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# Department of Defense's Bio-based Hydraulic Fluid Initiatives

*By Iris Garcia Labuda, Chemist, Hazardous Minimization and Green Products*

The Farm Security and Rural Investment Act of 2002, Section 9002 (Public Law 107-17), better known as the 2002 Farm Bill, was expanded by the Food, Conservation, and Energy Act of 2008 to establish a bio-based market program to increase the purchase and use of bio-based products. The Farm Bill defines a bio-based product as "a product determined by the Secretary of Agriculture to be a commercial or an industrial product (other than food or feed) that is composed, in whole or in significant part, of biological products or renewable domestic agricultural materials (including plant, animal, and marine materials) or forestry materials". The Farm Bill also directed the Department of Agriculture (USDA) to take the lead in those efforts, and named the mandated program the BioPreferred Program. In addition to the Farm Bill, Presidential Executive Order 13514 – Federal Leadership in Environmental, Energy, and Economic Performance, and the Federal Acquisition Regulation (FAR) mandate that the Federal government and its contractors purchase bio-based products. The USDA BioPreferred Program includes a preferred procurement program for Federal agencies and their contractors, and a voluntary labeling program for the broad scale consumer that can also be used by Federal agencies and contractors in their bio-based procurements.

When the Farm Bill was initially enacted, elements within the Department of Defense (DoD) responsible for its implementation began expressing concerns about the potential for its non-uniform interpretation and application. To alleviate the possibility for both interpretive and application challenges with respect to the regulations, the Defense

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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.

Logistics Agency (DLA) in collaboration with the Military Services established the DoD Bio-based Hydraulic Fluid Working Group in 2006. The Working Group serves as a communication and collaboration medium that promotes a coordinated DoD response to regulations for procuring bio-based products, as well as encourages DLA to provide bio-based hydraulic fluids to its DoD customers.

Currently, the Hazardous Minimization and Green Products Branch in the Hazardous Information Program Division of the Aviation Engineering Directorate (DLA Aviation Supply Chain) has partnered with the Naval Facilities Engineering Service Center (NFESC) at Port Hueneme, CA, to assist in the develoment of the new bio-based hydraulic fluids specifications that will fulfill the regulations for more procurement and usage of bio-based products. Because of the complexity of the task at hand, NFESC has secured the services of Dr. Lou Honary and his laboratory at the National Agriculture-Based Lubricants (NABL) Center, a division of the University of Northern Iowa, to work on developing testing protocols for the new bio-based hydraulic fluids specifications. Dr. Honary, an applied researcher and professor, is a widely recognized leader in the field of vegetable-based (primarily soybean) lubricants and greases. The new specifications that are being developed by Dr. Honary will possibly replace the 11 petroleum based hydraulic fluid military specifications that exist today. The 11 petroleum based specifications that are being studied are as follows:

- A-A-59354 – Hydraulic Fluids, Petroleum Base, for Machine Tools;
- MIL-PRF-87257 – Hydraulic Fluid, Fire Resistant, Low Temperature, Synthetic Hydrocarbon Base, Aircraft and Missile;
- MIL-PRF-32073 – Hydraulic Fluid Biobased;
- MIL-PRF-17672 – Hydraulic Fluid Petroleum inhibited;
- MIL-PRF-5606 – Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordnance;
- MIL-PRF-46170 – Hydraulic Fluid, Rust Inhibited, Fire Resistant, Synthetic Hydrocarbon Base, NATO Code H-544;
- MIL-PRF-6083 – Hydraulic Fluid, Petroleum Base, for Preservation and Operation;
- MIL-H-19457 – Hydraulic Fluid, Fire Resistant, Non-Neurotoxic;
- MIL-H-81019 – Hydraulic Fluid, Petroleum Base, Ultra-Low Temperature, Metric;
- VV-C-846 – Cutting Fluids, Emulsified Oils; and,
- A-A-59290 – Hydraulic Fluid, Arresting Gear.

