

UNIFIED FACILITIES CRITERIA (UFC)

PETROLEUM FUEL SYSTEMS MAINTENANCE



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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND \1\1/

AIR FORCE CIVIL ENGINEER CENTER \1\ (Preparing Activity)/1/

Record of Changes (changes are indicated by \1\ ... /1/)

Change No.	Date	Location
<u>1</u>	<u>29 April 2021</u>	<u>Chapter 1, 2, 3, 4, 5, 6, 7, 8, 11, Appendix A, Appendix B, Appendix C, Appendix G, Appendix I, Appendix J. Changes incorporated CCR and administrative changes.</u>

This UFC supersedes UFC 3-460-03, dated 21 January 2003.

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with [USD \(AT&L\) Memorandum](#) dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), host nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: [Criteria Change Request](#). The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source: Whole Building Design Guide web site <http://dod.wbdg.org/>.

Refer to UFC 1-200-01, *DoD Building Code*, for implementation of new issuances on projects.

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CHANGE SUMMARY SHEET

Document: UFC 3-460-03, *Petroleum Fuel Systems, Maintenance*, Change 1

Superseding: UFC 3-460-03, dated 21 January 2003

Description: Unified Facilities Criteria (UFC) 3-460-03 contains general inspection and maintenance criteria for military land-based liquid petroleum fuel facilities. It also applies to facilities dispensing Liquefied Natural Gas (LNG) and Compressed Natural Gas (CNG) for ground vehicle fueling. These criteria are applicable to all branches of the Department of Defense (DoD) and the Defense Logistics Agency (DLA).

Reasons for Document: UFC 3-460-03 was developed to harmonize requirements and guidance documents from the Army, Navy, U.S. Marine Corps, Air Force, industry guidelines, standards and codes. Creating a true unified criteria allows military services to define the required tasks for contractors and government personnel in maintaining petroleum fuel facilities.

Other military publications reviewed during the update to UFC 3-460-03 include United States Air Forces in Europe (USAFE) *Volume 1 General Description and Operation*; USAFE *Volume 2 Maintenance and Repair*; Standardization Agreement (STANAG) 3609 *Standards for Maintenance of Fixed Aviation Fuel Receipt, Storage and Dispensing Systems*; United States Air Force (USAF) Air Force Instruction (AFI) 23-204 *Organizational Fuel Tanks*; USAF Technical Order (TO) 37-1-1 *General Operation and Inspection of Installed Fuel Storage and Dispensing Systems*; and Unified Facilities Guide Specifications (UFGS).

Several industry standards, recommended practices, and codes have been incorporated into UFC 3-460-03 criteria including: American Petroleum Institute (API), Airlines for America (A4A), Energy Institute (EI), National Association of Corrosion Engineers (NACE) International, Petroleum Equipment Institute (PEI), Society of Automotive Engineers (SAE) International, and the Steel Tank Institute (STI).

Impact:

- Provides the requirements for tasks and frequencies for the inspection and maintenance of Petroleum Fuel Systems and components such as aircraft hydrant systems, tanks, and pipelines.
- Provides checklists for the inspection and maintenance of Petroleum Fuel Systems.
- Provides fuel quality, safety, environmental, fire protection guidance to follow during the inspection and maintenance of Petroleum Fuel Systems.

Unification Issues: The Army, Navy, U.S. Marine Corps, and Air Force could not unify on tank cleaning requirements listed in [Section 8-7](#). The Air Force will require fuel tanks above 20,000 gallon in capacity to be cleaned on a 10 year cycle. The Army, Navy, and U.S. Marine Corps will require tanks to be cleaned during out of service inspections. The period of out of service inspections may vary depending on the type and condition of each tank.

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE.

1-1.1 Introduction.

Clean, water-free fuel of the correct grade is essential to the safety of vehicles, ships and aircraft, and their operators and personnel. This manual emphasizes inspection and preventive maintenance to avoid system shutdowns, prevent fuel contamination, and decrease fire, safety, and health hazards. Periodic inspections and maintenance are essential to continue efficient safe operations and reduce major repairs.

1-1.2 Applicability.

UFC 3-460-03 applies to all real property facilities used for storing, distributing, and dispensing fuels for reciprocating and jet engine aircraft, automotive fuels, lubricating oils, and diesel fuel.

1-1.3 Scope.

This manual establishes the minimum inspection and maintenance standards for fueling systems and applies to all active installations. If the installation is in an inactive or surplus status, reduce maintenance standards to a point consistent with the anticipated mission.

1-1.4 Design Criteria.

This is not a design manual. Refer to UFC 3-460-01 for current design and construction standards.

1-2 ROLES AND RESPONSIBILITIES.

A role is a position or job defined by a set of responsibilities. A responsibility is a task or duty required of a designated party. Military services delegate tasks differently to military service-specific petroleum fuel personnel, contracted operations personnel, or maintenance contractors.

UFC 3-460-03 defines minimum maintenance tasks and their frequency. The criteria outlined within UFC 3-460-03 must be accomplished by DoD personnel (active duty/civilian) and/or DoD contractors.

The Command Authority (i.e., Army, Navy, U.S. Marine Corps, Air Force, and/or DLA) defines how tasks are divided among personnel at each facility. DoD 4140.25-M provides requirements applicable to all DoD fuel facilities.

1-2.1 Operational Tasks.

Operational tasks are actions taken to control and run the petroleum fuel system on a day-to-day basis. These tasks include monitoring control systems, bulk issue and receipt, and storage of petroleum fuel. Operating tasks help ensure the safety of personnel and the environment. Operating tasks often include specific measures to maintain petroleum fuel quality.

1-2.2 Maintenance Tasks

Maintenance tasks are recurring, daily, periodic, or scheduled work required to: preserve a facility, prevent deterioration, prevent component failure, prevent unscheduled outages, and identify components requiring replacement or repair. Maintenance tasks involve: routine inspection, testing of petroleum fuel systems, and identifying required repairs. Maintenance tasks help ensure product quality, safe working conditions, and environmental safety.

Maintenance tasks are separated into Operator Maintenance (OM) and Systems Maintenance (SM). OM is normally performed by facility operator personnel as part of normal use. SM is normally performed by trained personnel of base facility maintenance, facility operating contracts, or maintenance contracts for recurring maintenance and repair. Military services can delegate maintenance tasks between OM and SM differently. [Appendix C](#) includes a list of maintenance tasks included in this UFC and their associated designation as OM or SM for the Army, Navy and U.S. Marine Corps, and the Air Force.

1-3 DEPARTMENT OF DEFENSE FUELS \1\ DISCIPLINE WORKING GROUP /1/.

UFC 3-460-03 was updated by the DoD Fuels \1\ Discipline Working Group (FDWG) /1/. For more information on the \1\ FDWG /1/ refer to UFC 3-460-01, Appendix \1\B/1/.

1-4 SERVICE HEADQUARTERS SUBJECT MATTER EXPERTS.

Policies, obligations, and responsibilities vary between DoD components. For interpretation of components required in petroleum fuel systems, consult the applicable Service Headquarters Subject Matter Expert (SME). For interpretation, the SME at the appropriate Service Headquarters is defined as follows:

- Army – Headquarters, US Army Corps of Engineers, POL Facilities Proponent (CECW-EC).
- Air Force – The Air Force Fuels Facilities Subject Matter Expert (\1\1/ AFCEC/COS) through the applicable \1\ Regional Fuels Engineer (USAFE/PACAF) /1/.
- Navy/Marine Corps: NAVFAC POL Facility Subject Matter Expert (NAVFAC EXWC, CI11).

1-5 SERVICE CONTROL POINTS.

Service Control Points (SCP) have been established for each of the military services. SCPs serve as the central management function in coordinating requirements, technical issues, and supply actions with military units and DLA Energy. For interpretations on operation and maintenance requirements of fuel systems, consult the applicable SCP as defined in DoD 4140.25-M, Volume 1, Chapter 1, Section C1.3.1.5.

1-6 REGULATORY COMPLIANCE.

Inspection and maintenance activities must meet the most stringent of UFC and Military Specific requirements as well as applicable host nation, Federal, state, and local codes and regulations. For example, Ramstein Air Base must comply with the more stringent maintenance criteria of UFC 3-460-03, the applicable NATO STANAG, USAFE documents, or German law.

1-7 WAIVERS AND EXEMPTIONS.

Recommended UFC 3-460-03 language generated from recurring waivers and exemptions will be considered by the DoD \1\ FDWG /1/ with supporting rationale for inclusion on \1\ FDWG /1/ voting agendas. Recommended changes to UFC 3-460-03 are reviewed and approved by the voting members of the DoD \1\ FDWG /1/, preferably in a normal recurring meeting.

1-7.1 Waivers.

Waivers are temporary deviations from the stated criteria within UFC 3-460-03. Waivers are valid for up to one year or as stated on the waiver and are submitted to the military service-specific SCP for review. Refer to Military Standard (MIL-STD)-3007 for the waiver process.

1-7.2 Exemptions.

In contrast to waivers, exemptions are permanent deviations from the stated criteria within UFC 3-460-03. Exemption requests must be submitted through the military service-specific SCP for review. Refer to Military Standard (MIL-STD)-3007 for the exemption process. The \1\ FDWG /1/ must be advised when an exemption is granted.

1-8 REFERENCES.

Other sources for criteria related to petroleum fuel facilities are identified in \1\ [Appendix J. /1/](#) Any reference noted is the latest edition (as of the publication of this document) unless otherwise stated. Many of these documents are available within the public domain and can be found on the Internet; others require purchase. Before purchasing copies of referenced documents, contact the military service-specific SME to determine the need to have a complete copy of the referenced document versus obtaining the specific data needed from the referenced document from the SME.

1-9 CAPITALIZED FUEL SYSTEMS.

SM is normally eligible for DLA Energy funding at facilities that contain, handle, or distribute DLA Energy capitalized fuel under the Sustainment, Restoration, and Modernization (SRM) program. Proper coordination and scheduling with facility operators is necessary before conducting SM to ensure minimal mission impact.

DLA Energy also funds other inspection and maintenance programs at petroleum fuel facilities that contain, handle, or distribute DLA Energy capitalized fuel. See [11 Appendix A](#) for a list of current maintenance and inspection programs that are funded by DLA Energy.

1-10 MAINTENANCE AND INSPECTION FREQUENCIES.

The maintenance and inspection frequencies provided in this UFC are strict guidelines and are based on regulatory requirements and commercial practices. The military service-specific SCP can authorize deviations and alternate equivalent methodologies for specific individual tasks and only as needed to support the mission requirements. For example, the military service-specific SCP can authorize deviations to delay or accelerate an out of service inspection of a fuel storage tank to coincide with other work to avoid reducing mission capabilities.

CHAPTER 2 GENERAL

2-1 GENERAL MAINTENANCE INFORMATION.

This chapter contains information general to all chapters of UFC 3-460-03. This chapter includes health and safety information, information related to fuel quality, and general practices and requirements.

2-2 HEALTH AND SAFETY.

Personnel must comply with the measures outlined in this chapter. Petroleum fuel products are hazardous because of their toxic and flammable nature. Health and safety precautions are required and must be strictly adhered to in order to prevent incidents and accidents to personnel and Government property. Before initiating maintenance work on petroleum fuel facilities, a hazard analysis must be completed and procedures must be established to assure recognized hazards have been controlled, items to be serviced are properly isolated and adequate light is available for the task. Only properly trained and authorized personnel are permitted to operate and perform maintenance on petroleum fuel system components. Breaches of safety standards may result in disciplinary action and possible injury or death. Safe efficient maintenance activities require cleanliness, neatness, and order. Each individual is expected to recognize and correct hazardous situations promptly, if qualified, and/or report them to supervisors.

2-2.1 Safety References.

Military service-specific health and safety procedures and information listed in USACE EM 385-1-1, 11 AFMAN 91-203 /1/, Navy Occupational Safety & Health (NAVOSH) and Occupational Safety and Health Administration (OSHA) regulations, NFPA 2112, NFPA 2113, and ASTM F1449 must be followed as applicable. Refer to Installation Safety Office for additional local and Installation specific safety requirements and procedures.

2-2.2 Personal Protective Equipment.

11

- a. The purpose of this section is to reduce the health and safety risks associated with the incorrect selection and use of personal protective equipment when personnel are potentially exposed to petroleum fuels and associated fire hazards. Each facility is responsible for performing a hazard analysis in accordance with NFPA 2113 to identify, eliminate, and control recognized and identified hazards. Personnel Protection Equipment (PPE) will be selected to provide the user with the appropriate personal protection. Personnel will be trained in the proper selection, use, care and maintenance of their PPE in accordance with the Installation's written PPE program. Installations that determine there is the potential for a fire to exist from flammable vapors must utilize PPE that meets the minimal standards of NFPA 2112. Installations must reassess the hazard

analysis at least every 5 years, or when a significant change is made to the work environment.

- b. Any type of clothing may be worn as outer garments when working with high-flashpoint petroleum fuel (e.g., JP-5, JP-8, JP-10, Jet A, Jet A-1, additized Jet A (F-24) or diesel). However, personnel working with low-flashpoint petroleum fuel (e.g., JP-4, Jet B, aviation gasoline, or motor gasoline) must utilize PPE that meets the requirements of NFPA 2112 where the petroleum fuel facility hazard analysis has demonstrated that flammable materials or vapors are present in quantities that may result in a fire or endanger personnel. Wool socks, wool glove inserts, woolen caps, and underwear of nylon, silk, or polyester pose no significant hazard and are acceptable. Appropriate weather gear is allowed for personnel who are subject to outside work during inclement weather.
- c. Conventional 50% polyester and 50% cotton-blend coveralls are adequate for routine maintenance work in petroleum fuel facilities that do not pose a fire hazard potential. When completing tasks in petroleum fuel facilities where petroleum fuel is present (e.g., tank cleaning), the use of disposable protective coveralls having a static-dissipating coating may be necessary. Disposable coveralls may be worn alone or over polyester/cotton-blend coveralls. Replace fuel-contaminated clothing.

/1/

2-2.3 Health Hazards.

The following paragraphs describe health hazards of exposure to petroleum fuel vapors, liquid petroleum fuels, and solids. The paragraphs also provide guidance on administering appropriate types of first aid for personnel exhibiting symptoms resulting from petroleum fuel exposure. Review and become familiar with the health and exposure hazards listed on Safety Data Sheets (SDSs) for the types of fuel stored and handled in fuel systems to be maintained.

2-2.3.1 Petroleum Fuel Vapors.

Petroleum fuel vapors within a confined space, regardless of their toxicity and explosive potential, will displace oxygen and may cause suffocation. Petroleum fuel vapors can be harmful even at concentrations with a Lower Explosive Limit (LEL) of 0 (zero) unless the area has been completely freed of vapor. The Permissible Exposure Limit (PEL) of petroleum fuel vapors that can be safely inhaled is lower than the LEL. To reduce the potential for personnel exposure to hazardous petroleum fuel vapor concentrations, a facility industrial hygiene survey should be completed and safety controls implemented in accordance with applicable military service requirements as well as OSHA requirements and American Conference of Governmental Industrial Hygienists guidelines.

2-2.3.1.1 Petroleum Fuel Vapor Inhalation First Aid.

Safely remove all persons from the work area who exhibit adverse symptoms of exposure to petroleum fuel vapors to include dizziness, nausea, or headache. If a person is overcome by petroleum fuel vapors, first aid should be administered at once by someone trained in first aid, and the person exhibiting symptoms should get prompt medical attention. Recovery from initial exposure to vapors is usually prompt after exposure to fresh air. If breathing has stopped, Cardiopulmonary Resuscitation (CPR) should be administered by a person trained in CPR. Promptly report all incidents or accidents potentially resulting from petroleum fuel vapor inhalation to supervisors.

2-2.3.2 Liquid Petroleum Fuel.

Avoid getting liquid petroleum fuel on skin or clothing. Liquid petroleum fuel products remove protective oils from the skin, causing drying, chapping, and cracking. Swallowed liquid petroleum fuel products may cause central nervous system depression and pneumonia.

2-2.3.2.1 Liquid Petroleum Fuel Contact/Ingestion First Aid.

External Contact: Remove contaminated clothing at once and avoid any source of ignition. Remove liquid petroleum fuel products from the skin by washing with soap and water as soon as possible after contact. Remove liquid petroleum fuel that comes in contact with eyes immediately with an eyewash or other available means of flushing the eye with water. Obtain medical attention as soon as possible after exposure to liquid petroleum fuel. Do not expose a person to flame producing activities once they have been contaminated with liquid petroleum fuel.

Ingestion: Do not induce vomiting except as directed by physician, as uncontrolled vomiting may cause liquid petroleum fuel to go into the lungs. A person that has ingested liquid petroleum fuel should be taken to a medical facility at once. Be sure to inform medical administrators of the type and approximate amount of liquid petroleum fuel ingested.

2-2.3.3 Solids.

Dusts are formed by additives in petroleum fuel products remaining after the volatile liquids have evaporated. Solid particles in sludge may be dispersed as the sludge dries. Dust can also result from scale, sandblast, and rust particles removed from tank walls and strainers during cleaning operations. Consult the Installation Environmental Office for proper procedures for sludge and solid waste cleaning and disposal.

2-2.3.3.1 Solids Contact/Inhalation First Aid.

Solids will enter the body through inhalation of contaminated dust particles. Treat bodily contact with dust as you would with liquid petroleum fuels ([Section 2-2.3.2.1](#)) and

inhalation of dust as you would with petroleum fuel vapors ([Section 2-2.3.1.1](#)). Seek immediate medical attention.

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2-2.4 Confined Spaces.

A confined space is a space large enough and configured so personnel can bodily enter and perform assigned work, has limited or restricted means for entry or exit, and is not designed for continuous human occupancy. Examples include tanks, pits, manholes, etc.

2-2.4.1 Construction Activities.

Employees engaged in construction activities at a worksite with one or more confined spaces must comply with 29 CFR 1926, Subpart AA, state, local and installation requirements.

2-2.4.2 Hazards.

Personnel entering or working in confined spaces may encounter a number of potentially serious hazards. These hazards may include atmospheric hazards such as oxygen deficiency insufficient to support life, oxygen-enriched levels that increase the danger of fire or explosion, flammable or explosive atmospheres and materials, or toxic gases or materials. In addition, the confined space may include electrical, mechanical, engulfment or entrapment hazards that must be locked out, or controlled by other means of securing hazardous energy. Many of these hazards are not readily apparent, nor detectable by odor, or by sight, which may result in workers entering confined spaces without adequate consideration of potential dangers. Workers must consider that all confined spaces may contain unfavorable and unsafe conditions and must not enter or work in these spaces until tests, evaluation, and locally-developed procedures are performed to ensure safe conditions exist prior to entry and are maintained during the entire work period. *11*

2-3 ELECTRICAL SAFETY.

This section provides general information related to electrical safety with regard to maintenance operations, static electricity, stray electric currents, hazardous locations, and power generators. These hazards must be considered when handling and dispensing petroleum products. See National Fire Protection Association (NFPA) 70, National Electrical Code, for the practical safeguarding of persons and property from hazards arising from the use of electricity. See NFPA 70E, *Standard for Electrical Safety in the Workplace*, for electrical safety requirements for employee workplaces that are necessary for the practical safeguarding of employees in their pursuit of gainful employment. See NFPA 77, for additional guidance on static electricity hazards.

2-3.1 Lockout/Tagout.

An electrically safe work condition must be established while operating or performing maintenance on electrical equipment, regardless of whether the equipment is energized or de-energized. NFPA 70E includes detailed information on safety-related work practices, safety-related maintenance requirements, and installation safety requirements.

Establishing and following lockout/tagout procedures is essential for the safe execution of maintenance work on electrical equipment. While specific lockout/tagout procedures can differ from site to site, they must abide by the general principles outlined in NFPA 70E, Article 120, Section 120.2(B). In general, all sources of electrical energy must be controlled in such a way as to minimize personnel exposure to electrical hazards. NFPA 70E also includes Annex G, "Sample Lockout/Tagout Procedure," which can be used as a basis for establishing a site specific procedure.

2-3.2 Static Charges.

Low-conductivity liquids, such as jet fuel and gasoline, become electrostatically charged while flowing through petroleum fuel systems and during transport in barges, tanker trucks, rail cars and other fuel transport systems. This can produce enough electrical energy to cause ignition, fire, or explosion of petroleum fuel vapor-air mixtures above the liquid petroleum fuel surface.

Grounding and bonding components of petroleum fuel facilities are important to prevent ignition, fire and explosion. All petroleum fuel system components must be bonded and grounded to dissipate static electric charges and stray electrical currents that can discharge in the form of an electric arc. Bonding across flanges is not required provided they are not electrically insulated. UFC 3-460-01, Section 2-11.3, includes information on grounding petroleum fuel system equipment in order to prevent the accumulation of static electricity.

2-3.2.1 Personnel Static Prevention Requirements.

Personnel must periodically ground themselves to pump house structures, tanks, and equipment by making firm contact with attached grounding bars or approved grounding points. Personnel must not put on or remove garments while conducting petroleum fuel handling operations.

Personnel must ground sampling devices to grounding bars or approved grounding points before collecting petroleum fuel samples.

2-3.3 Electrical Currents.

Electrical currents originate in generators, transmission systems, wiring, and electrical devices. They are more dangerous than static electric charges because of the continuous electric spark that can be created versus the brief electric spark created by a

static electric discharge. Verify all electrical work on petroleum fuel storage and dispensing systems complies with NFPA 70, 501, Class I Locations to reduce electrical current hazards.

2-3.3.1 Stray Currents.

Stray currents flow through unintended paths or are extraneous current in the earth. Sources of stray currents include electric railways, electric power systems, electric welders, cathodic protection systems, and aircraft aeronautics electrical equipment malfunctions. Since many fixed petroleum fuel systems are in intimate earth contact, stray currents can take paths through the conducting parts of petroleum fuel systems. Stray currents can cause electric arcs that may ignite combustible petroleum fuel vapor-air mixtures.

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2-3.3.1.1 Fuel System Grounding Requirements.

Ground systems used to dissipate static electric charges also reduce stray electric current hazards. These systems provide a path to conduct stray electric currents into the earth without arcing.

2-3.3.1.2 Tank Car Loading and Unloading Requirements.

Railroad spurs used for loading and unloading tank cars should be insulated from the main line rails, ensuring isolation from stray currents that may flow in the main line rails.

2-3.3.1.3 Marine Terminal Requirements.

Stray currents from cathodic protection systems at marine terminals require special attention. These systems protect piping and steel piers and cause current flow in the water. Steel hull vessels act as a conductor of these currents. The ship-to-shore fuel-handling hose will act as a conductor and will complete a low-resistance circuit from the vessel to shore-side piping. Arcs may occur between the vessel and the hose when the hose is connected, disconnected, or brought into contact with the vessel's deck. Arcing can be prevented by connecting a bonding cable between shore-side piping and the vessel before operations begin. A switch on the shore side wired inline with the bonding cable must be closed after the cable connection is made and before the petroleum fuel handling hose is taken aboard the vessel.

2-3.3.1.4 Piping Requirements.

Stray current may flow through petroleum fuel piping systems because their electrical resistance is low compared to the surrounding earth. Removal of piping or components will interrupt the continuity of the petroleum fuel system. A bonding jumper wire must be installed prior to removal of piping or components and must remain in place until the items are replaced. Installing a jumper will prevent an arc when the piping or components are removed or replaced.

/1/

2-3.4 Hazardous Location Classification.

NFPA 70 defines hazardous locations including areas where fire or explosion hazards may exist due to flammable gases or vapors, flammable liquids, flammable liquid produced vapors, combustible liquids produced vapors, and combustible dust. Hazardous locations are classified in three ways: Type (Class), Condition (Division), and Nature (Group). Petroleum fuel facilities are Class 1 where flammable gases or vapors may be present in the air in sufficient quantities to be explosive or ignitable. Class 1 is divided into two divisions. Division 1 areas include environments where the hazard is to be expected under normal operating conditions, and Division 2 areas include environments where the hazard is not normally present in an explosive concentration or present only through accidental rupture, breakage or unusual faulty operation. The National Electrical Code (NEC) further defines the nature or “group” of the hazardous substance. Most petroleum fuel facilities will fall under Group D: hydrocarbons, fuels, solvents. Personnel must ensure that all electrical components and equipment installed, operated or replaced meet the required hazardous classification for the intended environment. Refer to UFC 3-460-01 for additional hazardous location information.

2-4 PETROLEUM FUEL QUALITY.

Every type and grade of petroleum fuel or lubricant has been specifically formulated to provide the most satisfactory and economic performance possible for a particular engine, under the operating conditions for which it was designed. Petroleum fuels or lubricants that have become contaminated or have degraded, can cause fires, explosions, injuries, loss of life, and loss of valuable machinery and equipment. Petroleum fuel product suspected of being contaminated must be reported to the military service-specific SCP.

2-4.1 Water Contamination.

Water contamination usually occurs during the transportation and storage of petroleum fuel. Water contamination is the most common form of contamination and may take one of the following three forms.

\1\

2-4.1.1 Free Water.

Free water consists of relatively large drops of water which, if left undisturbed, will settle to the bottom of the container. In low density petroleum fuel products with low viscosity, free water settlement can be quite rapid, but in higher density or more viscous petroleum fuel products, settlement will take longer. Some petroleum fuels contain anti-corrosive or cleaning agents otherwise known as surfactants, which tend to prevent the settlement of free water.

2-4.1.2 Dissolved Water.

In this state, the water is invisible, and the petroleum fuel appears to be clear; but a drop in temperature may cause dissolved water to separate from the petroleum fuel in tiny droplets that remain suspended and give the petroleum fuel a cloudy appearance.

2-4.1.3 Emulsified Water.

Emulsions are mechanical dispersion of petroleum fuel and water having a frothy appearance. Emulsions can be very stable and hard to separate. Separation may require special mechanical and chemical treatments.

/1/

2-4.2 Prevention and Removal of Water Contamination.

- a. Operate sump drains on tanks, filter separators, and other vessels and equipment and check for free water on a daily basis when the systems are operated.
- b. During petroleum fuel flow operations, observe filter separator differential pressure gauges and be sure units are functioning properly.
- c. Ensure that operator and system maintenance is properly performed.
- d. Newly received aviation petroleum fuels must be allowed to stand undisturbed in receiving tanks to permit settlement of free water before product is dispensed. Aviation petroleum fuel must be allowed to stand for 1 hour per 1 foot (0.31 m) of liquid level rise in storage tanks up to a maximum standing time of 24 hours or in accordance with undisturbed standing time allowed by military service-specific established procedure or policy. Ground vehicle petroleum fuels do not require settlement time before they are dispensed.
- e. When field fabricated aboveground vertical tanks are available for entry, they must be inspected for unintended low spots and repaired as required to eliminate unintended low spots which could collect free water.
- f. Tank roofs, seals, and fittings of all types must be maintained in good, weather-tight condition.
- g. Testing and inspections required for tanks and underground piping must be followed and documented. If unexplained accumulation of water is detected, the underground petroleum fuel tank(s) suspected of leaking must be tested using a temperature-controlled, hydrostatic stand-pipe test. Underground petroleum fuel piping suspected of leaking must be isolated and subjected to the applicable underground piping annual test as described in [Appendix G](#) - Petroleum Fuel Pipeline Pressure Testing Guidelines and Criteria.

2-4.3 Solid Matter Contamination.

Iron rust, scale, sand, and airborne dirt are examples of solid matter contamination most prevalent in petroleum fuel. The principal source of iron rust is corrosion in pipelines, storage tanks, or other inline steel components. Sand and dirt are particularly serious in extremely sandy or dusty areas where they may accumulate around tank gauge hatches, tank manways, or other openings and enter the tank when the covers are removed. The presence of large amounts of particulate matter in petroleum fuel results in restricting or clogging of filter separators, silting and plugging of fuel control components and nozzles, and wear and scoring of petroleum fuel system components by abrasion.

2-4.4 Prevention and Removal of Solids Contamination.

- a. Brush away or remove accumulated dirt or sand around fill covers, manholes, and other covered openings before removing them.
- b. Whenever petroleum fuel tanks, piping, or equipment are open for construction, repairs, or inspection, ensure they are protected against entry of dirt and foreign objects. Normally closed tank openings not required to be open for ventilation or access must remain closed. Open ends of piping and equipment such as pumps and meters must be sealed by temporary closures when they are not required to be open for inspection or repair.
- c. Do not operate petroleum fuel handling equipment unless all filters, strainers, screens, and nozzle spout caps are properly installed.
- d. Never remove filter, strainer basket, or strainer screens for any purpose, other than cleaning or maintenance. Filters, strainers baskets, and strainer screens must always be replaced immediately after cleaning or maintenance.
- e. Observe water that is drained from filter separator sumps and report unusual accumulation of foreign matter to supervisors.
- f. The inside of new petroleum fuel pipe must be carefully inspected for loose scale, dirt, or rust. Debris must be removed by brushes, swabs, plugs, or pigs before installation. New piping and pipeline systems must be thoroughly flushed according to UFGS 33 08 55. Temporary strainers installed at strategic points to remove trapped matter will assist with removal of solids.
- g. When changing grades of petroleum fuel in a tank, piping or pipeline, the penetrating action of the new grade may loosen existing scale or rust. Prior to changing petroleum fuel grade, the tank, piping or pipeline may need to be thoroughly mechanically or chemically cleaned. Even if a good cleaning job is done, loosened scale or rust can continue to appear in the product for several weeks after starting the new operation. Extra

precautions such as more frequent sampling, circulating of petroleum fuel product, temporary use of strainers, frequent cleaning of strainers, and use of cleaning pigs may need to be taken. See Section 2-5 Changes in Tank Product for additional information related to changing grades of petroleum fuel product in tanks.

- h. Ensure replacement parts or equipment, such as hoses, packing, gaskets, O-rings, seals, and pipe compounds, are made from materials compatible with the petroleum fuel type and grade.
- i. Do not allow petroleum fuel systems to lie unused for long periods of time. Inactive systems may accumulate water at low points and cause corrosion or biological activity leading to solids contamination.

2-4.5 Microbiological Contamination

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- a. When water and petroleum fuels exist together, yeast, fungus, and, bacteria may be present at the interface of the two fluids or at the water-steel interface. These organisms live in water and feed on petroleum fuel. Only a small amount of water, such as a puddle in a tank bottom, is required to support large colonies of these organisms.
- b. Microbiological contamination usually appears as a brown, black, or gray slime-like deposit that adheres to the inner surface of fuel tanks. This results in corrosion of fuel system components also known as Microbial Induced Corrosion (MIC), clogging of filters, and erratic operation of petroleum fuel quality indicating systems. Microbiological contamination is most severe in high temperature/high humidity environments and in alternative ground vehicle fuel products. Damage from microbiological induced corrosion is caused by hydrogen sulfide that is produced as waste by micro-organisms as they metabolize petroleum fuel in the absence of sufficient oxygen and can cause significant damage to tanks and piping and environmental problems in very short periods of time.
- c. The presence of microbiological contamination in petroleum fuel is a reliable indication of failure of petroleum fuel filtration equipment, inadequate water stripping of petroleum fuel storage tanks and a need for more frequent cleaning of petroleum fuel storage tanks.

11

2-4.5.1 Prevention of Microbiological Contamination.

To prevent microbiological contamination, remove water from petroleum fuel systems by the use of sumps on tanks, filter vessels and low point drains. The use of biocides in aviation fuels and F-76 is prohibited under current product specifications. Biocides are allowed on a case-by-case basis on rare occasions and require extensive justification and approval by the military service-specific SCP.

2-4.6 Other Product Contamination.

The properties of one type or grade of petroleum fuel can be greatly changed by mixing it with another grade or type of petroleum fuel. Some causes of cross contamination between petroleum fuels are leaky bulkheads between tanks, leaky valve manifolds separating product systems, use of multiproduct pipelines, delivery of improper petroleum fuel grade, and improper cleaning of a tank compartment or pipeline prior to changing petroleum fuel product service.

“Jelly” or “Apple Jelly” is a contaminant found in petroleum fuel systems, specifically filtration equipment, resulting from media migration. “Apple Jelly” occurs when free water particles in the petroleum fuel react with small quantities of super-adsorbent polymers that pass or migrate into the petroleum fuel as it flows through water adsorption media filter and/or monitors. The mixture creates an aggressive solvent that when mixed with other particulates and debris creates a thick “jelly-like” substance. Fuel System Icing Inhibitor (FSII – Diethylene Glycol Monomethyl Ether (DiEGME)) has been shown to increase the rate of media migration, and as a result, water adsorption media filters and/or monitors are no longer used in systems that handle petroleum fuel containing FSII.

2-4.6.1 Prevention of Other Petroleum Fuel Contamination.

Clear identification of petroleum fuel systems and equipment by product type and grade is essential to operational safety and product quality protection. Systems must be clearly identified in accordance with [Section 2-7](#).

- a. Be sure that system flow diagrams are available to all operators. Use arrows to indicate the direction of petroleum fuel flow within pipes. Include petroleum fuel product labeling on all petroleum fuel tanks, piping, and load and offload points.
- b. Do not begin petroleum fuel transfer operations until markings of all needed petroleum fuel equipment has been checked and found to agree.
- c. Ensure valves in valve manifolds are positively shut-off and locked out between petroleum fuel products. Do not depend solely on single valves to separate petroleum fuel products as they may leak. Install spectacle blinds, blind flanges, or use double block and bleed valves in manifolds where petroleum fuel product is to be separated.
- d. Be sure that newly arrived petroleum fuel products were not contaminated during shipment. Take samples per military service-specific quality control directives or MIL-STD-3004, and if possible, do not ship or use a petroleum fuel product until test results are confirmed acceptable.
- e. Use separate pipelines and equipment for each petroleum fuel product. Unless designed to act as a multi-product line, or required as an alternative capability in a contingency, pipelines should never be used for

more than one type of petroleum fuel. Common piping systems must never be used for incompatible petroleum fuel products.

2-4.7 Special Considerations for Biodiesel Blend B20.

Biodiesel Blend B20 is 20 (± 1) volume percent biodiesel conforming to specifications ASTM 6751 and 80 volume percent petroleum diesel fuel conforming to ASTM D975.

- a. Biodiesel fuel is comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats. Biodiesel is meant to be used in standard diesel engines and should not be confused with the vegetable and waste oils used to fuel converted diesel engines.
- b. A B20 product must be pre-blended prior to delivery. It is not acceptable to attempt blending into a Government tank during the delivery.
- c. DoD Components and Federal agencies must not order B20 where projected consumption and product storage duration exceeds three months, due to extended and unresolved product stability concerns.
- d. B20 may be stored in tanks and handled with equipment used for diesel service. Nevertheless, Defense Energy Support Points (DFSPs) must comply with standard military service-specific procedures and directives regarding tank cleaning prior to converting existing storage tanks from diesel to B20 service.
- e. A generally higher cloud point than standard diesel may occasionally affect B20 cold flow properties. DoD Components and Federal agency customers should order more frequent, smaller B20 quantities to achieve advantage of seasonal diesel cloud point adjustments that minimize potential vehicle and equipment cold weather operation problems.
- f. DoD only allows the use of B20 biodiesel in non-tactical equipment.

2-4.8 Special Considerations for Fuel Ethanol Blend E85.

Fuel Ethanol Blend E85 is 75 to 85 volume percent fuel ethanol blended with 25 to 15 volume percent hydrocarbon fuel, usually unleaded gasoline. ASTM 5798 governs E85 procurement as fuel ethanol intended for use in ground vehicles with spark-ignition engines.

- a. DoD Components and Federal agencies must ensure material compatibility with storage tanks and dispensing equipment prior to converting facilities to E85 service.
- b. Special materials requirements are described in DOE's "Handbook for Handling, Storing, and Dispensing E85." Pre-1992 fiberglass tanks may not be suitable to convert to E85 service.

- c. Three vapor pressure classes of fuel ethanol (Ed75 – Ed85) with ethanol content varying between 75 and 85 percent for different seasonal conditions and geographic regions serve to ensure proper vehicle operation throughout the year in all locations.
- d. High E85 ethanol content may reduce lubricating properties as well as increase water tolerance. Decreased temperature and increased water content may reduce hydrocarbon fuel solubility in fuel ethanol.
- e. Monitor and keep water content to a minimum, due to water's miscibility in fuel alcohol, to minimize performance degradation.
- f. Ethanol is not compatible with aluminum, and all aluminum products must be removed from a gasoline dispensing system that will be used to dispense E85.
- g. In accordance with EPA regulations, all commercial grades of gasoline must contain certain additives, detergents, and corrosion inhibitors. In a finished blend of E85, any additive that was found previously in gasoline is now contained in E85 (although at reduced levels). While adding detergent to the hydrocarbon component of E85 is necessary, it is not necessary to add detergent based on the alcohol portion of the product. Overuse of additives with E85 may result in poor vehicle operation.

2-5 CHANGES IN TANK PRODUCT.

Changes of petroleum fuel product in tank and piping systems must be conducted in accordance with the more stringent of military service-specific quality control directives and MIL-STD-3004.

2-6 ENVIRONMENTAL PROTECTION.

The DoD is actively committed to protecting quality of the environment by preventing and controlling pollution resulting from use and operation of petroleum fuel facilities. The DoD is required to comply with environmental laws and regulations. Individuals who violate environmental regulations may be subject to serious civil and criminal penalties, including fines and jail terms. Significant precautions as listed in UFC 3-460-01, such as petroleum fuel storage tank, load, and offload secondary containment systems, are used to prevent the discharge of petroleum fuel products to sanitary and storm sewer systems, ground water systems, local streams and waterways.

2-6.1 Spill Planning.

Facilities containing or handling petroleum fuel products are designed and constructed in a manner that should prevent spillage. Should a spill occur, the facilities should prevent the spill from leaving the property and/or entering a waterway or ground water table. Installations must have a Spill Prevention Control and Countermeasure (SPCC) plan or, for overseas sites, the spill response document required by the Overseas

Environmental Baseline Guidance Document or Environmental Final Governing Standards, as applicable. Refer to UFC 3-460-01, and included references for SPCC requirements. Personnel should be familiar with SPCC requirements specific to the petroleum fuel facility where they are performing inspections and maintenance.

While performing maintenance activities where a petroleum fuel release is imminent, a drip pan or other suitable means must be utilized to contain petroleum fuel that may be released from a system. Spill pads must also be readily available. Bonding the drip pan to the petroleum fuel system or a grounding rod will reduce the risk of a static electric discharge. Bonding points for drip pans should be provided where they are put into regular use.

2-6.1.1 Reference of UFC 3-460-03 in SPCC Plans.

Spill plans, response plans, operational plans, or other plans required by law should not include UFC 3-460-03 by title for complete inclusion. Only specific items from the document should be included when required.

2-6.2 Containment.

Secondary containment should be provided for petroleum fuel systems and components as required by UFC 3-460-01. These systems may include earthen berms, containment paving, spill kits, and/or liners.

2-6.3 Containment Drain Valves.

Containment areas must be drained as frequently as required to maintain them in a clean, dry, and accessible state. Debris caught in the drainage inlet grate must be removed after each draining. Containment drain valves must be maintained as outlined in [Section 6.6 Valves](#). Coordinate containment area draining with operational personnel.

2-6.4 Waste Disposal.

To ensure waste is disposed of properly, check that adequate waste disposal containers are available and disposal procedures are identified. Coordinate waste disposal procedures with the Installation Environmental Office. Coordination must include strict adherence to the most stringent of host nation, Federal, state, or local hazardous waste regulations to include permitting.

2-7 SIGNAGE AND MARKINGS.

Signs and marking require periodic inspections and maintenances to ensure that important information is easily accessible.

2-7.1 Inspection and Maintenance - Signage and Markings.

- a. Check permanent signs and markings for adequacy and readability. Repair or replace deteriorated or illegible signs and markings.
Frequency: Weekly
- b. Inspect the location of Department of Transportation (DOT) regulated underground petroleum fuel pipelines and ensure they are marked in accordance with 49 Code of Federal Regulations (CFR) 195.410.
Frequency: Monthly
- c. Check that petroleum fuel pipelines, tanks, valves, pumps, meters, and other equipment are marked in accordance with UFC 3-460-01 Section 2-11.17.11. If markings are missing or insufficient, repair or add markings in accordance with UFC 3-460-01.
Frequency: Monthly
- d. Ensure petroleum fuel system Emergency Fuel Shutoff (EFSO) pushbuttons are properly identified at each location. Ensure that signage is properly secured and that the lettering is legible from 25 feet (7.5 meters) away and not faded.
Frequency: Monthly
- e. Verify enough movable or temporary signs are maintained in good condition to serve anticipated needs; for example: "DANGER," "CLOSED TO TRAFFIC," "KEEP FLAMES AWAY," "MEN WORKING," "NO SMOKING," "DANGER NO OPEN FLAME OR IGNITION SOURCE BEYOND THIS POINT." Use bilingual signs when appropriate.
Frequency: Annually

2-8 FIRE PROTECTION.

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- Three simultaneous conditions are necessary to create petroleum fuel fires: the petroleum fuel product must be in the form of vapor; petroleum fuel vapor-air mixture must be present in correct proportions to support combustion or explosion; and the combustible mixture of petroleum fuel vapor and air must be raised to its ignition temperature or subjected to a source of ignition. The absence of any one of these conditions prevents occurrence of a fire.
- It is not practical to eliminate air completely or to control petroleum fuel vapor-air proportions where petroleum fuel is handled and dispensed, and temperatures cannot be controlled to the point where petroleum fuel vapors are not possible. Therefore, the elimination of sources of ignition is the primary controllable factor for the prevention of petroleum fuel fires.

- NFPA 10 details the number and types of portable fire extinguishers that should be located around petroleum fuel areas and storage locations.

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2-8.1 Petroleum Fuel Vapor Sources for Fires and Explosions.

Petroleum fuel vapors escaping to atmosphere are quickly diluted to within the flammable or explosive limit, and if ignited will cause fire. Eventually the petroleum fuel vapor concentration within a tank or vessel is diluted, creating an explosive hazard within the tank. Petroleum fuel vapors are heavier than air and can travel long distances before they dissipate into the atmosphere. Any source of ignition may ignite petroleum fuel vapors causing a fire or explosion.

2-8.2 Solid Sources for Fires and Explosions.

Sludge and other petroleum fuel saturated material (such as sediment, hollow roof supports, sidewall scale, foam pan seals, and oil-soaked wooden structures) emit petroleum vapors which can accumulate to the flammable or explosive limit.

2-8.3 Ignition Sources for Fires and Explosions.

Primary causes and sources of ignition are poor maintenance or defective electrical equipment, negligence, relaxed disciplinary action to violations of safety regulations, and static or stray electrical currents.

2-8.3.1 Maintenance Tools.

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- Non-sparking tools provide protection against fires and explosions in petroleum fuel product environments. Non-sparking tools should be used for operation and maintenance work on highly volatile petroleum fuels with flash points below 100 °F (38 °C) unless the environment has been certified to be vapor free. Common non-sparking tool materials are brass, bronze, copper-nickel alloy, copper-beryllium alloy and copper-aluminum alloy. Ensure non-sparking tools are kept clean of ferrous or other contaminants which have sparking properties.
- Electric tools must have a three-wire cord with a ground and be plugged into a grounded receptacle, be double insulated, or be powered by a low-voltage isolation transformer. Electric tools must be protected by a ground-fault circuit interrupter or an assured equipment-grounding conductor program. All electric power tools, battery or corded, and electrical extension cords must be intrinsically safe and Underwriters Laboratory (UL) listed for the intended hazardous location.
- Refer to OSHA Booklet 3080 *Hand and Power Tools* (based upon 29 CFR, Part 1910, Subpart P) or military service-specific directives for

additional safety and guidance regarding the appropriate tools for work to be performed.

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2-8.3.2 Power Generators.

Diesel and gasoline engine-powered generators and other internal combustion powered tools (e.g. internal combustion engine driving pumps) must only be used in close proximity to petroleum fuel systems if equipped with spark arrestors. The equipment must be located outside of petroleum fuel tank containment areas and upwind of petroleum fuel tanks and at least 50 feet (15.2 meters) from the nearest petroleum fuel tank manhole or vent.

2-8.3.3 Smoking Clearances.

“No Smoking” signs must be placed conspicuously around petroleum fuel systems. Smoking must only be permitted in designated smoking areas outside of petroleum fuel vapor clearances.

2-8.4 Fire and Explosion Preventative Measures.

- a. Provide proper ventilation for pump houses, pits, and other enclosed spaces where petroleum fuel vapors may accumulate.
- b. Take precautions to prevent leakage or spillage of petroleum fuel products.
- c. When spillage is expected from petroleum fuel pipes, hoses connections, or opened equipment, ventilate the area and eliminate sources of ignition. Direct the expected spillage to an approved container or a drip pan as applicable. Bonding the drip pan to the petroleum fuel system or a grounding rod will reduce the risk of a static electric discharge. Bonding points for drip pans should be provided where they are put into regular use.
- d. If a small amount of petroleum fuel spills on the ground, asphalt or concrete, cover it with dry absorbent. Remove used absorbent once petroleum fuel has been absorbed.
- e. Where major operations raise a possibility of sizeable petroleum fuel spills, call fire department authorities for possible standby.
- f. Be familiar with local petroleum fuel spill contingency plans and the proper contact information for the local fire department.
- g. Do not start or run a vehicle in an area where petroleum fuel has been spilled until all flammable or combustible liquid is removed and the area is freed of petroleum fuel vapors unless the vehicle is required to clean up the spill (e.g., vacuum truck or skimmer boat).

- h. Do not weld, cut, rivet, do mechanical or other hot work on out of service petroleum fuel storage tanks, pipe, or other equipment that has contained flammable or combustible substances until the equipment has been properly ventilated and certified vapor free. In limited cases, hot work can be performed safely on in-service equipment with an approved plan. Always obtain a hot work permit before hot work is conducted on petroleum fuel systems.
- i. Only allow personnel that meet the requirements of UFGS 33 52 90.00 20 to conduct welding on petroleum fuel tanks or vessels that have contained flammable or combustible liquids or petroleum fuel vapors.
- j. Drain, purge, and ventilate petroleum fuel tanks or other equipment brought back to maintenance buildings for repair and keep them outside of buildings, well away from open flames and other sources of ignition.
- k. Do not allow open flames near Class 1 hazardous areas as established in NFPA 70.
- l. Artificial light and power tools must meet the requirements of Section 2-8.3.1, "Maintenance Tools."
- m. Immediately dispose of petroleum fuel soaked rags or waste, or place them in approved closed noncombustible containers. Refer to Section 2-6.4 Waste Disposal for waste disposal procedures.

