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Determining the Hazard Classification for Radioactive and Magnetized Materials

By Philip Saunders, Chemical Engineer, HTIS

The Hazardous Materials Information Resource System (HMIRS) is an electronic repository for material safety data sheets (MSDS), and other information used to comply with occupational safety and health (OSH), as well as environmental and transportation regulations. The records in HMIRS are identified by National Stock Number (NSN), contract number, product identity and the MSDS's responsible party. Since the NSN is one of the identifiers for a record, the information for that record must be based on the unit of issue (UI), quantity per unit pack and/or container quantity for that NSN as shown in the Federal Logistics Information System (FLIS). This can present some unique challenges when using this information to ship radioactive or magnetized materials. This article will discuss what information will be found (or not found) in HMIRS regarding such materials as well as some of the applicable transportation regulations.

The transportation regulations for many common hazardous materials (e.g. flammable or corrosive liquids, compressed gases or oxidizers) depend on the physical or chemical properties (e.g. the flash point for flammable liquids) as well as the volume of material contained in the inner package. For example, the flash point for isopropanol results in it being classified as a Class 3 (flammable liquid) hazard with a Packing Group II. If the FLIS information for a NSN applicable to a container of isopropanol indicates that the container quantity is 0.5 liters, the transportation information included in an HMIRS record for that NSN should reflect the hazard class and packing group for isopropanol as well as the fact that it can be shipped as a limited quantity. If instead the container quantity for that NSN was 2 liters, the limited quantity classifi-

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HTIS BULLETIN WILL TRANSITION TO AN ALL ELECTRONIC EDITION

With the (Jan-Mar2013) edition of the BULLETIN, we will no longer publish the bulletin in the hard copy format which you are currently receiving. We have thought long and hard about this decision, and concluded that the expense and time as well as the diminishing number of printing companies available to produce the hard copy version necessitates that we move to the electronic medium of delivery.

If you currently receive the BULLETIN in hard copy, please send your official/work site e-mail address to Mr. Leonard Lambert (leonard.lambert@dla.mil) thereby enabling you to continue to receive the BULLETIN while conserving resources. Receipt of the HTIS BULLETIN will allow you to electronically transmit either all or selected BULLETIN articles of interest to your colleagues. No ones' e-mail address will be visible to any electronic recipient. Thank you for your continued interest in and for being a loyal reader of the HTIS Bulletin.

cation would not apply, and the information shown in HMIRS would be slightly different. However, conveying the transportation regulations for magnetized or radioactive materials is more complicated because the hazard classification itself can depend on the number of units shipped in the same package (for magnetized materials), or in the same shipment or consignment (for radioactive materials).

Transporting magnetized materials differs from that of other hazards in that magnetized materials are only classified as a hazard when they are transported aboard an aircraft since strong magnetic fields can interfere with the aircraft's navigational equipment. Even then, not all packages containing magnets are classified as hazardous since the magnetic field strength of the entire package must exceed the regulatory threshold established by the International Air Transport Association's (IATA) Dangerous Goods Regulations before it is subject to those regulations. According to IATA's paragraph 3.9.2.2, a package exceeds that threshold if the field strength exceeds 0.00525 gauss, or produces a compass deflection exceeding 2 degrees when the field strength is measured at a distance of 7 feet from any surface of the package. If that threshold is exceeded, the material is regulated as a Class 9 hazard, and is subject to IATA Packing Instruction 953. If the package still exceeds those thresholds when the field strength is measured at 15 feet from the package, competent authority approvals are needed before the package can be shipped. In the end, the magnetic field strength for a package will depend on the field strength of the individual articles inside the package, as well as the number of articles and their orientation to each other within the package.

One source of confusion with magnetized materials is that the information in HMIRS is based on the unit of issue. In the case of magnetic articles, the unit of issue is usually "each", or as one individual item. This is also true for the Hazardous Characteristic Code (HCC) M1 (Magnetized Materials), since it is based on IATA's regulatory threshold, but is assigned based on the field strength for an individual article rather than for a package. Most items containing magnets that do not individually exceed IATA's regulatory threshold will not have a record in HMIRS since individually they do not present a hazard. Thus, there has to be a limiting principle on what magnetized material goes into HMIRS, or else its scope could end up being expanded to cover innocuous items (e.g. refrigerator magnets). Since HMIRS does not provide information on every conceivable package quantity or configuration, the hazardous materials packager or certifier will need to measure the field strength of a package containing magnetic materials, regardless of what information is or is not available in HMIRS. Figure 1 reflects the label that one uses to ship regulated magnetized materials.

In a somewhat analogous manner, in the transportation of radioactive materials, like that of magnetic items, the shipper needs to consider more than just the unit of issue. In 49 CFR 173.403(b), the US Department of Transportation (DoT) defines the two criteria that must be satisfied to classify a material containing radioisotopes as a Class 7 (Radioactive) hazard. The first criterion requires that the activity concentration for the material must exceed the "activity concentration for exempt material" for the isotope that is listed in the table found in 49 CFR 173.436. The activity concentration is a measure of the density of the radioactive material. It can be equal to the isotope's specific activity (curies or becquerels per gram) if the isotope is pure, or if the isotope is dispersed throughout an item, it can be calculated by dividing the activity of the isotope within the item by the total mass of the item. If the activity concentration for a radioactive item is below the exempt material activity concentration limit, the item will never meet the definition of a Class 7 radioactive material. If the activity concentration exceeds that limit, then it will be a Class 7 hazard, if it also satisfies the other requirement of the definition.