Under the BioPreferred Program, the USDA designated 83 product categories that are divided into seven rounds. An eighth round with 19 product categories has been proposed and is being reviewed for comments. These product categories are groupings of bio-based products that consist of several individual products. Each of the product categories has a minimum bio-based content standard that must be met for the product to be considered bio-based. Simply stated, the bio-based content is the amount of bio-based renewable carbon, as opposed to fossilized carbon in the material or product, and is determined in accordance with test standard ASTM D6866. If a product category is not established for a specific product, that product must meet the 25% minimum bio-based content standard, as stated in the Farm Bill for it to be considered bio-based. Once the product has met this requirement or the corresponding requirement under its product category, the manufacturer can use the USDA certified bio-based label on its product (See Figure 1 sample). The label only certifies that the said product has been tested in accordance with test standard ASTM D6866, and meets the corresponding bio-based percent content standard for that product category, or a minimum of 25%. This is crucial for the military services and Federal agencies to understand when using the USDA Bio-Preferred Catalog for their procurements. The product still needs to meet any associated, established military specification required by the Government. Failing to meet the Government performance standards is one of the exceptions for Federal agencies not to consider bio-based products in their procurements. The Farm Bill sites two other exceptions: the items are not reasonably available within a reasonable period of time, or the items are available only at an unreasonable price.

**Figure 1.** Sample of USDA certified bio-based label for federal procurement

Members or stakeholders of the Bio-based Hydraulic Working Group continue to meet to discuss the objectives of the group, the strategy needed to accomplish the task at hand, what efforts have been realized, and stakeholders' concerns. Dr. Honary met with the Working Group to present the results of the NABL's work on the development of the test protocols that will be helpful in establishing bio-based specifications. He also gave a presentation on the differences between bio-based and petroleum based lubricants, differences that are important in understanding why there is a lack of data for developing these bio-based specifications, and why there is a need for additional laboratory testing. Field demonstrations to validate the new bio-based specifications were discussed as being part of the project. Once the task at hand is completed, 'green' National Stock Numbers (NSNs) will be assigned and be available thru DoD's E-MALL, and other military requisition systems for procurement by the military services and other federal agencies.

As Dr. Honary and his team continue to move forward with these efforts, DLA and the Navy are looking for additional stakeholders (i.e., petroleum based hydraulic specification custodians/owners and user community) that have a strong interest in the work at hand, have well-rounded technical knowledge on the hydraulic fluids, and are currently using the listed petroleum based hydraulic specifications. This will help in addressing operating issues unknown to those working on the project. The more involvement there is by the DoD community, the greater the success will be in bringing bio-based hydraulic fluids on board. Remember, it is the law to show a preference for purchasing bio-based products over petroleum based products when they meet the user's requirements, are delivered in a timely manner, and the price is right.

For additional information on DoD's Bio-based Hydraulic Fluids or the Working Group, please contact:

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1. Farm Bill website: http://www.nationalaglawcenter.org/farmbills

2. Executive Order website: http://www.archives.gov/federal-register/executive-orders/index.html

3. Federal Acquisition Regulations website: https://www.acquisition.gov

4. USDA BioPreferred Program website: http://www.biopreferred.gov

5. Test standard ASTM D6866 website: http://www.asatm.org

6. Military specifications website: http://www.assist.daps.dla.mil/online/start

7. DoD E-mall website: http://www.emall.dla.mil

## Environmental News

### EPA Releases —
## 2012 TSCA Work Plan Chemicals

*By Abdul H. Khalid, Chemical Engineer, HTIS*

On March 1, 2012, the Environmental Protection Agency (EPA) announced the availability of its Toxic Substances Control Act (TSCA) Work Plan Chemicals. TSCA Work Plan Chemicals are chemicals that the EPA has identified as meeting its requirements for having a risk assessment performed. The Work Plan explains the hazard, exposure, persistence/bioaccumulation criteria, the data sources used, and the manner in which the selected chemicals were scored. The EPA made efforts to have a comprehensive approach to enhance the Agency's current chemicals management program. The TSCA Work Plan Chemicals are available online at: http://www.epa.gov/oppt/existingchemicals/pubs/Work_Plan_Chemicals_Web_Final.pdf.