2-9 EMERGENCY ACTION PLANS.

Agencies that operate and/or maintain petroleum fuel infrastructure must be knowledgeable of their applicable emergency action plans that include measures to address a variety of emergency responses including but not limited to natural disasters, terrorist threat conditions, and environmental protection.

2-10 SITE MAINTENANCE PROGRAM.

Facility maintainers (e.g., Base Civil Engineering, Department of Public Works, contractors, operators) have the primary responsibility for maintaining and repairing petroleum fuel infrastructure (e.g., petroleum fuel or lubricant receipt, issue and storage systems) under their stewardship. DoD petroleum fuel sites may have more than one facility maintainer depending on the type of mission, the facility owner, or other contractual relationship. Military services can delegate maintenance tasks between operator maintenance and system maintenance differently. See [Section 1-2.2](#), "Maintenance Tasks," for more information on the delegation of maintenance tasks.

Agencies responsible for infrastructure maintenance must develop site maintenance programs that include:

- List and details of petroleum fuel equipment requiring maintenance.

- Coordination requirements and points of contact for other agencies that may support or provide input on maintenance activities (e.g., cathodic protection, electrical, environmental, fire department, plumbing, and safety).
- Documentation and record retention procedures.
- Details for maintaining infrastructure as-built information.
- Details for developing and submitting projects to maintain, repair or upgrade existing infrastructure and details for coordination with agencies on requirements for new infrastructure.
- Quality assurance requirements for contractors working on petroleum fuel infrastructure.

2-10.1 Maintaining Petroleum Fuel Infrastructure.

Petroleum fuel facility maintainers should utilize recurring maintenance systems to track inspections, scheduled and unscheduled maintenance actions, and equipment serviceability.

Petroleum fuel facility maintainers and operators must coordinate requirements and schedule maintenance actions to minimize mission impact.

2-10.2 Documentation and Record Retention.

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- a. Petroleum fuel system documentation and record retention must include maintenance records in sufficient detail to identify each real property or equipment item's current maintenance status (e.g., tanks, pumps, valves, piping). These records must be maintained at the Installation and should be used to justify recommendations for repair, upgrade, and replacement.
- b. Each Installation must develop and have site-specific maintenance manuals such as Operation and Maintenance Support Information (OMSI) or Operation, Maintenance, Environmental, and Safety Plan (OMES). These manuals must include manufacturer's operation and maintenance information for the specific equipment and components installed. The Installation-specific OMSI or OMES manuals must be used in conjunction with the inspection and maintenance criteria of UFC 3-460-03.
- c. Unless otherwise specified by military service-specific or contract requirements, maintenance agencies must retain petroleum fuel infrastructure records of tests and inspections (e.g., API Standard 570 and API 653). Copies of these records must be issued to the Installation for official record retention.
- d. Environmental regulations typically require retention of records for a minimum of three to five years. In some cases environmental regulations

require record retention for the life of the system (e.g., tanks). Records must be maintained for a minimum of three years unless more stringent military service, Federal, state, host nation, or local requirements apply.

- e. For agencies that are responsible for maintenance of DOT regulated petroleum fuel pipelines, additional inspection and repair information is required and must comply with 49 CFR 195.310, 195.404, 195.507 and 195.589.
- f. For agencies that are responsible for maintenance of underground storage tanks inspection and repair recordkeeping must comply with 40 CFR 280.34.
- g. For agencies that are responsible for maintenance of hose and pipelines near, over, or through navigation and navigable waters, inspection and repair recordkeeping must comply with 33 CFR 154.740.

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2-10.3 As-built Information.

Available as-built information for petroleum fuel systems must be preserved and protected. As-built information must be updated when projects that change the configuration of the system are executed at petroleum fuel facilities. An accurate process flow diagram of each petroleum fuel system is the minimum amount of documentation that must be maintained. Copies of as-built information must be maintained at the Installation's petroleum fuel facility operations building and permanent Installation files.

As-built information required for DOT regulated pipelines must comply with 49 CFR 195.404.

2-10.4 Operation and Maintenance Support Information.

Each Installation must maintain a current library or access to manufacturer's operation and maintenance manuals for all equipment that is associated with petroleum fuel infrastructure under the Installation's responsibility.

Operation and maintenance information required for DOT regulated pipelines must comply with 49 CFR 195, Section 402. Operation and maintenance information required for facilities that conduct petroleum fuel transfer to or from marine vessels must comply with 33 CFR Part 154 Sections 300 to 325.

2-10.5 Safety Reports.

All petroleum fuel facilities must follow military service or contract requirements when reporting safety and risk assessments on infrastructure.

Facilities regulated by DOT have additional reporting requirements that are governed by 49 CFR 195 Subpart B. The facility operators or maintainers must copy DLA Energy and/or military service commands when notifying the Pipeline and Hazardous Materials Safety Administration (PHMSA) of a regulated pipeline incident.

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CHAPTER 3 BULK TRANSFER FACILITIES

3-1 INTRODUCTION.

This chapter applies to permanent petroleum fuel infrastructure and is not intended for contingency or mobility equipment or temporary petroleum fuel receipt or issue systems.

3-2 TRUCK RECEIPT.

Major components of petroleum fuel truck offloading facilities include offloading hoses, piping, basket strainers, air eliminator tanks, pumps, meters, pre-filters, filter separators, grounding systems, ground verification systems and control panels.

- a. Piping used to distribute petroleum fuel from truck offloading positions to petroleum fuel tanks may be installed underground, aboveground, or in a combination of aboveground and underground segments.
- b. Sometimes these systems use drop tanks which can be underground, vaulted, or low-profile equipped with submerged turbine pumps.
- c. Pumps are typically self-priming centrifugal or rotary vane positive displacement.
- d. Underground or low-profile petroleum fuel tanks typically receive fuel by gravity offload.

3-2.1 Inspection and Maintenance - Truck Receipt.

- a. Refer to Section 3-9.2, "Offloading Fuel Hoses," for inspection and maintenance requirements of offloading hoses.
- b. Refer to Section 6-1, "Pipe Testing And Inspections," for inspection and maintenance requirements of pipelines and piping.
- c. Refer to Section 3-6.4, "Basket Strainers," for inspection and maintenance requirements of basket strainers.
- d. Refer to Section 3-10.1, "Air Eliminator Tanks," for inspection and maintenance requirements of air eliminator tanks.
- e. Refer to Section 3-8, "Pumps," for inspection and maintenance requirements of petroleum fuel pumps.
- f. Refer to Section 3-7, "Meters," for inspection and maintenance requirements of petroleum fuel meters.
- g. Refer to Section 3-6.1, "Pre-Filters," for inspection and maintenance requirements of pre-filters.
- h. Refer to Section 3-6.2, "Filters Separators," for inspection and maintenance requirements of filter separators.

- i. Refer to Section 9-1.6, "Grounding Systems," for inspection and maintenance requirements of grounding systems.
- j. Refer to Section 9-5, "Ground Verification Systems," for inspection and maintenance requirements of ground verification systems.
- k. Refer to Section 9-1.9, "Electronic Equipment," for inspection and maintenance requirements of control panels.

3-3 PIPELINE RECEIPT.

Fuel can be supplied to petroleum fuel storage tanks from on-base or off-base pipelines. These pipelines can be Government Owned/Government Operated (GOGO), Government Owned/Contractor Operated (GOCO), or Contractor Owned/Contractor Operated (COCO).

Major components of pipeline receipt systems include piping, basket strainers, automatic air vents, meters, pre-filters, filter separators, grounding systems, and control panels.

3-3.1 Inspection and Maintenance – Pipeline Receipt.

- a. Refer to Section 6-1, "Pipe Testing and Inspections," for inspection and maintenance requirements of pipelines and piping.
- b. Refer to Section 3-6.4, "Basket Strainers," for inspection and maintenance requirements of basket strainers.
- c. Refer to Section 3-10.2, "Automatic Air Vents," for inspection and maintenance requirements of automatic air vents.
- d. Refer to Section 3-7, "Meters," for inspection and maintenance requirements of petroleum fuel meters.
- e. Refer to Section 3-6.1, "Pre-Filters," for inspection and maintenance requirements of pre-filters.
- f. Refer to Section 3-6.2, "Filter Separators," for inspection and maintenance requirements of filter separators.
- g. Refer to Section 9-1.6, "Grounding Systems," for inspection and maintenance requirements of grounding systems.
- h. Refer to Section 9-1.9, "Electrical Equipment," for inspection and maintenance requirements of control panels.

3-4 RAIL RECEIPT.

Rail receipt systems use components that are similar to the components used for truck receipt. Refer to [Section 3-2 Truck Receipt](#) for a list of typical components that should be expected in a rail receipt system and associated maintenance requirements.

3-5 BULK ISSUE.

3-5.1 Truck Issue.

The preferred connection system for jet fuel issue is a metal, counterbalanced, swivel type pantograph constructed of aluminum or stainless steel; although an approved loading fuel hose is acceptable. Loading fuel hoses, if provided, must be stored away from direct sunlight.

Major components of petroleum fuel truck issue facilities include piping, basket strainers, pumps, filter separators, meters, Truck Fill Valve (TFV), loading fuel hoses, fixed pantographs, fueling nozzles, grounding systems, ground verification equipment, electronic overfill protection systems, and control panels.

3-5.1.1 Inspection and Maintenance – Truck Issue.

- a. Refer to Section 6-1, "Pipe Testing and Inspections," for inspection and maintenance requirements of pipelines and piping.
- b. Refer to Section 3-6.4, "Basket Strainers," for inspection and maintenance requirements of basket strainers.
- c. Refer to Section 3-8, "Pumps," for inspection and maintenance requirements of petroleum fuel pumps.
- d. Refer to Section 3-6.2, "Filter Separators," for inspection and maintenance requirements of filter separators.
- e. Refer to Section 3-7, "Meters," for inspection and maintenance requirements of petroleum fuel meters.
- f. Refer to Section 6-6.5.1, "Truck Fill Valves," for inspection and maintenance requirements of TFVs.
- g. Refer to Section 3-9.1, "Loading Fuel Hoses," for inspection and maintenance requirements of loading fuel hoses.
- h. Refer to Section 4-7.1.1, "Fixed Pantographs," for inspection and maintenance requirements of fixed pantographs.
- i. Refer to Section 4-7.3, "Fueling Nozzles," for inspection and maintenance requirements of fueling nozzles.

- j. Refer to Section 9-1.6, "Grounding Systems," for inspection and maintenance requirements of grounding systems.
- k. Refer to Section 9-5, "Ground Verification Systems," for inspection and maintenance requirements of ground verification systems.
- l. Refer to Section 9-6, "Electronic Overfill Prevention Systems," for inspection and maintenance requirements of electronic overfill prevention systems.
- m. Refer to Section 9-1.9, "Electrical Equipment," for inspection and maintenance requirements of control panels.

3-5.2 Pipeline Issue.

Major components of pipeline issue systems include piping, basket strainers, automatic air vents, pumps, filter separators, meters, grounding systems, and control panels.

3-5.2.1 Inspection and Maintenance – Pipeline Issue.

- a. Refer to Section 6-1, "Pipe Testing and Inspections," for inspection and maintenance requirements of pipelines and piping.
- b. Refer to Section 3-6.4, "Basket Strainers," for inspection and maintenance requirements of basket strainers.
- c. Refer to Section 3-10.2, "Automatic Air Vents," for inspection and maintenance requirements of automatic air vents.
- d. Refer to Section 3-8, "Pumps," for inspection and maintenance requirements of petroleum fuel pumps.
- e. Refer to Section 3-6.2, "Filter Separators," for inspection and maintenance requirements of filter separators.
- f. Refer to Section 3-7, "Meters," for inspection and maintenance requirements of petroleum fuel meters.
- g. Refer to Section 9-1.6, "Grounding Systems," for inspection and maintenance requirements of grounding systems.
- h. Refer to Section 9-1.9, "Electrical Equipment," for inspection and maintenance requirements of control panels.

3-5.3 Rail Issue.

Counterbalanced articulated (swivel-type) tank car loading pantographs or loading fuel hoses are used to load railcars.

Major components of rail issue facilities include piping, basket strainers, pumps, filter separators, meters, TFV, loading fuel hoses, fixed pantographs, fueling nozzles,

grounding systems, ground verification systems, electronic overfill protection, and control panels.

3-5.3.1 Inspection and Maintenance – Rail Issue.

- a. Refer to Section 6-1, “Pipe Testing and Inspections,” for inspection and maintenance requirements of pipelines and piping.
- b. Refer to Section 3-6.4, “Basket Strainers,” for inspection and maintenance requirements of basket strainers.
- c. Refer to Section 3-8, “Pumps,” for inspection and maintenance requirements of petroleum fuel pumps.
- d. Refer to Section 3-6.2, “Filter Separators,” for inspection and maintenance requirements of filter separators.
- e. Refer to Section 3-7, “Meters,” for inspection and maintenance requirements of fuel meters.
- f. Refer to Section 6-6.5.1, “Truck Fill Valves,” for inspection and maintenance requirements of TFVs.
- g. Refer to Section 3-9.1, “Loading Fuel Hoses,” for inspection and maintenance requirements of loading fuel hoses.
- h. Refer to Section 4-7.1.1, “Fixed Pantographs,” for inspection and maintenance requirements of fixed pantographs.
- i. Refer to Section 4-7.3, “Fueling Nozzles,” for inspection and maintenance requirements of fueling nozzles.
- j. Refer to Section 9-1.6, “Grounding Systems,” for inspection and maintenance requirements of grounding systems.
- k. Refer to Section 9-5, “Ground Verification Systems,” for inspection and maintenance requirements of ground verification systems.
- l. Refer to Section 9-6, “Electronic Overfill Prevention Systems,” for inspection and maintenance requirements of electronic overfill prevention systems.
- m. Refer to Section 9-1.9, “Electrical Equipment,” for inspection and maintenance requirements of control panels.

3-6 **FILTRATION.**

3-6.1 **Pre-Filters.**

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- a. Micronic pre-filters meeting the requirements of UFGS 33 52 43.28 are sometimes installed upstream of filter separators to extend the life of coalescer cartridges in filter separators. Pre-filters remove particles that cause contamination. Petroleum fuel to be filtered enters the lower part of the housing and flows through the filter cartridges from outside to inside. Coarse dirt particles settle immediately; finer particles are absorbed by the pleated paper type filter cartridges.
- b. An elevated differential pressure measurement indicates dirty filter cartridges. Investigate sudden drops or spikes in differential pressure measurement reading. A drop in the flow rate or an increase in pressure of a system may indicate filters cartridges are fouled with debris or contaminants. A sudden increase in flow rate or decrease in pressure may indicate that the filter cartridges are damaged or torn. Replacement filter cartridges must meet the filter cartridge requirements of UFGS 33 52 43.28.
- c. The Installation must maintain an inventory of filter cartridges. The inventory must be sufficient to allow the Installation to change the filter cartridges of all pre-filters at an Installation once. The inventory must be kept in a temperature controlled environment in accordance with manufacturer recommendations.

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Figure 3-1 Pre-Filter



3-6.1.1 Inspection and Maintenance – Pre-Filters.

Stencil pre-filters in accordance with [Section 3-6.1.3 Stenciling of Pre-Filters](#) when filter cartridges are changed. Pre-filters require the following inspection and maintenance:

- a. Open drains under flow conditions until clear fuel is observed from the drain valve.
Frequency: Daily
- b. Monitor differential pressure in filter cartridges. Chart differential pressure measurements from readings taken during normal operations.
Frequency: Daily
- c. Operate pre-filter isolation valves.
Frequency: Quarterly
- d. Replace filter cartridges when the acceptable maximum differential pressure is reached, the maximum in-service duration has passed, or the fuel becomes visibly dirty or discolored. Acceptable maximum differential pressure for a specific pre-filter is dependent on the system flow rate. The military service-specific SCP may extend in-service duration filter cartridge replacement period based on differential pressure for high throughput systems. Check expiration date of replacement filter cartridges before installation.
Frequency: When differential pressure has reached the lower of manufacturer's recommendation or 20 psid (140 kPa), filter cartridge in-service period of 24 months has expired, or when fuel becomes visibly dirty or discolored.
- e. Refer to Section 6-7.2, "Differential Pressure Gauges," for inspection and maintenance requirements of differential pressure gauges.
- f. Refer to Section 3-10.2, "Automatic Air Vents," for inspection and maintenance requirements of automatic air vents.
- g. Refer to Section 6-6.3, "Thermal and Pressure Relief Valves," for inspection and maintenance requirements of thermal and pressure relief valves.
- h. Conduct inspections of code rated vessels in accordance with UFC 3-430-07.

3-6.1.2 Pre-Filter Waste Disposal.

Refer to [Section 2-6.4 Waste Disposal](#) for proper disposal of filtered waste and used filter cartridges.

3-6.1.3 Stenciling of Pre-Filters.

Use stencils or embossing tape (0.75 to 1-inch (19 to 25 mm) letters) to permanently mark pre-filters when filter cartridges are changed with date changed, due date for next change, and maximum differential pressure.

3-6.2 Filter Separators.

Filter separators meeting which meet the requirements of UFGS 33 52 43.28 remove undissolved (free) water and solids from petroleum products. Very fine water particles pass through coalescer cartridges from inside to outside and grow in size (coalesce) into larger droplets that fall to the water collection sump.

Figure 3-2 Filter Separator



Second-stage Teflon or nylon coated screens or treated paper cartridges (separator) repels water droplets and prevents them from leaving the filter separator and cause them to fall to the water collection sump. The solids in the fuel are trapped in the coalescer cartridges and build up a differential pressure across the filter separator. Water accumulated in the water collection sump at the bottom of the filter separator is typically removed manually under flow conditions. Additional important notes for filter separators are as follows:

- a. Filter separators must be equipped with coalescer and separator cartridges that meet the requirements of UFGS 33 52 43.28. Older units must be modified to accept these cartridges or must be replaced with modern units.
- b. If installed, remove automatic water drain option from filter separators at the first opportunity, unless they are installed on a receipt system that

must handle excessive water, or if waived by the military service-specific SME. If automatic water drains are to remain they must be piped to a product recovery or drain tank.

- c. Filter separators are equipped with differential pressure gauges to indicate when coalescer cartridges should be changed. The piston-type differential pressure gauge is preferred for petroleum fuel systems. Replace individual gauges with the piston-type as soon as practical.
- d. Filter separators have a sampling port in the outlet pipe used to obtain petroleum fuel quality samples. Check the flow direction arrow on sample probes to ensure they are installed in the proper orientation.
- e. The Installation must maintain an inventory of coalescer and separator cartridges. The inventory must allow the Installation to change the coalescer and separator cartridges of all filter separators at an Installation once. The inventory must be kept in a temperature controlled environment in accordance with manufacturer recommendations.

3-6.2.1 Inspection and Maintenance – Filter Separators.

Stencil filter separators in accordance with [Section 3-6.2.4 Stenciling of Filter Separators](#) when coalescer cartridges are changed. Filter separators require the following inspection and maintenance:

- a. Open drain under flow conditions until clear fuel is observed from the drain valve.
Frequency: Daily
- b. Monitor differential pressure of coalescer cartridges. The acceptable maximum differential pressure for a specific filter separator is dependent on the system flow rate. Monitor and chart differential pressure measurements of filter separators from readings taken during normal operations. Investigate sudden drops or spikes in differential pressure measurement readings.
Frequency: Daily
- c. Operate filter separator isolation valves.
Frequency: Quarterly
- d. Inspect components and check operation of water shutoff system.
Frequency: Quarterly

- e. Change coalescer cartridges. Refer to Section 3-6.2.2 Replacement of Coalescer Cartridges for general instructions on replacement of coalescer cartridges. military service-specific SCP may extend the coalescer cartridge replacement frequency based on differential pressure if filters separators are used on high throughput systems. Check expiration date of replacement coalescer cartridges before installation.
Frequency: Every 36 months or sooner if required by differential pressure.
- f. Inspect and clean separator cartridges at time of coalescer cartridge change in accordance with Section 3-6.2.3 Separator Cleaning. Worn or damaged separator cartridges must be replaced.
Frequency: Every 36 months or sooner if required by differential pressure.
- g. Refer to Section 6-7.2, "Differential Pressure Gauges," for inspection and maintenance requirements of differential pressure gauges.
- h. Refer to Section 3-10.2, "Automatic Air Vents," for inspection and maintenance requirements of automatic air vents.
- i. Refer to Section 6-6.3, "Thermal and Pressure Relief Valves," for inspection and maintenance requirements of thermal and pressure relief valves.
- j. Refer to Section 4-4.2.2, "Filter Separator Control Valves," for inspection and maintenance requirements of filter separator control valves.
- k. Conduct inspections of code rated vessels in accordance with UFC 3-430-07.

3-6.2.2 Replacement of Coalescer Cartridges.

General instructions for the replacement of filter separator coalescer cartridges are included in [Appendix D](#). Refer to manufacturer's maintenance and operation manual for additional guidelines.

3-6.2.3 Separator Cleaning.

Separator cartridges, when new, operate in a satisfactory manner, but over time they gradually become less effective. Every time the coalescer cartridges are changed, the separator cartridges must be inspected and cleaned. Typical instructions for cleaning separator cartridges are included in [Appendix D](#). Refer to manufacturer's operation and maintenance manual for additional guidelines.

3-6.2.4 Stenciling of Filter Separators.

Use stencils or embossing tape (0.75 to 1-inch (19 to 25 mm letters) to permanently mark filter separators when coalescer cartridges are changed with date changed, due date for next change, and maximum differential pressure.

3-6.2.5 Initial Filling of Filter Separators.

Internal flash fires have occurred within filter separators. In some cases, there were no audible sounds or immediate indications of a problem. These incidents are mainly due to electrostatic ignition of the petroleum fuel vapor-air mixture during the initial filling operation. Ignition inside filter separators is possible regardless of the type of petroleum fuel handled (e.g., JP-4, JP-5, JP-8, Jet A, additized Jet A (F-24)). Filling a filter separator must take a minimum of ten minutes to perform. Slow filling is the only authorized method of refilling an empty filter separator. This slows buildup of static electricity in fuel, reducing the possibility of a spark igniting the explosive atmosphere inside the vessel. In most cases, coalescer elements cannot be grounded or bonded to dissipate the static electric charge that is generated during filling.

3-6.3 Haypack Filters.

Haypack filters are typically only used for marine barge and tanker offloading where large amounts of water are expected to be present in the fuel.

3-6.3.1 Inspection and Maintenance – Haypack Filter.

Refer to manufacturer's operation and maintenance manual for inspection and maintenance requirements of haypack filters. Refer to [Section 2-6.4 Waste Disposal](#) for disposal of requirements.

3-6.4 Basket Strainers.

Basket strainers, which meet the requirements of UFGS 33 52 43.13, remove large particulate matter from petroleum fuel streams. Basket strainers are typically equipped with 60 mesh (0.25 mm sieve) wire strainer screens. In most cases basket strainers are equipped with differential pressure gauges that can be used to measure the differential pressure across the strainer. The maximum retaining capacity of rust and sediment in the basket strainer is reached when the acceptable maximum differential pressure is indicated across the strainer. The acceptable maximum differential pressure for a specific basket strainer is dependent on the size of the strainer and the system flow rate. Reference the manufacturer's data sheet for the maximum differential pressure of a particular basket strainer.

Dirty strainer screens can be washed (using air jets or pressurized liquid streams) and reused as long as they are not ruptured or otherwise damaged. Gum or tar can be removed by soaking strainer screens in a high flash point petroleum fuel, such as kerosene. In order to reduce shutdown time, it is advisable to have extra strainer screens on hand.

3-6.4.1 Inspection and Maintenance - Basket Strainers.

- a. Monitor and chart differential pressure measurements of basket strainers from readings taken during normal operations. Investigate sudden drops or spikes in differential pressure measurement reading.

Frequency: Daily

- b. Clean and inspect basket and strainer screen. Basket strainer isolation valves must be closed and the strainer body must be drained before removing the cover. After cleaning, the strainer screen must be inserted in the strainer body, and the head tightened and checked for leakage. If strainer is not equipped with means to measure differential pressure, unit must be opened monthly and inspected.

Frequency: Semi-annually if basket strainer is equipped with means to measure differential pressure; otherwise monthly.

- c. Refer to Section 6-7.2, Differential Pressure Gauges, for inspection and maintenance requirements of differential pressure gauges.

3-6.5 Filter Separator Sump Heaters.

Heaters are used in sumps to prevent freezing of separated water during winter months in cold climates. Sump heaters are not approved for DoD systems. If heaters are installed contact the military service-specific SCP for guidance. Existing heaters installed in systems must be maintained.

3-6.5.1 Inspection and Maintenance – Filter Separator Sump Heaters.

- a. Inspect filter separator sump and drain line heater elements for proper operation per manufacturer's operation and maintenance manual. Ensure heater elements meet manufacturer's requirements by measuring resistance of heater elements with an ohm meter.

Frequency: Semi-annually.

3-7 METERS.

3-7.1 Positive Displacement Meters.

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Positive displacement meters that meet the requirements of \\ UFGS 33 57 55 // are used to record the amount of petroleum fuel received, transferred, or issued. Flow control devices and strainers are sometimes installed upstream of meters to help ensure accuracy and protect meter internals.

Truck and railcar loading meters may be equipped with a preset feature. This feature is used to slow the petroleum fuel flow to a predetermined rate when the preset petroleum fuel total is approached. Slower fill rates allow a more accurate final fill and reduce the likelihood of hydraulic shock to the system once flow of petroleum fuel is stopped.

Meters installed at custody transfer points may be equipped with temperature compensation. This feature allows the meter to adjust the measurement of the flow rate to a standard temperature.

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Figure 3-3 Positive Displacement Meter



3-7.1.1 Inspection and Maintenance – Positive Displacement Meters.

Component wear and accumulation of solids make periodic calibration necessary. Certified master meters or volumetric prover tanks are used for calibration. Master meters must have been certified within a year of calibration operations. Master meters are tested at a predetermined flow rate. Master meters must be calibrated within $\pm 10\%$ of the normal operating flow rate through the inline positive displacement meter. Volumetric prover tanks must have been certified within the last five (5) years of calibration operations.

- a. Inspect counter head for unusual noises and smooth operation.
Frequency: Monthly
- b. Positive displacement meters must be inspected and calibrated semi-annually or when improper performance is suspected; when unusual sounds or register actions develop; or after repairs have been made which may affect performance. Positive displacement meters are satisfactory when the measurement error in the normal flow direction is within $\pm 0.3\%$ of actual quantity delivered (e.g., ± 1.8 gallons for a 600-gallon test (± 6.8 liters for a 2275-liter test)). Adjustment of the meter's register will be in accordance with manufacturer's instructions. Identify the next calibration date on meters (example: Mar 14 for March 2014). Use weather resistant label that will remain legible and affixed for at least one year.
Frequency: Semi-annually or as required

- c. Inspect temperature element operation of meters equipped with temperature compensation feature per manufacturer's operation and maintenance manual.
Frequency: Semi-annually

3-7.2 Turbine Flow Meters

Turbine flow meters that meet the requirements of UFGS 33 52 43.11 utilize an axially aligned rotor to measure fluid flow. Clearances between the rotor and housing allow some slippage which can reduce the accuracy of the flow meter.

Figure 3-4 Turbine Flow Meter



3-7.2.1 Inspection and Maintenance- Turbine Flow Meters.

Component wear makes periodic calibration necessary. Certified master meters or volumetric prover tanks are used for calibration of turbine flow meters in accordance with *API Manual of Petroleum Measurement Standards*. Master meters must have been certified within a year of calibration operations. Master meters are tested at a predetermined flow rate. Master meters must be calibrated within $\pm 10\%$ of the normal operating flow rate through the turbine meter. Volumetric prover tanks must have been certified within the last five (5) years of calibration operations. Refer to the manufacturer's operation and maintenance manual for turbine flow meter-specific calibration procedures.

- a. Turbine flow meters must be inspected and calibrated semi-annually or when improper performance is suspected, register actions develop, or after repairs have been made which may affect performance. Turbine flow meters are satisfactory when the measurement error in the normal flow direction is within $\pm 0.5\%$ of actual quantity delivered (e.g., ± 3 gallons for a 600-gallon test (± 11 liters for a 2275-liter test)). Adjustment of the meter's register will be in accordance with the manufacturer's instructions. Identify the next calibration date on meters (example: Mar 14 for March 2014). Use weather resistant label that will remain legible and affixed for at least one year.
Frequency: Semi-annually or as required

- b. Inspect temperature element operation of meters equipped with temperature compensation feature per manufacturer's operation and maintenance manual.

Frequency: Semi-annually

3-7.3 Orifice Flow Meters.

Orifice flow meters that meet the requirements of UFGS 33 52 43.11 typically do not require calibration. Orifice flow meters are customized to a specific flow rate and are only accurate over a small range.

3-7.3.1 Inspection and Maintenance - Orifice Flow Meters.

Refer to manufacturer's operation and maintenance manual for unit-specific maintenance requirements.

- a. Refer to [Section 6-7.2, Differential Pressure Gauges](#), for inspection and maintenance requirements of differential pressure gauges.
- b. Refer to [Section 6-7.4, Differential Pressure Transmitters](#), for inspection and maintenance requirements of differential pressure transmitters.

3-8 PUMPS.

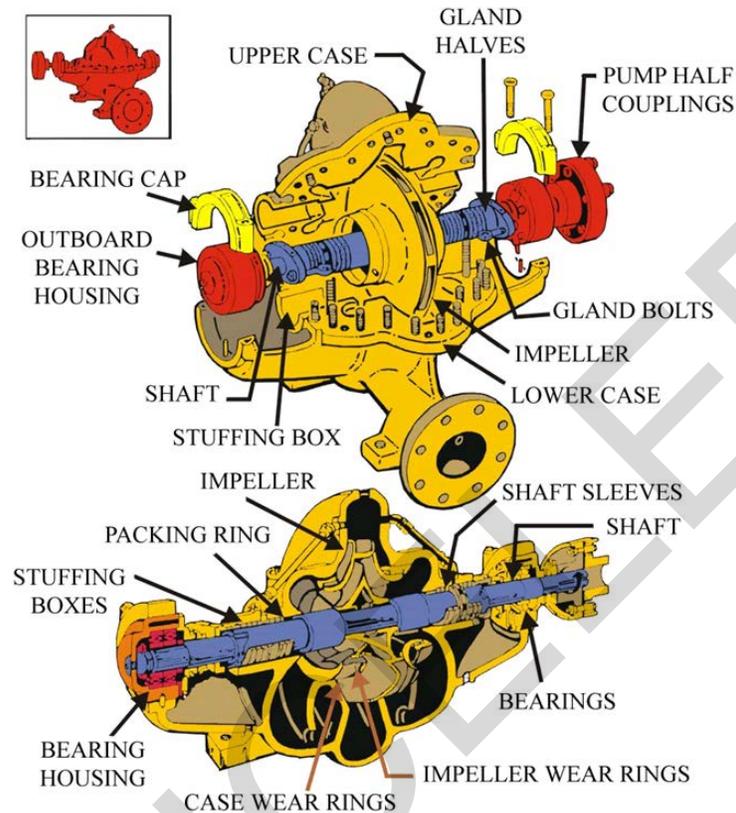
3-8.1 Centrifugal Pumps.

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- a. Centrifugal pumps work best if the impeller is completely immersed in liquid. It is important to prevent air pockets from delivery trucks and hoses from entering pumps. If air gets into a pump the performance can be drastically reduced. Air eliminator tanks and automatic air vents are used to release air from the suction lines of pumps. In some cases air eliminators are attached directly to the housing of pumps.
- b. Centrifugal pumps must have proper shaft alignment with the motors. The pumps must also be properly shimmed and mounted securely. Both inlet and outlet pipe connections should be made with vibration dampeners. The bearings must be adequately lubricated and the mechanical seals should show no signs of leaks.
- c. Mechanical seals require maintenance, but they provide reliable service if properly installed on a true shaft. Frequent trouble is usually caused by shaft vibration, wear, or improper installation. It is most important to protect seal faces from contact with skin, grease, or metal particles, which can contaminate the seal and cause premature seal failure.

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Figure 3-5 Split-Case Centrifugal Pump



3-8.1.1 Inspection and Maintenance - Centrifugal Pumps.

Refer to manufacturer's operation and maintenance manual for specific maintenance procedures and schedules associated with a specific model of pump. Follow applicable general maintenance and safety requirements listed in the manufacturer's operation and maintenance manual.

- a. Check for proper operations while pump is in use. Check suction and discharge pressure gauges for abnormal readings.
Frequency: Quarterly
- b. Check for unusual noise, vibration, and overheating of bearings or case.
Frequency: Quarterly
- c. If equipped with lubricating oil charge, check oil level and adjust as necessary.
Frequency: Quarterly
- d. Tighten or replace loose, missing or damaged nuts, bolts, or screws.
Frequency: Quarterly

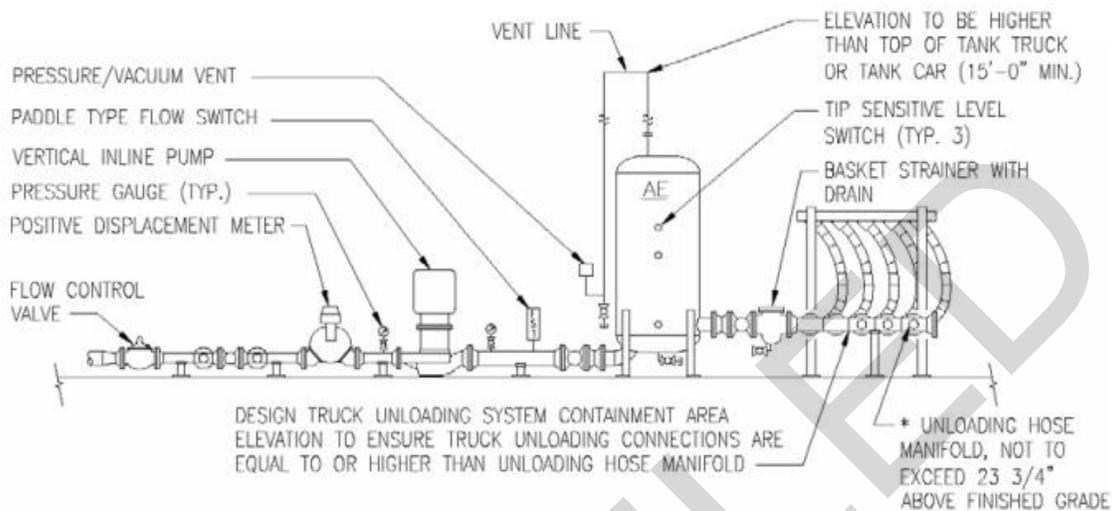
- e. Inspect suction and discharge isolation dampeners for misalignment and wear.
Frequency: Quarterly
- f. Inspect mechanical seals, if possible, for proper operating temperature, drips, leaks and dirt.
Frequency: Quarterly
- g. Check for alignment, clearances, and rotation of shaft and coupler (requires removal of coupler shroud or cover).
Frequency: Annually
- h. Lubricate pump bearings.
Frequency: Annually
- i. If equipped with lubricating oil charge, drain old oil, and fill with new oil to full mark on sight indicator (also fill bulb).
Frequency: Annually
- j. Refer to Section 9-1.7, "Electric Motors," for inspection and maintenance requirements of electric motors.

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3-8.2 /1/ Vertical Inline Pumps.

Vertical inline pumps should meet the requirements of 11 UFGS 33 52 43.23 /1/. Off-loading pump can operate at lower liquid levels than similarly sized end suction pumps due to the geometry of the impeller location and are used frequently in petroleum fuel offloading applications. Vertical inline pumps must be properly supported to prevent unnecessary stress on inlet and outlet piping.

Figure 3-6 Vertical Inline Pump



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3-8.2.1 /1/ Inspection and Maintenance – Vertical Inline Pumps.

Refer to manufacturer's operation and maintenance manual for specific maintenance procedures and schedules associated with a specific model of pump. Follow applicable general maintenance and safety requirements listed in the manufacturer's operation and maintenance manual.

- a. Check for proper operations while pump is in use. Check suction and discharge pressure gauges for abnormal readings.
Frequency: Quarterly
- b. Check for unusual noise, vibration, and overheating of bearings.
Frequency: Quarterly
- c. Tighten or replace loose, missing or damaged nuts, bolts, or screws.
Frequency: Quarterly
- d. Inspect suction and discharge isolation dampeners for misalignment and wear.
Frequency: Quarterly
- e. Inspect mechanical seals, if possible, for proper operating temperature, drips, leaks and dirt.
Frequency: Quarterly
- f. Check for alignment, clearances, and rotation of shaft and coupler (requires removal of coupler shroud or cover).
Frequency: Annually

- g. Lubricate pump bearings.
Frequency: Annually
- h. Refer to [Section 9-1.7 Electric Motors](#) for inspection and maintenance requirements of electric motors.

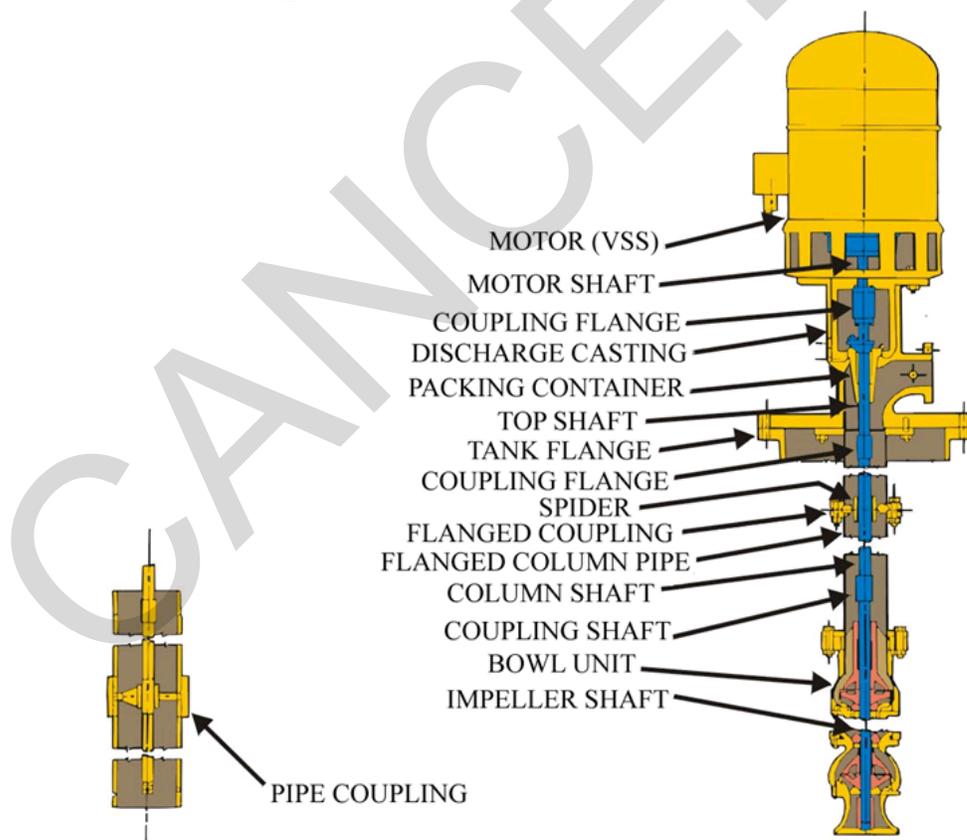
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3-8.3 /1/ Vertical Turbine/Submerged Turbine Pumps.

Submerged turbine pumps that meet the requirements of UFGS 33 52 43.23 are used to pump from aboveground, underground, and cut and cover tanks. This type of pump is also used to transfer fuel from drop tanks used in some petroleum fuel truck offloading systems. A “can” pump is another type of vertical turbine pump.

Submerged turbine pumps are sometimes used in military service station applications to supply fuel to vehicle fuel dispensers and petroleum fuel truck loading positions. Refer to manufacturer's operation and maintenance manual for more information on each type of pump.

Figure 3-7 Vertical Turbine Pump



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3-8.3.1 /1/ Inspection and Maintenance – Vertical Turbine/Submerged Turbine Pumps.

Refer to manufacturer's operation and maintenance manual for specific maintenance procedures and schedules associated with a specific model of pump. Follow applicable general maintenance and safety requirements listed in the manufacturer's operation and maintenance manual.

- a. Check for proper operation while pump is in use. Check discharge pressure gauge for abnormal readings.
Frequency: Quarterly
- b. Check for unusual noise, vibration, and overheating of bearings or case.
Frequency: Quarterly
- c. If equipped with lubricating oil charge, check oil level and adjust as necessary.
Frequency: Quarterly
- d. Tighten or replace loose, missing or damaged nuts, bolts, or screws.
Frequency: Quarterly
- e. Inspect mechanical seals, if possible, for proper operating temperature, drips, leaks and dirt.
Frequency: Quarterly
- f. Inspect anti-rotation device for proper operation.
Frequency: Semi-annually
- g. Check for alignment, clearances, and rotation of shaft and coupler (requires removal of coupler shroud or cover).
Frequency: Annually
- h. Lubricate pump bearings.
Frequency: Annually
- i. If equipped with lubricating oil charge, drain old oil, and fill with new oil to full mark on sight indicator (also fill bulb).
Frequency: Annually
- j. Refer to [Section 9-1.7 Electric Motors](#) for inspection and maintenance requirements of electric motors.

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3-8.4 /1/ Positive Displacement Pumps.

Positive displacement pumps have an expanding cavity on the suction side and a decreasing cavity on the discharge side. Liquid flows into the pumps as the cavity on the suction side expands and the liquid flows out of the discharge as the cavity collapses. The pumped volume is constant given each cycle of operation.

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3-8.5 /1/ Sliding Vane Pumps.

Sliding vane pumps (sometimes referred to as rotary vane pumps) are self-priming positive displacement pumps used where suction lifts are high or where the pump may frequently lose prime such as petroleum fuel truck offload systems. These pumps must have internal or downstream pressure relief.

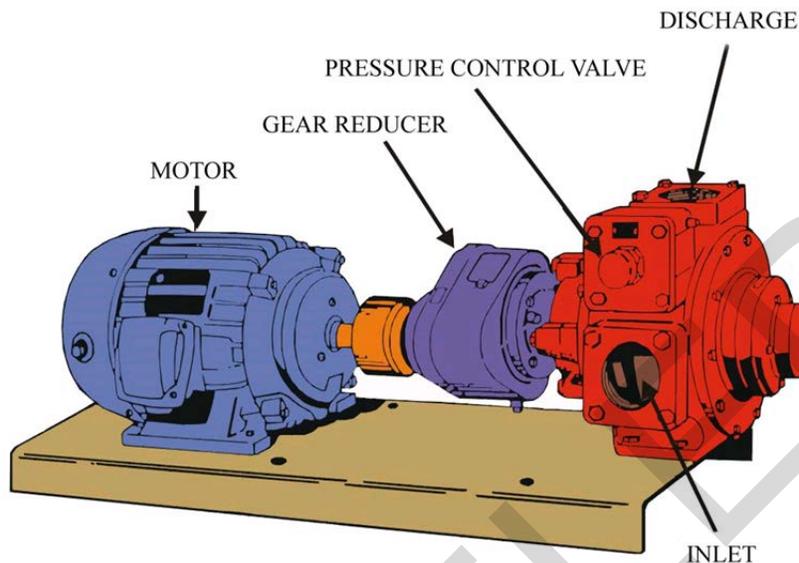
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3-8.5.1 /1/ Inspection and Maintenance – Sliding Vane Pumps.

Refer to manufacturer's operation and maintenance manual for specific maintenance procedures and schedules associated with a specific model of pump. Follow applicable general maintenance and safety requirements listed in the manufacturer's operation and maintenance manual.

- a. Inspect pump for unusual noise, vibrations, and overheating of bearings and case.
Frequency: Quarterly
- b. Inspect mechanical seals, if possible, for drips or leaks and dirt.
Frequency: Quarterly
- c. Lubricate pump bearings.
Frequency: Quarterly
- d. Inspect pump and motor coupling for proper alignment.
Frequency: Annually
- e. Refer to manufacturer's operation and maintenance manual for internal pressure relief testing and calibration procedures.
Frequency: Annually
- f. Refer to [Section 3-8.4 Gearboxes](#) for inspection and maintenance of reduction gearboxes.
- g. Refer to [Section 9-1.7 Electric Motors](#) for inspection and maintenance requirements of electric motors.

Figure 3-8 Rotary Vane Pump



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3-8.6 // Gear Pumps.

Gear pumps may be used to transfer petroleum fuel at moderate flow rates and can operate at high pressures.

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3-8.6.1 // Inspection and Maintenance – Gear Pumps.

Refer to manufacturer's operation and maintenance manual for specific maintenance procedures and schedules associated with a specific model of pump. Follow applicable general maintenance and safety requirements listed in the manufacturer's operation and maintenance manual.

- a. Inspect pump for unusual noise, vibrations, and overheating of bearings and case.
Frequency: Quarterly
- b. Inspect mechanical seals, if possible, for drips or leaks and dirt.
Frequency: Quarterly
- c. Lubricate pump bearings.
Frequency: Quarterly
- d. Inspect pump and motor coupling for proper alignment.
Frequency: Annually

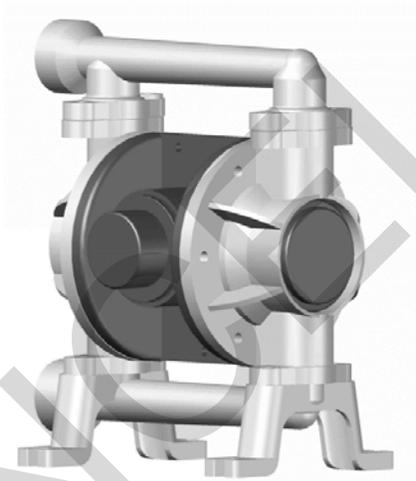
- e. Refer to [Section 3-8.4 Gearboxes](#) for inspection and maintenance of reduction gearboxes.
- f. Refer to [Section 9-1.7 Electric Motors](#) for inspection and maintenance requirements of electric motors.

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3-8.7 /1/ Diaphragm Pumps.

Diaphragm pumps are relatively low maintenance pumps that provide good performance for transferring high viscosity liquids such as petroleum sludge left in a tank.

