use with the JC/80 and supplies a 2 to 10V D.C. output voltage to an AT/7.



N-6800 Electro-Pneumatic Transducer

The N-6800 Electro-Pneumatic Transducer converts a 6 to 15 volt D.C. output signal from an electronic controller into a proportional 0 to 20 PSIG (0 to 138 kPa) output pressure to operate standard pneumatic equipment in proportional control applications. The transducer is direct acting. When used with a Cybertronic controller, the output pressure—factory set at 3 to 18 PSIG (21 to 124 kPa)—varies as the square root of the input voltage.

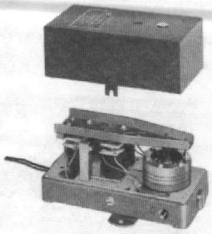


N-6810 Electro-Pneumatic Transducer Current Input—Linear Pressure Output

The N-6810 Electro-Pneumatic Transducer converts a D.C. milliampere input signal into a linear pressure output of 3 to 15 PSIG (21 to 103 kPa), adjustable within a 0 to 30 PSIG (0 to 207 kPa) range. The N-6810 can be made either direct or reverse acting by changing the polarity of the input. For a given electrical input, the transducer's torque motor produces many times the torque output of a conventional linear motor. Hysteresis is negligible.

N-6820 Electro-Pneumatic Transducer Voltage Input—Linear Pressure Output ☐

The N-6820 converts a D.C. voltage input signal into a linear pressure output of 3 to 15 PSIG (21 to 103 kPa), adjustable within a 0 to 30 PSIG (0 to 207 kPa) range. The action can be changed by reversing the polarity of the input. For a given electrical input, the transducer's torque motor produces many times the torque output of a conventional linear motor. Hysteresis is negligible.



N-9000 Enthalpy Logic Center ☐

The N-9000 Enthalpy Logic Center is a prepackaged pneumatic logic network that provides the true economizer cycle for any air handling system capable of using outside air for free cooling. The N-9000 compares the enthalpy of one air stream to that of another—typically, the outside and return air streams. Enthalpy comparison enables the total heat content (sensible and latent heat) to be considered, not just the sensible heat content as in previous economizer systems.

Pressure Controllers — Section P

P-5210 Pressure Transmitter ☐

The P-5210 Pressure Transmitter measures a pressure, converts the measurement into a proportional 3 to 15 PSIG (21 to 103 kPa) output signal, and transmits the signal to a pneumatic receiver. Pneumatic feedback assures an exact proportional relationship between the measured pressure and the transmitted signal. The P-5210 is a direct acting, low-volume instrument used with a 0.007-in. (0.18 mm) external restrictor.

P-5215 Differential Pressure Transmitter ☐

The P-5215 Differential Pressure Transmitter is a low-volume, direct acting instrument which measures low differential pressure and converts the measurement into a proportional 3 to 15 PSIG (21 to 103 kPa) output signal. It is especially suited to measuring static, velocity, and differential pressures.

P-5217 Differential Pressure Transmitter ☐

The P-5217 is a low-volume, direct acting instrument which measures differential pressure and converts the measurement into a proportional 3 to 15 PSIG (21 to 103 kPa) output signal. Used with an external restrictor, the P-5217 is used to measure a static pressure differential—for example, that of the filter and fan discharge segments of an air distribution system.

P-5231 Pneumatic Air Flow Switch ☐

The P-5231 Air Flow Switch is a static pressure sensing device for applications where duct pressure is a function of duct air flow. It is used primarily for determining whether or not a fan is operating.

P-5500 Pressure Receiver-Indicator ☐

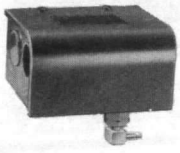
The P-5500 provides continuous visual indication of the pressure measurement of one transmitter in a 3 to 15 PSIG (21 to 103 kPa) pneumatic transmission system. The dial-type indicator is available in standard sizes of 2-1/2 and 3-1/2 inches and is flush or surface mounted. The dial range must match the range of the transmitter with which it is used. All receiver-indicators have a recalibration screw. Breakoff notches are stamped into all "U" clamps to speed flush mounting into various panel thicknesses.

P-7100 Pneumatic Electric Switch ☐

The P-7100 Pneumatic Electric Switch is designed for use in any application that requires an electric device to be actuated by a pneumatic controller. The set point is factory calibrated at 10 PSIG (69 kPa) but is adjustable from 3 to 18 PSIG (21 to 124 kPa). UL component recognized.

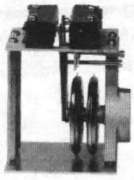
P-7200 Two-Stage Pressure Electric Switch Two SPDT Switches ☐

The P-7200 is a two-stage pressure electric switch designed primarily for use on self-contained, heating-cooling unit ventilators with mechanical refrigerators. One stage can be used to change unit operation from heating to cooling, and the other stage can be used to actuate the refrigeration compressor. The P-7200 has two SPDT snap-acting switches. It is rated for a full load at 16 amps at 120 volts A.C. and is also available in 208, 240, and 277 volt A.C. motor ratings. UL Listed.



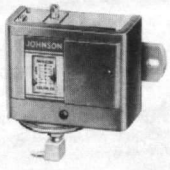
P-7210 High-Low Pressure Electric Switch ☐

The P-7210 consists of two SPDT pressure electric switches that operate independently—one on an increase in pressure, and one on a decrease in pressure. Each switch can be adjusted independently to operate at up to 20 PSIG (138 kPa) and has a fixed differential of 0.15 PSI (1 kPa). Fifteen amps at 125, 250, or 480 volts A.C. is the instrument's full-load rating.



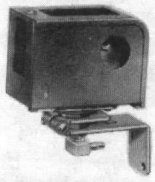
P-7220 DPST Pressure Electric Switch N.O. or N.C. Models ☐

The P-7220 Pressure Electric Switch is designed for use in applications where 0 to 30 PSIG (0 to 207 kPa) air pressure is used to switch low or line voltage devices. Two models are available: a normally closed model which opens its contacts on increasing pressure, and a normally open model which closes its contacts on increasing pressure. The P-7220 is rated for a full load at 12 amps at 120 volts A.C., single phase, and is also available in 208, 240, and 277 volt A.C. motor ratings. UL Listed.



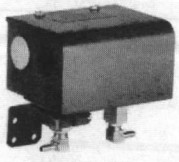
P-7221 Pressure Electric Switch SPDT Switch

The P-7221 is a UL-Listed pressure electric switch designed for applications where a pneumatic controller is used to actuate an electric device. It features a snap-acting SPDT switch designed especially for slow or fast cycling applications. The set point is adjustable between 3 and 20 PSIG (21 and 138 kPa), and the differential is adjustable between 2 and 6 PSI (14 and 41 kPa). The P-7221 is rated for a full load at 16 amps at 120 volts A.C. and is also available in 208, 240, and 277 volt A.C. motor ratings.



P-7222 Pressure Electric Switch Three SPST Switches

The P-7222 is a duplex pressure electric switch that provides continuous fan operation and damper control during a day cycle and intermittent fan operation during a night cycle. It has three SPST N.C. switches, two of which are ganged. The P-7222 is rated for a full load at 6 amps at 120 volts A.C. and is also available in 208 and 240 volt A.C. motor ratings. UL Listed.

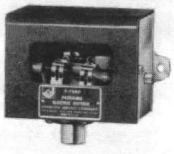


P-7230 Pressure Electric Switch With Adjustable Differential

The P-7230 is used in systems where a pneumatic controller is required to actuate an electric device. Two external knobs allow independent adjustment of the high and low pressure limits over the entire range of the instrument. Five models with various electrical ratings and switch actions are available.

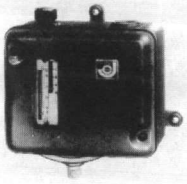
P-7240 Pressure Electric Switch With Fixed Differential

The P-7240 is used in applications where a pneumatic controller must operate an electric device. All models have an external set point adjustment and a fixed differential. Five models with various differentials, switch actions, and electrical ratings are available.



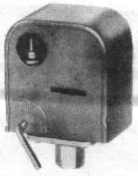
P-7302 Pressure to Electric Transducer Proportional Action One Potentiometer

The P-7302 is a pressure to electric transducer which accepts a 3 to 20 PSIG (21 to 138 kPa) input pressure signal, such as the output of a pneumatic thermostat, and produces a proportional 0 to 135 ohm resistance change. The change may be used to operate an SCR Electric Heat Control Unit or position a gear train actuator.



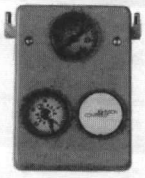
P-7500 Pressure Electric Switch For Controlling Air Compressors Normally Closed

The P-7500 Pressure Electric Switch is an automatic motor control for air compressors (motor or engine driven) that do not require mechanical release valves. It can also be used with other types of pressure equipment. The range of the P-7500 is from 40 to 100 PSIG (276 to 689 kPa). The differential is adjustable from 15 to 35 PSI (103 to 241 kPa).



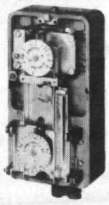
P-8000 Pressure Controller Proportional or Two Position

The P-8000 Controller is designed for a wide range of pressure control applications. The pressure sensing line can be located where extreme conditions do not permit controller mounting or where operational adjustments to the controller would be inconvenient. This instrument is ideally suited for installations that require the controller to be mounted on a local control panel. Models are available with proportional or two-position action and are furnished with a low-pressure or high-pressure element assembly. The controller is either direct or reverse acting depending on the position of the sliding control port.



P-8575 Differential Pressure Controller ☐

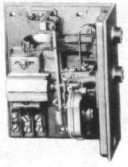
The P-8575 Differential Pressure Controller is adaptable to a wide range of pressure differential control applications. Pneumatic feedback stabilizes the control point of the instrument. Models are available as either direct or reverse acting, but the pivots may be changed in the field if the opposite action is desired. The operating differential is adjustable between 0 and 90 PSI (0 and 620 kPa). The controller should not be used for pressure applications in excess of 250 PSIG (1723 kPa).



Restrictors and Pressure Regulators — Section R

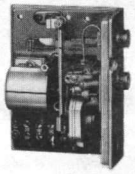
R-26 Load Limiting Relay ☐

The R-26 Load Limiting Relay is designed primarily to protect centrifugal refrigeration compressors against electrical overload though it may be used in any application where electrcial load is controlled pneumatically. The device reduces electrical load in proportion to measured overload current. The R-26 is adjustable for any current value between 3 and 7 amperes. Used with the proper transformer, it can be used in electrical circuits of any current rating.



R-27 Load Limiting Relay With Remote Set Point Adjuster ☐

The R-27 is designed primarily to protect centrifugal compressor motors against electrical overload though it will provide current overload protection in any application where electrical load is controlled pneumatically. Its remote set point adjuster is calibrated from 40 through 100 percent of full electrical load in 10 percent increments. The Load Limiting Relay reduces electrical load in proportion to measured overload current. It is adjustable to any current value between 3 and 7 amperes. With the proper transformer, it can be used in electrical circuits of any current rating.



R-130 Air Pressure Reducing Valve ☐

The R-130 Air Pressure Reducing Valve reduces the primary air pressure to a desired level. The valve is available in 1/8, 3/8, 1/2, and 3/4 in. sizes with capacities of 1, 25, 35, and 60 SCFM, respectively (0.47, 11.8, 16.5, and 28.3 L/s). The output pressure setting is easily adjusted. A relieving feature reduces the output pressure when the pressure setting is lowered.

3/4-in. Valve

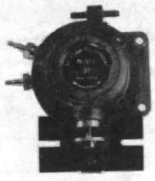
1/8-in. Valve and Mounting Nut (Nut Ordered Separately)

R-131 Air Pressure Reducing Valve ☐

The R-131 is used where a highly accurate regulation of air pressure is required. The valve will maintain an output pressure within ±0.1 PSIG. The R-131 is supplied in 1/4-in. pipe size with two auxiliary 1/4-in. ports.

R-317 Air Flow Controller ☐

The R-317 Air Flow Controller is a direct acting, low-volume instrument for maintaining a constant volume discharge in a high-velocity mixing unit. The R-317 controls duct pressure or air flow or is for use with all mixing units in which volume can be controlled by measuring a pressure differential (within one of the R-317's ranges).

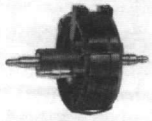


R-318 Air Flow Controller ☐

The R-318 Air Flow Controller is a proportional action low-volume instrument designed to maintain a constant volume discharge in a high-velocity mixing unit. The controller is direct acting. It is suitable for control of duct pressure or air flow as well as for use with all mixing units in which the volume can be controlled by measuring a pressure differential within the R-318's range: 0.1 to 1.0 in. WG (24.8 to 248.8 kPa).

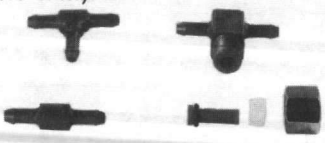
R-2080 1:1 Booster Relay ☐

The R-2080 operates as a pneumatic repeater and volume amplifier. The pilot signal received by the R-2080 is repeated at its output at a 1:1 ratio. It is amplified to a large volume output signal to either improve the response time of a controlled device or to operate additional controlled devices.

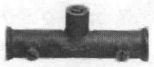


R-3710 Series Restrictors ☐

The R-3710 Series Restrictors are available with fixed and variable size orifices in various styles for convenience in installation. The fixed restrictors come in two sizes that are color coded for easy identification: 0.005 in. (0.12 mm), red; and 0.007 in. (0.18 mm), aqua. The R-3710-2000 model is a variable size restrictor. Its orifice is adjustable from 0 to 0.0625 in. (0 to 1.6 mm).



Fixed



Variable

R-3712 Diode Restrictor Tee ☐

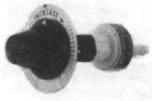
The R-3712 has an integral diode and restrictor. It allows air flow through the bottom of the tee in one direction only. A 0.007-in. restrictor is in the marked branch.

R-3714 Diode Tee ☐

The R-3714 Diode Tee is designed to be installed in a low-volume thru-line to exhaust the thru-line whenever the pressure to the diode branch is at a lower value than that of the thru-line. A higher pressure at the diode branch closes the diode and allows normal operation in the thru-line.

R-4000 Miniature Pressure Regulator ☐

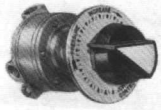
The R-4000 Miniature Pressure Regulator is a low-volume instrument used primarily for readjusting the set point of pneumatic and fluidic controllers. Its output pressure varies in proportion to the rotation of the adjusting knob. The R-4000 is available in output pressure spans of 1, 2, 3, 5, 6, and 12 PSI (7, 14, 21, 34, 41, and 83 kPa). These spans can be placed anywhere within the output pressure limits of 2 and 17 PSIG (14 and 117 kPa) for the 12 PSI span model and 2 and 12 PSIG (14 and 83 kPa) for all other span models.



Switches — Section S

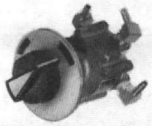
S-224 Pneumatic Gradual Switch ☐

The S-224 Pneumatic Gradual Switch is a proportional action, relay-type device that slowly changes the pressure in air lines from a remote location. Its output pressure setting can be set from zero to full control pressure—20 PSIG (138 kPa). The output pressure spans (per 300° knob rotation) of the two available models are 6 and 20 PSI (41 and 138 kPa); there is a conversion kit to convert either span to 2 PSI (14 kPa).



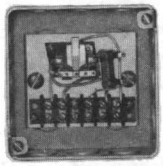
S-230 Series Pneumatic Selector Switches ☐

S-230 Series Pneumatic Selector Switches are designed for manual switching of air flow in pneumatic control systems. There are two-(S-232), three-(S-233), and four-(S-234) position switching models, with or without exhausts. A variety of preprinted switchplate service labels are available.



S-1206 24V D.C. Motor Control Unit for Local and Remote Start-Stop ☐

The S-1206 is an electrical control station which makes it possible to both start and stop an electric motor from a local or remote location, whichever is convenient. The unit draws 15 mA and consists of a 22-volt minimum pull-in relay, a 50-ohm resistor, and a 6-point terminal strip, all housed in a standard conduit box. The contacts of the relay have a rating of 345 VA and a maximum voltage limit of 220 volts.

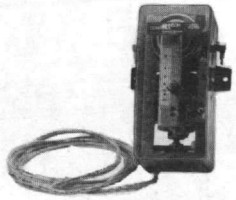


S-6100 Electro-Pneumatic Servo with Motor Drive ☐

The S-6100 Electro-Pneumatic Motor-Driven Servo produces a pneumatic output directly proportional to an electric input signal to reset pneumatic controlling receivers or to reposition pneumatic controlled devices. This transducer is ideally suited for manual or multiplexed applications where multi-point remote adjustment or repositioning is desired. Four models of the S-6100 are available with output spans of either 5 or 10 PSI (34 or 69 kPa) and indication potentiometer resistances of 100 or 5000 ohms. For JC/80 applications, two models of the S-6180 are available with output spans of either 5 or 10 PSI and indication potentiometer resistances of 5000 ohms. The output pressure range of all S-6100 and S-6180 models is adjustable from 0 to 20 PSIG (0 to 138 kPa).

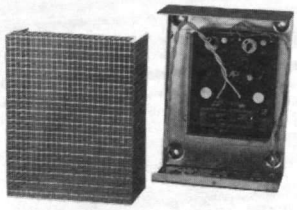
S-6110 Electro-Pneumatic Motor-Driven Servo ☐

The S-6110 Electro-Pneumatic Motor-Driven Servo provides a pneumatic output which can be changed by the application of a D.C. signal to its input. The magnitude of the output change is directly proportional to the duration of the electric input signal. The output is used to reset remote pneumatic controlling receivers or to reposition pneumatic controlled devices. The S-6110 has an output pressure span that is adjustable from 2 to 20 PSI (14 to 138 kPa) ±5% of the span.



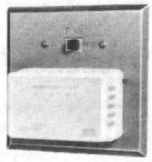
S-6600 Regulated Power Supply ☐

Designed for use with the N-6600 Pressure-Electric Transducer, the S-6600 can provide a regulated ±15 volt D.C. output for up to 7 current/voltage output transducers or 17 voltage output transducers. Any combination of the transducers can be connected in parallel as long as the total current draw between "+15V" and "Com" on the power supply does not exceed 300 mA—the unit's maximum current output. Input voltage of the S-6600 is 115/230 volts A.C., 50/60 Hz ±10%. The power supply is furnished in an electrical equipment enclosure.



S-7200 Fan Control Switch and Mounting Base for T-4000 Series Thermostats ☐

The S-7200 is a combination fan speed selector switch and mounting base for Johnson T-4000 Series Pneumatic Room Thermostats. A three-position electrical switch marked "Low—Off—High" and rated for 1/2 HP at 120 volts, 60 Hz is used to select the desired fan speed. The thermostat, horizontally mounted, controls the valve on fan coil units according to room conditions.

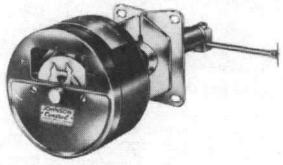


S-7300 Circulating Pump Sequencer ☐

The S-7300 Circulating Pump Sequencer is an automatic electric switching device that activates a "standby" circulating pump whenever the operating pump fails. Models are available for 120V A.C., 50/60 Hz, or 240V A.C., 50/60 Hz electrical service. Control circuit voltage is 24V A.C., 50/60 Hz. The sequencer is also equipped for the addition of an outside air thermostat to stop and start the operating pump according to outside temperature.

S-7500 Damper Position Switch SPDT Line Voltage

The S-7500 Damper Position Switch delays fan operation until the damper to which it is connected is in the proper position. It can also be used to operate a light to indicate whether the damper is open or closed. The unit is equipped with a SPDT, hermetically sealed, mercury switch rated at 4 amp. 115 volts, 2 amp. 230 volts, A.C. or D.C.



Thermostats and Thermometers — Section T

T-335 Submaster Airstream Thermostat Averaging Element

The T-335 Thermostat is a non-relay instrument especially designed for controlling unit ventilator discharge air temperatures between selected limits. This is a proportional action, direct acting thermostat with a built-in restrictor and adjustable sensitivity. Its set point is automatically adjusted by the master room thermostat. A liquid-filled averaging element designed for temperatures up to 270F is furnished on the T-335.

T-2100 Dial Thermometers Direct or Remote Mounted Air or Liquids

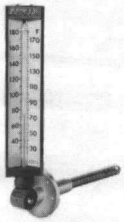
The T-2100 Dial Thermometers are available in two models: one for direct mounting and one with a capillary for remote mounting (surface or flush). Both models are supplied with an 8-ft. (2.44 m) averaging element or with a bulb insertion element. A mounting bracket is furnished with the flush-mounted thermometer that will accommodate panels up to 7/8 in. (22 mm) thick.

Direct Mounting with 8-ft. Averaging Element

Direct Mounting with Bulb Insertion Element

T-2110 Vertical Scale Thermometer Air or Liquids

The T-2110 Thermometers give accurate, continuous temperature indication. An insertion model is available for measuring temperatures in air ducts, and an immersion model is available for indicating temperatures in tanks, process piping, and other pipe lines. Both have 9-in. scales.

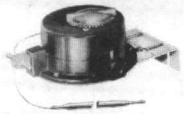


Insertion Model

Immersion Model

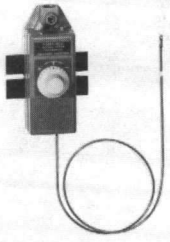
T-3100 Thermostat Single Temperature Single Pressure

The T-3100 proportional action pneumatic thermostat maintains space temperature according to return air temperature in a terminal air conditioning unit. Direct or reverse acting models with liquid-filled bulb elements are available.



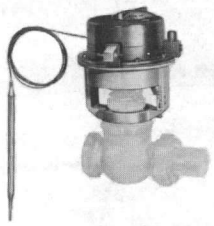
T-3101 Reverse Acting Thermostat with Averaging Element

The T-3101 Reverse Acting Thermostat proportionally controls air temperature. In a typical application, it is used as a high-limit control and is connected to a G-7185 electric heat step controller. The T-3101 is furnished with an 8-ft. (2.44 m) averaging element for remote temperature sensing. An in-line fixed restrictor is supplied and must be appropriately installed according to the thermostat's application.



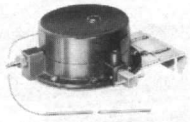
T-3110 Integral Thermostat and Piston Top Valve Actuator
Single Temperature
Single Pressure

Designed primarily for use on a valve-controlled terminal air conditioning unit, the T-3110 is a combination pneumatic thermostat and valve actuator that provides proportional control of a steam or water valve in a single temperature application. The unit will fit any Johnson N.O., N.C., or mixing valve sizes 1/2 in. through 2 in. Direct or reverse acting models with external set point adjustment and liquid-filled temperature measuring elements are available. A direct acting model with an averaging element and concealed set point is available for low-limit applications.



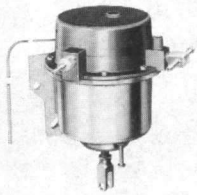
T-3200 Thermostat
Single Temperature
Dual Pressure

The T-3200 is a proportional action, pneumatic controller with an averaging temperature-measuring element and concealed set point adjustment. This compact unit is designed to control pneumatic actuators on heating-cooling unit ventilator applications. The thermostat is direct acting with 15 or 20 PSIG (103 or 138 kPa) supply pressure and inoperative with 11 PSIG (76 kPa) supply pressure.



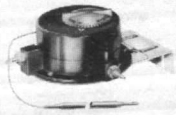
T-3250 Low-Limit Thermostat and Piston Top Damper Actuator
Single Temperature
Dual Pressure

The T-3250 is a combination pneumatic low-limit thermostat and piston top damper actuator designed to proportionally control dampers on heating-cooling unit ventilator applications. The instrument has an integral switch that will render the thermostat inoperative at 11 PSIG (76 kPa) supply pressure; the room thermostat will then directly control the damper actuator. When the supply pressure is 15 or 20 PSIG (103 or 138 kPa) the T-3250 actuator will respond to the demands of the room thermostat except that the T-3250 will override the room thermostat to maintain a minimum discharge temperature. The low-limit set point is 56F at 7.5 PSIG (13°C at 52 kPa). The T-3250 has an 8-ft. (2.44 m) averaging element with an 18-in. (457 mm) capillary.



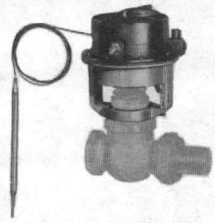
T-3300 Thermostat
Dual Temperature
Dual Pressure

The T-3300 proportional action thermostat maintains space comfort in accordance with the temperature of air returning to a terminal air conditioning unit. Both models have a bulb element and an external set point adjustment. One model is direct acting with 15 PSIG (103 kPa) supply pressure and reverse acting with 20 PSIG (138 kPa) supply pressure. The other is direct acting at 20 PSIG and reverse acting at 15 PSIG.



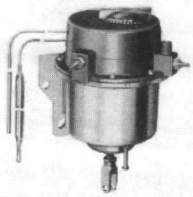
T-3310 Integral Thermostat and Piston Top Valve Actuator
Dual Temperature
Dual Pressure

Designed primarily for use on a valve-controlled terminal air conditioning unit, the T-3310 is a combination pneumatic thermostat and valve actuator that provides proportional control of a steam or water valve in a heating-cooling installation. The unit will fit any Johnson N.O., N.C., or mixing valve, sizes 1/2 in. through 2 in. The T-3310 is a non-relay controller requiring dual supply air pressures of 15 PSIG (103 kPa) and 20 PSIG (138 kPa). Changeover from heating to cooling is accomplished by switching the supply air pressure.



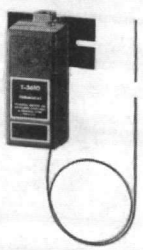
T-3350 Integral Thermostat and Piston Top Damper Actuator Dual Temperature Dual Pressure ☐

Especially suited for heating-cooling applications on terminal air conditioning units, the T-3350 is a combined thermostat and piston actuator that proportionally controls air flow by regulating damper position. The unit is direct acting with 15 or 20 PSIG (103 or 138 kPa) supply pressure and reverse acting with 11 PSIG (76 kPa) supply pressure. The actuator has a 1-1/2-in. (38 mm) stroke and a spring range of 5 to 10 PSIG (34 to 69 kPa). At 20 PSIG input it can provide up to 80 pounds (356 N) of force on power stroke and up to 40 pounds (178 N) on return stroke.



T-3610 Pneumatic Low-Limit Thermostat ☐

The T-3610 is a proportional action, non-relay controller with pneumatic feedback. It is used primarily to maintain a minimum air temperature. Models with an 8-ft. (2.44 m) averaging element or an 18-in. (457 mm) insertion element are available for duct mounting, and a model with an 18-in. insertion element is available for unit ventilator mounting. Mounting brackets are furnished with all models.



T-3610 with 8-ft. Averaging Element

T-4000 Series Pneumatic Thermostats ☐

T-4000 Series Thermostats provide individual space temperature control in heating and cooling systems. They produce a proportional signal to modulate controlled devices in response to load changes. All thermostats have a standard set point dial range of 55 to 85F. Most have a volume amplifier and pneumatic feedback.

The **T-4002** is a single temperature thermostat.

The **T-4003** is a single temperature thermostat featuring a local and/or remote set point readjustment.

The **T-4004** is a single temperature, low capacity thermostat. It requires only one air line connection at the thermostat.

The **T-4502** is a dual temperature thermostat for individual day control and programmed night or weekend setback.

The **T-4512** is similar to the T-4502; however, it features an additional output air terminal which can be used as an on-off switchline to actuate auxiliary devices through the system program.

The **T-4752** is a heating-cooling thermostat.

T-5002 Room Temperature Transmitter ☐

The T-5002 measures space temperature and transmits a proportional 3 to 15 PSIG (21 to 103 kPa) signal to a remote pneumatic thermometer for indication or to a receiver-controller for automatic temperature control. It is available in 50 to 100F, 60 to 85F, and 10 to 35°C ranges.

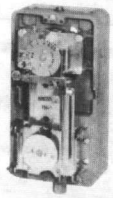
T-5210 Pneumatic Temperature Transmitter ☐

The T-5210 measures temperature and converts the measurement to an air pressure signal that is transmitted to a pneumatic receiver, controller, or receiver-indicator. It is a low-volume instrument incorporating pneumatic feedback. Models are available with bulb elements with 5-1/2-in. (140 mm) or 4-ft. (1.22 m) capillaries, or with 8- or 17-ft. (2.44 or 5.18 m) averaging elements with 1-ft. (305 mm) capillaries. Four models are available with long capillaries, two of which have stainless steel bulbs and capillaries for use in hostile environments.

T-5210 with 8-ft. Averaging Element

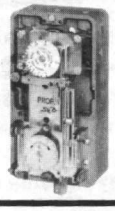
T-5302 Receiver-Controller ☐

The T-5302 Receiver-Controller controls valves, dampers, or other control devices according to temperature, pressure, or humidity measured by a pneumatic transmitter. Direct or reverse acting models are available and have pneumatic feedback. Gain is adjustable.



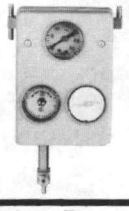
T-5303 Receiver-Controller Submaster ☐

The T-5303 is used where it is desirable to vary the set point of a receiver-controller from either of two remote locations either automatically or manually. Direct and reverse acting models with direct or reverse readjustment are available. The instrument is designed for surface or semi-flush mounting on a central panel.



T-5312 Receiver-Controller for Pneumatic Transmission Systems ☐

The T-5312 produces an output that is proportional to a 3 to 15 PSIG (21 to 103 kPa) signal from a remote transmitter to directly control dampers, valves, and other devices. The instrument can be made either direct or reverse acting and can be surface or panel mounted. A two-position instrument is also available.



T-5500 Series Pneumatic Thermometers ☐

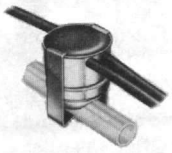
The T-5500 Pneumatic Thermometers provide continuous visual indication of the temperature measurement of one transmitter in a 3 to 15 PSIG (21 to 103 kPa) pneumatic transmission system. All thermometers have a recalibration screw and are equipped to be flush or surface mounted.

T-7610 Electric High-Limit Thermostat with Manual Reset ☐

The T-7610 has been specifically designed to meet the requirements of the National Board of Underwriters regarding the spread of fire through ducts passing through fire walls. When an excessively high temperature causes the unit to cut out, it must be manually reset after the temperature has dropped 12F below the cut-out setting. Power to the unit may be 115, 230, or 440 volts A.C. or D.C. UL and CSA Listed.

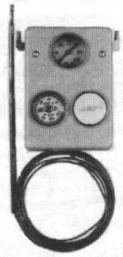
T-7900 Strap-On Line Voltage Thermostat for Heating-Cooling Changeover ☐

When wired in series with a space thermostat, the T-7900 provides automatic heating-cooling changeover on terminal air conditioning units. It straps directly onto a pipe and opens or closes its contacts depending on the temperature of the fluid in the pipe.



T-8000 Bulb Element Thermostat Proportional or Two-Position Action Direct or Reverse Acting ☐

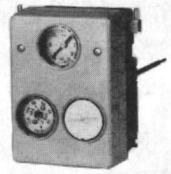
The T-8000 Thermostat is designed for applications which require the sensing element to be located where extreme conditions do not permit controller mounting, or where operational adjustments to the controller would be inconvenient. The thermostat can be made to be either direct or reverse acting. Proportional action models are available with either bulb or averaging elements; two-position models have bulb elements. Surface or panel mounted.



T-8000 with Bulb Element

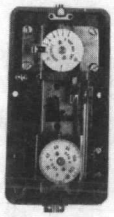
T-8020 Immersion Thermostat Proportional or Two-Position Action Direct or Reverse Acting ☐

The T-8020 controls liquid temperatures. It is mounted directly on a tank or in a pipe tee and is available with or without a separable well for the liquid-filled immersion element. Models with proportional or two-position action are available and can be made to be either direct or reverse acting.



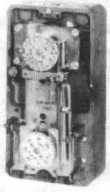
T-8500 Thermostat Bulb Element ☐

The T-8500 employs pneumatic feedback and gives extremely accurate proportional control—even at low sensitivities. This accuracy makes it an ideal master controller in a master-submaster control system. It is also used for direct temperature control. Direct or reverse acting models are available. Action can be changed by a simple field change of the pivot. The T-8500 is recommended when a measuring element must be installed where vibration exists and highly accurate control is required.



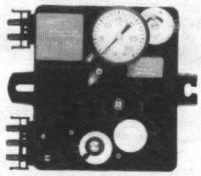
T-8501 Submaster Thermostat Bulb Element ☐

The T-8501 has a set point that can be automatically readjusted by a remote master controller. An adjusting dial permits manual readjustment of the set point at the instrument. The T-8501 is recommended when a measuring element must be installed where vibration exists and highly accurate control is required. The instrument can be field set for direct or reverse action and direct or reverse readjustment.

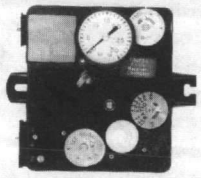


T-9001 Single Input and T-9002 Two Input Pneumatic Receiver-Controllers ☐

T-9001 and T-9002 Receiver-Controllers provide proportional control of pneumatic devices and are designed for use with remote temperature, humidity, or pressure transmitters. Built-in transmitter manifolds provide restricted supply air to low-volume remote transmitters; thus, only one air line connection is required between the two instruments. T-9001 and T-9002 units can be used with any pneumatic output device which has a calibrated output of 3 to 15 PSIG (21 to 103 kPa). For applications using high-volume transmitters or requiring extreme accuracy, a blank manifold (less restrictor) is furnished.



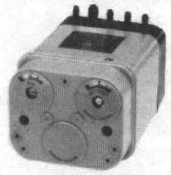
T-9001



T-9002
(Program Module Removed)

T-9110 Remote Set Point T-9111 Integral Set Point PI Receiver-Controllers ☐

The T-9110 and T-9111 Proportional-Integral (PI) Receiver-Controllers add integral function (reset action) to the proportional control action of a pneumatic controller. They also add proportional and integral function to the output of a pneumatic transmitter. The T-9110 is capable of direct or reverse action; the T-9111 must be ordered either as direct or reverse acting. Gain is fixed at 1:1. The controllers significantly reduce energy waste due to excessive offset.



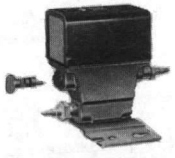
T-9111

Valves

Section V

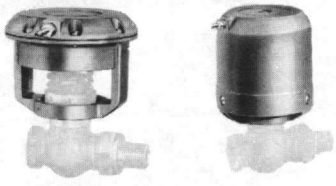
V-24 Solenoid Three-Way Air Valve

The V-24 Solenoid Three-Way Air Valve is used in applications where a pneumatic control device is operated by an electric circuit. The V-24 has two-position action and three piping connections marked "N.O." (normally open), "N.C." (normally closed), and "COM" (common). Several models with different electrical ratings are available.



V-3000 Pneumatic Valve Actuator Exposed or Enclosed

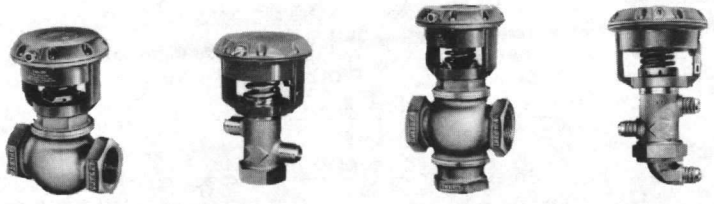
V-3000 Valve Actuators accurately position steam or water valve modulating plugs in response to the pneumatic signal from a thermostat or humidostat. The exposed model is for installation in a protected location; the enclosed model is installed where environmental conditions would be damaging to an exposed actuator.



Exposed Enclosed

Steam and Water Valves for Use With Piston Top Actuators or Valve Top Thermostats

This group of valves controls the flow of steam or water through coils and heat exchangers. They have stainless steel stems and are available in a variety of body patterns of cast brass with modulating valve plugs.



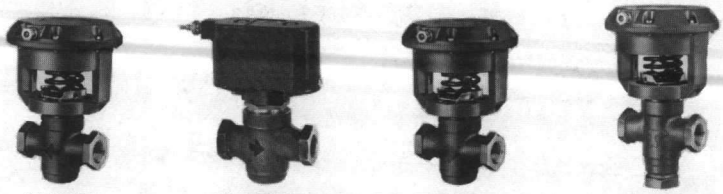
V-3752 V-3962 V-4322 V-4440

(Valves Shown with V-3000 Exposed Actuators)

Valve	Size (inches)	Service Connection	Spring Range PSIG / kPa	C_V/k_V Factor	Service	Valve Body Pressure-Temperature Rating
V-3752 N.O.	1-1/2 & 2	Screwed	4-8 or 9-13 / 28-55 or 62-90	20 & 26 / 17 & 22	Water	150 PSIG @ 281F (1034 kPa @ 138°C)
					Steam	35 PSIG @ 281F (241 kPa @ 138°C)
V-3762 N.O.	1/2 & 5/8	Flared	4-8 / 28-55	0.9-3.3 / 0.77-2.8	Water	250 PSIG @ 281F (1723 kPa @ 138°C)
V-3962 N.C.	1/2 & 5/8	Flared	9-13 / 62-90	1.6-4.1 / 1.4-3.5	Water	250 PSIG @ 281F (1723 kPa @ 138°C)
V-3970 N.C.	1-1/2 & 2	Screwed	9-13 / 62-90	17 & 27 / 15 & 23	Water	150 PSIG @ 281F (1034 kPa @ 138°C)
					Steam	35 PSIG @ 281F (241 kPa @ 138°C)
V-4322 3-Way	1-1/2 & 2	Screwed	4-8 or 9-13 / 28-55 or 62-90	21 & 30 / 18 & 26	Water	150 PSIG @ 281F (1034 kPa @ 138°C)
V-4332 3-Way	1/2	Flared	4-8 or 9-13 / 28-55 or 62-90	1.2 & 2.0 / 1.0 & 1.7	Water	250 PSIG @ 281F (1723 kPa @ 138°C)
V-4334 3-Way	5/8	Flared	4-8 or 9-13 / 28-55 or 62-90	4.7 / 4.0	Water	250 PSIG @ 281F (1723 kPa @ 138°C)
V-4440 Htg-Clg	1/2 & 5/8	Flared	4-12 or 6-9 / 28-83 or 41-62	1.4-4.7 / 1.2-4.0	Water	250 PSIG @ 281F (1723 kPa @ 138°C)

Cage Trim Valves

Cage Trim Valves feature a removable cage which provides valve plug guiding throughout its travel and permits high rangeability. The cage also has an integral seat for easy replacement. By loosening a single set screw, the complete actuator can be removed without disturbing the rest of the valve assembly. All trim parts can then be removed and replaced through the top opening of the valve body without removing the valve from the system. All of the valves in this group can use Piston Top Actuators or Valve Top Thermostats except for the V-3854 which is supplied with its own oval-shaped, enclosed pneumatic actuator. The bodies of these units are made of cast brass, and the stems are stainless steel. The V-3754, V-3854, and V-3974 all use the same body and cage.