The second criterion for classifying a material as a Class 7 hazard requires that the total activity of a shipment or consignment, must exceed the "activity limit for exempt consignment" for the isotope as found in 49 CFR 173.436. This can result in a single radioactive item not being regulated as a Class 7 hazard if shipped by itself, whereas a shipment containing several of the same items could be regulated. The number of units required to exceed the consignment limit can be calculated by dividing the exempt consignment activity limit by the activity for the individual unit or item, and rounding that number up to the next integer. If this calculation results in any value above one, then it will take 2 or more of them in the same shipment for the shipment to be regulated as a radioactive hazard. If it only takes one radioactive device to exceed

the consignment activity limit, then the item will always be regulated as a Class 7 hazard. Figure 2 is one of three possible labels utilized with the shipment of radioactive materials.

As with magnetic materials, the transportation information entered into an HMIRS record for radioactive materials will be based on the unit of issue for the NSN assigned to that record. If a shipment of a single unit does not contain enough radioactive material to exceed the consignment activity limit, then the applicable HMIRS record will show that the item is not regulated for transportation as a Class 7 hazard. The record might also include clarifying information describing the conditions under which it would be regulated as a hazard for transportation, but the HMIRS user would have to read the additional comments added to the record rather than relying on the Proper Shipping Name (PSN) codes.

In conclusion, when it comes to preparing shipments of radioactive or magnetized materials, it is important to look beyond the unit of issue information that is displayed in HMIRS, and understand that this information does not necessarily apply to larger quantities of these items. With a full understanding of the applicable transportation regulatory requirements, errors (and the resulting delays, citations and fines) can be avoided.

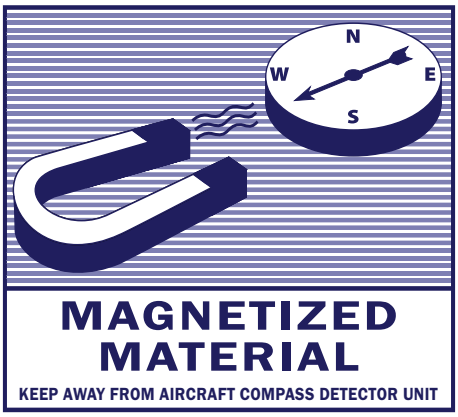

Figure 1. Magnetized Material Shipping Label

Figure 2. Radioactive Material Shipping Label

Environmental News

The 2011 RCRA Biennial Hazardous Waste Report

By Abdul H. Khalid, Chemical Engineer, HTIS

The Environmental Protection Agency's Resource Conservation Recovery Act (RCRA) biennial report is an ongoing collection of information from hazardous waste generators and hazardous waste treatment, storage, or disposal facilities (TSDFs) that occurs over a two-year cycle, as required by Sections 3002 and 3004 of RCRA. The information is collected via EPA's Form 8700-13 A/B, known as the Hazardous Waste Report. Both RCRA Sections 3002 and 3004 require the EPA to establish standards for recordkeeping and reporting of hazardous waste. Section 3002 applies to hazardous waste generators, while Section 3004 applies to hazardous waste TSDFs. The implementing regulations are found at 40 CFR Parts 262.40(b) and (d); 262.41(a)(1)-(5), (a)(8), and (b); 264.75(a)-(e) and (j); 265.75(a)-(e) and (j); and 270.30(l)(9).

Section 3002(a) (6) of RCRA requires the EPA to develop a program for hazardous waste generators to report the nature, quantities, and disposition of hazardous waste generated at least biennially. In addition, section 3004(a) (2) of RCRA requires TSDFs to submit a report on the wastes which they receive from off-site. Implemented in 1985, the Biennial Report Form (8700-13A/B) must be submitted to the authorized state agency or the EPA Regional Office by March 1st of every even-numbered year. The form includes the facility's EPA ID number, the name and address of the facility, the quantity of hazardous waste sent to each TSDF in the U.S., and the manner in which the waste was treated during the previous year. The reports also list the management method by which each waste is treated, recycled, or disposed and the quantity managed.

Federal regulations require that all large quantity generators, and all facilities that treat, store, or dispose of hazardous waste must file a report on their waste handling activities with the EPA (or authorized State agency). In most states, small and conditionally exempt generators are excluded from this report. However, these generators need to check with their respective State environmental regulatory body as well as review Subpart D of 40CFR262. One can obtain the full instructions for filling out the "Biennial Report" from the EPA, or visit the EPA's website at: http://www.epa.gov/wastes/inforesources/data/br11/br2011rpt.pdf.

The EPA uses the Biennial Report data for planning and developing regulations, compliance monitoring, and enforcement. The data also allow the Agency to determine whether its regulations are having the desired effect on the generation and management of hazardous waste. Numerous States use the Report data to support their RCRA office's planning, fee assessment, compliance monitoring, and enforcement programs. On the other hand, some businesses consider part or all of

their hazardous waste information to be Confidential Business Information (CBI). In these cases, a business may, if it desires, protect its Biennial Report information from public disclosure by asserting a claim of confidentiality to cover all or part of its information. When a CBI claim is made, the EPA will treat the information in accordance with the confidentiality regulations in 40 CFR Part 2, Subpart B. The EPA also ensures that the information collection procedures comply with the Privacy Act of 1974 and Office of Management and Budget (OMB) Circular 108.