Figure 3-9 Diaphragm Pump



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3-8.7.1.2 /1/ Inspection and Maintenance – Diaphragm Pumps

Refer to manufacturer's operation and maintenance manual for specific maintenance procedures and schedules associated with a specific model of pump. Follow applicable general maintenance and safety requirements listed in the manufacturer's operation and maintenance manual. Ensure pump, hoses, and fittings are kept clean and are stored in a protected area out of the elements when is not in use.

- a. Inspect hoses for cracks or dry rot.
Frequency: Quarterly
- b. Inspect compressed air connections and hose couplings for signs of leaks.
Frequency: Quarterly
- c. Inspect compressed air hose coupling safety pins or safety wires for wear and damage. Replace damaged components.
Frequency: Quarterly

- d. Diaphragm pumps should have the internal diaphragm replaced if the pump shows decreased performance. Also check operation of actuator valve and ensure ball checks seat properly.
Frequency: As required

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3-8.8 /1/ Internal Combustion Drives.

Internal combustion drives are used where equipment is needed on a temporary or portable basis such as temporary pumps or power generators. Internal combustion drives are also used to operate permanent power generators when standard power is interrupted such as emergency backup generators, and where large power feeds for large equipment is not available or cost effective to install such as petroleum fuel transfer pumps installed in remote locations.

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3-8.8.1 /1/ Inspection and Maintenance – Internal Combustion Drives.

- a. Refer to manufacturer's operation and maintenance manual for specific maintenance procedures and schedules associated with a specific model of internal combustion drive. Follow all applicable general maintenance and safety requirements listed in the manufacturer's operation and maintenance manual.
Frequency: As required

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3-8.9 /1/ Gearboxes.

Gearboxes transmit power from motors to pumps and other rotating equipment. Gearboxes must be monitored for proper alignment and oil level. Do not overfill gearboxes during maintenance.

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3-8.9.1 /1/ Inspection and Maintenance – Gearboxes.

When replacing lubricating oil, verify metal shaving content is within manufacturer's recommendations. Refer to manufacturer's operation and maintenance manual for oil testing procedures, proper oil levels, and proper type of oil which should be used. Refer to the applicable manufacturer's operation and maintenance manual for specific maintenance procedures and schedules, and follow applicable general maintenance and safety requirements.

- a. Inspect gearboxes for signs of smoke near shaft connections or discoloration of the gearbox from overheating.
Frequency: Quarterly

- b. Verify that the oil in the sight glass is not dark or appears to have foam. Adjust oil level if required.
Frequency: Quarterly
- c. Lubricate bearings per manufacturer's recommendations.
Frequency: Semi-annually
- d. Check motor and gear box and gear box and pump couplers for wear and alignment.
Frequency: Semi-annually
- e. Inspect gear alignment within gearbox.
Frequency: Annually
- f. Replace lubricant oil in accordance with manufacturer's specifications and recommendations.
Frequency: Annually

3-9 HOSES.

3-9.1 Loading Fuel Hoses.

Loading fuel hoses must meet the requirements of aviation fueling hoses listed in **11 UFGS 33 57 55 /1/**. General requirements for loading fuel hose use are as follows:

- a. Hoses must be stored away from direct exposure to sun and extreme weather such as rain and snow in a hinged enclosure when not in use.
- b. Dust covers or other protective devices must be used to keep out dirt and water.
- c. Hoses must be installed within 2 years of the date of the hose's manufacture, and have a maximum service life of 10 years from the date of manufacture.

3-9.1.1 Inspection and Maintenance – Loading Fuel Hoses.

- a. Visually inspect hoses for loose covers, cracks, brittle surface coatings, exposed wire braids, exposed reinforcement, flattening, kinks, and bulges or soft spots which might indicate broken or displaced reinforcement.
Frequency: Monthly
- b. Pressurize hose to normal working pressure. Check flanged and threaded connections for leaks and inspect hose couplers for fluid seepage by pushing at the base of the coupling with thumbs. A hose softened by petroleum fluid seepage must be replaced.
Frequency: Monthly

- c. Check for coupling slippage. Replace hose that shows signs of coupling slippage.
Frequency Quarterly
- d. **1\1/**
- e. Conduct test of petroleum fuel hose electrical resistivity using an electrostatic meter in accordance with NFPA 77 and API 2003.
Frequency: Annually

3-9.2 Offloading Fuel Hoses.

Offloading petroleum fuel hoses meeting the requirements of UFGS 33 52 43.11 are used for offloading operations. Offloading petroleum fuel hoses must be stored away from direct sunlight in a hinged enclosure when not in use or must be purchased with ultraviolet (UV) light protection.

3-9.2.1 Inspection and Maintenance - Offloading Fuel Hoses.

- a. Visually inspect hoses for cracks, brittle surface coatings, exposed wire braids, exposed reinforcement, flattening, kinks, and bulges or soft spots which might indicate broken or displaced reinforcement.
Frequency: Monthly
- b. Check flanged and threaded connections for leaks and inspect hose couplers for fluid seepage by pushing at the base of the coupling with thumbs. A hose softened by petroleum fluid seepage must be replaced. Damaged or leaking hoses must be replaced immediately or isolated and taken out of service.
Frequency: Quarterly
- c. Conduct test of offloading petroleum fuel hose electrical resistivity as directed in NFPA 77 and API 2003.
Frequency: Annually

3-10 AIR ELIMINATORS.

Air eliminators are used to remove non-condensing gases such as air from petroleum fuel systems.

3-10.1 Air Eliminator Tanks.

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- a. Air eliminator tanks meeting the requirements of UFGS 33 52 43.11 are used to remove air from petroleum fuel offloading systems. Air eliminator tanks should include a sight gauge, float vent valve, level sensors, and a pressure/vacuum vent.

- b. A float vent valve is installed at the top of air eliminator tanks in an extractor fitting at the base of the vent pipe. The float and body of the valve are suspended from the extractor fitting inside the air eliminator tank. The float of the valve is buoyant in petroleum fuel and rises to close the float vent valve and block off the vent pipe when the air eliminator tank is full of petroleum fuel. When the level of petroleum fuel in the air eliminator tank drops, the float of the float vent valve drops and opens the vent pipe.
- c. A pressure/vacuum vent is installed at the end of the vent pipe. The pressure/vacuum vent allows air to vent from the tank when a small positive pressure is developed in the air eliminator tank and allows air to enter the vent line when a small negative pressure is developed inside the air eliminator tank.
- d. Level sensing probes are installed at two or three locations in the air eliminator tank. The level probes are used by the offloading control system to control the operation of the offloading pump.

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Figure 3-10 Air Eliminator Tank



3-10.1.1 Inspection and Maintenance - Air Eliminator Tanks.

- a. Inspect operation of petroleum fuel level probes. Ensure probes operate correctly when the level of petroleum fuel in the tank rises to the level of the probe sensing unit.
Frequency: Annually
- b. Remove the float vent valve from the air eliminator tank. Clean and inspect the sealing surfaces of the float vent valve. Ensure the float is buoyant in petroleum fuel and test the valve to ensure it closes properly.
Frequency Annually
- c. Refer to [Section 8-9.3 Tank Pressure/Vacuum Vents](#) for inspection and maintenance requirements of pressure vacuum vents.

3-10.2 Automatic Air Vents.

Automatic air vents meeting the requirements of UFGS 33 52 43.13 automatically vent air under pressure and prevent a vacuum when pressure drops below positive pressure. The vents are operated by a float ball that is buoyant in petroleum fuel. When air is present the float will drop allowing air to escape, and when petroleum fuel is present the ball will float and seal the vent opening. In most cases, automatic air vents are piped to a tank such as a product recovery tank.

Figure 3-11 Automatic Air Vent



3-10.2.1 Inspection and Maintenance - Automatic Air Vents.

- a. Check for proper operation of the automatic air vent. Ensure the vent opens to allow air to escape and ensure the float of the vent is buoyant in petroleum fuel and rises to close the vent when the float is suspended in petroleum fuel.
Frequency: Annually

3-11 FUEL ADDITIVE INJECTORS.

Fuel additive injectors are used to inject additives into fuel to change its grade such as a change from Jet A to F-24.

3-11.1 Inspection and Maintenance – Fuel Additive Injectors.

Refer to the manufacturer's operation and maintenance manual for specific calibration and maintenance procedures and schedules and follow all applicable general maintenance and safety requirements.

- a. Inspect injectors to ensure they are operating properly.
Frequency: When system has flow through it, inspect injectors weekly. When system is idle, inspect injectors monthly.
- b. Calibrate injector to ensure proper additive to fuel ratio.
Frequency: Annually

3-12 CODED VESSELS.

Coded vessels such as filter separators, filters, and relaxation tanks are used when spaces larger than standard piping is required to conduct operations such as filtering or static dissipation in petroleum fuel systems.

3-12.1 Inspection and Maintenance – Coded Vessels.

Pressure vessels used in petroleum fuel system are built to applicable pressure vessel codes and stamped with plates that provide information on the coded vessel. These vessels must follow inspection and maintenance requirements included in UFC 3-430-07.

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CHAPTER 4 AIRCRAFT FUELING FACILITIES

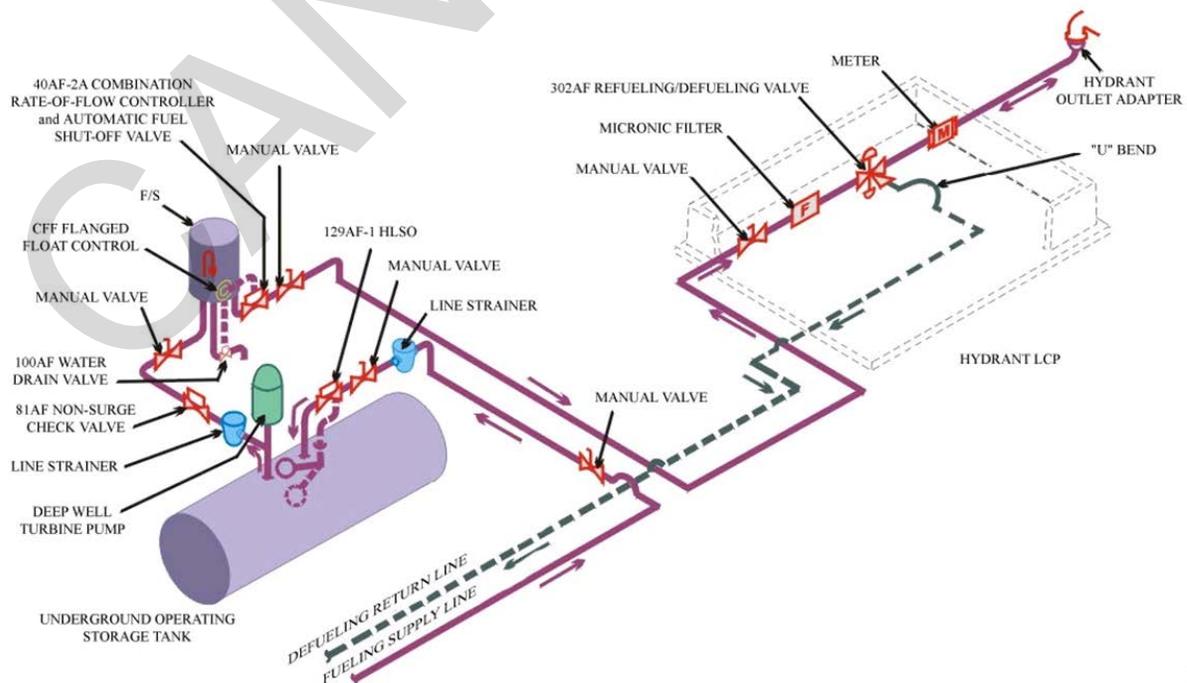
4-1 INTRODUCTION.

This chapter contains a brief operational description of each type of hydrant system and the major components included in each system. Hydrant systems are site-specific. The settings provided within this manual are derived from standard designs and may vary due to configuration, climate, and location of an installed system. Before systems or components are calibrated or maintained, personnel should consult as-built and start up data and must be familiar with proper settings of the specific system.

4-2 HYDRANT SYSTEM – TYPE I.

Type I hydrant systems are known as Panero systems. Panero systems were built in the 1940's and 50's, and were the first hydrant system used by the DoD. Panero systems have been superseded by more modern hydrant systems, but a limited number are still in use. Panero systems pump petroleum fuel to refueling outlets, and aircraft are moved to outlets to conduct refueling operations. These systems typically use vertical turbine pumps and underground horizontal storage tanks. Original Panero systems had automatic control valves on the issue and defuel lines in filter/meter pits. Major modifications to the original Panero created the Modified Panero system. The Modified Panero system uses one automatic control valve to perform both issue and defuel operations and uses MH-2 hose carts instead of filter/meter pits. With these systems defuel operations are conducted by gravity to a dedicated defuel tank.

Figure 4-1 Modified Panero, Type I Hydrant System



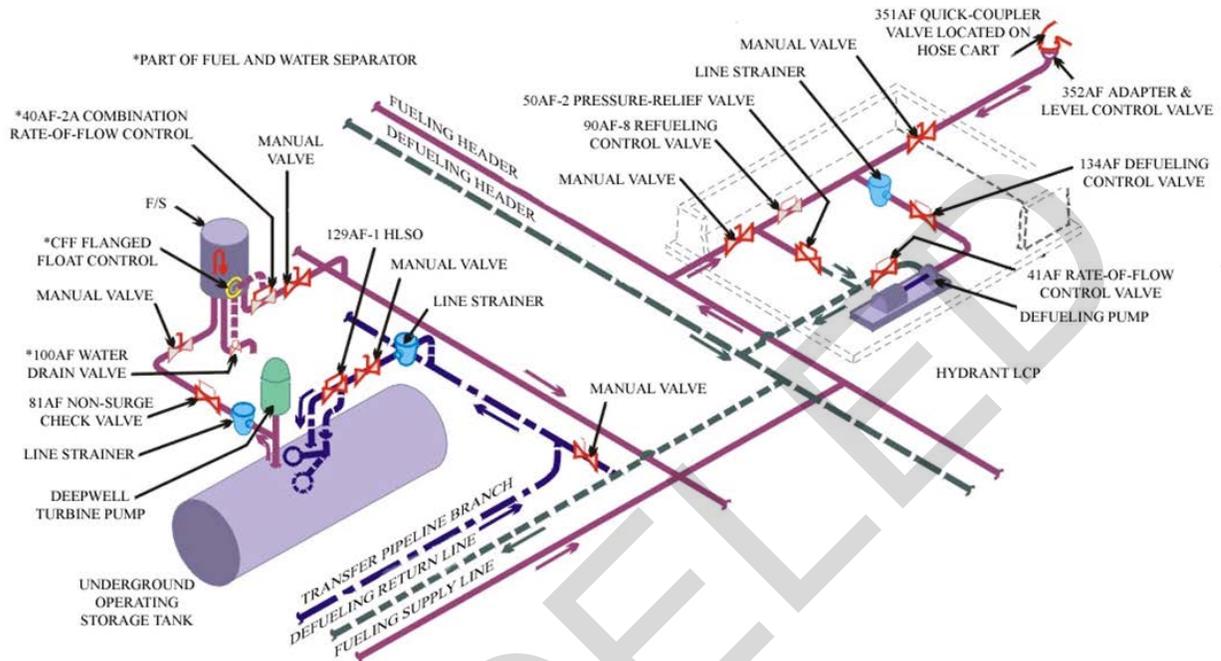
4-3 HYDRANT SYSTEM – TYPE II.

4-3.1 General Description.

Type II hydrant systems are known as Pritchard systems. Pritchard systems were developed in 1955 to improve hydrant refueling operating characteristics. These systems employ Lateral Control Pits (LCPs) and typically use vertical turbine pumps and underground horizontal storage tanks. Pritchard systems can service multiple hydrant outlets per LCP. This system allows flexibility in hydrant outlet locations and enables aircraft to be refueled at parking positions. The Type II Pritchard pumphouse is similar to the Type I, but the Type II Pritchard pumphouse does not include a separate defuel tank. Instead, one of the system operating tanks is designated as the defuel tank on a rotational basis. LCPs include a defueling pump and automatic valves. The MH-2 hose cart equipped with a filter separator, meter, and hoses is used for connecting hydrant outlets to aircraft, and as a result, filtration or meters are not required in LCPs. The following is a simplified description of operation:

- a. Fuel Issue: When fuel is required at a hydrant outlet, the operator places a magnet on the refueling magnetic control assembly. This causes a preselected pump in the pumphouse to start and energizes a solenoid on the refueling control valve in the LCP that supplies the activated hydrant outlet. Fuel moves from the pumphouse into the fueling manifold and to the LCP. Fuel enters the refueling control valve and causes it to open. The refueling control valve provides pressure reduction, non-surge, pressure relief, excess flow shutoff, and emergency shutoff capabilities. Fuel flows through the hydrant outlet adapter and to the MH-2 hose cart and into the aircraft. During fuel issue operations, the defueling valve solenoid is de-energized and the defuel valve is held closed. The pressure relief valve relieves excess pressure from the upstream side of the refueling control valve into the defuel line if required.
- b. Defueling: When a defuel operation is required the operator places the magnet on the defuel refueling magnetic control assembly switch. This causes a solenoid on the defueling valve connected to the hydrant pit to energize and the associated defuel pump to start. When the defuel solenoid energizes the defuel valve opens and fuel is drawn through the defuel pump and forced through the rate-of-flow control valve into the defuel line at a rate of 200 gallons per minute (gpm) (12.5 Liters per Second (lps)). Fuel flows to the operating tank designated to receive defuel product.

Figure 4-2 Pritchard, Type II Hydrant System



4-3.2 System Specific Control Valves.

4-3.2.1 General System Control Valves.

Petroleum fuel system control valves use hydraulic pressure from the upstream side of petroleum fuel piping connected to the valve to open or close the valve. The valves are equipped with flexible diaphragms and control pilots that are used to operate the valves. The valves can be used to perform many functions. The functionality of the valve is dependent on the type of control pilot that is installed on the valve and the orientation of flow through the valve.

4-3.2.1.1 Inspection and Maintenance - General System Control Valves.

- a. Verify operating settings of valve. Valve adjustment must be in accordance with manufacturer's operation and maintenance manuals and final start-up and commissioning set points. Use of DoD standard set points should only be used as a reference starting point as pipe size and other hydraulic factors influence final system settings.

Frequency: Quarterly

- b. Remove and clean strainer installed in the petroleum fuel supply line to the pilot and main valve diaphragm. This strainer is provided to prevent clogging of the orifice in the supply line. Clogging of the screen will cause malfunctioning of the valve.

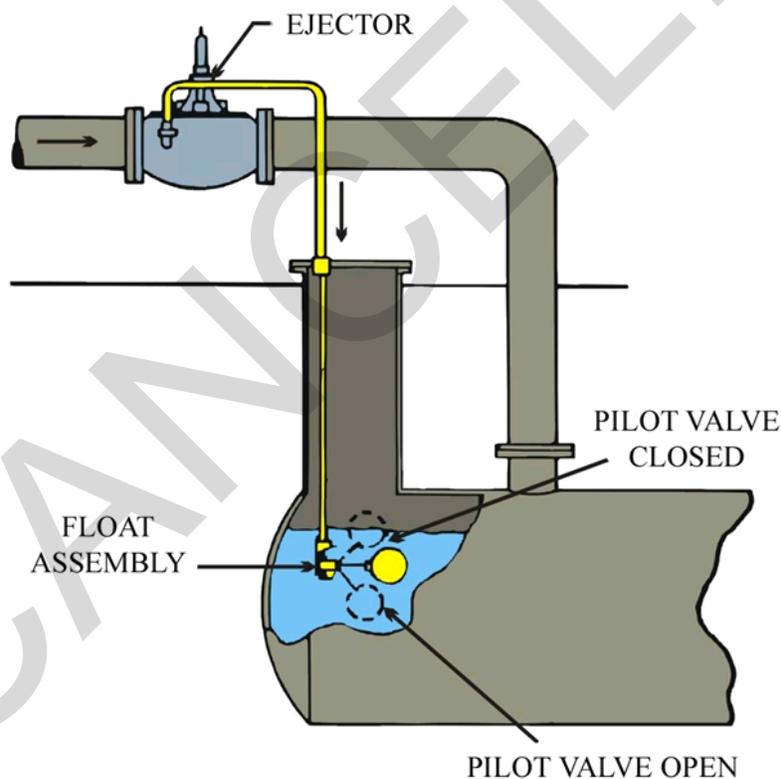
Frequency: Annually for unfiltered systems and as required for filtered systems.

- c. Diaphragms must be removed and inspected for deterioration and breaks at the flexing joint. Damage is often caused by pipe scale, pipe tape, and thread sealant compound that collect above the diaphragm and become lodged between the diaphragm and bonnet of the valve. Damage may also be caused by a change of operational petroleum fuel type or grade (such as a change from JP-4 to JP-8).
Frequency: Every 10 years

4-3.2.2 High Level Shut-off Valve.

For information on the operation and maintenance of a High Level Shut-Off (HLSO) valves, refer to [Section 8-9.6 High Level Shut-off Valve \(HLSO\)](#).

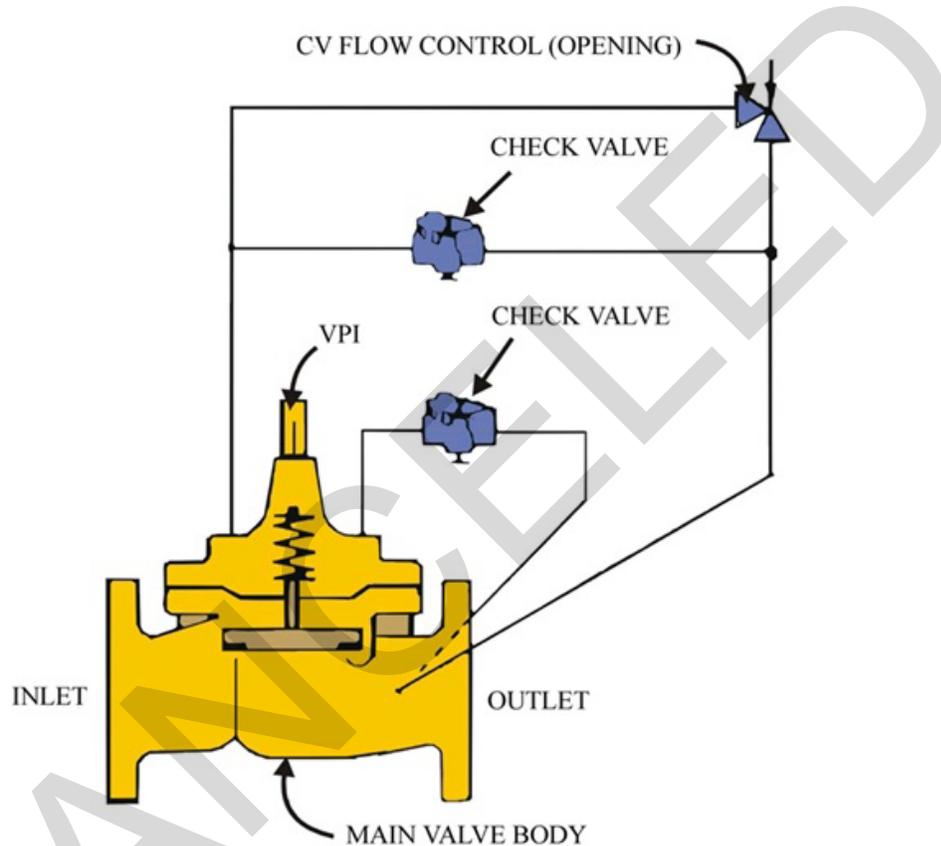
Figure 4-3 High Level Shut-off Valve (Type II)



4-3.2.3 Non-Surge Check Valves.

Type II system non-surge check valves are similar in design and operation to Type III non-surge check valves. Refer to [Section 4-4.2.1 Non-Surge Check Valves](#) for information on inspection and maintenance of non-surge check valves.

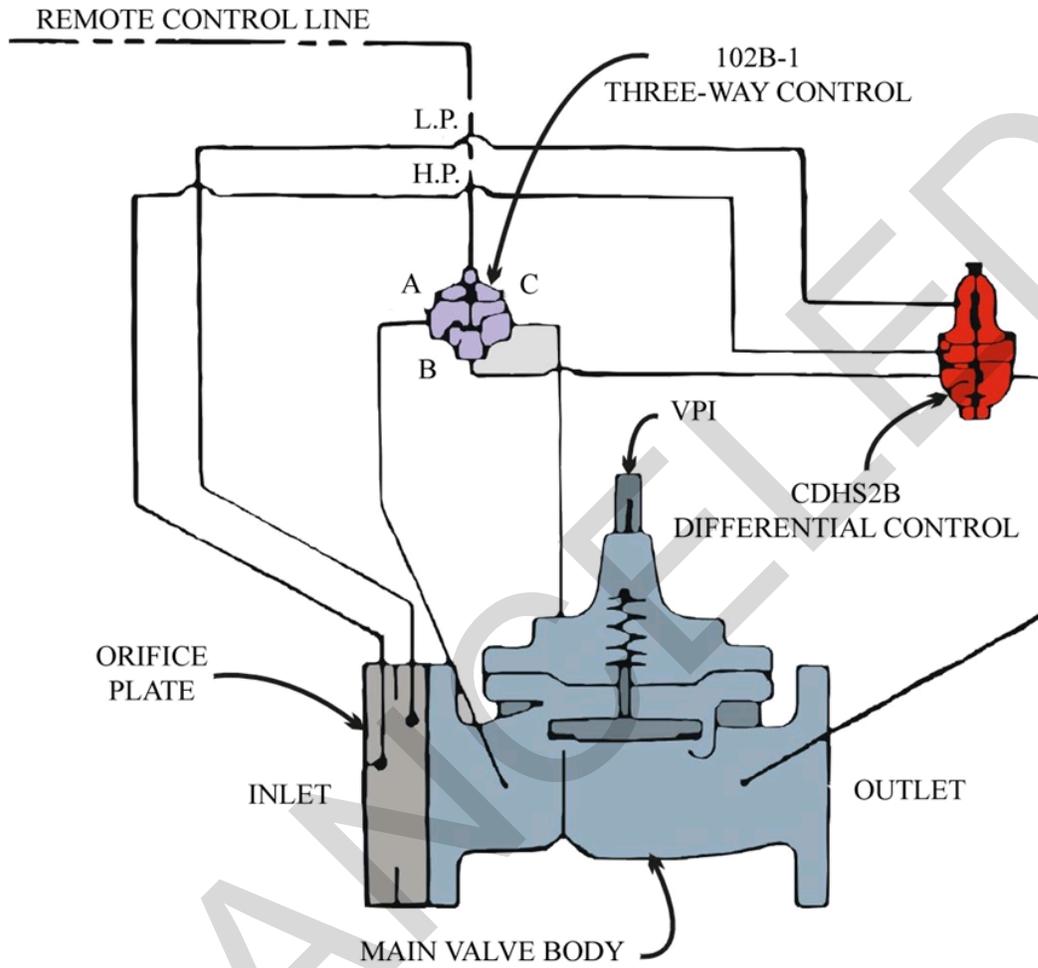
Figure 4-4 Non-Surge Check Valve (Type II)



4-3.2.4 Filter Separator Control Valves.

Type II system filter separator control valves are similar in design and operation to Type III filter separator control valves. Refer to [Section 4-4.2.2 Filter Separator Control Valves](#) for information on inspection and maintenance of filter separator control valves.

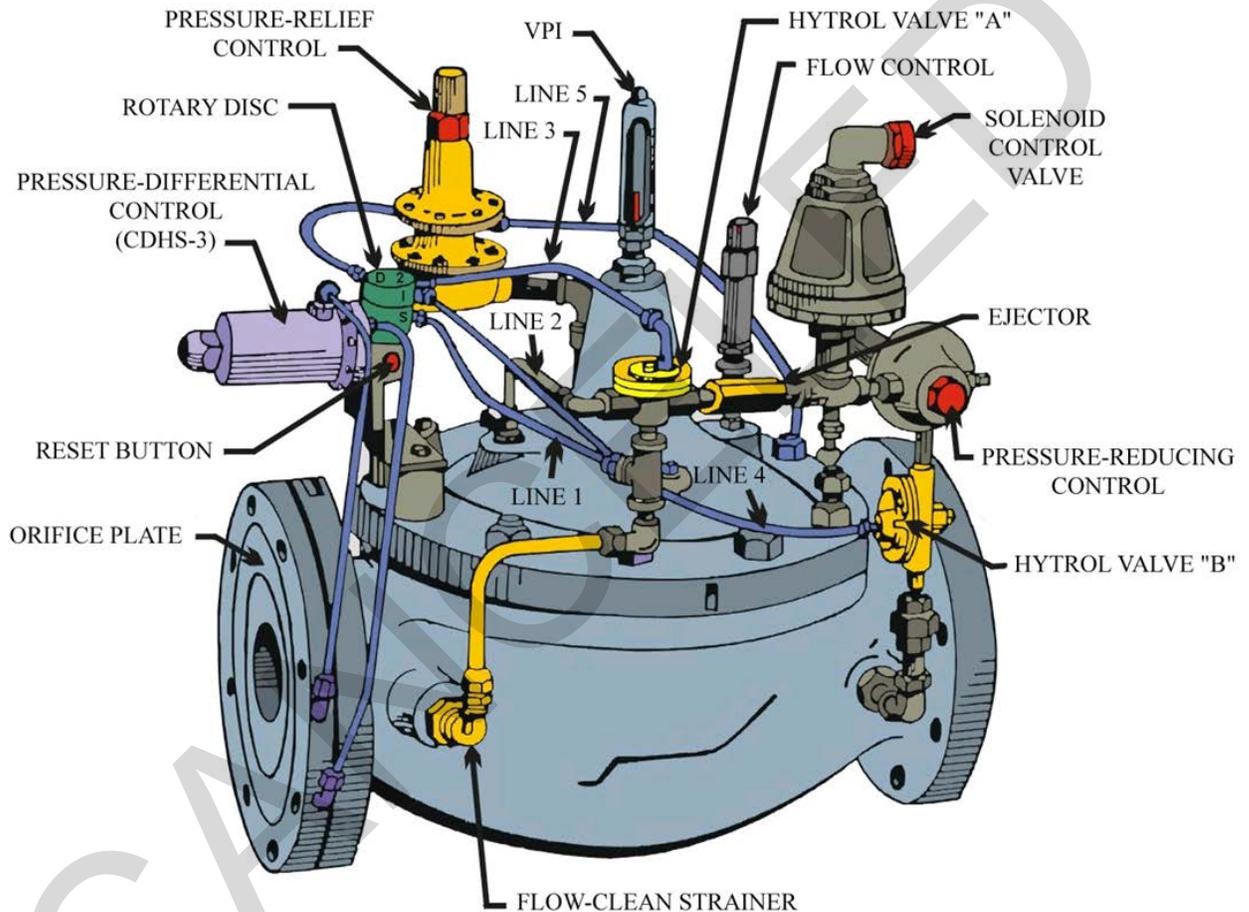
Figure 4-5 Filter Separator Control Valve (Type II)



4-3.2.5 Refuel Control Valves.

The diaphragm actuated refuel control valve provides five functions: pressure reduction; non-surge; pressure relief; excess flow shutoff; and emergency shutoff for Type II systems.

Figure 4-6 Refueling Control Valve (Type II)



4-3.2.5.1 Inspection and Maintenance – Refuel Control Valves.

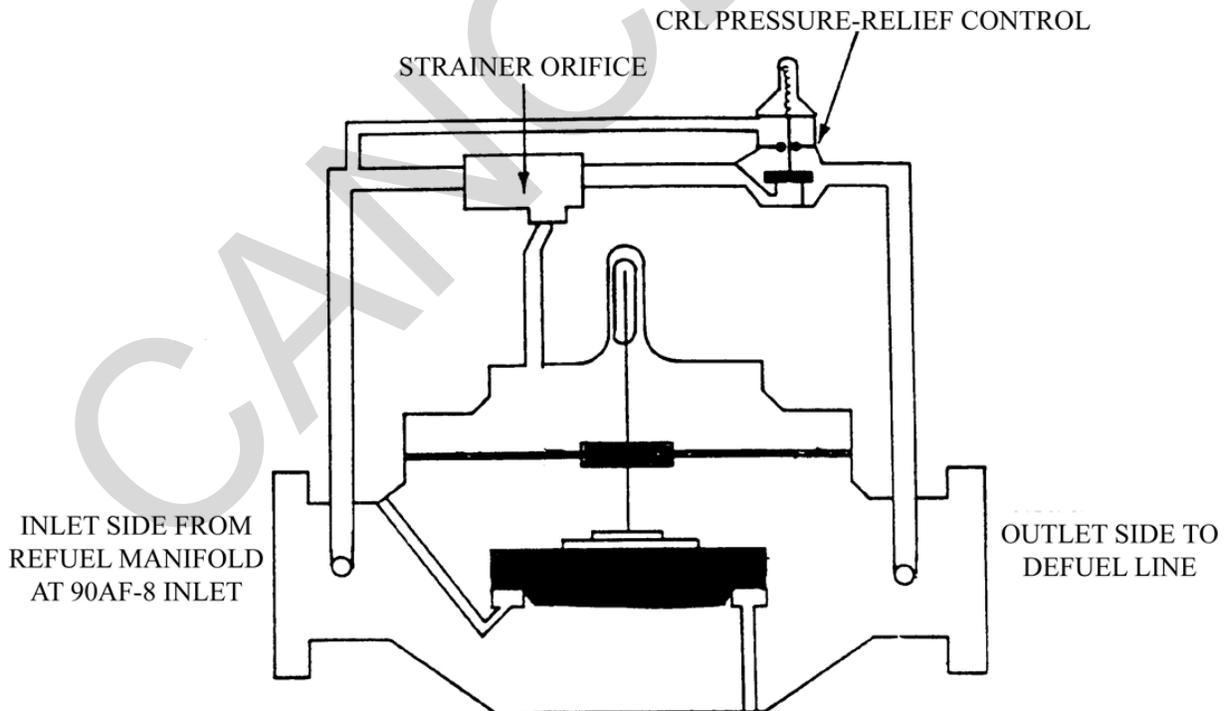
- a. Verify refuel control valve is set to maintain 100 psig (690 kPa) (typical operating pressure) as measured at the furthest hydrant outlet.
Frequency: Quarterly
- b. Verify pressure-reducing control will open at 5 psig (35 kPa) above normal operating pressure (typically 105 psig (725 kPa) as measured at the farthest hydrant outlet).
Frequency: Quarterly

- c. Verify refueling control valve opening rate is set between 15 and 20 seconds. The valve should open as quickly as possible without tripping the pressure differential control shut-off.
Frequency: Quarterly
- d. Verify operation of excess flow shutoff function.
Frequency: Quarterly
- e. Verify operation of solenoid.
Frequency: Quarterly
- f. Refer to [Section 4-3.2.1 General System Control Valves](#) for additional inspection and maintenance requirements.

4-3.2.6 Pressure Relief Valves.

The pressure relief valve is installed in the LCP between the fuel issue line and the defueling line. Pressure relief valves are provided to relieve excessive pressure caused by closing a downstream valve or thermal expansion in a closed section of pipeline. This valve is designed for petroleum fuel to flow under the seat disc inside the valve so that it "fails safe" in the open position if the main valve diaphragm fails.

Figure 4-7 Pressure Relief Valve (Type II)



4-3.2.6.1 Inspection and Maintenance – Pressure Relief Valves.

- a. Verify pressure relief valve will open at 10 psig (69 kPa) above normal inlet pressure to the refuel control valve.

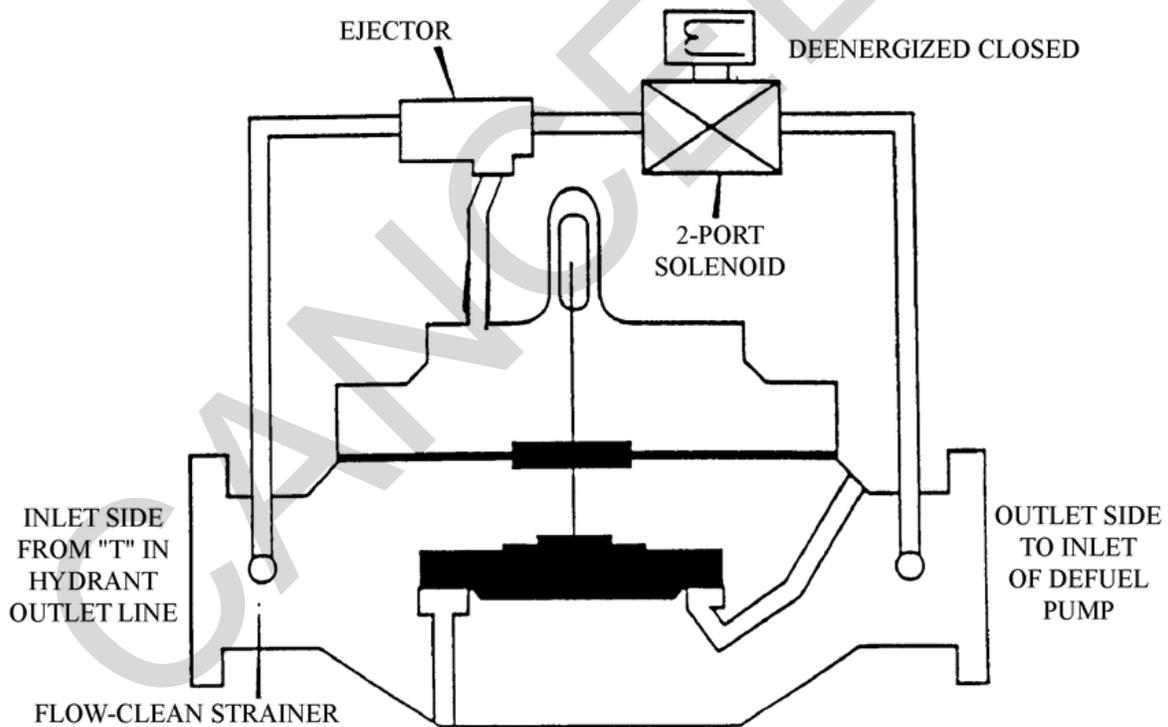
Frequency: Semi-annually

- b. Refer to [Section 4-3.2.1 General System Control Valves](#) for additional inspection and maintenance requirements.

4-3.2.7 Defuel Control Valve.

The defueling control valve is a diaphragm-actuated solenoid shutoff valve. This valve and the defueling pump energize simultaneously. When the solenoid valve on the defuel control valve is energized, it allows the defuel control valve to open and permit defueling through the system.

Figure 4-8 Defuel Control Valve (Type II)



4-3.2.7.1 Inspection and Maintenance – Defuel Control Valves.

- a. Verify the defuel control valve opens when the solenoid on the defuel control valve is energized.

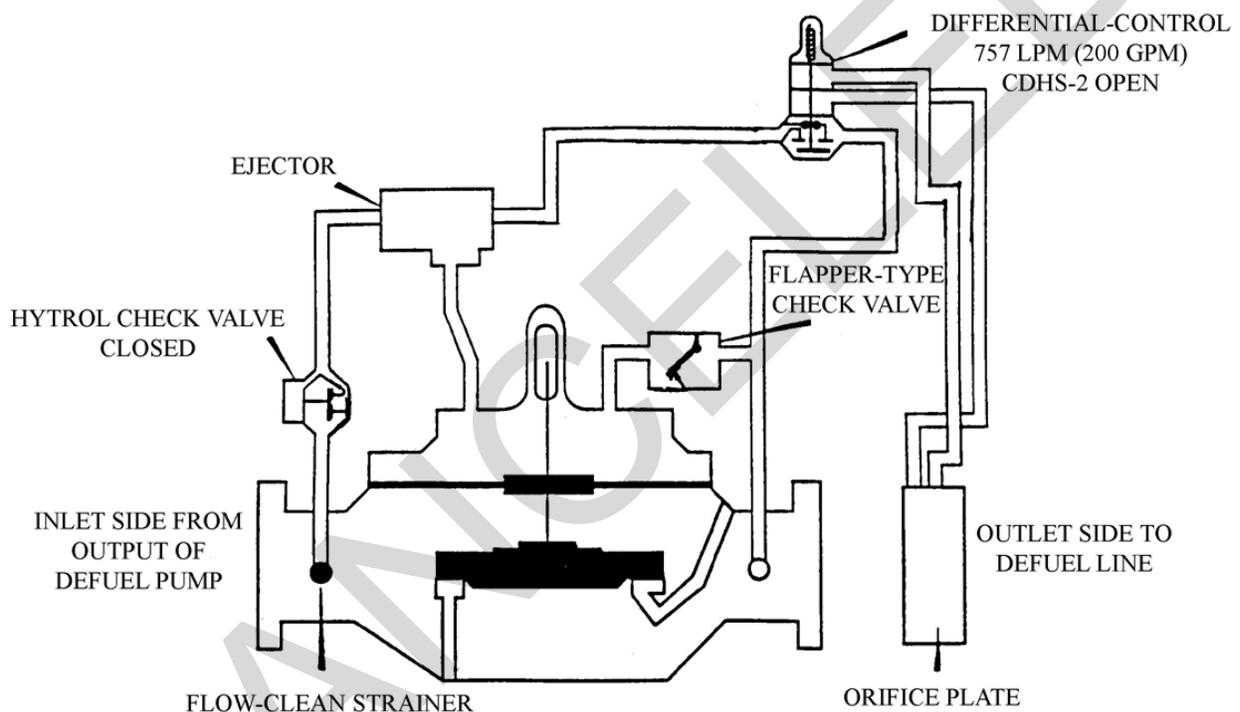
Frequency: Quarterly

- b. Refer to [Section 4-3.2.1 General System Control Valves](#) for additional inspection and maintenance requirements.

4-3.2.8 Dual Rate-of-Flow Control Valves.

The dual rate-of-flow control valve is a combination rate-of-flow control valve and fast closing, hydraulically operated check valve that closes the main valve against reverse flow. It performs two distinct functions: maintaining a preset flow rate (typically set at 200 gpm (12.5 lps)), and acting as a check valve to prevent reverse flow.

Figure 4-9 Dual Rate-of-Flow Control Valve (Type II)



4-3.2.8.1 Inspection and Maintenance – Dual Rate-of-Flow Control Valves.

- a. Verify dual rate-of-flow control valve is set to maintain a flow rate of 200 gpm (12.5 lps).
Frequency: Quarterly
- b. Verify operation of check valve feature.
Frequency: Quarterly
- c. Refer to [Section 4-3.2.1 General System Control Valves](#) for additional inspection and maintenance requirements.

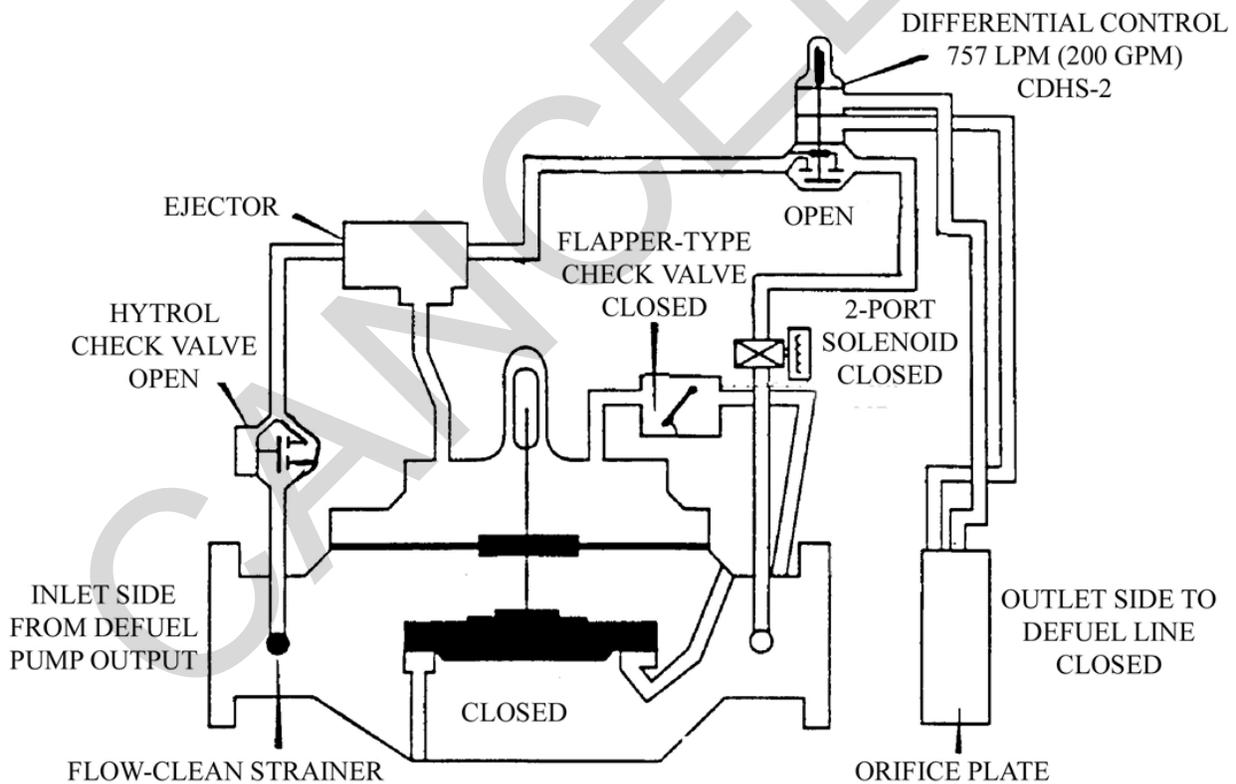
4-3.3 Type II Modified Control Valves (Rapid Flow).

The rapid flow modification was done on some Type II systems to increase defuel rates from 200 to 300 gpm (12.5 to 19 lps). A pump on the aircraft is used to transfer petroleum fuel from the aircraft through the LCP and into the designated defuel tank. The defueling pump in the LCP is only used to evacuate the hose cart after the aircraft pump is de-energized. Two modified control valves are used in the rapid flow system (combination dual rate-of-flow control valve and solenoid valve and dual pressure relief, solenoid shutoff, and check valve).

4-3.3.1 Combination Dual Rate-of-Flow Control and Solenoid Valves.

Combination dual rate-of-flow control and solenoid valves operate like the standard dual rate-of-flow control valves, with the addition of a solenoid for remote-control operations. All settings and functions are the same as the standard dual rate-of-flow control valve.