V-3754 V-3854 V-3974 V-4324

(V-3754, V-3974, and V-4324 Shown with V-3000 Exposed Actuators)

Valve	Size (inches)	Service Connection	Spring Range PSIG / kPa	C_V/k_V Factor	Service	Valve Body Pressure-Temperature Rating
V-3754 N.O.	1/2, 3/4, 1	Screwed	4-8 or 9-13 / 28-55 or 62-90	0.2-13.9 / 0.17-11.9	Water	400 PSIG (2756 kPa) Between -20 and 150F (-29 to 66°C) Decreasing to 345 PSIG (2377 kPa) at 281F (138°C)
					Steam	35 PSIG (241 kPa)—Saturated
V-3854 N.O.	1/2	Screwed	4-8 or 9-13 / 28-55 or 62-90	1.2-4.4 / 1.0-3.8	Water	400 PSIG (2756 kPa) Between -20 and 150F (-29 to 66°C) Decreasing to 345 PSIG (2377 kPa) at 281F (138°C)
					Steam	35 PSIG (241 kPa)—Saturated
V-3974 N.C.	1/2, 3/4, 1	Screwed	9-13 / 62-90	0.2-13.9 / 0.17-11.9	Water	400 PSIG (2756 kPa) Between -20 and 150F (-29 to 66°C) Decreasing to 345 PSIG (2377 kPa) at 281F (138°C)
					Steam	35 PSIG (241 kPa)—Saturated
V-4324 3-Way	1/2, 3/4, 1	Screwed	4-8 or 9-13 / 28-55 or 62-90	1.2-13.9 / 1.0-11.9	Water	400 PSIG (2756 kPa) Between -20 and 150F (-29 to 66°C) Decreasing to 345 PSIG (2377 kPa) at 281F (138°C)

Steam Valves for Use With Piston Top or Diaphragm Actuators

These valves are designed to control the flow of medium-pressure steam through coils and heat exchangers. They have stainless steel stems and a cast brass body with a single seat and modulating valve plug.

V-5230 with V-3000 Actuator and V-9502 Positioner

V-5430 with Diaphragm Actuator

Valve	Size (inches)	Service Connection	Spring Range PSIG / kPa	C_V/k_V Factor	Service	Valve Body Pressure-Temperature Rating
V-5230 N.O.	*1/2 to 1 **1 to 2	Screwed	3-7 / 21-48	0.9-30 / 0.77-26	Steam	125 PSIG @ 400F (861 kPa @ 204°C) to 200 PSIG @ 150F (1378 kPa @ 66°C)
V-5430 N.C.	*1/2 to 1 **1 to 2	Screwed	9-14 / 62-96	0.9-30 / 0.77-26	Steam	125 PSIG @ 400F (861 kPa @ 204°C) to 200 PSIG @ 150F (1378 kPa @ 66°C)

*Piston Top Actuator Only **Diaphragm Actuator Only

Steam and Water Valves for Use With Diaphragm Actuators

These valves are designed to control the flow of steam or water through coils and heat exchangers. The replaceable composition disc used with the equal percentage modulating plug is especially compounded for steam, hot, or cold water service to assure tight seating. Valves up to 2 inches in size are made of cast brass; valves 2-1/2 through 6 inches in size are made of high tensile cast iron. Some of the models are available with stainless steel trim. All have stainless steel stems.

V-5210 Flanged

V-5250 Screwed

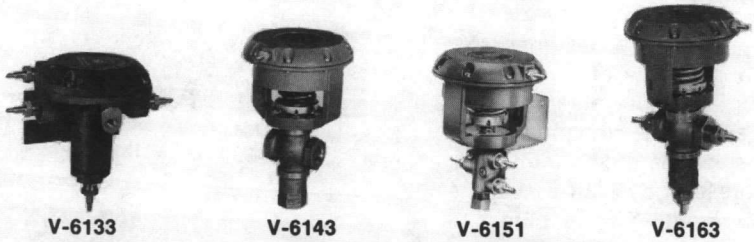
V-5460 Screwed

V-5840 Flanged

Valve	Size (inches)	Service Connection	Spring Range PSIG / kPa	C_V/k_V Factor	Service	Valve Body Pressure-Temperature Rating
V-5210 N.O.	Water 3/4 to 4	Flanged	3-7 / 21-48	0.9-165 / 0.77-141	Water	250 PSIG @ 406F (1723 kPa @ 208°C) to 400 PSIG @ 150F (2756 kPa @ 66°C)
	Steam 2-1/2 to 4	Flanged	3-7 / 21-48	51-165 / 44-141	Steam	125 PSIG @ 353F (861 kPa @ 178°C) to 175 PSIG @ 150F (1206 kPa @ 66°C)
V-5250 N.O.	1/2 to 6	Flanged, Screwed, Union	4-8 or 9-13 / 28-55 or 62-90	1.5-350 / 1.3-300	Water	150 PSIG @ 281F (1034 kPa @ 138°C)
					Steam	35 PSIG @ 281F (241 kPa @ 138°C)
V-5410 N.C.	Water 3/4 to 4	Flanged	9-13 / 62-90	0.9-165 / 0.77-141	Water	250 PSIG @ 406F (1723 kPa @ 208°C) to 400 PSIG @ 150F (2756 kPa @ 66°C)
	Steam 2-1/2 to 4	Flanged	9-13 / 62-90	51-165 / 44-141	Steam	125 PSIG @ 353F (861 kPa @ 178°C) to 175 PSIG @ 150F (1206 kPa @ 66°C)
V-5460 N.C.	1/2 to 6	Flanged, Screwed	9-13 / 62-90	2.2-344 / 1.9-295	Water	150 PSIG @ 281F (1034 kPa @ 138°C)
					Steam	35 PSIG @ 281F (241 kPa @ 138°C)
V-5650 Bypass	2-1/2 to 6	Flanged	9-13 / 62-90	68-414 / 58-355	Water	125 PSIG @ 281F (861 kPa @ 138°C)
V-5840 3-Way	1/2 to 6	Flanged, Screwed	4-8 or 9-13 / 28-55 or 62-90	3.2-347 / 2.7-297	Water	150 PSIG @ 281F (1034 kPa @ 138°C)

Air Switching Valves

These valves are used in dual supply pressure systems to switch the flow of control air from one supply pressure to another. The V-6151 can also be used in a variety of other applications. Control air connections are made to barbed fittings on the actuators. Valve bodies are cast brass; actuators are die cast aluminum.



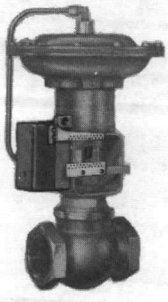
V-6133 V-6143 V-6151 V-6163

(V-6143, V-6151, and V-6163 Shown with V-3000 Exposed Actuators)

Valve	Size (inches)	Service Connection	Spring Range PSIG / kPa	Maximum Pressure PSIG	Maximum Pressure kPa	Body Rating PSIG	Body Rating kPa
V-6133 3-Way	1/8	Barbed Fitting	3-5 / 21-34	75	517	125	861
V-6143 3-Way	3/8 / 3/4	Screwed	9-11 / 62-76; 9-13 / 62-90	125	861	125	861
V-6151 3-Way	1/4	Barbed Fittings	15-19 / 103-131	125	861	125	861
V-6163 3-Way	1/4	Barbed Fittings	12-14 or 16-18 / 83-96 or 110-124	50	345	150	1034

V-9502 Pneumatic Positioner for Rubber Diaphragm Valve Actuators

The V-9502 Positioner is a precision, pneumatic relay device that adjusts and maintains a valve actuator in an exact position in applications requiring accurate, stable control. The positioner is mounted directly to a valve actuator for precise flow control. The V-9502 is furnished as part of a factory-mounted assembly consisting of a positioner attached to a V-3000-1, 3-R, 4-R, 5-R, or 8-R actuator, or is available as a separate unit.

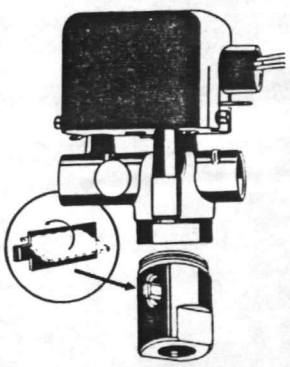


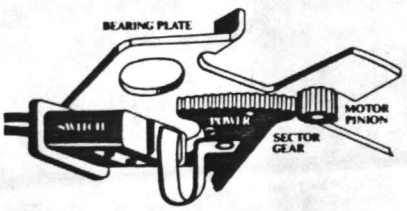
V-9502 Mounted to Diaphragm Actuator and Valve

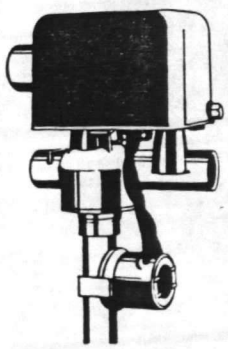
Johnson Controls, Inc.
Milwaukee, Wisconsin 53201

MOTOR OPERATED VALVES FOR SUPER CHILLED WATER APPLICATIONS

- Fan coil systems
- Gas absorption chiller systems
- Convection systems
- Valance systems
- Radiant systems
- Induction systems







MOTORTROL two position compact MOTORTROL valves offer a wide range of models to handle all water system control needs. MOTORTROL valves are designed to withstand high moisture conditions found in many concealed fan coil installations.

Important MOTORTROL Features

- ☐ Silent valve operation.
- ☐ 100% shut-off
- ☐ Optional summer/winter change over switch.
- ☐ No bleed ports to plug.
- ☐ Super-quick disconnect inverted flare connections on 647 and 687 series.
- ☐ Rubber parts specially compounded for chilled or hot water.
- ☐ Built in adjustable flow controller (optional).
- ☐ Optional auxiliary switch sealed .

Valves are available in both normally open and normally closed. Normally open valves provide a fail safe installation. MOTORTROL's biggest advantage over other valves is its day after day reliable, service free performance.

OPTIONS AVAILABLE

ADJUST-O-FLOW

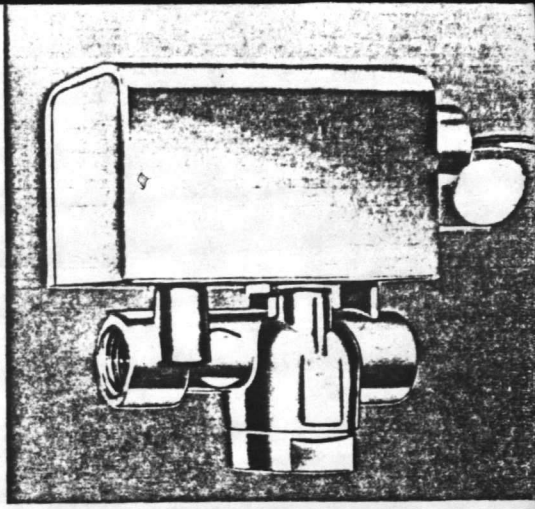
Adjust-O-Flow is built into the MOTORTROL units thus eliminating the need for a separate balancing valve. To adjust the flow to the capacity desired merely turn the cock to the desired position. Ideal for fan coil, baseboard units, boilers, convectors and wherever a system needs balancing to provide varied heating and cooling requirements.

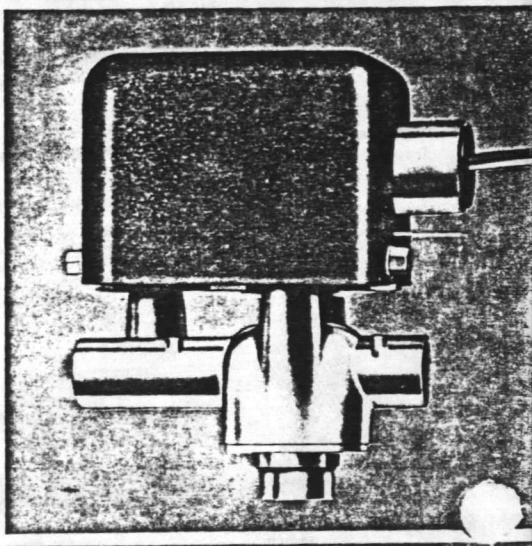
AUXILIARY SWITCH

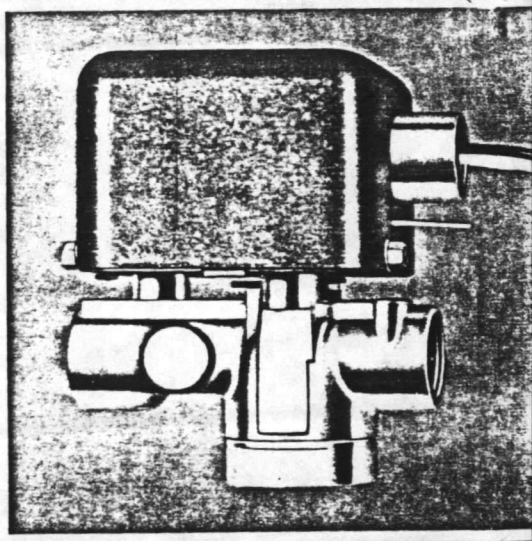
Available for control panel monitoring or operating auxiliary equipment on standard models. It is activated after valve is fully open and is reset as valve starts to close. For pilot duty only. (Only sealed switches should be specified for chilled water applications.) Rating 5 amp at 125/250 V A.C.

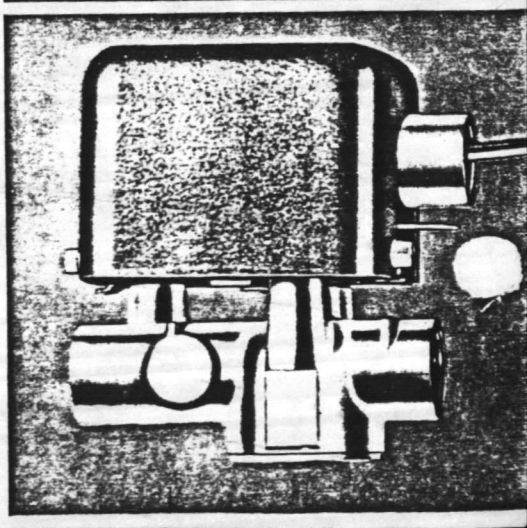
STRAP-ON SUMMER/WINTER CHANGE OVER SWITCH

Encapsulated switch completely sealed against moisture and factory wired to operate valve motor only. Suitable for ⅞" and ⅝" O.D. tube and ½" pipe. It will operate on thermostat heating contacts with water temperatures of 88°F or higher. With water temperatures of 60°F or lower the valve will operate on thermostat cooling contacts.









JOHNSON CONTROLS

Johnson Controls, Inc.
Penn Division

2221 Camden Court
Oak Brook, IL 60521

Type A19ANC
General Purpose Industrial Thermostats With Rainproof Enclosure

APPLICATION

These SPDT thermostats are designed for a variety of applications where rainproof enclosures are necessary or desirable. A typical use is to control the temperature of fluids conveyed through pipes (commonly termed pipe tracing). An alarm or signal circuit can be operated by the auxiliary contacts (see Wiring Diagram).

These thermostats are designed for operating or limit control applications. Where critical or high value products are to be maintained within a specific temperature differential, a single thermostat should not be applied to function as both an operating and a limit control. In these applications, a separate limit control with alarm contacts should be wired to indicate when the limit control operates.

FEATURES

- Rainproof gasketed enclosure has gray U.L. listed outdoor finish.
- Liquid-filled element is unaffected by barometric pressure and cross ambient temperatures.
- Dependable field proved snap-acting contacts with heavy duty rating for inductive or resistance loads. Pilot rating to 600 V. A.C.
- Wide choice of range options.
- Simple strain-free mounting on three rubber cushioned mounting feet.
- High limit dial stop.
- Copper bulb well available.

GENERAL DESCRIPTION

This thermostat has an enclosed SPDT Pennswitch contact unit. May be wired to open on temperature rise ("R" to "B"), or close on temperature rise ("R" to "Y").

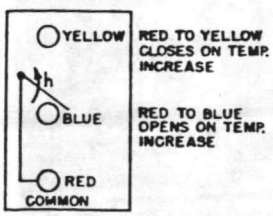


Fig. 2 — Terminal arrangement.

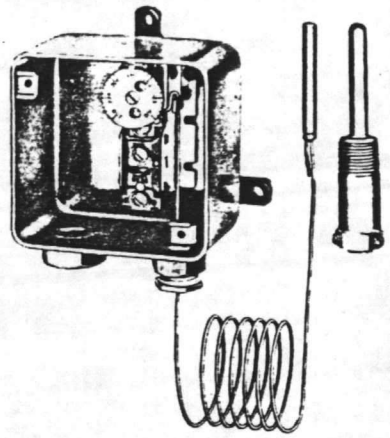


Fig. 1 — Interior of Type A19ANC.

This thermostat has a keyed adjustable high limit stop. A special spanner wrench (Part No. 836-61), required to adjust stop, is supplied with each control.

OPTIONAL CONSTRUCTIONS

Sensing Elements: Standard capillary length is 10 feet. Other lengths available at extra cost, consult Customer Service.

Bulb Well: Copper bulb wells with ½" NPT brass connector are supplied when required, at extra cost. See "Specifications Table" for Part Numbers.

MISCELLANEOUS SPECIFICATIONS

Conduit Opening: Welded ¾" female bushing.

Case and Cover: .062" cold drawn steel.

Finish: U.L. listed outdoor baked-on gray enamel.

Shipping Weight: Individual pack 2.3 lbs.

ORDERING INFORMATION

To order specify Product Number. If Product Number is not known, specify the following:

1. Type A19ANC.
2. Range required.
3. Capillary length if other than 10 feet (consult Customer Service).
4. Bulb well, if required.

SPECIFICATIONS

Product Number	Range °F.	Nominal Differential °F.*	Maximum Allowable Temp. °F.	Length of Capillary	Bulb Size	Bulb Well (If Required)
A19ANC-1	0 to 150	6	190	10'	0.290 x 2½"	WEL11A-601R
A19ANC-2	100 to 250	6	290	10'	0.290 x 2½"	WEL11A-601R
A19ANC-3	200 to 350	6	390	10'	0.366 x 2¼"	WEL16A-601R
A19ANC-4	325 to 475	6	515	10'	0.366 x 2¼"	WEL16A-601R

* Differential based on direct bulb immersion in liquid at 1° per minute rate of change. In a bulb well, differential will widen. When clamped to a surface such as a pipe, differential may be wider or narrower depending on several variables.

JOHNSON CONTROLS

Johnson Controls, Inc.
Penn Division

2221 Camden Court
Oak Brook, IL 60521

Series A41 Wire Wound Temperature Sensors For Duct, Immersion and Outdoor Sensing

Application

These nickel wire wound sensors are used with Penn electronic controllers that require wire wound sensor inputs, such as the Series R41 'MIZER, R48 MINI-'MIZER or R94 controller.

Features

—Highly sensitive nickel wire sensing element.

—Solid state components.

—Easy to install and wire.

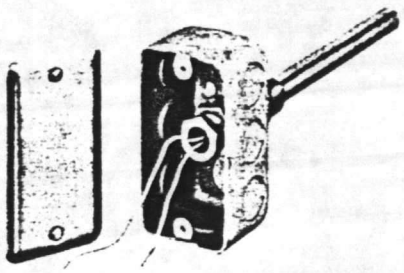


Fig. 1—Type A41BA Immersion Sensor.

—Shielded wire not normally required.

Specifications

Type Number	A41BA	1000 ohms, Immersion, NEMA Type 1 Enclosure, 6" Wire Leads
	A41FA	1000 ohms, Duct, Plug Connector
	A41FT	50 ohms, Duct, Zone Discharge, 20:1 Authority, Plug Connector
	A41GA	1000 ohms, Duct, 6" Wire Leads
	A41GT	50 ohms, Duct, Zone Discharge, 20:1 Authority, 6" Wire Leads
	A41HA	1000 ohms, Duct, NEMA Type 1 Enclosure, 6" Wire Leads
	A41QA	1000 ohms, Outdoor, Weathertight Condulet, 6" Wire Leads
	A41WA	1000 ohms, High Temperature to 350 F (177 C), Wire Leads
Insertion Depth of Duct and Immersion Sensors		6" (152 mm)
Material	Duct	Aluminum Support and Mounting Plate
	Immersion	Steel Handi-box and Packing Nut Assembly, ½" NPT Brass Bulb Well
	Outdoor	Aluminum Condulet Fitting with Gasketed Cover
Operating Temperature Range		−40 to 240 F (−40 to 116 C) Unless Otherwise Specified
Reference Resistance		50 ohms at 70 F (21 C) for Types A41FT and A41GT; 1000 ohms at 70 F (21 C) all others
Resistance Tolerance	1000 ohms	± 1% at 70 F (21 C)
	50 ohms	± 1 ohm at 70 F (21 C)
Sensing Element		Nickel Wire Wound, Encapsulated
Shipping Weight (Individual Pack)	A41BA	.8 lb. (.36 kg)
	A41GA, A41FA, A41FT, A41GT	.5 lb. (.23 kg)
	A41HA	1.0 lb. (.45 kg)
	A41QA	1.1 lbs. (.51 kg)
	A41WA	.06 lb. (.027 kg)
Temperature Coefficient	1000 ohms	Positive Resistance Change Approximately 3 ohms Per Degree Fahrenheit (5.4 ohms Per Degree Celsius)
	50 ohms	Positive Resistance Change Approximately 3/Authority ohms Per Degree Fahrenheit (5.4/Authority ohms Per Degree Celsius) Example: 3/20:1 = .15 ohms Per Degree Fahrenheit

General Description

The Series A41 sensors are available for duct, immersion and outdoor sensing applications.

The duct sensor mounts directly to the flat surface of the duct with sheet metal screws. It has a rigid aluminum support which is inserted into the duct and supports the nickel wire

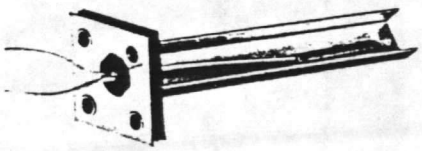


Fig. 2—Type A41GA Duct Sensor less enclosure.

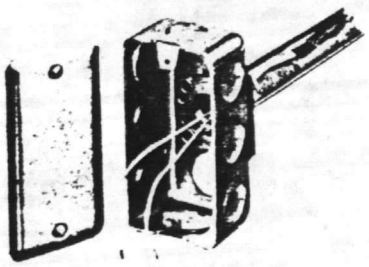


Fig. 3—Type A41HA Duct Sensor with NEMA Type 1 enclosure.

JOHNSON CONTROLS

Johnson Controls, Inc.
Penn Division

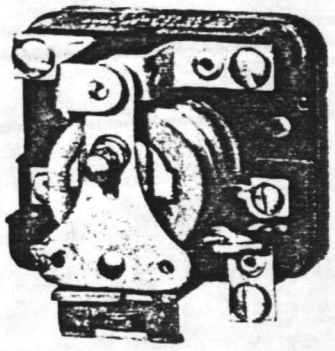
2221 Camden Court
Oak Brook, IL 60521

KZ-4000
General Purpose Relays

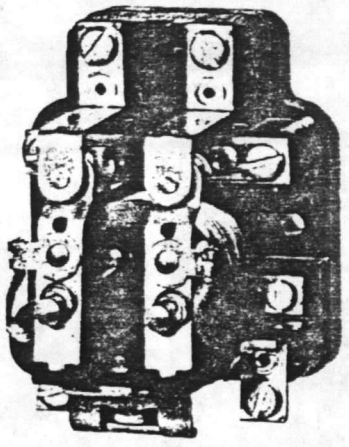
KZ-4000 General Purpose Relays are used to control large electrical loads from lower powered sources. All models are listed by both Underwriters' Laboratories, Inc. and Canadian Standards Association. Two relay contact arrangements are available; double-pole, double-throw and single-pole, double-throw. The nominal coil rating is 10 VA for all voltages. The self-wiping silver alloy contacts are rated for 25 ampere resistive loads and relay contact terminals are an integral part of the assembly.

Installation

KZ-4000 relays are designed for panel mounting. If an enclosure is required, a BZ-1000-2 enclosure must be ordered separately. Wiring connections are made to screw terminals on the relay. All wiring must be in accordance with applicable electrical code requirements.



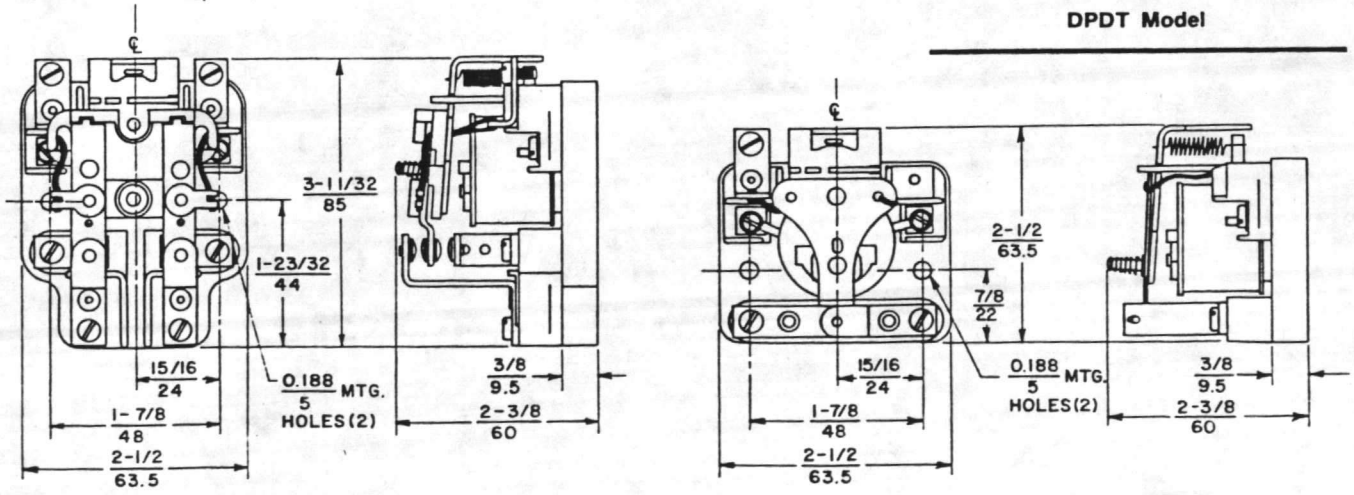
SPDT Model



DPDT Model

Specifications

Product		KZ-4000 General Purpose Relays					
Models	Code No. Suffixes	-4	-5	-6	-7	-8	-9
	Coil Voltages (A.C.)	24	120	240	24	120	240
	Contacts	SPDT			DPDT		
Coil Ratings		10 VA at 24, 120 or 240 Volts, 50/60 Hz					
Pilot Duty Ratings		690 VA at 120 or 240 Volts, 50/60 Hz					
Contact Load Ratings		25 Amperes (Resistive) or 1 HP (746 Watts) at 120 or 240 Volts, 50/60 Hz					



DPDT (left) and SPDT (right) Dimensions $\frac{\text{in.}}{\text{mm}}$

JOHNSON CONTROLS

Johnson Controls, Inc.
Penn Division

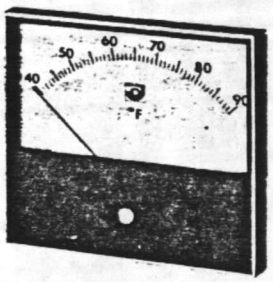
2221 Camden Court
Oak Brook, IL 60521

MZ-7000 Series Cybertronic Indication Meters

MZ-7000 Series Cybertronic Indication Meters are signal readout devices designed for flush mounting (with bezels), surface mounting or back mounting applications. Table 1 lists the ranges available for each model. All MZ-7000 series meter movements are magnetically shielded and can be used in all types of panels without calibration shift. The accuracy of all models is ± 2 % of the full scale values. MZ-7000 meters feature specially designed scales that can be changed without disassembling the meter. Bezel kits and panel lens kits for flush mounting are available for all models (ordered separately).

Applications

MZ-7006 and MZ-7008 meters, with scale sizes of 3 in. (76 mm) and 4 in. (102 mm) respectively, have a fixed internal resistance of 2000 ohms for a 100 microampere full scale deflection and are used with the GQ-4000 Indication System.



MZ-7000 Series Meter

Table 1: Sales and Divisions

Code Number MZ-7006- or MZ-7008-	Scale Range	Scale Data
2	Position 0 to 100%	Linear, Graduated in %
11	Humidity Reset 10 to 90% R.H.	Non-Linear, Graduated in % R.H.
4	Dual: 0 ± 15F & 0 ± 50F Reset, Both Unnumbered	Linear, Graduated in F°
5	-30 to 120F	
6	40 to 240F	
7	40 to 90F	
8	40 to 150F	
9	-20 to 180F	
10	0 to 200F	
33	200 to 400F	
35	100 to 300F	
23	Dual: 0 ± 8C & 0 ± 27C Reset, Both Unnumbered	Linear, Graduated in C°
24	-34 to 49C	
25	4 to 116C	
26	4 to 32C	
27	4 to 66C	
28	-29 to 82C	
29	-18 to 93C	
30	0 to 140C	
34	93 to 204C	
36	38 to 149C	
*	R.H. Indication 30 to 80%	Linear, Graduated in % R.H.

*MZ-7006-13, MZ-7008-13

Installation

All MZ-7000 series meters are furnished with a shorting clip across the meter input terminal studs. Do not remove this clip until the meter is installed on the job site and ready for operation.

The positive terminal is designated by a + identification mark permanently stamped on all meter cases. Observe correct polarity when wiring.

In many cases, where meters are mounted on remote panels, the resistance of interconnecting wires becomes a factor in system accuracy. To avoid stray signal pickup, do not run interconnecting wires in the same conduit or cable carrying A.C. power. All wiring must be in accordance with applicable electrical code requirements. The scale range of the meter selected for a particular application must always match the range of the associated bridge. To remove and replace scales, follow exactly the procedure outlined on the meter case.

JOHNSON CONTROLS

Johnson Controls, Inc.
Penn Division

2221 Camden Court
Oak Brook, IL 60521

Series R34, A41
Solid State Differential Temperature Controller and Sensor for Solar Heating Applications

APPLICATION

The Series R34 differential temperature controller was designed for use on solar heating applications. It automatically turns on a circulating pump or blower to transfer hot liquid or air from the collector to the storage facility when a predetermined temperature differential is exceeded. The pump or blower is turned off when the medium temperature from the collector approaches the storage temperature. This controller is also for other differential temperature control applications.

Type R34ABB model has a preset solar collector low limit and a programmable storage high limit. When the collector temperature drops below the preset low limit, the pump is energized. When the selected storage high limit is exceeded, the pump is de-energized. No additional sensors are required for these limits.

The Type A41WA temperature sensor is a nickel wire wound temperature element for use with the Series R34 controller. It is for temperatures up to 350F (177C) with a resistance of 1000 ohms ±1% at 70F (21C). It has a temperature coefficient of approximately 3 ohms per degree Fahrenheit.

FEATURES

— All solid state components.

— Easy to install and wire.

— Shielded wire not normally required.

— Accurate sensitive nickel wire sensing element.

GENERAL DESCRIPTION

The differential temperature controller has all solid state components and operates from two Type A41WA precision nickel resistance temperature sensors. One sensor is located at the collector panel and the other in the storage facility.

Fig. 2 — Type R34AAA controller.

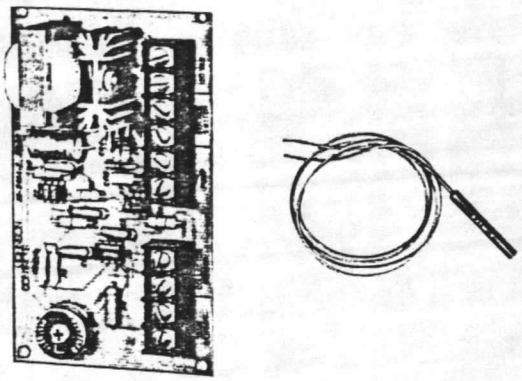


Fig. 1 — Type R34AAB controller and Type A41W sensor.

The output triac is isolated from the control circuitry with an optically coupled isolator. The "isolated tab" output triac inherently provides an electrically insulated heat sink.

Types R34AAB and R34ABB are open construction and mount on four standoffs within the controlled equipment. External wiring is connected to identified screw terminals on a terminal strip. The differential turn-on and turn-off set points are set and sealed at the factory to the customers specifications.

The Series A41 sensor must not be immersed directly in the sensed liquid. It must be installed in a bulb well mounted in the collector panel and in the storage tank on liquid systems. A well is not required for the storage sensor when the air storage system is used. The sensors have two 22" long #18 AWG wire leads.

SPECIFICATIONS

Type A41WA

Electrical Connections: Two 22" long #18 AWG stranded wire leads.

Operating Temperature Ranges: —40 to 350F (—40 to 177C).

Reference Resistance: 1000 ohms at 70F (21C).

Resistance Tolerance: 1% at 70F (21C).

Sensing Element: Temperature sensitive nickel wire wound.

Temperature Coefficient: Positive at approximately 3 ohms per degree Fahrenheit (5.4 ohms per degree Celsius).

SPECIFICATION TABLE

Type Number	Description	Temperature Differential Setting F (C)		Limits F (C)		Enclosure
		Turn-On	Turn-Off	Collector Low Limit	Storage High Limit	
A41WA	Sensor	—	—	—	—	—
R34AAA	Controller	20±5 (11±3)	5±3 (3±2)	—	—	NEMA Type 1
R34AAB	Controller	20±5 (11±3)	5±3 (3±2)	—	—	Open
R34ABB	Controller With Collector Low Limit and Storage High Limit	20±5 (11±3)	5±3 (3±2)	35±3 (1.7±2)	Selectable 140, 160, and 180±6 (60, 71 and 82±3)	Open

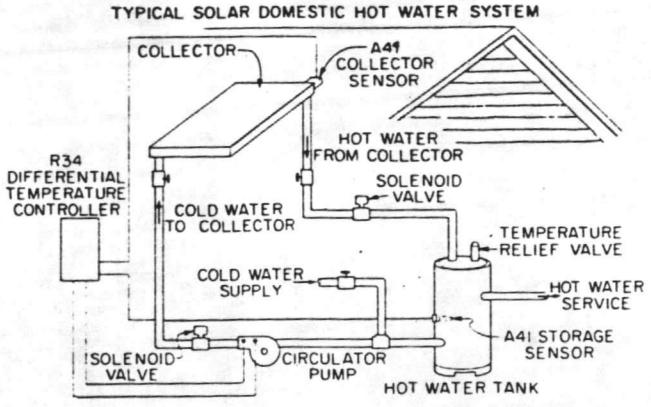


Fig. 3 — Drawing of typical solar domestic hot water system.

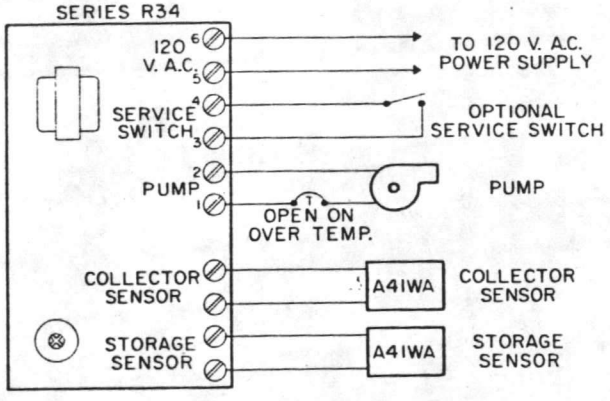


Fig. 4 — Typical wiring diagram.

Types R34AAA, R34AAB, R34ABB

Ambient Temperature: 0 to 120F (−18 to 49C). Maximum heat sink temperature is 194F (90C).

Electrical Connections: Identified terminal screw on terminal strip. See Fig. 5.

Electrical Load: 120 V. A.C., 2 amps. maximum.

Supply Voltage: 120 V. A.C. +10, −15%.

ACCESSORIES

Bulb Wells For Type A41WA

Part Number	Insertion Length	Type of Connector
WEL12A-600R	2 13/16"	Sweat
WEL16A-600R	2 3/8"	1/2" NPT

SHIPPING WEIGHT

Type Number	Individual	
	lbs.	kg
A41WA	.06	.027
R34AAA	1.84	.84
R34AAB, R34ABB	.4	.18

REPAIRS AND REPLACEMENT

Field repairs must not be made. Replacement units may be obtained from the nearest Penn Commercial Systems Wholesaler. When ordering a replacement controller or sensor, specify Product Number shown on the units.

For trouble-shooting procedure, see Series R34 Installation and Operation Instructions Form 996-94.

ORDERING INFORMATION

To order, specify:

1. Complete Product Number.
2. Bulb well Part Number for Type A41WA, when required.
3. If set points other than shown in Bulletin are desired, write Customer Service.

Catalog Section R
Series R34
Bulletin No. 4210-A
Supersedes 4210

JOHNSON CONTROLS

Johnson Controls, Inc.
Penn Division

2221 Camden Court
Oak Brook, IL 60521

Series R34D Solid State Differential Temperature Controller—For Use With Nickel Wire Wound Sensors

Application

These differential temperature controllers are for use on applications where it is desirable to provide on-off control by the difference between two sensed temperatures. Controllers are supplied with calibrated adjustments.

Typical applications include:

— Solar heating systems.

— Fruit and vegetable storage spaces.

— Machine tool equipment.

These controllers provide a SPDT relay output that is switched according to the temperature differential measured by two Penn nickel wire resistance sensors. Sensor No. 1 is located in the lower temperature area and sensor No. 2 is located in the higher temperature being sensed.

Features

— Solid state components.

— Easy to install and wire.

— Field adjustable set points.

— Input from nickel wire wound sensing elements.

— Relay (SPDT) output.

General Description

The Series R34D compares the difference in temperatures at the two sensors with the two set point values. The results of that comparison control the operation of an internal SPDT relay.

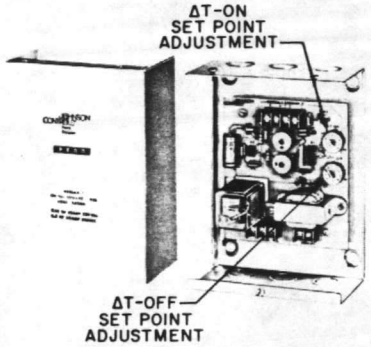


Fig. 1—Type R34DCA Differential Temperature Controller.

The relay is energized when the temperature at sensor No. 2 (higher temperature sensor) exceeds that of sensor No. 1 (lower temperature sensor) by more than the "ON" setting. The relay remains energized until the difference in sensed temperatures is less than the "OFF" setting.

If the "OFF" setting equals or exceeds the "ON" setting, the minimum 1 F (½ C) operating differential is obtained. The relay is energized when the difference in sensed temperatures exceeds the "OFF" setting and de-energized if difference in sensed temperatures falls 1 F (½ C) below the "OFF" setting.

Series R34D controller is available in a NEMA Type 1 enclosure with four mounting holes in back of case, or in an open construction which mounts on four standoffs within a control panel. External wiring is connected to identified screw terminals.