Waste is created daily that could be either a solid waste or a hazardous waste, depending on what is in the waste products. At homes, normal garbage forms solid waste, while industrial and manufacturing processes or operations create solid and hazardous wastes, depending on the ingredients of the materials involved during processes and operations. Hazardous wastes are liquid, solid, contained gas, or sludge wastes that contain properties that are dangerous or potentially harmful to human health and the environment. As with the commercial sector, the RCRA also requires Federal Agencies to assess the impact that debris, debris removal, hazardous wastes, and hazardous waste clean-up projects have on land, air, and water quality, and to also take actions to prevent environmental degradation due to such materials.

With the 2011 Report, the EPA now recognizes a sub-category of "short-term generators", including hazardous waste generators such as construction sites, whose waste generating activities are of an intentionally limited duration. In addition, the 2011 Report has the following changes:

- **The Contact Phone Number** in RCRA Information is now 15 characters in length;
- **Form Codes:** Two new form codes, W005 and W406, have been added to the form code list. W005 tracks waste pharmaceuticals managed as hazardous waste. W406 tracks dried paint (paint chips, filters, air filters, other). Additionally, the description for form code W206 has been changed to "waste oil managed as hazardous waste"; and,
- **Source Codes:** The descriptions for three source codes, G11, G24, and G25, have been changed:
  - ✓ **G11** is now described as "discarding off-specification, out-of-date, and/or unused chemicals or products";
  - ✓ **G24** is described as "Solvent or product distillation as part of production process (including totally enclosed treatment systems), and does not include batch treatment in a separate process"; and,
  - ✓ **G25** is described as "Hazardous waste management – indicate management method (for residuals from regulated hazardous waste processes – enter the related H code)".

The EPA encourages electronic reporting of the Biennial Report where possible, and the instructions for that process can also be obtained by contacting one's State or EPA Regional Offices.

References:

1. EPA Waste Information Resources, website at: http://www.epa.gov/osw/inforesources/data/biennialreport/

2. RCRA Info-File Specification Guide 2011Hazardous Waste Report Submissions, November 2011, website at: http://www.epa.gov/wastes/inforesources/data/br11/br11-specification.pdf

3. 2011 Hazardous Waste Report Instructions and Forms EPA Form 8700-13 A/B (OMB #2050-0024; expires 12/31/2014), December 2011, website at: http://www.epa.gov/wastes/inforesources/data/br11/br2011rpt.pdf.

Testing Homes for Harmful Levels of Radon Gas

By Abdul H. Khalid, Chemical Engineer, HTIS

Radon is a naturally occurring, colorless, odorless, tasteless radioactive gas that is formed from the radioactive decay of uranium. Uranium is found in small amounts mostly in rocks and soils. It slowly breaks down to other products such as radium, which breaks down to radon. Radon gas can move through small spaces in soil and rock on which a house or structure is built. It can seep into a structure through dirt floors, cracks in concrete floors and walls, floor drains, sumps, joints, and tiny cracks or pores in hollow-block walls. Radon gas becomes a health hazard when it accumulates in poorly ventilated spaces or enclosed areas, and the occupants breathe the radon over a prolonged period of time. High levels of radon in homes can increase the risk of developing lung cancer.

Radon and its radioactive daughters usually enter the body through inhalation. Most of the radon is breathed out again. However, some radon and most of its daughters remain in the lungs and undergo radioactive decay. The radiation released during this process passes into lung tissue, and is the cause of lung damage. Long-term exposure to radon and radon daughters may cause lung cancer.

The U.S. Environmental Protection Agency (EPA) recognizes January as National Radon Action Month. Each year, the EPA reminds and encourages people to take simple and necessary affordable steps to test their homes for harmful levels of radon gas. According to the EPA, more than 21,000 Americans die annually from radon related lung cancer. Nearly one of every 15 homes in the U.S. is estimated to have elevated radon levels. American families and communities can easily avoid radon gas' dangerous health threat by taking samples and testing for radon gas.

The EPA recommends testing for radon level and reducing radon in homes that have levels of radon equal to or greater than 4 picocuries per liter (pCi/L). Radon levels less than 4 pCi/L still pose a risk, and in most cases can be reduced. The DoD services have an action level for radon that is equal to 4 pCi/L. Individual

states have laws requiring certification and licenses for people who test for radon or perform radon mitigation activities.

The EPA and the U.S. Surgeon General recommend that all homes, both with and without basements, be tested for radon. Affordable Do-It-Yourself radon test kits are available at home improvement centers, hardware stores, and online. In addition, some companies provide testing through qualified radon testers. One can also locate qualified testers by reviewing EPA's website at: http://www.epa.gov/radon/radontest.html Addressing high radon levels often costs the same as other minor home repairs, and by testing for and eliminating elevated levels of radon in the home, one can help prevent lung cancer while creating a healthier home and community.

In 2011, the EPA, along with the General Services Administration, as well as the Departments of Agriculture, Defense, Energy, Health and Human Services, Housing and Urban Development, Interior, and Veterans Affairs announced the development of the Federal Radon Action Plan. This action plan demonstrates the importance of radon risk reduction, addresses finance and incentive issues to drive testing and mitigation, and builds demand for services from industry professionals.

Within DoD, each military service has its own "Radon Assessment and Mitigation Program" for assessing and mitigating radon at DoD facilities. Facilities on DoD installations are assessed according to a priority. Priority 1 facilities include military family housing, daycare centers, hospitals, schools, unaccompanied officer/enlisted quarters, confinement facilities, visiting officer/enlisted quarters, and dormitories/barracks. Priority 2 facilities are administrative areas having 24-hour operations, while priority 3 includes all other structures routinely occupied over 4 hours per day.