Figure 4-10 Combination Dual Rate-of-Flow Control and Solenoid Valve (Type II)



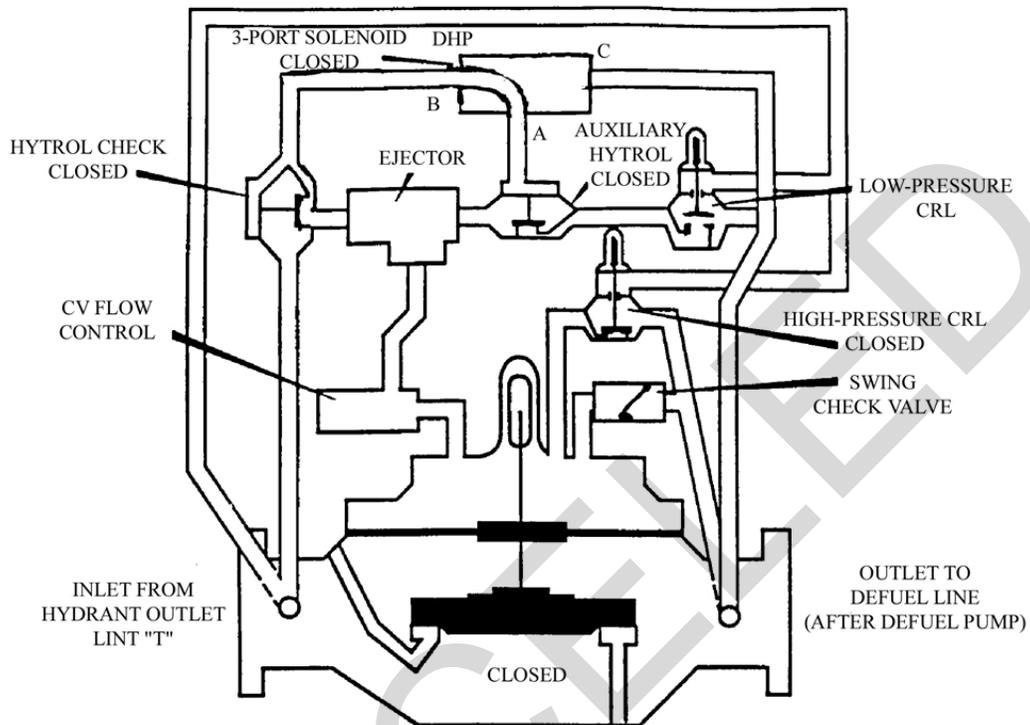
4-3.3.1.1 Inspection and Maintenance – Combination Dual Rate-of-Flow Control and Solenoid Valves.

- a. Verify valve is set to maintain a flow rate of 300 gpm (19 lps).
Frequency: Quarterly
- b. Verify operation of check valve feature.
Frequency: Quarterly
- c. Verify solenoid operation.
Frequency: Quarterly
- d. Refer to [Section 4-3.2.1 General System Control Valves](#) for additional inspection and maintenance requirements.

4-3.3.2 Dual Pressure Relief, Solenoid Shutoff, and Check Valves.

The dual pressure relief, solenoid shutoff, and check valve is installed in the modified hydrant lateral control pit downstream of the refueling control valve between the issue and defuel line. This relief valve performs two functions: relieves excess pressure in the issue line caused by quick-closing valves during the refueling operation; and maintains a minimum pressure of 5 psig (35 kPa) on the issue line piping when the refueling pumps are not in operation. This valve also has a flow control used to slowly close the valve during rapid defuel operations.

Figure 4-11 Dual Pressure Relief, Solenoid Shutoff, and Check Valve (Type II)



4-3.3.2.1 Inspection and Maintenance – Dual Pressure Relief, Solenoid Shutoff, and Check Valves.

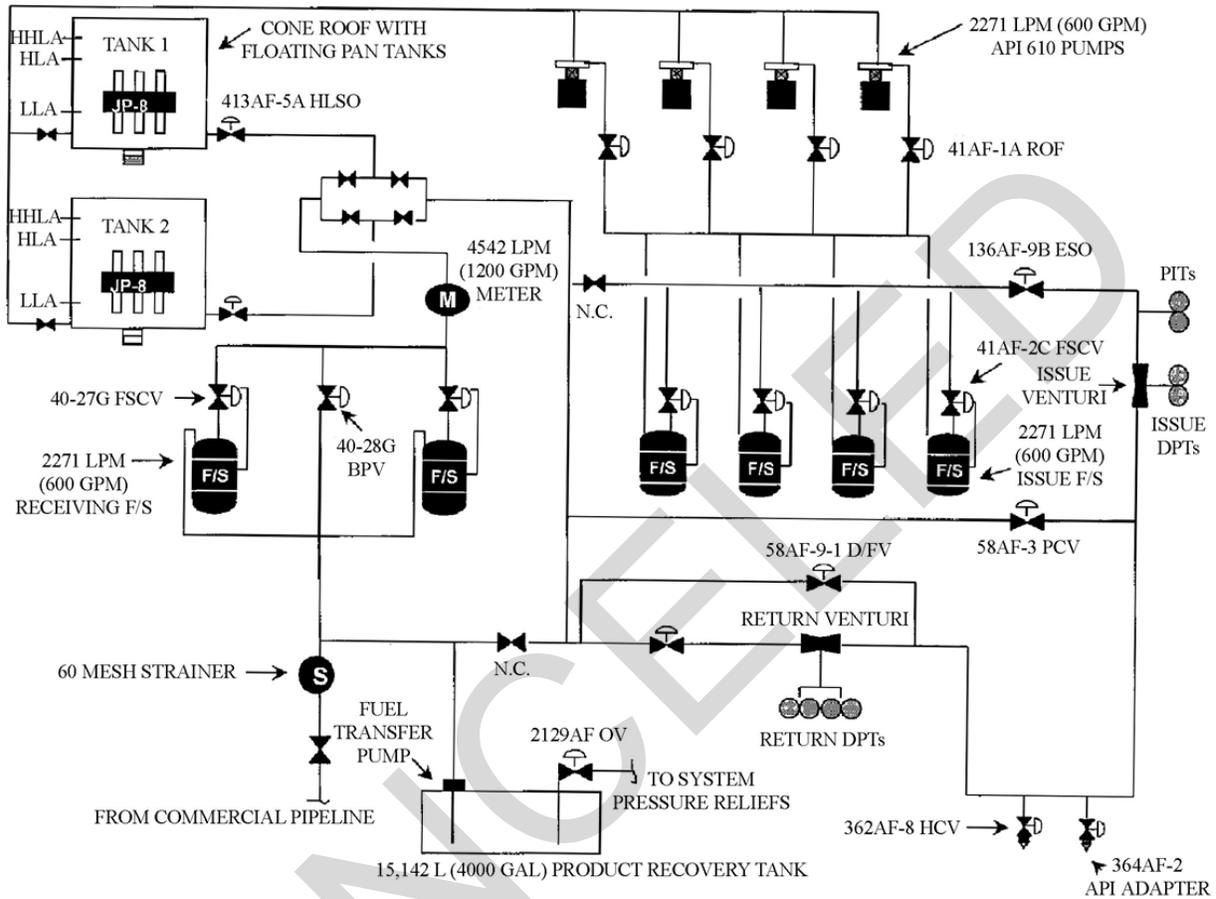
- a. Verify high pressure relief control will open at 5 psig (35 kPa) above the refuel control valve pressure relief control set point (typically set at 110 psig (760 kPa)).
Frequency: Quarterly
- b. Verify low pressure relief control will open at 5 psig (35 kPa) when refueling pumps are stopped.
Frequency: Quarterly
- c. Verify closing speed provides a smooth; pulsation free operation.
Frequency: Quarterly
- d. Verify operation of solenoid valve.
Frequency: Quarterly
- e. Refer to [Section 4-3.2.1 General System Control Valves](#) for additional inspection and maintenance requirements.

4-4 HYDRANT SYSTEM – TYPE III.

4-4.1 General Description.

The DoD large-frame aircraft direct fueling system is referred to as the Type III pressurized fueling system. This system is generally comprised of two operating storage tanks, a pumphouse, a hydrant loop, and hydrant outlets at aircraft parking positions. Two redundant Program Logic Controllers (PLCs) are used to control the operation of the system including the pumps and control valves. The system is constantly pressurized when operating. Petroleum fuel is pumped from the tanks, through filter separators and an issue venturi into the hydrant loop. The petroleum fuel flows through the appropriate hydrant valve, through a hydrant servicing vehicle or mobile pantograph and into the aircraft. A backpressure control valve keeps the hydrant loop at a pre-set pressure and a return venturi measures flow back to the storage tank. Working in conjunction with the return venturi, pumps are turned on and off depending on petroleum fuel issue requirements. Systems are generally sized in 600 gpm (38 lps) increments up to 2,400 gpm (152 lps). Issue pumps are sized to provide a minimum of 100 psig (690 kPa) at the furthest hydrant outlet. Each hydrant pit control valve is equipped with a pressure control and surge shutdown pilot and newer systems also include a differential pilot. (See UFGS 33 52 43.14 for more information). The pilot controls are set at 45 psig (310 kPa) and 50 psig (345 kPa), respectively. Hydrant control valves allow flow rates up to 900 gpm (57 lps) using 4-inch (DN100) valve bodies. Hydrant control valves are typically set to 600 gpm (38 lps). Flow rates of up to 1,200 gpm (76 lps) are possible using 6-inch (DN150) hydrant control valve bodies.

Figure 4-12 Type III Hydrant System Diagram

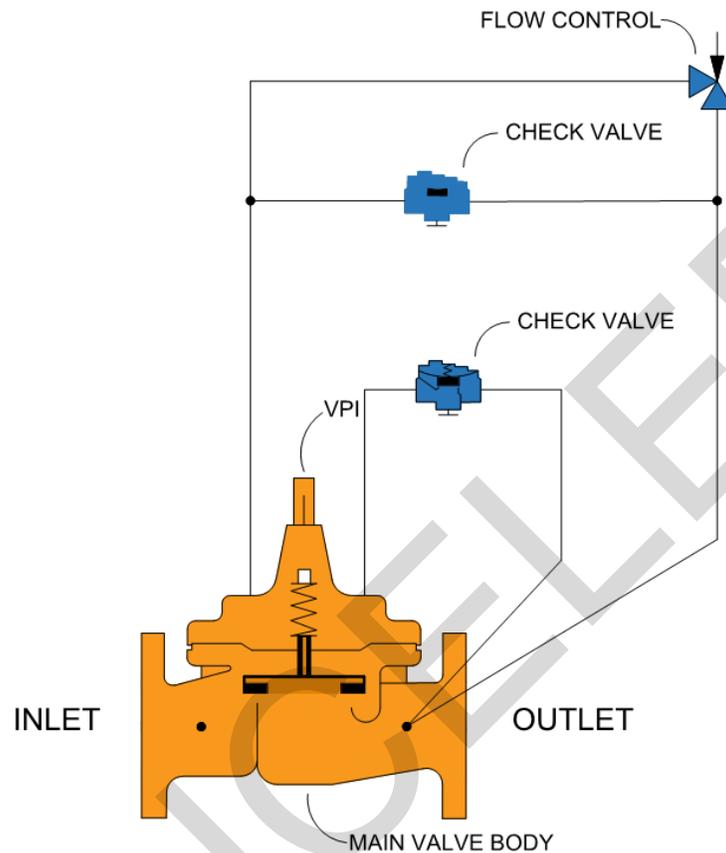


4-4.2 System-Specific Control Valves.

4-4.2.1 Non-Surge Check Valves.

Diaphragm non-surge check valves that meet the requirements of UFGS 33 52 43.14 are used as a flow control feature on the discharge of pumps. A non-surge check valve is used to prevent a pump from running out of its curve when petroleum fuel is flowing through multiple filter separators and to prevent backflow through the pump.

Figure 4-13 Non-Surge Check Valve



4-4.2.1.1 Inspection and Maintenance – Non-Surge Check Valves.

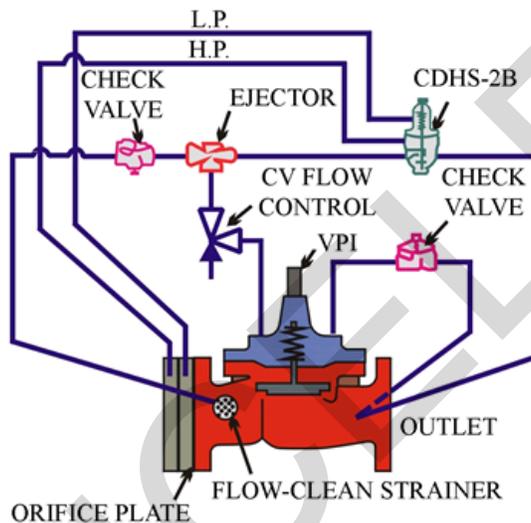
For more information on features, valve settings, and replacement, refer to commissioning documents, as-builts, and manufacturer's operation and maintenance manuals.

- a. Verify main valve opening speed (typically 20 seconds). Adjust if required.
Frequency: Semi-annually
- b. Verify valve maintains 650 gpm (41 lps) flow rate (some instances 950 gpm (60 lps) flow rate). Adjust if required.
Frequency: Semi-annually
- c. Ensure the check valve function is operating properly.
Frequency: Semi-annually
- d. Refer to [Section 4-3.2.1 General System Control Valves](#) for additional inspection and maintenance requirements.

4-4.2.2 Filter Separator Control Valves.

Filter Separator Control Valves (FSCVs) that meet the requirements of UFGS 33 52 43.14 are used to control the rate of flow through filter separators, prevent reverse flow, prevent water discharge when the water level float control reaches the high position, and act as an emergency shutoff valve when equipped with an emergency stop solenoid valve. Most FSCVs operate at 600, 900 or 1,200 gpm (38, 57 or 76 lps) based on the rated flow capacity of the filter separator.

Figure 4-14 Filter Separator Control Valve (Type III)



4-4.2.2.1 Inspection and Maintenance – Filter Separator Control Valves.

- a. Test FSCV emergency shut off solenoid under flow conditions and ensure that valve closes within 10 seconds of EFSO button activation. Coordinate with overall EFSO test listed in [Section 9-1.2.1 Inspection and Maintenance - Electrical Equipment](#).
Frequency: Quarterly
- b. Operate test button (if installed) to ensure the FSCV closes at high water level. Physically press the test button, while recirculating fuel, and ensure the FSCV closes. Note: closing speed is a function of the number of open filter separators and the number of pumps operating. With all filters open and only one pump operating, the valve will close very slowly.
Frequency: Quarterly
- c. Verify valve maintains flow rate (typically 600 gpm (38 lps), operating range based on commissioning documentation). Adjust flow rate if required. Flow rate is determined by filter separator vessel gpm (lps) rating, or element flow rate, whichever is less. Use return venturi to measure and confirm flow rate during valve testing and adjustment.
Frequency: Annually

- d. Ensure the check valve function is operating properly.
Frequency: Annually
- e. Test buoyancy of water level float. Remove the ball or float assembly and place it in a bucket of water. Correctly operating ball or float will float at the top of the water's surface.
Frequency: When coalescer cartridges are changed
- f. Refer to [Section 4-3.2.1 General System Control Valves](#) for additional inspection and maintenance requirements.

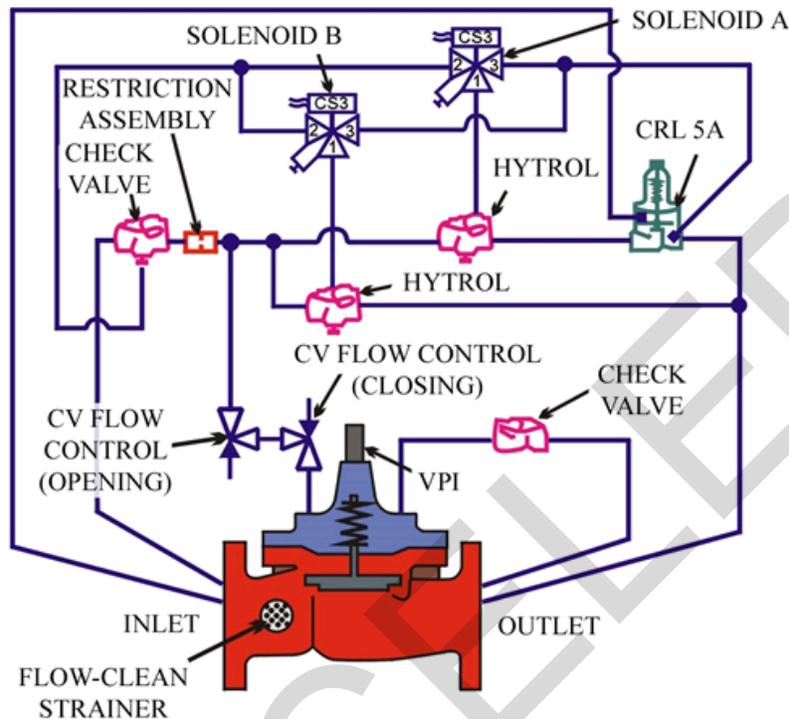
4-4.2.3 Defuel/Flush Valves.

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- a. Defuel/Flush Valves (D/FV) that meet the requirements of UFGS 33 52 43.14 are controlled by two different solenoids. Solenoid A controls the defuel portion of the main valve and holds the valve closed any time a fuel pump is running. Solenoid B controls the flush portion of the main valve and functions only when the system is placed in flush mode. When the lead pump de-energizes, solenoid A energizes, allowing the valve to open and drop the system pressure to 80 psig (550 kPa) (typical set pressure). While the system is in the idle position, the valve will open to allow defueling when the hydrant loop pressure rises above 80 psig (550 kPa) (typical set pressure).
- b. Defueling can be conducted using a Hydrant Hose Truck (HHT) to pump fuel off aircraft and force fuel into the hydrant loop. The HHT pump will overcome the 80 psig (550 kPa) setting of the D/FV and open the valve.
- c. Solenoid B energizes only when the system is placed in flush mode. Flush mode is used to move fuel through the system in order to clean the loop. Flushing procedures vary based on system design and should be approved by the military service-specific SME.

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Figure 4-15 Defuel/Flush Valve (Type III)



4-4.2.3.1 Inspection and Maintenance – Defuel/Flush Valves.

For more information on features, settings, and replacement, refer to commissioning documents, as-builts, and manufacturer's operation and maintenance manuals.

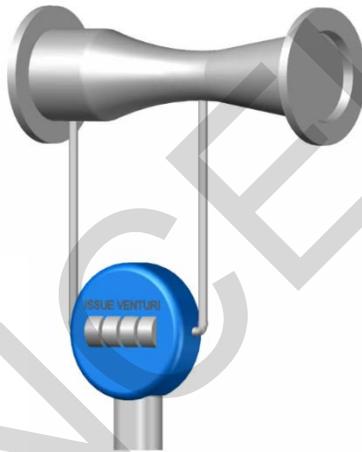
- a. Ensure Solenoids A and B are de-energized with system in automatic mode and lead pump operating.
Frequency: Quarterly
- b. Ensure Solenoid A is energized and Solenoid B is de-energized to allow main valve to open and drop system pressure to 80 psig (550 kPa) (typical set pressure) with system in automatic mode and lead pump off.
Frequency: Quarterly
- c. Ensure Solenoid A is de-energized and Solenoid B is energized when system is in flush mode.
Frequency: Quarterly
- d. Ensure Solenoids A and B are de-energized when system is in tightness test mode.
Frequency: Quarterly

- e. Check opening and closing speed. Speed should be as fast as possible while still maintaining smooth operation.
Frequency: Quarterly
- f. Refer to [Section 4-3.2.1 General System Control Valves](#) for additional inspection and maintenance requirements.

4-4.2.4 Issue Venturi.

The issue venturi is downstream of the issue filter separator manifold and is typically rated at 2,400 gpm (151 lps). The venturi has upstream and downstream sensing line connections for two redundant Differential Pressure Transmitters (DPTs). The control PLCs determines the flow rate using electronic signals from the DPTs.

Figure 4-16 Issue Venturi



4-4.2.4.1 Inspection and Maintenance - Issue Venturi.

- a. Ensure issue venturi DPTs are reading the same value within $\pm 2\%$ full scale.
Frequency: Semi-annually
- b. Refer to [Section 6-7.4 Differential Pressure Transmitters](#) for inspection and maintenance requirements of DPTs.

4-4.2.5 Return Venturi.

The return venturi is located upstream of the Back-Pressure Control Valve (BPCV). It is similar to the issue venturi but is typically rated at 800 gpm (50 lps).

4-4.2.5.1 Inspection and Maintenance - Return Venturi.

- a. Ensure return venturi DPTs are reading the same value within $\pm 2\%$ full scale.

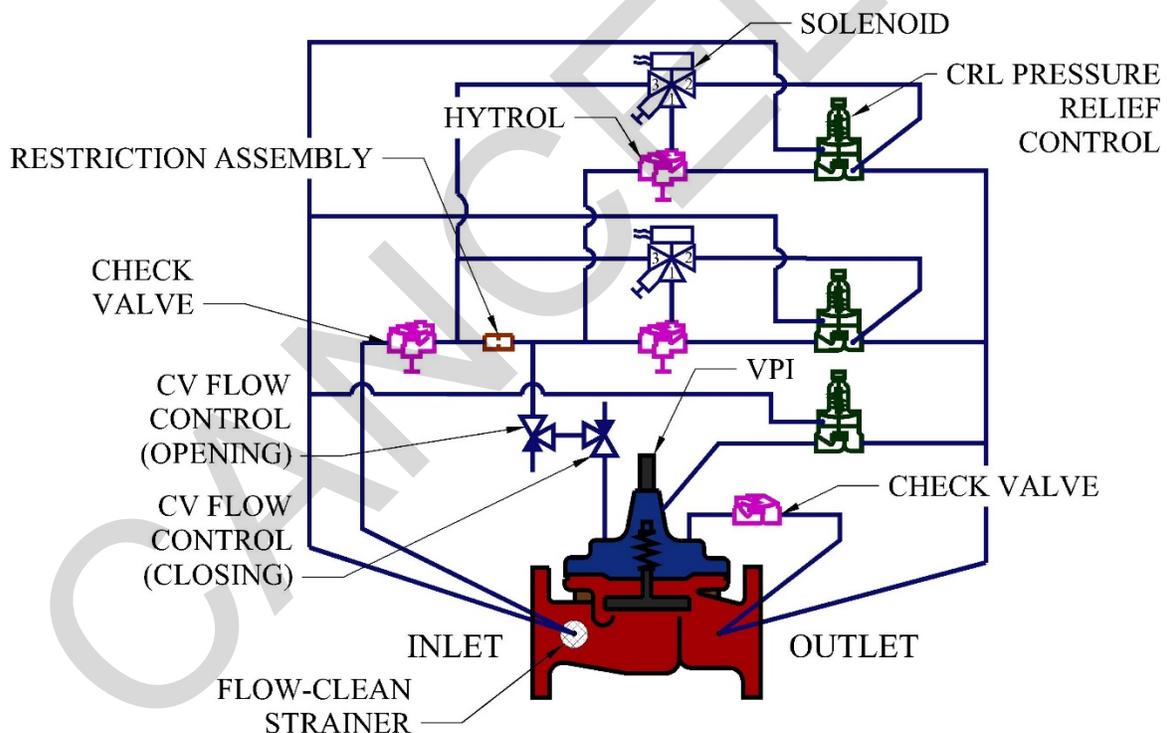
Frequency: Semi-annually

- b. Refer to [Section 6-7.4 Differential Pressure Transmitters](#) for inspection and maintenance requirements of DPTs.

4-4.2.6 Back Pressure Control Valves.

Back Pressure Control Valves (BPCVs) that meet the requirements of UFGS 33 52 43.14 are used to maintain a constant hydrant loop pressure. The valve is typically 6-inch (DN 150), and the valve is typically set to maintain 100 psig (690 kPa) fuel pressure at the furthest hydrant outlet.

Figure 4-17 Back Pressure Control Valve (Type III)



4-4.2.6.1 Inspection and Maintenance – Back Pressure Control Valves.

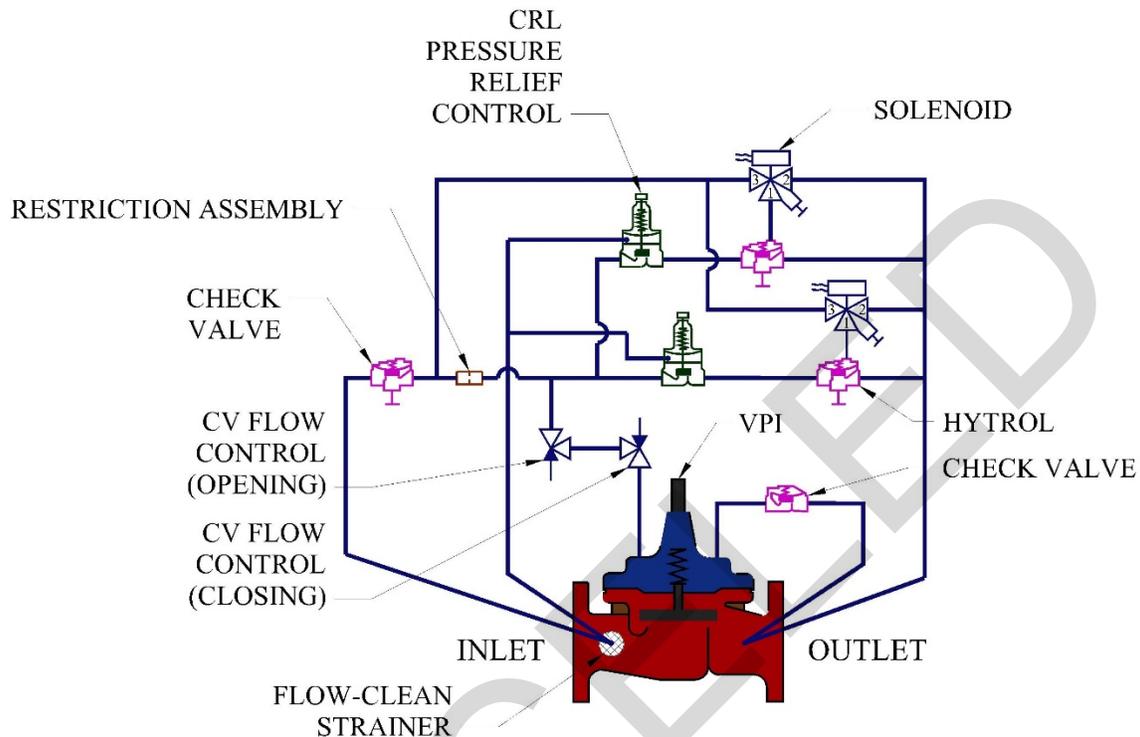
For more information on features, valve settings, and replacement, refer to commissioning documents, as-builts, and manufacturer's operation and maintenance manuals.

- a. Verify constant upstream pressure is maintained at the set point established and listed in the system commissioning documents. Adjust setting of BPCV as necessary.
Frequency: Quarterly
- b. Ensure Solenoid A is energized and Solenoid B is de-energized while lead pump is operating in automatic mode.
Frequency: Quarterly
- c. Ensure Solenoids A and B are de-energized prior to lead pump shutdown and system going to stand-by.
Frequency: Quarterly
- d. Ensure Solenoids A and B are de-energized while system is in flush mode.
Frequency: Quarterly
- e. Ensure that Solenoid A is de-energized and Solenoid B is energized while system is in tightness test mode.
Frequency: Quarterly
- f. Verify closing speed control. Valve should close as fast as possible while still maintaining smooth operation.
Frequency: Quarterly
- g. Check solenoid EFSO feature when equipped. Coordinate test with overall EFSO test listed in [Section 9-1.2.1 Inspection and Maintenance - Electrical Equipment](#).
Frequency: Quarterly
- h. Refer to [Section 4-4.2.1 General System Control Valves](#) for additional inspection and maintenance requirements.

4-4.2.7 Pressure Control Valves.

Pressure Control Valves (PCV) meeting the requirements of UFGS 33 52 43.14 reduce system pressure down to 75 psig (515 kPa) during system shutdown process and provide thermal relief during idle periods. The valves are typically 2-inch (DN50). A solenoid installed on the valve energizes to close the valve when the lead pump is operating and de-energizes when the lead pump stops. When the solenoid is de-energized, the valve opens to reduce the system pressure to 75 psig (515 kPa) and the thermal relief function is operable. If the pressure rises above 75 psig (515 kPa), the valve opens and excess pressure flows to the operating storage tank. The valve opening and closing speed controls are typically set at three (3) seconds. In some cases, to prevent valve chattering, the PCV pressure-sensing line is connected to the large defuel/flush line.

Figure 4-18 Pressure Control Valve (Type III)



4-4.2.7.1 Inspection and Maintenance – Pressure Control Valves.

For more information on features, valve settings, and replacement refer, to commissioning documents, as-builts, and manufacturer's operation and maintenance manuals.

- a. Ensure Solenoid A is energized and Solenoid B is de-energized while system is in automatic mode and lead pump is operating.
Frequency: Quarterly
- b. Ensure Solenoids A and B are de-energized while system is in automatic mode and lead pump is off. Verify valve opens to maintain system pressure at 75 psig (515 kPa).
Frequency: Quarterly
- c. Ensure Solenoid A is energized and Solenoid B is de-energized while system is in flush mode and lead pump is operating.
Frequency: Quarterly
- d. Ensure Solenoids A and B are de-energized while system is in flush mode and pumps are off.
Frequency: Quarterly

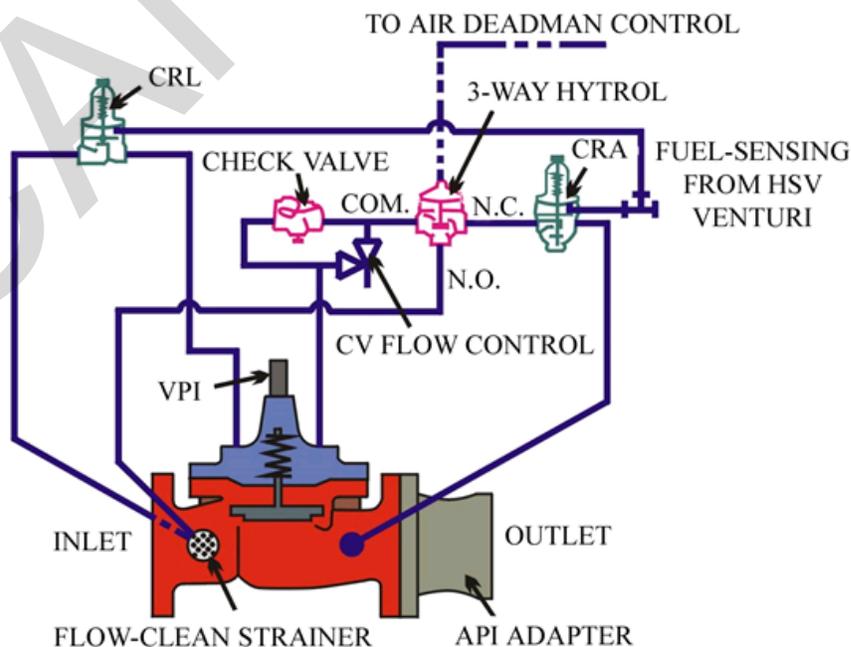
- e. Ensure Solenoids A and B are energized while system is in tightness test mode.
Frequency: Quarterly
- f. Verify closing speed control. Valve should close as fast as possible while still maintaining smooth operation.
Frequency: Quarterly
- g. Refer to [Section 4-3.2.1 General System Control Valves](#) for additional inspection and maintenance requirements.

4-4.2.8 Hydrant Control Valves.

Hydrant Control Valves (HCV) meeting the requirements of UFGS 33 52 43.14 provide constant nozzle pressure and relieve excess pressure. An air-sensing line is connected from the HHT to the HCV three-way hydraulically operated/diaphragm actuated globe valve. When the HHT's pneumatic deadman is depressed, air is supplied to the three-way valve, allowing the valve to open. A fuel-sensing line is connected from the HHT venturi to the Pressure-Reducing Control (CRA) and the Pressure-Relief Control (CRL) on the HCV. The venturi is calibrated to provide the same pressure as the actual nozzle pressure at the skin of the aircraft. The CRA maintains 45 psig (310 kPa) at the nozzle. The HCV is designed to close rapidly when the nozzle pressure exceeds the 50 psig (345 kPa) setting of the CRL. It reopens when the pressure drops below the 50 psig (345 kPa) set point.

Some Type III systems use towable pantographs instead of HHTs. The operation of a towable pantograph with a HCV is similar to the operation with a HHT.

Figure 4-19 Hydrant Control Valve (Type III)



4-4.2.8.1 Inspection and Maintenance – Hydrant Control Valves.

For more information on features, valve settings, and replacement, refer to commissioning documents, as-builts, and manufacturer's operation and maintenance manuals.

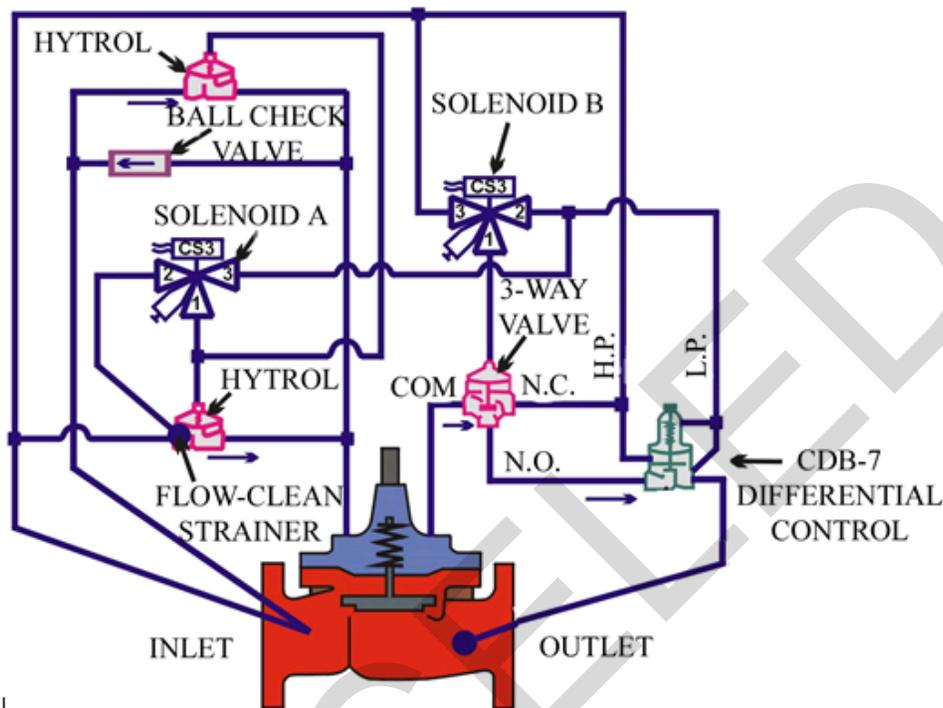
- a. Verify HCV maintains 45 psig (310 kPa) nozzle pressure at a flow of 50 to 600 gpm (3 to 38 lps).
Frequency: Quarterly
- b. Verify HCV closes when nozzle pressure exceeds 50 psig (345 kPa).
Frequency: Quarterly
- c. Verify HCV opening speed is set at a minimum of 20 seconds.
Frequency: Quarterly
- d. Verify HCV opens when the deadman control lever is pressed.
Frequency: Quarterly
- e. Verify HCV closes within two to five seconds after the deadman lever is released.
Frequency: Quarterly
- f. Refer to [Section 4-3.2.1 General System Control Valves](#) for additional inspection and maintenance requirements.

4-4.2.9 Emergency Shut-off Valves.

This valve has been removed from the standard Type III design, but it still exists in some systems. New Type III systems achieve the same function as the emergency shut-off valve by including a similar function on the FSCVs.

Emergency Shut-Off (ESO) valves that meet the requirements of UFGS 33 52 43.14 have two solenoids that are energized when power is on, enabling the main valve to open when fuel is flowing. Should power fail or an emergency stop button be pushed, the solenoids will de-energize and the main valve will close within 10 seconds. The valve also has a thermal relief feature that relieves excess cover chamber pressure back to the valve inlet, and a differential control is used to maintain a relatively constant differential pressure between the inlet and outlet of the main valve.

Figure 4-20 Emergency Shut-Off Valve (Type III)



4-4.2.9.1 Inspection and Maintenance – Emergency Shut-off Valves.

For more information on features, valve settings, and replacement, refer to commissioning documents, as-builts, and manufacturer's operation and maintenance manuals.

- a. Ensure Solenoids A and B are energized under normal operations.
Frequency: Quarterly
- b. Ensure Solenoids A and B are de-energized during emergency stop conditions.
Frequency: Quarterly
- c. Test emergency stop function of the valve under flow conditions. Ensure the valve closes within 10 seconds of EFSO button activation. Coordinate test with overall EFSO test listed in [Section 9-1.2.1 Inspection and Maintenance - Electrical Equipment](#).
Frequency: Quarterly
- d. Verify differential control maintains a constant seven psig (48 kPa) differential pressure between the inlet and outlet of the valve.
Frequency: Quarterly

- e. Ensure thermal relief function (ball check valve) relieves excess pressure when cover chamber pressure exceeds inlet pressure. **Frequency: Quarterly**
- f. Refer to [Section 4-3.2.1 General System Control Valves](#) for additional inspection and maintenance requirements.

4-5 HYDRANT SYSTEM – TYPE IV.

4-5.1 General Description.

Type IV hydrant systems are similar in function to the Type III systems except that the Type IV system uses fixed pantographs, designed for fixed-wing, small frame aircraft direct fueling stations. Type IV systems are often designed to support hot refueling operations.

4-5.2 System-Specific Control Valves.

4-5.2.1 High Level Shut-off Valve (HLSO).

Refer to [Section 8-9.6 High Level Shut-off Valves \(HLSO\)](#) for inspection and maintenance requirements of Type IV HLSOs.

4-5.2.2 Non-Surge Check Valves.

Refer to [Section 4-4.2.1 Non-Surge Check Valves](#) for inspection and maintenance requirements of non-surge check valves.

4-5.2.3 Filter Separator Control Valve (FSCV).

Refer to [Section 4-4.2.2 Filter Separator Control Valves](#) for inspection and maintenance requirements of Type IV FSCVs.

4-5.2.4 Defuel/Flush Valve (D/FV).

Refer to [Section 4-4.2.3 Defuel/Flush Valves](#) for inspection and maintenance requirements of Type IV D/FV. Ignore the maintenance and inspection requirements for Type IV systems that are not equipped with a defuel/flush valve.

4-5.2.5 Flush Valves.

Refer to [Section 4-4.2.3 Defuel/Flush Valves](#) for inspection and maintenance requirements of Type IV flush valve. Ignore the maintenance and inspection requirements for Type IV systems that are not equipped with a flush valve.

4-5.2.6 Issue Venturi.

Refer to [Section 4-4.2.4 Issue Venturi](#) for inspection and maintenance requirements of issue venturi.

4-5.2.7 Return Venturi.

Refer to [Section 4-4.2.5 Return Venturi](#) for inspection and maintenance requirements of return venturi.

4-5.2.8 Back Pressure Control Valves.

Refer to [Section 4-4.2.6 Back Pressure Control Valves](#) for inspection and maintenance requirements of back pressure control valves.

4-5.2.9 Pressure Control Valves.

Refer to [Section 4-4.2.7 Pressure Control Valves](#) for inspection and maintenance requirements of pressure control valves.

4-5.2.10 Hydrant Control Valve (HCV).

Refer to [Section 4-4.2.8 Hydrant Control Valves](#) for inspection and maintenance requirements of Type IV HCVs.

4-5.2.11 Emergency Shut-off Valve (ESO).

Refer to [Section 4-4.2.9 Emergency Shut-off Valves](#) for inspection and maintenance requirements of Type IV ESOs.

4-5.2.12 Pantograph Control Valves.

The Pantograph Control Valve (PTCV) is used to control flow and pressure of fuel through the pantograph. The unit operates in conjunction with a pantograph venturi installed downstream of the PTCV. The valve is equipped with a deadman control lever.

4-5.2.12.1 Inspection and Maintenance – Pantograph Control Valves.

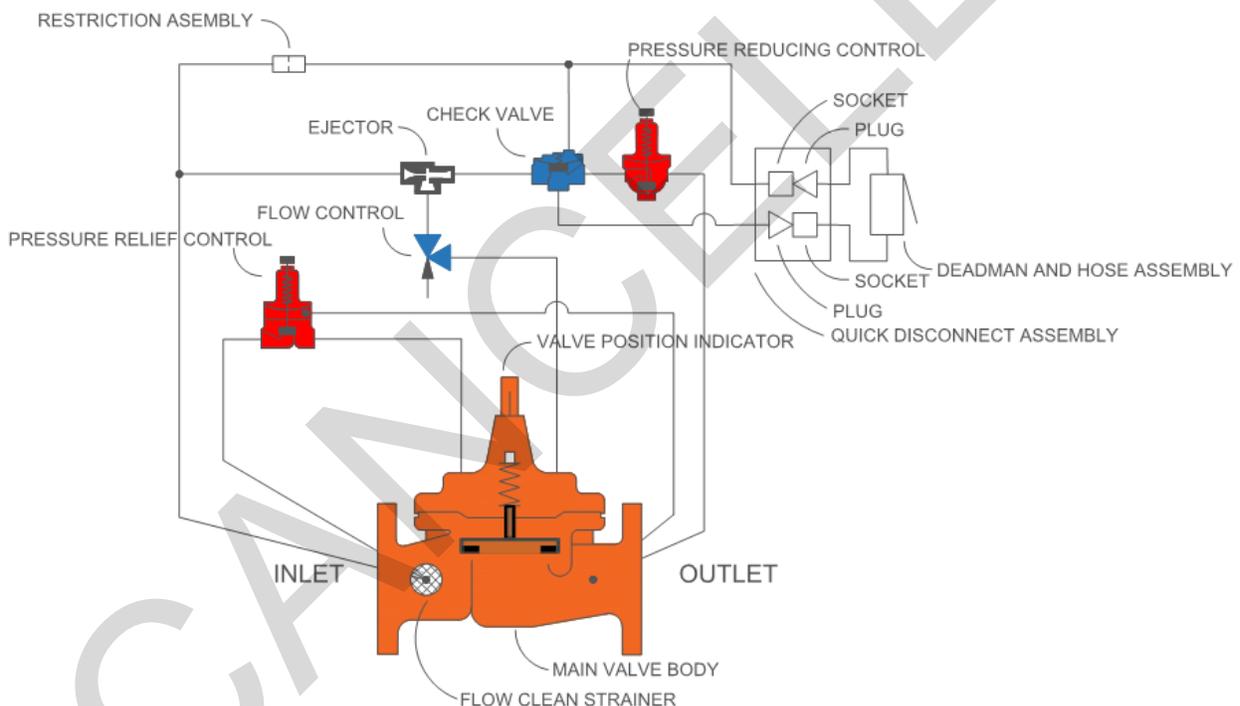
- a. Verify PTCV maintains 55 psig (380 kPa) nozzle pressure at a flow of 50 to 600 gpm (3 to 38 lps).
Frequency: Quarterly
- b. Verify PTCV opens when the deadman control lever is pressed.
Frequency: Quarterly

- c. Verify PTCV closes in a maximum of 10 seconds after deadman lever is released.
Frequency: Quarterly
- d. Refer to [Section 4-3.2.1 General System Control Valves](#) for additional inspection and maintenance requirements.

4-5.2.13 Pantograph Pressure Control Valves.

The Pantograph Pressure Control Valve (PPCV) relieves pressure from the pantograph downstream of the PTCV. The PPCV is set to open at 75 psig (515 kPa) and prevents excessive pressure from reaching the aircraft fuel tank.

Figure 4-21 Pantograph Pressure Control Valve



4-5.2.13.1 Inspection and Maintenance – Pantograph Pressure Control Valves.

- a. Verify PPCV opens at 75 psig (515 kPa).
Frequency: Quarterly
- b. Verify PPCV opening and closing speed are three seconds maximum.
Frequency: Quarterly

4-6 HYDRANT SYSTEM – TYPE V.

4-6.1 General Description.

Type V hydrant systems are similar to the Type IV systems except that the refueling points are located in hardened aircraft shelters.

4-7 HYDRANT SYSTEM GENERAL EQUIPMENT.

4-7.1 Pantographs.

Pantographs that meet the requirements of UFGS 33 52 43.12 are used in aircraft fueling facilities. Pantographs can be fixed at a single location or mounted on a towable frame to make them mobile. Pantographs have a number of swivel joints. The focus of a pantograph's maintenance centers on the care of the joints. Most pantographs have a sufficient number of swivel joints to prevent excessive strain. The movable joints require periodic lubrication when equipped with lubricated swivels and replacement of packings, seals, or O-rings. Once existing lubricated swivels show signs of leaks and failure, they should be replaced with stainless steel non-lubricated type swivels.

Care must be taken to ensure that grounding or bonding wire is not damaged during maintenance or allowed to deteriorate. Pantographs are treated roughly during refueling operations. Personnel who perform preventive maintenance must be alert for leaks, wet spots, and erratic mechanical operation.

4-7.1.1 Fixed Pantographs.

Fixed pantographs are connected to piping at a single location and are not relocated.

4-7.1.1.1 Inspection and Maintenance – Fixed Pantographs.

- a. Place entire pantograph under static pump head pressure and check for leaks, ease of movement, and damaged grounding or bonding wire.
Frequency: Monthly
- b. Inspect wheels (if equipped) for warping, cracking, and uneven wear.
Frequency: Quarterly
- c. Inspect exposed piping and components for corrosion.
Frequency: Quarterly
- d. Refer to [Section 4-7.3 Fueling Nozzles](#) for inspection and maintenance requirements of fueling nozzle.

Figure 4-22 Fixed Pantograph



4-7.1.2 \\\ Detachable /1/ Pantographs.

Mobile pantographs are used in locations that are not equipped with fixed pantographs or hydrant hose trucks. These pantographs are mounted on wheels and can be towed to the use point. Each pantograph is equipped with a hydrant adaptor used to connect to a HCV and a fueling nozzle used to connect to the aircraft receiving fuel.

4-7.1.2.1 Inspection and Maintenance – \\\ Detachable/ 1/ Pantographs.