Specifications

Product	**R34DCA**	120 V., 50/60 Hz Input, NEMA Type 1 Enclosure
	R34DCB	120 V., 50/60 Hz Input, Open Construction
	R34DCG	24 V., 50/60 Hz Input, NEMA Type 1 Enclosure
	R34DCH	24 V., 50/60 Hz Input, Open Construction
Ambient Temperature At Controller		0 to 120 F (−18 to 49C)
Conduit Openings (NEMA Type 1 Models)		Combination Knockouts for ½" and ¾" Conduit. Three on Top, Three on Bottom.
Electrical Connections		Identified Screw Type Terminals.
Enclosure (NEMA Type 1 Models)		Cold Rolled Steel
Output Relay		SPDT (See Table for Electrical Rating)
Power Supply		24V.A.C. or 120V.A.C., 50/60 Hz, 5 Watts (9 VA)
Set Point Range (△T-ON and △T-OFF)		0 to 40 F (0 to 22 C)
Shipping Weight (Individual Pack)	**With Enclosure**	5.5 lbs. (2.5 kg)
	Open Construction	1.8 lbs. (.8 kg)

Repairs and Replacement

Field repairs must not be made. If the controller needs servicing or repair, return it to the factory. Replacement controllers and sensors may be obtained from the nearest Penn-Baso Wholesaler. When ordering a replacement controller or sensor, specify Product Number shown on the unit.

Ordering Information

To order, specify:

1. Complete Product Number of controller.
2. Sensors required.

Electrical Rating For Relay Contacts

Volts A.C.	120	208	240	277
Full Load Amps.	5.8	5.4	4.9	—
Locked Rotor Amps.	34.8	32.4	29.4	—
Non-Inductive or Resistance Load Amps. (Not Lamp Loads)	10.0	8.0	8.0	7.0
Pilot Duty—1 A., 24/125 V. A.C.; 125 VA., 125/240 V. A.C.				

Rating is 10 Amps at 28 V. D.C.

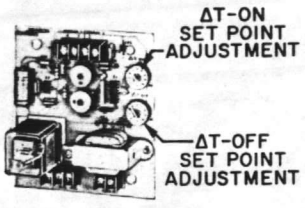


Fig. 2—Type R34DCB Differential Temperature Controller.

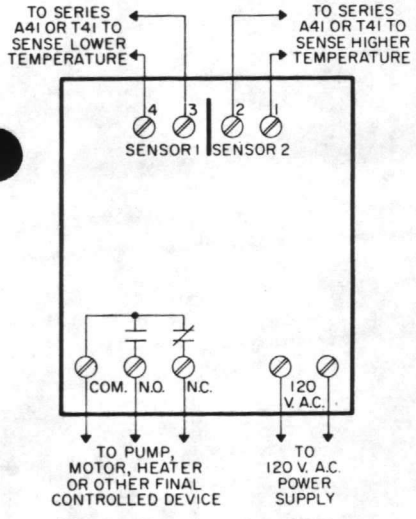


Fig. 3—Drawing of controller showing wiring connections.

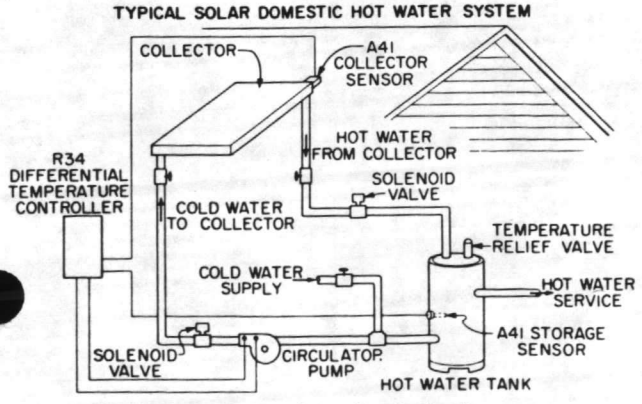
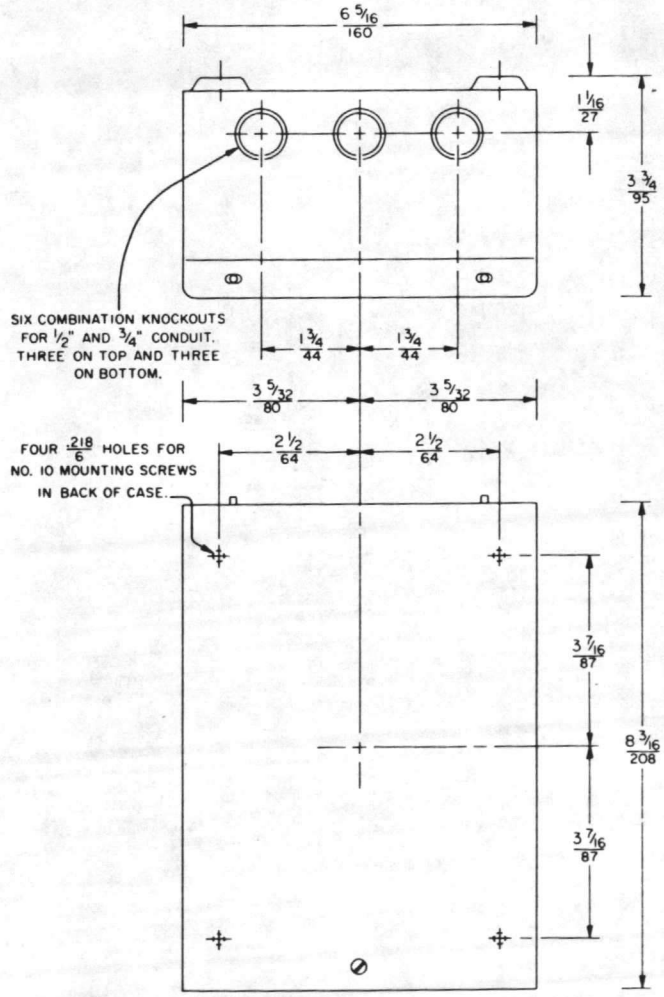


Fig. 4—Drawing of typical solar domestic hot water system.



R34D Dimensions $\frac{\text{in}}{\text{mm}}$

Litho in U.S.A. 9-5-77

JOHNSON CONTROLS

Johnson Controls, Inc.
Penn Division

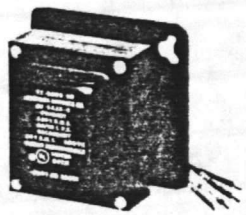
2221 Camden Court
Oak Brook, IL 60521

TZ-5000
Step-Down Transformers

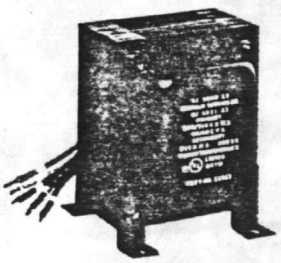
The TZ-5000 Step-Down Transformers are Underwriters' Laboratories, Inc. listed and are used to supply power to 24 volt A.C. control circuits. Models are available with 100 or 300 VA ratings at 120 or 208/240 volts, 50/60 Hz line voltages. All 208/240 dual input voltage transformers have a single primary winding with a tap for the lower input voltage.

Installation

Convenient mounting arrangements are provided on all TZ-5000 transformers. 100 VA models are furnished with a mounting plate to fit a 4×4 in. conduit box. The 300 VA models are provided with a 1/2 in. -14 male conduit hub and mounting feet. All models have color-coded leads. All wiring must in accordance with applicable electrical code requirements.



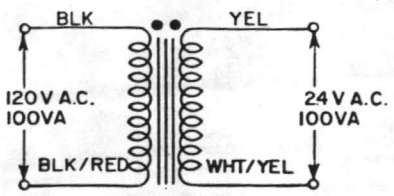
TZ-5000 100 VA Model



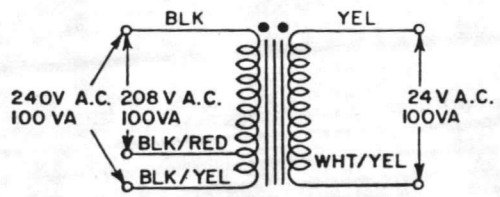
TZ-5000 300 VA Model

Specifications

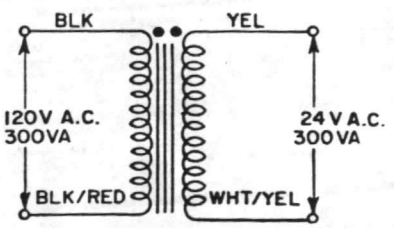
Product		TZ-5000 Step-Down Transformers			
Models	Code No. Suffix	-10	-11	-12	-13
	Rating VA	100	300	100	300
	Primary Voltage 50/60 Hz	120 Volts +10% -15%		208/240 Volts +10% -15%	
Secondary Voltage		24 ±1.25 Volts A.C. for Full Load at "Design Center" Input Voltages			
Regulation		10% from No Load to Full Load			
Ambient Temperature		150F (66C) Maximum			



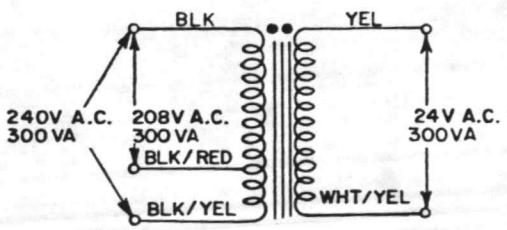
TZ-5000-10



TZ-5000-12



TZ-5000-11



TZ-5000-13

JOHNSON CONTROLS

Johnson Controls, Inc.
507 E. Michigan Street
P.O. Box 423
Milwaukee, WI 53201

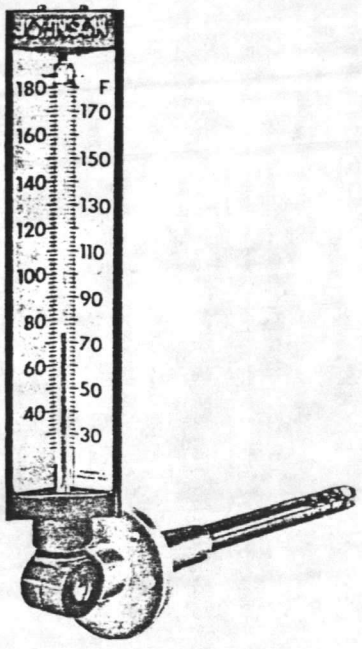
T-2110
Vertical Scale Thermometer
Air or Liquids

The T-2110 Vertical Scale Thermometers are designed to accurately provide continuous temperature indication. An insertion model is available for indicating temperatures in air ducts; an immersion model is available for indicating temperatures in tanks, process piping and other pipe lines. All models have a hinge assembly which allows adjustment to any angle for maximum scale readability.

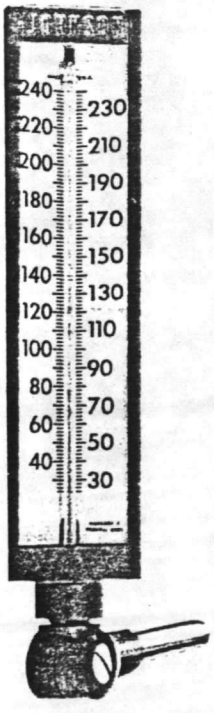
The red reading mercury tubing provides an accurate temperature reading against the white background and black embossed numerals and graduations.

The insertion models are furnished with a perforated aluminum bulb guard for maximum sensitivity in air ducts. They are also furnished with an aluminum flange which may be reversed when duct insulation up to 2 in. (51mm) does not permit direct mounting.

The immersion model is furnished without the separable brass well. The T-2110-100 well, which is supplied with Insulgrease, must be ordered separately.



Insertion Thermometer



Immersion Thermometer

Specifications

Product		T-2110 Vertical Scale Thermometer
Models		Immersion or Insertion (See Table I)
Scale Height		9 in. (229 mm)
Materials	**Case**	Die Cast Aluminum
	Lens	Acrylic Plexiglass
	Shank	Aluminum for Insertion
		Brass for Immersion
Accessories		T-2110-100 Separable Well

Table I

Models	Type	Scale Range	Shank Length
T-2110-1	Insertion	30 to 180F	8 in.
T-2110-2		-40 to 110F	203 mm
T-2110-5	Immersion	0 to 120F	3-1/2 in.
T-2110-6		30 to 240F	89 mm

JOHNSON CONTROLS

Johnson Controls, Inc.
Penn Division

2221 Camden Court
Oak Brook, IL 60521

TC-4100
Cybertronic Temperature Controller

The Johnson TC-4100 Cybertronic Temperature Controller is a solid state proportional temperature control device. It is used with Cybertronic damper actuators in air systems or valve actuators in liquid-flow systems. It may also be used with the PC-3001 electro-pneumatic transducer or any other device which operates on a variable 0 to 16 volt D.C. control signal

The TC-4100 has separate reverse and direct acting bandwidth settings, adjustable throttling range, a D.C. sensing circuit and mounting facilities for a PC-3001 electro-pneumatic transducer

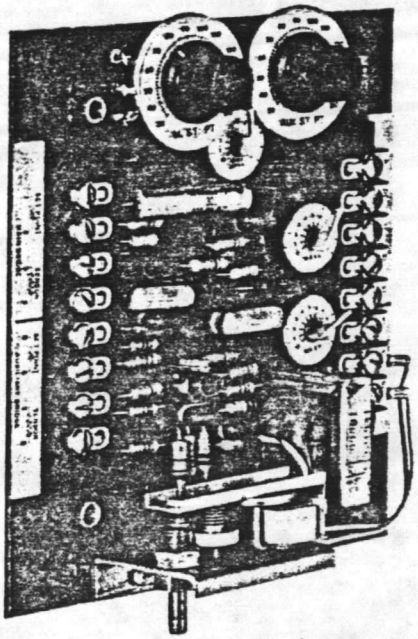
Basically, the controller consists of a resistance sensing circuit and a control amplifier. A difference between the sensing element resistance and the set point resistance produces a proportional voltage which is amplified to provide a 0 to 16 volt D.C. control output. The output is direct acting when the sensed temperature is above the set point (or null) and reverse acting when the sensed temperature is below the set point. An output from either side of null will control one or two electro-pneumatic actuators or up to six thermal actuators. The throttling range is governed by the individual bandwidth settings, one for the direct acting output and one for the reverse acting output.

All-electronic sensing and control insure rapid response to temperature changes at the sensing element. Trouble-free operation is assured and periodic maintenance is not required. Special circuitry gives protection against accidental short circuits across the output.

The TC-4100 is furnished with both main and auxiliary sensing circuits for master-submaster type applications. Either circuit can be supplied for local or remote set point adjustment, and for local or remote sensing.

Both Fahrenheit and Celsius set point ranges are available. An AQ-5000 remote set point control may be used instead of a local adjustment. Central control panel readjustment of a local or remote set point is accomplished by using an AQ-4100 motor-driven reset control.

Appropriate remote sensing elements may be chosen from any of the Cybertronic nickel wire resistance element assemblies.



TC-4100 with PC-3001 Attached

Operation

The TC-4100 provides both direct and reverse acting output signals. When the temperature at the main sensing element is equal to the set point of the main sensing circuit both outputs are zero. If the temperature increases above the set point, only the direct acting output signal increases in proportion to the change. If the temperature decreases below the set point, only the reverse acting

Specifications

Product	TC-4100 Cybertronic Temperature Controller
Operating Voltage	120 or 24 Volts A.C., ±10%, 50/60 Hz, (5 VA Nominal)
Ranges	See Table I
Control Voltage	0 To 16 Volts D.C. Across Load Resistance of 500 Ohms (Servo Valve or Resistor)
Bandwidth	Adjustable Overall 0 To 50F° (0 To 25C°) With 500 Ohm Output Load (Each Adjustable 0 To 25F°)
Auxiliary Authority	Adjustable 0 To 100% (0 To 10% For 55 To 85F and 10 To 30°C Ranges)
Ambient Temp. Limits	0 To 130F (-17 To 54°C)
Set Point Adjustment	Local or Remote
Sensing Elements	Remote Cybertronic Nickel Wire Element Assemblies: TE-1100, TE-1300, TE-1500, TE-1700, TE-1800, TE-1900

output signal increases in proportion to the change.

When the controller is furnished with an auxiliary sensing circuit, a temperature change at the auxiliary sensing element will readjust the main sensing circuit control point. All models have reverse readjustment. The Auxiliary Authority setting determines what percentage of the auxiliary sensing circuit output will be algebraically added to the main sensing circuit signal, to readjust the main sensing circuit set point.

The TC-4100 has four basic applications:

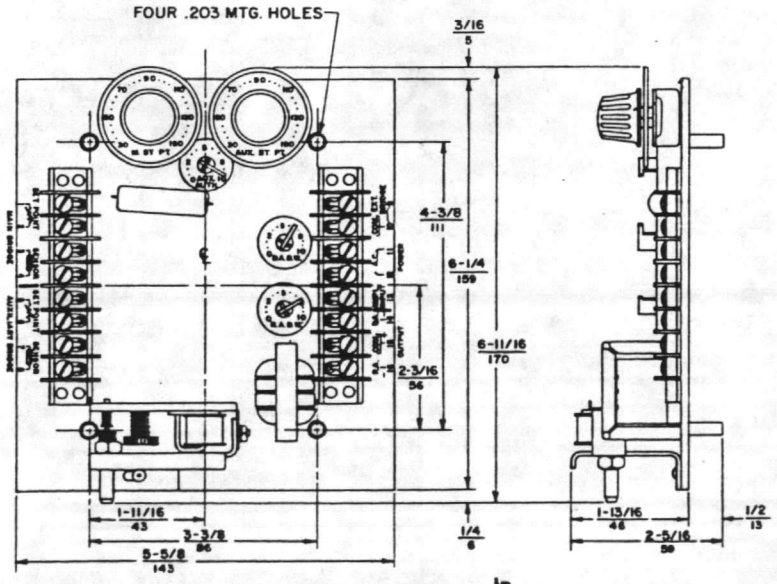
1. The controller can be used with one or two electro-hydraulic actuators or up to six thermal actuators, connected to either the direct or reverse acting output, or a pneumatic actuator with a PC-3001 electro-pneumatic transducer.
2. The controller can be used with a heating-cooling switch which will connect one or two electro-hydraulic actuators or up to six thermal actuators to either the direct or reverse acting output, depending on the season.
3. The controller can be used with actuators connected to both outputs for sequencing heating and cooling equipment. No seasonal switches are necessary because the system will automatically go from heating to cooling, as required.
4. Use the TC-4100 with Cybertronic Q, N and Z devices to perform additional control functions as required.

The TC-4100 is furnished without an enclosure, and can be mounted in any position. If an enclosure is desired, use BZ-1000-6. To assure proper wiring during installation, each terminal is identified by markings adjacent to the terminals. All wiring must be in accordance with applicable electrical code requirements.

Table I
Calibration Resistances for Bridge Set Point Ranges

BRIDGE RANGE	CALIBRATION POINT	RESISTANCE VALUE
55 to 85F	70F	1000 ohms
10 to 30°C	21°C	1000 ohms
30 to 150F	70F	1000 ohms
0 to 65°C	21°C	1000 ohms
140 to 240F	190F	1395 ohms
60 to 115°C	8°C	1395 ohms

(For a complete list of temperature-resistance equivalents, see TE-1100 Product Data).



TC-4100 Dimensions $\frac{\text{in.}}{\text{mm}}$

JOHNSON CONTROLS

Johnson Controls, Inc.
Penn Division

2221 Camden Court
Oak Brook, IL 60521

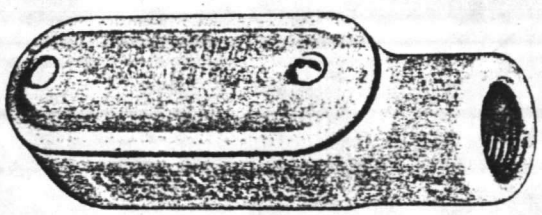
TE-1300 Outdoor Element and TE-1500 Solar Compensated Element Temperature Sensing

The Johnson TE-1300 Outdoor Element and the TE-1500 Outdoor Element with Solar Compensation are used with Cybertronic temperature controllers and sensing bridges for control applications, and with measuring bridges in temperature indication applications.

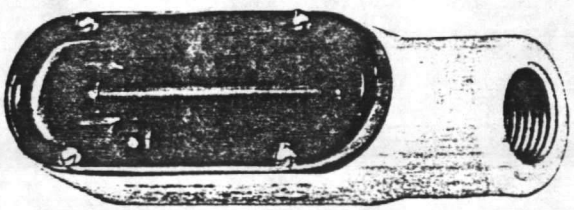
The element assembly consists of a standard or precision wound nickel wire resistance element mounted in a waterproof condulet fitting. The TE-1300 has a metal cover, and the TE-1500 has a transparent cover.

Shielded wires are not required to connect the remotely mounted TE-1300 or TE-1500 to a controller.

The TC-4100 Controller, used with the TE-1300 and TE-1500, must be ordered without an auxiliary set point. The TE-1300 acts as the set point for this application and causes the bridge output to be proportional to the solar gain.



TE-1300 Outdoor Element



TE-1500 Outdoor Element with Solar Compensation

Operation

A TE-1300 or TE-1500 element completes a bridge circuit. If the temperature at the element changes, the resistance of the element varies and unbalances the bridge in proportion to the change. In control applications, a variation from the bridge set point produces a signal which is applied to a control amplifier. An indication bridge produces a signal in proportion to the element resistance which is used as an input to an indicating meter.

In a typical control application, a TE-1500 solar element and a TE-1300 outdoor element are

Specifications

PRODUCT	TE-1300 OUTDOOR ELEMENT
	TE-1500 OUTDOOR ELEMENT WITH SOLAR COMPENSATION
TEMPERATURE LIMITS	–40 TO +250F (–40 TO +120C)
ELEMENT	NICKEL WIRE RESISTANCE ELEMENT: TE-1300–STANDARD AND PRECISION WOUND, TE-1500–STANDARD ONLY
REFERENCE RESISTANCE	1000 OHMS AT 70F (21C)
TEMPERATURE COEFFICIENT	POSITIVE, APPROXIMATELY 3 OHMS/F°
ELEMENT RESISTANCE TOLERANCE	STANDARD, USED FOR CONTROL, ±1% OF NOMINAL ELEMENT RESISTANCE AT 70F (21C)
	PRECISION, USED FOR INDICATION, ±1/4% OF NOMINAL ELEMENT RESISTANCE AT 70F (21C)
SOLAR EFFECT	TE-1500 WILL SENSE 0F° IN NO SUN TO APPROXIMATELY 30F° IN FULL SUN (0C° TO 17C°)

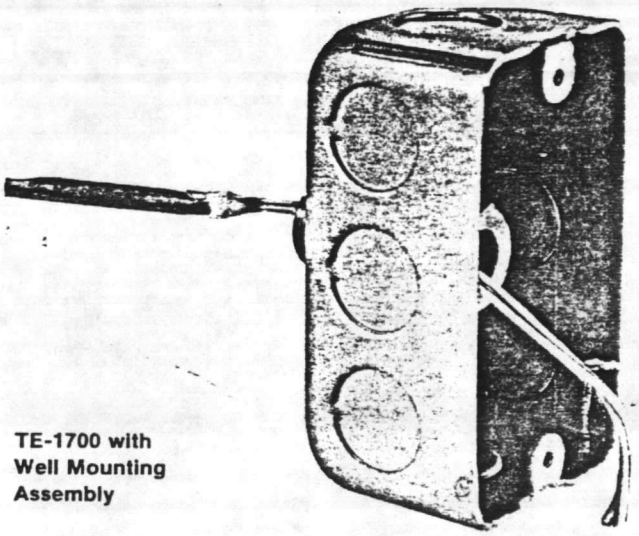
JOHNSON CONTROLS

Johnson Controls, Inc.
507 E. Michigan Street
P.O. Box 423
Milwaukee, WI 53201

TE-1700
Temperature Sensing Elements Strap-On or Well Mounted

The TE-1700 Cybertronic Temperature Sensing Elements are designed for use with a Cybertronic temperature control or indication system. Models are available for either strap-on or well mounting applications. One or more elements can be strapped onto a hot water pipe, radiator or convector. Well mounting assemblies are furnished with a control or indication element for use with a WZ-1000 series well. TE-1700 elements are available in three nominal resistance values; 333.5, 500 or 1000 ohms at 70F (21°C).

TE-1700 Strap-On Element



TE-1700 with Well Mounting Assembly

Operation

The TE-1700 is a nickel wire element with a positive temperature coefficient. The resistance of the element is specified at 70F (21°C), and changes approximately 3 ohms per 1F (5.5 ohms per 1°C) per 1000 ohms. As the sensed temperature deviates from the controller set point, the controller produces an output signal which is proportional to the measured change.

Installation

Strap-On TE-1700 elements are strapped onto a heating surface using gang straps or aviation hose clamps. TE-1700 well elements are designed for insertion into WZ-1000 series wells with a special packing gland. TE-1700 elements are furnished with 10 in. (254mm) color-coded leads for connection with system wiring. Elements may be connected in series or series-parallel for average temperature sensing (See Table 1); however, the combined resistance value must be equal to 1000 ohms at 70F (21°C). All wiring must be in accordance with applicable electrical code requirements.

Specifications

Product		TE-1700 Cybertronic Temperature Sensing Elements			
Elements (Nickel Wire Resistance Type)	**TE-1700 Code Numbers**	-1	-2	-3	-4
	Ref. Resistance (Nom.) @ 70F (21°C)	1000 Ohms	500 Ohms	333.3 Ohms	1000 Ohms
	Accuracy	± 1% of Nominal Resistance			± 1/4% of Nominal Resistance
	Color Leads	White			White
	Application	Control			Precision Indication
	Temperature Coefficient	Positive, 3 Ohms/F/1000 Ohms (5.5 Ohms/°C/1000 Ohms)			
Assemblies	**TE-1700-7**	TE-1700-1 With Handi-Box and Packing Nut Assembly			
	TE-1700-8	TE-1700-4 With Handi-Box and Packing Nut Assembly			
Ambient Temperature Limits		–40 to 250F (–40 to 121°C)			
Accessories (Order Separately)		WZ-1000 Series Wells			

JOHNSON CONTROLS

Johnson Controls, Inc.
Penn Division

2221 Camden Court
Oak Brook, IL 60521

VA-3200
Electro-Hydraulic Valve Actuator

The VA-3200 Electro-Hydraulic Valve Actuator provides either proportional or two-position control of valves in central heating, ventilating and air conditioning systems. The actuator is especially designed for use with a Cybertronic controller and an appropriate Johnson valve body in systems regulating the flow of fluid, such as water or steam.

The VA-3200 is a completely self-contained unit consisting of an actuator shaft and a sealed electro-hydraulic system. The electro-hydraulic system is composed of electrically driven pumps, a servo valve and a piston. These components are arranged so that the VA-3200 is fail-safe in operation; the actuator shaft returns to the retracted position in the event of power failure.

Models are available with a 1-1/8 in. (29 mm) stroke length which is compatible with valve sizes 1/2 in. (13 mm) thru 4 in. (102 mm). The VA-3200 is furnished for direct acting proportional control applications. For two-position operation, a PZ-4000 two-position power supply must be separately ordered.

Two SPDT auxiliary switches, independently wired for N.O. and/or N.C. operation, are available on all models. The "on" and "off" operating points of each switch may be set at any percentage of actuator shaft travel.

Operation

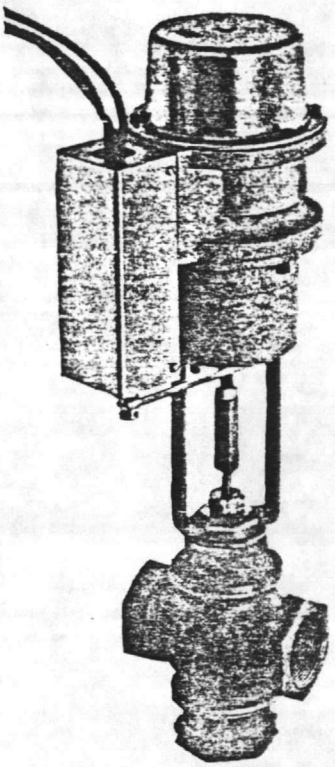
In operation, the actuator is connected to an A.C. power source and to an appropriate Cybertronic controller, such as the TC-4100 temperature controller.

When a change in temperature from the set point occurs, the controller transmits a proportional 0 to 16 volt D.C. control signal to the integral servo valve. (Refer to the Internal View Diagram). The servo valve proportionally modulates the hydraulic pressure in response to the signal. This causes the hydraulic fluid to move the piston and actuator shaft and position the valve in response to the proportional control signal.

For two-position action, the servo valve of the actuator is connected to the output of a PZ-4000 two-position power supply which is controlled by a two-position thermostat. The thermostat opens and closes the circuit to the actuator servo valve causing the two-position action of the actuator.

Installation

VA-3200 actuators for new installations are available factory



VA-3200 Electro-Hydraulic Valve Actuator

Specifications

Product	VA-3200 Electro-Hydraulic Valve Actuator
Models	See Table I
Control Mode	Direct Acting — Proportional
Supply Voltage	24 or 120 Volts A.C., 60 Hz (75 VA) (See Table I)
Control Signal Voltage	0 to 16 Volts D.C. Across Servo Valve (Approx. Resistance of 1200 Ohms) with Nominal Operating Range of 8 to 12 Volts D.C.
Power (Opposing)	100 lbs. (445 newtons) Extended or Retracted
Strokes 1-1/8 in. (29 mm)	Extends at 105 Seconds; Retracts at 20 Seconds (See Table I)
Ambient Temperature Limits	-25 to 135F (-30 to 55°C)
Max. Allowable Temperature (Where Shaft Enters Bonnet)	135F (57°C)
Accessories (Order Separately)	PZ-4000-1 (24 Volt A.C.) or PZ-4000-2 (120 Volt A.C.) Two-Position Power Supply
	VZ-1000-3 Valve Coupling Hardware Kit For Valves 2-1/2 in. (64 mm) to 4 in. (102 mm)
	VA-1000-10 Valve Coupling Hardware Kit For Valves 1/2 in. (13 mm) to 2 in. (51 mm)

JOHNSON CONTROLS

Johnson Controls, Inc.
Penn Division

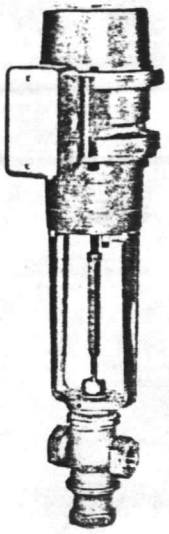
2221 Camden Court
Oak Brook, IL 60521

VB-4322 Mixing Valve
½" — 2" Cast Brass 2½—6" Cast Iron
150 psig Body Rating

The Johnson VB-4322 3-Way Mixing Valve is designed to regulate the flow of hot or cold water through coils or heat exchangers of all types. This valve is accurately positioned by a VA-3200, VA-3400 or VA-5000 actuator.

Installation

It is recommended that the VB-4322 valve be mounted in an upright position. It must be piped so that the valve seats against the flow and arranged so that the actuator can be easily removed and replaced.



VB-4322 Three-Way Mixing Valve with VA-3200 Actuator

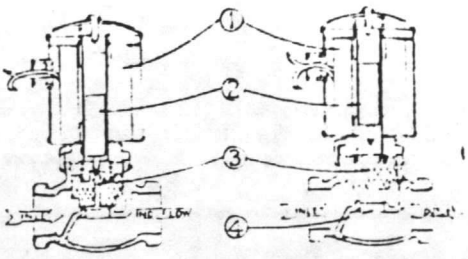
Specifications

PRODUCT			VB-4322 3-WAY MIXING VALVE
SERVICE			HOT AND COLD WATER
SERVICE CONNECTIONS AND SIZES	SCREWED ENDS		1/2 THRU 2 IN.
	125 psig FLANGED ENDS		2-1/2 THRU 6 IN.
VALVE PLUGS			TWO CHARACTERIZED MODULATING PLUGS
NORMAL POSITION			UPPER SEAT CLOSED, LOWER SEAT OPEN
BODY RATING			150 psig (10.5 kp/cm²)
MAX. PRESSURE AND TEMPERATURE			150 psig (10.5 kp/cm²); 281F (138C)
MATERIALS	BODY	1/2—2 IN.	CAST BRASS, NATURAL FINISH
		2-1/2—6 IN.	CAST IRON, BLACK LACQUER FINISH
	TRIM	1/2—2 IN.	BRASS
		2-1/2—6 IN.	BRASS, WITH SCREWED-IN SEAT RING
	DISCS		BRASS
	STEM		STAINLESS STEEL
	STEM PACKING	1/2—4 IN.	U-CUP, ELASTOMER
		3—6 IN.	TEFLON ROPE (VA-3400)
ACTUATORS (ORDER SEPARATELY)	VA-5000		1/2—2 IN. VALVES
	VA-3200		1/2—4 IN. VALVES
	VA-3400		3—6 IN. VALVES

GOULD basic solenoid valve types . . . . .

2 WAY - INTERNAL PISTON PILOT

Requires 5 psi minimum pressure drop across valve for operation. The Solenoid ① activates a Pilot Valve ② which opens a Pilot Orifice ③ relieving pressure on top of piston. Line pressure acts on lower side of piston to open Main Valve Orifice ④



CLOSED OPEN

BRONZE CONSTRUCTION

TYPE Q

3/8 - 3" NPT

Normally Closed – Packless – for noncorrosive fluids with viscosities not exceeding 400 SSU – pressures 5 to 400 psi. 220°F maximum. Molded epoxy coils for most AC or DC voltages. Type QR – normally open. Type Q–1 – 450°F maximum fluid temperature. Type Q–2 – explosion proof. Refer to Bulletin 200–Q

ANDOVER CONTROLS
CORPORATION
P.O. Box 34, Shawsheen Village Station
Andover, Massachusetts 01810
Telephone 617-470-0555

SUNKEEPER

CONTROLLER

the first microprocessor-based, programmable system designed specifically for total energy management. It fills the gap between labor-intensive, limited purpose controls and complex, costly computer-type systems.

Total Energy Management

Energy management is the conservative use of energy to preserve scarce supplies and to reduce operating costs. Total energy management requires a versatile, manageable control device capable of performing those functions necessary to supervise and select the best options.

Sunkeeper offers the first commercially available system specifically designed for user control of conventional energy sources and integration of all energy sources, including solar energy, on a cost-effective basis.

The Controllable Controller

The Sunkeeper Controller gives the user direct, immediate, personal control over energy consumption. It provides a means of scheduling and directing energy usage through the establishment of programmed instructions and the capability for modifying those instructions instantaneously to meet changing conditions or to achieve further efficiencies.

Demand-limiting and timed duty cycling can be user programmed both to normal turn on/turn off requirements and to variations in building usage and occupancy. Heating, ventilating and air conditioning can also be regulated automatically in response to sensor data as well as to pre-set date/time conditions. Enthalpy control, outdoor re-set, night set-back and weekend skip are all within the capabilities of the Sunkeeper.

Process equipment start-up and shut-down, integrated into a total building energy usage program, will increase load factor efficiency and reduce energy costs.

The Sunkeeper System also permits the introduction of supplementary or alternate energy sources at the proper times without imbalance or interruption. Off-peak power usage and solar heating can be optimized when included in an overall management system.

The simplicity and flexibility of the Sunkeeper System make it universally adaptable to industrial, commercial and institutional applications. And the comparatively-low price of the Sunkeeper Controller, together with its labor-saving features and inherent reliability, means immediate, continuing cost reductions which can substantially shorten payback periods.

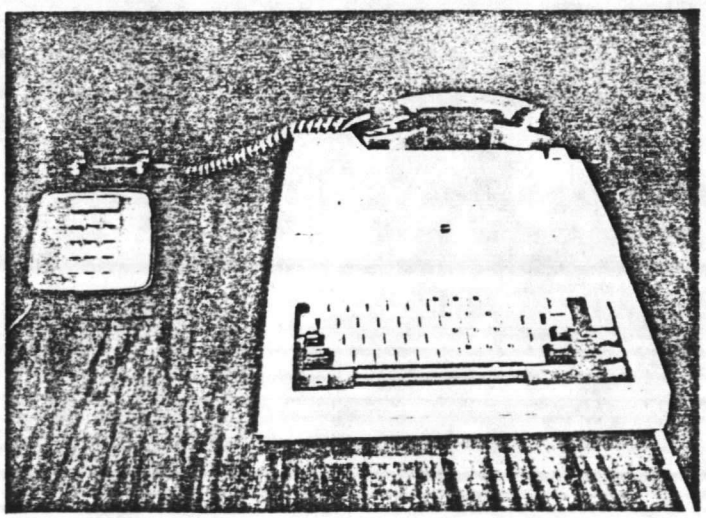
Relay Simplicity . . . Computer Flexibility

Sunkeeper uses sophisticated microprocessor hardware and software to produce a configuration that is as easy to use as a conventional relay system but has the broad decision-making capabilities of a minicomputer system.

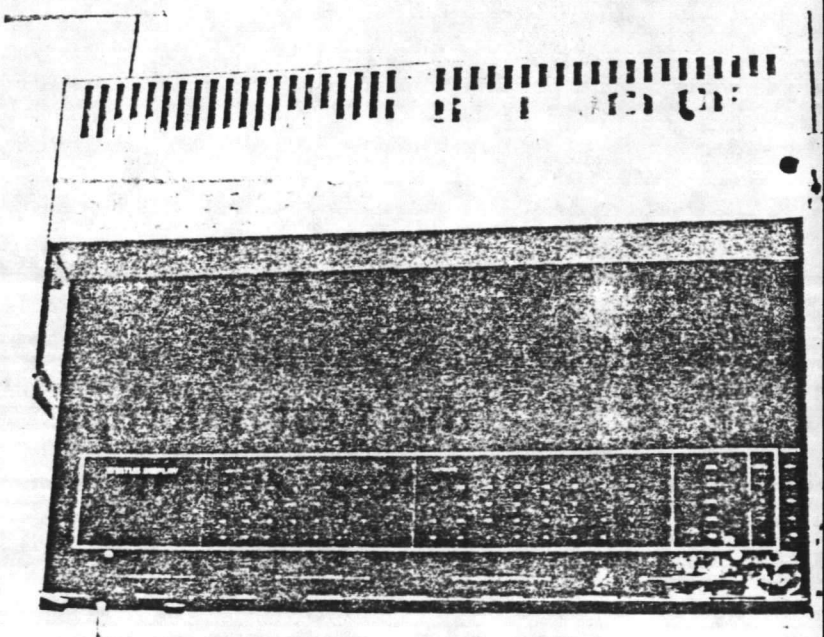
As a result, the Sunkeeper Controller can accept a variety of input signals from sensors and switches, and can generate a set of output signals based on a comparison of the inputs with information the user has included in the control program. It can also produce output signals to operate equipment and processes according to user-programmed time schedules.

The system has 32 analog inputs for analog data, such as temperature and pressure readings, and 32 digital inputs for on/off-type readings from thermostats, overrides and similar devices. And it has 32 discrete digital output drivers which can be upgraded to 115 v. with standard relays to control machinery, lighting, alarms and other equipment.

The selection of input signals and



~~Local or~~ Remote
SUNKEEPER COMMUNICATIONS TERMINAL



SUNKEEPER CONTROLLER

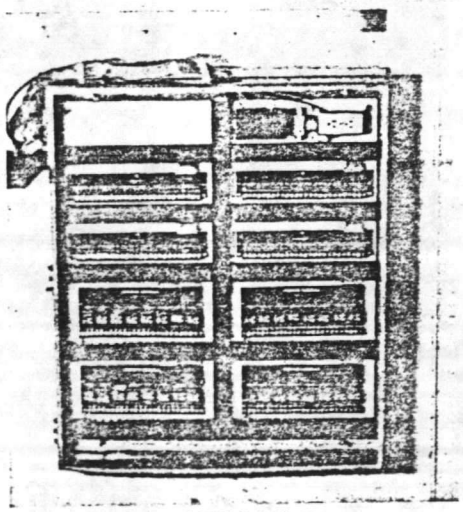
the assignment of output signals can be revised to accommodate any shifts in control requirements—often with little or no modification of the System instructions and with no hard wiring changes.

