

## Tungsten/Nickel/Cobalt Alloy Study

*For Service members and their Families*

### Important Facts

- Initial animal research studies at the Armed Forces Radiobiology Research Institute (AFRRI), published in June 2005, indicated that rats implanted with tungsten alloy pellets containing tungsten, nickel, and cobalt developed cancerous tumors at the implantation site (leg muscle) which then rapidly spread to the lungs.
- A second study in 2007, at the US Army Center for Health Promotion and Preventive Medicine (USACHPPM) confirmed the results of the AFRRI study and also showed that neither pure tungsten nor a tungsten/nickel/iron alloy caused cancerous tumors.
- The AFRRI and USACHPPM studies are considered first steps in researching the health effects of tungsten alloy exposures. Results in rats cannot be generalized to predict the effects in humans who may suffer injuries from tungsten alloy munitions. Some chemicals that cause cancer in rats do not cause cancer in humans. More laboratory animal research is underway.
- A limited number of metal fragments removed from our Service members in Iraq have been analyzed to determine their content. None of the fragments removed have contained tungsten or tungsten alloys as of the date of this fact sheet.

### What is tungsten?

Tungsten is a naturally occurring metal. Tungsten can be used either in pure form or mixed with other metals to make alloys. Tungsten alloys tend to be strong, and resistant to heat and wear. Tungsten and its alloys are used in a variety of commercial products including light bulb filaments, x-ray tubes, welding electrodes, grinding wheels, ceramic pigments, and fire retardants.

Tungsten has been used without ill effects as a component in US Food and Drug Administration (FDA)-approved medical implants such as orthopedic hardware and tungsten coils for heart defects. Numerous countries have used tungsten and various tungsten alloy munitions for a number of years because of its high density and ability to penetrate armor. Initially, tungsten carbide was used in munitions, but newer composites such as tungsten/nickel/cobalt and tungsten/nickel/iron have superior properties.

### Why were the tungsten alloy studies conducted?

After the 1991 Gulf War, the Department of Defense (DoD) realized that retained embedded fragments such as shrapnel resulting from combat operations were a unique military exposure where the long-term health effects were not fully understood. Therefore, a series of medical investigations were funded to look specifically at embedded depleted uranium fragments. At that same time, the DoD decided to include in the AFRRI study a tungsten/nickel/cobalt alloy, one of the alternatives to the depleted uranium (DU) already in use, to see if there were health effects associated with embedded fragments made out of this material.

### What did the Armed Forces Radiobiology Research Institute (AFRRI) find in their study?

The AFRRI's four-year rat study examined the effects of embedded DU and tungsten alloy pellets. The AFRRI found implanted DU pellets did not cause cancer when placed in the leg muscles of rats. Pellets of both the tungsten alloy and pure nickel (a metal known to cause cancer) resulted in tumor formation around the pellets. The tumors associated with the embedded tungsten/nickel/cobalt alloy fragments quickly spread to the lungs, while those resulting from the pure nickel pellets did not. The rate of growth of these tumors depended on the dose level (e.g. with more pellets, tumors developed more quickly). Embedded pellets of pure tantalum (a non-cancer causing material) did not cause any cancers. This study did not indicate the specific metal or combinations of metals in the tungsten alloy that were responsible for causing the tumors.

### What did the US Army Center for Health Promotion and Preventive Medicine (USACHPPM) find in their studies?

The USACHPPM conducted a confirmatory study to examine the effects of pellets made of the same tungsten/nickel/cobalt alloy, of tungsten alone, and of tungsten/nickel/iron, a combination used in some US munitions. Using the same type of rat, the USACHPPM confirmed the AFRRI results indicating cancerous tumor formation resulting from tungsten/nickel/cobalt alloy. The USACHPPM results also indicated no cancer development with either the plain tungsten or the tungsten/nickel/iron alloy.