To date, there are 83 chemicals that have been approved for risk assessment under the Plan, and seven of these have been identified for a risk assessment in 2012. In February 2012, the EPA also issued its "TSCA Work Plan Chemicals: Method Document" and the "Existing Chemicals Program Strategy". The EPA's existing chemical programs address pollution prevention, risk assessment, hazard and exposure assessment and charaterization, and risk management for chemicals substances and mixtures on the TSCA Inventory. The EPA will complete some of the assessments this year, and initiate new assessments from the work plan in the coming years. The seven chemicals that are being assessed are:

- Antimony and Antimony Compounds;
- HHCB (1,3,4,6,7,8-Hexahydro-4,6,6,7,8,8,-hexamethyl-cyclopenta[g]-2-benzopyran);
- Long-Chain Chlorinated Paraffins;
- Medium-Chain Chlorinated Paraffins;
- Methylene Chloride;
- N-Methylpyrrolidone; and,
- Trichloroethylene.

In conducting risk assessments on the seven chemicals, the EPA used information that is available through the data sources cited in the TSCA Work Plan Chemicals Methods Document, as well as other sources. The EPA welcomes the submission of additional relevant information, such as unpublished studies, on these chemicals. To meet the schedule for the completion of risk assessments this year, any relevant information should have been submitted to the Agency on or before March 30, 2012, to be included in the review process. The EPA anticipates issuing draft risk assessments for public review and comments as they are completed. If an assessment indicates significant risk, the EPA will evaluate and pursue appropriate risk reduction actions, as warranted. If an assessment indicates no significant risk, the EPA will conclude its current work on that chemical. Over time, additional chemicals will be added to the work plan as more data are developed and more chemicals screened.

The process which the EPA adopted emphasizes focusing on chemicals that meet one or more of the following factors:

- Potentially of concern to children's health (for example, because of reproductive or developmental effects);
- Neurotoxic effects;
- Persistent, Bioaccumulative, and Toxic (PBT);
- Probable or known carcinogens;
- Used in children's products; and,
- Detected in biomonitoring programs.

The EPA also considers the following other factors when evaluating chemicals for the work plan:

- Whether the chemical was identified as a "High" ranking chemical.
- Whether the chemical reflects more than one of the factors identified in Step 1 (e.g., chemicals that were identified as a potential concern for children's health and also were persistent, bioaccumulative, and toxic) and whether each of the factors was covered by the set of chemicals.
- Whether certain chemicals, or groups of chemicals, would benefit from some preliminary work to assure that risk assessments are targeted and scoped appropriately, and therefore would best be addressed in an out year.
- Whether certain chemicals, or groups of chemicals, have previously been assessed and addressed by the Agency, so that risk assessment in later years may be more appropriate than in the earlier years of the work plan.
- Agency work load considerations, including scope and timing of work needed on specific chemicals, and existing commitments for assessment.

Besides the identification of chemicals under TSCA's Work Plan Chemicals, the EPA would consider other chemicals for risk assessment, and potential risk management action under TSCA and other applicable statutes. The EPA will also continue to use its TSCA information collection, testing, and subpoena authorities including sections 4, 8, and 11(c) of TSCA, to develop needed information on additional chemicals for which less than robust hazard or exposure data exist.

**References:**

1. Enhancing EPA's Chemical Management Program, website at: http://www.epa.gov/oppt/existingchemicals/pubs/enhanchems.html.

2. TSCA Work Plan Chemicals: Method Document, website at: www.epa.gov/oppt/existingchemicals/pubs/wpmethods.pdf3. The TSCA Work Plan Chemicals at: http://www.epa.gov/oppt/existingchemicals/pubs/Work_Plan_Chemicals_Web_Final.pdf.