Man and Machine

Sunkeeper believes that the user should be able to fine-tune his control system whenever he recognizes an opportunity for further energy savings—without expending the time and effort required to revamp a relay system or experiencing the delay and expense involved in using software specialists.

Consequently, the Sunkeeper Controller is designed to accept instructions in plain English, Boolean-style statements through a regular office teletype or CRT terminal connected to the unit's programming and computer channel. Anyone with an understanding of the most rudimentary control functions can quickly learn to issue operator commands and to request status information from the Controller.

Another major advantage of the Sunkeeper Controller is the ease of system implementation. Most users will find that they can handle installation, programming and maintenance without the aid of outside specialists. However, Sunkeeper representatives are readily available to assist with system planning, software training and final checkout.



NEMA 1

Enclosure includes:
Digital Input Boards (201-201)
Analog Input Boards (211-212)
Electro-Mechanical Relay Boards (311-312-313-314)
Cables (401-402)
Power Supply (612)
Convenience Outlet-2 Position
Wire Track

More System . . . More Control

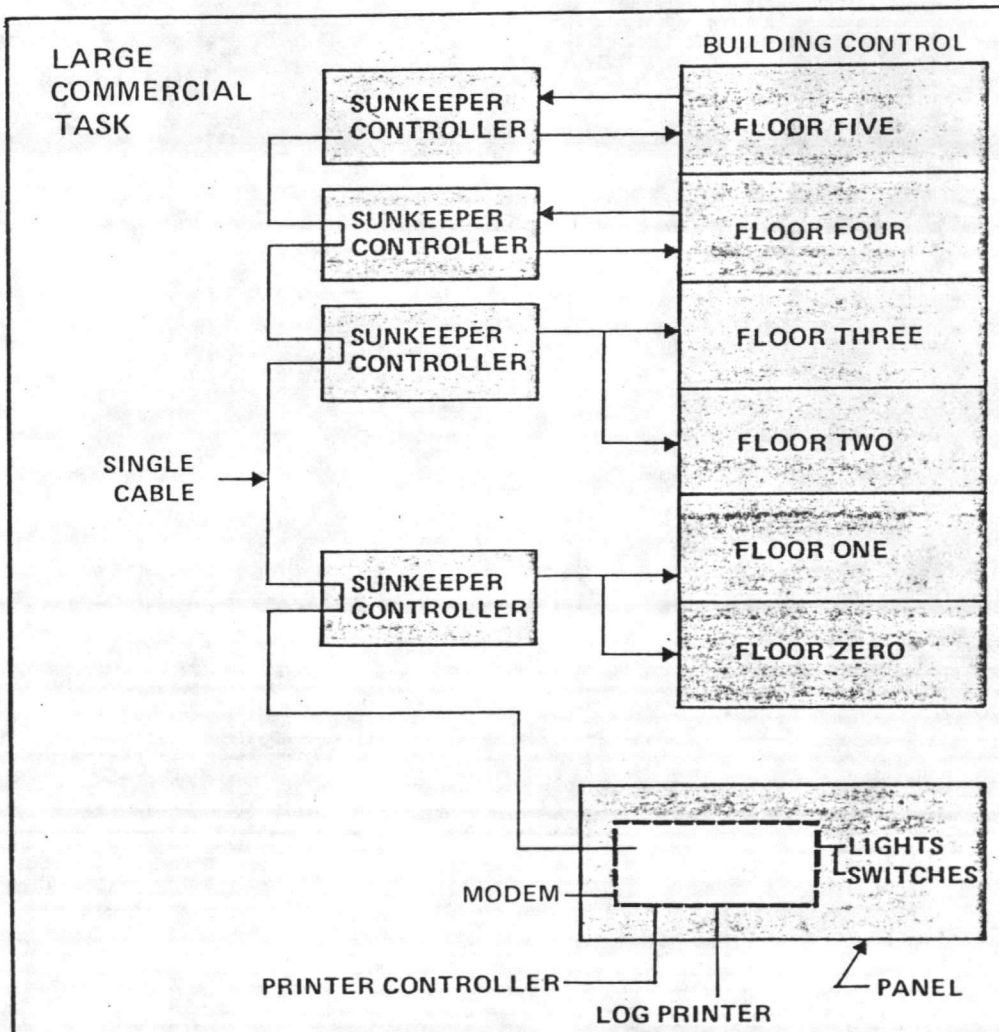
Many fully implemented applications will require more than the 64 inputs and 32 outputs provided in the standard Controller. In this case, several Controllers can be connected serially in a "daisy chain" configuration. If more comprehensive control is required, the Sunkeeper units can be interfaced to a host computer, which will supply indirect management and dynamic instruction modification.

The data logging capability of the Sunkeeper can be an important tool for the end user. By selective data collection, the cost effectiveness of individual segments of a total system can be studied and evaluated. In this way, energy conservation measures can be continually measured and upgraded to fine tune any system for maximum economic return and minimum energy usage.

Ultimate Programming Simplicity

Obviously, a prime requisite for this kind of system is a control program which handles both user instructions and data movement in a logical, understandable manner. Sunkeeper meets this need with a unique "drum" organization represented as revolving cylinders with 100 lines of programming capacity on each drum.

Incoming data is examined by each drum and compared with the instruc-



Sunkeeper systems can be configured to virtually any situation. Here, locations with more critical environmental or functional demands are assigned to individual Controllers, while others are accommodated on a shared-Controller basis. All Controllers are interconnected and share a modem link to a remote computer and outputs to a logging printer and a printer controller.

tion data stored on that drum. If the -set conditions are met, the drum exits the line to initiate an action. This action may also be compared with other drum-generated data in internal memory and be recycled if the additional conditions are not satisfied.

Time-related operations are controlled by a built-in crystal clock with calendar and time-of-day capability, and by an interval timer with a range of 1 second to 256 days.

Handling Special Conditions

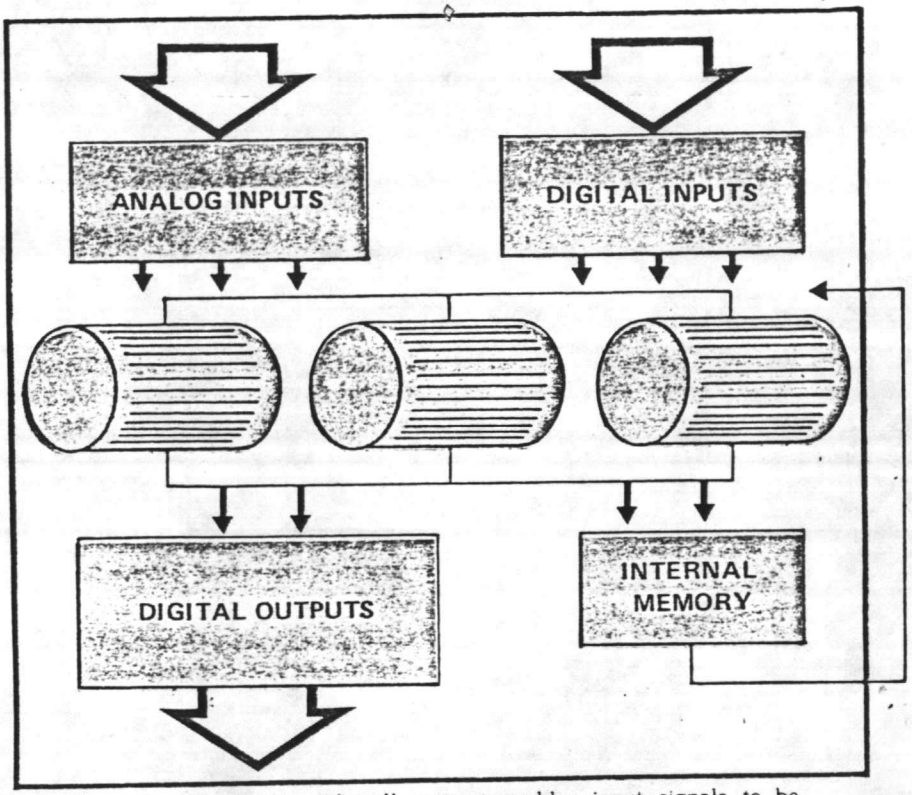
In addition to normal programming procedures, the user must be able to take command of the system for various reasons. He may want to perform routine maintenance tests or examine the contents of a particular drum. And, on occasion, he may want to bypass instructions he has already entered. In the Sunkeeper Controller, there is adequate provision for these manual overrides.

The Sunkeeper System is also signed to respond to emergency nditions automatically. If such a situation occurs, the Controller leaves the drum line being processed and moves immediately to the instructions entered on the emergency line.

Provision is also made for data logging and monitoring. The Controller can be instructed to note the status of as many as 16 digital or analog variables once a minute and to enter the readings in individual accumulators. The accumulators are averaged periodically, and the results for up to 32 periods can be stored and printed out to provide hard-copy records of system performance.

Controller Specifications

Electrical and Physical
Power: 117VAC ± 20%, 60 Hz, 55 Watts
Size: 24.0" X 16.0" X 4.75"



The unique Sunkeeper "drum" concept enables input signals to be introduced selectively to any of 100 data lines on forty standard operations drums. If conditions are satisfied, the inputs will either be transferred to other data lines for further processing per internal instructions or exited as output signals.

32 Analog Inputs
24 Thermistor
8 Analog: .0 to 5.1 Volts

32 Switch Inputs
Senses contact closure
State Definition: OPEN = OFF
LED indicator with each input

32 Digital Outputs
Current Capability: 100 mA sink max.
Voltage: 24V D.C.
LED indicator with each output

Voltages (Available to user)
+5, +8, +24, ±12 available on connectors @ 250 mA max. each.

Relay Board Outputs
SPDT relays rated
10 Amp @ 240V A.C.

Maximum Overvoltage Protection
All inputs and outputs are protected to withstand momentary line voltage.

Modem Channel
EIA interface with a baud rate of 300.

Non-Volatile Real-Time Clock
Clock programmed through the year 2000. 60 Hz line clock with 3-day system battery back-up for power failure. A crystal automatically maintains real-time clock in the back-up mode.
Timing available: 1 sec. to 255 days.

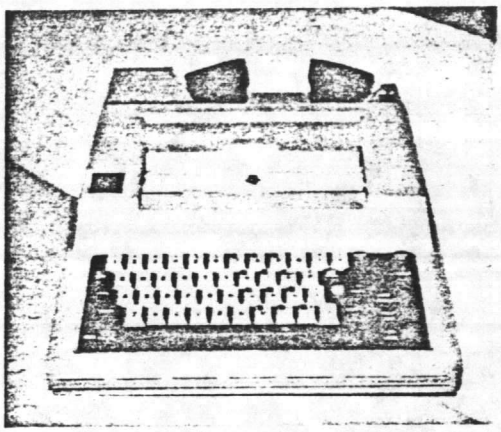
ANDOVER CONTROLS
CORPORATION

P.O. Box 34, Shawsheen Village Station
Andover, Massachusetts 01810
Telephone 617-470-0555

ANDOVER CONTROLS
CORPORATION

PRODUCT SPECIFICATION

MODEL 601
~~LOCAL OR~~ REMOTE DATA TERMINAL



DESCRIPTION

THE 601 IS A PORTABLE DATA TERMINAL WITH PRINTER CAPABILITY. THIS UNIT PROVIDES FOR REMOTE AS WELL AS LOCAL COMMUNICATION WITH THE SUNKEEPER CONTROLLER OR ANY OTHER COMPUTER COMPATIBLE DEVICE.

FEATURES

HIGH SPEED

PERMANENT RECORDS ARE PRINTED AT OPERATOR SELECTABLE SPEEDS OF 10 AND 30 CHARACTERS PER SECOND. INCREASED EFFICIENCY IS ACHIEVED WITH TRUE 30 CPS THROUGHPUT, I.E., NO FILLER CHARACTERS REQUIRED AFTER LINE FEED OR CARRIAGE RETURN CHARACTERS.

QUIET OPERATION

THE UNIQUE SOLID STATE PRINTHEAD DEVELOPS CHARACTERS ON THERMAL SENSITIVE PAPER AND ELIMINATES THE UNDESIRABLE NOISE ASSOCIATED WITH IMPACT PRINTING.

MICROPROCESSOR RELIABILITY

THE MICROPROCESSOR, MOS/LSI INTEGRATED CIRCUITS, SOLID STATE PRINTHEAD, AND A MINIMUM OF MOVING PARTS ARE KEYS TO PERFORMANCE AND RELIABLE, LONG LIFE OPERATION.

STANDARD FEATURES

- 5 x 7 DOT MATRIX WITH PRINT CONTRAST CONTROL
- BUILT IN SOLID STATE ACOUSTIC COUPLER FOR COMMUNICATION VIA SWITCHED TELEPHONE NETWORK
- SWITCH SELECTABLE HALF OR FULL DUPLEX
- BRIEFCASE-LIKE CARRYING CASE
- STANDARD ASCII KEYBOARD
- AUXILIARY EIA INTERFACE - ENABLES OPERATION OF THE 601 WITH SUCH EXTERNAL DEVICES AS MODEMS, DATA LOGGERS, CASSETTE RECORDERS, MINICOMPUTERS, ETC., AS WELL AS IN ITS STANDARD CONFIGURATION.

P.O. Box 34, Shawsheen Village Station
Andover, Massachusetts 01810
Telephone 617-470-0555

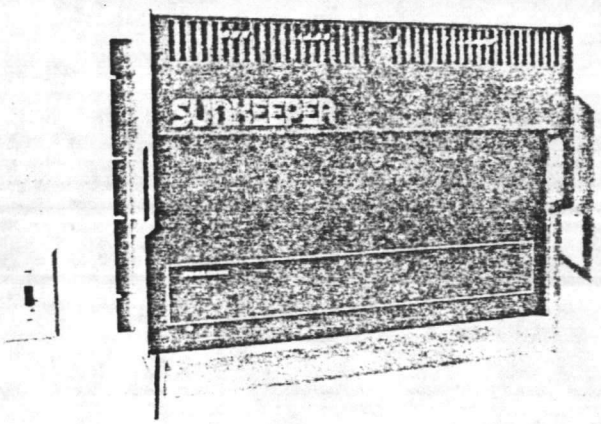
ANDOVER CONTROLS
CORPORATION

PRODUCT SPECIFICATION

MODEL 101
SUNKEEPER CONTROLLER

DESCRIPTION

THE SUNKEEPER CONTROLLER GIVES THE USER DIRECT, IMMEDIATE, PERSONAL CONTROL OVER ENERGY CONSUMPTION. IT PROVIDES A MEANS OF SCHEDULING AND DIRECTING ENERGY USAGE THROUGH THE ESTABLISHMENT OF PROGRAMMED INSTRUCTIONS AND THE CAPABILITY FOR MODIFYING THOSE INSTRUCTIONS INSTANTANEOUSLY TO MEET CHANGING CONDITIONS OR TO ACHIEVE FURTHER EFFICIENCIES.



THE MODEL 101 IS GENERALLY USED WHERE HIGH ACCURACY AND HIGHER TEMPERATURES (ABOVE 100 DEGREES F) ARE NECESSARY - SUCH AS SOLAR INSTALLATIONS.

THIS UNIT IS USED IN CONJUNCTION WITH MODEL 701, 702, AND 703 SENSORS.

FEATURES

- PROGRAMMABLE
  - DUTY CYCLING
  - DEMAND LIMITING
  - TIME CLOCKING BY ELAPSED TIME OR REAL TIME
  - NIGHT & WEEKEND SETBACK
  - PROCESS START-UP & SHUT DOWN
  - OFF PEAK POWER USAGE
- 32 DIGITAL OUPUTS
- 32 DIGITAL INPUTS
- 32 ANALOG INPUTS
  - 24 TEMPERATURE
  - 8 VOLTAGE
- EASY TO PROGRAM
- FUNCTIONAL USER PROGRAMMING LANGUAGE
- DESIGNED FOR THE ENERGY MANAGEMENT MARKET
- SOLID STATE RELIABILITY

P.O. Box 34, Shawsheen Village Station
Andover, Massachusetts 01810
Telephone 617-470-0555

ACC-PS-101

ANDOVER CONTROLS
CORPORATION

PRODUCT SPECIFICATION

GENERAL DESCRIPTION

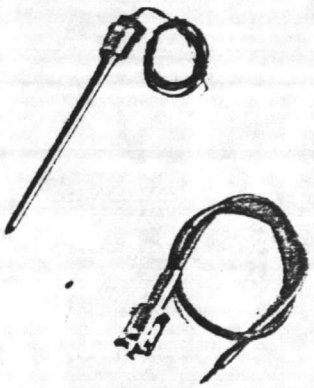
USED TO SENSE TEMPERATURES OVER A WIDE RANGE AND DELIVER THE INFORMATION VIA ANALOG INPUT TO THE SUNKEEPER CONTROLLER FOR DIRECT CONTINUOUS TEMPERATURE READINGS WHICH ARE TRANSLATED INTO DEGREES FARENHEIT BY THE SUNKEEPER CONTROLLER.

MEETS THE NEEDS OF MOST SOLAR APPLICATIONS.

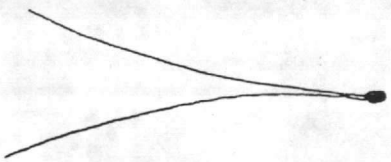
FEATURES

- HIGH ACCURACY
- HIGH RELIABILITY
- SMALL SIZE
- MEETS REQUIREMENTS OF MIL-T-23648

MODEL 701, 702, & 703 TEMPERATURE SENSORS

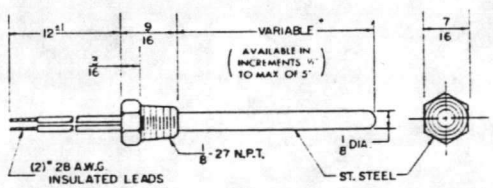


MODEL 701



BEAD TYPE

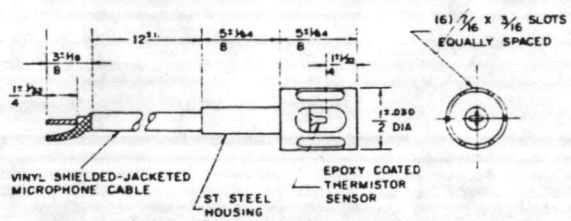
MODEL 702



Liquid immersion fluid sensor assembly: ideal for obtaining temperature measurement and control readings in pipes or closed vessels within pressurized systems. Threaded hex. head design affords greater resistance to shock and vibration when mounted.

St. Steel housing with 7/16 hex. head and 1/8-27 N.P.T. threaded body. Thermistor sensor epoxy encapsulated in housing with teflon insulated leads.

MODEL 703

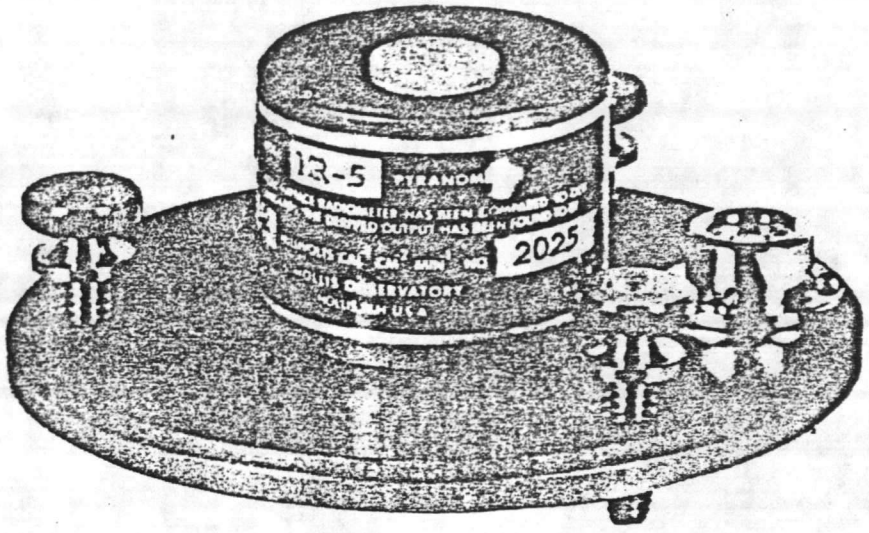


Air temperature measurement, control and indication: design characteristics offer a perfect sensor assembly for monitoring gas streams. Ideal for temperature measurement and control of remote air readings.

Exposed Epoxy Coated Thermistor Sensor mounted in open-end St. Steel housing with Vinyl Shielded-Jacketed Microphone Cable

P.O. Box 34, Shawsheen Village Station
Andover, Massachusetts 01810
Telephone 617-470-0555

Hollis Observatory



MR-5 PYRANOMETER

for the measurement of Global (total sun and sky) Radiation

The MR-5 Pyranometer is a ruggedized silicon cell based instrument which has been temperature compensated over a wide range. It has been designed for routine field use in AGRO-MET applications with a minimum of operator care. Each instrument is individually calibrated against a thermal response pyranometer having a useful band pass of 0.28 to 2.8 microns. When used under open sky conditions, the MR-5 demonstrates an excellent correlation with thermal response pyranometers.

The housing is gold anodized aluminum, with a base carrying a circular spirit level and adjustable leveling screws.

Instrument Specifications

• Sensitivity	Approximately 50 millivolts/Cal/Cm^2/Min
• Linearity with temperature	± 1.5% -20 to +40 C
• Linearity with intensity	± 1% up to 2 Cal/Cm^2/Min
• Cosine response	± 1.5% up to 80 degrees of incidence
• Stability	Less than 2% change over 1 year
• Weight is 0.23 Kgs.	
• Height: 3.5Cm.	
• Base Diameter: 15.2 Cm.	

Models Available

- MR-5 as described above.
- Other sensitivities, intensity and temperature ranges available.

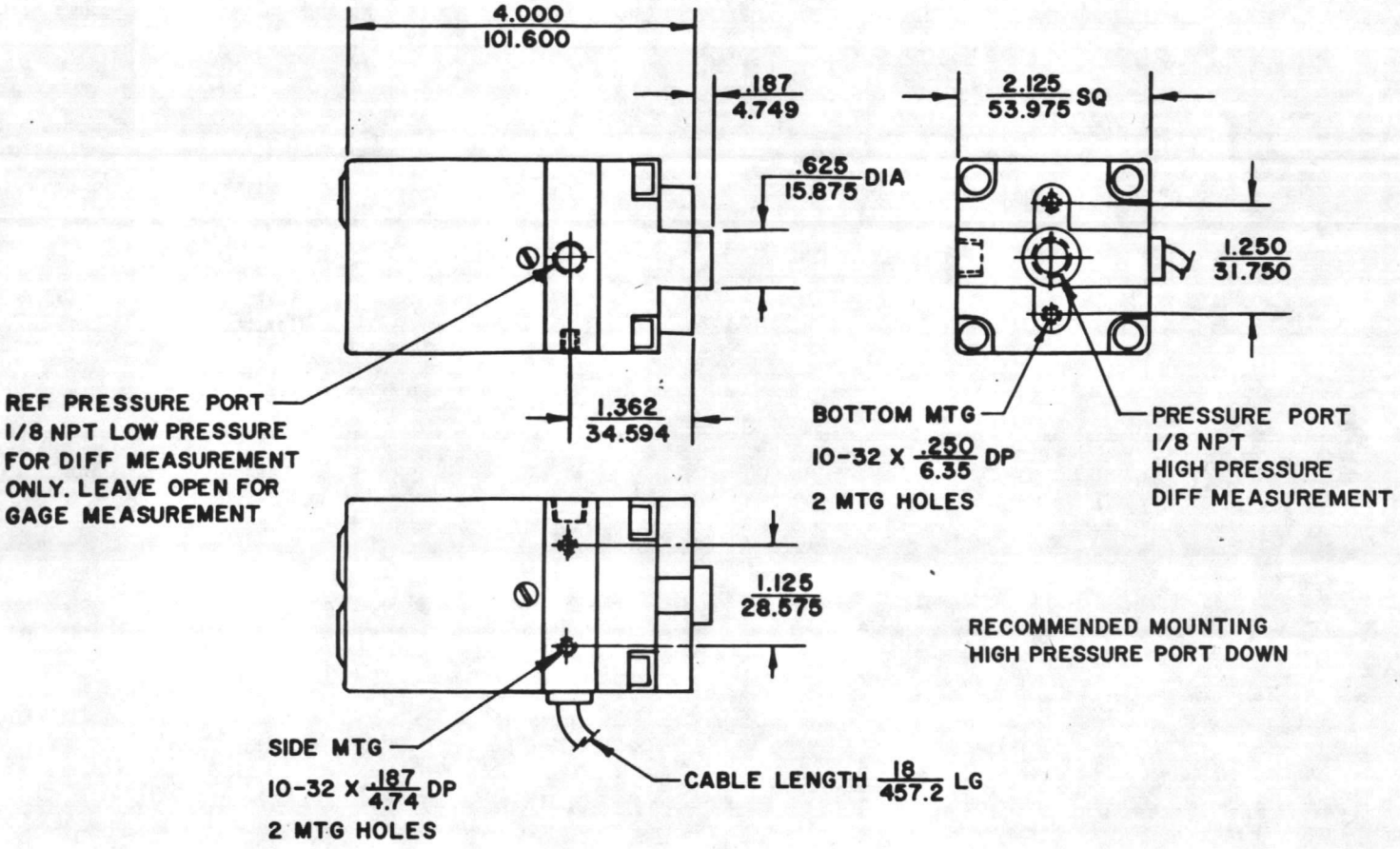
Hollis Observatory

One Pine Street, Nashua, New Hampshire 03060 USA • 603-882-5017

Robinson-Halpern

Installation and Operating Instructions

MODEL 151A



CABLE A

B

	COLOR CODING	
Blk	BLU	+V IN
R	WHT	−V IN COMMON
	GRN	(CASE)
Blk	BLK	−V OUT COMMON
Red	RED	+V OUT

DIM INCHES / MM

ROBINSON-HALPERN COMPANY
One Apollo Rd Plymouth Meeting Pa. 19462

215-825-9200
TWX #510-660-8637 (ROBHALCOPMTG)

INTRODUCTION

Read Robinson-Halpern General Installation and Operating Instructions for LVDT pressure transducers before installation.

MOUNTING AND INSTALLATION

The 151 series pressure transducer provides bottom or side mounting requiring (2) 10-32 screws. Mounting should be in the vertical position with the pressure port down. The pressure port requires a 1/8" NPT male fitting which should be installed using teflon tape or other thread sealant. Care should be taken not to obstruct the hole in the low pressure port in differential or gage applications.

ELECTRICAL CONNECTION AND GROUNDING

The 151A transducer is supplied with a multi-conductor cable.

Refer to color coding chart for electrical connection information.

The non-current carrying ground lead may be connected to system ground as desired or as required by safety codes. The minus input and minus output are internally connected. If grounding is necessary, it is recommended that only one of these leads be connected to ground to prevent circulating currents that may affect accuracy.

INPUT POWER REQUIREMENTS

Input	Model No Suffix
6.0 volts	S360
9.0 volts	S390
12.0 volts	S412
15.0 volts	S415
24.0 volts	S424

Note: A regulated voltage source is required.

OUTPUT AND LOAD

In the Model 151, the output is fully protected against short circuits. See table below for load limits. If the load is not within limits specified, calibration will not be valid.

Model No Suffix	Output	Load Impedance
V31	0-1 volt	5K min
*V35	0-5 volt	5K min
*V95	1-5 volt	5K min

*Requires minimum 12.0 volt input

PRESSURE RANGES

The table below lists the standard pressure ranges.

Range PSI	Model No Suffix	Range PSI	Model No Suffix
0-1.5	P015	0-100	P210
0-3	P030	0-150	P215
0-6	P060	0-200	P220
0-10	P110	0-300	P230
0-15	P115		
3-15	P905	inches Hg	
0-30	P130	-30 to +50	H930
0-60	P160	0-30 VAC	H995

OVERPRESSURE RATING

Applications of a pressure up to 150% of range for a maximum of five minutes may cause a temporary zero shift of up to 0.2% FS maximum. After less than one hour, the transducer will return to its original condition. If a transducer exhibits a large permanent zero shift in the positive direction, it's usually an indication that the unit has been overpressured. Usually the calibration, hysteresis and linearity are affected as well as zero, necessitating factory repair (replacement of the capsule) and recalibration.

PRESSURE MEDIA

Gage or Absolute: Fluids or gases compatible with Ni-span-C, solder, aluminum and Buna-N.

Differential: Same as above plus type 316 stainless steel and alloy 52.

Any liquids or gases that have a corrosive effect on the above materials should be avoided.

TEMPERATURE LIMITS

The operating temperature limits are -40° to +175°F (-40° to +80°C) with storage temperature limits of -65° to +185°F (-55° to +85°C).

CALIBRATION

The transducer is factory calibrated at the operating voltage specified. The output will be within -0% and +4% of nominally specified lowest output at the lowest pressure input and within -4% and +0% of the nominal full scale output at full scale pressure input.

MAINTENANCE, REPAIR & RETURN

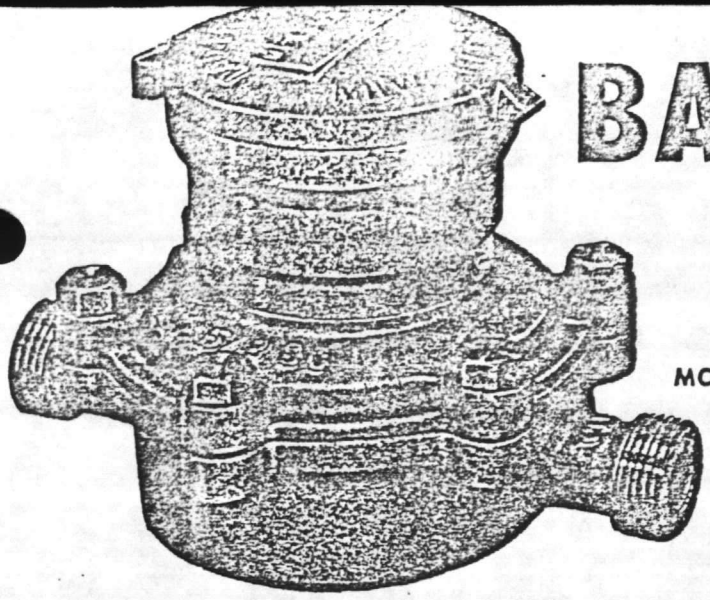
Refer to General Instructions for details.

BADGER

EASY-READ™ METER

MODEL ER

SIZES 5/8" thru 2"



MODEL SC-ER

- Magnetic Drive (No Packing Gland)
- Bronze Housing
- Hard Rubber Disc for Operating Temperature to 120°F
- Synthetic Rubber, Bronze or Aluminum Disc for Operating Temperature to 250°F at Additional Cost
- Working Pressure 150 psi
- Built in Screen
- Accuracy ±0.5% Repeatability at Constant Flow Rate and Temperature; ±2% Spread Over Normal Flow Range.
- Noryl Chamber for operation to 120°F.
- Bronze Chamber for operation to 250°F.

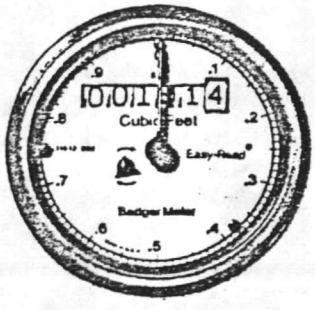
Here is performance unmatched by any other meter on the market. Only the Badger Easy-Read combines time-proven disc meter accuracy and dependability with the efficiency of magnetic drive.

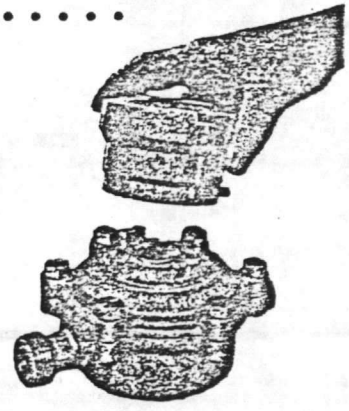
The benefits of this new type meter are many, beginning with the elimination of the troublesome stuffing box and consequent drag and leaks.

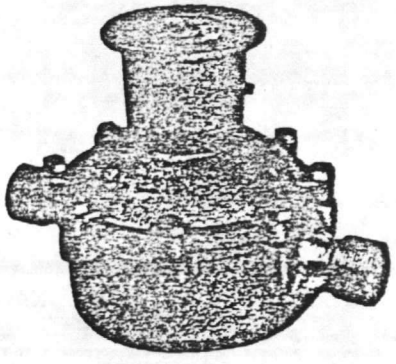
Still more top features: a low-friction, self-cleaning sapphire jewel bearing, located in the water chamber, carries the thrust of the magnetic coupling . . . a tamperproof sealed register . . . a new, exclusive removable register . . . the most readable register face of any meter yet marketed.

CHECK THESE EASY-READ EXCLUSIVES

NEW SEALED REGISTER . . . . . .







EASIER TO READ . . . AND IT'S REMOVABLE

Digits are ¼" high, with centersweep test circle 2¾" in diameter. Extra wheel extends capacity of 5/8" meter to 10 million gallons. Permanently sealed against foreign elements . . . eliminates fogging or clouding of reg- glass. Large clear lens (tempered glass) resists breakage, protects Easy-Read parts. For operating temperature up to 120°F.

The self-contained Easy-Read register assembly may be removed – even under water – without opening the meter housing or disturbing the meter in the line. The register and cover can also be mounted in any of four positions for most convenient reading.

METER WITH GEAR TRAIN ADAPTOR

The magnetic drive gear train provides an external gear train with change gears for calibration and a mounting base for accessories. For operating temperature up to 250°F.

Badger Meter, Inc. Flow Products Division
4545 West Brown Deer Road, Milwaukee, Wisconsin 53223

APPLICATIONS

The specific Model SC-SOT or Model SC-ER Meter configuration selected for use in a fluid metering application is determined, primarily, by the physical characteristics of the liquid to be metered, i.e., flow rate, pressure, temperature, viscosity and chemical composition. In general, Model SC-SOT-C and Model SC-ER-C Meter configurations are intended for use in applications involving low temperature water (to 120°F), while Model SC-SOT-H and Model SC-ER-H meter configurations are intended for use in applications involving high temperature water (to 250°F) or chemical solutions, depending on the disc employed. For specific information concerning Model SC-SOT and Model SC-ER applications relative to a particular liquid, refer to Badger Application Note AN-10 or contact the Local Badger Meter Representative or the Flow Products Division of Badger Meter, Inc. (address on title page).

ACCESSORIES

A meter-mounted and driven accessory device such as a register or pulse transmitter must be used with Model SC-SOT or Model SC-ER Series Meters to obtain a visual and/or signal output that is directly proportional to the volume of liquid flowing through the meter. Figures 1-4 and 1-5 illustrate the Model SC-SOT and Model SC-ER meter-accessory combinations available. In addition to meter-mounted and driven accessories, the figures also indicate the free-standing accessories that are available. For detailed information (such as function, dial capacities, units of measure, pulse rates, etc.) regarding any of the accessories shown, contact the local Badger Meter Representative or the Division of Badger Meter, Inc.

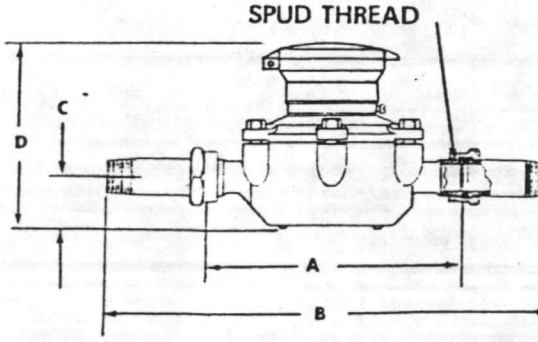
SIZE	SHIP. WT. (LBS.)	SPUD THREAD	CONNECTOR THREAD	DIMENSIONS					MAX. WORKING PRESSURE	CONFIGURATIONS							
										SC-ER-C*		SC-ER-H**					
										Hard Rubber Disc (to 120°F		Syn. Rubber Disc (to 250°F)		Aluminum Disc (to 250°F)		Bronze Disc (to 250°F)	
				A	B	C	D	Width		Normal Flow Range (GPM)	Max. Cont. Flow (GPM)	Normal Flow Range (GPM)	Max. Cont. Flow (GPM)	Normal Flow Range (GPM)	Max. Cont. Flow (GPM)	Normal Flow Range (GPM)	Max. Cont. Flow (GPM)
5/8"x1/2"	10	3/4-14 NPS	1/2-14 NPT	7 1/2"	12 1/4"	1 1/8"	5 1/4"	5 1/16"	150 psi	1-20	10	2-20	10	‡2-10	10	‡2-10	10
5/8"x3/4"	10	1-11 1/2 NPS	3/4-14 NPT	7 1/2"	12 1/4"	1 1/8"	5 1/4"	5 1/16"	150 psi	1-20	10	2-20	10	‡2-10	10	‡2-10	10
3/4"	12	1-11 1/2 NPS	3/4-14 NPT	9"	14"	1 1/2"	6 1/8"	6 1/4"	150 psi	2-30	12	3-30	12	‡3-15	12	‡3-15	12
1"	21	1 1/4-11 1/2 NPS	1-11 1/2 NPT	10 1/4"	16"	2 1/4"	7 1/2"	7 1/8"	150 psi	3-50	36	5-50	36	‡5-25	25	‡5-25	25
1"x1 1/4"	21	1 1/2-11 1/2 NPS	1 1/4-11 1/2 NPT	10 3/4"	16"	2 1/4"	7 1/2"	7 1/8"	150 psi	3-50	36	5-50	36	‡5-25	25	‡5-25	25
1 1/2"	36	1 1/2-11 1/2 NPT Hex-Female	1 1/2-11 1/2 NPT Hex-Female	12 5/8"	18 1/16"	2 1/16"	9 1/8"	9 1/2"	150 psi	5-100	83	8-100	83	10-50	50	10-50	50
2"	62	2-11 1/2 NPT Hex-Female	2-11 1/2 NPT Hex-Female	15 1/4"	22 7/8"	3 1/16"	10 1/4"	13 1/2"	150 psi	8-160	120	12-160	120	16-80	80	16-80	80

NOTES:

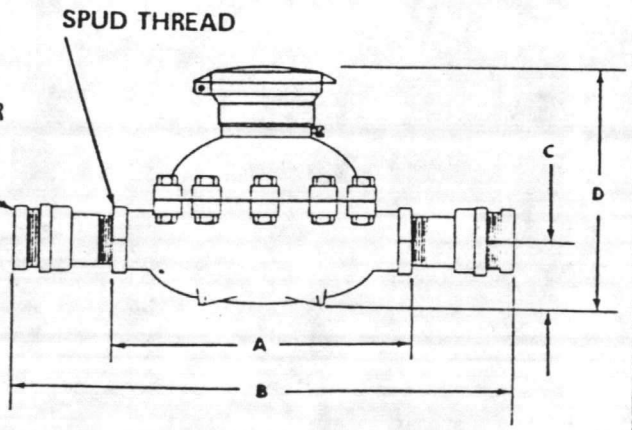
*Noryl Chamber Std. on 5/8"-1"x1 1/4" SC-ER-C Meters unless Bronze is specified at time of order. Bronze chamber std. on 1 1/2" and 2" SC-ER-C Meters.