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*A collaborative effort between the Air Force Institute for Operational Health, the Deployment Health Clinical Center, Force Health Protection and Readiness, the Navy Environmental Health Center, the U.S. Army Center for Health Promotion and Preventive Medicine, and the OUSD(P&R)/Military Family and Community Policy*



## What do the results mean?

The health effects of tungsten/nickel/cobalt alloy pellets require further investigation. Scientific research has shown that some chemicals that cause cancer in rats do not cause cancer in humans. For this reason, a study limited to one type of rodent is not enough evidence to indicate that people will or will not develop cancer as a result of embedded fragments. More research in other laboratory animals is needed to see if similar effects might be expected in humans.

The AFRRRI is currently conducting additional follow-on research in mice, using different combinations of tungsten, nickel, and cobalt to aid in determining which components of the alloy are responsible for the cancers. If the results are similar to those found in the AFRRRI and the USACHPPM rat studies; then it is more likely that these same health effects could be expected in people.

## Have any Service members in Operation Enduring Freedom or Operation Iraqi Freedom been injured with metal fragments containing tungsten alloys?

At this time, there is no evidence of injury from metal fragments containing tungsten alloys. As a precaution, some metal fragments removed from our soldiers have been analyzed to determine their content. So far, none of the fragments analyzed have contained tungsten or its alloys. The DoD recently initiated a program to analyze all metal fragments removed for medical indications, and with this effort, the DoD expects to have even more data on the metal composition of fragments wounding our Service members.

## Are there tungsten alloys in the Army's "green bullet" (lead-free, small arms ammunition)?

Tungsten alloys are not used in the "green" or lead-free bullet. The bullets are "green" because they're considered more environmental friendly than bullets containing lead. Green bullets typically contain tungsten that is mixed together with either nylon or tin. Tungsten alloys used in armor-piercing munitions, on the other hand, contain other metals, such as

nickel, cobalt, iron, or copper, and are subjected to high temperature and pressure to bond the materials together. While the green bullet has been used in training operations at a limited number of Army installations, it has not yet been used on the battlefield.

## Why is the Army now saying that tungsten might be harmful, when you said a few years ago that it wasn't?

Initial assessments of tungsten were based on reviews of the scientific literature available at the time it was evaluated. No information was available on the adverse effects of the embedded tungsten alloy fragments or the pellets that were used in the AFRRRI and the USACHPPM research.

## How can I learn more about the studies that were performed by the AFRRRI and the USACHPPM?

You can contact the AFRRRI's Public Affairs Office at (301) 295-1953. An abstract and the full-text of the *Environmental Health Perspectives* article: "Embedded weapons-grade tungsten alloy shrapnel rapidly induces metastatic high-grade rhabdomyosarcomas in F344 rats" can be found at: <http://ehp.niehs.nih.gov/docs/2005/7791/abstract.html>. The results of the USACHPPM study have not been published yet.

For specific technical questions on the AFRRRI study, you may also contact the DoD Health Affairs Force Health Protection and Readiness (FHP&R) Office (see below). For specific military Service-related issues with tungsten alloy policies, operations, and health issues, contact the Service point of contacts listed in the box below.

For general background information on tungsten, contact the Agency for Toxic Substances & Disease Registry (ATSDR), Department of Health and Human Services:

800-232-4636

TTY 888-232-6348

E-mail: [cdcinfo@cdc.gov](mailto:cdcinfo@cdc.gov)

Web site: <http://www.atsdr.cdc.gov/tfacts186.html>

## Where Do I Get More Information?

### Air Force Institute for Operational Health (AFIOH)

Phone: (888) 232-3764

<http://www.brooks.af.mil/afioh/>

### DoD Force Health Protection and Readiness (FHP&R) Programs

Phone: (800) 973-6261

<http://fhp.osd.mil>

### DoD Deployment Health Clinical Center (DHCC)

Phone: (866) 559-1627

<http://www.pdhealth.mil/>

### US Navy and Marine Public Health Center

Phone: (757) 953-0700

<http://www.nehc.med.navy.mil>

### U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM)

Phone: (800) 222-9698

<http://chppm-www.apgea.army.mil>

### DeployMed ResearchLINK

Published Research on Depleted Uranium and other Heavy Metals

<http://fhp.osd.mil/deploymed/projectsList.jsp?researchTopic=3&researchSubTopic=15>



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