## Occupational Safety & Health News

### OSHA Selects — New Training Program Providers

*By Abdul H. Khalid, Chemical Engineer, HTIS*

Potential workplace hazards and disasters can be avoided by the proper safety and health training of all employees. To help keep American workplaces free from injuries and illness, the U.S. Occupational Safety and Health Administration (OSHA) selected ten training providers to deliver 25 online courses as part of its "Outreach Training Program". This Program teaches workers how to identify, prevent, and eliminate workplace hazards, and it also informs workers of their rights, employers' responsibilities, and the manner in which to file a workplace safety complaint.

The online courses are not a part of OSHA's regulations, and they are voluntary as well as advisory in nature. However, these courses do provide training that can help in protecting workers' safety and health, and can assist employers reduce the high costs of workers injuries and illnesses if the employees are fully trained to include additional training on hazards related to their specific job requirements.

The selected training organizations offer online courses in 10-hour and 30-hour classes in three industry areas: Construction,

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General Industry, and Maritime. Web-based distance learning courses provided by OSHA authorized organizations have become very popular, and more than 135,000 workers took the online courses in 2011. Access to the courses and other information about the program are available at: http://www.osha.gov/dte/outreach/courses.html.

The 10-hour classes are intended for entry level workers, while the 30-hour classes are more appropriate for supervisors or workers with some safety responsibility. Through this training, OSHA helps to ensure that workers become more knowledgeable about hazards in their respective workplaces, as well as their rights were unsafe practices or injuries to occur.

The newly selected OSHA-authorized Outreach Training Program online training providers are:

- Construction 10-Hour: Advance Online Solutions, Career Safe, Click Safety, Compliance Solutions, Pure Safety, Safety Unlimited, and Texas Engineering Extension Service.
- Construction 10-Hour Spanish: Click Safety and Pure Safety.
- Construction 30-Hour: Advance Online Solutions, Click Safety, Pure Safety, Texas Engineering Extension Service, and Turner Knowledge Network
- General Industry 10-Hour: Advance Online Solutions, Career Safe, Click Safety, North Carolina State University, Pure Safety, Safety Unlimited, and Texas Engineering Extension Service.
- General Industry 30-Hour: Advance Online Solutions, Click Safety, and Pure Safety.
- Maritime 10-Hour: Moxie Media.

This OSHA Outreach Training Program allows employers and employees to become familiar with current safety and health policies as well as with the latest OSHA standards. In addition, the training program also provides practical hands-on experience that helps to keep working personnel safe and alert for potential workplace hazards and disaster that could happen due to negligence on the part of employees and/or employers.

**References:**


1. OSHA Trade News Release, January 12, 2012 "OSHA announces new online Outreach Training Program Providers, website at: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=NEWS_RELEASES&p_id=21636

2. OSHA Outreach Training Program Requirements, website at: http://www.osha.gov/dte/outreach/program_requirements.html

3. OSHA Training Institute website at: http://www.osha.gov/dte/edcenters/index.html.

4. OSHA Authorizing Training Organizations, website at: http://www.osha.gov/dte/outreach/ato.html


## Other News

# A General Concept of Batteries

*By Noel Romey, Chemical Engineer, HTIS*

Battery technology is all around us, and in most cases, we encounter batteries on a daily basis. Batteries are in our pocket sized smartphones, in our homes, in our laptop computers, and in our vehicles. They are the workhorse for many tasks, and they keep economies and infrastructure ticking in our "on the go" society. They are also paramount to the defense industry, supporting communications, transportation, and other vital military needs. There is one thing that you, the user must know about batteries: no matter how small or how large they are, no matter the application, they all power our "stuff" with chemistry. Chemical reactions, proper to the chemical make-up of battery, are the source of "power". In this article, we will briefly consider several different battery chemistries that are available and where they are used, as well as briefly touch on the new batteries that may be powering the phone, digital camera, or car of the future.

Let us get started with the basics of battery chemistry. Electrochemistry is the science that is central to studying batteries. Electrochemistry and all of its nuances are beyond the scope of this article, but all batteries essentially follow the basic rules of electrochemistry. Electrons flow through a conductive electrolyte downhill relative to potential, from a positive potential to a negative one. We see this electropotential behavior in our bodies as travelling electrons use salts, minerals, and other electrolytes to trigger neuron impulses and "power" our muscles, thoughts, and actions. All batteries have two dissimilar or unlike electrode metals or substances, the *Anode* (oxidation occurs) and the *Cathode* (reduction occurs); see Figure 1.