**Bronze Chamber Std. on All Sizes of SC-ER-H Meters.

‡Available for fluids other than water.

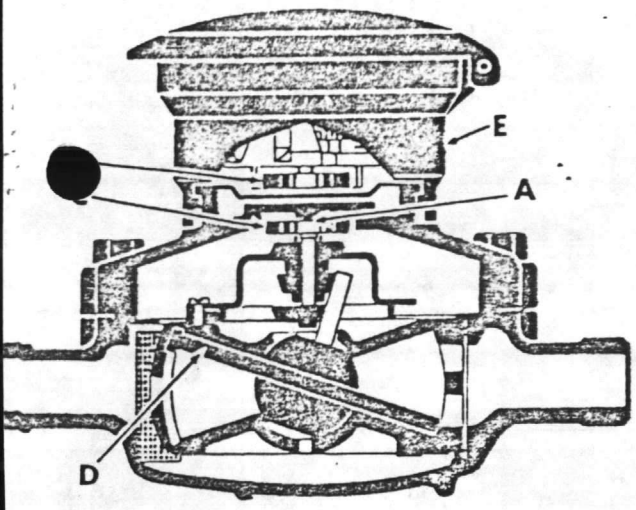


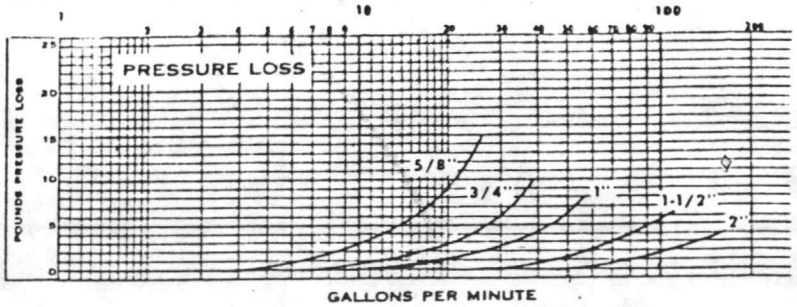
5/8" THRU 1" x 1¼" MODEL SC-ER WITH STANDARD TOTALIZING REGISTER



1½" AND 2" MODEL SC-ER WITH STANDARD TOTALIZING REGISTER

Configuration and Specification Data for Model SC-ER Series Disc Meters





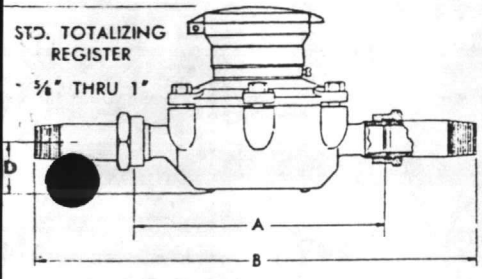
Stronger magnets assure more positive drive

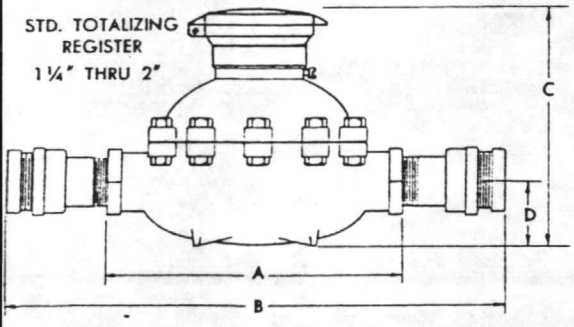
As water flows through the meter chamber, a full-size disc turns the lower drive assembly. The entire assembly, including the four-pole ceramic ring magnet, is suspended in a dual bearing system.

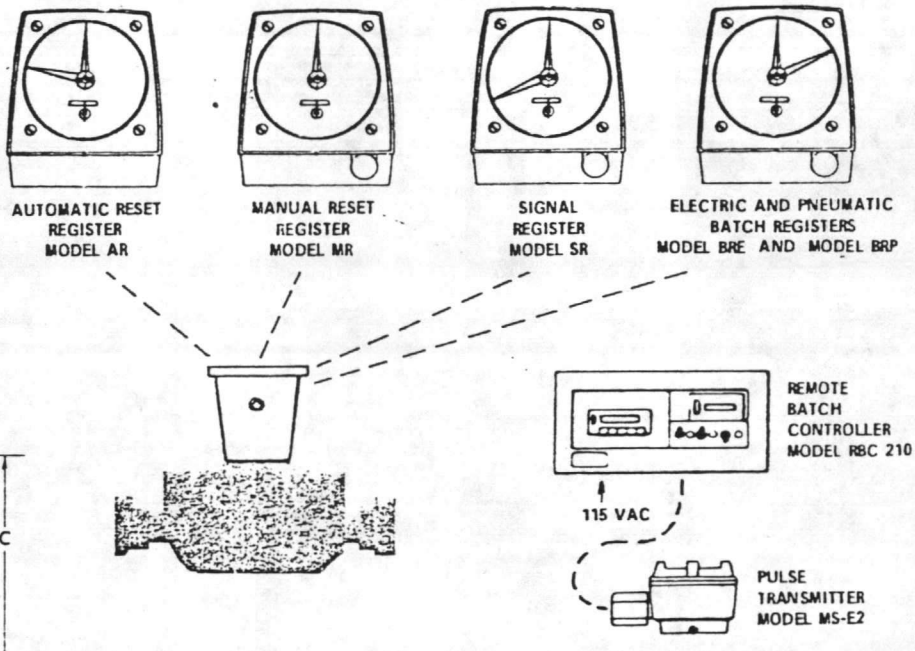
Badger's stronger magnets transmit power through the cast bronze wall separating measuring and register units. Four poles lock to provide positive drive.

A—Sapphire jewel bearing. B—Driven magnet. C—Drive magnet. D—Disc. E—Sealed register and gear train assembly.

SPECIFICATIONS, SIZES, MODELS AND CAPACITIES OF EASY-READ DISC METERS







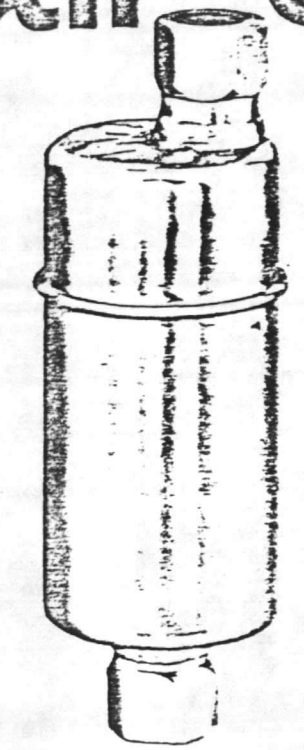
Meter Size Inches	Net Weight Lbs.	A Length Inches	B Overall Length	C Height Inches	D Port Holes Center to Base	Width Inches	Type of Nutating Disc					
							Hard Rubber For up to 120°F		Syn. Hard Rubber For up to 250°F		Bronze or Aluminum For up to 250°F	
							Normal Flow — GPM	Max. Cont. Flow	Normal Flow — GPM	Max. Cont. Flow	Normal Flow — GPM	Max. Cont. Flow
MODEL SC-ER												
⅝	10	7½	12¼	5¾	1⅜	5 15/16	1-20	10	2-20	10	‡2-10	10
⅝ x ¾	10	7½	12¼	5¾	1⅜	5 15/16	1-20	10	2-20	10	‡2-10	10
[illegible]	12	9	14	6⅛	1¾	6⅜	2-30	12	3-30	12	‡3-15	15
[illegible]	21	10¾	16	7½	2¼	7⅛	3-50	36	5-50	36	‡5-25	25
1 x 1¼	21½	10¾	16½	7½	2¼	7¼	3-50	36	5-50	36	‡5-25	25
*1½	36	12⅝	18⅜	9⅛	2⅝	9½	5-100	83	8-100	65	‡10-50	50
*2	62	15¼	21¼	10¾	3 3/16	13½	8-160	120	12-160	100	‡16-80	80

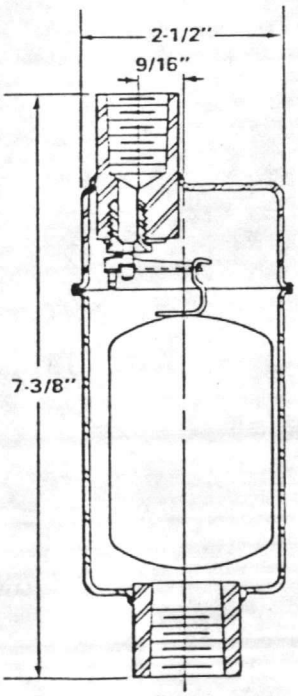
*1½" and 2" housing bottoms can be furnished with female spuds for union connections, as shown above, with laying lengths of 12⅝" and 15¼" respectively. Also available are two bolt elliptical or four bolt round companion flanges, with laying lengths of 12⅝" for the 1½" size and 15¼" for the 2" size.

Up to 250°F with Magnetic Gear Train Adaptor. ‡Available for fluids other than water.

ARMSTRONG No. 11-AV ALL STAINLESS STEEL

air and gas vent





- High resistance to corrosion — stainless construction
- Heliarc welded body and float
- Sealed, tamperproof construction — no gaskets
- Positive performance of a proven, simple guided lever mechanism
- Ample distance between liquid level and valve makes carryover unlikely
- Maximum operating pressures to 400 psig

The Armstrong No. 11-AV Air and Gas Vent has been designed especially to combine the durability and corrosion resistance of stainless steel with a dependable, proven operating mechanism in the low to moderate capacity range.

Design of the Armstrong No. 11-AV is very simple. It employs a float to actuate a guided free-floating valve. There are no fixed pivots to wear or create friction that could interfere with vent operation. The lever guide assures positive closure under all conditions.

SPECIFICATIONS

Body and Cap — 304-L stainless steel
Valve and Seat — 440-F heat treated chrome steel
Float and Leverage — 304 stainless steel
Inlet Connection — 3/4"
Discharge Connection — 1/2"
Vessel Design Limitation — 400 psig at 500°F
Approximate Weight — 1-3/4 lbs.

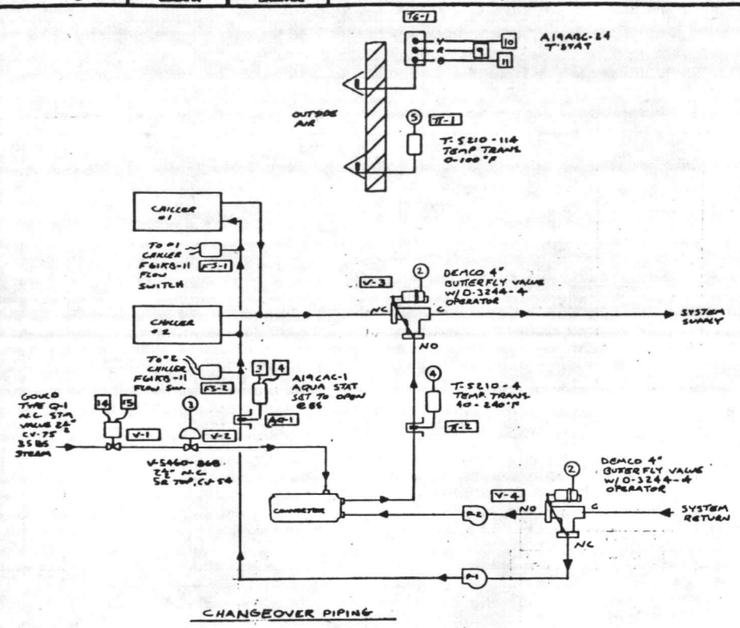
MAXIMUM OPERATING PRESSURES
for different orifices with specific gravity of liquid between 1.00 and 0.80

Orifice Size	Max. Pressure
1/8"	175
#38	300
5/64"	400

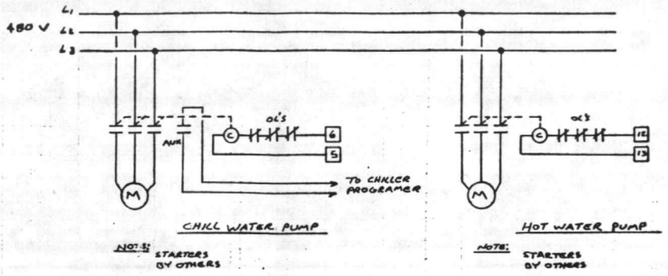
VENTING CAPACITIES in SCFM at standard atmospheric pressure.

Orifice Size	System Pressure, psig																	
	5	10	15	20	25	30	40	50	60	75	100	125	150	175	200	250	300	400
1/8"	2.5	3.5	4.3	5.1	5.8	6.5	8.0	9.5	10.6	13.1	16.9	20.5	24.3	28.0	–	–	–	–
#38 Drill	1.6	2.3	2.8	3.3	3.8	4.3	5.3	6.2	7.2	8.8	11.1	13.9	16.3	19.0	21.1	26.1	31.3	–
5/64"	1.0	1.4	1.7	1.9	2.2	2.5	3.1	3.7	4.2	5.1	6.8	7.9	9.5	10.9	12.4	15.3	18.3	24.1

All dimensions are approximate. Use certified print for exact dimensions.

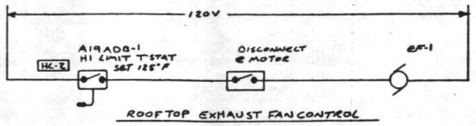


CHANGEOVER PIPING

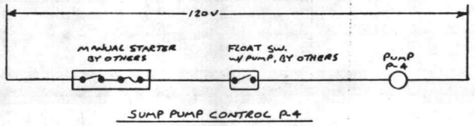


CHILL WATER PUMP

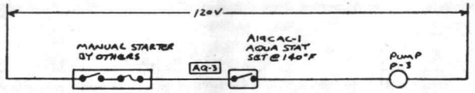
HOT WATER PUMP



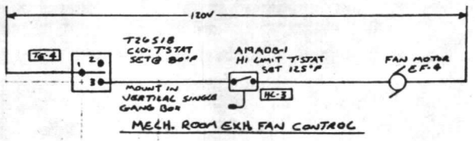
ROOFTOP EXHAUST FAN CONTROL



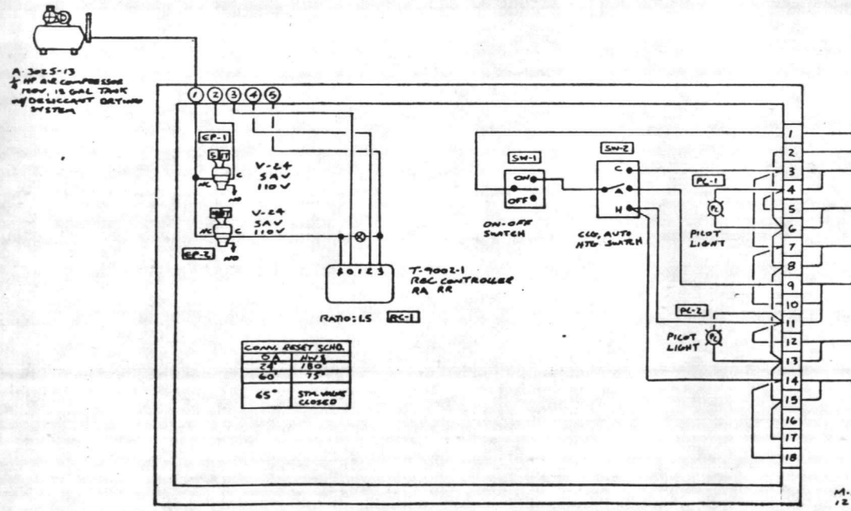
SUMP PUMP CONTROL P-4



DOMESTIC H.W. PUMP CONTROL P-3

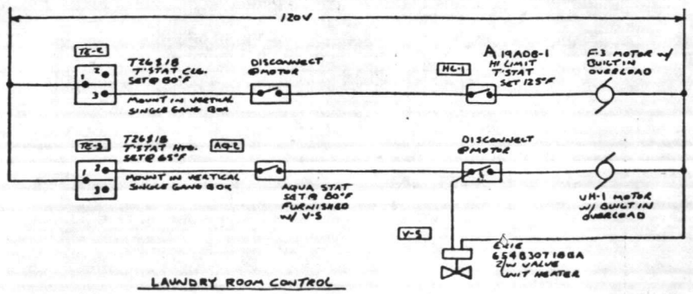


MECH. ROOM EXH. FAN CONTROL



HTG. & CLG. CONTROL

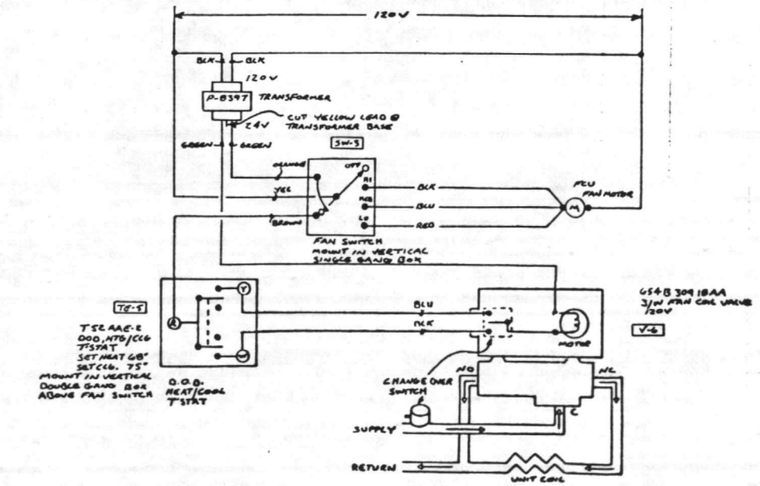
1 REQ'D.



LAUNDRY ROOM CONTROL

1 REQ'D
3 REQ'D.

AS BUILT
DATE 1/14/86



FAN COIL UNIT CONTROL & PIPING

4 REQ'D.

DESCRIPTION OF OPERATION

HEATING With system switch SW-1 on and heating/auto/cooling switch SW-2 set to HEAT, hot water pump is energized and heating controls are energized by solenoid air valve EP-2. Safety steam valve V-1 is open and hot water temperature will be reset to a predetermined scheduled by outside air temperature transmitter TT-1 and HWS temperature transmitter TT-2 through receiver controller RC-1 modulating steam control valve V-1.

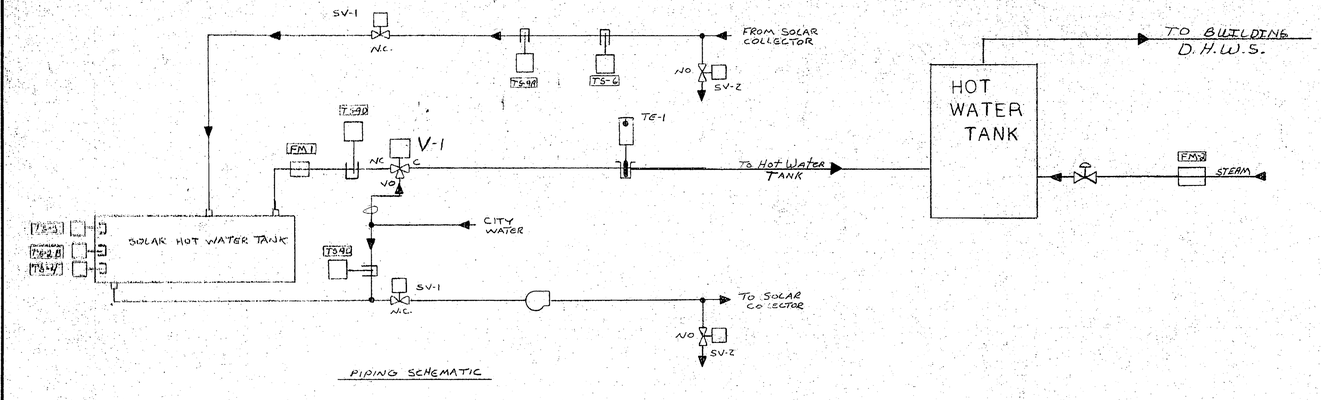
COOLING With SW-2 in cool, hot water pump will de-energize and chilled water pump will start subject to safety thermostat AQ-1. Change over valves V-3 & V-4 will position to allow for system water to flow through the chiller and bypass the hot water converter.

AUTOMATIC With SW-2 in AUTO, outside air thermostat TE-1 will cycle heating or cooling as required as previously described.

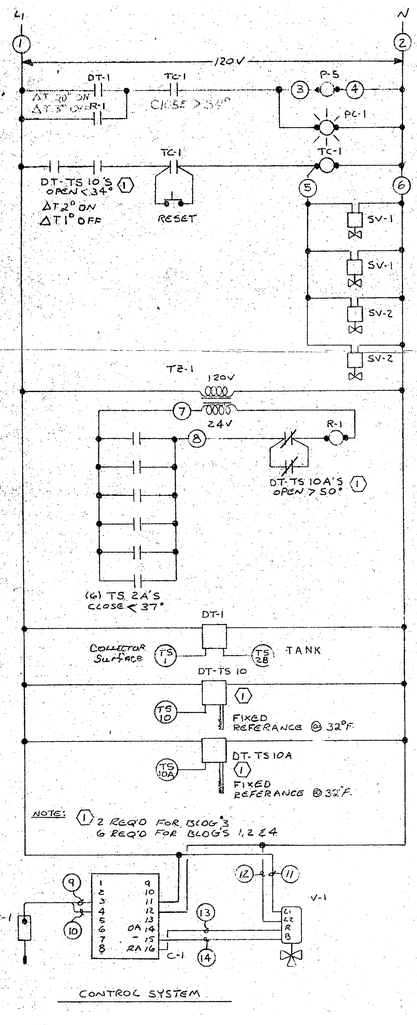
FAN COIL UNITS With the fan running by speed switch SW-3, heating/cooling thermostat TE-5 and chengeover aquastat will position heating/cooling valve V-6 as required to maintain desired space conditions.

LAUNDRY ROOM & UNIT HEATER CONTROL Room thermostat TE-2 will energize fan F-3 subject to high limit thermostat HC-1 for cooling. Room thermostat TE-3 through hot water aquastat AQ-2 will cycle unit heater fan and open hot water valve V-5 for heating.

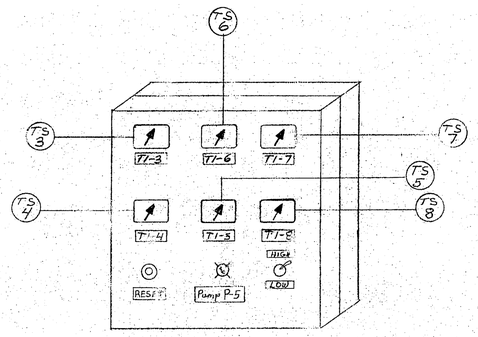
DRAWING TITLE: BARRACKS CONTROL							
REFERENCE DRAWINGS	NO	REVISION – LOCATION		ECN	DATE	BY
SALES ENGR. C.S	APPLICATION ENGR. T.W.S	DRAWN BY T.W.S DATE		APPROVED BY DATE		
PROJECT: BEQ's III, CAMP LEJEUNE, N.C.	JOHNSON CONTROLS Systems & Services Division	JCI 4304 MARKET ST. WILMINGTON, N.C.		CONTRACT NUMBER		
				DRAWING NUMBER 8129-0006		



PIPING SCHEMATIC



CONTROL SYSTEM



SOLAR SYSTEM CONTROL PANEL 36"W x 42"H

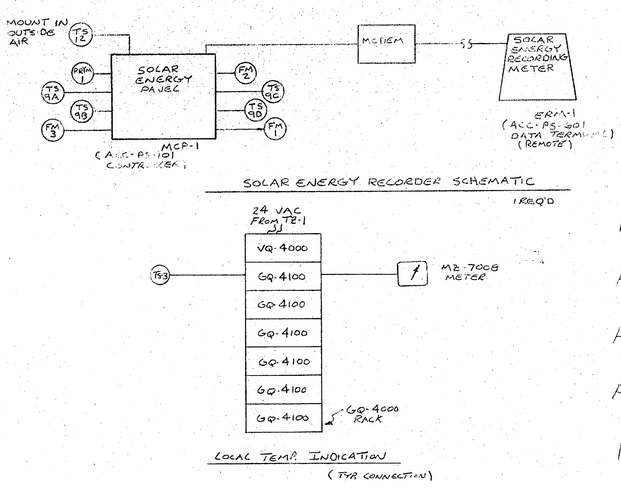
4 REQ'D.

IDENT #	DESCRIPTION	RANGE	NOTES	MFG	PART NO.	WELL	QUAN
PI-1	Water pressure indicator	0-150PSI	1				4
CP-1	Master Solar Control Panel		1	Andover	ACC-PS-101		1
DT-1	Solar Differential Thermostat		1	JCI	R34AAB		4
TI-1	Pump Discharge Water Temp. Indicator	30-240°F	1 5	JCI	T-2110-6	A	4
TI-2	Water Supply Temp. Indicator	30-240°F	1 5	JCI	T-2110-6	A	8
TI-3	Panel Mtd. Tank (Top) Indicator	0-200°F	1	JCI	M2-7008-10		4
TI-4	Panel Mtd. Tank (Bottom) Indicator	0-200°F	1	JCI	M2-7008-10		4
TI-5	Panel Mtd. Collector Inlet Lo Indicator	0-200°F	1	JCI	M2-7008-10		4
TI-6	Panel Mtd. Collector Outlet Lo Indicator	0-200°F	1	JCI	M2-7008-10		4
TI-7	Panel Mtd. Collector Surface Indicator	0-400°F	1	JCI	YM2-7008		4
TI-8	Panel Mtd. Ambient Indicator	30-120°F	1	JCI	M2-7008-5		4
TS-1	Collector Surface Temp. Sensor	0-400°F	2 3 4	JCI	A41WA-1		4
TS-2B	Tank Water Operating Sensor	0-250°F	2 5	JCI	TE-1700-8	B	4
TS-3	Tank Top Indicating Sensor	0-250°F	2 5	JCI	TE-1700-8	B	4
TS-4	Tank Bottom Indicating Sensor	0-250°F	2 5	JCI	TE-1700-8	B	4
TS-5	Collector Inlet Water Indicating Sensor	0-250°F	2 5	JCI	TE-1700-8	B	4
TS-6	Collector Outlet Water Indicating Sensor	0-250°F	2 5	JCI	TE-1700-8	B	4
TS-7	Collector Surface Indicating Sensor	0-400°F	2 4	JCI	A41AW-1		4
TS-8	Ambient Indicating Sensor	0-120°F	2	JCI	TE1300-2		4
TS-9	Temperature Sensor	0-250°F	2 5 6	Andover	ACC-PS-702	C	4
EM-1	Collector Thermal Energy Meter		6	Andover	ACC-PS-601		1
EM-2	Solar Energy Meter		6	Andover	ACC-PS-601		1
EM-3	Aux. Steam Energy Meter		6	Andover	ACC-PS-601		1
EM-4	Hot Water Thermal Load Energy Meter		6	Andover	ACC-PS-601		11
TS-10 & TS-10A	Freeze Protection Temp. Sensor	250 F Operating	2 3 4	JCI	A41AW-7AR34DCB		40
FM-1	Domestic Water Flow Meter	12-160 GPM	6	Badger 2"	SC-ER-H & MS-EZ		1
FM-2	Aux. Steam Flow Meter	0-1000 lbs/hr	6	EMCI	TMPS-700		1
FM-3	Collector Water Flow Meter	12-160 GPM	6	Badger 2"	SC-ER-H & MS-E2		1
TC-1	Emergency Temp Controller	110 v		JCI	KZ4000-8		4
SV-1A	Air-Water Vent Valve	3/4"		Armstrong	AV-11		40
SV-1	Normally Closed Solenoid Valve	3"		Gould	Type Q 115VAC		8
SV-2	Normally Open Solenoid Valve	1 1/2"		Gould	Type Qr115VAC		8
PYRM-1	Pyranometer		6	Hollis	MR-5		1
TS-2A	Standard Freeze Protection Temp Sensors	190° Max	2 5	JCI	A19ANC-1	D	24
TI-9	Collector Return Temp. Indicator	30-240°F	1 5	JCI	T2110-6	A	4
TI-10	Collector Water Make-Up Temp. Indicator	30-240°F	1 5	JCI	T2110-6	A	4
TI-11	Tank Temp. Indicator	30-240°F	1 5	JCI	T2110-6	A	7
ERM-1	Energy Recording Meter		6	Andover	ACC-PS-601		1
TE-1	Control Temp. Sensor		5	JCI	TE 1700-7	B	4
C-1	Temp. Controller	110v		JCI	TC4100-10		4
V-1	3 way control valve	2½"		JCI	VB-4322-9 W/VA3200-110		4
TZ-1	110/24 Transformer			JCI	TZ-5000-10		4
R-1	Relay	110 v		JCI	KZ-4000-8		4
TS-12	O.A. °F Recording Sensor	0-100°	6	Andover	ACC-PS-703		1

NOTES:
1. Indicating Range
2. Operating Range
3. Shall be mounted to back of collector resorber surface
4. Maximum operating range 350 F
5. With well
6. These instruments will appear in Bldgs 2 only

WELLS

A - T2110-100 - ¾" MPT x 3½" (27 REQ'D.)
B - W2-1000-1 - ½" MPT x 4⅝" (24 REQ'D.)
C - 702 - ⅛" MPT x 1" (4 REQ'D.)
D - WELL1A-GCIR - ½" MPT x 2⅜" (24 REQ'D.)

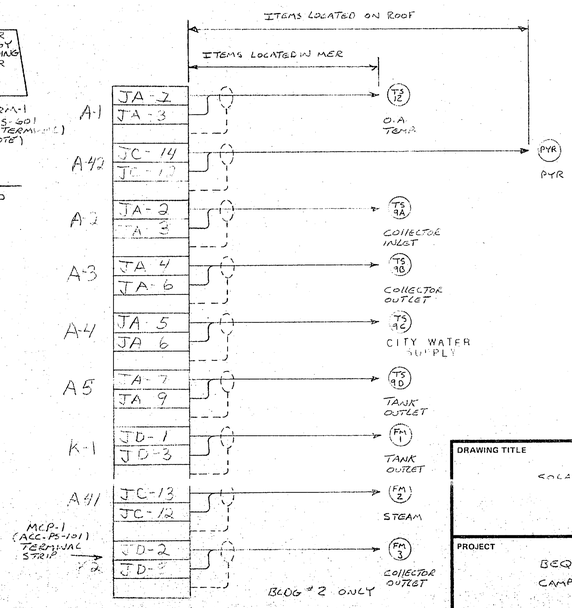


SOLAR ENERGY RECORDER SCHEMATIC

1 REQ'D

LOCAL TEMP. INDICATION

(TYP. CONNECTION)



AS BUILT

DATE

REFERENCE DRAWINGS	NO.	REVISION – LOCATION	ECN	DATE	BY	
SALES ENGR. CES	APPLICATION ENGR. M H	DRAWN BY TWS DATE 7-15-79	APPROVED BY	DATE		

DRAWING TITLE: SOLAR CONTROLS

PROJECT: BEQ'S, SOLAR H.W. CAMP LEJEUNE, N.C.

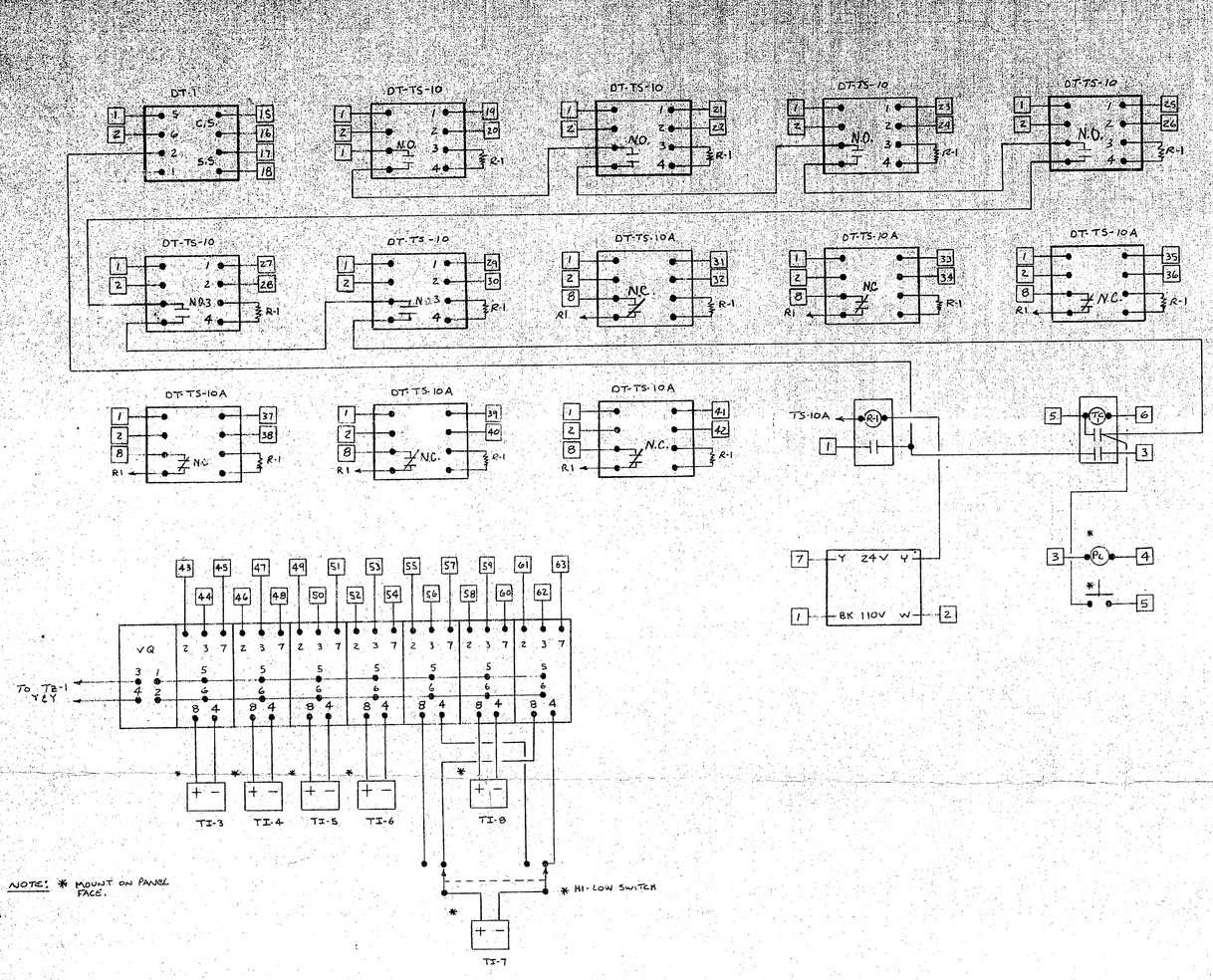
JOHNSON CONTROLS Systems & Services Division

CONTRACT NUMBER: 8129-0013

DRAWING NUMBER: 1 OF 2

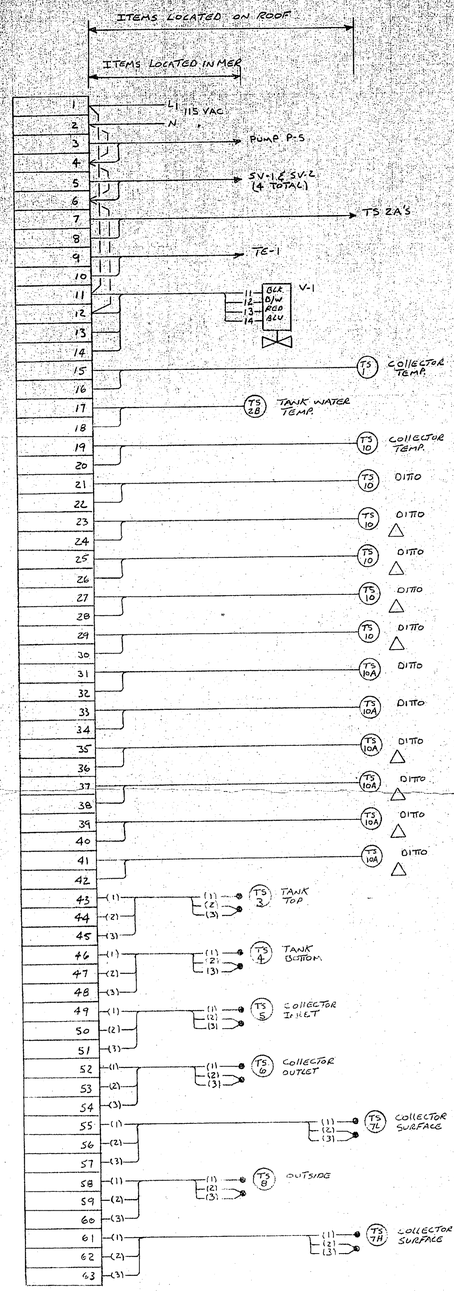
FORM NO. 1752-C (BES 45-3.01)

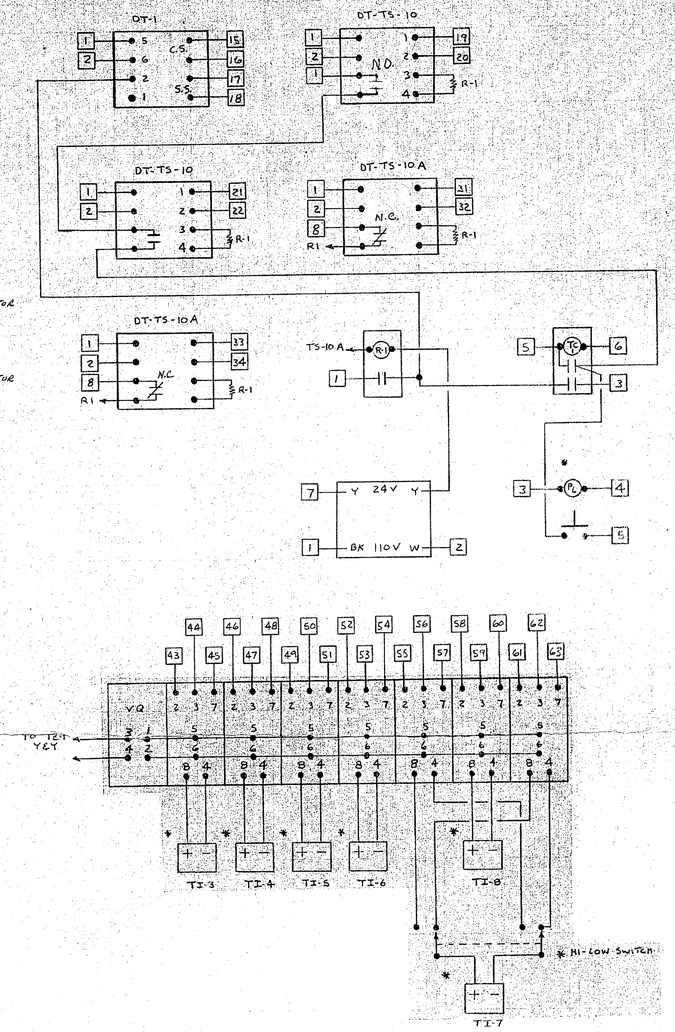
22 x 34 ORIGINAL



NOTE: * MOUNT ON PANEL FACE.