- a. Place pantograph under static pump head pressure and check for leaks, ease of movement, and damaged grounding or bonding wire.
Frequency: Monthly
- b. Inspect exposed piping and components for corrosion.
Frequency: Quarterly
- c. Lubricate wheels.
Frequency: Quarterly
- d. Inspect wheels for warping, cracking, and uneven wear.
Frequency: Quarterly
- e. Refer to [Section 4-7.2 Hydrant Adapters](#) for inspection and maintenance requirements of pantograph hydrant adapters.
- f. Refer to [Section 4-7.3 Fueling Nozzles](#) for inspection and maintenance requirements of fueling nozzles.

4-7.2 Hydrant Adapters.

Hydrant adaptors are used to connect to hydrant control valves. Hydrant adaptors are installed on hydrant hose trucks and mobile pantographs.

4-7.2.1 Inspection and Maintenance – Hydrant Adapters.

- a. Inspect hydrant adapter for proper operation, damage, and wear.
Frequency: Quarterly
- b. Test operation of dry break system.
Frequency: Quarterly

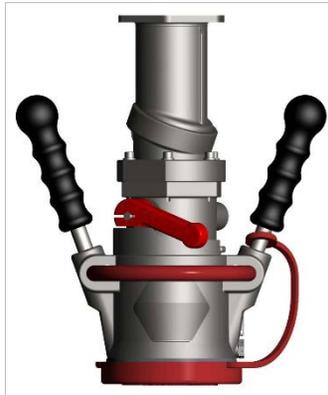
Figure 4-23 Hydrant Adapter



4-7.3 Fueling Nozzles.

Fueling nozzles are used to connect issue systems to refueler trucks and aircraft. They are installed on fuel issue hoses, pantographs, R-11 refuelers, R-12 hydrant hose trucks, and other systems that issue fuel. The fueling nozzle is equipped with 60-100 wire mesh screen (0.25-0.15mm sieve) to trap particulates from the issue system.

Figure 4-24 Fueling Nozzle



4-7.3.1 Inspection and Maintenance – Fueling Nozzles.

- a. Inspect the condition of the dust cap at the aircraft adapter end and ensure it is in good working order. Dust caps must be attached to nozzles when they are not in use.
Frequency: Monthly
- b. Test leak resistance of poppet valve against full pump pressure. Unusual conditions found during this test indicate that repair is necessary and the nozzle must be removed from service.
Frequency: Monthly
- c. Inspect storage racks for moisture or dirt accumulation. Correct conditions that may be attributing to accumulation of moisture or dirt in the storage racks.
Frequency: Monthly
- d. Remove nozzle for inspection of content impinged upon the mesh screen. Clean and dry screens before nozzles are returned to service. If a strainer ball valve is installed upstream of the nozzle only the strainer in the strainer ball valve needs to be checked. Nozzles should not be used while strainers are removed from upstream strainer ball valves.
Frequency: Monthly
- e. Test nozzle interlocks. Ensure interlocks prevent release of fuel when the fueling nozzle is not properly connected. Adjust the seating of the poppet valve if required.
Frequency: Monthly
- f. Check the operation of the manual valve crank assembly for smooth and positive motion on a special test stand.
Frequency: Monthly

4-7.4 Surge Suppressors.

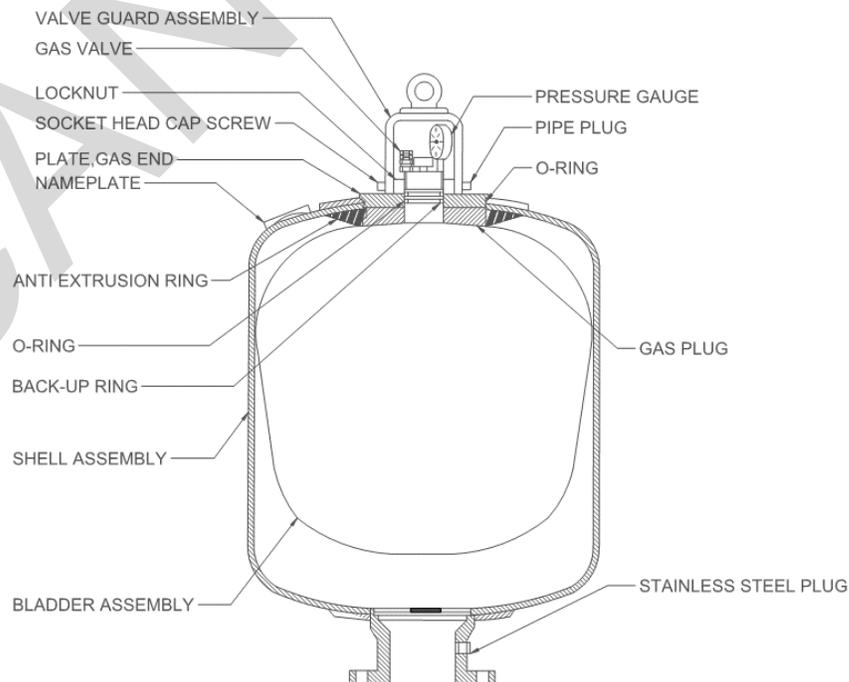
If the flow of liquid in a pipeline is suddenly stopped, a high pressure wave can be created as kinetic energy of flow is converted to pressure. The resulting pressure spike can cause leaks and damage to connected equipment. A common device designed to decrease pressure spikes in pipelines is a surge suppressor. Surge suppressors can reduce pressure spikes but will not eliminate them entirely.

Surge suppressors can be constructed with diaphragms or bladders. Surge suppressors are equipped with a top-mounted pressure gauge, isolation valve, limited bleed-back check valve, and drains.

4-7.4.1 Inspection and Maintenance - Surge Suppressors.

- a. Inspect for nitrogen leaks.
Frequency: Quarterly
- b. Bladder pressure inside surge suppressors must be validated and recharged as needed with nitrogen. Some surge suppressors are also equipped with needle valves. Settings established in the startup and commissioning documents should be maintained. Adjust nitrogen charge per manufacturer's recommendations.
Frequency: Quarterly

Figure 4-25 Surge Suppressor



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4-7.5 Aircraft Fueling Hoses.

Fuel issue hoses must meet the requirements of aviation fueling hoses listed in UFGS 33 52 43.12.

4-7.5.1 Inspection and Maintenance - Fuel Issue Hoses.

- a. Visually inspect hoses for loose covers, cracks, brittle surface coatings, exposed wire braids, exposed reinforcement, flattening, kinks, and bulges or soft spots which might indicate broken or displaced reinforcement.
Frequency: Monthly
- b. Pressurize hose to normal working pressure. Check flanged and threaded connections for leaks and inspect hose couplers for fluid seepage by pushing at the base of the coupling with thumbs. A hose softened by petroleum fluid seepage must be replaced.
Frequency: Monthly
- c. Check for coupling slippage. Replace hose that shows signs of coupling slippage.
Frequency Quarterly
- d. For hot pit refueling hoses only, refer to [Appendix D, Section D-2.1 Loading Hose Hydrostatic Test](#) for loading hose hydrostatic testing requirements and procedures.
Frequency: Annually
- e. Conduct test of petroleum fuel hose electrical resistivity using an electrostatic meter in accordance with NFPA 77 and API 2003.
Frequency: Annually /1/

4-8 HYDRANT SYSTEM PRODUCT RECOVERY.

This system stores fuel from drain lines, filter separator drains, thermal relief valves and other components. It permits fuel and water to separate, the water to be drained off, and fuel to be returned to storage tanks.

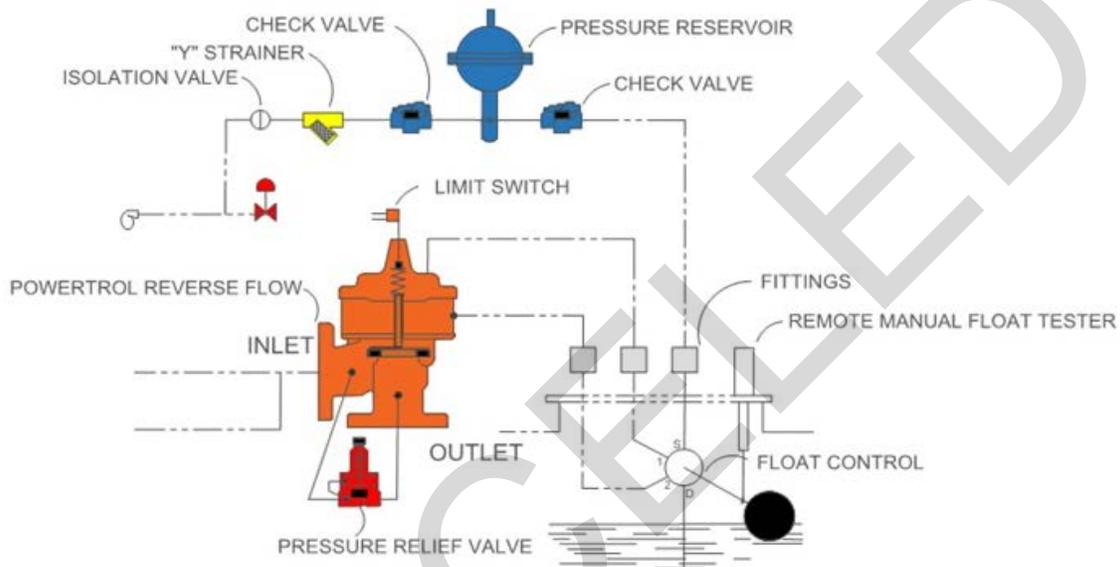
4-8.1 Overfill Valve for Product Recovery Tanks.

Overfill Valves (OVs) that meet the requirements of UFGS 33 52 43.14 are installed on product recovery tanks. Overfill valves are used to stop flow of fuel into product recovery tanks when the product recovery tanks reach a high level condition. A high-level alarm is activated at 85% full capacity, a high-high level alarm is activated at 90% full capacity, and the OV closes at 95% full capacity.

The valve is equipped with a pressure reservoir which supplies hydraulic pressure required to operate the valve. Reservoir pressure is supplied by the Fuel Transfer

Pump (FTP) installed on the product recovery tank. When the FTP operates, pressurized fuel is supplied to the reservoir. The reservoir utilizes a check valve to isolate the pressure in the reservoir. Automatic opening and closing of the OV is controlled by a float installed in the product recovery tank. The OV will close upon loss of reservoir pressure.

Figure 4-26 Overfill Valve for Product Recovery Tank



4-8.1.1 Inspection and Maintenance - Overfill Valve for Product Recovery Tanks.

For more information on features, valve settings, and replacement, refer to commissioning documents, as-builts, and manufacturer's operation and maintenance manuals.

- a. Verify that a green light is illuminated on the pump control panel graphic display when OV is open.
Frequency: Semi-annually
- b. Ensure pressure reservoir bladder is charged with 13 to 15 psig (90 to 103 kPa) of nitrogen and that the reservoir holds fuel pressure.
Frequency: Semi-annually
- c. Verify that the OV closes when the control float is lifted (normally 95% full). Use the manual tester to lift the float. NOTE: When the float in the product recovery tank rises and the OV closes, the pressure in the pressure reservoir tank will decrease.
Frequency: Semi-annually

- d. Verify that a red light is illuminated and that an alarm is activated on the pump control panel graphic display when OV is closed. Alarm is activated by a limit switch installed on the OV.
Frequency: Semi-annually
- e. Ensure the pressure reservoir tank holds FTP deadhead pressure when the pump is deactivated.
Frequency: Semi-annually
- f. Open and clean reservoir inlet strainer.
Frequency: Semi-annually
- g. Refer to [Section 6-6.3 Thermal and Pressure Relief Valves](#) for inspection and maintenance requirements of thermal and pressure relief valves.

4-8.2 Product Recovery Tank Release Detection.

Underground double-walled product recovery tanks are provided with release detection in the annular space between the inside and outside walls of the underground tank.

4-8.2.1 Inspection and Maintenance - Product Recovery Tank Release Detection.

Refer to [Section 8-9.13 Release Detection Monitoring](#) for inspection and maintenance requirements of product recovery tank release detection systems.

4-8.3 Product Recovery Tank Automatic Tank Gauges.

Underground product recovery tanks are typically equipped with automatic tank gauges that are similar to underground storage tanks equipped with automatic tank gauges.

4-8.3.1 Inspection and Maintenance - Product Recovery Tank Automatic Tank Gauges.

Refer to [Section 8-9.8 Automatic Tank Gauges](#) for inspection and maintenance requirements of product recovery tank automatic tank gauges.

4-8.4 Product Recovery Tank Fuel Transfer Pump.

Product recovery tanks are equipped with transfer pumps that are used to transfer recovered fuel back to store tanks for use.

4-8.4.1 Inspection and Maintenance - Product Recovery Tank Fuel Transfer Pump.

Refer to [Section 3-8.1.3 Vertical Turbine/Submerged Turbine Pumps](#) for inspection and maintenance requirements of product recovery tank fuel transfer pumps.

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CHAPTER 5 MARINE RECEIVING AND DISPENSING FACILITIES

5-1 PERS AND WHARVES.

A pier is a deck structure supported above the water on piles (open type), a solid fill structure retained by bulkheads (closed type with apron), or a combination of the two. It extends outward from the shore into a harbor or other navigable waters to permit berthing along one or both sides of its length.

A wharf is a deck structure supported above the water on piles (open type), a solid-fill structure retained by bulkheads (closed), or a combination of the two. It runs parallel to the shore and is connected to it at more than one point (usually continuously) to provide berthing along one side.

5-1.1 Inspection and Maintenance – Piers and Wharves.

Refer to UFC 4-150-07 for inspection and maintenance requirements of piers and wharves.

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5-1.2 Inspection and Maintenance – Fuel Containment Systems

- a. Containment systems on piers and wharves degrade and will collect debris, which can clog drainage inlets or prevent drain valves from sealing properly. Hydrostatically test the secondary containment and associated drainage systems to include containment concrete/sealant, drain inlets, drain lines and containment drain valves to ensure containment is liquid tight. This test may use opportune rainfall by holding rainwater in the containment system for one hour. Where evaporation is a concern, conduct the testing when this concern would be minimized, such as at night/early morning or during a time of year when this would not be as much of an issue. Record the water level at the start of the the 60 minute (minimum) hold period. If the water level drops by 1/8 inch or more, perform and record an investigation to determine the cause and any required repairs. Once repairs are completed, a new test must be completed. Refer to [Appendix B](#) for testing procedures and to document the testing.

Frequency: Every 3 Years

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5-2 MARINE RECEIPT.

These facilities include piers or wharves equipped with petroleum fuel transfer piping. Major components of marine receipt systems include marine hoses, marine loading arms, piping, strainers, fuel meters, stripper pumps, and grounding systems.

5-2.1 Inspection and Maintenance – Marine Receipt.

- a. Conduct a shore side inspection of the pier or wharf for signs of damage as soon as marine barge or tanker disembarks.
Frequency: After each use
- b. Inspect the ground switch used between the marine barge or tanker and the petroleum fuel receipt piping.
Frequency: Monthly
- c. Inspect mooring lines, cleats, bollards, bitts, pulley blocks, steel wire ropes, and winches. Use UFC 4-150-08 as a guide when conducting inspections. Repair or replace damaged components as required.
Frequency: Monthly
- d. Refer to [Section 6-1 Pipe Testing and Inspections](#) for inspection and maintenance requirements of petroleum fuel pipelines installed above water surfaces. These pipelines are regulated under 33 CFR 154 and 156. Any additional requirements listed under 33 CFR 154 and 156 must also be followed.
- e. Refer to [Section 5-1.1 Marine Transfer Hoses](#) for inspection and maintenance requirements of petroleum fuel marine hoses.
- f. Refer to [Section 5-4 Marine Loading Arms](#) for inspection and maintenance requirements of petroleum fuel marine loading arms.
- g. Refer to [Section 3-6.4 Basket Strainers](#) for inspection and maintenance requirements of basket strainers.
- h. Refer to [Section 3-7 Meters](#) for inspection and maintenance requirements of petroleum fuel meters.
- i. Refer to [Section 3-8.2 Positive Displacement Pumps](#) for inspection and maintenance requirements of stripper pumps.
- j. Refer to [Section 9-1.6 Grounding Systems](#) for inspection and maintenance requirements of grounding systems.

5-3 MARINE ISSUE.

Marine petroleum fuel issue systems are used to transfer petroleum fuel from shore storage systems to marine barges and tankers.

5-3.1 Inspection and Maintenance – Marine Issue.

Major components of marine petroleum fuel issue systems include piping, basket strainers, pumps, meters, marine hoses, marine loading arms, stripper pumps, and grounding systems.

- a. Inspect pier or wharf for signs of damage as soon as marine barge or tanker disembarks.
Frequency: After each use
- b. Inspect the ground switch used between the marine barge or tanker and the petroleum fuel issue piping.
Frequency: Monthly
- c. Inspect mooring lines, cleats, bollards, bitts, pulley blocks, steel wire ropes, and winches. Use UFC 4-150-08 as a guide when conducting inspections. Repair or replace damaged components as required.
Frequency: Monthly
- d. Refer to [Section 6-1 Pipe Testing and Inspections](#) for inspection and maintenance requirements of petroleum fuel pipelines installed above water surfaces. These pipelines are regulated under 33 CFR 154 and 156. Any additional requirements listed under 33 CFR 154 and 156 must also be followed.
- e. Refer to [Section 3-6.4 Basket Strainers](#) for inspection and maintenance requirements of basket strainers.
- f. Refer to [Section 3-8 Pumps](#) for inspection and maintenance requirements of marine loading and stripper pumps.
- g. Refer to [Section 3-7 Meters](#) for inspection and maintenance requirements of petroleum fuel meters.
- h. Refer to [Section 5-5.1 Marine Transfer Hoses](#) for inspection and maintenance requirements of petroleum fuel marine hoses.
- i. Refer to [Section 5-4 Marine Loading Arms](#) for inspection and maintenance requirements of petroleum fuel marine loading arms.
- j. Refer to [Section 9-1.6 Grounding Systems](#) for inspection and maintenance requirements of grounding systems.

5-4 MARINE LOADING ARMS.

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- a. Marine loading arms are used to connect shore based petroleum fuel receipt and issues systems to marine barges and tankers.
- b. The swivel, or swing joint attaching the arm to supply piping can be a source of leaks, especially if the arm is subject to stress when attached to the vessel. A program of periodic lubrication and inspection will ensure longer swivel life. If seals leak in spite of lubrication and seal replacement, complete refurbishment of the swivel may be required and the reason for the recurring failures should be identified. Non-lubricated swivels should not be lubricated.

- c. A common cause of failure is inadequate support for the arm. Fully stocked kits are available to complete seal or joint renewal. Non-lubricated type swivels must be refurbished or replaced by the original equipment manufacturer.
- d. Additional information pertinent to loading arms can be found in UFC 3-460-01 Section 5-8.a.

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5-4.1 Inspection and Maintenance – Marine Loading Arms.

Signs of leaking lubricant or grease contaminated with fuel are clear signs of swivel joint failure. Refer to the manufacturer's operation and maintenance manual for specific maintenance procedures and schedules and follow applicable general maintenance requirements.

- a. Check swivel for smooth operation. Check seals for signs of wear and discoloration which may indicate a seal or ball bearing failure.
Frequency: Quarterly
- b. Inspect ball bearings when accessible. Rough and/or uneven wear on the surface are indications of swivel joint failure.
Frequency: Annually
- c. Conduct pressure test of marine loading arms in accordance with 33 CFR 156.170 *Equipment Tests and Inspections*, Section (f)(1).
Frequency: Annually

5-5 MARINE AND UNDERWATER HOSES.

5-5.1 Marine Transfer Hoses.

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- a. Many fueling operations are completed between piers and smaller vessels with non-buoyant hoses because the distance between the vessel and pier is minimal, and because the fuel hose will never touch the water during these fueling operations. Hose sizes can range from 2 to 6 inches (50 to 150 mm) in diameter and range in length from 25 to 100 feet (7.5 to 30.5 meters). These hoses are used to issue and receive petroleum products. The hoses must meet the requirements of 33 CFR 154.500.
- b. In some cases floating hoses are used to attach between shore-based facilities and marine barges and tankers. Floatation buoyancy is typically built into the petroleum fuel hose string components, but it can also be externally attached. Hose strings are made up of 30 to 40-foot (9 to 12m) long sections of individual hose lengths bolted together by steel flanges built into the ends of each floating hose. Each hose connection should

have a drain connection on the marine barge or tanker side of the block valve.

- c. Floating petroleum fuel hose diameters are standardized, in accordance with Oil Companies International Marine Forum (OCIMF) best practices, and range from 6-inch (DN150) to a maximum of 24-inch (DN600) internal diameter. The hose string length is determined by mooring equipment, marine barge or tanker size, and manifold location. Floating petroleum fuel hose strings will typically end in a blind flange that must be removed by the marine barge or tanker crew before the petroleum fuel hose can be connected to the marine barge or tanker. Floating petroleum fuel hose strings include a pick-up line which is attached to the marine barge or tanker end of the petroleum fuel hose. This pick-up line is used to bring the petroleum fuel hose onto the marine barge or tanker and is connected to a marker buoy which makes the free end of the petroleum fuel hose pick-up line easier to locate.

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5-5.1.1 Inspection and Maintenance – Marine Transfer Hoses.

- a. Visually inspect petroleum fuel marine transfer hoses. Transfer hoses must have no loose covers, kinks, bulges, soft spots, and no gouges, cuts or slashes that penetrate the hose reinforcement. Hoses must also have no external deterioration.
Frequency: Before each use
- b. Visually survey petroleum fuel marine hoses. Observe the general condition and look for fluid puddles, fine mists, physical damage such as jacket abrasion or deformation, and deteriorated joints. Use sense of smell to detect petroleum vapor. Look for improper hose handling that may overstress the hose by stretching, relative movement, or kinking.
Frequency: During each use
- c. Refer to [Appendix D, Section D-2.2 Marine and Underwater Transfer Hose Hydrostatic Test](#) for marine transfer hose hydrostatic testing requirements and procedures.
Frequency: Annually or not less than 30 days prior to the first transfer conducted past one year from the date of the last test and inspection.

5-5.2 Underwater Hoses.

Underwater petroleum fuel hoses are similar in construction to petroleum fuel marine transfer hoses but may have additional chafing gear covering some sections. External reinforcements may also be added to prevent kinking due to tidal motion when they are used in petroleum fuel transfer service in offshore moorings. Experience has shown that some sections of the underwater hose consistently wear more than others. Hose life

can be extended by periodically changing the position of individual sections in the hose string. Ensure that the proper stainless steel bolts and Monel nuts are used to reassemble the string.

5-5.2.1 Inspection and Maintenance – Underwater Hoses.

It is recommended that, when equipment is available to lift buoys, anchors, chains, and other offshore mooring equipment, an effort be made to schedule hose inspection and testing concurrently, regardless of the duration since the last test. Work on the mooring systems can cause additional strain and wear on hoses.

- a. Refer to [Appendix D, Section D-2.2 Marine and Underwater Transfer Hose Hydrostatic Test](#) for underwater hose hydrostatic testing requirements and procedures.
Frequency: Annually or not less than 30 days prior to the first transfer conducted past one year from the date of the last test and inspection.

5-6 DISPENSERS.

Dispenser systems located at marine facilities are similar to military service station type dispensers and typically include hose reels to refuel various types of watercraft. Hoses are routinely pulled across concrete and other abrasive surfaces that can cause damage to hoses. Automatic nozzle shut-off clips must be removed from marine fuel dispensing nozzles.

5-6.1 Inspection and Maintenance – Dispensers.

- a. Refer to [Section 7-2 Dispenser Nozzles](#) for inspections and maintenance requirements of dispenser nozzles.
- b. Refer to [Section 7-3 Dispenser Hoses](#) for inspections and maintenance requirements of dispenser hoses.
- c. Refer to [Section 7-4 Breakaways](#) for inspections and maintenance requirements of dispenser hose breakaways.
- d. Refer to [Section 7-5 Swivels](#) for inspections and maintenance requirements of dispenser hose swivels.
- e. Refer to [Section 7-8 Dispenser Meters](#) for inspections and maintenance requirements of dispenser meters.
- f. Refer to [Section 7-9 Dispenser Filters](#) for inspections and maintenance requirements of dispenser filters.
- g. Refer to [Section 7-10 Dispenser Strainers](#) for inspections and maintenance requirements of dispenser strainers.

- h. Refer to [Section 7-12 Emergency Shutoff Valves](#) for inspections and maintenance requirements of emergency shutoff valves installed in the petroleum fuel supply line at the base of dispensers.
- i. Refer to [Section 7-15 Dispenser Pumps](#) for inspections and maintenance requirements of dispenser pumps.

5-7 OFFSHORE MOORING SYSTEMS.

Offshore moorings designed in accordance with UFC 4-159-03 are located out of navigable shipping lanes with necessary anchorage suitable for holding specific capacity marine tankers. Typically a single steel pipeline connected to the shore petroleum fuel storage system extends underwater from the shore to the area of the mooring. This pipeline is used to handle all petroleum fuel products. Underwater petroleum fuel hose, flanged to the underwater pipeline provides a flexible connection to marine tankers. The mooring anchors installed for marine tankers are marked with buoys. The underwater petroleum fuel hose is equipped with a spool piece and a chain at the marine tanker end. The chain is connected to a marker buoy and is used to lift the petroleum fuel hose from the sea bottom for connection to the marine tanker.

Inspection and maintenance of offshore mooring systems focuses on buoy coatings, anchors, and chains. Cathodic protection systems are used to protect the anchors and chains and require routine inspection and replacement of sacrificial anodes.

5-7.1 Single Point Mooring Systems.

Single point moorings (monobuoys) consist of a single buoy. The buoy is attached to marine tankers by means of bow lines or anchor chain. The ship is free to swing 360 degrees around the buoy as it responds to environmental loading conditions (weather vane). This type of mooring may use either a riser or non-riser buoy system.

A diesel engine-driven air compressor is located in the interior of the buoy; its purpose is to provide compressed air displacement for the float/sink hoses. The product hoses are packed at all times, either with petroleum product or water, depending on the operational requirements.

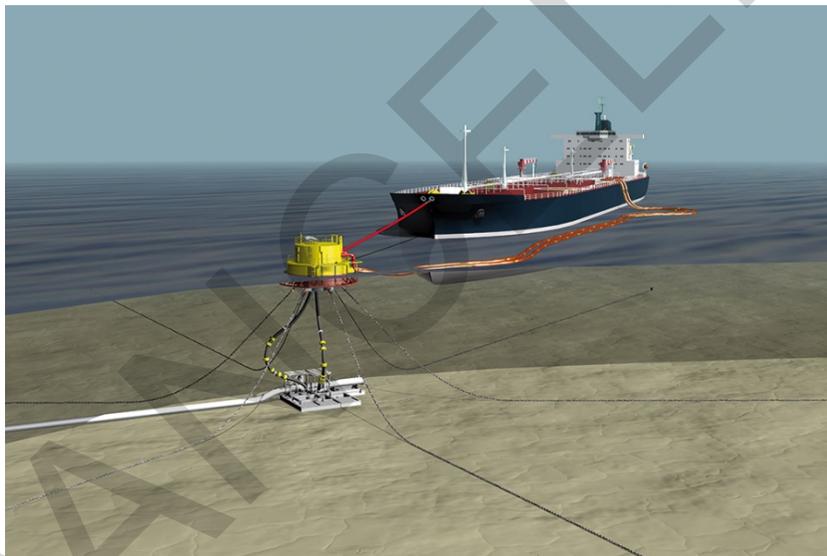
5-7.1.1 Inspection and Maintenance – Single Point Mooring Systems.

Refer to NAVFAC MO-124 for frequencies of inspection and additional maintenance required for mooring systems. Required underwater inspections and testing must be performed by experienced professional divers.

- a. Inspect and, if necessary, repair or replace all mooring hawsers or lines, deck hose, chain, chair stoppers, flange adaptors, gaskets or other gear used in mooring the marine tanker and in connecting hoses.
Frequency: Monthly

- b. Inspect air-compressor for proper operation.
Frequency: Annually
- c. Inspect navigation aids and mooring buoy, in accordance with NAVFAC MO-124 Mooring Maintenance Manual, for evidence of damage and possible movement or dragging by marine tankers, current or winds.
Frequency: Annually
- d. Divers must conduct underwater inspections of mooring chains, shackles and anchors attaching buoys to bay/harbor floors.
Frequency: Annually
- e. Conduct overhaul of single point mooring buoys every 3 to 5 years. Single point mooring buoys must be brought ashore for repair in these instances.
Frequency: Every 5 years

Figure 5-1 Single Point Mooring System



5-7.2 Multi-point Mooring Systems.

Multi-point moorings are designed for use by a single ship secured by its bow and stern lines to buoy systems. This mooring is normally installed near a shoreline, parallel to the direction of water current, and outside the normal navigational channel. Riser buoy systems are normally used in this type of mooring.

5-7.2.1 Inspection and Maintenance – Multi-point Mooring Systems.

Refer to NAVFAC MO-124 for frequencies of inspection and additional maintenance required for mooring systems. Required underwater inspections and testing must be performed by experienced professional divers.

- a. Inspect and, if necessary, repair or replace all mooring hawsers or lines, deck hose, chain, chair stoppers, flange adaptors, gaskets or other deck gear used in mooring the marine tanker and in connecting underwater hoses.
Frequency: Monthly
- b. Inspect navigation aids and mooring buoys, in accordance with NAVFAC MO- for evidence of damage and possible movement or dragging by marine tanker, current or winds.
Frequency: Annually
- c. Divers must conduct underwater inspections of mooring chains, shackles and anchors attaching buoys to bay/harbor floors.
Frequency: Annually

5-8 SUBMERGED PIPING SYSTEMS.

Submerged piping is used to connect shore based petroleum fuel systems to mooring locations of marine tankers. A hose is typically installed to connect the submerged piping to the moored marine tanker.

5-8.1 Inspection and Maintenance – Submerged Pipelines.

Required underwater inspections and testing must be performed by experienced professional divers.

- a. Inspect water above submerged pipelines and their seaward end for tell-tale petroleum fuel slicks indicating leakage from pipes or underwater hoses.
Frequency: Weekly
- b. If equipped, electrically check the cathodic protection rectifier for proper performance.
Frequency: Six times each calendar year with intervals not exceeding 2½ months.
- c. Divers must inspect submerged pipe and hoses for signs of incipient failure or indications of rapid wear of parts subject to wave motion or abrasion on the ocean floor.
Frequency: Semi-annually
- d. Conduct annual pipe test as specified in [Appendix G](#) – Petroleum Fuel Pipeline Pressure testing Guidelines and Criteria. Testing requirements of marine pipelines are regulated under 33 CFR 154 and 156, particularly 33 CFR 156 Section 170.
Frequency: Annually
- e. Conduct cathodic protection tests on the protected pipeline as specified in [Section 9.2.1 Cathodic Protection](#) at least once each calendar year with

intervals not exceeding 15 months between tests from consecutive years.
Frequency: Annually

5-9 BOOM REELS.

Boom reels are hydraulic or manually operated. They are used to store floating spill containment booms that are used to surround marine barges and tankers and contain spills.

5-9.1 Inspection and Maintenance – Boom Reels.

- a. Visually inspect hydraulic drives and hose connections for leaks.
Frequency: Quarterly
- b. Grease bearings.
Frequency: Quarterly
- c. Inspected boom reel for signs of corrosion. Inspect breaking system and ensure it is in good working order.
Frequency: Quarterly
- d. Inspect boom for wear, rips, and tears. Repair or replace as required to ensure containment of petroleum fuel in the event of a spill.
Frequency: Annually

CHAPTER 6 PIPING SYSTEMS

6-1 PIPE TESTING AND INSPECTIONS.

This chapter includes information on testing and inspection requirements of pipelines and piping.

6-1.1 On-Base Pipelines.

On-base pipelines are routed exclusively within an Installation's property and do not pass outside of Installation boundaries. The pipelines are not regulated by the Department of Transportation (DOT). Where more than one type of petroleum fuel is transferred, separate pipelines are typically provided for each type of petroleum fuel. These pipelines include transfer lines between petroleum fuel truck and rail offloading and storage tanks, pump houses and petroleum fuel truck and rail loading systems, transfer lines between storage areas, and hydrant supply and return lines.

6-1.1.1 Inspection and Maintenance – On-Base Pipelines.

- a. Conduct petroleum fuel pipeline visual inspection of aboveground piping in accordance with [Section 6-1.5 Pipeline Visual Inspection](#).
Frequency: Monthly
- b. Conduct line walk in areas of petroleum fuel piping in accordance with [Section 6-1.6 Line Walk](#).
Frequency: Conduct during transfer operations, or monthly, at a minimum.
- c. Conduct annual test as specified in [Appendix G](#) – Petroleum Fuel Pipeline Pressure Testing Guidelines and Criteria.
Frequency: Annually
- d. Conduct cathodic protection tests as specified in [Section 9.2.1 Cathodic Protection](#) on protected petroleum fuel pipelines at least once each calendar year, but with intervals not exceeding 15 months.
Frequency: Annually
- e. Conduct five year test as specified in [Appendix G](#) – Petroleum Fuel Pipeline Pressure Testing Guidelines and Criteria.
Frequency: Every 5 years
- f. Conduct petroleum fuel pipeline API 570 inspection in accordance with [Section 6-1.9 API 570 Inspections](#).
Frequency: Every 5 or 10 years depending on API class piping or in accordance with Pipeline Integrity Management Plan (PIMP).
- g. Conduct petroleum fuel pipeline cleaning in accordance with [Section 6-2 General Pipeline Cleaning](#).
Frequency: As required to ensure fuel quality.

6-1.2 Inter-Terminal Pipelines.

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- a. Inter-terminal petroleum fuel pipelines which cross outside of an Installation's property for more than one mile and are operated by non-government personnel are regulated by the DOT. Operation and maintenance of DOT regulated pipelines must comply with 49 CFR 195. Inter-terminal pipelines which cross outside of an Installation's property for more than one mile and are operated by government personnel are currently exempt from 49 CFR 195 requirements. Although government operated pipelines are not subject to DOT regulations, certain states may regulate or force an activity to adhere to a standard such as 49 CFR 195.
- b. Inter-terminal pipelines supplying petroleum fuels to DoD petroleum fuel facilities may be dedicated to serving a single facility or may handle several types or grades of petroleum fuel for more than one user. These pipelines may be owned, operated, and maintained by DoD or commercial agencies; however, only those operated by contractors or non-government entities are potentially DOT regulated.
- c. Inter-terminal pipelines owned, operated, and maintained by commercial agencies delivering petroleum fuel to DoD petroleum fuel facilities may be constructed on DoD property in order for the inter-terminal pipelines to reach the DoD petroleum fuel facilities located on DoD property. Responsibility of commercial agencies for maintaining inter-terminal pipelines owned and operated by commercial agencies usually terminates at the custody transfer point located on the DoD Installation. The custody transfer point is typically located close to the location where the commercial inter-terminal pipeline crosses into the Installation and is usually demarcated by a custody transfer valve.
- d. In some cases supplier and operator contracts allow the responsible Installation activity to perform emergency maintenance on on-base segments of commercial inter-terminal pipelines, if necessary, to protect against environmental damage to public property or meet emergency wartime mission requirements.

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6-1.2.1 Inspection and Maintenance – Non-DOT Regulated Inter-Terminal Pipelines (Operated by DoD).

- a. Conduct petroleum fuel pipeline volume check in accordance with Section [6-1.8 Volume Check](#).
Frequency: Monthly

- b. Conduct line patrol in areas of underground petroleum fuel pipeline in accordance with [Section 6-1.7 Line Patrol](#).
Frequency: Annually
- c. Government operated inter-terminal petroleum fuel pipelines must follow the maintenance requirements listed in [Section 6-1.1.1 On-Base Pipelines](#).

6-1.2.2 Inspection and Maintenance – DOT Regulated Inter-Terminal Pipelines.

DOT regulated petroleum fuel pipelines must be maintained and operated in accordance with the provisions of 49 CFR 195. This includes but is not limited to O&M Plans, Integrity Management Plans, and Operator Qualification Plans, which are outside the scope of this document.

6-1.3 Aboveground Piping.

Aboveground piping includes visible piping installed outside and inside of buildings. This piping is supported on aboveground pipe supports or in open trenches or trenches with removable covers.

6-1.3.1 Inspection and Maintenance – Aboveground Piping.

- a. Conduct petroleum fuel piping visual Inspection in accordance with [Section 6-1.5 Pipeline Visual Inspection](#).
Frequency: Weekly
- b. Conduct petroleum fuel piping annual test as specified in [Appendix G – Petroleum Fuel Pipeline Pressure Testing Guidelines and Criteria](#).
Frequency: Annually
- c. Conduct petroleum fuel piping API 570 inspection in accordance with [Section 6-1.9 API 570 Inspections](#).
Frequency: Every 5 or 10 years depending on API class piping or in accordance with Pipeline Integrity Management Plan (PIMP).
- d. Conduct cleaning of petroleum fuel piping in accordance with [Section 6-2 General Pipeline Cleaning](#).
Frequency: As required to ensure fuel quality.

6-1.4 Double-Wall Piping.

Double-wall piping is required by some states or host nations. In the event that the carrier pipe develops a leak, there are techniques for detecting the presence of fuel in the interstitial space of the double-wall piping. See [Section 6-13.1 General Inspection of Release Detection Systems](#) for more information on systems used for monitoring the interstitial space.

6-1.4.1 Inspection and Maintenance – Double-Wall Piping.

- a. Conduct petroleum fuel pipeline visual inspection of aboveground piping in accordance with [Section 6-1.5 Pipeline Visual Inspection](#).
Frequency: Monthly
- b. Conduct line walk in areas of petroleum fuel piping in accordance with [Section 6-1.6 Line Walk](#).
Frequency: Conduct during transfer operations, or monthly, at a minimum.
- c. Conduct annual carrier pipe test as specified in [Appendix G](#) – Petroleum Fuel Pipeline Pressure Testing Guidelines and Criteria.
Frequency: Annually
- d. Conduct cathodic protection tests as specified in [Section 9.2.1 Cathodic Protection](#) on protected petroleum fuel pipelines at least once each calendar year, but with intervals not exceeding 15 months.
Frequency: Annually
- e. Conduct containment pipe test as specified in [Appendix G](#) – Petroleum Fuel Pipeline Pressure Testing Guidelines and Criteria.
Frequency: Every three years
- f. Conduct petroleum fuel pipeline API 570 inspection in accordance with [Section 6-1.9 API 570 Inspections](#).
Frequency: Every 5 or 10 years depending on API class piping or in accordance with Pipeline Integrity Management Plan (PIMP).
- g. Conduct petroleum fuel pipeline cleaning in accordance with [Section 6-2 General Pipeline Cleaning](#).
Frequency: As required to ensure fuel quality.

6-1.5 Pipe Visual Inspection.

Visually inspect aboveground petroleum fuel piping for leaks (e.g., drips, mist spray). Repair identified leaks. Some leaks can be repaired by replacing or repairing mechanical components. Other leaks will require welding of the pipe for permanent repair. Approval through local work management processes is required before beginning welding or hot work in connection with repairs. The following list is a baseline for petroleum fuel pipeline operability:

- a. Visually inspect piping and coatings for signs of corrosion or damage. Schedule maintenance or repair as necessary.
- b. Inspect flanges and gaskets.
- c. Inspect pipe supports to ensure pipe is properly supported without binding, misalignment, or tipping. Ensure insulating or sliding material between the

supports and piping is securely fastened and not missing or deteriorated. Ensure contact points between support and pipe are not corroded.

- d. Inspect pipe support anchor bolts and grout for signs of cracking, corrosion, or missing fasteners. Repair as required.
- e. Visually inspect expansion bellows for cracks, tears, leaks, or misalignments. Expansion bellows cannot be repaired and must be replaced if damaged.
- f. Inspect braided hoses and vibration dampeners for wear and damage to braiding. Also check for compression or tension that could indicate improper loading on the hose or dampener.
- g. Visually inspect grounding wires and connection points between pipes and grounding rods.

6-1.6 Line Walk.

Line walkers or vehicle patrols must make detailed inspections of area conditions around aboveground petroleum fuel piping and above underground petroleum fuel piping. Inspections must include general condition of the right-of-way, valves in remote areas, and conditions that may indicate a leak. Leaks in underground pipelines can be detected by fuel surfacing on the ground, fuel runoff in storm drainage systems, fuel in underground pits or manholes, dead vegetation, or the continuous odor of fuel in a particular area. Investigate suspicious circumstances.

Inspections of DOT regulated petroleum fuel pipelines must be in accordance with 49 CFR 195, Subpart F, Section 195.402, which requires inspections of right-of-way conditions at intervals not exceeding 3 weeks, but at least 26 times each calendar year.

6-1.7 Line Patrol.

Line patrols should occur on sections of petroleum fuel pipelines not easily accessible by vehicle or foot. Line patrols are conducted by observations from aircraft. Line patrols should be flown at an elevation of less than 500 feet (152 meters) from the ground and at speeds from 65 to 80 miles per hour (105 to 130 kilometers per hour). Petroleum fuel pipelines must be marked with posts or signs at 1 mile (1.6 kilometer) intervals and at bends. During line patrols the pilot acts as an observer who checks for unnatural changes in vegetation color and oil slicks on lakes and streams, which are evidence of leaking petroleum fuel pipelines; area construction work (e.g., roads, sewers) that could cross and possibly damage the petroleum fuel pipeline; and the overall condition of the right-of-way.

6-1.8 Volume Check.

Compare records kept on volume and temperature of petroleum fuel that has passed through each pumping station. Differences in meter readings not accounted for by

temperature corrections between two stations may indicate a leak, but could also indicate theft, out-of-calibration meters, faulty temperature sensors, or human error.

6-1.9 API 570 Inspections.

Periodic inspections by an API 570 certified inspector must provide documentation of remaining pipeline life; recommended repairs; and/or need for replacement. Intervals for inspection are based on the class of piping and corrosion rate of the piping.

- Class 1: Over water – 5 years maximum.
- Class 2: Natural Gas – 10 years maximum.
- Class 3: Aboveground and underground petroleum fuel piping – 10 years maximum.

6-2 GENERAL PIPELINE CLEANING.

Petroleum fuel pipelines designed as suitable for pigging may be cleaned using various cleaning pigs. Intervals between cleanings are based on site conditions and the type of petroleum fuel. A drop in the flow rate; the continual presence of dirt, rust, or particulate in basket strainers; and/or shortened filter life may indicate a need for cleaning.

6-2.1 Cleaning Operations.

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- a. Decide on the cleaning tool best suited for the pipe system and operation. For most petroleum fuel applications, a foam pig may be sufficient. For heavier petroleum fuel applications, or extensive cleaning requirements, brush and magnet pigs may be required. Verify operational specifications to be sure the pig will pass through all valves and bends.
- b. Keep accurate time records of run start and quantity of petroleum fuel pumped to trace pig progress and determine its arrival at the receiving station. Meters must be bypassed during cleaning operations to avoid fouling. Cleaning pigs must be run at the manufacturer's suggested minimum velocity with no shutdowns while the pig is in the line. Shutdowns cause debris to settle in front of the pig and may cause it to become stuck.
- c. Pigging operations may produce debris in the pipe system and extensive flushing and filtering should be performed once a pigging operation is completed. Flushing and filtering should be continued until all debris is removed from the pipe system.

6-3 PIPE SYSTEM REPAIRS.

- a. Temporary repairs are defined as repairs made to piping systems that restore sufficient integrity to continue safe operation until permanent

repairs can be scheduled and accomplished. The military service-specific SCP must be notified of temporary repairs and must have jurisdiction on how long a temporary repair may stay in place. The military service-specific SCP may require increased inspection while temporary repairs are in place.

- b. Permanent repairs generally require planning and potentially welding or patching of the pipeline. Approvals through local work management processes are required before beginning welding or hot work in connection with repairs. All welding pipe repairs must meet the requirements of UFGS 1133 52 23.15/1/ including documentation of welding procedures and welder qualifications before welding repairs are conducted.
- c. Pipeline failures can create a welding safety hazard due to fuel-soaked soil in the area of the leak. Temporary pipeline repairs can be accomplished by clamping a steel plate of the same curvature as the pipe over the damaged area (i.e., clockspring repair) and using petroleum-resistant rubber, epoxy compounds, or gaskets for a seal. Once a temporary repair is in place, the area should be cleared of hazards. Permanent repairs may require replacement of failed sections.

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6-3.1 Pits and Small Leaks.

Pitting on pipeline exterior surface is caused by corrosion and can lead to pipeline failure. Pitting can be repaired in a number of ways, but severe pitting must be repaired by either a patch plate or pipe replacement. In some cases, a full encirclement sleeve should be considered. All pipeline welded repairs must meet the requirements of UFGS 11 33 52 23.15 /1/ including documentation of welding procedures and welder qualifications before welding repairs are conducted.

6-4 PIPELINE INTEGRITY MANAGEMENT PLAN.

Each petroleum fuel pipeline facility should have a Pipeline Integrity Management Plan (PIMP) to assist with and guide pipeline integrity maintenance. PIMPs improve the integrity management of piping systems and help prevent leaks or pipeline failures. The plans are developed based on the principles of API Standard 570 Federal, state, host nation, and local codes and regulations.

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6-4.1 Certified Pipeline Inventory.

DLA-E requires that a fuel system volume be calculated using as-constructed pipe lengths, internal diameters, fittings, and components of a system; i.e., all items containing fuel with the exception of tanks. If the inventory does not exist, record and

provide a detailed list with sizes, lengths, quantity, and volumes for each of the systems inspected or repaired. */1/*

6-5 FLANGE GASKETS.

When installing a gasket, measure the gap between the flanges to ensure consistent dimensions around the circumference of the connection. The faces of each flange must be inspected for scratches, burs, or other signs of damage before gaskets are installed. Pipe can expand and contract during temperature changes and gaskets should be replaced during consistent temperature conditions.

6-6 VALVES.

6-6.1 Valve Tagging.

/1/ Mark valves, pumps, meters, and other system components with easily discernible painted numbers or numbered corrosion-resistant metal or plastic tags attached with a suitable fastener. Ensure numbers correspond to those on the schematic flow diagrams and other drawings for the installation. */1/*

6-6.2 Manual Valves.