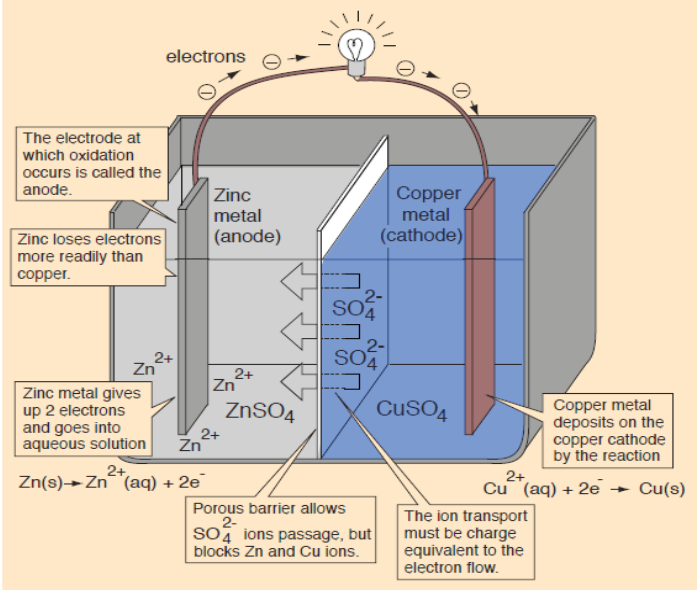


**Figure 1.** Basic battery electrochemistry

Each dissimilar metal produces a set voltage based on metal type. A lithium ion rechargeable battery, that is common in handheld electronics and contains a metallic lithium anode and a manganese dioxide ($MnO_2$) cathode with a lithium salt dissolved in a solvent, has a cell voltage of 3.65 volts. Lead acid batteries, used in cars and trucks, produce 1.6 volts per cell when first used, and then decrease over time and/or electric load. These cells are usually connected in series to equal the target voltage for an application. Over time, fouling of the electrodes within a battery occurs decreasing the surface area of the electrodes available to an electrochemical reaction. In a non-rechargeable battery, once the voltage drops below the threshold value, a battery becomes unusable. Rechargeable batteries, however, can be returned to their original charged condition by applying voltage to the battery that reverses the electrochemical reaction, and allows the battery to become "like new" again. Most rechargeable batteries can withstand many recharge cycles before disposal, and the battery industry spends a considerable amount of money to increase both the time between charges and the total charge cycles for these battery types.

Battery electrolytes can be solids, pastes, or liquids, and the availability of these three forms lead to different battery configurations and applications. Gone are the days where batteries used in telegraphy or railroad switching systems consisted of jars full of acidic liquid. Today's demanding "on-the-go" society requires batteries that operate in the pocket, on the road, and in the air. Many consumer products use dry cells such as button cells found in watches and other small electronics, as well as AA and AAA alkaline and lithium batteries used in cameras and other handheld electronics and flashlights. Dry cells achieve electrolytic transport by using a conductive paste. In this configuration, the battery casing is hermetically sealed, and therefore, can be operated in virtually any orientation. Car batteries are generally lead acid batteries, and use a water soluble electrolyte *sulfuric* acid — ($H_2SO_4$) in most cases. These batteries can only operate in upright orientations due to their susceptibility to spilling. New lead-acid battery designs are nonspillable, and incorporate the electrolyte within a grid or glass mat. In this configuration, the cathode and anode plates are in contact with the electrolyte enough to facilitate an electrochemical reaction, but do not spill or leak. Some of these batteries are used in aviation and marine applications that require large current draws, and others are deep cycle batteries that must operate in emergency situations or remote locations. No matter what one does, one will encounter battery technology in many forms, sizes, and configurations as technology improves and advances. Knowing the basics of battery technology can help one to understand more about a device, and why or how it ticks.