BUILDINGS #1, #2 & #4





BUILDING #3

NOTE: △ NOT REQUIRED FOR BLDG #3

AS BUILT

DATE

DRAWING TITLE: SOLAR CONTROLS							
REFERENCE DRAWINGS	NO.	REVISION	LOCATION	ECN	DATE	BY	
SALES ENGR. CES	APPLICATION ENGR. MH	DRAWN BY TGS	DATE	APPROVED BY	DATE		
PROJECT: BEQ'S, SOLAR H.W. CAMP LEJEUNE, N.C.	JOHNSON CONTROLS Systems & Services Division			CONTRACT NUMBER: 8129-0013			
				DRAWING NUMBER: 2 OF 2			

FORM NO. 1752-C (BES 45-5.01)

22"x34" ORIGINAL

"Perma-Pipe" Underground Conduit System for U. S. Military Construction

PERMA-PIPE

September 15, 1964

MIDWESCO ENTERPRISE, Inc.
Permanent Piping Systems Division
1650 North Elston Avenue
Chicago 22, Illinois

DEPARTMENT OF THE ARMY
Office of the Chief of Engineers

DEPARTMENT OF THE NAVY
Bureau of Yards and Docks

DEPARTMENT OF THE AIR FORCE
Directorate of Civil Engineering

May 1, 1965

Tri-Service Letter of Acceptability

TO: MIDWESCO ENTERPRISE, Inc.
Permanent Piping Systems Division
1650 North Elston Avenue
Chicago 22, Illinois

Gentlemen:

1. The "Perma-Pipe" underground conduit system described in the MIDWESCO brochure dated September 15, 1964, and the accompanying test results comply with the requirements for Class A heat distribution systems as specified in the Tri-Service coordinated specification for Heat Distribution Systems, issued under separate cover by each service as follows:

Army - CE-301.21 (latest revision)
Navy - TS-P28 (latest revision)
Air Force - AFP 88-007-1 (latest revision)

2. Approval of all systems and components for compliance with contract specifications is the responsibility of the contracting officer for the particular project involved. In each case, it will be necessary for you to provide the prime contractor with a copy of this letter and the brochure it references, for his submittal to the contracting officer.

3. Furthermore, if any changes in the components or basic changes in the design of the system referenced in this letter are made, it will be necessary for you to obtain a separate letter indicating compliance of such changes with the specification requirements.

H. B. ZACKRISON, Sr.
Chief, Engineering Division
Military Construction
Office of the Chief of Engineers

B. S. MERRILL, Jr., CDR, CEC, USN
Director, Engineering Division
Bureau of Yards and Docks

C. W. HARRIS
Deputy Chief, Engineering Div.
Directorate of Civil Engineering
Headquarters, U. S. Air Force

PERMA -PIPE

Permanent Piping Systems Division

1650 No. Elston Avenue, Chicago 22, Illinois • Telephone 489-5800 (Area Code 312)

A division of Midwesco-Enterprise, Inc.

September 15, 1964

MANUFACTURER'S CERTIFICATION

Permanent Piping Systems Division, Midwesco-Enterprise, Inc., certifies that all components of the conduit system, as described in this brochure, of which this certification is a part, are in accordance with the Tri-Service Specification for Heat Distribution Systems Outside of Buildings.

We further certify that materials to be furnished are identical to those described in this brochure.

PERMANENT PIPING SYSTEMS DIV.

Richard Klink
Sales Manager

SUBSCRIBED AND SWORN to before me

this...14.....day of...September.....A.D., 1964..

.....

Notary Public

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FIBREBOARD
PAPER PRODUCTS CORPORATION

P O BOX 4331 • OAKLAND [illegible]

July 12, 1963

Permanent Piping Systems Division
Midwesco-Enterprise, Inc.
1650 Elston Ave.
Chicago 22, Illinois

Gentlemen:

This will certify that our Caltemp Thermal Insulation complies with the U. S. Air Force Publication 88-007-1 Section 10. It meets Federal Specification HH-I-523 Class 2, and its thermal conductivity "k" factor is below 0.35 at 200F.

FIBREBOARD PAPER PRODUCTS CORPORATION

H. P. Hoopes - Manager-Manufacture
Pabco Industrial Products Division

HPH:ma

Subscribed and sworn to before me this
10 day of July 1963
Edith G. [illegible]
NOTARY PUBLIC IN AND FOR [illegible] COUNTY
OF ALAMEDA, STATE OF CALIFORNIA
MY COMMISSION EXPIRES SEPT. 23, 1964

CONDUIT CASING

Spiral welded 10-gauge steel pipe, full-welded seam, as supplied to meet ASTM Specifications A-211 and A-245, Grade C. PERMA-PIPE Chart 9-62, Table of Casing Weights, is enclosed. It is supplied in nominal 39'-6" lengths as shown on Drawing MP-75AF, page 14.

CONDUIT COVERING

Koppers Bitumastic 70-B Standard coal tar enamel as supplied by the Koppers Co., Inc. of Pennsylvania. The material was supplied for permeance testing as a coating applied on a steel plate with a 30 square centimeter hole in the plate. An outer jacket of 15 pound asbestos pipe line felt saturated with the same coal tar is tension wrapped as an outer jacket. The layers of coal tar enamel under jacket are applied with one tension wrap of glass fabric. All of above as specified in AFP 88-007-1.

INNER CASING COATING

Spray-painted film of Benjamin Foster Company Acid Resistant Primer No. 51-05 applied to the inside surface of the casing. This was made available for permeance tests as a coating over porous ceramic tile. Manufacturer's specification sheet is enclosed, page 6.

FITTING AND FIELD JOINT COATING

ROSKOTE Mastic 612XM, as described in Royston Laboratories' specification sheet, pages 7 and 8, is applied over the fitting (shop-fabricated) or over the field closure sleeve. Then, a layer of

FITTING AND FIELD JOINT COATING (Cont'd.)

Royston Laboratories' Insultape, minimum thickness .085 inches, as described on page 9, is applied under hand tension. Another layer of ROSKOTE 612XM is applied over the Insultape. Total coating thickness is 1/8". The field joint coating overlaps factory coating a minimum of 1".

TABLE OF CASING WEIGHTS

CASING TYPE	DIAMETER (Inches)	MINIMUM THICKNESS
Zinc Coated Corrugated	Up thru 21	0.0598 Inch (16 Gauge)
	22 thru 26	0.1045 Inch (12 Gauge)
	27 and above	0.1345 Inch (10 Gauge)
Zinc Coated Smooth Wall	Up thru 21	0.0747 Inch (14 Gauge)
	22 thru 26	0.1345 Inch (10 Gauge)
	27 and above	0.1644 Inch (8 Gauge)
Black Steel Smooth Wall	Up thru 21	0.1345 Inch (10 Gauge)
	22 thru 26	0.1943 Inch (6 Gauge)
	27 and above	0.2242 Inch (4 Gauge)

KOPPERS COMPANY, INC.
Pittsburgh 19, Pennsylvania
TAR PRODUCTS DIVISION

BITUMASTIC ENAMELS

(Supercedes Bulletin dated October 26, 1960)

BITUMASTIC 70-B ENAMEL

This is the oldest wide-temperature range coal-tar enamel currently marketed. Another Koppers first. When coating pipe with this grade of enamel, it is advisable to add 10°F - 25°F to the low side of the temperature exposure range for safe storage and handling. The incorporation of a plasticizing agent during the processing makes possible the wide-temperature range. There are three types of Bitumastic 70-B Enamel:

A. FREE-FLOWING - This type was specifically formulated for application by line traveling coating and wrapping machines. It has a temperature exposure range of -10°F. to 160°F.

B. STANDARD - This type is most popular for plant-coated pipe. It also has a temperature exposure range of -10°F. to 160°F.

C. AWWA - This type is generally used on water pipe. However, it is sometimes applied to oil and gas lines when exposures to less than -10°F. are to be encountered before back-filling. It has a temperature exposure range of -20°F. to 160°F.

Material used for conduit coating

TESTS	BITUMASTIC 70-B FF ENAMEL	BITUMASTIC 70-B Std. ENAMEL	BITUMASTIC 70-B AWWA ENAMEL
S. P. (°F.) ASTM D36 (R & B)	220-235	220-235	220 Min.
Ash (%) By Weight By Ignition	20-25	25-35	25-35
Sp. Gravity at 77°F. ASTM D 71	1.35 - 1.45	1.40 - 1.60	1.40 - 1.60
Penetration at 77°F.	4-9	4-9	10-20
at 115°F. (ASTM D5)	12-25	12-25	15-55
Sag			
100° - 5 hours	-	-	-
120° - 5 "	-	-	-
140° - 5 "	-	-	-
160° - 24 "	Max. 1/16"	Max. 1/16"	Max. 1/16"
Crack			
45°F. - 6 hours	-	-	-
32°F. - 6 "	-	-	-
20°F. - 6 "	-	-	-
10°F. - 6 "	-	-	-
-10°F. - 6 "	None	None	-
-20°F. - 6 "	-	-	None
Normal Application Temperatures (°F.)	450-490	450-490	450-490

foster COATINGS · SEALERS · ADHESIVES

product data for 51-05

Printed in U.S.A.

ACID RESISTANT PRIMER

COLOR
Black

VISCOSITY
Brushing

GALLON WEIGHT
7.34 lbs.

AVERAGE NON-VOLATILE
62% by volume

COVERAGE RANGE (RECOMMENDED)
300 sq.ft. per gallon
.005" wet film thickness

DRYING TIME
Touch: 2 hours
Through: 6 hours

SERVICE TEMPERATURE LIMITS*
0°F to 250°F

APPLICATION
Brush or Spray

SOLVENT FOR CLEANUP
Mineral Spirits

FLAMMABILITY
Wet: Flash Point 80°F (TOC)
Dry: Burns

ACID RESISTANT PRIMER is a non-asphaltic acid resistant primer designed to protect steel from rust and corrosion due to intermittent contact with moisture and chemicals.

LIMITATIONS
Contains volatile, flammable solvent. Use with adequate ventilation. Keep away from heat and open flame.

Do not apply over oily, greasy or wet surfaces.

1/62-1-R

Note: Coatings end 3-inches from casing ends.

BENJAMIN foster COMPANY • 4635-37 W. GIRARD AVE., PHILA. 31, PA.

Royston LABORATORIES, INC.

ROSKOTE

BLAWNOX,
PITTSBURGH 38, PA.

MANUFACTURERS OF QUALITY CORROSION RESISTANT COATINGS

PITTSBURGH TELEPHONE STERLING 1-1691

TWX OKM 879

February 12, 1962

Midwesco, Inc.
Prefabricated Pipe Division
1650 N. Elston
Chicago, Illinois

(The Midwesco-Enterprise company name now replaces the old Midwesco name.)

Attention: Bert Eaton

Gentlemen:

Certification: This is to certify that the following is a typical analysis of the ROSKOTE MASTIC 612XM.

Solubility (Base Resin) In Carbon Disulfide - 98+%

Specific Gravity (Base Resin) - 1.05

Water Vapor Permeability ASTM E96-53T Procedure E
(90% Relative Humidity at 100°F. Pressure = 44.2 M.M. Hg.)
Value = .105 grams per 24 hours per square meter at 44.2 M.M. Hg.
To convert to Perms: (Grains per square foot per hour per inch of mercury) use factor ".0343"x .105 = .00359 perms.
ASTM Standards 1958, Part 9, Page 1237.

Penetration: at 32°F. - .01 cm
at 77°F. - .03 cm
at 115°F. - .06 cm

Ring & Ball (Base Resin) - 241°F.

Flash Point (Base Resin) - 550° - 600°F.

General Analysis of this formula:

47.0% Resin
22.5% Inorganic Fillers (Mg SiO3)
30.5% Aromatic Solvent

Base Resin Analysis:

Fixed Carbon - 5%
Saturated Hydrocarbon - 12%
Saponifiable Constituents - Trace Oxygen [illegible]
[illegible]
Asphaltic Resins [illegible]2%
Oily Constituents - 12%

ROYSTON LABORATORIES, INC.

By: [signature]
H. C. O'Brien, Jr., President

Royston LABORATORIES, INC.
ROSKOTE
BLAWNOX,
PITTSBURGH 38, PA.
MANUFACTURERS OF QUALITY CORROSION RESISTANT COATINGS
TELEPHONE: AREA 412 781-1691
TWX 412 828-4113

The following characteristics apply to the electrically insulative outerwrap, Insultape, as proposed for field joint application coating using Roskote 612XM Mastic and fulfilling the specification of the Bureau of Yards and Docks TS-P28e and the Tri-Service Guide Specification for underground conduit systems.

1. Glass mat base reinforced, flexible bituminous compound, imperforate film.

2. Minimum Thickness - 85 mils (.085 inches)
Weight - Over 45 lbs. per 100 sq. ft.

3. Base Resin - Bituminous, miscible and compatible with the coating compound described in 3.2.1.2.1. TS-P28e.

4. Base Resin - Electrical volume resistivity, 1×10^{14} ohms $cm.^3$.

5. Base Resin - Ring and Ball Softening Point A.S.T.M. Method E 28, 220° F.

6. Base Resin - Water Absorption, 75 mg. per 100 sq. cm. per 1000 hours at 77° F., maximum.

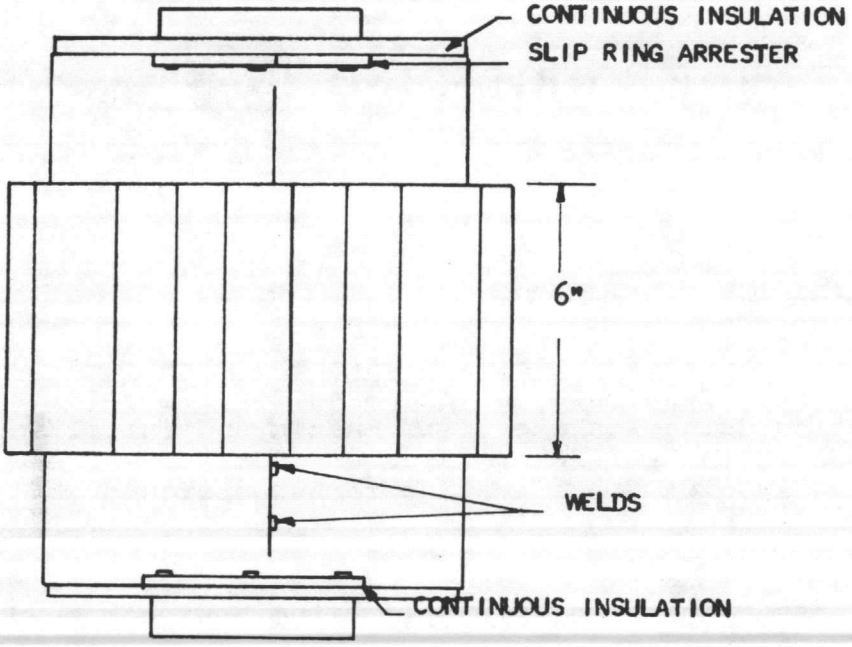
7. Base Resin compound must contain no filler.

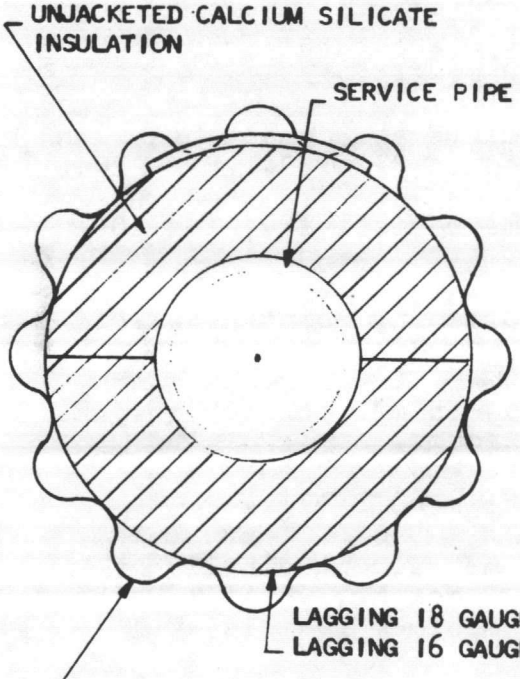
8. Reinforcement - Bonded glass mat longitudinally reinforced with glass fibers. Weight, .8 to 1.0 lbs. per 100 sq. ft. Thickness, minimum 10 mils.

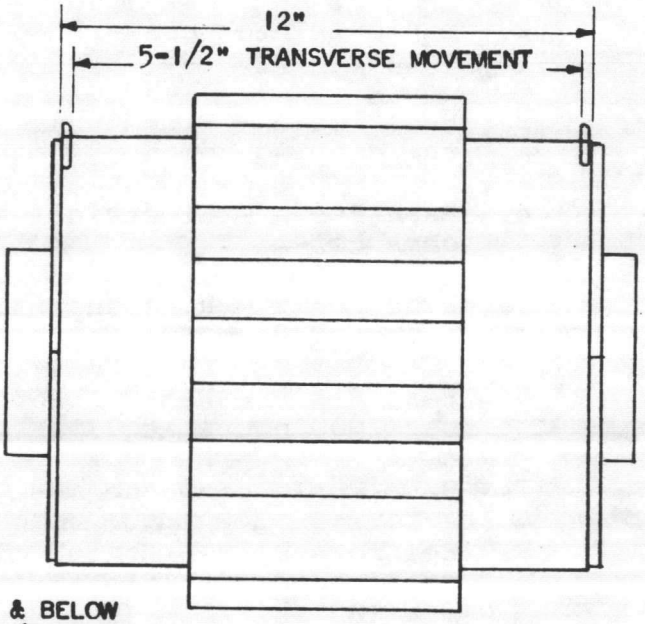
9. Parting or Anti-blocking Surfacing Agent - Maximum of 10% by weight.

10. Dielectric Strength Test Voltage - 10,000 volts.

This wrap is quite compatible with Roskote 612XM and sets up quickly to form a bond.







NOTE: WHERE EXPANSION EXCEEDS 5-1/2", LAGGING WILL BE MADE LONGER

PERMANENT PIPING SYSTEMS DIVISION
MIDWESCO ENTERPRISE INC.
1650 NORTH ELSTON AVENUE
CHICAGO 22, ILLINOIS

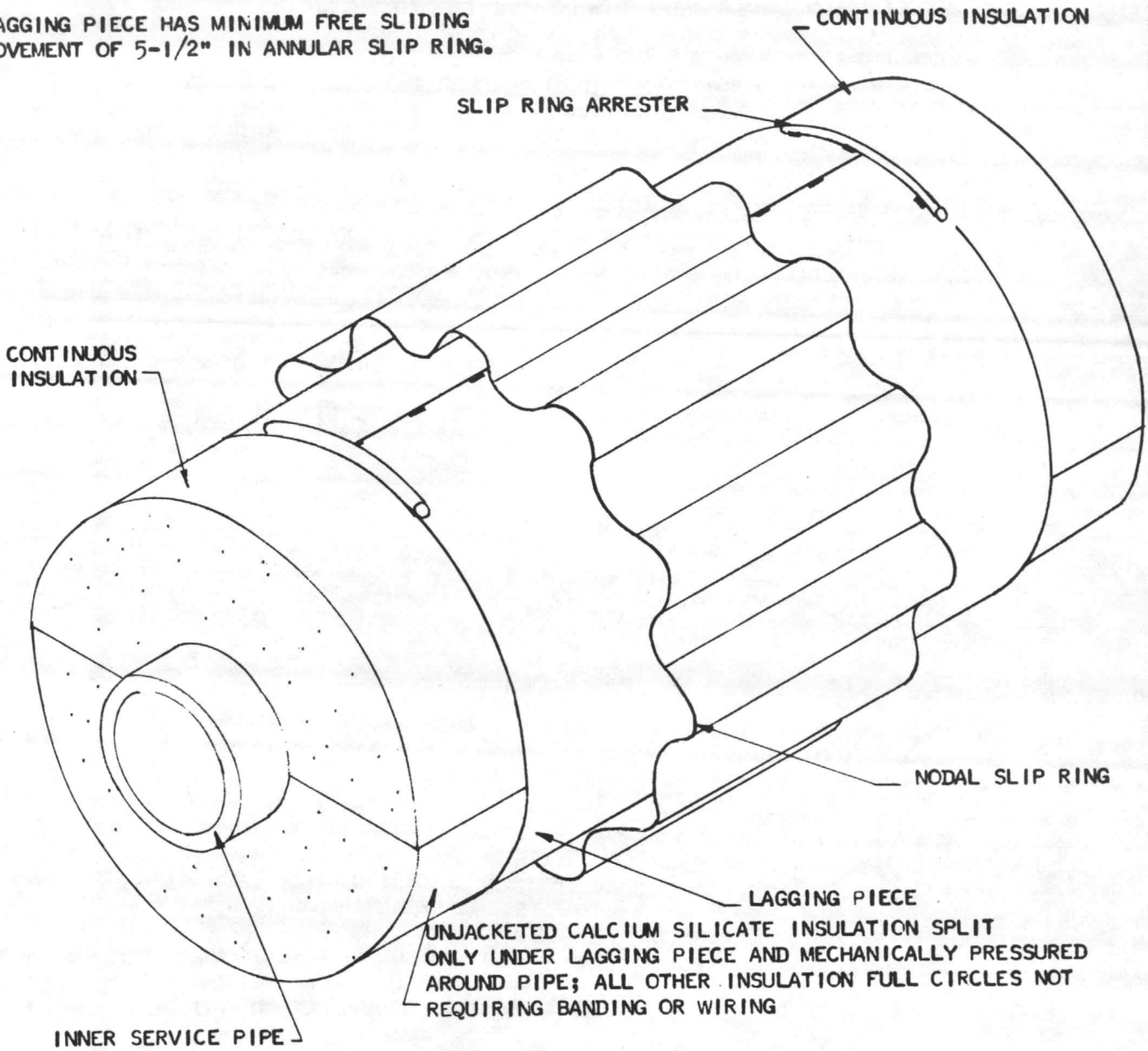
ARCH.
HT'G. CONT'R.

SPACER DETAILS

DATE	BY	No. MP-90

INNER PIPE IS ISOLATED THERMALLY AND ELECTRICALLY FROM OUTER CASING BY THICKNESS OF INSULATION.

LAGGING PIECE HAS MINIMUM FREE SLIDING MOVEMENT OF 5-1/2" IN ANNULAR SLIP RING.



SLIP RING SUPPORTS LAGGING PIECE FOR LOWER 180°
SLIP RING RESTS AGAINST CASING FOR LOWER 180°
SLIP RING DOES NOT MOVE INSIDE AFTER INSERTION

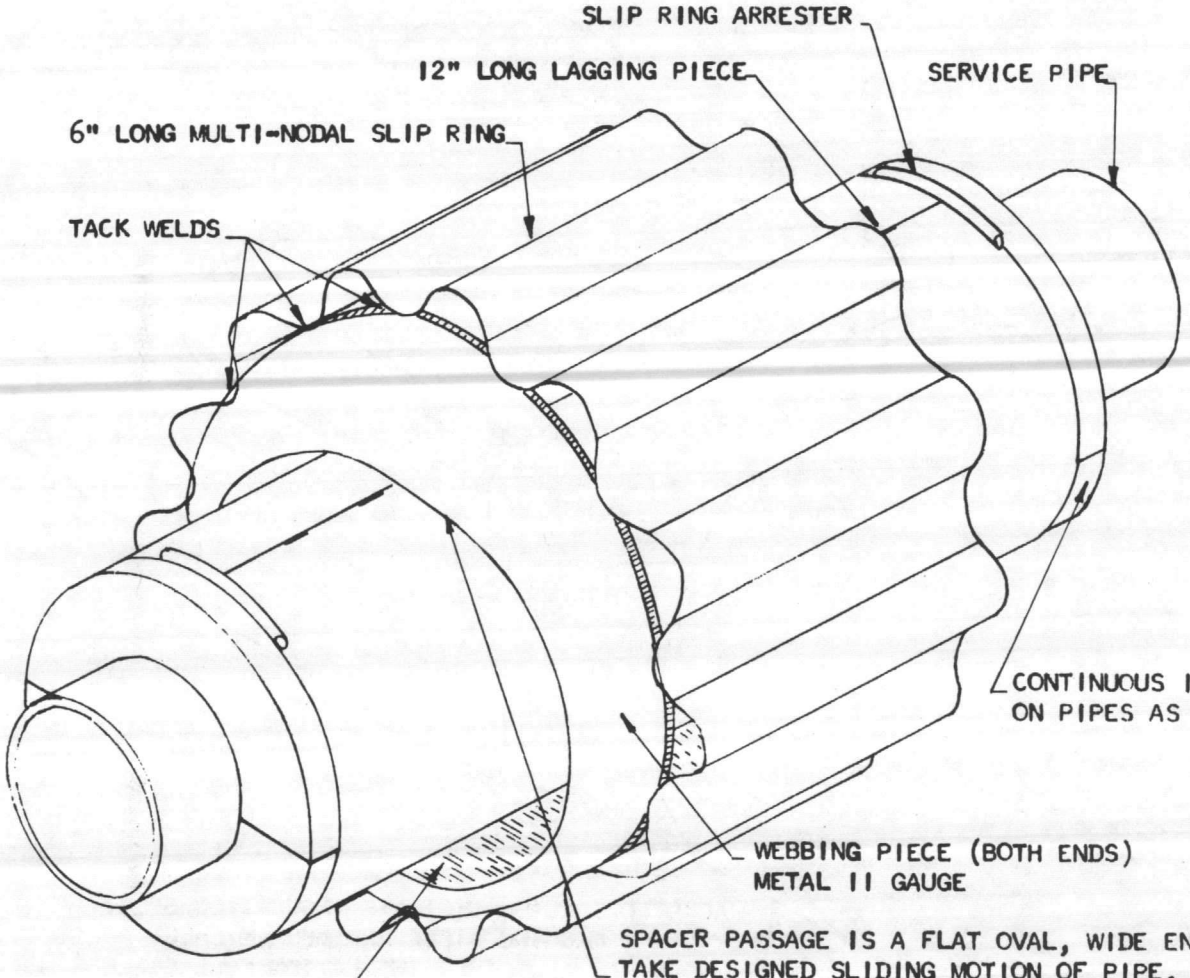
SLIP RING 14 GAUGE ON SERVICE PIPES 8" & ABOVE
SLIP RING 16 GAUGE ON SERVICE PIPES 6" & BELOW
LAGGING 18 GAUGE METAL ON SERVICE PIPES 3" & BELOW
LAGGING 16 GAUGE METAL ON SERVICE PIPES 3-1/2" & ABOVE
WHERE EXPANSION EXCEEDS 5-1/2", LAGGING WILL BE MADE LONGER

PERMANENT PIPING SYSTEMS DIVISION MIDWESCO ENTERPRISE INC.		
1650 NORTH ELSTON AVENUE CHICAGO 22, ILLINOIS		
ARCH.		
HT'G. CONT'R.		
SPACER DETAILS		
DATE	BY	No. MP-91

NOTE: INSULATED PIPE AND INTEGRAL LAGGING MOVE AS A UNIT.

LAGGING MOVES BACK AND FORTH ON LOAD CARRYING SUPPORT.

LAGGING PIECE WELDED TIGHTLY AROUND INSULATION.
SLIP RING RESTS AGAINST CASING FOR LOWER 180°.
SLIP RING DOES NOT MOVE INSIDE AFTER INSERTION.



NOTE: THIS CONSTRUCTION TYPICAL FOR SPACERS USED IN EXPANSION LOOPS AND ELBOWS AND CAN BE ALTERED TO CONTAIN ANY NUMBER OF PIPES.

INSULATION SHALL BE HHI-523 CLASS II UNJACKETED CALCIUM SILICATE.

INNER PIPE IS ISOLATED THERMALLY AND ELECTRICALLY FROM OUTER CASING BY THICKNESS OF INSULATION. WHERE EXPANSION EXCEEDS 5-1/2", LAGGING WILL BE MADE LONGER.

PERMANENT PIPING SYSTEMS DIVISION
MIDWESCO ENTERPRISE INC.
1650 NORTH ELSTON AVENUE
CHICAGO 22, ILLINOIS

ARCH.

HT'G. CONT'R.

OVAL SPACER DETAILS

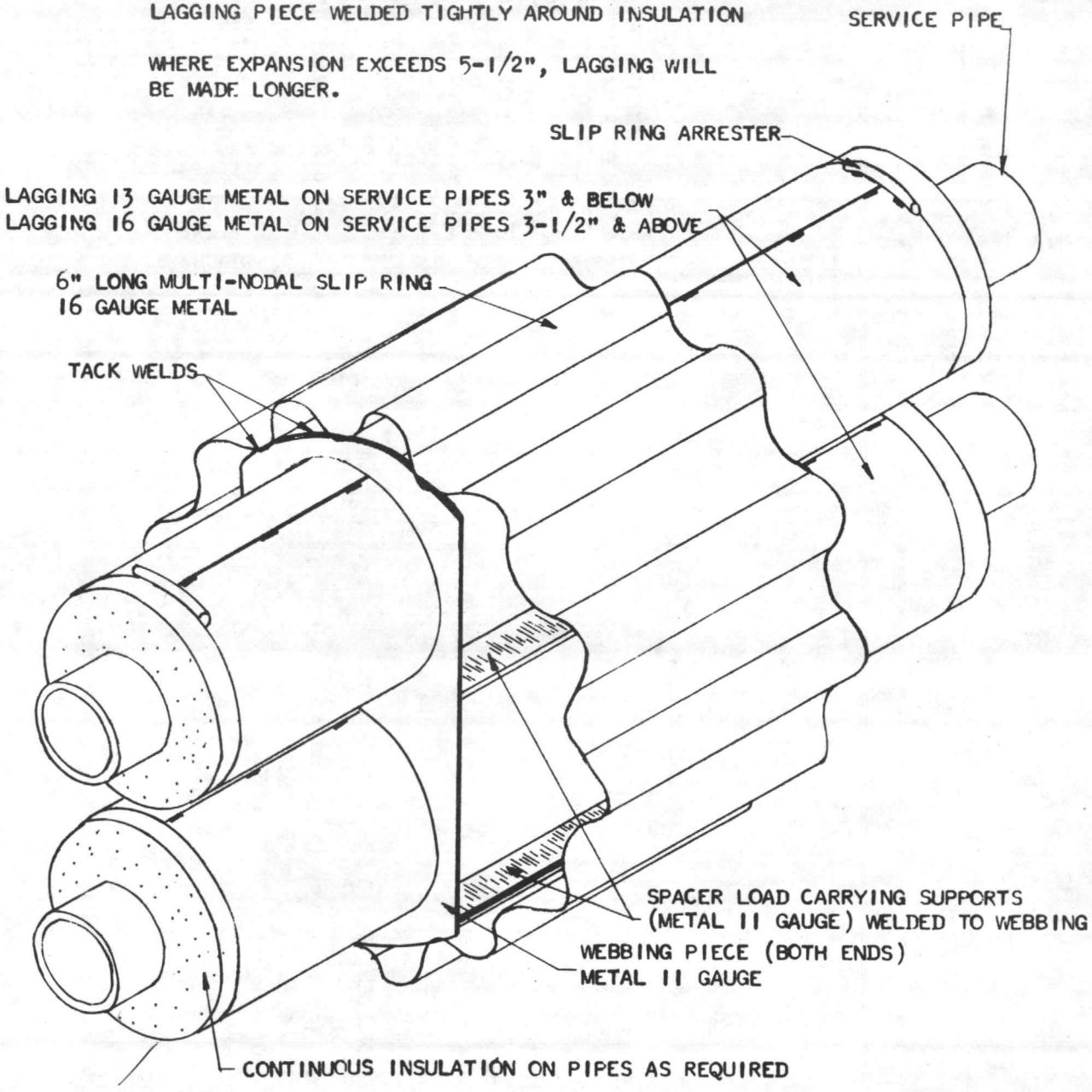
DATE	BY	No. MP-92AF

NOTE: INSULATED PIPE AND INTEGRAL LAGGING MOVE AS A UNIT.

LAGGING MOVES BACK AND FORTH ON LOAD CARRYING SUPPORT.

LAGGING PIECE WELDED TIGHTLY AROUND INSULATION

WHERE EXPANSION EXCEEDS 5-1/2", LAGGING WILL BE MADE LONGER.



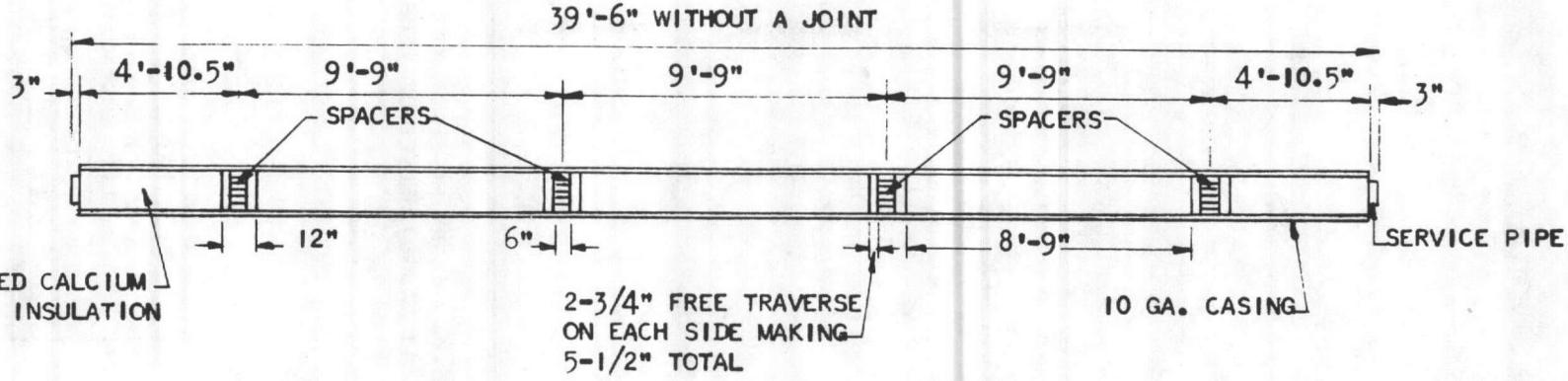
NOTE: THIS CONSTRUCTION TYPICAL FOR MULTI-PIPE SUPPORTS AND CAN BE ALTERED TO CONTAIN ANY NUMBER OF PIPES.

INSULATION SHALL BE HHI-523 CLASS II UNJACKETED CALCIUM SILICATE

SLIP RING RESTS AGAINST CASING FOR LOWER 180° SLIP RING DOES NOT MOVE INSIDE AFTER INSERTION

MULTI-PIPE INSTALLATIONS MAY BE USED FOR HOT WATER SYSTEMS OR FOR STEAM AND CONDENSATE LINES 2" AND SMALLER

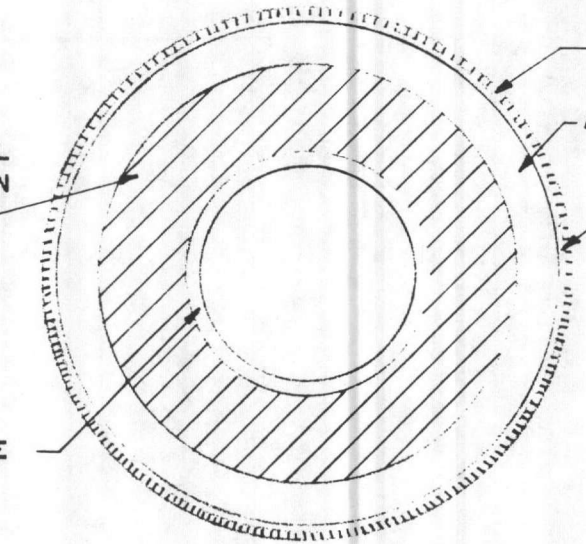
PERMANENT PIPING SYSTEMS DIVISION MIDWESCO ENTERPRISE INC.		
1650 NORTH ELSTON AVENUE CHICAGO 22, ILLINOIS		
ARCH.		
HT'G. CONT'R.		
MULTI-PIPE SPACER		
DATE	BY	No. MP-93



NORMAL STANDARD LENGTH

NOTE: FOR SPACER DETAILS SEE DWG. NOS. MP-90 & 91

SPIRAL WELDED CASING	
GAUGE	AVAILABLE DIA.
10	6" TO 20"
6	22" TO 26"
4	28" AND ABOVE



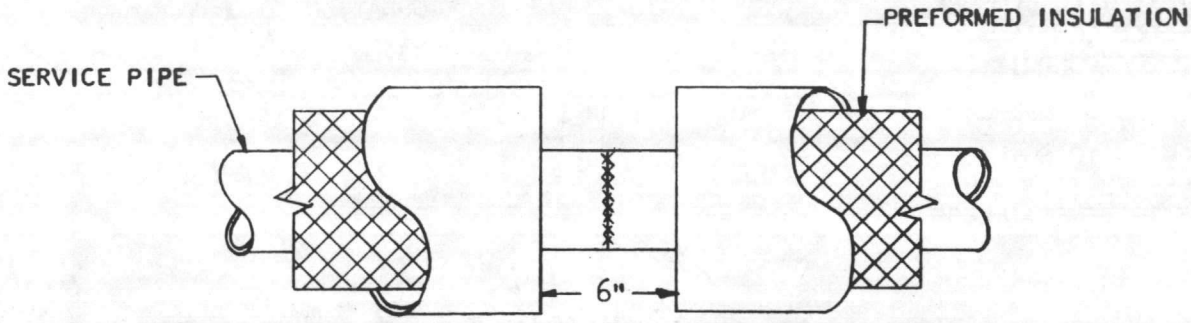
CROSS SECTION OF STANDARD LENGTH

PERMANENT PIPING SYSTEMS DIVISION
MIDWESCO ENTERPRISE INC.
1650 NORTH ELSTON AVENUE
CHICAGO 22, ILLINOIS

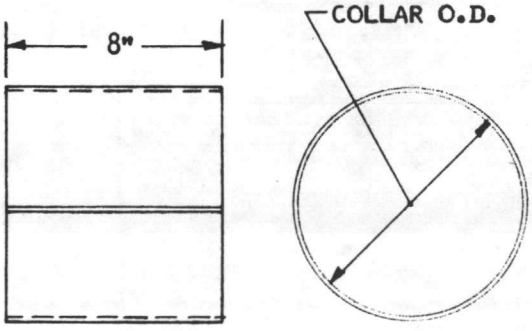
ARCH.
HTG. CONTR.