For guidance on radon assessment and mitigation, policies, and procedures, please use the following current points of contacts (POCs) for the DoD Services Radon Programs:

DLA HQ
ATTN: DES-O
Mr. Michael Coogen
Radiological Affairs Support Office
Ft. Belvoir, VA

PH: Commercial: 703.767-6231 • DSN: 427.6231

eMail: Michael.coogen@dla.mil

Department of Navy
ATTN: Mr. Steven W. Doremus, Ph.D.
Director
Environmental Management & Waste Programs
Radiological Affairs Support Office
Yorktown, Virginia

PH: NAVSEADET RASO —
Commercial 757.887.7745 • DSN 953.7745
Cell 757.570.1517 • FAX 757.887.4900

eMail: steve.doremus@navy.mil

Department of the Air Force
ATTN: David A. Smith, Lt Col, USAF, BSC, PhD
Chief, Radiation Health
Chief, RIC Secretariat
AFMSA/SG3PB
USAF Radioisotope Committee
1780 AF Pentagon
Washington, DC 20330-1780

PH: Commercial 703.588-6427 • DSN 425.6427

eMail: DavidA.Smith@pentagon.af.mil

Department of Army
ATTN: Mr. Greg R. Komp,
Army Safety Office
9351 Hall Road, Bldg. 1456
Fort Belvoir, VA 22060-5860

PH: Commercial 703.697.1194 • Cell 703.459.7385

email: greg.komp@us.army.mil

Readers can call their state radon contact for a copy of the Map and the Zones document that contains information on radon potential variations within counties. The EPA recommends that this map be supplemented with any available local data in order to further understand and predict the radon potential of a specific area. For State Radon Contact, visit EPA's web site at: http://www.epa.gov/radon/whereyoulive.html.

References:

1. EPA News Releases, January 4, 2012, "EPA Recognizes National Radon Action Month: Test for Radon Gas to Protect Health / 21,000 Americans die from radon related lung cancer each year." Website at: http://www.epa.gov/

2. A Citizen's Guide to Radon: The Guide to Protecting Yourself and Your Family from Radon, website at: http://www.epa.gov/radon/pubs/citguide.html

3. The Federal Radon Action Plan: http://www.epa.gov/radon/action_plan.html

4. A Citizen's Guide to Radon: The Guide to Protecting Yourself and Your Family from Radon.

The Lead-based Paint Disclosure Rule

By Abdul H. Khalid, Chemical Engineer, HTIS

The Lead Disclosure Rule provides renters and purchasers of houses that were built before 1978 with information on lead-based paint in general, and known lead-based paint hazards in specific housing, that should enable the buyer/renter to make informed decisions about whether to lease or purchase the property.

Federal law requires that sellers and landlords, who sell or rent housing that was built before 1978, provide a lead hazard

information pamphlet to inform renters and buyers of the dangers associated with lead-based paint. The law also requires that sellers and landlords:

- Include lead notification language in sales and rental forms.
- Disclose any known lead-based paint and lead-based paint hazards in the living unit and property, and provide copies of all available reports to buyers or renters.
- Allow a lead inspection or risk assessment by home buyers.
- Maintain records certifying compliance with federal laws for a period of three years.

On January 10, 2012, the U.S. Environmental Protection Agency (EPA) identified two contracting companies that violated the Federal Lead-based Paint Disclosure Rule during work on Department of Defense facilities at the Portsmouth Naval Shipyard in Kitty, ME as well as the U.S. Naval Submarine Base, New London in Groton, CT.

The EPA asserts that these contracting companies violated the Lead Disclosure Rule while executing leasing contracts to personnel at these Navy bases from 2007 to 2010. According to the EPA, these companies failed to provide available records and reports related to lead-based paint health risks, and/or lead-based paint hazards to the renters residing at these bases.

The housing at both bases is owned by Northeast, a joint venture limited liability company between the Department of the Navy and a wholly-owned subsidiary of Balfour Beatty Communities (BBC), LLC, of which the BBC affiliate is the managing member. There are approximately 25 target housing units located at Portsmouth Naval Shipyard, where housing was built in the 1800s and early 1900s. There are approximately 735 target housing units at the Naval Submarine Base in Groton, CT that were built in the early 1960s.

Curt Spalding, regional administrator of the EPA's New England office, noted that "exposure to lead paint is a serious public health concern here in New England because of the number of older housing units here. Furthermore, military families make significant sacrifices to protect our Nation, and the health of those families, as well as all families, should not be jeopardized by not being notified of potential lead hazards in the housing where they reside. Property managers and owners play an important part in helping to prevent lead poisoning by following the lead paint disclosure requirements and making sure families are aware of potential lead hazards in homes."

Infants and young children are especially vulnerable to lead paint exposure, since such exposure can cause intelligence quotient deficiencies, reading and learning disabilities, impaired hearing, reduced attention span, hyperactivity and behavior problems. Adults with high lead levels can suffer difficulties during pregnancy, high blood pressure, nerve disorders, memory problems and muscle and joint pain.

References:

1. EPA News Release, January 10, 2012, " Companies Face Fines for Lead Paint Disclosure Violations at Two Navy Bases in New England" website at: http://yosemite.epa.gov/opa/admpress.nsf/0/F9D0A008BACE76EB852579810061D27D

2. Lead in Paint, Dust, and Soil- http://epa.gov/lead/

3. EPA enforcement of lead-based paint disclosure rule in New England- http://epa.gov/ne/enforcement/leadpaint/index.html

4. The most recent amendments to the Renovation, Repair, and Painting (RRP) regulation of October 4, 2011, http://epa.gov/lead/pubs/renovation.htm

Occupational Safety & Health News

The Identification and Classification of Potential Carcinogens

By Abdul H. Khalid, Chemical Engineer, HTIS

Cancer is one of the leading causes of death in the industrialized world, and the identification and classification of potential carcinogens continues to be a challenge for the Occupational Safety and Health Administration (OSHA).