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1. Wiberg, Egon, Wiberg, Nils, and Holleman, Arnold Frederick – A Textbook of Inorganic Chemistry, Academic Press (2001) ISBN 0-12-352651-5. Wiberg, pp. 215-216;

2. Lithium Battery Production –Protomatic.com – http://www.protomatic.com/markets/alternative-energy/batteries. Retrieved 01.19.2011; and,

3. Batteries for Medical, Consumer, Hobbyist – http://batteryuniversity.com/learn/article/batteries_for_medical_consumer_hobbyist

## Military Battery Applications and Logistics

*By Noel Romey, Chemical Engineer, HTIS*

The Warfighter relies on the roar of a jet engine, the purr of a troop transporter, and the glow of a handheld computer screen to get the job done overseas and at home. These days, the technology that underlies our military might is powered, at least initially, with batteries. Batteries provide power to start generators that start jet engines, batteries turn tank and truck engine starters, and batteries power electronic devices like night vision goggles and pocket tactical computers. As technology progresses, batteries will become even more essential to the success of the war-fighter. Batteries will power combat robots, and aerial surveillance aircrafts that are powered by solar cells in the day and battery power at night. In short, the military, and frankly life as we know it, would come to a "screeching halt" without the electrical "juice" provided by batteries. This article will briefly review military battery applications, and how supply logistics works to get these essential items to the warfighter, when and where they are needed.

Millions of items are cataloged in the Defense Logistics Agency's Federal Logistics Information System (FLIS). From backpacks to batteries, this system is designed to help identify and organize items so that anyone involved in the requisitioning, procuring, receiving, storing, and distributing the desired asset can proceed in an orderly fashion. This cataloging system all starts with the national stock number (NSN). This NSN consists of two parts: the federal supply class (FSC), and the National Item Identification Number (NIIN). The FSC classifies items by form, fit or function. Currently, there are a total of 665 federal supply classes, three of which address batteries per se. FSC 6135 deals exclusively with non-rechargeable batteries, while FSC 6140 encompasses rechargeable batteries, and FSC 6240 includes batteries contained with or in equipment. Before explaining what these items actually are within these three supply classes, it is important to be able to understand the "rest" of the story when it comes to the NSN. The NIIN is a unique nine digit number that identifies the actual item of interest. Items are assigned an NSN either based on specific technical characteristics i.e. for batteries, voltage, battery type, or battery application, or may be part number specific to a manufacturer as appropriate to an application.

In an effort to continue to do more with less, military services desire to use batteries that are more efficient for the task at hand, while striving to be more effective. In searching the DLA Logistics Information Services (DLIS) FLIS database for the major battery FSCs, it is apparent that this practice is in full swing. To decrease the number of batteries that must be procured, rechargeable batteries are used in lieu of their non-

rechargeable counterparts. Examples of non-rechargeable batteries include alkaline dry cells such as AA, AAA, C and D that are used to power flashlights and other electronics. These batteries can be used for one charge cycle and must be disposed of properly. These batteries are less expensive than their rechargeable counterparts at the outset, but due to their single use characteristics, the U.S. government prefers to procure those batteries that can be recharged. The vast majority of new batteries applications that are rechargeable contain lithium components, but the military still uses some nickel cadmium (NiCd) or Nickel Metal Hydride (NiMH) batteries for certain applications. Lithium batteries are the most expensive rechargeable batteries supplied to the military, but they generally have longer shelf lives than other alternatives, and suffer fewer problems than other non-lithium rechargeable battery technologies that have battery memory effects. Battery memory effect is a phenomenon, sometimes called "voltage depression". The battery voltage depression will, over time, decrease the battery's life as well as the time between charges. Lithium batteries also have a higher power density than batteries having non-Lithium chemistries (3.6 volts for Lithium based batteries, 1.6 for alkaline). This means that fewer battery cells may be needed for the same application, and can therefore be packed into a smaller, lighter package. Rechargeable batteries seem to be the trend for many military applications of the future.