STRAIGHT CONDUIT

DATE | BY | No. MP-75AF

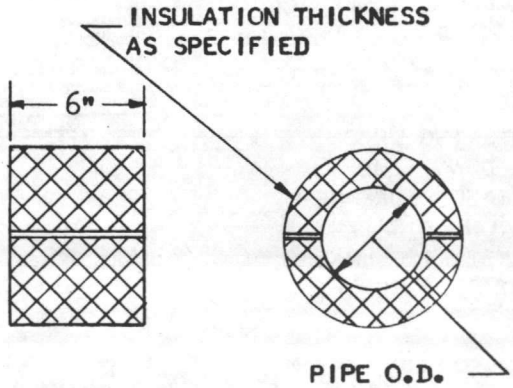


FIELD SETTING OF CONDUIT



10 GAUGE STEEL

CONDUIT CLOSURE SLEEVE



CLOSURE INSULATION PIECE
BAND WITH 32 GAUGE, 1/2"
WIDE, STAINLESS STEEL BAND

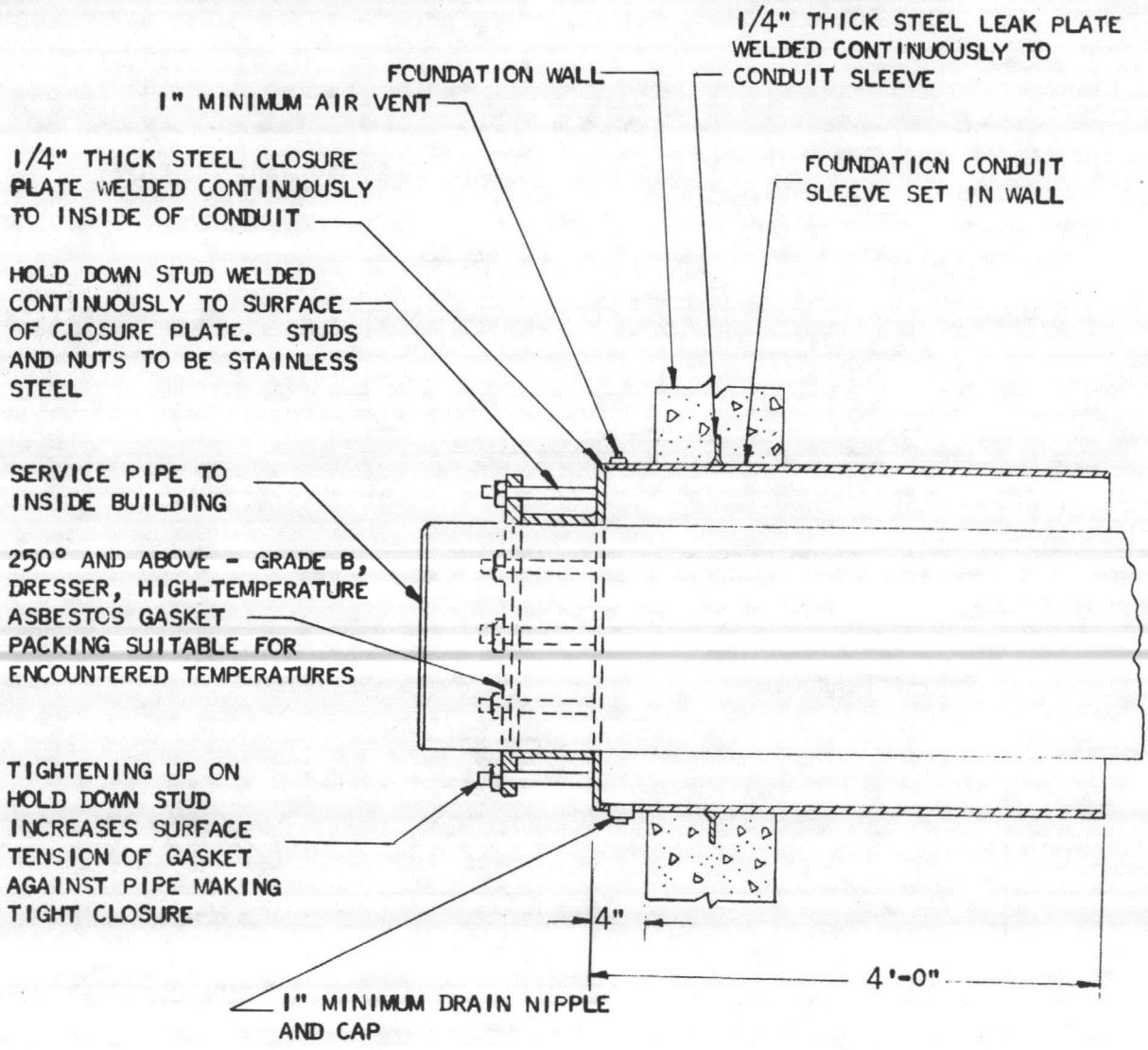
FIELD JOINT COATING
ONE LAYER ROSKOTE 612XM MASTIC
ONE TENSION WRAP INSULTAPE
FINAL COAT ROSKOTE 612XM MASTIC
TOTAL THICKNESS 1/8"

PERMANENT PIPING SYSTEMS DIVISION
MIDWESCO ENTERPRISE INC.
1650 NORTH ELSTON AVENUE
CHICAGO 22, ILLINOIS

ARCH.
HT'G. CONT'R.

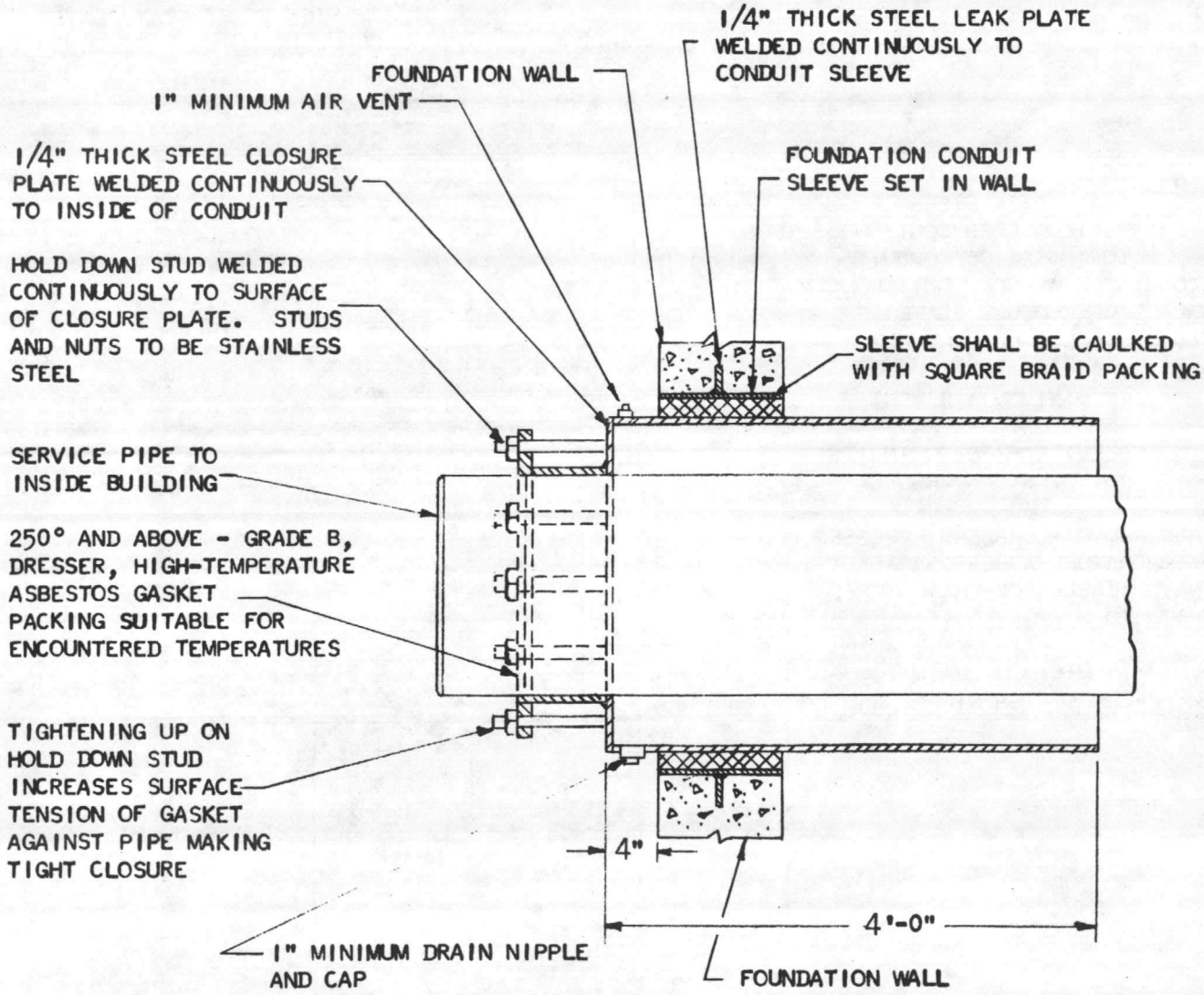
FIELD CLOSURE KIT

DATE	BY	No. MP-19



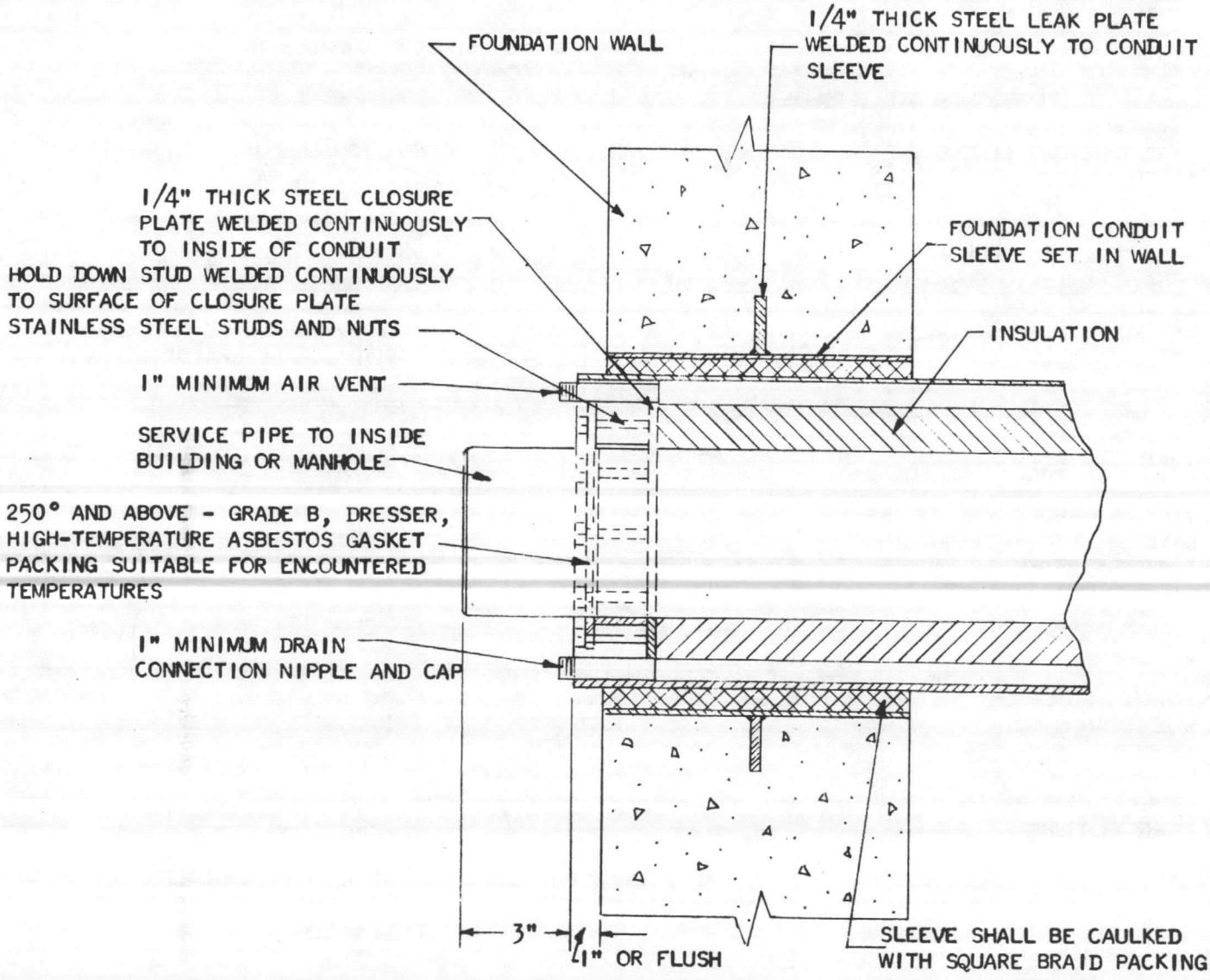
NOTE: CASING PORTION CAN BE SHIPPED IN ADVANCE FOR ENCASEMENT INTO CEMENT CASTINGS TO ELIMINATE BOXING OUT FOR LATER MOUNTING.

PERMANENT PIPING SYSTEMS DIVISION MIDWESCO ENTERPRISE INC.		
1650 NORTH ELSTON AVENUE CHICAGO 22, ILLINOIS		
ARCH.		
HT'G. CONT'R.		
GLAND SEAL		
DATE	BY	No. MP-102AF



NOTE: CASING PORTION CAN BE SHIPPED IN ADVANCE FOR ENCASEMENT INTO CEMENT CASTINGS TO ELIMINATE BOXING OUT FOR LATER MOUNTING.

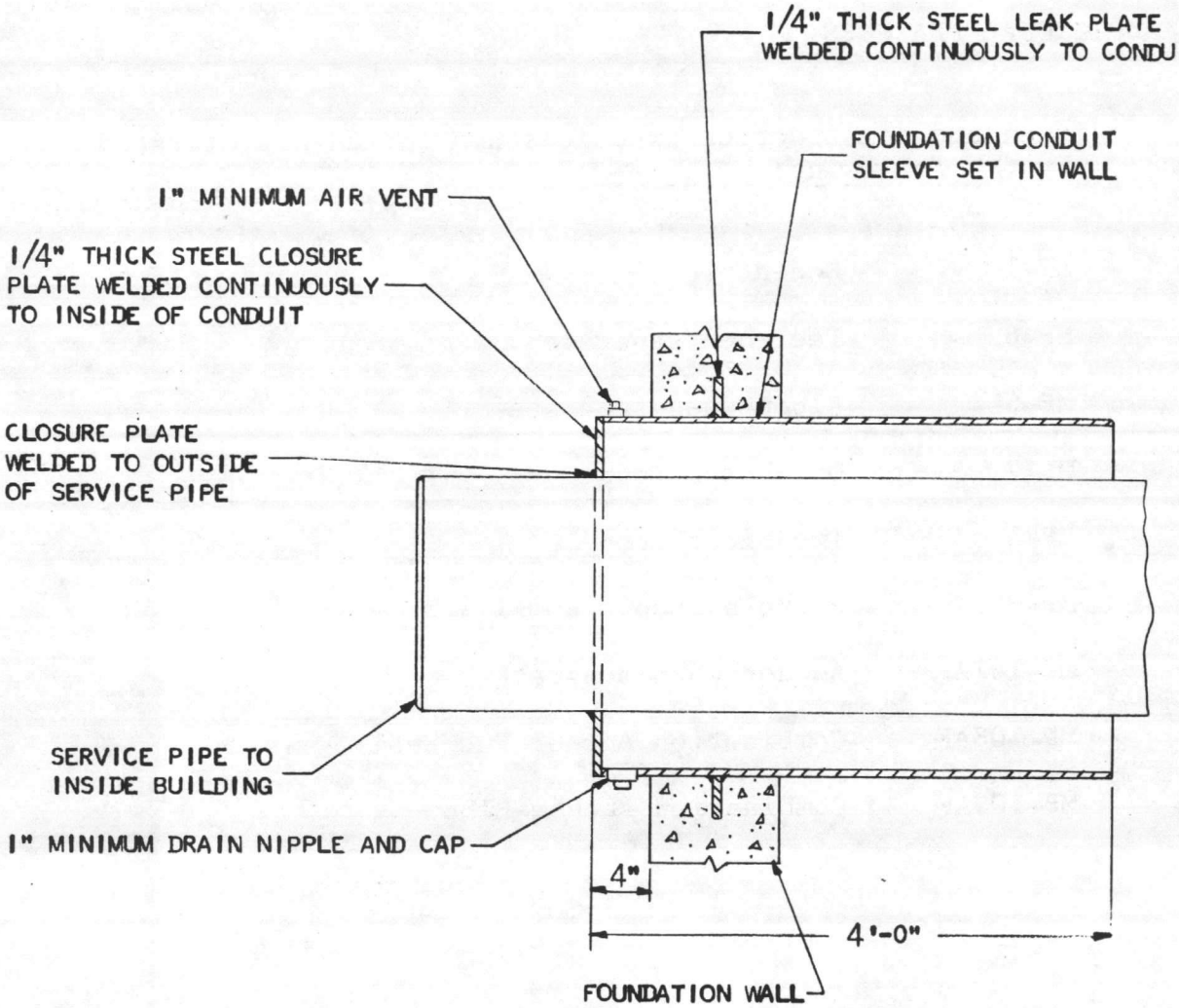
PERMANENT PIPING SYSTEMS DIVISION MIDWESCO ENTERPRISE INC.		
1650 NORTH ELSTON AVENUE CHICAGO 22, ILLINOIS		
ARCH.		
HT'G. CONT'R.		
GLAND SEAL		
DATE	BY	No. MP-110AF



NOTE: THIS TYPE OF CONSTRUCTION EMPLOYED WHEN SPACE IS AT A PREMIUM.

THIS TYPE OF GLAND SEAL RECOMMENDED FOR USE WITH H.T.H.W., H.P. STEAM OR WHEN ANY SERVICE PIPE IS NOT INSULATED. SPECIAL PROVISION HAS BEEN MADE FOR INDEPENDENT THERMAL EXPANSION OF SERVICE PIPE AS WELL AS CASING.

PERMANENT PIPING SYSTEMS DIVISION MIDWESCO ENTERPRISE INC.		
1650 NORTH ELSTON AVENUE CHICAGO 22, ILLINOIS		
ARCH.		
HT'G. CONT'R.		
RECESSED GLAND SEAL		
DATE	BY	No. MP-102AF



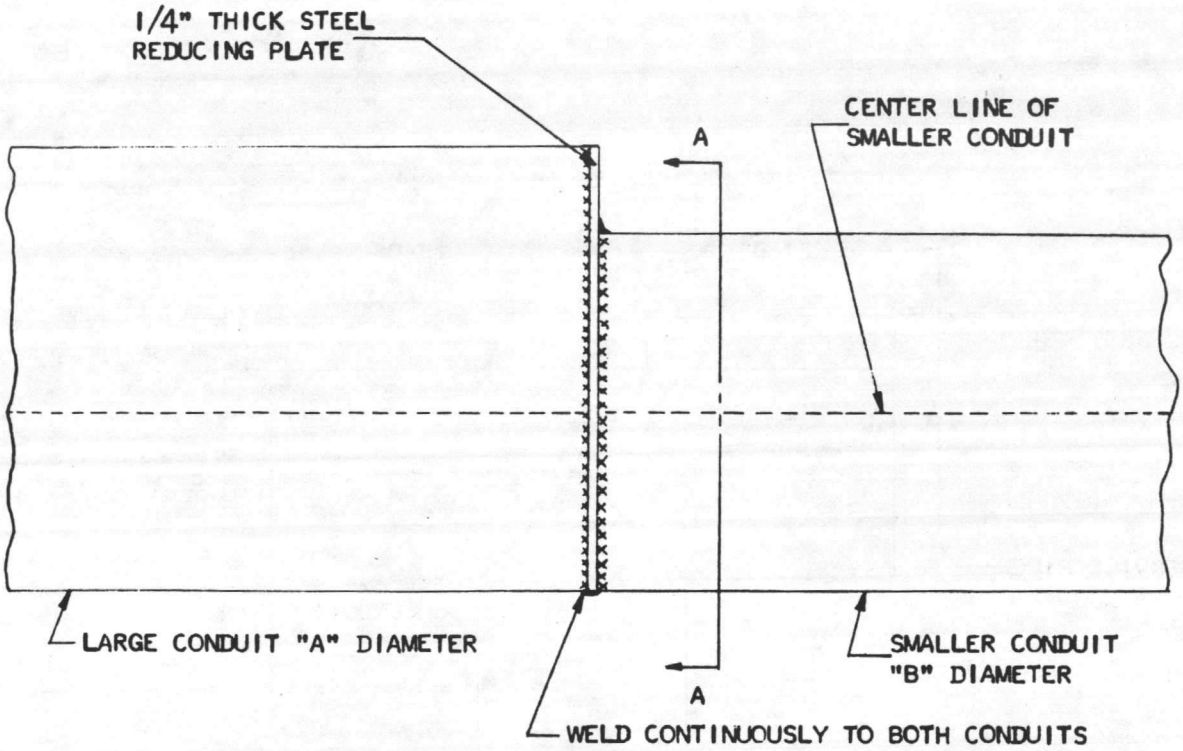
NOTE: CASING PORTION CAN BE SHIPPED IN ADVANCE FOR ENCASEMENT INTO CEMENT CASTINGS TO ELIMINATE BOXING OUT FOR LATER MOUNTING.

PERMANENT PIPING SYSTEMS DIVISION MIDWESCO ENTERPRISE INC.		
1650 NORTH ELSTON AVENUE CHICAGO 22, ILLINOIS		
ARCH.		
HT'G. CONT'R.		
END SEAL		
DATE	BY	No. MP-105AF

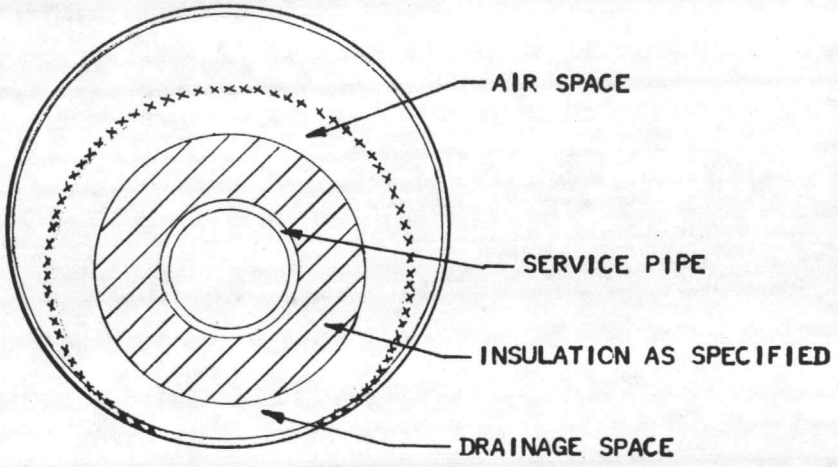
ADDITIONAL FEATURES

Standard construction practices are further illustrated by the following:

MP-10	Eccentric
MP-6	Tee when separate
MP-5	Elbow when separate
MP-2	One Piece Loop
MP-3	Two Piece Loop
MP-4	Hairpin Loop
MP-107AF	Anchor when separate
MP-108AF	Combination Anchor End Seal
MP-109AF	Combination Anchor-Elbow



NOTE: DRAINAGE SPACE REMAINS LEVEL DESPITE CONDUIT DIAMETER CHANGES



SECTION A-A

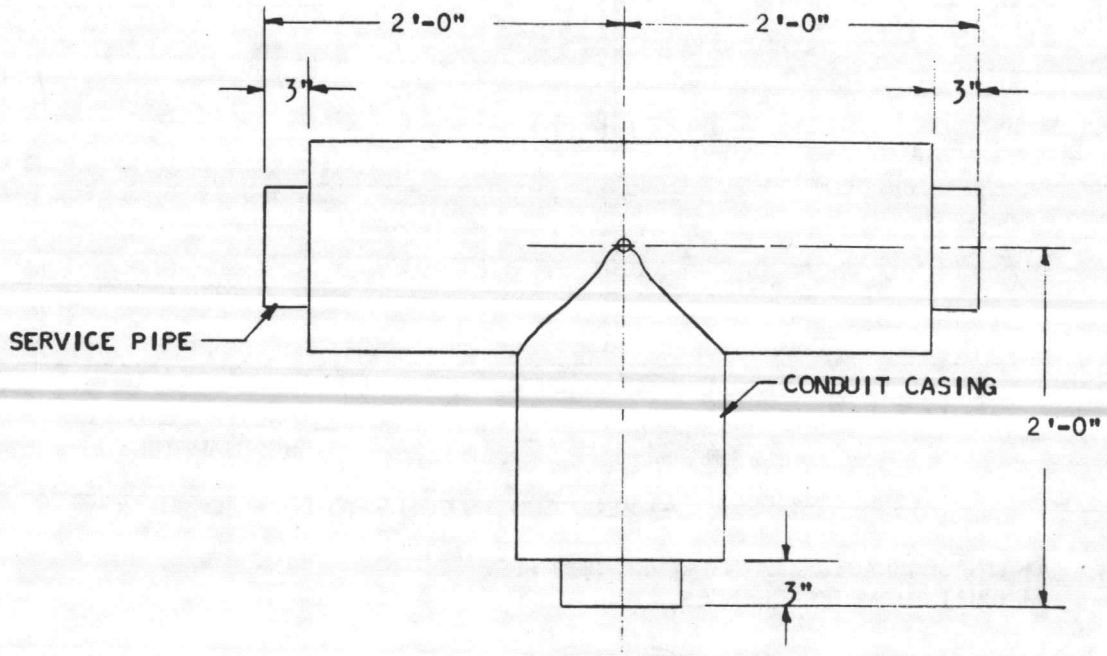
DIMENSIONS	REMARKS
A	
B	

PERMANENT PIPING SYSTEMS DIVISION
MIDWESCO ENTERPRISE INC.
1650 NORTH ELSTON AVENUE
CHICAGO 22, ILLINOIS

ARCH.
HT'G. CONT'R.

EXAMPLE OF CONDUIT ECCENTRIC OR CHANGE OF CONDUIT DIAMETERS

DATE | BY | No. MP-10



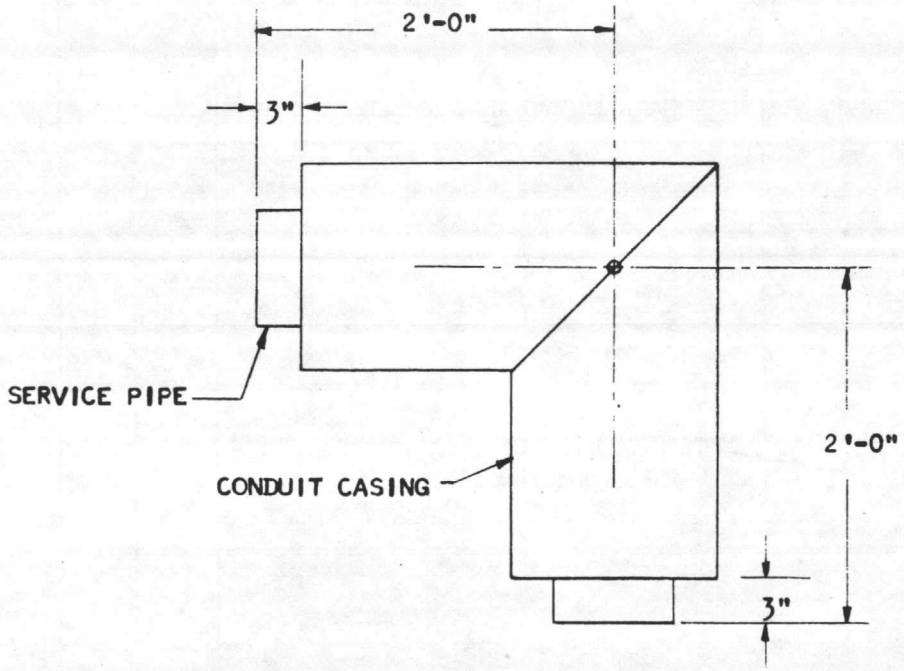
PERMANENT PIPING SYSTEMS DIVISION
MIDWESCO ENTERPRISE INC.
1650 NORTH ELSTON AVENUE
CHICAGO 22, ILLINOIS

ARCH.

HT'G. CONT'R.

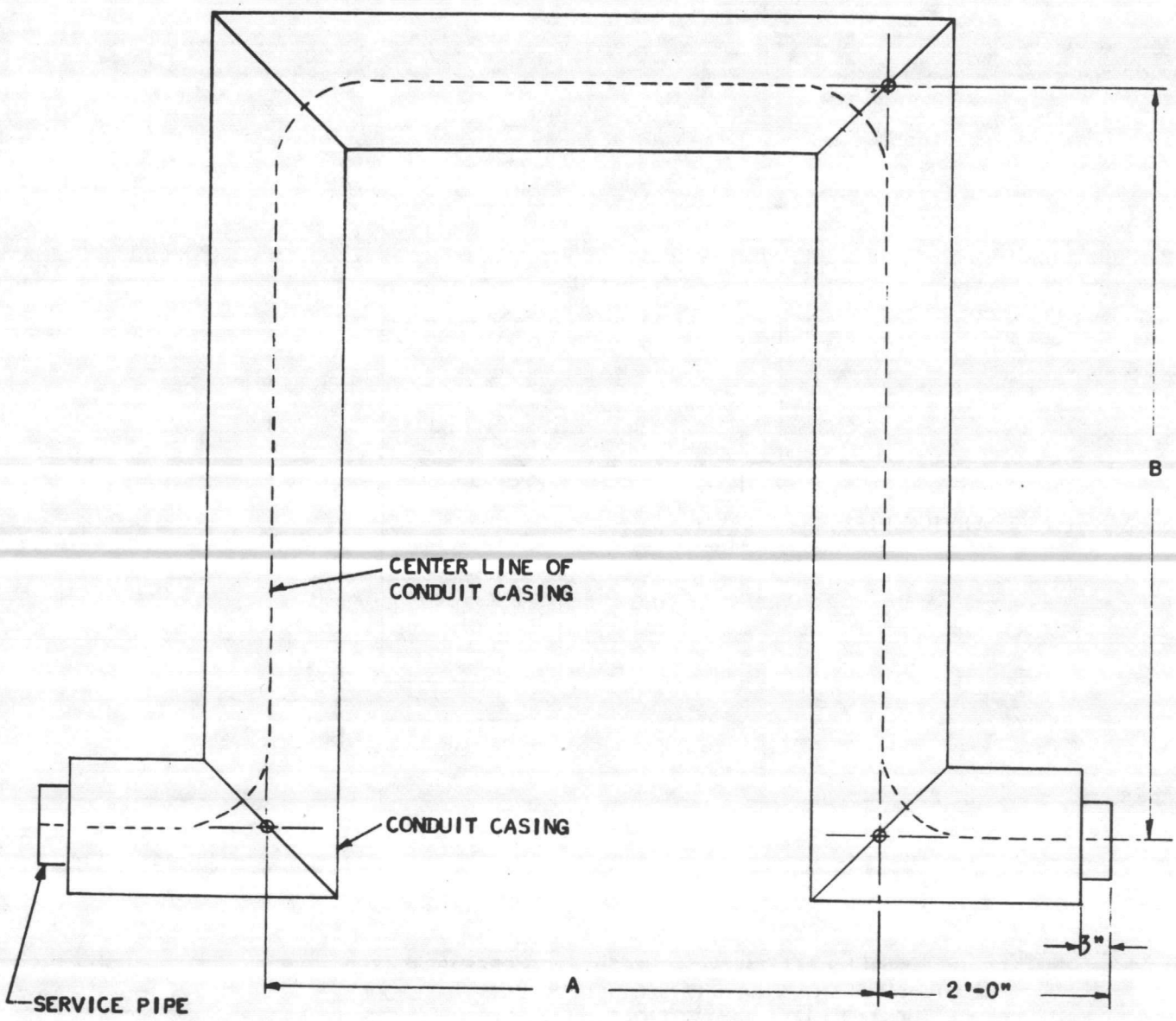
STANDARD TEE

DATE	BY	No. MP-6



NOTE: IF POSSIBLE, ELBOW WILL BE SHIPPED PREFABRICATED ONTO ADJACENT STRAIGHT SECTION TO ELIMINATE ONE OF THE TWO FIELD CONNECTIONS.

PERMANENT PIPING SYSTEMS DIVISION MIDWESCO ENTERPRISE INC.		
1650 NORTH ELSTON AVENUE CHICAGO 22, ILLINOIS		
ARCH.		
HT'G. CONT'R.		
STANDARD ELBOW		
DATE	BY	No. MP-5



DIMENSIONS		REMARKS
A		
B		
SERVICE PIPE TEMPERATURE		
AMOUNT OF COLD SPRING REQUIRED		
EXPANSION PROVIDED FOR		

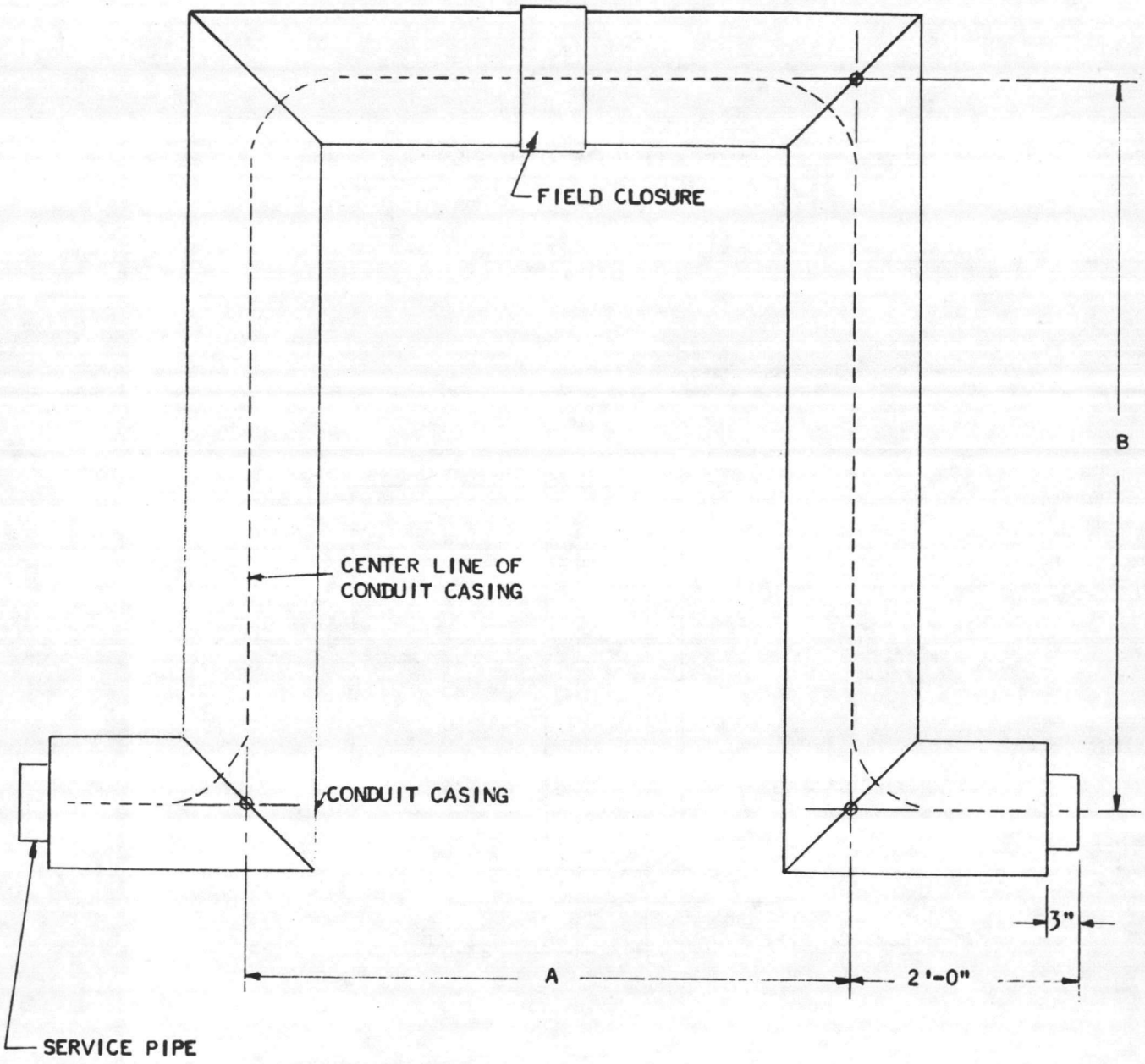
PERMANENT PIPING SYSTEMS DIVISION
MIDWESCO ENTERPRISE INC.
1650 NORTH ELSTON AVENUE
CHICAGO 22, ILLINOIS

ARCH.

HT'G. CONT'R.

FACTORY PREFABRICATED
ONE PIECE EXPANSION LOOP
MODEL 1-PL

DATE	BY	No. MP-2



DIMENSIONS	REMARKS
A	
B	
SERVICE PIPE TEMPERATURE	
AMOUNT OF COLD SPRING REQUIRED	
EXPANSION PROVIDED FOR	

PERMANENT PIPING SYSTEMS DIVISION
MIDWESCO ENTERPRISE INC.
1650 NORTH ELSTON AVENUE
CHICAGO 22, ILLINOIS

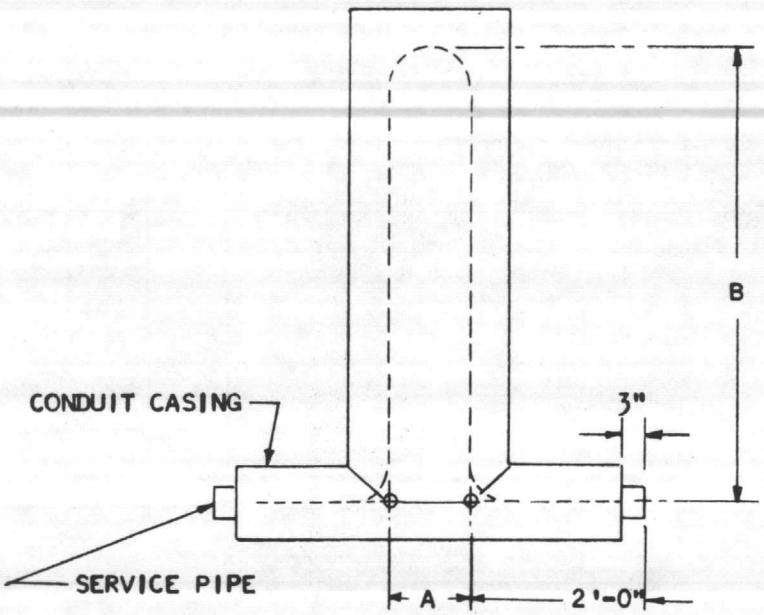
ARCH.

HT'G. CONT'R.

FACTORY PREFABRICATED
TWO PIECE EXPANSION LOOP
MODEL 2-PL

DATE	BY	No MP-3

NOTE: THIS CONSTRUCTION EMPLOYED WHEN SPACE IS AT A PREMIUM AND PIPE SIZE PERMITS.