OSHA provides the standard for the identification, classification, and regulation of carcinogens at 29 CFR Part 1990. 29CFR1990.112(a), (b), (b)(1), and (b)(2) establish the criteria for categorization, unless the Secretary of the U.S. Department of Labor (DOL) considers evidence under the provisions of 1990.143 (general provisions for the use of human and animal data), and/or 1990.144 (criteria for consideration of arguments on certain issue), and/or 1990.145 (consideration of substantial new issues or substantial new evidence), and determines that such evidence warrants an exception to these criteria.

The potential carcinogens categories are:

1990.112 (a) — Category I Potential Carcinogens
A substance shall be identified, classified, and regulated as a Category I Potential Carcinogen if, upon scientific evaluation, the Secretary of Labor determines that the substance meets the definition of a potential occupational carcinogen in (1) humans, or (2) in a single mammalian species in a long-term bioassay where the results are in concordance with some other scientifically evaluated evidence of a potential carcinogenic hazard, or (3) in a single mammalian species in an adequately conducted long-term bioassay, in appropriate circumstances where the Secretary determines

the requirement for concordance is not necessary. Evidence of concordance may be positive results from independent testing in the same or other species, positive results in short-term tests, or induction of tumors at injection or implantation sites.

1990.112 (b) — Category II Potential Carcinogens
A substance shall be identified, classified, and regulated as a Category II Potential Carcinogen if, upon scientific evaluation, the Secretary determines that:

1990.112(b) (1) The substance meets the criteria set forth in 1990.112(a), but the evidence is found by the Secretary to be only "suggestive"; or

1990.112(b) (2) The substance meets the criteria set forth in 1990.112(a) in a single mammalian species without evidence of concordance.

OSHA and the National Institute for Occupational Safety and Health (NIOSH) are still studying ways to revise their cancer policies. OSHA's Permissible Exposure Limits (PELs), and NIOSH's Recommended Exposure Limits (RELs) are precautionary limits that are used to draw rapid attention to certain chemicals.

As noted below, various government agencies or professional organizations also have carcinogen classification systems. Thus one should consider the information provided by these entities along with the recommended exposure levels (e.g. PELs, RELs, Threshold Limit Values (TLVs) or other occupational exposure levels (OELS)) to assist in determining potential carcinogen risks based on scientifically evaluated evidence of a potential carcinogenic hazard.

Carcinogen classification agencies are:

International Agency for Research on Cancer (IARC)

- Group I- Carcinogenic to humans-107 agents;
- Group 2A- Probably carcinogenic to humans-59 agents;
- Group 2B- Possibly carcinogenic to humans-267 agents;
- Group 3- Not classifiable as to its carcinogenicity to humans-508 agents; and,
- Group 4- Probably not carcinogenic to humans -agent 1.

National Toxicology Program (NTP)

- Group 1- Known to Be Human Carcinogens-Sufficient information from human studies showing causal relationship; and,
- Group 2-Reasonably anticipated being a human carcinogen-limited evidence of carcinogenicity in human; or sufficient evidence of carcinogenicity in experimental animals.

American Conference of Governmental Industrial Hygienists (ACGIH)

- A1-Confirmed human carcinogen;
- A2-Suspected human Carcinogen;
- A3-Confirmed animal carcinogen with unknown relevance to human;
- A4-Not classifiable as a human carcinogen; and,
- A5-Not suspected as a human carcinogen.

European Union (EU)

- Category 1-Substances known to be carcinogenic to man;
- Category 2-Substances which should be regarded as if they are carcinogenic to man; and,
- Category 3-Substance which cause concern for man owing to possible carcinogenic effects but in respect of which the available information is not adequate for making a satisfactory assessment.

One can visit the following agencies websites if additional information is desired on industrial chemicals that are recognized as carcinogenic or suspected carcinogens:

- International Agency for Research on Cancer, website at: http://www.iarc.fr/;
- National Toxicology Program (NTP), website at: http://ntp.niehs.nih.gov/;
- 12th Report on Carcinogens (ROC), website at: http://ntp.niehs.nih.gov/?objectid=03C9AF75-E1BF-FF40-DBA9EC0928DF8B15;
- National Institute for Occupational Safety and Health (NIOSH), website at: http://www.cdc.gov/NIOSH/ ;
- American Conference of Governmental Industrial Hygienists. (ACGIH) website at: http://www.acgih.org/home.htm;
- U.S. Environmental Protection Agency website at: http://www.epa.gov/;
- California EPA, Office of Environmental Health Hazard Assessment (OEHHA). Chemicals Known to the State to Cause Cancer or Reproductive Toxicity. Website at: http://www.oehha.ca.gov/prop65/prop65_list/Newlist.html; and,
- Chemicals CLP/GHS - Classification, labeling and packaging of substances and mixtures, website at: http://ec.europa.eu/enterprise/sectors/chemicals/classification/index_en.htm.

Workplace Respiratory Program is the Employer's Responsibility

By Abdul H. Khalid, Chemical Engineer, HTIS

29 CFR 1910.134 (d)(1)(iii) requires employers to identify and evaluate respiratory hazards in places of employment. The evaluation includes a reasonable estimate of an employee's

exposures to respiratory hazard(s), and an identification of the contaminant's chemical state and physical form. When the employer cannot identify or reasonably estimate the employee exposure, the employer shall consider the atmosphere to be immediately dangerous to life or health (IDLH). IDLH means that an atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from the dangerous atmosphere.