The two figures below show the various sources of supply (SOS) for unique products (NSNs) by service for rechargeable (Figure 1) and non-rechargeable (Figure 2) batteries. For both battery types, the Defense Logistics Agency (DLA) is DoD's primary logistical source of supply. Within the DLA, the Land-Maritime Supply Chain, located at the Defense Supply Center Columbus (DSCC), is the Primary Inventory Control Activity (PICA) for most of the DLA managed batteries. DLA's Troop Support Supply Chain (Medical) and Aviation Supply Chain manage batteries unique to their supply chain specialization. DLA currently actively buys over four times as many recharge

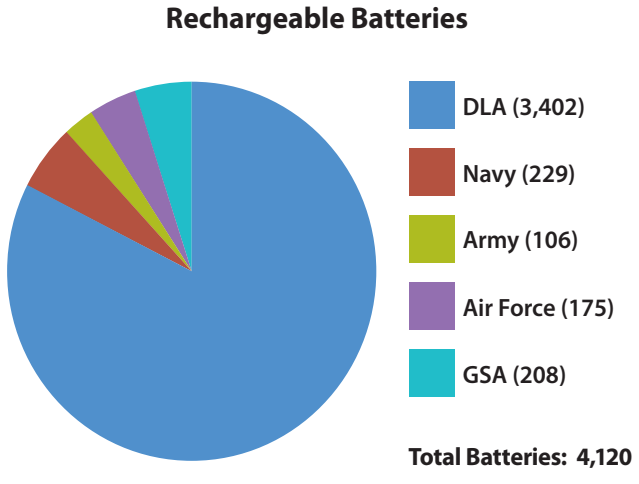


**Figure 1.** Battery source of supply percentage contributions by service component for rechargeable batteries, FSC 6135.

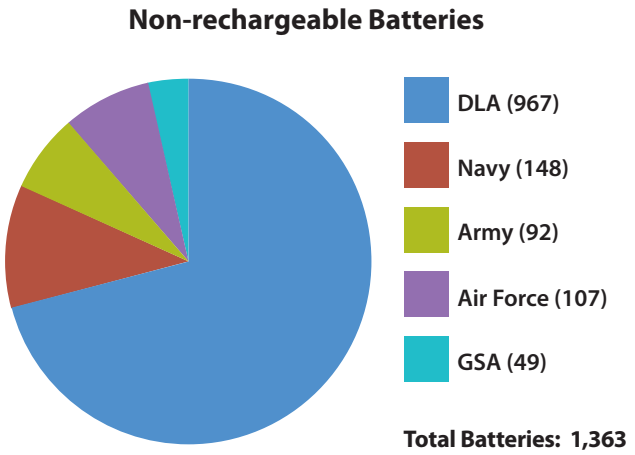


**Figure 1.** Battery source of supply percentage contributions by service component for non-rechargeable batteries, FSC 6135.

able versus non-rechargeable batteries, and this trend will most likely continue as battery technology improves over time.

Reviewing the FLIS data for a particular battery using the publicly accessible portion of WEBFLIS, or Information Handling Services' (IHS) Haystack Gold (subscription required) can help one requisition the appropriate battery for one's particular military application. As always, one needs to review the Technical Manual or Orders associated with a particular end item / platform / system to determine if a particular NSN is to be utilized as a power source. In most cases, one discovers that WEBFLIS can be used for basic searches and information, while Haystack Gold can provide more specialized information and search capabilities with access to multiple databases combined on one screen. One finds information such as technical characteristics (voltage, physical dimensions, battery composition, etc.), source of supply, or Acquisition Advice Code (AAC). The AAC is the code that describes the way an item is acquired whether it be directly delivered to the customer under a central contract (H), or centrally procured and stocked (D), or centrally procured and not stocked (J), or even local procured (L), etc. One need not fear the multiple acronyms, codes, and numbers that one confronts when viewing data. Both platforms make "decoding" the alphabet soup that makes up the Total Item Record (TIR) a snap—no PhD. required. In addition, these databases are nicely hyperlinked with definitions, "decoder rings and gadgets" that should make one's life as a battery logistician more manageable.