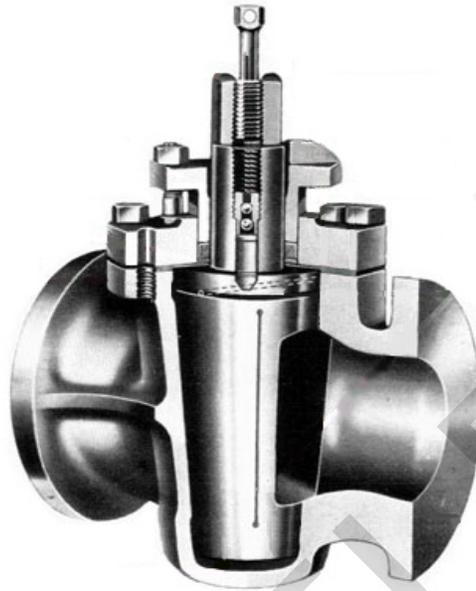
Manual valves are used to isolate portions of fuel systems and equipment, to control flow, or to direct the flow of fuel to a desired location.

6-6.2.1 Plug Valves – Lubricated.

Lubricated plug valves are not allowed in aircraft petroleum fuel systems and must be replaced. If lubricated plug valves are installed in other systems and cannot be replaced, they must be inspected regularly for proper operation.

Lubricated plug valves require lubrication and occasional flushing to keep them working properly. The valves require lubrication through a grease fitting on top of the valve that forces grease into feed channels within the valve plug. The plug is lubricated so that it passes freely over the seats without binding.

Figure 6-1 Lubricated Plug Valve



6-6.2.1.1 Inspection and Maintenance – Plug Valves – Lubricated.

- a. Open and close valve to check for ease of operation.
Frequency Quarterly
- b. Lubricate valve operator stems and grease fittings.
Frequency: Semi-annually
- c. Inspect valve exterior for corrosion and tightness of bolts. Repaint and retighten as required.
Frequency: Semi-annually

6-6.2.2 Plug Valves – Non-lubricated.

Non-lubricated plug valves use cylindrical or conically shaped plugs that are rotated within the valve body. They are used as block valves, or where shut-off is required in various parts of the system. Plug valves can be either reduced port or full port depending on the location.

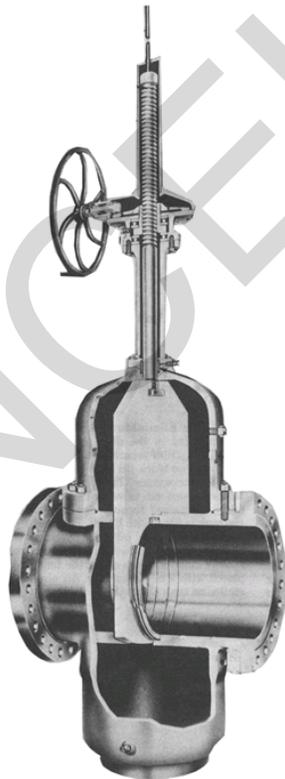
6-6.2.2.1 Inspection and Maintenance – Plug Valves – Non-Lubricated.

- a. Open and close valve to check for ease of operation. Adjust or replace packing as needed.
Frequency Quarterly
- b. Inspect valve exterior for corrosion and tightness of bolts. Repaint and retighten as required.
Frequency: Semi-annually

6-6.2.3 Gate Valves.

A gate valve is equipped with a round or rectangular wedge that is lifted out of the path of fluid to allow flow, and lowered back to its seat to block flow. Gate valves are not designed for throttling. They are designed to be either fully open or fully closed. Gate valves are either of the rising stem type, to visually see that the gate is opening or closing as the stem rises and falls; or of the non-rising stem type, where the hand wheel is fixed and the stem threads are internal to the valve. Rising stem gate valves are preferred in order to keep the stem threads out of the fluid. Gate valves should be equipped with a stem position indicator to indicate the open or closed position. Gate valves are equipped with a bonnet to ensure leak-proof closure of the valve body and are equipped with a valve stem packing tightening mechanism.

Figure 6-2 Gate Valve



6-6.2.3.1 Inspection and Maintenance – Gate Valves.

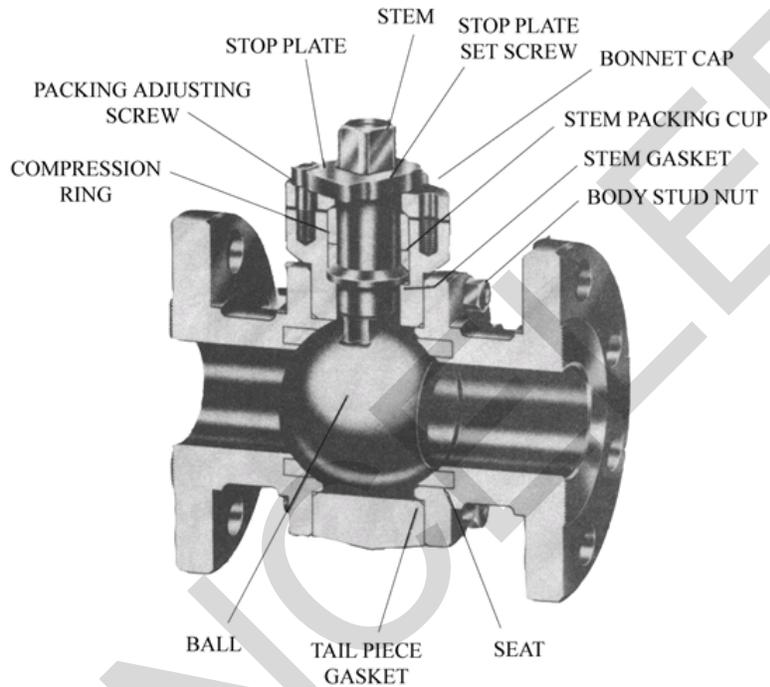
- a. Open and close valve to check for ease of operation. Adjust or replace packing as needed.
Frequency Quarterly
- b. Lubricate valve operator stem.
Frequency: Semi-annually

- c. Inspect valve exterior for corrosion and tightness of bolts. Repaint and retighten as required.

Frequency: Semi-annually

6-6.2.4 Ball Valves.

Figure 6-3 Ball Valve



Ball valves are used as quick shut-off (block) valves in applications such as piping to hydrant outlets, between pumps and headers, and between pumps and filter separators. They are quarter turn, 0 to 90 degree, open to close type valves consisting of a solid metal ball with either reduced or full port, usually of stainless steel, and tetraflouroethylene (TFE) or fluoroelastetomer (FKM, commonly referred to as Viton) seats, body seals and stem seals. When the valve ball is in its open position (0 degrees) flow is through the open port. When the valve is in its closed position the port is 90 degrees perpendicular to the flow, allowing no flow through the valve. The valves are lever operated or gear operated, depending on the size.

6-6.2.4.1 Inspection and Maintenance – Ball Valves.

- a. Open and close valve to check for ease of operation.
Frequency Quarterly
- b. Lubricate overhead valve chain operator gears.
Frequency: Quarterly

- c. Adjust packing per manufacturer's specifications as needed.
Frequency: Quarterly
- d. Inspect valve exterior for corrosion and tightness of bolts. Repaint and retighten as required.
Frequency: Quarterly
- e. Refer to [Section 6-6.2.10 Manual Valve Gear Operators](#) for inspection and maintenance of gear operators if equipped.

6-6.2.5 Double Block and Bleed Valves.

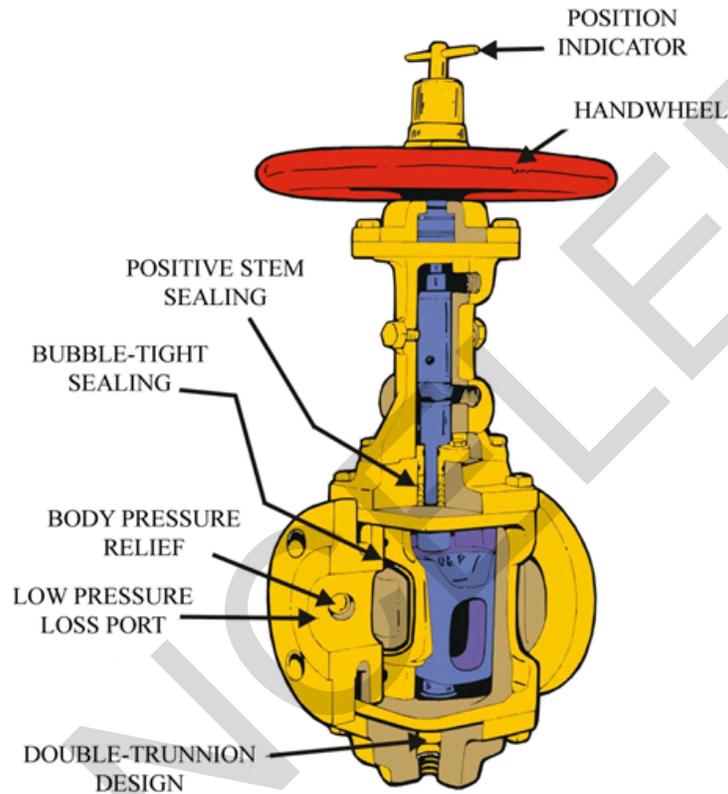
Double block and bleed (DBB) valves provide positive shutoff that can be verified by opening the cavity between the two blocks. They are used as positive isolation valves around tanks and in piping runs. They comply with API Specification 6D. Refer to UFC 3-460-01 for recommended locations.

DBB valves can be plug, ball, or gate type, and reduced or full port depending on the location. Typically reduced port plug type DBB valves are used around tanks and in piping systems that do not require periodic pigging. Full port ball DBB valves are required in pipelines that require pigging.

- a. Plug type DBB valves are equipped with non-lubricated, resilient, double-seated, trunnion-mounted, tapered lift plugs capable of two-way shutoff. The tapered plug is usually of ductile iron with chrome or nickel plating with the plug supported on upper and lower trunnions. Sealing slips are usually of steel or ductile iron with Viton seals which are held in place by dovetail connections. The sealing slips are removable and replaceable from the bottom of the valve while the valve is mounted in the pipeline in the open position. The valve hand wheel operates the valve from fully closed to fully open by first lifting the plug off the seats and then turning the plug so that the valve is in the fully open position.
- b. Ball type DBB valves are equipped with non-lubricated, trunnion-mounted independent spring and hydraulically actuated, floating, single piston effect, self-relieving seat rings with bi-directional sealing. The ball is solid with a flow through conduit opening, suitable for the passage of pipeline pigs. The stems are anti-static, blow-out-proof design with O-ring seals and are provided with an emergency sealant injection fitting. The valves are 3-piece, bolted body design with flanged connections and are equipped with body drain, bleed valve and vent fitting.
- c. Gate type DBB valves, when applicable per UFC 3-460-01 are non-lubricated with a bolted bonnet using an expanding gate which does not require pressure to produce a proper two-way seal. These valves are intended for fully open or fully closed operation and must not be used to throttle. The gate segments are usually of ductile iron with chrome or nickel plating. The hand wheel operates the valve from fully open to fully

closed by moving the expanding gate into position then wedging the segments against the seats. The valves use flanged connections and are equipped with a body drain, bleed valve and vent fitting.

Figure 6-4 Double Block and Bleed Plug Valve



6-6.2.5.1 Inspection and Maintenance – DBB Valves.

Refer to valve manufacturer's operation and maintenance manual for disassembly, parts, additional maintenance for specific models, reassembly parts, and repair of DBB valves.

- a. Open and close valve to check for ease of operation.
Frequency Quarterly
- b. Lubricate overhead valve chain operator gears if equipped.
Frequency: Quarterly
- c. Adjust packing per manufacturer's specifications as needed.
Frequency: Quarterly
- d. Inspect valve exterior for corrosion and tightness of bolts. Repaint and retighten as required.
Frequency: Quarterly

- e. Operate the body cavity drain when the valve is in the closed position to ensure that the valve is closing properly.

Frequency: Quarterly

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- f. Keep the valve operator housing full of lubricant to displace and prevent moisture from accumulating and freezing, in accordance with manufacturer's recommendations.

Frequency: Semi-annually

- g. Remove bottom drain plug and drain valve.

Frequency: Annually

- h. Refer to [Section 6-6.2.10 Manual Valve Gear Operators](#) for inspection and maintenance of gear operators if equipped.

- i. Some double block and bleed valves are equipped with integrated pressure/thermal relief valves. Refer to [Section 6-6.3 Thermal and Pressure Relief Valves](#) for inspection and maintenance requirements of pressure/thermal relief valves

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6-6.2.6 **Butterfly Valves.**

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- a. UFC 3-460-01 does not allow butterfly valves to be used as isolation valves in the construction of new petroleum fuel systems, as they are not considered positive shut-off valves. However, UFC 3-460-01 does specify that high-performance wafer trunnion butterfly type valves with synthetic seating material and a metal-to-metal seat that comply with API Std 607, equipped with a self-closing mechanism and a fusible link, must be used in two locations on Army and Navy projects. These locations are the inlet to truck fillstands, and on supply and return risers at aircraft direct fueling stations.

- b. A butterfly valve is a short face to face valve incorporating a trunnion mounted flat disc that when closed is held tight against a synthetic seating material. Butterfly valves meeting the requirements of API Std 607 include a metal-to-metal seat as a back-up to the synthetic seat which enables the valve to continue to block flow in the closed position if the synthetic seat is burned out in a fire.

- c. Butterfly valves are available in flanged, wafer, and lug style configurations. The wafer configuration does not include flanges on the valve body and fits between mating flanges installed in piping. A wafer style valve is centered inside the flange bolts of mating flanges when installed. Lug style valves include threaded lug bolts holes on the body of the valve. A lug style valve can be bolted to mating flanges from either

side. For example, a lug style butterfly valve can be used at the end of a pipeline on a single mating pipe flange with the other end open, such as on a drain line.

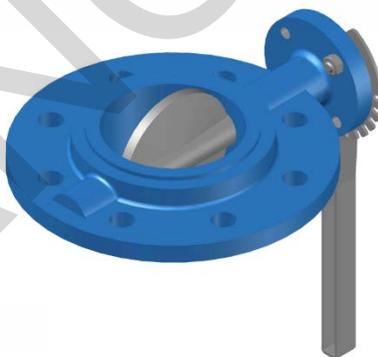
- d. Existing butterfly valves installed in petroleum fuel systems must be inspected and maintained.

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6-6.2.6.1 Inspection and Maintenance – Butterfly Valves.

- a. Open and close valve to check for ease of operation. Ensure that lever operators and locking mechanisms are in place and working properly.
Frequency Quarterly
- b. Adjust packing per manufacturer's specifications as needed. If butterfly valves are leaking or not shutting off flow, tightening the gland flange to tighten the stem packing or remove the valve from service and replace the seats as necessary.
Frequency: Quarterly
- c. Inspect valve exterior for corrosion and tightness of bolts. Repaint and retighten as required.
Frequency: Quarterly

Figure 6-5 Butterfly Valve



6-6.2.7 Globe Valves.

Globe valves are used for isolation and throttling purposes. Hand wheel operated globe valves consist of a disc that is tightened via the hand wheel against a seat. These valves are equipped with a gland seal mechanism to seal the packing against the valve stem. The valve stem packing is accessible through a gland seal on top of the valve, and the valve seat is typically accessible through the valve bonnet.

Figure 6-6 Globe Valve



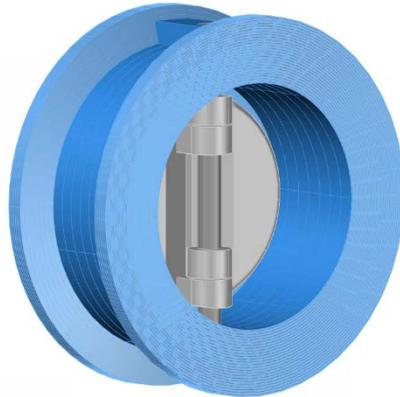
6-6.2.7.1 Inspection and Maintenance – Globe Valves.

- a. Open and close valve to check for ease of operation.
Frequency Quarterly
- b. Adjust packing per manufacturer's specifications as needed.
Frequency: Quarterly
- c. Inspect valve exterior for corrosion and tightness of bolts. Repaint and retighten as required.
Frequency: Quarterly

6-6.2.8 Check Valves.

Check valves are used to prevent backflow through pumps, branch lines, meters, or other locations where reverse flow must be prevented. Check valves may be of the swing disk, globe, dual plate hinged disk, spring-loaded poppet, ball, or diaphragm-actuated types. Check valves require upstream pressure in order for the check valve mechanism to close. Check valves must conform to API Specification 6D.

Figure 6-7 Check Valve



6-6.2.8.1 Inspection and Maintenance – Check Valves.

Refer to the particular check valve manufacturer's operation and maintenance manual for additional maintenance and parts.

- a. Use external test lever to make sure the valve is not sticking if equipped. If a check valve is suspected of not checking and cannot be serviced in place, it must be removed from the piping system and serviced in a shop.
Frequency: Quarterly
- b. Inspect valve exterior for corrosion and tightness of bolts. Repaint and retighten as required.
Frequency: Quarterly

6-6.2.9 Line Blanks, Ring Spacers, and Spectacle Blinds.

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- a. A line blank is a flat plate designed to fit between two flanges as an isolation device. They are designed to fit between flanges inside the bolt circle with gaskets on either side. For example, blanks may be used at tank connections to isolate a tank from an active system while the tank is being cleaned or inspected. Line blanks are equipped with a handle that protrudes between flange bolts and is visible when it is installed. The handle should be stamped with information about the design of the blank. These are often referred to as blinds or skilllets.
- b. A ring spacer is a metal ring with gasket seating surfaces with an inner open hole matching the inner diameter of the pipe flanges where it is installed. Ring spacers are used to allow flow in a location where a blank may be installed to block flow. The ring spacer and the associated blank should have the same take-out dimensions and both should fit in the gap installed between the associated pipe flanges. Ring spacers should be equipped with a handle that protrudes between flange bolts and is visible

when it is installed. The handle should be stamped with information about the design of the ring spacer.

- c. Spectacle blinds include a blank and a ring spacer in one unit. They look like a pair of round eye glasses with one side open to flow and one side blanked off to prevent flow. These allow a line to be drained and the spectacle blind to be flipped to allow flow or provide isolation.

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Figure 6-8 Line Blank

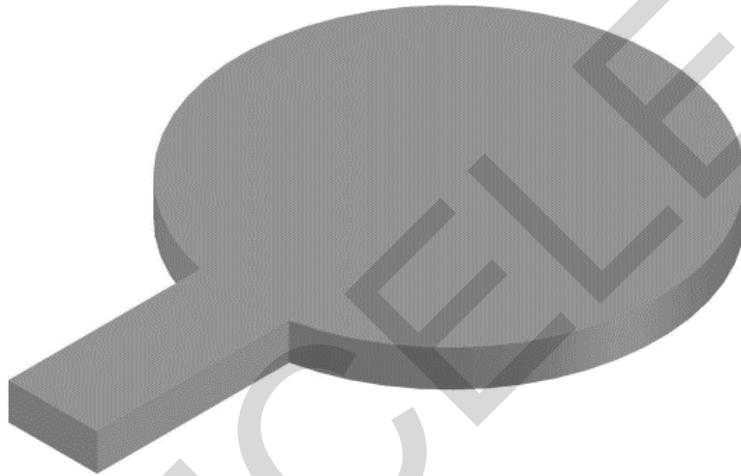


Figure 6-9 Ring Spacer

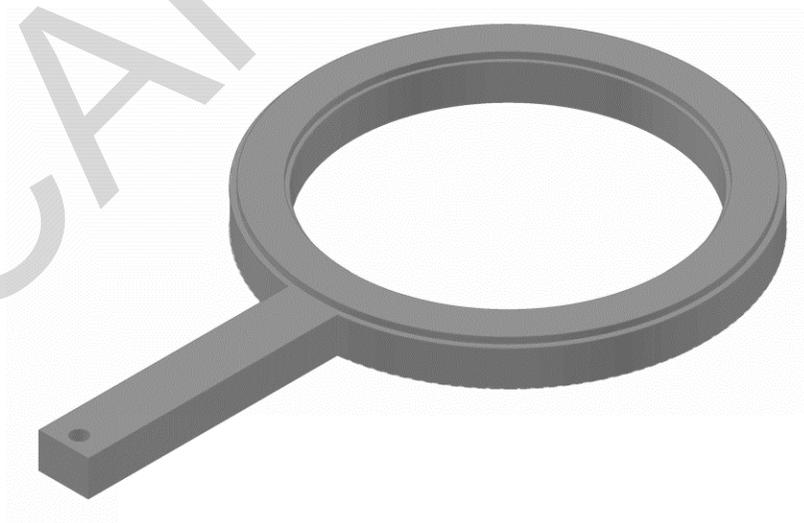
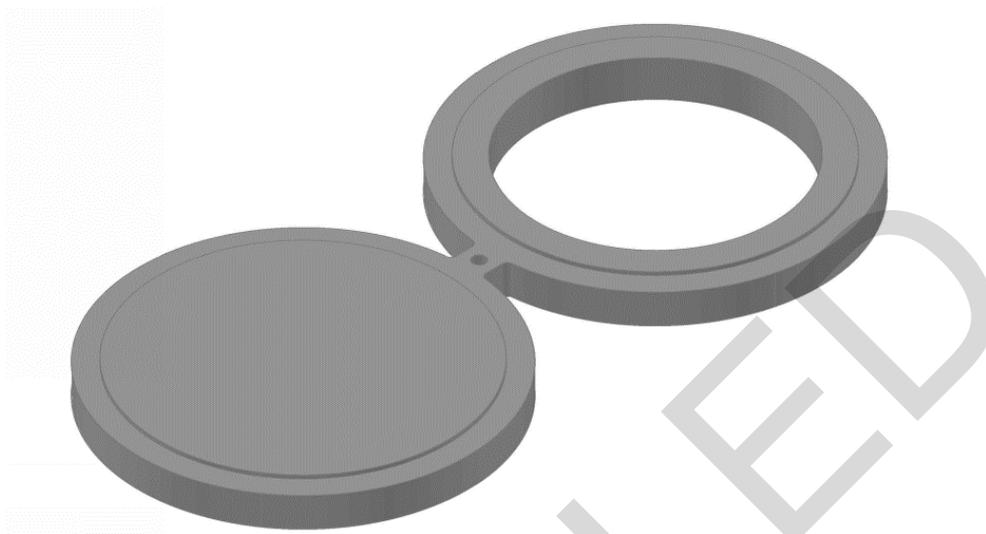


Figure 6-10 Spectacle Blind



6-6.2.9.1 Inspection and Maintenance – Line Blanks, Ring Spacers, and Spectacle Blinds.

- a. Inspect exposed side of spectacle blinds. The exposed side must be kept clean and free of corrosion.
Frequency: Quarterly
- b. Spectacle blinds should be inspected to ensure they are installed with the correct orientation for the desired flow or no-flow condition.
Frequency: Quarterly

6-6.2.10 Manual Valve Gear Operators.

Gear operators are used to open and close large valves. Gear operators can be installed on most types of large valves.

6-6.2.10.1 Inspection and Maintenance – Manual Valve Gear Operators.

- a. Lubricate gear driven operators and check for smooth operation.
Frequency: Quarterly

6-6.3 Thermal and Pressure Relief Valves.

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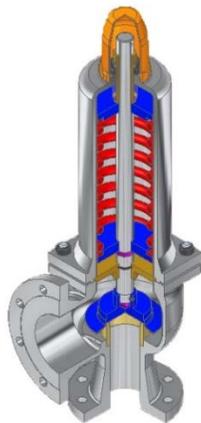
- a. Thermal and pressure relief valves are used to relieve high pressures in piping and system components. Thermal and pressure relief valves are factory set to relieve at a specified pressure and are furnished with certified test paperwork. Pressure relief valves are typically sized for an operating pressure and a flow rate. The flow rate required for a pressure

relief valve will be dependent on the system that it is used to protect and may be based on vessel size, vessel surface area, pump operating capacity, or piping flow rate. Thermal relief valves are typically only sized for operating pressure and the flow rate is not specified.

- b. Thermal relief valves are used to relieve relatively small volumes of fluid from static or blocked-off systems that may develop high pressures do to thermal heating of the petroleum fuel isolated in piping or a pressure vessel. The coefficient of expansion of liquid petroleum fuel at 60 °F (16 °C) is 0.0005 gallon per gallon per degree F (0.0009 L per L per degree C). The total volume generated in most cases is very small, but the pressure increase resulting from this expansion can equate to as much as 75 psi (515 kPa) for every degree rise in the fuel temperature if not relieved. Therefore, it is absolutely essential that all closed systems have a pressure relief bypass system (thermal release by-pass valve and or check valve). Relieved fuel should be directed to a tank vented to atmosphere.
- c. There are two primary types of thermal and pressure relief valves: conventional and balanced type. Conventional spring-loaded relief valves are affected by back pressure. For these valves an increase in downstream back pressure is applied to the seating mechanism and increases the valve opening relief pressure setting. Balanced relief valves are designed so that the downstream back pressure is not applied to the valve seating mechanism and the opening relief pressure setting is not impacted by the back pressure.
- d. Thermal and pressure relief valves must be replaced with models that match the type, size, flow rate, and function of valves they are replacing.

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Figure 6-11 Thermal and Pressure Relief Valve



6-6.3.1 Inspection and Maintenance – Thermal and Pressure Relief Valves.

- a. Thermal and pressure relief valves must be inspected for signs of leak-by. Inspect relief valves for leaks by visually inspecting downstream flow indicators (if installed) for flow. If no flow indicators are installed listen for possible leaks. If suspect: isolate and test the relief valve; check opening pressure; and verify re-seating. Malfunctioning valves must be repaired or replaced.

Frequency: Monthly

- b. Ensure manual isolation valves installed upstream and downstream of thermal and pressure relief valves are open with valve handles removed, wired open or locked.

Frequency: Monthly

- c. Inspect exterior of thermal and pressure relief valves for corrosion. Repaint as required. Information plates attached to thermal and pressure relief valves must not be painted over.

Frequency: Quarterly

- d. Verify thermal and pressure relief valve setting by consulting as-built and historical data.

Frequency: Annually

- e. Thermal and pressure relief valves must be validated for proper calibration by isolating the valve and using the test connection provided on the piping in conjunction with a hand pump and portable reservoir. The operating pressure must be checked against the set pressure listed on the stamped information plate attached to the valve. The operating pressure must be adjusted to the stamped set pressure if necessary. If there is no test connection provided, isolate the relief valve and remove the valve to test. If there is no valve isolation or test connection, consider adding these to simplify future testing. **11**

Frequency: Annually

6-6.4 Semi-Automatic Valves.

6-6.4.1 Fire Valves.

Fire valves are spring loaded to close in case of a fire to prevent fuel flow. The valves usually incorporate a fusible link that holds the valve open until it melts at 165 °F (74 °C) and allows the valve to close. Fusible link check valves are installed at some locations to close against the flow of fuel when the fusible link melts.

Fire-safe ball valves are sometimes used with a fusible link and a spring actuated closing mechanism.

6-6.4.1.1 Inspection and Maintenance – Fire Valves.

- a. Ensure the fusible link mechanism is attached properly to actuate in case of a fire and that it has not been by-passed, blocked, or damaged in any manner. Ensure the fusible link is not filled with debris or paint which could impact operation. \1\ Maintain fusible links per manufacturer's recommendation. /1/
Frequency: Quarterly
- b. Check the closing mechanism to ensure that it closes the valve properly.
Frequency: Annually

6-6.4.2 Fusible Link Butterfly Valves.

Fusible link butterfly valves must be fire rated for use on petroleum fuel systems.

6-6.4.2.1 Inspection and Maintenance - Fusible Link Butterfly Valves.

Fusible links are designed to yield under heat generated by a nearby fire. Once the fusible link breaks a spring operated actuator closes the butterfly valve.

- a. Ensure the fusible link mechanism is attached properly to actuate in case of a fire and that it has not been by-passed, blocked, or damaged in any manner. Ensure the fusible link is not filled with debris or paint which could impact operation. \1\ Maintain fusible links per manufacturer's recommendation. /1/
Frequency: Quarterly
- b. Test the operation of spring closure unit. Ensure that the spring actuator closes the valve and that the valve closes securely against the seat.
Frequency: Annually
- c. Refer to [Section 6-6.2.6 Butterfly Valves](#) for additional inspection and maintenance requirements of butterfly valves.

6-6.5 Automatic Control Valves.

Automatic valves that meet the requirements of UFGS 33 52 43.14 are found throughout fuel systems and are typically of the diaphragm actuated globe type design. Flow through the valve can be either up and over the seat or under the seat and out, depending on the configuration and function of the control valve. The diaphragm is actuated by hydraulic pressure that forces the valve disc against the seat to close the valve or to open or throttle the valve for flow control purposes. An orifice plate is installed with the valve in some instances to control flow based on pressure differential. In other cases a separate float mechanism is installed to actuate the valve, such as in high-level shutoff valves. Almost all fuel control valves are installed in a fail-safe position (i.e., if the main valve diaphragm ruptures the valve will close or open to a safe

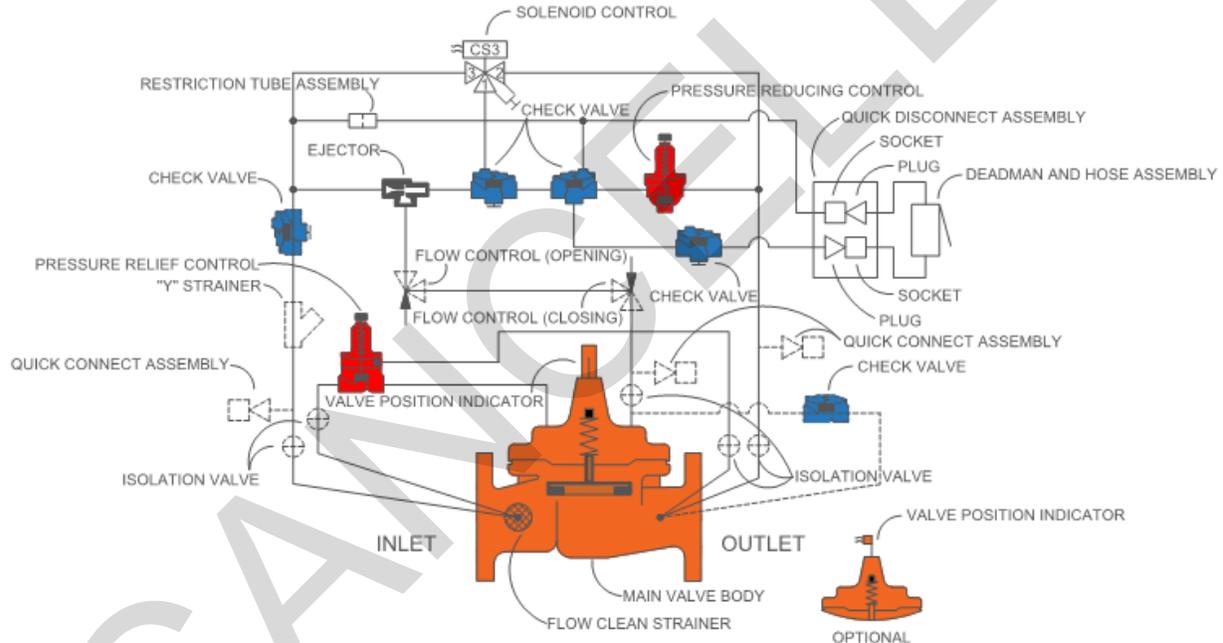
operating position). Automatic valves can be installed in either a Normally Open (NO) or Normally Closed (NC) position.

Due to the many types of diaphragm-operated automatic valves in service, it is best to consult the particular valves schematic flow diagram and related parts list to understand the parts involved and to maintain and troubleshoot the valve if service is needed.

6-6.5.1 Truck Fill Valves.

Truck fill valves (TFV) meeting the requirements of UFGS 33 52 43.14 are used for petroleum fuel truck loading. TFVs include a deadman feature that is used to start and stop flow through the valve.

Figure 6-12 Truck Fill Valve



6-6.5.1.1 Inspection and Maintenance - Truck Fill Valves.

Deadman control is used to open and close TFVs on fillstands. Deadman controls may be hydraulic or electric. If deadman control fails functional check, remove deadman control from service and repair.

- Verify TFV maintains 35 psig (240 kPa) nozzle pressure at a flow range of 50 to 600 gpm (3 to 38 lps).
Frequency: Quarterly
- Verify TFV closes rapidly when outlet pressure exceeds control set point.
Frequency: Quarterly

- c. Verify TFV opens when the deadman control lever is pressed.
Frequency: Quarterly
- d. Verify TFV closes after the deadman control lever is released.
Frequency: Quarterly
- e. If equipped, verify operation of solenoid connected to grounding verification system. Ground verification system should energize solenoid when an acceptable ground is detected by the ground verification unit.
Frequency: Quarterly
- f. Systems that have overflow protection systems must be inspected and maintained concurrently with the inspection and maintenance of TFVs.
Frequency: Quarterly
- g. Refer to [Section 4-3.2.1 General System Control Valves](#) for additional inspection and maintenance requirements.

6-6.6 Motor Operators.

Motor operators provide electrical actuation of valves for open or closed service.

6-6.6.1 Inspection and Maintenance – Motor Operators.

Refer to the motor operator manufacturer's operation and maintenance manual for particular repair instructions and additional maintenance and parts.

- a. Visually inspect motor operators to ensure smooth movement during opening and closing operation and adjust, if necessary, to ensure that they are opening and closing fully. Listen for and investigate unusual noises during operation.
Frequency: Quarterly
- b. Lubricate mechanical overrides (if equipped).
Frequency: Quarterly
- c. Refer to [Section 9-1.7 Electric Motors](#) for inspection and maintenance requirements of electric motors.

6-7 PRESSURE AND VACUUM INSTRUMENTATION.

6-7.1 Pressure and Pressure/Vacuum Gauges.

Round scale type pressure gauges are used to directly indicate line pressure. In some cases these gauges are liquid filled with a silicon based oil.

6-7.1.1 Inspection and Maintenance – Pressure and Pressure/Vacuum Gauges.

Refer to the manufacturer's operation and maintenance manual for specific calibration procedures.

- a. Check operation of gauge. Ensure gauge is indicating pressure of the system.
Frequency: Monthly
- b. Clean outside of gauge glass.
Frequency: Quarterly
- c. Inspect liquid filled gauges for leakage, refill or replace as needed.
Frequency: Semi-annually
- d. Conduct calibration check by comparing readings of the process gauge with the readings of a certified master calibration gauge which has been calibrated within the last year. The process gauge and the master calibration gauge must be connected to the same pressure source for testing. Verify accuracy of gauge is within $\pm 2\%$ of full scale. Calibrate gauge if required.
Frequency: Annually

6-7.2 Differential Pressure Gauges.

Differential pressure gauges are used to measure the difference in pressure between two sensing points.

6-7.2.1 Inspection and Maintenance - Differential Pressure Gauges.

Refer to the manufacturer's operation and maintenance manual for specific calibration procedures.

- a. Verify proper operation of differential gauge in accordance with gauge manufacturer's procedures.
Frequency: Monthly
- b. Clean outside of gauge glass.
Frequency: Quarterly
- c. Conduct calibration check by comparing readings of the differential process gauge with the readings of a certified differential master calibration gauge which has been calibrated within the last year. The differential process gauge and the differential master calibration gauge must be connected to the same pressure source for testing. Verify accuracy of gauge is within $\pm 2\%$ of full scale. Calibrate if required.
Frequency: Annually

- d. Some differential pressure gauges have a small gauge protection filter located at the high pressure inlet of the gauge that must be checked and replaced as needed. Filters need to be replaced if the indicator is moving slow or sluggishly inside the sight glass or if the sight glass is dirty. Refer to manufacturer's operation and maintenance manual for filter replacement procedures.
Frequency: Annually for inspections and maximum 5 years of service between filter replacements.

6-7.3 Pressure Transmitters.

Pressure transmitters are used to measure pressure at sensing points. These units transmit a 4 to 20 mA (common in US installations) or 0 to 20 mA (common in European installations) electrical signal to a display or a PLC to indicate pressure.

6-7.3.1 Inspection and Maintenance - Pressure Transmitters.

- a. Inspect the exterior of the transmitter enclosure for accumulated oil, dust, and dirt. Clean if required.
Frequency: Quarterly
- b. Check that both enclosure caps are fully threaded onto the enclosure, compressing the O-ring between the cap and the enclosure. The O-ring must not be cracked, broken, or otherwise damaged.
Frequency: Quarterly
- c. Inspect the display viewing glass for cleanliness and damage. Replace the enclosure cap assembly if the glass is damaged or missing. No accumulation of dust, dirt, or water (condensate) should be present inside the enclosure.
Frequency: Quarterly
- d. Inspect transmitter and mounting bracket hardware for tightness. Tighten loose hardware as necessary.
Frequency: Quarterly
- e. Inspect for loose, bent, or cracked sensing lines. Replace damaged sensing lines.
Frequency: Quarterly
- f. Check operation of transmitter. Ensure transmitter is indicating accurate pressure of the system.
Frequency: Quarterly
- g. Bleed sensing lines between the transmitter and the main line to ensure they are clean and free of suspended solids and air.
Frequency: Semi-annually

- h. Check that all wire connections inside enclosure are tight.
Frequency: Annually
- i. Pressure transmitters (PTs) and pressure indicating transmitters (PITs) must be calibrated mechanically and electrically with test equipment and adjusted if applicable. The presence of air in the sensing line of a pressure transmitter is a common cause for failure. Conduct calibration check by comparing readings of the PT or PIT with the readings of a certified master calibration gauge which has been calibrated within the last year. The PT or PIT and the master calibration gauge must be connected to the same pressure source for testing. Verify accuracy of PT or PIT gauge is within $\pm 2\%$ of full scale. Calibrate in accordance with manufacturer's operation and maintenance manual if required.
Frequency: Annually

6-7.4 Differential Pressure Transmitters.

Differential pressure transmitters (DPT) are used to measure the difference in pressure between two sensing points. These units transmit a 4 to 20 mA (common in US installations) or 0 to 20mA (common in European installations) electrical signal to a display or a PLC to indicate differential pressure. These same signals can also be used to determine flow rate measurements using a function that correlates pressure differential to flow.

6-7.4.1 Inspection and Maintenance - Differential Pressure Transmitters.

- a. Inspect the exterior of the transmitter enclosure for accumulated oil, dust, and dirt. Clean as required.
Frequency: Quarterly
- b. Check that both enclosure caps are fully threaded onto the enclosure, compressing the O-ring between the cap and the enclosure. The O-ring must not be cracked, broken, or otherwise damaged.
Frequency: Quarterly
- c. Inspect the display viewing glass for cleanliness and damage. Replace the enclosure cap assembly if the glass is damaged or missing. No accumulation of dust, dirt, or water (condensate) should be present inside the enclosure.
Frequency: Quarterly
- d. Inspect transmitter and mounting bracket hardware for tightness. Tighten loose hardware as necessary.
Frequency: Quarterly
- e. Inspect for loose, bent, or cracked sensing lines. Replace damaged sensing lines.
Frequency: Quarterly

- f. Check operation of transmitter. Ensure transmitter is indicating accurate differential pressure measurement.
Frequency: Quarterly
- g. Bleed sensing lines between the transmitter and the main line to ensure they are clean and free of suspended solids and air.
Frequency: Semi-annually
- h. Check that all wire connections inside enclosure are tight.
Frequency: Annually
- i. DPTs must be calibrated mechanically and electrically with test equipment and adjusted, if applicable. The presence of air in sensing lines of differential pressure transmitters is a common cause for failure. Conduct calibration check by comparing readings of the DPT with the readings of a certified differential master calibration gauge which has been calibrated within the last year. The DPT and the differential master calibration gauge must be connected to the same pressure source for testing. Verify accuracy of DPT is within $\pm 2\%$ of full scale. Calibrate in accordance with manufacturer's operation and maintenance manual if required.
Frequency: Annually

6-8 FLEXIBLE BALL JOINTS.

6-8.1 Flexible Ball Joints.

Flexible ball joints are used to provide flexibility in connections between petroleum fuel tanks and pipelines. These joints may also be used in other areas where flexibility is required.

Figure 6-13 Flexible Ball Joint



6-8.1.2 Inspection and Maintenance – Flexible Ball Joints.

Flexible ball joints can be a source of leaks, especially if the piping is subject to stress when it mates to a tank or coupling adapter. A program of periodic lubrication and

inspection will ensure longer joint life, since a fully lubricated joint will not allow dirt to enter. However, if seals leak despite lubrication and seal replacement, the entire joint must be replaced.

- a. Lubricate ball joints and inspect for wear and stress.
Frequency: Monthly

6-9 THERMOMETERS.

Thermometers are used to measure temperature at the sensing point.

6-9.1 Dial Thermometers.

Dial thermometers indicate the temperature on the face of a dial.

6-9.1.1 Inspection and Maintenance – Dial Thermometers.

Thermometers are typically bi-metallic or volatile fluid based, and must be periodically inspected.

- a. Inspect thermometer for cracked face and proper operational condition. Replace if damaged.
Frequency: Quarterly
- b. Check accuracy of thermometer against calibrated master thermometer. Ensure process and calibrated master thermometers are reading the same heat source. Verify accuracy of thermometer is within $\pm 2\%$ of full scale. Calibrate process thermometer if required.
Frequency: Annually

6-10 PIPE AND EQUIPMENT COATINGS.

This section includes information related to periodic inspection of external coating systems that are typically applied to DoD piping systems.

6-10.1 Aboveground Piping and Equipment Coatings.

A three coat system (primer, intermediate, and top coat) is the primary protective coating system for aboveground piping. The primer and intermediate coats should be a two component epoxy-polyamide system and the topcoat should be a UV resistant polyurethane. Refer to UFGS 33 52 43.13 or UFGS 09 97 13.27 for current aboveground exterior pipe coating system requirements. Do not paint stainless steel, aluminum or galvanized surfaces.

6-10.1.1 Inspection and Maintenance – Aboveground Piping and Equipment Coatings.

Coating repairs of aboveground piping, piping in pits, equipment, pipe supports, filter separators, and miscellaneous metal should match color of finish and reflectivity of existing, consistent with the Installation's Architectural Standards.

Maintenance personnel must determine existing external coating type prior to repairs to ensure proper adhesion. It is recommended to protect surrounding areas of repair by squaring off with masking tape. Ensure the area to be repaired is clean and dry. All surface corrosion or damage coating must be removed per coating manufacturer's requirements. In addition, abrade immediate area surrounding repair to feathered edge to allow proper adhesion of repair coating layers. Remove all dust particles by brush or vacuum and clean surface with appropriate solvents to prepare area for coating system. Apply coating system in accordance with manufacturer's instructions. The protective coatings section of UFGS 09 97 13.27 includes coating information and application instructions that should be followed.

- a. Visually inspect coatings for signs of deterioration, corrosion or damage. Repair damaged or deteriorated coatings.
Frequency: Quarterly

6-10.2 Underground Piping Coating Repairs.

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- a. Three coating types have recently been used for underground piping: 2-layer extruded polyolefin coating over soft adhesive per AWWA C215, fusion-bonded epoxy coatings per AWWA C213, and Federal Specification L-C-530C. Refer to UFGS 33 52 80 or UFGS 33 52 43.13 for current underground exterior coating requirements.
- b. Maintenance personnel must determine existing coating type prior to repairs to ensure proper adhesion and longevity of repairs. Polyolefin (AWWAC215), fusion-bonded epoxy (AWWA C213), and Federal Specification L-C-530C are common, but other types of coatings may be encountered. Some older pipes may be coated with a coal tar asbestos wrap. Ensure the coating is identified and that proper procedures are used to handle the hazard level associated with the identified coating. Contact the military service-specific SME with questions regarding coating types and appropriate repair methods.
- c. In all cases, surfaces must be clean, dry, grease-free, dust-free, free of rust and damaged coatings and prepared in accordance with repair method chosen and the manufacturer's published procedures. UFGS 33 52 80 includes additional coating information and application instructions that should be followed.

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6-10.2.1 Two-Layer Extruded Polyolefin Coating Repairs.

The following repair methods must be used for two-layer extruded polyolefin coating:

- Coal Tar Enamel per AWWA C203, Type II enamel, Type III outer wrap.
- Coal Tar Tape per AWWA C203.
- Cold Applied Tape per AWWA C209.
- Petroleum or Petroleum Wax Tape Coating per AWWA C217.
- Heat Shrink Sleeve per AWWA C216.

The military service-specific SME must determine the best repair method for the type of repair required. Weld beads must be covered with one wrap of tape prior to spiral wrapping. Fittings must be wrapped spirally beginning with one complete wrap three inches back from each edge of the coating. For pipe less than 4-inches (100 mm) in diameter, one layer half-lapped must be used. For pipe 4-inches (100 mm) and larger in diameter, two layers half-lapped must be used with the second layer wrapped opposite hand of the first.

6-10.2.2 Fusion-Bonded Epoxy Repairs.

Fusion-bonded epoxy must be repaired with a fusion-bonded epoxy coating per NACE Recommended Practice (RP) 0402 to match existing coating or Liquid-Epoxy Coating System per AWWA C210.

Maintenance personnel must coordinate with military service-specific SME to determine best repair method for the type of repair required.

6-10.2.3 Federal Specification L-C-530C Coating Repairs.

Coatings that meet the requirements of Federal Specification L-C-530C have been used on underground fuel piping. The coating is no longer covered by a UFGS specification but it has continued to be used on a case by case basis. Repair of these coatings must be in accordance with manufacturer's instructions.

6-10.3 Internal Carbon Steel Pipe Coatings.

Epoxy coatings systems meeting the requirements of MIL-PRF-4556 (two component epoxy system) or AWWA C213 (fusion bonded epoxy system) are sometimes used on the interior of carbon steel piping used for the transport of petroleum fuels. These coatings are applied to the piping at the factory and are not typically repaired in the field. The inside edges of each pipe segment is left uncoated 1 to 1.5-inches (25 to 40 mm) from each end to prevent coating damage during welding operations. The inside areas of the welds are left uncoated after welding is complete.

6-11 UNDERGROUND FUEL PITS.

Fuel pits such as low point drain pits, high point vent pits, lateral control valve pits, isolation valve pits, and hydrant pits are included in many fueling systems.

6-11.1 Isolation Valve Pits.