In conducting an analysis, an industrial hygienist or other qualified party collects air samples and other data related to the contaminants during the course of an employee's normal work hours. The collected samples are sent to an accredited laboratory for analysis, and from an analysis of the gathered data, one obtains information to determine the potential for an employee's exposure to work place contaminants. The sample gathering phase as well as analysis must not only consider those factors associated with the normal use of the materials generating the contaminants, but also "worst-case" scenarios. Material Safety Data Sheets (MSDSs) or the Safety Data Sheets (SDSs) for chemicals, available from manufacturers or suppliers can be very helpful when doing a hazard analysis.

Small employers can conduct their own sampling, but one needs training and experience to use sampling equipment and its media, and must be knowledgeable of the sampling protocols. Therefore, consultation with an accredited laboratory is recommended when sampling media and related matters of taking samples as well as custody of samples become an issue.

Air sampling provides the concentration information needed to assess the exposure level and it is expressed as a Time Weighted Average (TWA). TWA is the average exposure to a contaminant or condition, such as chemicals or noise to which workers may be exposed without adverse effect over a given period (e.g., an 8-hour day or 40-hour week). The TWA is then compared to OSHA's permissible exposure limits (PELs). If the level is below the PEL, no respirator protection is required. If the PEL is exceeded, and either engineering or administrative controls cannot reduce the exceeded level to below the PEL, then elements of an established respiratory protection program, required under 29CFR134(c) are placed into action.

The employer must develop and implement a written respiratory protection program with required worksite-specific procedures and elements for required respirator use. The program must be administered by a suitably trained program administrator. In addition, certain program elements may be required for voluntary use to prevent potential hazards associated with the use of the respirator.

OSHA recently published a "comprehensive step-by-step guide" for its revised respiratory protection standard compliance guide for small businesses. Intended to help both employers and employees understand OSHA's respiratory protection standard, this 24 page compliance guide contains an explanation of the standard, a sampling program, check lists, and frequently asked questions. According to OSHA, this guide is "advisory in nature, informational in content, and is intended to assist employers by using plain English to explain each provision of the standard, whenever possible. However, technical terms that apply to respiratory protection have legal definitions, as set forth in the Respiratory Protection standard. In this guide, whenever these terms are used, they are used only as they are legally defined."

OSHA indicates that the recently updated standard provides the regulated community with:

- A complete set of definitions that will eliminate confusion about terminology and how these terms apply to respirators and their use;
- Criteria for selecting respirators;
- Revised Assigned Protection Factors (APFs); and,
- Updated Maximum Use Concentrations (MUCs).

According to OSHA, the revised APFs standards clarify when employers may safely place employees in respirators that impose less stress on the cardiovascular system (e.g. filtering face piece respirators). OSHA has indicated that many of these alternative respirators may have the additional benefit of being less expensive to purchase and operate. Furthermore, OSHA concludes that small employers may reach out, at no cost, to OSHA's Consultation Services, for assistance to help them identify and correct hazards, and to improve their injury and illness prevention programs.

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Other News

Lead-Free Solder has Benefits and Drawbacks

By Philip Saunders, Chemical Engineer, HTIS

In 2003 the European Union (EU) implemented a new directive that severely restricts the use of certain materials (lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls, and polybrominated diphenyl ethers) in the manufacture of certain electronic and electrical equipment. This directive, called the Restriction of Hazardous Substances Directive (RoHS), became effective in 2006. Although only enforceable in the EU,

this directive has essentially become a manufacturing standard. With the EU being a major market place for electronics and electrical equipment, manufacturers of such products realized that it made more sense to have a common manufacturing process rather than having one design intended for sale within the EU, and another for sale elsewhere. In addition, non-EU countries have implemented their own regulations that utilize aspects of RoHS, or that prohibit the sale of some or all of the materials that are forbidden by RoHS, thereby making even more sense for companies to comply with the EU's directive.

This article focuses on RoHS's prohibition of the use of lead in electronics that has effectively resulted in banning the use of tin-lead solders that contain more than 0.1% lead. One justification for this prohibition is that when electronic and electrical devices are placed in landfills, their exposure to water may cause the lead to leach out of the solder, and that the resulting contaminated water can find its way into groundwater. The exposure to excessive quantities of lead in drinking water is a major health issue since it can impair physical and mental development in children. Furthermore, lead exposure in children can cause learning disorders. In adults, lead exposure can cause a variety of medical problems and such health effects as high blood pressure, behavior changes, and damage to the nervous, urinary and reproductive systems. Because of the dangers associated with lead, the US Environmental Protection Agency currently allows no more than 15 parts per billion of lead in drinking water.

In addition to the benefit gained by preventing electronics with solder containing-lead from entering landfills and eventually contaminating the water supply, there is also a benefit for people who use lead-free solder. Soldering uses high heat to melt the solder, and that heat also generates fumes that can be inhaled if there is insufficient ventilation or if little or no protective equipment is utilized. If the solder contains lead, then the fumes will also contain lead, so the prohibition of the use of lead in solder will protect both workers and hobbyists from lead exposure when they manufacture or repair electronic equipment. However, there are ramifications of this prohibition other than the effects on the environment and human health.