Whether or not one works on a dock, at a desk, on a flight line, or in a shipyard, one will be exposed to myriads of batteries in multiple sizes, shapes, and battery chemistries. Although one may not have the knowledge or experience that is necessary to determine the exact battery for one's application or how to order it, it is hoped that the basics of battery logistics, in this article, will be available to you for future reference. There are many lifelines that our forces depend on every day, but the battery supply lifeline is one that will be required to power our military's success now and into the future.

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The HTIS Bulletin is produced bimonthly. If you have questions or would like to communicate with us, mail us your requests, call, email, or visit us on the WEB using the contact information to the right.

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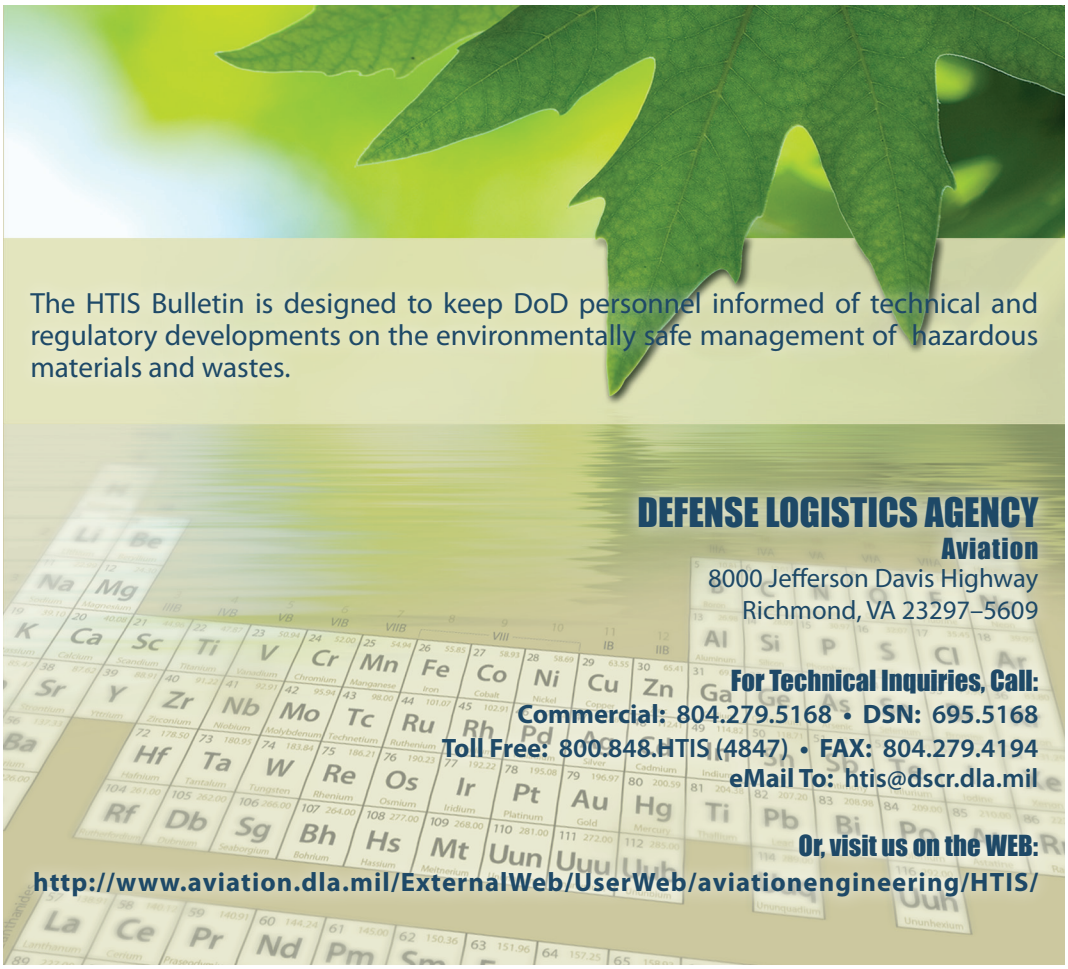
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