Isolation valve pits are buried fiberglass or concrete pits with a rolling or hinged cover designed in accordance with the DoD Standard Design AW 78-24-28 for isolation valves installed in non-traffic areas on underground petroleum fuel piping systems. Valve pits and valve operators are typically designed so that valves can be operated by personnel without confined space entry.

6-11.1.1 Inspection and Maintenance – Isolation Valve Pits.

- a. Isolation valve pits should be inspected to ensure that the pits are dry and clean and that all components within the pit are clean and in good working order. Maintain seals and boot seals as appropriate. Obtain necessary confined space entry permits before entry. Inspect the pit for signs of fuel or water. Water or fuel should be removed from the pit as soon as possible and the source of water infiltration or fuel leak determined.
Frequency: Monthly, or more often based on local conditions.
- b. Check for cracks in concrete and check piping penetrations through pit wall or bottom to ensure that mechanical seals and boot seals are in good working condition and are allowing no seepage of water into the pits. Make note of cracks in concrete and schedule maintenance as necessary. Check for fuel leaks at all flanged and other piping connections. Check for rusted or deteriorated ladders or grating platforms that might make entry unsafe. Check pit lids for proper sealing. Check rolling pit covers for ease of operation and signs of deterioration, damage or corrosion. Make sure required locks are in place and locking mechanisms are not broken.
Frequency: Monthly, or more often based on local conditions.

6-11.2 Hydrant Fuel Pits.

Hydrant fuel pits are located close to the aircraft parking positions. Hydrant fuel pits contain fuel block valves, pressure gauges, and hydrant control valves. The pits are equipped with counter-weighted lids. A sump out connection is provided to sump collected water or fuel from the pit. Grating installed in the pit provides access to valves and is removable to allow close inspecting of pit pipe penetration seals and general maintenance.

6-11.2.1 Inspection and Maintenance – Hydrant Fuel Pits.

- a. Hydrant fuel pits must be inspected to ensure that they are dry and clean and that all fueling components within the pit are clean and in good

working order. Obtain necessary confined space entry permits before entry. Inspect the pit for fuel or water. Fuel or water found in the pit must be sumped out as soon as possible.

Frequency: Monthly, or more often based on local conditions.

- b. Check pipe penetrations through pit walls or bottom to ensure that mechanical and boot seals are in good working condition and are allowing no water seepage into the pits.
Frequency: Monthly
- c. Check for fuel leaks at all flanged and other piping connections.
Frequency: Monthly Check pipe penetrations through pit walls or bottom to ensure that mechanical and boot seals are in good working condition and are allowing no water seepage into the pits.
Frequency: Monthly
- d. Check pit lids to ensure that seals are in good working order and are preventing water entry into the pits.
Frequency: Monthly, or more often based on local conditions.
- e. Inspect hydrant fuel pit bonding cables for corrosion and ensure electrical continuity between bonded equipment.
Frequency: Monthly

6-11.3 High Point Vent Pits.

High point vent pits are located throughout fueling systems. High point vents are used to vent air from fuel lines during start-up and operation.

6-11.3.1 Inspection and Maintenance – High Point Vent Pits.

- a. Inspect high point vent pits to ensure they are dry and free of water and other debris and that pit and piping components are leak free and in good working condition. Inspect the pit for fuel or water. Fuel or water found in the pit must be sumped out as soon as possible
Frequency: Monthly
- b. Check pipe penetrations through pit walls or bottom to ensure that mechanical and boot seals are in good working condition and are allowing no water seepage into the pits.
Frequency: Monthly
- c. Check pit lid seals for deterioration and replace as necessary.
Frequency: Monthly
- d. Ensure that high point vent valves, quick-disconnect couplings or pit lids are lockable and that locking mechanisms are in good working order.
Frequency: Monthly

- e. Inspect high point vent pit bonding cables for corrosion and ensure electrical continuity between bonded equipment.
Frequency: Monthly

6-11.4 Low Point Drain Pits.

Low point drain pits are located throughout fueling systems. Low point drains are used to sump fuel piping where water in the fuel may settle and for draining the pipeline.

6-11.4.1 Inspection and Maintenance – Low Point Drain Pits.

- a. Inspect low point drain pits to ensure they are dry and free of water and other debris and that all pit and piping components are leak free and in good working condition. Inspect the pit for fuel or water. Fuel or water found in the pit must be sumped out as soon as possible.
Frequency: Monthly
- b. Check pipe penetrations through pit wall or bottom to ensure that mechanical seals and boot seals are in good working condition and are allowing no water seepage into the pits.
Frequency: Monthly
- c. Check pit lid seals for deterioration and replace as necessary.
Frequency: Monthly
- d. Ensure that low point vent valves, quick-disconnect couplings or pit lids are lockable and that locking mechanisms are in good working order.
Frequency: Monthly
- e. Inspect low point drain pit bonding cables for corrosion and ensure electrical continuity between bonded equipment.
Frequency: Monthly

6-11.5 Lateral Control Pits.

Lateral control pits are buried fiberglass or concrete pits with rolling or hinged covers. Valve operators installed in lateral control pits are typically designed so that the valves can be operated by personnel without confined space entry. Lateral control pits may include isolation valves and hydrant system automatic control valves.

6-11.5.1 Inspection and Maintenance – Lateral Control Pits.

- a. Inspect lateral control pits to ensure they are dry and free of water and other debris and that all pit and piping components are leak free and in good working condition. Inspect the pit for fuel or water. Fuel or water found in the pit must be sumped out as soon as possible.
Frequency: Monthly

- b. Check pipe penetrations through pit wall or bottom to ensure that mechanical seals and boot seals are in good working condition and are allowing no water seepage into the pit.
Frequency: Monthly
- c. Check pit lid seals for deterioration and replace as necessary.
Frequency: Monthly
- d. Check for fuel leaks at all flanged and other piping connections.
Frequency: Monthly
- e. Ensure that pit lids are lockable and that locking mechanisms are in good working order.
Frequency: Monthly
- f. Inspect lateral control pit bonding cables for corrosion and ensure electrical continuity between bonded equipment.
Frequency: Monthly

6-12 MINOR PIPING SYSTEMS.

6-12.1 Low Point Drains.

Water and other fuel contaminants that are not removed by filtration tend to end up at low points in a fuel system. Low point drains are provided at low points in a fuel system to allow water and contaminants to be removed.

6-12.1.1 Inspection and Maintenance – Low Point Drains.

- a. Visually inspect low point drains. Ensure that quick-disconnect dust caps are in place and that valves are locked closed.
Frequency: Weekly
- b. Operate low point drains when system is not under operating pressure. If there is an absence of sufficient line pressure close the low point drain and pressurize the system. Once adequate pressure is available, continue draining until the piping fuel sample is clear and bright with no visible water.
Frequency: Monthly or as required by local conditions. Verify low point drains are closed after maintenance.

6-12.2 High Point Vents.

High point vents are provided in fuel systems to provide a means of venting trapped air.

6-12.2.1 Inspection and Maintenance – High Point Vents.

- a. Inspect high point vents. If fuel leaks are observed they should be repaired as soon as possible. Ensure that quick-disconnect dust caps are

in place and that high point vent valves are locked.

Frequency: Weekly

6-12.3 Sight Flow Indicators.

Sight flow indicators are used to visually confirm that fuel is flowing through a system. These devices use a wheel installed in the fluid stream behind a transparent glass or plastic film. Flow is indicated when the wheel turns.

6-12.3.1 Inspection and Maintenance - Sight Flow Indicators.

- a. Verify there are no leaks around pipe connection fittings and glass seals. Also check glass for indications of cracks.

Frequency: Daily or at each use

6-13 ELECTRONIC RELEASE DETECTION MONITORING.

6-13.1 General Inspection of Release Detection Systems.

Piping release detection systems are designed to quickly detect fuel leaks from concealed and underground portions of fueling systems. A licensed and/or certified technician is required to troubleshoot or inspect leak/release sensors for operation. If an issue is suspected, appropriate military service-specific SCP or Installation Environmental Office personnel should be contacted for support. Refer to SPCC plan for further direction on who to contact.

host nation, state, and local agencies may have additional design, inspection, and maintenance requirements that may be more stringent than DoD or Federal guidance. Facility operators and maintainers must be familiar with the site's SPCC plan in order to comply with all inspection and recordkeeping requirements

6-13.1.1 Rope Sensor Systems.

Rope sensors are installed along the length of underground piping, either within the interstice of double-wall piping (common) or direct buried (uncommon). Rope sensors can be installed in service pits and sumps as well. This system uses a discrete sensor built along the length of a rope. Rope sensors send a signal to a monitoring panel indicating the location of the detected liquid within a few feet. Rope sensors are sensitive to the presence of any petroleum based product and care should be taken when handling the rope sensor. A licensed and/or certified technician is required to troubleshoot or inspect rope sensors for operation.

6-13.1.1.1 Inspection and Maintenance - Rope Detector Systems.

- a. Ensure the monitoring panel associated with the rope sensor(s) is powered on and no alarms are present.

Frequency: Daily

- b. Test rope sensor system and ensure it is functional.
Frequency: Annually

6-13.1.2 Point Sensor – Dry.

Dry point sensors are installed at the lowest point within the space between the fueling system and secondary barrier. Dry point sensors send a signal to a monitoring panel indicating liquid detection. Dry point sensors may include float switches, or electrical resistor switches. A licensed and/or certified technician is required to troubleshoot or inspect dry point sensors for correct operation.

In double-wall piping systems these sensors are placed in the low points of the piping and continuously monitor for the presence of fuel in the annulus of the double-wall pipe.

6-13.1.2.1 Inspection and Maintenance - Point Sensor – Dry.

- a. Ensure the monitoring panel associated with the point sensor(s) is powered on and no alarms are present.
Frequency: Daily
- b. Ensure monitoring space is clear and free of debris and liquid.
Frequency: Monthly
- c. Test sensor and ensure it is functional.
Frequency: Annually

6-14 VISUAL RELEASE DETECTION MONITORING.

6-14.1 Visual Monitoring.

Release detection method utilizing inspection ports to visually inspect for the presence of liquids.

6-14.1.1 Inspection and Maintenance – Visual Monitoring.

- a. Visually inspect ports for signs of leaks. Remove debris or foreign objects obstructing the view.
Frequency: Weekly

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CHAPTER 7 GROUND VEHICLE FUEL FACILITIES

7-1 GENERAL.

This chapter contains inspection and maintenance information associated with ground vehicle fuel systems.

7-2 DISPENSER NOZZLES.

Dispenser nozzles that meet requirements of 11UFGS 33 57 55/1/are designed to automatically close when the dispenser nozzle handle is released. When the dispenser nozzle vacuum sensing port is blocked by petroleum fuel it will cause the internal poppet valve to close. This feature helps prevent overfilling vehicle tanks. Dispenser nozzles can also be equipped with automatic nozzle shut-off clips to allow the operator to latch dispenser nozzles open during fuel dispensing. When the dispenser nozzle senses fuel at the vacuum sensing port, the shut-off clip disengages and the nozzle closes. Do not remove automatic shut-off clips on ground vehicle fuel dispenser nozzles. Dispenser nozzles should have splash guards in case of overflow.

Figure 7-1 Dispenser Nozzle



7-2.1 Inspection and Maintenance – Dispenser Nozzles.

- a. Inspect dispenser nozzle spout. Ensure it is tight, round, has no cracks, or excessive wear. Inspect automatic shutoff hole. Ensure the hole is open and free of obstructions. Inspect nozzle hold-open latch. Ensure the latch is straight, moves freely, and the return spring operates correctly. Inspect body of nozzle. Ensure the body is in good condition and that the valve stem is clean and free of fuel. Inspect the nozzle to hose connection and ensure it is clean and free of fuel.

Frequency: Daily

- b. 11/1/

- c. Test automatic shutoff feature and ensure it is operating properly. Test automatic shutoff at all nozzle hold-open latch positions.
Frequency: Annually

7-3 DISPENSER HOSES.

Dispenser hoses that meet requirements of 11\UFGS 33 57 55/1/are designed to transfer petroleum fuel from dispensers to motor vehicle fuel tanks. Hoses must be reinforced with metallic mesh that prevents kinks and collapse. Reinforcement mesh also provides a conductive path to direct static charges to ground. The outer surface of hoses must be resistant to abrasion, cuts, and degradation from the surrounding environment. No more than 6 feet (1.8 meters) of the dispenser hose may touch the ground. Hose retractors may be installed to elevate long dispenser hoses. Dispenser hoses with a working pressure under 20 psi (138 kPa) do not require annual pressure testing.

Dispenser systems equipped for Stage II vapor recovery require coaxial hoses which are used to provide a path for reclaimed fuel vapors to return to the petroleum fuel storage tank.

7-3.1 Inspection and Maintenance – Dispenser Hoses.

- a. Inspect dispenser hoses and hose whips for gouges, cuts, blisters, or outside wear that may lead to rupture during use. Replace hose or hose whips that show signs of wear. Inspect connection points of hoses and hose whips to the dispenser, breakaways, swivels, and the nozzle and ensure the connection points are clean and free of fuel.
Frequency: Daily

7-4 BREAKAWAYS.

Fuel hose breakaways that meet requirements 11\UFGS 33 57 55/1/are used to connect dispenser hoses to dispensing units. Breakaways are designed to disconnect hoses from dispensers if hoses are subjected to strong tensile stresses such as strong pulling forces. Breakaways are double bonnet systems designed to close off fuel flow.

7-4.1 Inspection and Maintenance – Breakaways.

- a. Inspect breakaways for loose connections and signs of damage to poppets. Ensure breakaways are clean and free of fuel.
Frequency: Daily
- b. Inspect breakaway for an expiration date established by the manufacturer. Breakaways must be replaced before the indicated expiration date.
Frequency: Monthly

7-5 SWIVELS.

Fuel hose swivels are installed between dispenser nozzles and hoses. They provide flexibility and reduce strain on hoses by allowing nozzles to rotate around the swivel. They also make it easier for operators to handle hoses during fuel dispensing.

7-5.1 Inspection and Maintenance – Swivels.

- a. Inspect swivel for loose connections and signs of damage. Ensure swivel rotates easily and is clean and free of fuel.
Frequency: Daily
- b. Inspect swivel for expiration date established by manufacturer. Swivels must be replaced before the indicated expiration date.
Frequency: Monthly

7-6 HOSE RETRIEVER.

Hose retrievers support the hose and limit contact of the hose with the ground.

7-6.1 Inspection and Maintenance – Hose Retriever

- a. Test hose retriever and ensure it is operating correctly and supporting the hose.
Frequency: Monthly

7-7 DISPENSER CABINET.

Dispenser cabinets enclose the inner components of fuel dispensers. The cabinets protect the inner components from the elements and protect the connection points of the underground supply piping.

7-7.1 Inspection and Maintenance – Dispenser Cabinet.

- a. Inspect outside of cabinet and ensure it is free of damage. Inspect for fuel stains on the concrete island around the cabinet and on the outside of the cabinet. Ensure the cabinet is free of dirt and fuel.
Frequency: Monthly
- b. Open both sides of the cabinet and inspect the inside of the cabinet. Ensure the inside of the cabinet and all of the components inside the cabinet are clean and free of fuel.
Frequency: Monthly
- c. Ensure door panels and locks operate easily. Inspect anchor bolts of cabinet to dispenser island and ensure the bolts are in good condition.
Frequency: Annually

7-8 DISPENSER METERS.

Dispenser meters allow operators to monitor the amount of fuel dispensed into a given vehicle fuel tank. Intelligent dispenser meters can reconcile all fuel dispensed against the operating storage tank level readings to verify usage. Meters are able to constantly recalibrate due to changes in temperature that affect the volumetric flow rate.

7-8.1 Inspection and Maintenance – Dispenser Meters.

- a. Inspect meter and ensure meter is clean and free of fuel. Ensure calibration mechanism is sealed.
Frequency: Monthly
- b. Since moving parts inside meters are subject to wear, periodic calibration is necessary. Meters must be recalibrated utilizing a certified 5 gallon (20 liter) prover can or other approved method. Meters are considered satisfactory for further operation when the error does not exceed $\pm 0.2\%$ of actual quantity delivered.
Frequency: Annually

7-9 DISPENSER FILTERS.

Dispenser filters that meet requirements of 11UFGS 33 57 55/1/are used to collect particulates in fuel systems. 11 Depending on the fuel type different filter strategies may be recommended. Refer to UFC 3-460-01 for filter strategies for each fuel type. /1/

7-9.1 Inspection and Maintenance – Dispenser Filters.

- a. Inspect filter and ensure filter is clean and free of fuel and that filter is labeled with a legible installation date.
Frequency: Monthly
- b. Replace dispenser filters annually or when a change in flow rate is noted.
Frequency: Annually or as needed

7-10 DISPENSER STRAINERS.

Dispenser strainers are designed to capture particulates and protect dispenser pumps and meters in self-contained units or meters in remote units.

7-10.1 Inspection and Maintenance – Dispenser Strainers

- a. Inspect and clean strainers. Inspect strainer cover gasket for cracks, distortion, and dry rot. If breaks are detected in strainer mesh, replace the strainer.
Frequency: Annually

7-11 GROUND VEHICLE FUEL PIPING.

Underground lines for ground vehicle petroleum fuel products must be constructed in accordance with UFC 3-460-01 and 40 CFR Part 280.

In addition to 40 CFR Part 280, host nation, state, and local regulations may have additional design, inspection, and maintenance requirements that may be more stringent than DoD or Federal guidance. Facility operators and maintainers must be familiar with the site's SPCC plan in order to comply with all inspection and recordkeeping requirements.

7-11.1 Inspection and Maintenance – Ground Vehicle Fuel Piping.

- a. Visually inspect aboveground lines for leaks. Shut down systems that are found with leaks and repair.
Frequency: Daily
- b. Visually inspect leak detection systems installed on underground piping. Inspections include line leak detectors and leak detection sensors installed in transition sumps and dispenser sumps. Perform leak testing on pressurized underground piping with installed leak detection equipment and record results.
Frequency: Monthly
- c. Test leak detection systems installed on underground piping used for ground vehicle petroleum fuel products. Underground leak detection systems include discrete detection sensors installed in transition and dispenser sumps, and line leak detectors installed at the outlet of pumps used to supply pressurized liquid petroleum fuel to underground lines. Repair faulty components. Execution of this work may require state certification or license.
Frequency: Annually
- d. Conduct service station aboveground piping annual test as outlined in Appendix G – Petroleum Fuel Pipeline Pressure Testing Guidelines and Criteria. Execution of this work may require state certification or license.
Frequency: Annually
- e. Conduct service station underground piping annual test outlined in Appendix G – Petroleum Fuel Pipeline Pressure Testing Guidelines and Criteria. Execution of this work may require state certification or license.
Frequency: Annually
- f. Refer to [Section 2.7 Signage and Markings](#) for inspection and maintenance requirements of ground vehicle petroleum fuel pipe markings.

- g. Refer to [Section 6-10.1 Aboveground Piping and Equipment Coatings](#) for inspection and maintenance requirements of ground vehicle petroleum fuel pipe coatings.

7-12 EMERGENCY SHUTOFF VALVES (SHEAR VALVES).

Emergency shutoff valves that meet the requirements of ~~11~~ UFGS 33 57 55 ~~11~~ are located at the base of ground vehicle fuel dispensers and are designed to close if the dispenser is struck or exposed to a fire. Emergency shutoff valves are securely mounted to stabilizer bars installed in the containment sumps mounted under dispensers. The valve is designed to break at a weak point in the body of the valve if the dispenser is struck and dislodged. The valve is also designed to close if the valve is subjected to shock of an impact to the dispenser. In addition, the valve is equipped with a fusible link that will melt in the event of a fire and cause the valve to close.

Figure 7-2 Emergency Shutoff Valve



7-12.1 Inspection and Maintenance – Emergency Shutoff Valves (Shear Valves).

- a. Inspect stabilizer bar to ensure that it is securely mounted below the base of the dispenser. Inspect the mounting bolts that secure the emergency shutoff valve to the stabilizer bar.
Frequency: Monthly
- b. Inspect fusible link and ensure it is not obstructed. Ensure valve body is clean and free of fuel.
Frequency: Monthly
- c. Inspect mechanical links of the valve for correct operation. Conduct test of valve to ensure it operates correctly. Execution of this work may require state certification or license.
Frequency: Annually

7-13 DISPENSER SUMPS.

Dispenser sumps are used to protect and provide access to valves and fuel pipe installed below dispensers.

7-13.1 Inspection and Maintenance – Dispenser Sumps.

- a. Inspect for signs of water, fuel, trash, and debris inside sumps. Remove and properly dispose of collected water, fuel, trash, and debris. Visually inspect penetration fittings. If fuel or water is detected investigate the source and repair.
Frequency: Monthly, or more often based on local conditions.
- b. Inspect sump pipe transition fittings for tears, cracks, or other signs of deterioration. Check hose clamp seals to ensure they are securely tightened.
Frequency: Quarterly
- c. Test dispenser sumps and ensure they are liquid tight by using vacuum, pressure, or liquid testing in accordance with 40 CFR 280, Section 43.
Frequency: Every three years

7-14 TRANSITION SUMPS.

Transition sumps are used to protect piping as it transitions from aboveground to below ground. In many cases the piping will change configuration as it transitions from aboveground pipe to underground pipe.

7-14.1 Inspection and Maintenance – Transition Sumps.

- a. Inspect for signs of water, fuel, trash, and debris inside sumps. Remove and properly dispose of collected water, fuel, trash, and debris. Visually inspect penetration fittings. If fuel or water is detected investigate the source and repair.
Frequency: Monthly, or more often based on local conditions.
- b. Inspect sump pipe transition fittings for tears, cracks, or other signs of deterioration. Check hose clamp seals to ensure they are securely tightened.
Frequency: Quarterly
- c. Test sumps and ensure they are liquid tight by using vacuum, pressure, or liquid testing in accordance with 40 CFR 280, Section 43.
Frequency: Every three years

7-15 DISPENSER PUMPS.

Dispenser pumps are either installed as an integral unit to the fuel dispenser or as a remote pump. Integral pumps are typically sliding vane pumps installed in the base of

the dispenser unit. Remote pumps are typically submerged turbine pumps mounted on petroleum fuel storage tanks.

7-15.1 Remote Dispenser Pumps.

Fuel dispensers in remote pump systems do not house pumps. Remote dispenser pumps are typically tank mounted submerged turbine pumps. The manufacturer's instructions for installation, operation, and maintenance will further describe pumping unit and parts requiring periodic inspection and maintenance.

7-15.1.1 Inspection and Maintenance – Remote Dispenser Pumps.

- a. Refer to [Section 7-19.1.2 Automatic Line Leak Detector](#) for maintenance and inspection requirements of automatic line leak detectors installed on submersible turbine pumps.
- b. Refer to Section [3-8.1.3 Vertical Turbine/Submerged Turbine Pumps](#) for inspection and maintenance requirements of remote dispenser pumps.

7-15.2 Self-Contained Dispenser Pumps.

Self-contained dispenser pumps are typically belt-driven, sliding vane type positive displacement pumps mounted within the dispenser housing. The pumps draw fuel to the dispenser by creating suction on the fuel line attached to the petroleum fuel storage tank.

7-15.2.1 Inspection and Maintenance – Self-Contained Dispenser Pumps.

- a. Inspect self-contained dispenser pump v-belt drives for proper tension and excess wear. Replace belt as recommended by manufacturer.
Frequency: Monthly
- b. Inspect pump body. Ensure pump body is clean and free of fuel. Inspect air eliminator. Ensure air eliminator is clean and free of fuel and that the vent tube is not obstructed.
Frequency: Monthly

7-16 EFSO SYSTEMS.

Emergency Fuel Shut-Off (EFSO) systems disable power to dispensers at service stations. Typically military service stations are unattended and require keys or cards to operate the dispensers. EFSO buttons to deactivate the dispensers are typically installed in close proximity to dispensers and at a distance of between 20 and 100 feet (6 to 30 meters) away from dispensers. EFSO systems can be activated by pushing one of the EFSO buttons.

7-16.1 Inspection and Maintenance – EFSO Systems.

- a. Check the operation of the EFSO system by activating the fueling system and then pressing each of the EFSO buttons. Ensure that each button disables power to all of the dispensers and fuel pumps installed at the service station.
Frequency: Quarterly
- b. Refer to [Section 2-7 Signage and Markings](#) for inspection and maintenance requirements of EFSO pushbutton signs.

7-17 VAPOR RECOVERY.

Vapor recovery at service stations is typically classified as Stage I or Stage II. These types of systems are required on fuels with high vapor pressures in many states. For military service station applications this is usually limited to Motor Gasoline (MOGAS).

7-17.1 Stage I Vapor Recovery.

Stage I Vapor Recovery is used for bulk receipt and issue operations and typically includes a vapor balance pipe. The vapor balance pipe is used to connect the head space of the fuel storage tank to the head space of the fuel truck. This allows vapors to move between the fuel storage tank and the fuel truck during receipt and issue operations.

7-17.1.1 Inspection and Maintenance - Stage I Vapor Recovery.

- a. Inspect vapor recovery hoses for gouges, cuts or outside wear that may result in vapor leaks.
Frequency: Daily or before each use
- b. Inspect caps and camlock fittings for tightness and leaks.
Frequency: Quarterly
- c. Refer to [Section 7-11 Ground Vehicle Fuel Piping](#) for inspection and maintenance requirements of Stage I vapor recovery piping.

7-17.2 Stage II Vapor Recovery.

Stage II vapor recovery includes the collection of vapors at the dispenser nozzle and may also include the collection of vapors developed from normal tank operations. In most cases these systems include vacuum pumps mounted in dispensers that collect and transfer vapors to petroleum fuel storage tanks. Stage II vapor recovery is no longer a Federal requirement but may still be required by some states. Existing Stage II vapor recovery systems may be phased out in accordance with state regulations. Stage II vapor recovery systems that have not yet been decommissioned (whether required or not) must still be maintained and inspected in accordance with state regulations.

7-17.2.1 Inspection and Maintenance - Stage II Vapor Recovery.

There are several approved vendors for Stage II Vapor Recovery systems. Consult the manufacturer's operation and maintenance manual that was provided with the system for periodic maintenance requirements.

7-17.3 Vapor Burners.

Vapor burners are used to combust vapors from tanks that would otherwise be vented to atmosphere.

7-17.3.1 Inspection and Maintenance - Vapor Burners.

Consult the manufacturer's operation and maintenance manual that was provided with the system for specific periodic maintenance requirements of the unit that is installed.

- a. Inspect vapor burners to ensure that the pilot flame system is operating properly. Fans, duct work, and dampeners must also be inspected to ensure proper air to fuel vapor mixtures allow for complete burns.
Frequency: Quarterly
- b. Inspect burner knock out pots for condensed fuel vapors and water if equipped.
Frequency: Quarterly
- c. Inspect thermowells and gas detection monitors for operability.
Frequency: Quarterly

7-18 TACTICAL REFUELER LOADING.

Tactical refueler loading operations at military service stations are similar to petroleum fuel truck issue systems. Refer to [Section 3-5.1 Truck Issue](#) for inspection and maintenance requirements of tactical refueler loading equipment.

7-19 ELECTRONIC RELEASE DETECTION MONITORING.

7-19.1 General Inspection of Release Detection Systems.

Release detection systems are designed to quickly detect fuel leaks from concealed and underground portions of fueling systems. A licensed and/or certified technician is required to troubleshoot or inspect leak/release sensors for operation. If an issue is suspected, appropriate military service-specific SCP or Installation Environmental Office personnel should be contacted for support. Refer to Installation SPCC plan for further direction on who to contact.

7-19.1.1 Point Sensor – Dry.

Dry point sensors are installed at the lowest point within the space between the fueling system and secondary barrier. Dry point sensors send a signal to a monitoring panel indicating liquid detection. Dry point sensors may include float switches or electrical resistor switches. A licensed and/or certified technician is required to troubleshoot or inspect dry point sensors for operation.

These sensors are placed in the low points of the dispenser sumps and fuel pipe transition sumps and continuously monitor for the presence of fuel or water in the sumps.

7-19.1.1.1 Inspection and Maintenance - Point Sensor – Dry.

- a. Ensure the monitoring panel associated with the point sensor(s) is powered on and no alarms are present.
Frequency: Daily
- b. Ensure monitoring space is clear and free of debris and liquid.
Frequency: Monthly
- c. Test sensor and ensure it is functional.
Frequency: Annually

7-19.1.2 Automatic Line Leak Detector.

Automatic line leak detector systems are used on underground pressurized piping to alert the operator to the presence of a leak by restricting or shutting off the flow through the piping or visual alarm. Automatic line leak detectors are commonly installed on submersible turbine pumps and less commonly installed remotely on other pump types.

7-19.1.2.1 Inspection and Maintenance – Automatic Line Leak Detector.

- a. Ensure the monitoring panel associated with the detector(s) is powered on and no alarms are present.
Frequency: Daily
- b. Simulate a 3 gallons per hour leak at 10 pounds per square inch; the automatic line leak detector must activate within one hour. A licensed and/or certified technician is required to, test, troubleshoot, or calibrate for operation.
Frequency: Annually

7-20 VISUAL RELEASE DETECTION MONITORING.

7-20.1 Visual Monitoring.

Release detection method utilizing inspection ports to visually inspect for the presence of liquids.

7-20.1.1 Inspection and Maintenance – Visual Monitoring.

- a. Visually inspect at inspection ports for signs of leaks. Remove debris or foreign objects obstructing the view.
Frequency: Weekly

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CHAPTER 8 PETROLEUM STORAGE TANKS

8-1 GENERAL INFORMATION.

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- a. This chapter includes information on inspection and maintenance of petroleum fuel storage tanks and associated equipment for the purpose of maintaining mechanical and operational integrity.
- b. Commercial codes API 653 and STI SP001 have been used to determine baseline inspection requirements for DoD-owned petroleum fuel tanks. API 653 has been used for field-erected tanks and STI SP001 has been used for shop-fabricated tanks. In some cases API 653 and STI SP001 can be applied to field erected tanks. In cases where API 653 or STI SP001 could be applied, the option to use either protocol has been provided. After a tank's inspection protocol has been set, it should continue following that inspection protocol unless the change is approved by the military service-specific SCP or SME. Contact the military service-specific SCP or SME for guidance if unsure of proper inspection protocol.
- c. In some cases API 653 and STI SP001 do not directly apply to a type of petroleum fuel tank installed in the field (e.g. cut and cover tanks). In these cases the requirements of the codes must be adjusted to fit the actual tank installed in the field. Contact military service-specific SCP or SME for guidance.
- d. Multi-compartment petroleum fuel tanks are a special case of shop-fabricated tank. Each compartment within a multi-compartment tank should be treated as a separate/individual tank, even though they may share components and secondary containment systems.

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8-2 CONTAMINATION PREVENTION.

Petroleum fuel storage tanks are environments where water can promote microbiological growth which can damage inner tank surfaces, restrict flow, damage downstream components, and degrade petroleum fuel product stability. Though water or other debris are inherent to petroleum fuel handling operations, maintaining petroleum fuel tank (e.g., floating roof seals, vent screens) integrity is critical to preventing additional contamination from entering tanks. Water is typically removed via drawoff systems or draining directly from petroleum fuel tank sumps.

8-3 TANK SURFACE COATINGS.

Only coating touch-up repair is performed by staff maintenance personnel on petroleum fuel tanks. Coating repair or replacement for an entire petroleum fuel tank is usually performed under contract.

Interior coating systems are programmed for replacement at 20 year intervals. Exterior coatings may fail more rapidly due to weathering and microbial growth. Numerous factors including surface preparation can lead to failure of the coating material. If inspection shows coating is in acceptable condition, the life may be extended past 20 years. There is generally no need to recoat the interior of petroleum fuel tanks unless the coating has failed or a significant change of petroleum fuel service type is planned. The condition of the internal coatings can only be determined during out-of-service internal tank inspections.

8-3.1 External Tank Coating Repairs.

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- a. The external surfaces of petroleum storage tanks are protected with coatings that meet the requirements of UFGS 09 97 13.27. Existing tanks may be protected by alternative coating systems not listed in UFGS specifications. Questions regarding alternative coatings that are encountered in the field should be directed to the military service-specific SME.
- b. Maintenance personnel must determine existing external coating type prior to repairs to ensure proper adhesion. It is recommended to protect surrounding areas of repair by squaring off with masking tape. Ensure the area to be repaired is clean and dry. All surface corrosion or damage coating must be removed per coating manufacturer's requirements. In addition, abrade immediate area surrounding repair to feathered edge to allow proper adhesion of repair coating layers. Remove all dust particles by brush or vacuum and clean surface with appropriate solvents to prepare area for coating system.
- c. Application information and instructions provided in UFGS 09 97 13.27 must be strictly adhered to when this type of coating system is applied to the exterior of tanks.

8-3.1.1 Vapor Corrosion Inhibitors.

Vapor Corrosion Inhibitors (VCI) technology has potential. VCIs are acceptable for tanks where the underbottom cathodic protection has failed. The tank's ringwall and liner system must not be compromised, such as drilling thru the concrete and flexible membrane liner, for the injection of the VCI. The amount of VCI must be checked annually to determine if additional VCI is required. VCI is not considered as a permanent repair. The cathodic protection system should be repaired during the tank's next out-of-service inspection. /1/

8-3.2 Internal Tank Coating Repairs.

There are two primary coating system types used for tank interiors: low VOC epoxy novolac polysulfide coatings that meet the requirements of UFGS 09 97 13.15, and two component epoxy coatings that meet the requirements of UFGS 09 97 13.17. Existing

tanks may be protected by alternative coating systems not listed in UFGS. Questions regarding alternative coatings that are encountered in the field should be directed to the military service-specific SME.

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8-3.2.1 Low VOC Epoxy Novolac Polysulfide Interior Coating.

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Epoxy novolac polysulfide interior coating systems are comprised of primer or base coat and top coat that are identical in material except for contrasting colors to allow for identification. When applied correctly, this coating system will last approximately 50 years.

Application information and instructions provided in UFGS 09 97 13.15 must be strictly adhered to when this type of coating system is applied to the interior of tanks.

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8-3.2.2 Two Component Epoxy Interior Coating.

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Two component epoxy coating systems are comprised of an epoxy polyamide primer or base coat in accordance with MIL-DTL-24441/29, and epoxy polyamide intermediate and top coats in accordance with MIL-DTL-24441/31. All primer and intermediate coating materials are supplied by one supplier. When applied correctly, this coating system will last approximately 20 years.

Application information and instructions provided in UFGS 09 97 13.17 must be strictly adhered to when this type of coating system is applied to the interior of tanks.

8-4 ABOVEGROUND FIELD-ERECTED TANKS.

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- a. The majority of the above ground field-erected tanks used for petroleum products are built and/or repaired in accordance with API-650 and DoD Standard Design AW 78-24-27.
- b. A baseline internal inspection must be conducted on aboveground field-erected tanks before they are placed into service. The baseline inspection must include floor, shell, and roof wall-thickness measurements. These initial measurements will be used by later inspectors to monitor and evaluate corrosion rates of specific tanks.
- c. military service-specific, host nation, state or local regulations may require additional inspections or increased frequency of inspections of field-erected tanks. The Installation must follow the more stringent of this UFC or military service-specific, host nation, state, or local regulations.

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8-4.1 Inspection and Maintenance – Aboveground Field-Erected Tanks.

- a. Visually inspect for evidence of leaks; shell distortions; signs of settlement; corrosion, condition of tank foundation, condition of coating, insulation systems, and appurtenances. Inspection must include all components and equipment located inside the containment area such as piping, pipe supports, containment valves, and product saver tanks. Items noted during the inspection will be documented for follow-up action by an authorized inspector. See Appendix F for the Field-Erected Tank Monthly Inspection Checklist.
Frequency: Monthly
- b. Visually inspect bottom edge projection (chime) to ringwall sealant. Seal should be maintained in good working order to prevent corrosion of the underside of the tank bottom.
Frequency: Monthly
- c. Visually inspect the exterior of the tank for leaks, corrosion, or irregularities such as tilting, settling, or out-of-roundness. Give special attention to seams and anchor bolts. Visual inspection must include all components and equipment located inside the tank containment area such as piping, pipe supports, containment valves, and product saver tanks. Retain records of inspections reports for five years. See Appendix F for the Field-Erected Tank Annual Inspection Checklist.
Frequency: Annually
- d. Perform a formal in-service external inspection of the tank in accordance with API 653 or STI SP001 to evaluate the tank for conditions which may affect the operational integrity of the storage tank, including minimum shell thickness measurements. This inspection must be performed by an applicable certified inspector. Inspection must include all components and equipment located inside the tank containment area such as piping, pipe supports, containment valves, and product saver tanks.
Frequency: Every five years or as required by an appropriately certified tank inspector in the previous API 653 or STI SP001 inspection report.
- e. Perform an out-of-service API 653 or STI SP001 inspection to evaluate the tank for conditions which may affect the operational integrity of the tank floor, shell, roof and floating roof or pan. API 653 or STI SP001 provides a checklist to be used as part of the assessment. This inspection must be performed by an appropriately certified API 653 or STI SP001 inspector. Inspection must include all components and equipment located inside the tank containment area such as piping, pipe supports, containment valves, and product saver tanks. The API 653 or STI SP001 inspector must recommend the date of the next inspection. The inspection interval must be based on the date the Suitability for Service

Letter is issued immediately prior to when the tank is returned to service.
Frequency: As recommended by the API 653 or STI SP001 inspector. If there is not a previous recommendation, the inspection must be performed within ten years after the tank was placed into operation. /1/

8-4.2 Geodesic Dome Roofs.

Geodesic dome roofs for aboveground vertical petroleum fuel storage tanks are constructed of aluminum and either welded or bolted to the vertical wall of the petroleum tank or wind girder and are self-supporting. Geodesic dome roofs are typically installed on petroleum fuel tanks originally constructed with external floating roofs to reduce infiltration of rainwater into the petroleum fuel tank, to protect the floating roof, seals, and internal coatings from the effects of weather, and to help reduce emissions and fuel odors.

8-4.2.1 Inspection and Repair – Geodesic Dome Roofs.

Internal geodesic dome inspections are most effective when the petroleum fuel in the tank is near or at high level and the floating roof is close to its highest position. Access to an internal floating roof is considered a permit required confined space, therefore all military service-specific safety procedures must be followed.

- a. Conduct external inspection of geodesic dome roofs, where accessible, for corrosion of tank-to-shell bolts, gasket connections, visible signs of corrosion, apparent roof leaks, clogging or deterioration of vent screens, and damage to the structure or panels.

Frequency: Monthly

- b. Conduct internal inspection of geodesic dome roofs from the floating roof, where accessible, for corrosion of tank-to-shell bolts, gasket connections, visible signs of corrosion, apparent roof leaks, clogging or deterioration of vent screens, and damage to the structure or panels.

Frequency: Annually

8-4.3 Foundations.

Field erected petroleum fuel tanks are generally constructed on a concrete ring wall foundation. In some cases tanks are constructed on a concrete mat foundation. Typically the tank is elevated and the tank containment floor is sloped away from the tank shell.

8-4.3.1 Inspection and Repair – Foundations.

- a. Inspect visible components of tank foundations for signs of erosion due to heavy rains, wash-down, etc. and repaired as necessary. Also inspect tank foundations for structural cracks, signs of settlement, spalling, or general deterioration. Remove vegetation found around the tank foundation.

Frequency: Monthly

8-5 SHOP-FABRICATED TANKS.

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- a. The most common types of shop fabricated tanks for petroleum fuel storage are horizontal cylindrical tanks; however, there are also vertical and rectangular tanks (e.g., Lube Cube® lube oil tanks and ConVault tanks). Shop-fabricated tanks can be constructed with integral secondary containment and fire protection. The most common tanks used for fuel service are described in the sections that follow.
- b. A baseline internal inspection must be conducted on shop-fabricated tanks before they are placed into service. The baseline inspection must include, floor, shell, roof, and end wall-thickness measurements as applicable for a specific type of tank. These initial measurements will be used by later inspectors to monitor and evaluate corrosion rates of specific tanks.
- c. Military service-specific, host nation, state or local regulations may require additional inspections or increased frequency of inspections of shop-fabricated tanks. The Installation must follow the more stringent of this UFC or military service-specific, host nation, state, or local regulations.

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8-5.1 Aboveground Shop-Fabricated Tanks.

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- a. UFC 3-460-01 Section 8-4 limits shop-fabricated tank size diameters to 12 feet (3.66 meter) and maximum capacities of 50,000 gallons (190,000 liters). Aboveground single-wall tanks are designed and constructed to meet the requirements of UL 142.
- b. Double-wall tanks are designed with a UL 142 compatible inner tank. Fire resistant doubled-walled tanks are equipped with an outer tank design to meet UL 2080. Protected double-walled tanks are equipped with an outer tank designed to meet UL 2085 requirements. Additional considerations and guidance are specified in NFPA 30. NFPA 30A should be consulted for requirements of tanks used to dispense fuel to ground vehicles or watercraft.

- c. In general, inspections fall into the categories of internal (first or subsequent), external (periodic or formal), and leak test. Unless more frequent inspection and testing is specified by military service-specific directives, host nation, state or local regulations or certified inspector as a result of the previous inspection, the inspection and testing protocol defined by STI SP001 based on the classification system shown in \1\ STI SP001 /1/ must be used to determine inspection and testing requirements of aboveground shop fabricated tanks.
- d. Inspection protocols must be assigned by the military service-specific SCP or SME. Where multiple inspection protocols could be applied, once selected, the initial inspection protocol should not be changed without prior coordination with the military service-specific SCP or SME. Prior inspection history is key to subsequent inspections being able to identify issues. Each tank's inspection protocol should be clearly documented and used as the basis for future projected inspections.
- e. When applying STI SP001 formal testing schedules, select the internal inspection option if the tank is physically able to be entered. Otherwise select the leak test option\1\1/. Only tanks equipped with a manway at least 18 inches wide (455 mm) should be entered.
- f. For multi-compartment tanks, the "tank size" is equivalent to the individual compartment that is being inspected.

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8-5.1.1 Inspection and Maintenance – Aboveground Shop Fabricated Steel Tank Inspections.

- a. Monthly External Inspection (Identified as P in \1\ STI SP001)/1/: Visually inspect for exterior signs of corrosion or coating deterioration. Visually inspect weld seams, tank-to-saddle connections, tank supports, tank anchors, foundation and anchor bolts, overfill valves and alarms, normal vents, emergency vents, leak detection probe or water/petroleum accumulation in the interstice on double-walled tanks, leaking valves, fittings, or components, spill containment systems and release prevention barriers. Leaking valves, fittings or components must be repaired immediately or immediately removed from service and isolated to prevent further discharge. Any irregularities, (e.g., missing valve handles, bolts, nuts, screens) will be assessed for priority and repaired as soon as possible or as required depending on the nature of the defect (see Appendix E for an example of the STI SP001 Standard Monthly Inspection Checklist).

Frequency: Monthly

- b. Annual External Inspection (Identified as P in \1\ STI SP001 /1/): A more detailed examination of the tank and appurtenances must be performed on an annual basis (See Appendix E for an example of the STI SP001 Standard Annual Inspection Checklist).
Frequency: Annually
- c. Formal External Inspection (Identified as E in \1\ STI SP001 /1/): A formal external inspection as defined in STI SP001 must be conducted by certified STI SP001 inspector.
Frequency: As established by SCP based on tank size and category \1\ as defined in STI SP001. /1/
- d. Formal Internal Inspection (Identified as I in \1\ STI SP001 /1/): A formal internal inspection as defined in STI SP001 must be performed by a certified STI SP001 inspector. \1\ The API 653 or STI SP001 inspector must recommend the date of the next inspection. The inspection interval must be based on the date the Suitability for Service Letter is issued immediately prior to when the tank is returned to service. /1/
Frequency: As established by SCP based on tank size and category \1\ as defined in STI SP001. /1/
- e. Leak Test (Identified as L in \1\ STI SP001 /1/): A leak test as defined in STI SP001 must be performed in accordance with STI SP001.
Frequency: As established by SCP based on tank size and category \1\ as defined in STI SP001. /1/

8-5.2 Self-Diking or Vaulted Tanks.

Self-diking tanks are designed to UL142 can be of either single or double-wall construction and are designed to sit within a fabricated steel containment dike. The dike is designed to contain small spills or the entire tank contents in the event of a major leak or rupture. These tanks usually range in size from 250 to 12,000 gallons (946 to 45,424 liters) but can be larger. NFPA 30 and NFPA 30A have specific criteria that must be met before using this type of tank. Secondary containment dikes may only be opened for draining purposes and performed in accordance with the Installation's SPCC plan. At a minimum, secondary containment drain valves will be monitored during draining, closed and locked after use.

8-5.2.1 Inspection and Maintenance – Self Diking or Vaulted Tank Inspections.

- a. Monthly External Inspection (Identified as P in \1\ STI SP001 /1/): Visually inspect for exterior signs of corrosion or coating deterioration. Visually inspect weld seams, tank-to-saddle connections, tank supports, tank anchors, foundation and anchor bolts, overfill valves and alarms, normal vents, emergency vents, leak detection probe or water/petroleum accumulation in the containment area, leaking valves, fittings, or

components. Leaking valves, fittings or components must be repaired immediately or immediately removed from service and isolated to prevent further discharge. Any irregularities, (e.g., missing valve handles, bolts, nuts, screens) will be assessed for priority and repaired as soon as possible or as required depending on the nature of the defect (See Appendix E for an example of the STI SP001 Standard Monthly Inspection Checklist).

Frequency: Monthly

- b. Annual External Inspection (Identified as P in \1\ STI SP001 /1/): A more detailed examination of the tank and appurtenances must be performed annually. (See Appendix E for an example of the STI SP001 Standard Annual Inspection Checklist).

Frequency: Annually

- c. Formal External Inspection (Identified as E in \1\ STI SP001 /1/): A formal external inspection as defined in STI SP001 must be conducted by certified STI SP001 inspector.

Frequency: As established by SCP based on tank size and category \1\ as defined in STI SP001. /1/

- d. Formal Internal Inspection (Identified as I in \1\ STI SP001 /1/): A formal internal inspection as defined in STI SP001 must be performed by a certified STI SP001 inspector.

Frequency: As established by SCP based on tank size and category \1\ as defined in STI SP001. /1/

- e. Leak Test (Identified as L in \1\ STI SP001 /1/): A leak test as defined in STI SP001 must be performed in accordance with STI SP001.