The lead-solder prohibition aspect of RoHS has been particularly challenging to electronics manufacturers because lead-free solder has different physical properties that can be beneficial or detrimental, depending on the situation. Lead-free solder generally has a higher surface tension than tin-lead solder, and that higher surface tension means that lead-free solder does not flow as readily as one with lead at the same temperature. This increased surface tension has the effect of giving lead-free solder lower wettability (the extent to which a drop of liquid spreads out and flattens on a surface), and longer wetting times (the time the liquid takes to achieve its maximum spread). This can be beneficial since lead-free solder can be applied more precisely because the low wettability means that it does not spread as much as tin-lead solder, and the longer wetting time means that the solder may be able to cool and harden before achieving its maximum spread. The result is improved control over where the solder is applied making it easier to predict how far the solder will spread. This "control" also allows the solder to be placed closer together without coming into contact and creating an unintended electrical connection. In turn, these actions increase miniaturization of electronic devices since more independent solder can be applied within a smaller area.

However, the higher surface tension (and the resulting lower wettability) can also be detrimental because the lead-free solder does not mold itself to exposed surfaces as well as lead-containing solder, and that can reduce the quality of electrical contacts. This means that if a high quality solder is needed, the solder's temperature must be maintained above the melting point (generally higher for lead-free solders) long enough for it to spread sufficiently enough to create a good bond with the electrical contacts. But this action also reduces the precision of the soldering, increases the soldering time, and reduces the number of independent solders that can be applied within restrictive spaces. In addition, the higher melting temperatures for lead-free solder can be an issue if the soldering involves temperature-sensitive materials, because higher temperatures run the risk of warping, melting or otherwise damaging nearby electrical components due to increased thermal stresses.

Since lead-free solder has been in use for a relatively short period of time, it can be difficult to assess the long-term reliability of such materials. However, a known drawback for lead-free solder is that it can grow microscopic hair-like filaments called 'tin whiskers' (see Figure 1). These tin whiskers can form in aging electrical equipment due to the migration of metal atoms due to various stresses such as heat or electrical currents. Tin whiskers can create unintended electrical pathways causing a short circuit if they make contact with other electrical components, and they can cause mechanical failures if they break off and interfere with moving parts. This "whiskering" effect became known in the 1940s, and the addition of lead to solders was discovered to prevent their formation. Since RoHS prohibits the use of lead in solder, this effect has, again, become an issue.

The failures of electronic equipment ranging from military hardware (such as military aircraft radar systems and missile guidance systems) to medical equipment (such as pacemakers) have been attributed to tin whiskers. In addition, tin whiskers caused the failure of a relatively new communications satellite, as well as the shutdown of a nuclear power plant. Some scientists and engineers have also implicated tin whiskers as the cause of several incidents where automobiles suddenly accelerated without input from the drivers. Malfunctions due to tin whiskers can be particularly difficult to diagnose since the problems tend to be idiosyncratic and intermittent because the whiskers can be fragile, but they do regrow.

Most manufacturers of RoHS-compliant equipment will place a label on their products indicating that the device is compliant. Such labels may be used as an indicator that the device is more environmentally friendly, but people who purchase, use and dispose of such items should beware of both their benefits and drawbacks.

To learn more about the impact of lead free electronics on DoD programs, one can review a training course that was presented at the DoD Diminishing Manufacturing Sources and Material Shortages (DMSMS) conference held in Orlando, FL on 29Oct2007, as well as visit the DoD's Executive Lead Free Integrated Process Team Website at http://www.leadfreedod.com.

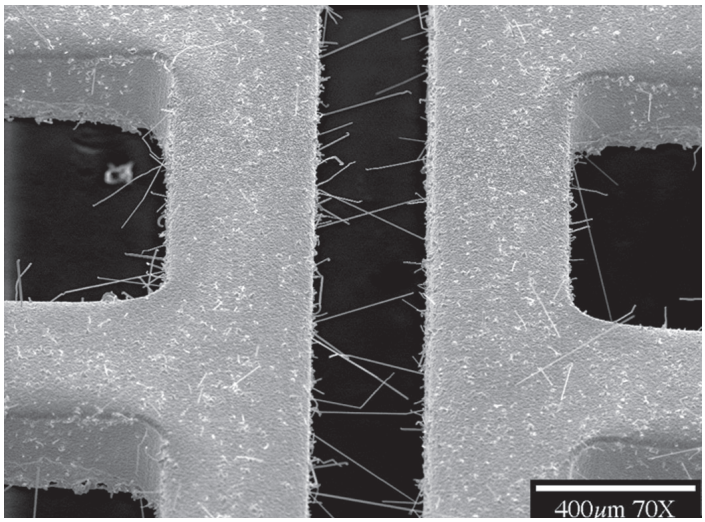

Figure 1. Microscopic hair-like filaments called "tin whiskers" on solder.

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2. "Basic Information About Lead in Drinking Water", US Environmental Protection Agency, http://water.epa.gov/drink/contaminants/basicinformation/lead.cfm

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Insects — Personal Protective Measures

When one reviews the history of wars and military conflicts, one will find that the numerous diseases (e.g., dysentery, typhus, yellow fever, malaria, dengue virus, etc.) that affected deployed units' strength were attributed to disease-carrying arthropods (DCAs). In addition to the diseases themselves, these arthropods (e.g., mosquitoes, sand flies, ticks, etc.) inflicted severe physical, psychological, and economic stresses that threaten the military objectives. Besides the disease itself, the arthropods inflicted bites that were painful, distracting and resulted in secondary infections, dermatitis, or allergic reactions. Also these same arthropods contaminated food as well as other assets necessary for the sustainment of both personnel and the mission.