DIMENSIONS	REMARKS
A	
B	
SERVICE PIPE TEMPERATURE	
AMOUNT OF COLD SPRING REQUIRED	
EXPANSION PROVIDED FOR	

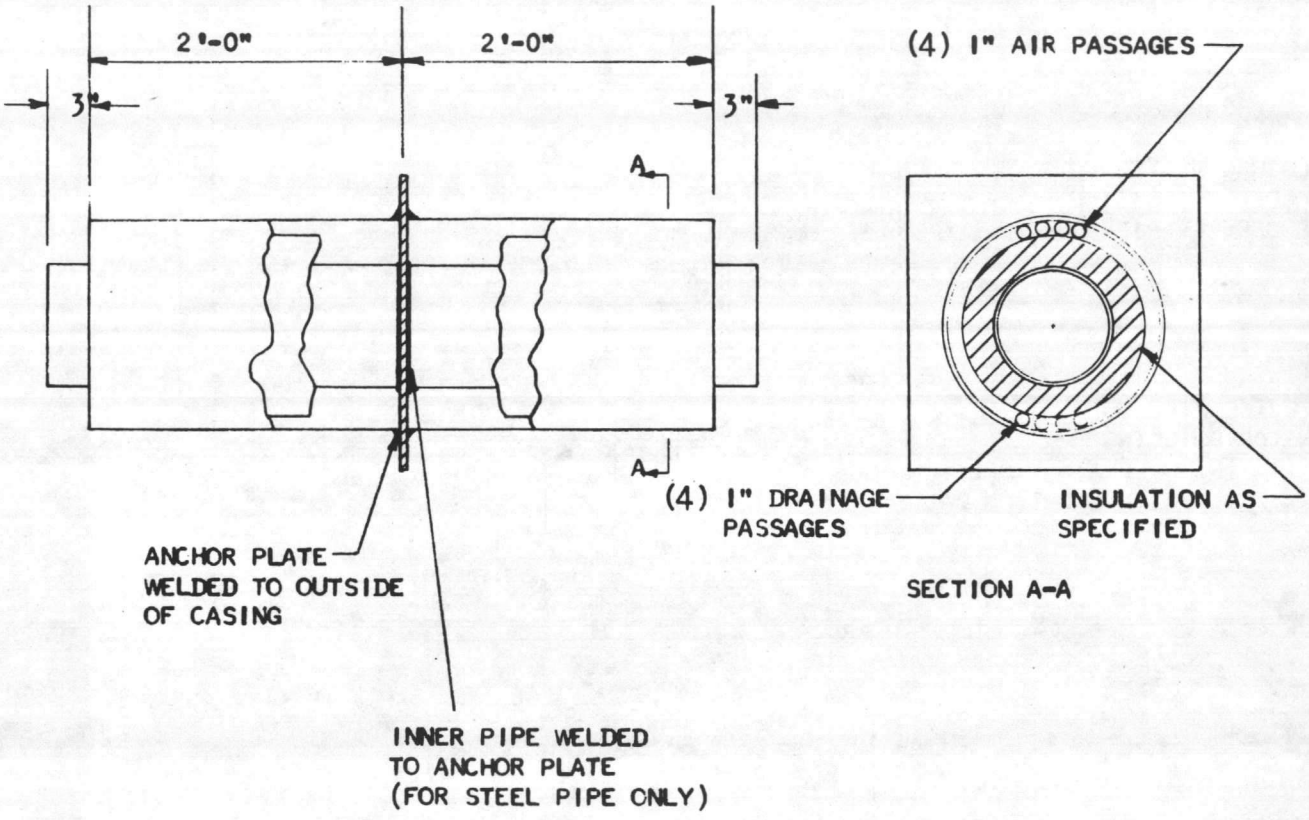
PERMANENT PIPING SYSTEMS DIVISION
MIDWESCO ENTERPRISE INC.
1650 NORTH ELSTON AVENUE
CHICAGO 22, ILLINOIS

ARCH.

HT'G. CONT'R.

FACTORY PREFABRICATED
1-PIECE HAIRPIN EXPANSION LOOP
MODEL 1-PHL

DATE	BY	No. MP-4



CONDUIT SIZE	6	8	10	12	14	16	18	20	22	24
DIMENSION OF SQUARE ANCHOR	12" X 12"	14" X 14"	16" X 16"	18" X 18"	20" X 20"	22" X 22"	24" X 24"	26" X 26"	28" X 28"	30" X 30"

ALL ANCHORS TO BE OF 1/2" THICK STEEL FOR CONDUITS UP TO 20" DIAMETER, ABOVE 20" TO BE 3/4" THICK, WITH AIR AND DRAINAGE PASSAGES CUT AWAY BETWEEN INNER PIPE OR PIPES AND CONDUIT CASING INNER WALL.
ALL ANCHORS TO BE ENCASED IN CONCRETE AFTER CONNECTION TO BOTH ADJACENT CONDUIT SECTIONS WITH CONCRETE BLOCK 32" LONG AND 10" ON EACH SIDE OF THE ANCHOR PLATE OUTER EDGE.

IF POSSIBLE, ANCHOR WILL BE SHIPPED PREFABRICATED ONTO ADJACENT CONDUIT SECTION TO ELIMINATE ONE OR BOTH OF THE TWO FIELD CONNECTIONS.

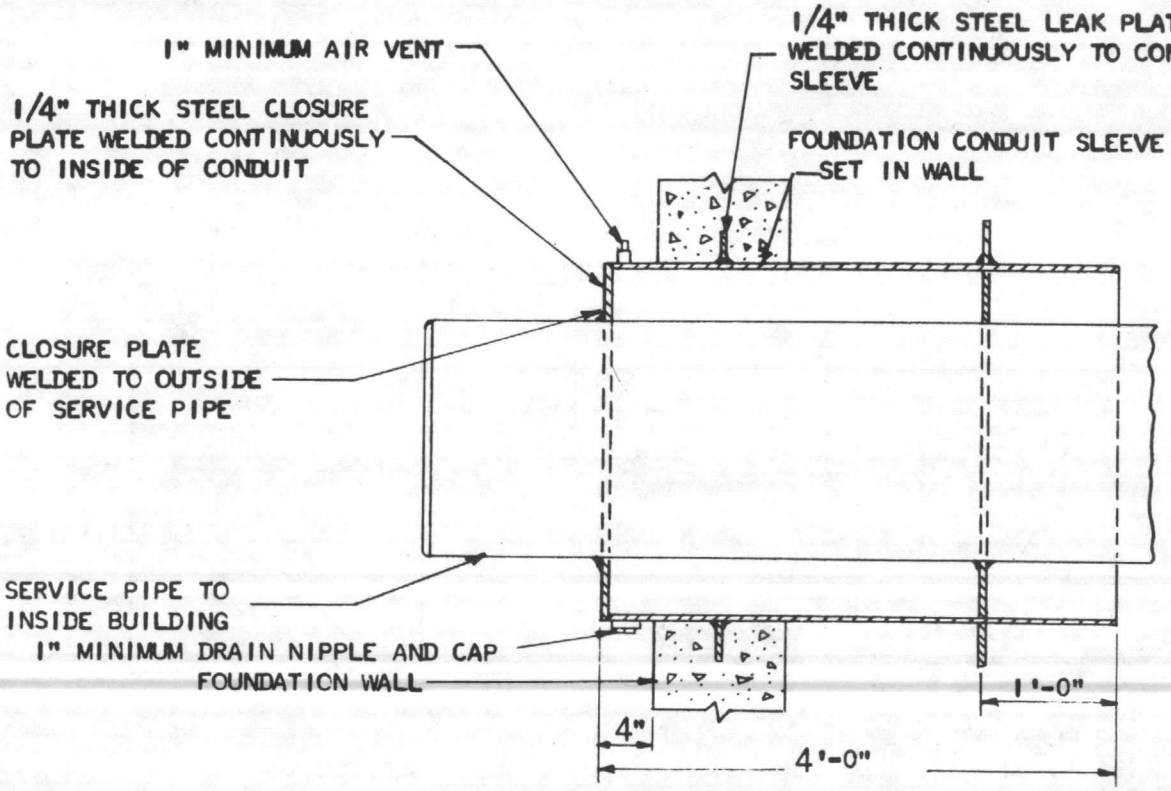
PERMANENT PIPING SYSTEMS DIVISION
MIDWESCO ENTERPRISE INC.
1650 NORTH ELSTON AVENUE
CHICAGO 22, ILLINOIS

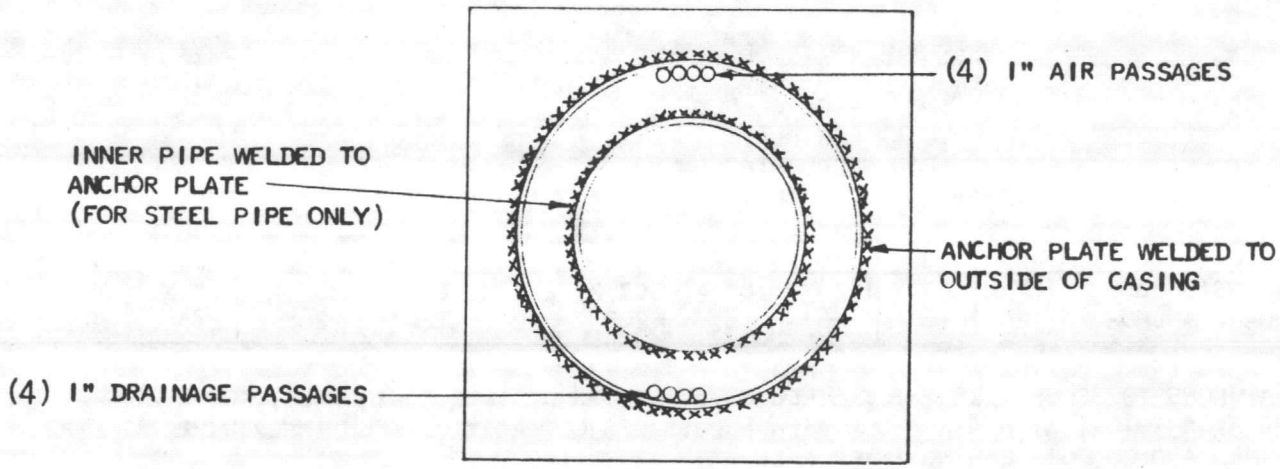
ARCH.

HT'G. CONT'R.

STANDARD ANCHOR

DATE | BY | No. MP-107AF





CONDUIT SIZE	6	8	10	12	14	16	18	20	22	24
DIMENSION OF SQUARE ANCHOR	12" X 12"	14" X 14"	16" X 16"	18" X 18"	20" X 20"	22" X 22"	24" X 24"	26" X 26"	28" X 28"	30" X 30"

ALL ANCHORS TO BE 1/2" THICK STEEL FOR CONDUITS UP TO 20" DIAMETER, ABOVE 20" TO BE 3/4" THICK, WITH AIR AND DRAINAGE PASSAGES CUT AWAY BETWEEN INNER PIPE OR PIPES AND CONDUIT CASING INNER WALL.
ALL ANCHORS TO BE ENCASED IN CONCRETE AFTER CONNECTIONS TO BOTH ADJACENT CONDUIT SECTIONS WITH CONCRETE BLOCK 32" LONG AND 10" ON EACH SIDE OF THE ANCHOR PLATE OUTER EDGE.

IF POSSIBLE, FITTING WILL BE SHIPPED PREFABRICATED ONTO ADJACENT CONDUIT SECTION TO ELIMINATE ONE FIELD JOINT.

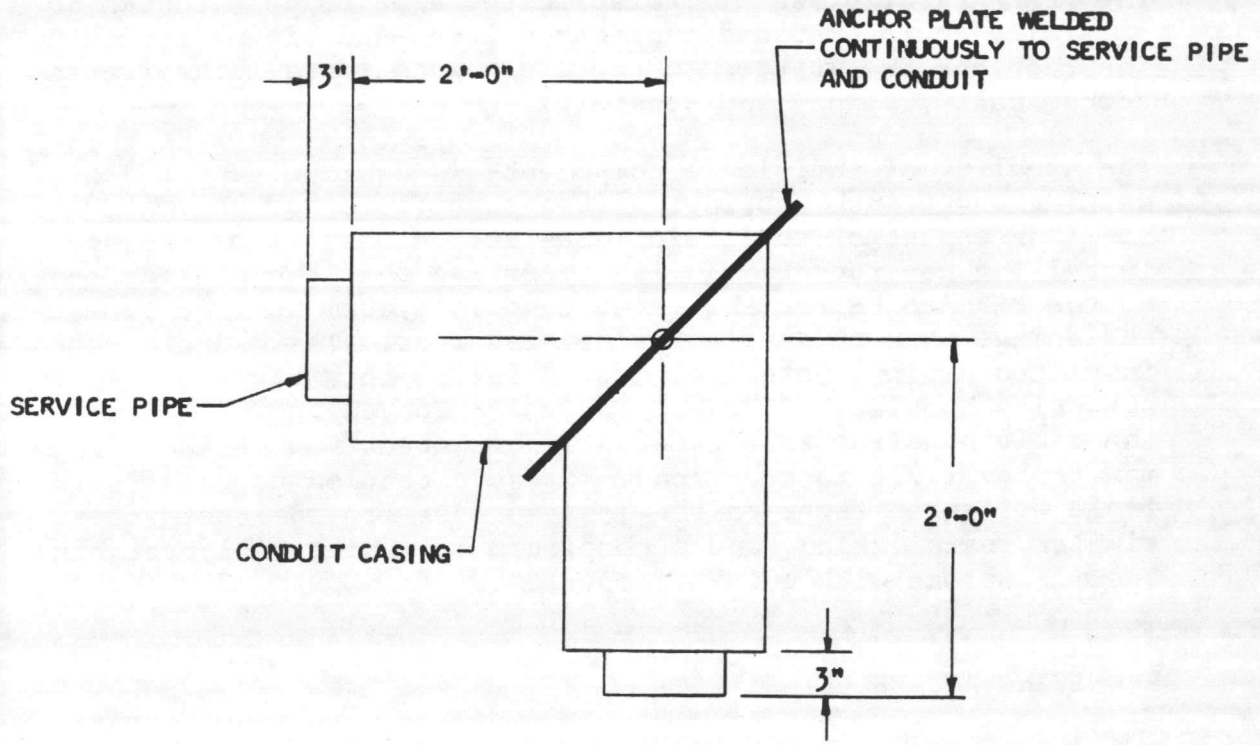
PERMANENT PIPING SYSTEMS DIVISION
MIDWESCO ENTERPRISE INC.
1650 NORTH ELSTON AVENUE
CHICAGO 22, ILLINOIS

ARCH.

HT'G. CONT'R.

COMBINATION ANCHOR AND END SEAL

DATE	BY	No. MP-108AF



CONDUIT SIZE	6	8	10	12	14	16	18	20	22	24
DIMENSION OF ANCHOR	12" X 15"	14" X 18"	16" X 21"	18" X 23"	20" X 26"	22" X 29"	24" X 32"	26" X 35"	28" X 38"	30" X 40"

ALL ANCHORS TO BE OF 1/2" THICK STEEL FOR CONDUITS UP TO 20" DIAMETER, ABOVE 20" TO BE 3/4" THICK, WITH AIR AND DRAINAGE PASSAGES CUT AWAY BETWEEN INNER PIPE OR PIPES AND CONDUIT CASING INNER WALL.

NOTE: IF POSSIBLE, ELBOW WILL BE SHIPPED PREFABRICATED ONTO ADJACENT STRAIGHT SECTION TO ELIMINATE ONE OF THE TWO FIELD CONNECTIONS.

PERMANENT PIPING SYSTEMS DIVISION
MIDWESCO ENTERPRISE INC.
1650 NORTH ELSTON AVENUE
CHICAGO 22, ILLINOIS

ARCH.

H.T'G. CONT'R.

COMBINATION ANCHOR AND ELBOW

DATE	BY	No. MP-109AF

PERMA-PIPE INSTALLATION INSTRUCTIONS

The PERMA-PIPE, Class A, Prefabricated Pipe Conduit System is a carefully engineered and fabricated insulated piping system. These instructions are written to explain how to install the system economically, simply and sensibly.

The handling of individual components is as important as the field welding and trench setting. Close supervision of the material handling aspect of the field installation must be maintained by the installing contractor. It is imperative that the outside coating of the PERMA-PIPE Prefabricated Conduit System be free from defects and damage when it is finally covered over. To insure a dependable insulated piping system, carefully follow this step-by-step instruction booklet. If questions arise concerning any aspect of the field handling and installation, contact your PERMA-PIPE Serviceman for explicit instructions. Close attention to details in the field will mean fewer on-the-job expenses for the contractor, simpler installation, and a completed job which will meet the specifications with quick approval.

RECEIVING AND CHECKING

The PERMA-PIPE components are shipped with protective coverings over all open ends and are carefully braced to prevent damage during shipment. Care should be taken to note all damage on the freight company's receipt. Notify the PERMA-PIPE DIVISION, 1650 N. Elston Avenue, Chicago 22, Illinois, for replacement components needed for the order. Damages or shortages reported to PERMA-PIPE but not noted on the freighter's receipt cannot be claimed. Therefore, it is extremely important to check the condition of the system as it is unloaded. The filing of any claim for shortage or damage is the receiver's responsibility.

UNLOADING AND STORING

On smaller systems requiring few components of small diameter, a rope can be used if braced with wood and padding to form a protective cradle (Illustration 2) around the casing. PERMA-PIPE

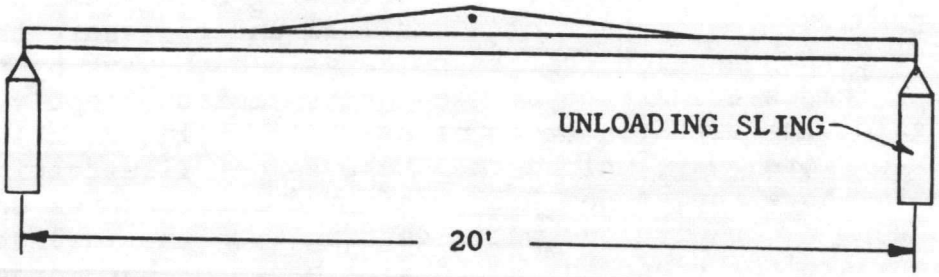
conduit sections must be handled with caution to avoid damaging the outer coating. On larger systems, or where the components are heavy, use a field piece, as per Illustration 1. The field piece is simple to build and will greatly reduce the time and cost of moving the conduit components. The unloading slings can be loaned by PERMA-PIPE on deposit of a small amount to assure their safe return - transportation charges to be paid both ways by the user. If the components are to be used or assembled promptly, unload alongside the ditch in order of use. If utilization is to be a week or more away, unload and store as per Illustration 3. Keep the units above the ground and retain the end closures until ready for use to avoid dirt and water getting into the insulation. When lowering into the trenches, avoid side bangs or hard drops. It is important that the PERMA-PIPE Elephant Hide be protected by excelsior padding - shipped with the conduit - when storing for future use. The open ends of the conduit must always be protected with the PERMA-PIPE shipping seals until the sections of conduit are to be assembled together.

TRENCHING AND FILLING

See PERMA-PIPE Drawing MP-21 for dimensions of the trench for all conduit sizes. The bottom of the trench should be graded to the installed designed slope of the system. The trench should be completely de-watered in the vicinity of the open end of the conduit system. There should be a packed dirt base 4" thick under the conduit without any rocks or hard patches (Illustration 4). If the conduit system is to be assembled unit by unit in the ditch, dig a 3'-0" bell hole under the weld area only. Hand tamp a dirt fill into the hole after the joint is closed.

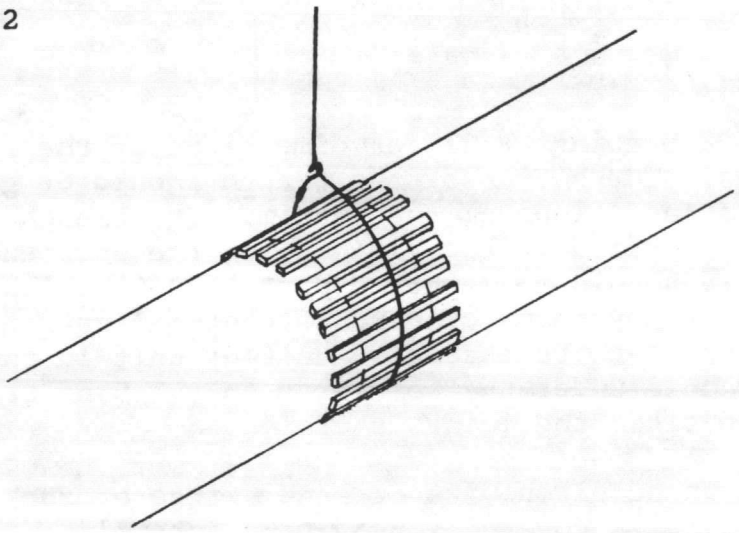
To back fill, hand pitch dirt or sand - free of rocks - around the conduit until it is covered. Hand tamp intermittently. Do not machine back fill until the conduit is covered over by hand. Do not back fill until the entire system has been tested and approved. Do not back fill with heavy wheeled or tracked moving vehicles. Care should be taken to back fill from both sides of the conduit to eliminate side pressures. Over traffic should run over the trench on cross timbered, pre-selected locations until the fill has settled.

ILLUSTRATION #1



FIELD PIECE FOR HANDLING ON LARGER JOBS

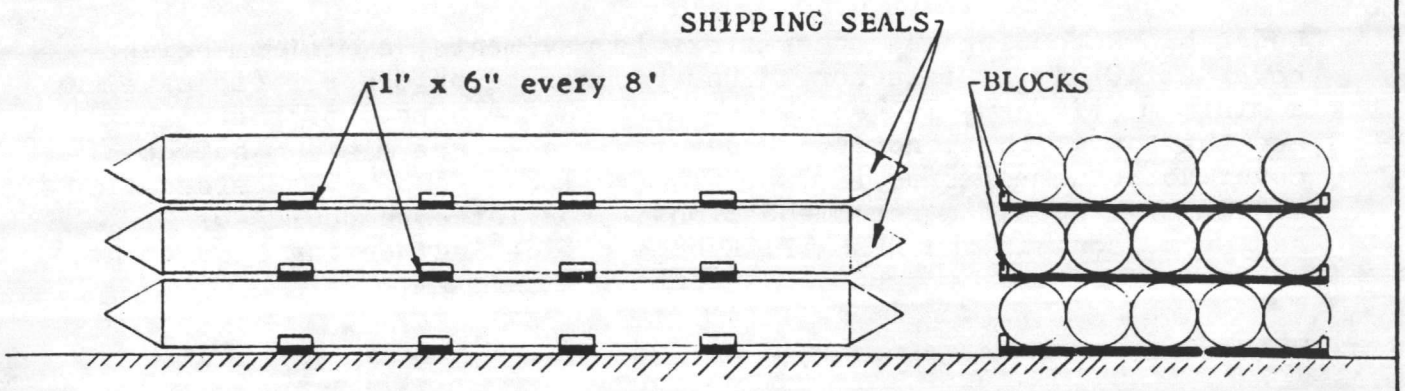
ILLUSTRATION #2



WOOD CRADLE FOR HANDLING ON SMALLER JOBS

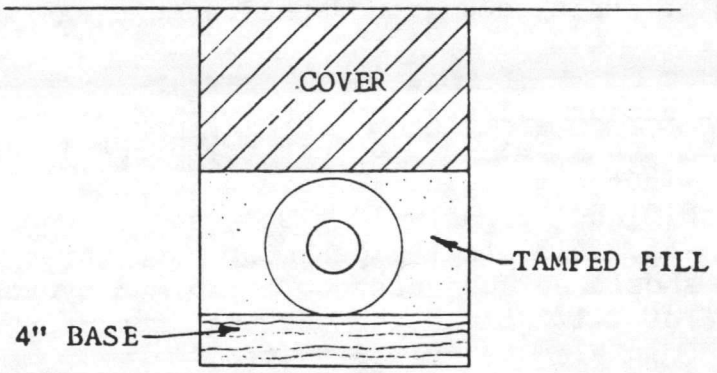
PERMANENT PIPING SYSTEMS DIVISION
1650 N. ELSTON AVE. CHICAGO 22, ILLINOIS
ARCH.
HT'G. CONT'R.
ILLUSTRATION #1 AND #2
DATE / BY / No. MP-23

ILLUSTRATION #3



STORAGE

ILLUSTRATION #4



CROSS SECTION TRENCH

PERMANENT PIPING SYSTEMS DIVISION		
1650 N. ELSTON AVE. CHICAGO 22, ILLINOIS		
ARCH.		
HT'G. CONT'R.		
ILLUSTRATION #3 AND #4		
DATE	BY	No. MP-24

Under black topping and other flexible pavements, a minimum height cover of 10" is satisfactory. Under concrete or other rigid pavement, a minimum of 4" cushion should be between the bottom of the slab and the top of the conduit. Under railroads, the minimum height of cover to bottom of ties is 20". The railroad company concerned should make specific recommendations. For larger conduits of 22" and over, consult the PERMA-PIPE home office Engineering Department.

WELDING

PERMA-PIPE Prefabricated Pipe units are usually shipped in 39'-6" jointless lengths unless design conditions warrant smaller lengths. The use of 39'-6" lengths will eliminate many field joints, thus saving costs by the contractor. Odd lengths to complete runs, loops, and other miscellaneous fittings, are shipped as necessary. Interior pipes extend 3" beyond each end of the conduit casing. (See PERMA-PIPE Drawing MP-75)

Conduit sections must be arranged so that pipe and conduit are in proper alignment before the interior pipes are welded. The closure sleeves should be positioned around the conduit casing, one sleeve for each joint.

After the field closure sleeves are positioned around the casing and the interior service lines and conduit are properly aligned, welding of the service lines can begin. To arc weld pipe, use rod equivalent to AWS-E-6010 and to gas weld pipe, use rod equivalent to AWS-GA-60 or GA-65. All steel pipes must have three pass welds. All pipe welds should be subjected to a minimum hydrostatic test of 150 P.S.I.G. or 1-1/2 times the working pressure, whichever is greater, and should also be hammer tested.

After testing, the shipping braces which hold the pipe in place during handling should be cut off. The internal service lines are then insulated with preformed, split, unjacketed calcium silicate held in place with 1/2" wide, 32 gauge, stainless steel bands.

The closure sleeve is now slipped back over the 6" gap and centered over the joint. A constant pressure is applied to the closure sleeve to squeeze it around the ends of each conduit section. The closure sleeve is now in position to be welded.

Welding of the 8" long closure sleeve piece to the conduit casing should be made downhand, single bead, using 1/8" welding rod AWS-E-6012 or E-6013. After making welds on either the pipe or the casing, wire brush both the welds and the adjacent bare metal surfaces.

It is imperative that all welding be accomplished with care and to a high degree of workmanship. The open ends of the conduit being welded must always be protected with the temporary PERMA-PIPE shipping seals until final connection is made and the system is completely sealed. Never allow water or dirt to get into the open portion of the units.

After the closure sleeve is welded, the conduit joints are then pneumatically tested at 15 P.S.I.G. Soap suds should be applied to all conduit welds to detect leaks.

When the pneumatic test is completed, all bare metal at the field joints is brushed clean of grease, oil, scale and dirt to prepare them for coating.

Each PERMA-PIPE conduit system is shipped with field joint coating material of ROSKOTE 612XM mastic and Royston Laboratories' Insultape minimum 85 mils thick. During cold weather installation, all coating material should be kept in a heated building at the job site.

First, the bare metal of the end of the conduit sections is coated with a single coat of 612XM mastic, no primer necessary. This is applied to the metal and up over the factory coating ends and is permitted to dry to a tacky state. Two lengths of 3-1/2" wide Insultape are cut to encircle this coated area without lapping. The inside of these pieces of Insultape is thoroughly coated with mastic and each is then affixed to the conduit ends - not covering the closure sleeves. After these pieces are in place, a second coat of mastic is applied to the entire joint area including closure sleeve and the external surfaces of the 3-1/2" wide Insultape and overlapping the ends of the factory coated area. An 18" width of Insultape is then cut in a length which will permit a cigarette-fashion lap of 2". The inside of this piece is then coated with mastic and it is then applied over the whole joint area in a cigarette fashion and lapped a width of 2". A final coating of mastic is then applied over the entire field joint area. Coated field joints can be covered with backfill within one(1) to two (2) hours.

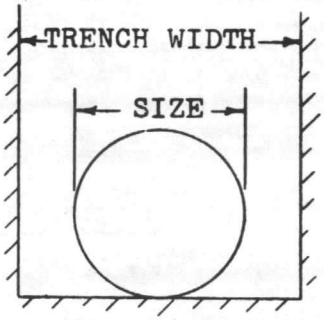
On application of the 612XM mastic, and Insultape, the following environmental limitations must be observed.

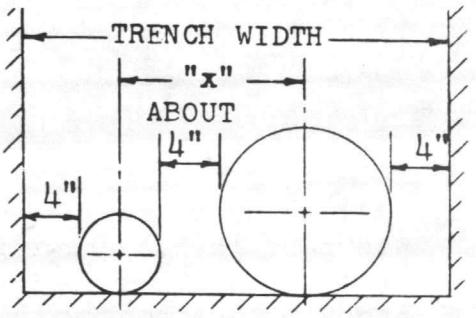
1. The Insultape may be applied readily at temperatures above 50° F. Should it be necessary to apply it at outside temperatures below 50° F., the Insultape should be stored in a heated area at least 24 hours prior to use. Once conformability and initial adhesion is attained, complete fusion bonding of the wrap occurs. Mechanical adhesion is attained immediately; more complete setting is obtained after several hours, or longer at lower temperatures. Severe handling of the Insultape should be avoided in extreme cold, to prevent damage.

2. The 612XM mastic can be readily applied at temperatures of approximately 32° F. Since it will become viscous at temperatures below this point, when applied at the lower temperatures, the mastic should be stored in a heated storage area (70° F.) to facilitate ease of application. The coating itself will not deteriorate even at sub-zero temperatures. Normal drying time of the mastic will be approximately 20-30 minutes in a temperature range from 32-60° F. At lower temperatures, the drying time will increase approximately ten minutes per 10° F. drop in temperature. The mastic should not be applied on metal that is over 120° F.

3. The mastic must not be applied over wet surfaces. Under conditions of high humidity, any condensation film must be removed prior to application of the mastic. Where it is necessary to apply the mastic under conditions of extremely high humidity, the evaporation rate is retarded, and a longer drying time is required. However, no loss of protection will occur once the film has sufficiently cured, regardless of the humidity.

SUGGESTED DIMENSIONS FOR ONE OR MORE CONDUITS IN ONE TRENCH





SINGLE CONDUIT		TWO CONDUITS								
Size	Trench Width	Conduit Combination	"x"	Trench Width	Conduit Combination	"x"	Trench Width	Conduit Combination	"x"	Trench Width
6"	1'-2"	6"-6"	10"	2'-0"	16"-12"	18"	3'-4"	22"-8"	19"	3'-6"
8"	1'-4"	8"-6"	11"	2'-2"	16"-14"	19"	3'-6"	22"-10"	20"	3'-8"
10"	1'-6"	8"-8"	12"	2'-4"	16"-16"	20"	3'-8"	22"-12"	21"	3'-10"
12"	1'-8"	10"-6"	12"	2'-4"	18"-6"	16"	3'-0"	22"-14"	22"	4'-0"
14"	1'-10"	10"-8"	13"	2'-6"	18"-8"	17"	3'-2"	22"-16"	23"	4'-2"
16"	2'-0"	10"-10"	14"	2'-8"	18"-10"	18"	3'-4"	22"-18"	24"	4'-4"
18"	2'-2"	12"-6"	13"	2'-6"	18"-12"	19"	3'-6"	22"-20"	25"	4'-6"
20"	2'-4"	12"-8"	14"	2'-8"	18"-14"	20"	3'-8"	22"-22"	26"	4'-8"
22"	2'-6"	12"-10"	15"	2'-10"	18"-16"	21"	3'-10"	24"-6"	19"	3'-8"
24"	2'-8"	12"-12"	16"	3'-0"	18"-18"	22"	4'-0"	24"-8"	20"	3'-10"
		14"-6"	14"	2'-8"	20"-6"	17"	3'-2"	24"-10"	21"	4'-0"
		14"-8"	15"	2'-10"	20"-8"	18"	3'-4"	24"-12"	22"	4'-2"
		14"-10"	16"	3'-0"	20"-10"	19"	3'-6"	24"-14"	23"	4'-4"
		14"-12"	17"	3'-2"	20"-12"	20"	3'-8"	24"-16"	24"	4'-6"
		14"-14"	18"	3'-4"	20"-14"	21"	3'-10"	24"-18"	25"	4'-8"
		16"-6"	15"	2'-10"	20"-16"	22"	4'-0"	24"-20"	26"	4'-10"
		16"-8"	16"	3'-0"	20"-18"	23"	4'-2"	24"-27"	27"	5'-0"
		16"-10"	17"	3'-2"	20"-20"	24"	4'-4"	24"-24"	28"	5'-2"
					22"-6"	18"	3'-4"			

NOTE: For more than two conduits in one trench add O. D. of additional conduit plus 4" clearance between units to trench dimension shown in table above to determine required trench width. See Column "x" for center to center distance of various combinations. Trench widths given in tables are at centerline of units. Increase width for sheathing or deep trench, etc., as conditions require.

MIDWESCO PREFABRICATED PIPE DIVISION

1650 N. ELSTON AVE.
CHICAGO 22, ILLINOIS

ARCH.

HT'G. CONT'R.

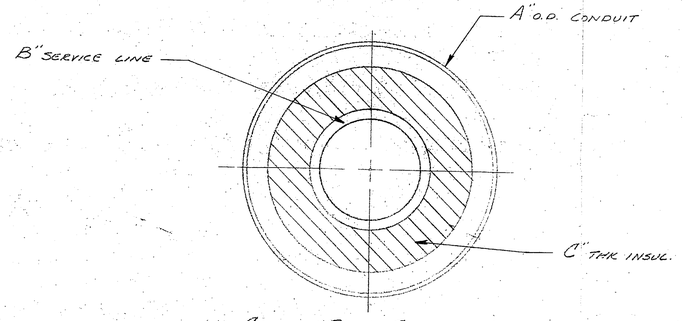
TRENCHING

DATE | BY | No MP-21

PERMA-PIPE COLD SPRINGING INSTRUCTIONS

1. All conduit sections shall be properly located according to part layout drawing supplied by Permanent Piping Systems. All field welds to internal service lines shall be made anchor to anchor with the exception of the field joints denoted by the symbol map shown on part layout drawings. Pour concrete anchor blocks around anchor plates.

2. Tack weld angles with stud holes to each end of service pipes at the field joint, or joints, denoted on map. Insert a bolt through the stud hole and tighten nut to draw pipe ends together to the specified amount of cold spring. Note: Conduit should be anchored by stakes to prevent springing of conduit. After cold spring, tack weld pipe joints, knock off angles, and complete pipe weld. Follow standard installation instructions.



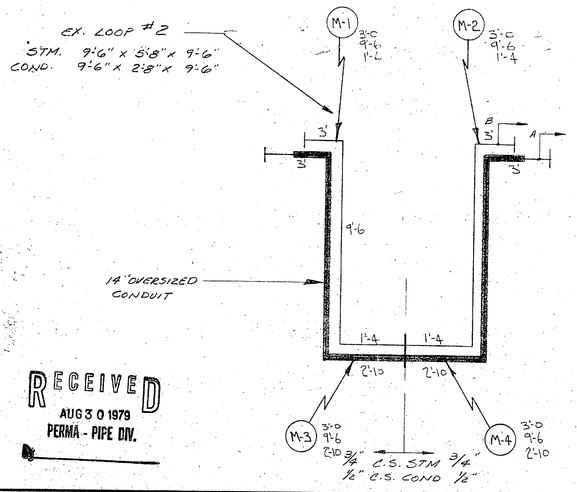
CONDUIT CROSS SECTION

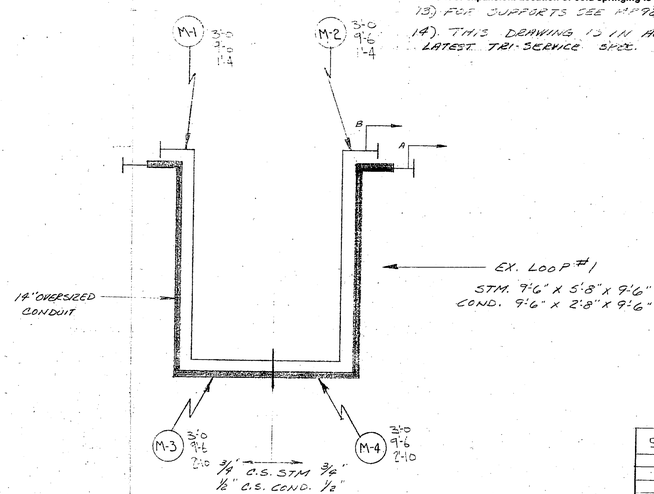
SCHEDULE OF CROSS SECTIONS

SERVICE	A	B	C	REMARKS
A	12¾	4"	2"	STEAM
B	8⅝	2"	1"	CONDENSATE

CONDUIT GENERAL NOTES

1. Conduit Casing - Black steel spirally welded having the following wall thickness:
   For conduit diameters 21" and below - 10 gauge
   For conduit diameters 22" to 26" inclusive - 6 gauge
   For conduit diameters 27" and above - 4 gauge
2. Conduit Casing Coating - conforming to military specifications (tri-service).
   Exterior - PERMA-PIPE "elephant hide", consisting of coal tar enamel, interposed layer of glass fabric, and an outer protective jacket of 15 pound coal tar saturated asbestos pipe line felt having a minimum coating thickness of 1/8", exclusive of felt over wrap.
   Interior - heat and acid resistance spray film.
3. Pipe Insulation — UNJACKET CALCIUM SILICATE CONFORMING TO SPEC MIL-I-533 TYPE II CLASS A
4. Field Joint Details — See attached MP-19.
5. All service pipe factory welds will be hydrostatically tested at the factory to a minimum of PSIG.
6. All fabricated conduit casing fittings will be air tested at the factory to a minimum of 15 PSIG.
7. Field measurements are entirely the responsibility of the purchaser.
8. The purchaser must furnish and/or verify the following before manufacturing of the system can begin:
   A. Field measurements including all wall thicknesses at points of entry.
   B. Service line temperatures: STEAM - 377° F
      CONDENSATE - 260 °F
9. Service piping shall be: SCH 40 HIGH STEEL GR. CL. B. A 53 SML OR ERW. FOR STEAM. SCH 80 BLACK STEEL GRADE B - A 53 SML. OR ERW.
10. Service pipe fittings shall be FORGED STEEL BW. WELD.
11. A stress analysis of this system has been made in accordance with the rules and procedures as set forth in the American National Standard Code For Pressure Piping (ANSI B31), Power Piping Section B31.1 - 1977. This system is within the limits set forth for allowable stress in that code.
12. WHERE REQUIRED: Service piping shall be cold sprung in the field 50% of the total amount of expansion. Location of cold springing is indicated on layout drawing.
13. FOR SUPPORTS SEE MP-92AF.
14. THIS DRAWING IS IN ACCORDANCE W. TH THE LATEST TRI-SERVICE SPEC.





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FIELD JOINT COUNT

SECTION	CAS. SIZE	QUANTITY
A	12¾"	4
A	14"	2
B	8⅝"	6

ARCHITECT				DRAWN BY	P.A.T.
ENGINEER				SCALE	N.T.S.
MECH. CONT.	SNEEDEN INC.			APPROVED	
P. O. NO.		REV. NO.	REVISION / BY / APPR. / DATE	DATE	7 20 79
		A	TO ADD PDL MT 7/17/79		
		0	AS SUBMITTED		

UNDERGROUND DISTRIBUTION SYSTEM

JOB: CAMP LEJEUNE
JOB NO. PC-6152 DWG. NO. 79-093-C-0

PERMANENT PIPING SYSTEMS
A DIVISION OF MIDWESCO ENTERPRISE, INC.
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