To assist military personnel in protecting themselves and their respective units against insects and other arthropods of military significance, the Defense Pest Management Information Services Division of the Armed Forces Pest Management Board (AFPMB) has produced an updated (Oct 2009) Technical Guide (TG) No. 36 (http://www.afpmb.org/content/technical-guides). This TG provides preventive medicine information and guidance to DoD personnel who may come in contact with nuisance or DCAs (i.e., disease vectors), or who are responsible for protecting the health of personnel. It describes the DoD Insect Repellent System (IRS) and other techniques that provide maximum, safe protection from arthropod attack. These techniques include the use of protective clothing and equipment, repellents, pesticides, and other strategies.

One needs to recall that AFPMB's Technical Guides are not policy documents, but serve to provide the DoD pest management community and others with technical guidance.

In addition to a table that lists the arthropods of military importance and the major diseases that they transmit, the TG contains figures (27 in all) that illustrate various techniques/protocols associated with personal protective measures. Following the introduction that focuses on arthropods of military significance as well as individual and organizational responsibilities for personal protection, the TG addresses the subject of methods of protection in six sections covering the following six major topics: Section II – Avoidance; Section III – Physical Barriers; Section IV – Repellents; Section V – Ineffective and Hazardous Practices; and Section VI – Pesticide Reduction through Physical / Mechanical Modifications and Sanitation.

These six sections are further divided in subsections that discuss or illustrate the major topic in greater detail. For example, under the topic of "Avoidance" in Section II, one finds beneficial information on: 1) Field Strategies, 2) Information Sources, and 3) Emergency Requisition of Repellents and Pesticides; while in Section V, one learns that troops widely use, a number of commercial products that are either not marketed for personal protection, or are not very effective repellents, for personal protection purposes. Such products are less effective than those containing N, N-Diethyl-meta-toluamide (DEET), and they may be hazardous when used in a manner not approved by the label. Products with concentrations in the range of about 20% to 40% DEET provide an appropriate mix of effectiveness and duration of protection. Within this range of concentration, percent active ingredient generally translates to duration of protection.

With the brief background provided above, let us consider DoD's IRS. The DoD IRS consists of three sequential steps that result in maximum personal protection: 1) applying Permethrin on the Uniform; 2) applying DEET on the Exposed Skin; and, 3) wearing the Uniform Properly.

Figure 1a. Permethrin Aerosol, 0.5% per 6oz. can. NSN 6840-01-278-1336

Figure 1b and 1c. Applying permethrin aerosol to the field uniform.

Step 1 consists of: treating one's uniform (ACUs, BDUs, DCUs) with the standard military clothing repellent (permethrin) identified as the Individual Dynamic Adsorption (IDA) kit (NSN 6840-01-345-0237). This permethrin impregnation kit contains 40-percent permethrin; and one kit treats one uniform, and the treatment lasts through approximately 50 washes of the uniform (generally considered the combat life of the uniform). If the IDA kit is not available, one uses the Aerosol Spray Can, NSN 6840-01-278-1336, containing 0.5-percent permethrin. One application of approximately three quarters of a can lasts through 5-6 washes of the uniform. Following all label directions, one should treat one's uniform PRIOR to deploying. DLA's Troop Support Supply Chain is the DoD Primary Inventory Manager (PICA) for non-treated as well as factory-treated uniforms. One can contact the AFPMB for details.

Step 2 requires one to apply a thin coat of standard military skin repellent containing DEET to all areas of the exposed skin. The NSN for this repellent is 6840-01-284-3982 (2 oz. /3M Ultrathon™), and it consists of a 33% controlled-release DEET lotion. One application protects for up to 12 hours depending on the climate. As in step one, one should follow label directions on the container. Additional NSNs in which DEET is present are: 6840-01-584-859 (23% - 6oz. pump / Backwood Cutter®) and 6840-01-8393 (30% - 2 oz./Ultra30:LipoDEET).

Step 3 involves the proper wearing of one's uniform since it acts as a physical barrier against insects. The sleeves should be rolled down, and all openings in one's clothing that might provide access to insects should be closed. Pants should be tucked into one's boots, and undershirt into one's pants. Finally, one should wear one's uniform loosely since some insects (e.g., mosquitoes) can bit through the fabric if the uniform is pulled tightly against the skin.

Section VII of the TG is succinct in its summary - "Conscientious use of the DoD Insect Repellent System and the other protective measures described in this TG, will provide maximum, safe protection from arthropod attack".

In closing, DLA's Aviation Supply Chain's Chemical-Petroleum/Gases-Cylinders Integrated Supplier Team (IST) at the Defense Supply Center Richmond (DSCR) manages the above cited NSNs. Mr. Clifford Myers, the DLA Aviation Supply Chain's as well as alternate HQ. DLA's representative to the AFPMB, is the lead chemist responsible for the technical and quality oversight of the above cited NSNs and other assets in Federal Supply Classes (FSCs) 3740 (Pest Disease, Frost Control Equipment) and 6840 (Pest Control Agents and Disinfectants).

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1. Armed Forces Pest Management Board, Technical Guide 36 (updated Oct2009) –"Personal Protective Measures Against Insects and Other Arthropods of Military Significance". http://www.afpmb.org/content/technical-guides

2. USA Public Health Command Fact Sheet – "DoD Insect Repellent System", June 2007, http://phc.amedd.army.mil/topics/envirohealth/epm/Pages/DoDInsectRepellentSystem.aspx

Figure 1. Standard Military Skin Repellent, 33-Percent DEET, 2-Ounce Tube Extended-Duration, NSN 6840-01-284-3982

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