Frequency: As established by SCP based on tank size and category \1\ as defined in STI SP001. /1/

8-5.3 Rectangular Concrete-Encased Tanks.

Concrete-encased tanks are constructed in accordance with UL 2085 (e.g., ConVault Tanks). The tank by design has an integral secondary containment in the form of a petroleum resistant plastic sheet encased in concrete. The concrete surface is exposed on the exterior of the tank as opposed to a steel shell. These tanks are maintained and inspected in a similar manner as a double-wall or protected steel tanks. Any formal testing of the primary (interior) tank or interstice must be conducted in accordance with manufacturer's instructions.

8-5.3.1 Inspection and Maintenance – Concrete-Encased Tank Inspections.

- a. Monthly External Inspection (Identified as P in \1\ STI SP001 /1/): Visually inspect tank supports, anchors and anchor bolts, overfill valve and alarms, normal vent, emergency vent, leaking valves, fittings or other components. In addition the exterior concrete must be visually inspected for cracking,

degradation, excessive calcareous deposits or signs of damage. Leaking valves, fittings or components must be repaired immediately or isolated to prevent further discharge. Any other deficiencies or irregularities noted must be repaired as soon as possible or as required depending on the nature of the defect (See Appendix E for an example of the STI SP001 Standard Monthly Inspection Checklist).

Frequency: Monthly

- b. Annual External Inspection (Identified as P in \1\ STI SP001 /1/): A more detailed examination of the tank and appurtenances must be performed on an annual basis (See Appendix E for an example of the STI SP001 Standard Annual Inspection Checklist).
Frequency: Annually
- c. Formal External Inspection (Identified as E in \1\ STI SP001 /1/): A formal external inspection must be conducted by certified STI SP001 inspector.
Frequency: As established by SCP based on tank size and category \1\ as defined in STI SP001 /1/.
- d. Formal Interior Inspection \1\ STI SP001 /1/: A modified formal internal inspection as defined in manufacturer's instructions or STI SP001 must be performed on concrete-encased tanks by a certified STI SP001 inspector if the tank interior is accessible.
Frequency: As established by SCP based on tank size and category \1\ as defined in STI SP001 /1/.

8-5.4 **Underground Shop-Fabricated Tanks.**

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- a. UFC 3-460-01 requires tanks to be constructed to meet requirements of NFPA 30 and, if required, NFPA 30A.
- b. Underground steel horizontal cylindrical storage tanks are constructed in accordance with UL-58 and conform to environmental requirements of 40 CFR 280.
- c. Underground fiberglass horizontal cylindrical storage tanks are constructed in accordance with UL 1316 and also meet requirements of 40 CFR 280.
- d. Military service-specific, host nation, state or local regulations may require additional inspections or increased frequency of inspections of shop-fabricated underground tanks. The Installation must follow the more stringent of this UFC or military service-specific, Host
- e. Nation, state, or local regulations.

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8-5.4.1 Single-walled Underground Shop-Fabricated Tanks.

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- a. Underground shop-fabricated tanks for fuel and oil service installed or replaced after April 11, 2016 must be secondarily contained and use interstitial monitoring in accordance with 40 CFR 280 Section 43. The use of existing single-walled tanks that have been upgraded and are maintained in accordance with 40 CFR 280 Section 21 Upgrading of Existing UST Systems is allowed to continue.
- b. In general, inspections fall into the categories of internal, external (monthly and annual), and tightness test. Unless more frequent inspection and testing is specified by military service-specific directives, host nation, state or local regulations or certified inspector as a result of the previous inspection, the inspection and testing protocol defined in \1\ Table 8-1 /1/ must be used to determine inspection and testing requirements of single-walled underground shop fabricated tanks.
- c. Strong consideration should be given to the replacement of single-walled underground tanks that are over 30 years old with double-walled tanks equipped with interstitial monitoring that meet the requirements of 40 CFR 280 Section 43.

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Table 8-1 /1/ Single-walled Underground Shop Fabricated Tank Inspection and Testing Schedules*

Tank Size ¹ (Gallons)	Release Detection Type	Steel with Cathodic Protection²	Fiberglass or Steel with Interior Lining³	Steel with Cathodic Protection and Interior Lining^{2,3}	Aviation Fuel Tank
111 - 1000	RD-1	P	P	P	P
1001 - 50,000	RD-2	I(10), P	I(INT-1), P	I(15), P	I(10), P
1001 - 50,000	RD-3	I(10), T(INT-2), P	I(INT-1), T(INT-2), P	I(15), T(INT-2), P	I(10), T(INT-2), P

P = periodic inspection (monthly and annual) Use PEI 900 checklists.

I = formal internal inspection by certified inspector. If tank cannot be entered, tanks should be cleaned and inspected with lights and/or cameras through existing openings as deemed practical by a certified tank inspector.

T = tightness test.

() = maximum inspection interval, in years.

1 = single-walled tank installed on or before April 11, 2016, that meet the requirements of 40 CFR 280 Section 21 for internal lining, cathodic protection, or both.

2 = Cathodic Protection: At time of cathodic protection installation the integrity of the tank must have been ensured using one of the following methods:

- 1) The tank was internally inspected and assessed to ensure that the tank was structurally sound and free of corrosion holes prior to installing the cathodic protection system; or
- 2) The tank had been installed for less than 10 years and has been monitored monthly for releases by automatic tank gauging, vapor monitoring, groundwater monitoring, or statistical inventory reconciliation as defined in 40 CFR 280 Section 43; or
- 3) The tank had been installed for less than 10 years and was assessed for corrosion holes by conducting two tightness tests. The first tightness test must have been conducted prior to installing the cathodic protection system. The second tightness test must have been conducted between three and six months following the first operation of the cathodic protection system.

3 = interior lining in accordance with 40 CFR 280 Section 33 or constructed of fiberglass.

RD-1 = monitored for release at least every 30 days by automatic tank gauging, vapor monitoring, groundwater monitoring or manual tank gauging as detailed in 40 CFR 280 Section 43.

RD-2 = monitored for release at least every 30 days by automatic tank gauging, vapor monitoring, or groundwater monitoring as defined in 40 CFR 280 Section 43.

RD-3 = monitored for leak detection by inventory control and manual tank gauging as defined in 40 CFR 280 Section 43.

INT-1 = within 10 years after lining, and every 5 years thereafter.

INT-2 = at least every 5 years until 10 years after the tank was installed.

* Military service-specific, host nation, state, or local regulations may require additional inspections or increased frequency of inspections. The installation must follow the more stringent of this UFC or military service-specific, host nation, state, or local regulations.

8-5.4.1.1 Inspection and Maintenance – Single-walled Underground Shop-Fabricated Tanks.

- a. Monthly External Inspection (Identified as P in \1\ Table 8-1 /1/): Ensure all tank port covers are present, are in good condition, and seated firmly on the correct tank. Inspect tank stick gauge and ensure markings are legible and that the stick gauge is not warped or broken. Inspect tank for water using ATG or stick gauge with water-finding paste. Remove water found in tank. Open and inspect tank-top containment sumps and ensure no fuel or water is collected in the sumps. Check for and remove obstructions in tank fill pipe.
Frequency: Monthly
- b. Annual External Inspection (Identified as P in \1\ Table 8-1 /1/): Inspect electrical connections and junction boxes in underground sumps and access ports on tank. Ensure boxes are sealed, and that boxes, conduit, and electrical fittings are not corroded. Inspect submerged turbine pumps if present. Ensure pumps are in good condition and that pumps and fittings show no signs of leaking. Inspect tank top containment sumps for cracks, holes, and budes. Ensure tank top containment sump electrical and pipe penetrations are intact and secured. For double-walled piping systems that drain into the tank top containment sump, ensure interstitial space of piping is open and that sump sensor is properly mounted at the bottom of the sump. Ensure tank top containment sump lid gasket and seals are in good condition. Inspect road access covers. Ensure covers are in good condition, that all bolts are present and that handles and lift mechanism is in good condition as applicable. Inspect concrete installed over tank and ensure there is no significant cracking.
Frequency: Annually
- c. Tank Tightness Test (Identified as T in \1\ Table 8-1 /1/): Perform test in accordance with 40 CFR 280, Section 43.
Frequency: As established by SCP based on tank size and release detection type listed in \1\ Table 8-1 /1/.
- d. Formal Internal Inspection (Identified as I in \1\ Table 8-1 /1/): A formal modified internal inspection in accordance with STI must be conducted by a certified STI SP001 inspector if the interior is accessible. The inspector will need to supplement and/or adapt portions of STI SP001 to evaluate the specific concerns of an underground tank. Check the tank for settlement and ensure that the tank slopes towards the water drain.
Frequency: As established by SCP based on tank size and release detection type listed in \1\ Table 8-1 /1/ or as recommended by an STI SP001 certified tank inspector in the previous inspection report.

- e. Test tank-top containment sumps and ensure they are liquid tight by using vacuum, pressure, or liquid testing in accordance with 40 CFR 280, Section 43.

Frequency: Every three years

8-5.4.2 Double-walled Underground Shop-Fabricated Tanks.

Underground shop-fabricated tanks for fuel and oil service installed or replaced after April 11, 2016 must be secondarily contained and use interstitial monitoring in accordance with 40 CFR 280 Section 43.

In general, inspections fall into the categories of internal and external (monthly and annual) inspections. Unless more frequent inspection and testing is specified by military service-specific directives, host nation, state or local regulations or certified inspector as a result of the previous inspection, the inspection protocol defined in [Table 8-2](#) must be used to determine inspection requirements of double-walled underground shop fabricated tanks.

Table 8-2

Table 8-2 /1/ Double-walled Underground Shop Fabricated Tank Inspection and Testing Schedules*

Tank Size ⁴ (Gallons)	Release Detection Type	Aviation Fuel Tank ⁶	Double-wall Steel Non- aviation Interior Coated ⁵	Double-wall Steel with no Interior Coating	Double-wall Fiberglass
111 - 1000	RD-4	P	P	P	P
1001 - 50,000	RD-5	I(10), P	I(20), P	I(20), P	I(20), P

P = periodic inspection (monthly and annual) Use PEI 900 checklists.

I = formal internal inspection by certified inspector. If tank cannot be entered, tanks should be cleaned and inspected with lights and/or cameras through existing openings as deemed practical by a certified tank inspector.

() = maximum inspection interval, in years.

4 = double-walled tank that meets the requirements of 40 CFR 280 Section 20.

5 = interior epoxy coating.

6 = operating tank that issues fuel to aircraft.

RD-4 = monitored for release at least every 30 days by automatic tank gauging, vapor monitoring, groundwater monitoring, interstitial monitoring or manual tank gauging as detailed in 40 CFR 280 Section 43.

RD-5 = tank installed on or before April 11, 2016, monitored for release at least every 30 days by automatic tank gauging, vapor monitoring, groundwater monitoring, interstitial monitoring, or statistical inventory reconciliation or tanks installed after April 11, 2016 monitored for release at least every 30 days by interstitial monitoring as defined in 40 CFR 280 Section 43.

* Military service-specific, host nation, state, or local regulations may require additional inspections or increased frequency of inspections. The installation must follow the more stringent of this UFC or military service-specific, host nation, state, or local regulations.

8-5.4.2.1 Inspection and Maintenance – Double-Walled Underground Shop-Fabricated Tanks.

- a. Monthly External Inspection (Identified as P in \1\ Table 8-2 /1/): Ensure all tank port covers are present, are in good condition, and seated firmly on the correct tank. Inspect tank stick gauge and ensure markings are legible and that the stick gauge is not warped or broken. Inspect tank for water using ATG or stick gauge with water-finding paste. Remove water found in tank. Open and inspect tank-top containment sumps and ensure no fuel or water is collected in the sumps. Check for and remove obstructions in tank fill pipe.
Frequency: Monthly
- b. Annual External Inspection (Identified as P in \1\ Table 8-2 /1/): Inspect electrical connections and junction boxes in underground sumps and access ports on tank. Ensure boxes are sealed, and that boxes, conduit, and electrical fittings are not corroded. Inspect submerged turbine pumps if present. Ensure pumps are in good condition and that pumps and fittings show no signs of leaking. Inspect tank top containment sumps for cracks, holes, and budes. Ensure tank top containment sump electrical and pipe penetrations are intact and secured. For double-walled piping systems that drain into the tank top containment sump, ensure interstitial space of piping is open and that sump sensor is properly mounted at the bottom of the sump. Ensure tank top containment sump lid gasket and seals are in good condition. Inspect road access covers. Ensure covers are in good condition, that all bolts are present and that handles and lift mechanism is in good condition as applicable. Inspect concrete installed over tank and ensure there is no significant cracking.
Frequency: Annually
- c. Formal Internal Inspection (Identified as I in \1\ Table 8-2 /1/): A formal modified internal inspection in accordance with STI must be conducted by a certified STI SP001 inspector if the interior is accessible. The inspector will need to supplement and/or adapt portions of STI SP001 to evaluate the specific concerns of an underground tank. Check the tank for settlement and ensure that the tank slopes towards the water drain.
Frequency: As established by SCP based on tank size and release detection type listed in \1\ Table 8-2 /1/ or as recommended by an STI SP001 certified tank inspector in the previous inspection report.
- d. Test tank-top containment sumps and ensure they are liquid tight by using vacuum, pressure, or liquid testing in accordance with 40 CFR 280, Section 43.
Frequency: Every three years

8-6 UNDERGROUND FIELD-CONSTRUCTED TANKS (CUT AND COVER TANKS).

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- a. Underground field-constructed tanks are vertical or horizontally constructed and can be constructed of welded steel or welded steel interior with concrete exterior. The tanks are covered with soil or buried in the ground.
- b. The tank design includes manways that extend to grade level for access to the interior of the tank for inspection and cleaning purposes. Deep-well vertical turbine pumps are mounted to the top of the tank and are enclosed in a small pump house or vault, or tanks are gravity fed and tunnels are used to access tank connections and skin valves. The fill connection extends to the bottom of the tank and is usually equipped with a splash deflector or diffuser. The tank is equipped with a sump pump to remove water from the tank, pressure-vacuum vents, level indicators and transmitters, and level switches.
- c. A baseline internal inspection must be conducted on underground field-constructed tanks before they are placed into service. The baseline inspection must include, floor, shell, and roof wall-thickness measurements. These initial measurements will be used by later inspectors to monitor and evaluate corrosion rates of specific tanks.
- d. Military service-specific, host nation, state or local regulations may require additional inspections or increased frequency of inspections of underground field-constructed tanks. The Installation must follow the more stringent of this UFC or military service-specific, host nation, state, or local regulations.

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8-6.1 Inspection and Maintenance – Underground Field-Constructed Tanks (Cut and Cover Tanks).

- a. Check the level gauge records and interstitial monitoring ports to determine if the tank is leaking.
Frequency: Daily
- b. Apply field-erected tank monthly external inspection to the maximum extent possible. Visually inspect tank and appurtenances for evidence of leaks, shell distortions, signs of corrosion, and settlement at accessible locations. Items noted during the inspection will be documented for follow-up action by an authorized inspector (See Appendix F for the Field-Erected Tank Monthly Inspection Checklist).
Frequency: Monthly

- c. Check tank under static storage conditions for 24 hours using existing inventory management system to determine if petroleum losses are occurring. If leakage is noted, further investigation must be conducted in accordance with military service-specific guidelines.
Frequency: Monthly
- d. Apply field-erected tank annual external inspection to the maximum extent possible. Visually inspect tank and appurtenances for evidence of leaks, shell distortions, signs of corrosion, and settlement at accessible locations. Visually inspect pump/equipment vaults for leaks and cracking in concrete walls and floors. Retain records of inspections reports for five years (See Appendix F for the Field-Erected Tank Annual Inspection Checklist).
Frequency: Annually
- e. Perform a modified out-of-Service API 653 internal inspection to evaluate the tank for conditions which may affect the operational integrity of the tank floor, shell, columns and roof by certified API 653 inspector. API 653 provides a checklist to be used as part of the assessment; however the certified API 653 inspector must modify this checklist to incorporate specific needs of underground field-constructed tanks. The API 653 or STI SP001 inspector must recommend the date of the next inspection. The inspection interval must be based on the date the Suitability for Service Letter is issued immediately prior to when the tank is returned to service.
Frequency: As recommended by the API 653 or STI SP001 inspector. If there is not a previous recommendation, the inspection must be performed within ten years after the tank was placed into operation.
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8-7 TANK CLEANING.

Tank cleaning operations are detailed in [Appendix H](#) for government personnel. Contractors must utilize UFGS 133 01 50.65 for cleaning requirements of tanks. [Appendix H](#) provides the minimum standards for safe entry of petroleum tanks.

- a. Conduct Tank Cleaning: Unless otherwise mandated by operational concerns or military service directives, schedule and conduct tank cleaning based upon the frequency listed below. After cleaning tanks must be stenciled in accordance with [Section 8-8.1 Tank Stenciling Requirements](#).
Frequency:
- **Air Force – Tanks above 20,000 gallon (75,700 liters) in capacity - Every 10 years unless required more frequently due to fuel quality issues. Contact AFPET and AF Fuel SME for deviations on schedule. Schedule changes are typically accepted based on TO 42B1-1 requirements.**

- **Air Force – Tanks 20,000 gallon (75,700 liters) in capacity and under - During out of service inspection cycle unless required more frequently due to potential fuel quality issues.**
- **Army, Navy, U.S. Marine Corps – During out-of-service inspection cycle unless required more frequently due to potential fuel quality issues.**

8-8 RETURNING TO SERVICE AFTER FORMAL OUT OF SERVICE INSPECTION/REPAIR.

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- Re-install all valves, piping, and manhole covers using new non-asbestos gasket material compatible with the product being stored. Gasket thickness must not be less than the thickness of the gasket replaced. Restore the entire area to its original condition. Reconnect and activate cathodic protection system.
- Limit the fill line and discharge velocity in the piping of the incoming liquid stream into petroleum fuel tanks to 3 feet per second (fps) (0.9 meter per second (mps)) until the fill pipe is submerged in fuel by either two pipe diameters or 2 feet (60 cm), whichever is less. In the case of a floating-roof or pan equipped tank, observe the 3 fps (1 mps) velocity limitation until the roof or pan becomes buoyant. For additional information, see API 2003.

NOTE: Wait thirty minutes after loading or unloading an aboveground fuel tank before gauging a tank. Wait at least 18 hours before attempting entry onto a floating roof or pan after an initial fill.

- At the completion of a tank inspection or cleaning operation, ensure the tank is stenciled in accordance with [Section 8-8.1 Tank Stenciling Requirements](#).
- Documentation that should be provided before a tank is placed back into service after a formal out of service inspection or repair includes the following:

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- A statement signed by an applicable code certified tank inspector indicating the tank is suitable for return to service including any caveats, clarifications, or limitations that would affect tank operations after return to service. The statement must include due dates for the next applicable formal inspections (internal, external, and leak test) and any repairs required prior to those next inspections. Next inspection due dates must be the maximum allowable by code, calculated from the latest of the inspection or repair completion dates.

- A completed inspection report compliant with the applicable code including all required calculations and analysis. Preliminary or field reports cannot be substituted for this requirement.
- A list of repairs identified during the inspection, including completed repairs and repairs that are still pending. All pending repairs must be annotated with a due date.
- Third-party certified calibration (“strapping”) charts when a tank is first placed in service, when certified calibration charts did not previously exist, or when repairs were made that would be reasonably expected to change the tank’s calibration. For shop-fabricated tanks, manufacturer-provided calibration charts require third-party certification before they can be accepted.
- A statement signed from the Execution Agent and repair contractor that custody of the tank is returned to the Installation and that items listed above have been delivered to the Government.

8-8.1 Tank Stenciling Requirements.

Tank stencils should be 0.75 to 1-inch (19-25 mm) height letters. The information must be stenciled on or next to the manhole covers for aboveground tanks, or stenciled on the manhole cover or tank pit wall for underground tanks. The following information must be stenciled if known:

- Date of the tank cleaning (Month/Year).
- Cleaning completed by (i.e., in-house or contractor’s name).
- Name of the individual certifying the cleaning.
- If applicable, the address or contact information for the contractor.
- Date of last formal internal inspection (Month/Year).
- Date of next formal internal inspection (Month/Year).

8-9 TANK APPURTENANCES.

8-9.1 Floating Roofs and Pans.

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- a. Floating roofs and pans rest directly on the petroleum surface, minimizing vapor space directly above the petroleum surface when storing light-weight volatile liquids and jet fuels. Floating roofs and pans also minimize water and contaminant infiltration into the petroleum and mitigate fire risks.
- b. Floating pans can be constructed of steel or aluminum. Pans float by displacement and are not equipped with large voids or hollow compartments to help provide buoyancy. When aluminum is used the

design can include an internal honeycomb in the sheet material. This internal honeycomb includes small void spaces that give the pan additional buoyancy.

- c. Pontoon floating pans can be constructed of steel or aluminum. Pontoon floating pans use hollow compartments to provide buoyancy. Typically the hollow compartments are constructed in a circle on the outside diameter of the pontoon floating pan. The compartments or pontoons are individually sealed.
- d. Floating roofs are installed on tanks that are not equipped with a sealed cone type roof. In most cases these tanks have been retrofitted with geodesic domes or steel framed roofs to mitigate water entrance into the tank through the open top. Floating roofs are typically constructed of steel and include pontoons for buoyancy. These type roofs are typically equipped with a drain system that will allow rain water that collects on the top of the roof to drain to a point outside of the tank. These roofs drain by sloping to a center sump. The center sump is connected to a hose or multi-jointed pipe extending through the fuel to an outside water draw-off valve.
- e. Tanks are typically equipped with internal ladders that can be used to access the top of the floating roof or pan from the top of the tank. In some cases these ladders are installed on rollers and the angle of the ladder changes as the floating roof or pan changes elevation. In other cases these ladders are vertical and penetrate the floating roof or pan and a rubber seal is installed on the floating pan or roof to close the annular space between the ladder and the metal of the floating roof or pan.
- f. Floating roofs or pans are equipped with anti-rotation cables or pipes. These anti-rotation devices keep the floating roof or pan in position as the elevation of the floating roof or pan changes due to fuel level changes. They also prevent the floating roof or pan from rotating due to currents produced from fuel receipt or issue operations.
- g. Most petroleum fuel tanks are equipped with gauge wells. These wells are used for temperature and level measurement devices. The wells are constructed of vertical pipes that penetrate the floating roof or pan. A rubber seal is installed on the floating roof or pan to close the annular space between the gauge wells and the floating roof or pan. In some cases the vertical risers of vertical ladders are also used as gauge wells.

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Figure 8-1 Floating Roof Seal

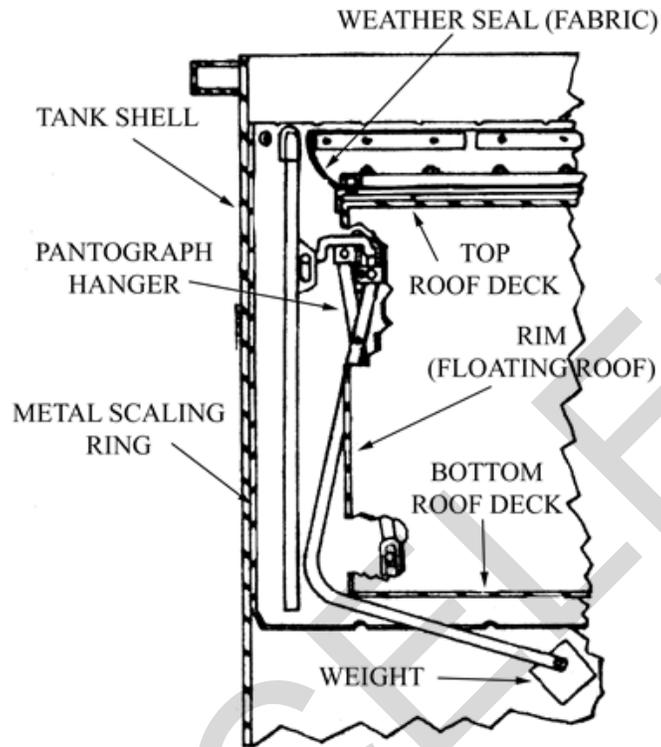


Figure 8-2 Floating Roof Detail

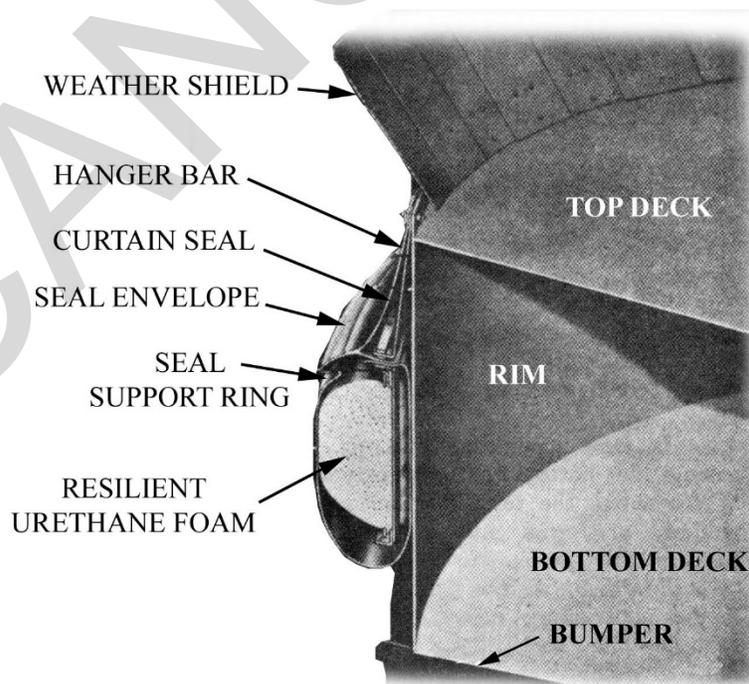
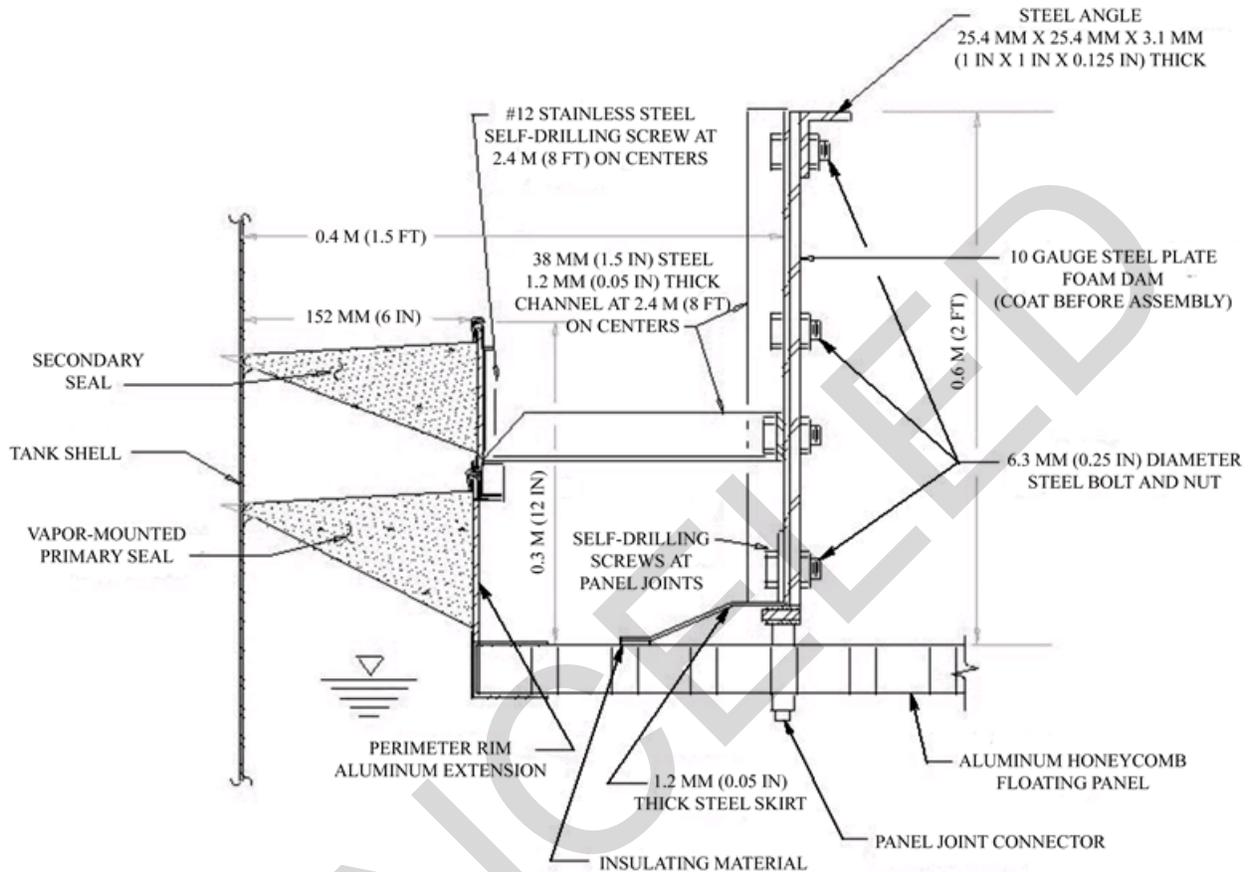


Figure 8-3 Standard Tank Seal on Aluminum Honeycomb Pans



8-9.1.1 Inspection and Maintenance - Aluminum Honeycomb Floating Pans.

Perform visual inspections from fixed roof hatch. Access to internal floating pans is considered a permit-required confined space, therefore all appropriate safety procedures must be followed before conducting internal inspections.

- Visually inspect pan guide/anti-rotation cables and centering of pan.
Frequency: Monthly
- Visually inspect pan grounding cables for proper attachment and wear or binding.
Frequency: Monthly
- Visually inspect for buckling or damage to the pan.
Frequency: Monthly
- Inspect grounding cables for proper attachment and wear or binding.
Frequency: Annually

- e. Inspect all floating roof penetration seals, such as ladder seals, stilling well seals, and other seals to ensure that they are in good working condition.
Frequency: Annually
- f. Clean and inspect perimeter tank/pan seals.
Frequency: At time of out of service internal inspection.
- g. Refer to Section 8-9.1.5, "Floating Roof and Pan Pressure/Vacuum Vents," for inspection and maintenance requirements of floating pan pressure/vacuum vents.
- h. Refer to Section 8-9.1.6, "Floating Roof and Pan Legs," for inspection and maintenance requirements of floating pan legs.

8-9.1.2 Inspection and Maintenance – Steel Floating Pans.

Perform visual inspections from fixed roof hatch. Access to internal floating pans is considered a permit-required confined space, therefore all appropriate safety procedures must be followed before conducting internal inspections.

- a. Visually inspect pan guide/anti-rotation cables or pipe and centering of pan.
Frequency: Monthly
- b. Visually inspect pan grounding cables for proper attachment and wear or binding.
Frequency: Monthly
- c. Visually inspect for buckling or damage to the pan.
Frequency: Monthly
- d. Visually inspect for damage or deflection in the rolling ladder (if equipped).
Frequency: Monthly
- e. Inspect grounding cables for proper attachment and wear or binding.
Frequency: Annually
- f. Inspect all floating pan penetration seals, such as gauge well seals to ensure that they are in good working condition.
Frequency: Annually
- g. Inspect gauge wells for abrasions that might indicate out of roundness, or improper centering.
Frequency: Annually
- h. Inspect vertical ladder for abrasions that might indicate out of roundness, or improper centering (if equipped).
Frequency: Annually
- i. Inspect for damage or deflection in the rolling ladder (if equipped).
Frequency: Annually

- j. Clean and inspect perimeter tank/pan seals.
Frequency: At time of out of service internal inspection
- k. Refer to Section 8-9.1.5, "Floating Roof and Pan Pressure/Vacuum Vents," for inspection and maintenance requirements of floating pan pressure/vacuum vents.
- l. Refer to Section 8-9.1.6, "Floating Roof and Pan Legs," for inspection and maintenance requirements of floating pan legs.

8-9.1.3 Inspection and Maintenance – Pontoon Floating Pans.

Perform visual inspections from fixed roof hatch. Access to pontoon floating pans is considered a permit-required confined space, therefore all appropriate safety procedures must be followed before conducting internal inspections.

- a. Visually inspect pan guide/anti-rotation cables or pipes and centering of pan.
Frequency: Monthly
- b. Visually inspect grounding cables for proper attachment and wear or binding.
Frequency: Monthly
- c. Visually inspect for buckling or damage to the pan.
Frequency: Monthly
- d. Visually inspect for damage or deflection in the rolling ladder (if equipped).
Frequency: Monthly
- e. Inspect pontoons for standing liquid and presence of strong vapors.
Frequency: Annually
- f. Remove mechanical gauge float cover and ensure float is securely fastened to gauge tape. Check gauge tape for ease of movement.
Frequency: Annually
- g. Inspect for damage or deflection in the rolling ladder (if equipped).
Frequency: Annually
- h. Inspect vertical internal ladder and internal ladder/pan seals for abrasions that might indicate out of roundness, or improper centering (if equipped).
Frequency: Annually
- i. Inspect gauge wells and gauge well/pan seals for abrasions that might indicate out of roundness, or improper centering.
Frequency: Annually
- j. Inspect steel floating pan coatings for corrosion. Touch up with compatible coating if required (aluminum pans do not require coatings).
Frequency: Annually

- k. Clean and inspect perimeter tank/pan seals.
Frequency: At time of out of service internal inspection.
- l. Refer to Section 8-9.1.5, "Floating Roof and Pan Pressure/Vacuum Vents," for inspection and maintenance requirements of floating pan pressure/vacuum vents.
- m. Refer to Section 8-9.1.6, "Floating Roof and Pan Legs," for inspection and maintenance requirements of floating pan legs.

8-9.1.4 Inspection and Maintenance – Floating Roofs.

Perform visual inspections from fixed roof hatch. Access to floating roofs is considered a permit-required confined space, therefore all appropriate safety procedures must be followed before conducting internal inspections.

- a. Visually inspect the center primary roof drain system. Confirm it is water-free.
Frequency: Monthly
- b. Visually inspect anti-rotation pipes/roof guides and centering of roof.
Frequency: Monthly
- c. Visually inspect grounding cables for proper attachment and wear or binding.
Frequency: Monthly
- d. Visually inspect for buckling or damage to the roof.
Frequency: Monthly
- e. Visually inspect for standing water on roof deck.
Frequency: Monthly
- f. Visually inspect for damage or deflection in the rolling ladder (if equipped).
Frequency: Monthly
- g. Ensure that the drip-tight plug is placed in the roof drain opening.
Frequency: Annually
- h. Ensure that the roof drain valve is closed. The drain valve is kept in the closed position except after each rain or snowfall when it is opened just long enough to drain the roofline. Tanks with retrofitted geodesic domes or metal roofs may have had the floating roof drain line removed, so before opening the roof drain valve ensure the roof drain line has not been removed.
Frequency: Annually
- i. Inspect pontoons for standing liquid and presence of strong vapors.
Frequency: Annually

- j. Remove mechanical gauge float cover and ensure float is securely fastened to gauge tape. Check gauge tape for ease of movement.
Frequency: Annually
- k. Ensure emergency drain is not blocked with debris (if equipped).
Frequency: Annually
- l. Inspect for damage or deflection in the rolling ladder (if equipped).
Frequency: Annually
- m. Inspect vertical internal ladder and internal ladder/roof seals for abrasions that might indicate out of roundness, or improper centering (if equipped).
Frequency: Annually
- n. Inspect gauge wells and gauge well/roof seals for abrasions that might indicate out of roundness, or improper centering.
Frequency: Annually
- o. Inspect the floating roof coating for corrosion. Touch up with compatible coating if required.
Frequency: Annually
- p. Clean and check perimeter tank/roof seals.
Frequency: At time of out of service internal inspection.
- q. Refer to Section 8-9.1.5, "Floating Roof and Pan Pressure/Vacuum Vents," for inspection and maintenance requirements of floating roof pressure/vacuum vents.
- r. Refer to Section 8-9.1.6, "Floating Roof and Pan Legs," for inspection and maintenance requirements of floating roof legs.

8-9.1.5 Floating Roof and Pan Pressure/Vacuum Vents.

Floating roof and pan pressure/vacuum vents are used to relieve vacuum pressure on the floating roof or pan when the legs of the floating roof or pan make contact with the tank bottom and a vapor space is created between the surface of the liquid and the bottom of the floating roof or pan as the liquid level continues to drop. The pressure/vacuum vent also relieves positive pressure as the fluid below the floating roof or pan rises before the surface of the liquid makes contact with the bottom of the floating roof or pan.

8-9.1.5.1 Inspection and Maintenance - Floating Roof and Pan Pressure/Vacuum Vents.

- a. Inspect the floating roof or pan pressure/vacuum vent to ensure that the seats and retaining straps or guides are in good working order and that the pressure/vacuum vent is not stuck to its seats, but instead lift easily off of its seats and reseats properly. Inspect gaskets for wear and replace as required. Refer to the manufacturer's operation and maintenance manual

provided with the floating roof or pan for additional guidance on servicing the pressure/vacuum vent.

Frequency: At time of out of service internal inspection.

8-9.1.6 Floating Roof and Pan Legs.

Floating roof and pan legs support the floating roof or pan in its high position for maintenance (approximately 6 foot-3 inch (1.9 meter) clearance from bottom of floating roof or pan to tank bottom), and limit the low position of the floating roof or pan when fuel is drawn down to approximately 2 foot 5-inches (0.7 meter) of clearance from bottom of floating roof or pan to tank bottom or minimum of 6-inch (150 mm) from the top of any internal nozzle flange to the bottom of the floating roof or pan, whichever is higher.

8-9.1.6.1 Inspection and Maintenance - Floating Roof and Pan Legs.

- a. Inspect the floating roof or pan legs and tank bottom striker plates for wear; inspect the seals where the legs penetrate the floating roof or pan for leaks; inspect the low leg position stops to make sure they are securely fastened to the legs and will stop the floating roof or pan at the low position; inspect the leg keeper straps to make sure they are securely fastened to the legs to prevent the legs from falling off or through the floating roof or pan; inspect the threaded keeper caps or high position locking mechanisms to ensure they are in proper working order for securing the floating roof or pan in the high position. Refer to the maintenance manual provided with the floating roof or pan for additional guidance on floating roof or pan legs and associated hardware.

Frequency: At time of out of service internal inspection.

8-9.2 Secondary Tank Bottoms.

Secondary tank bottoms are installed to repair original tank bottoms that degraded. Secondary tank bottoms are installed approximately 1-foot (300 mm) above the existing tank bottom. In most cases sand is installed between the original and secondary bottom, although in some cases a new release protection barrier is installed between the original and secondary tank bottom. Tanks equipped with secondary tank bottoms can be identified by the presence of a second chime about 1-foot (300 mm) above the original chime at the tank to concrete foundation interface.

8-9.2.1 Inspection and Maintenance - Secondary Tank Bottoms.

- a. Tanks designed with secondary tank bottoms should have tell-tale devices (leak detection ports) to allow for monitoring of the tank's floor integrity. The tell-tale devices are typically configured as valves or inspection ports to allow for visual monitoring of liquid that may be present between the foundation and the tank floor. The presence of water would indicate a breach in the foundation seals or flooring while the presence of petroleum

would indicate integrity loss in the tank floor. Open and check tell-tale valves or inspection ports. Verify the absence of water or petroleum.

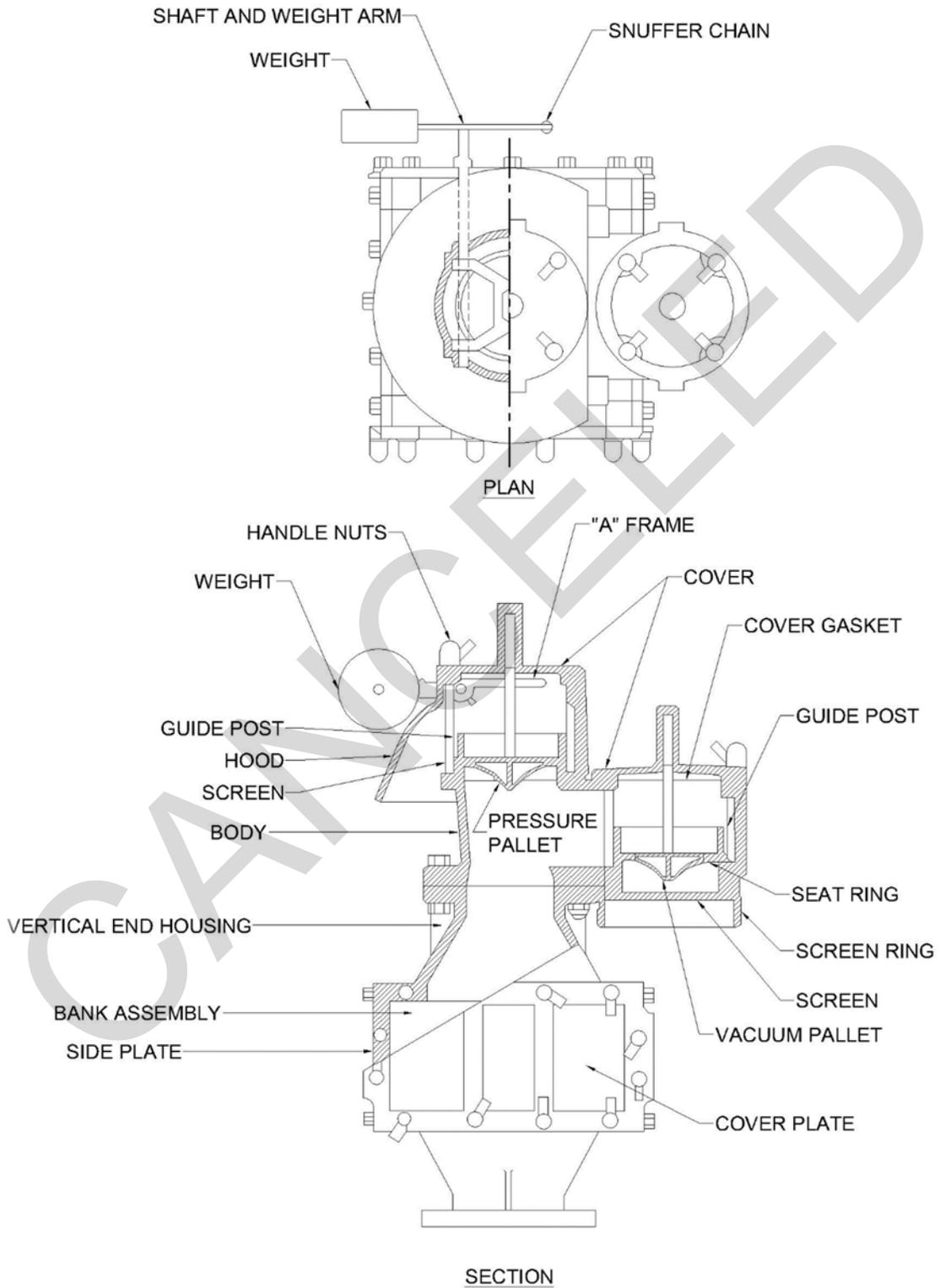
Frequency: Monthly

8-9.3 Tank Pressure/Vacuum Vents.

The pressure/vacuum vent allows air to escape when filling the tank and allows air to enter the tank when the tank is being emptied, or drawn down, in order to keep from damaging the tank and to keep fuels with high vapor pressures from evaporating from the tank. Pressure/vacuum vents are typically installed on petroleum fuel storage tanks storing petroleum fuels with vapor pressures exceeding 0.75 psi (5 kPa). They are not usually installed on API 650 tanks with floating roofs and atmospheric vents. The type and size of vent used can vary greatly.

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Figure 8-4 Pressure Vacuum Vent



8-9.3.1 Inspection and Maintenance – Tank Pressure/Vacuum Vents.

- a. On underground shop fabricated tanks, ensure tank pressure/vacuum vent is present and that the riser pipe is securely supported and vertical.
Frequency: Monthly
- b. Inspect vent settings. Pressure and vacuum settings for pressure/vacuum vents are usually specified on the vent nameplate or in the manufacturer's manual for the vent.
Frequency: Annually
- c. Clean the pressure/vacuum vent. Information on the type of pressure/vacuum vent and procedures for the removal of covers, hoods and/or pallet removal and reinstallation should be found in the manufacturer's operation and maintenance manual. Before removing the pallets, brush all accumulations from the protecting screens, the pallets, and all surfaces of the valve. Brush the screens from inside the valve so that dirt and other objects fall to the outer sides. Remove heavy loading weights prior to removing the pallet assembly. Remove deposits or foreign matter using reasonable care not to damage diaphragms or seats.
Frequency: Annually
- d. Inspect gaskets, seats, diaphragm, pallet stems and stem guides. Check all mating surfaces which must be free of nicks, cuts, cracks or deposits that might interfere with the proper seating or tightness of the valve. Test the pallets to ensure they move freely up and down over the full range of travel.
Frequency: Annually

8-9.4 Emergency Vents.

Emergency vents are installed on most tanks built to UL 142, UL, UL 2085 and API 650 standards. The type and size of the vent used can vary greatly and is determined by the wetted surface (square feet) or venting capacity (cubic feet per hour) of the tank.

8-9.4.1 Inspection and Maintenance – Emergency Vents.

- a. Inspect emergency vents for external damage, such as dents, rusting, severe pitting or obstruction by other equipment, piping or conduits.
Frequency: Annually
- b. Remove the vent, if possible, and inspect the seals and diaphragms for cracking or breakdown. Inspect retaining cables to ensure they are fastened to the vent and the manway or tank. Inspect guides to ensure emergency vents can function properly and re-seat.
Frequency: Annually

- c. Verify that emergency vents have not been removed or modified. Emergency vents should not be replaced with ATGs, manual sample ports, level alarms, etc.
Frequency: Annually
- d. Tanks that are equipped with manways for emergency vents must be inspected for appropriate type, length, number of bolts, and lift clearance of the manway in accordance with UL-142, Sections 8 and 9.
Frequency: Annually

8-9.5 Flame Arrestors.

Flame arrestors are intended to provide a positive flame-stop and prevent a fire from spreading to the interior of storage tanks and are typically installed in conjunction with a pressure/vacuum vent. Flame arrestors normally utilize a tube bank consisting of alternate flat and corrugated metal sheets around a solid core of like material sandwiched between two end sections with uniform precision-ground faces to ensure a tight seal.

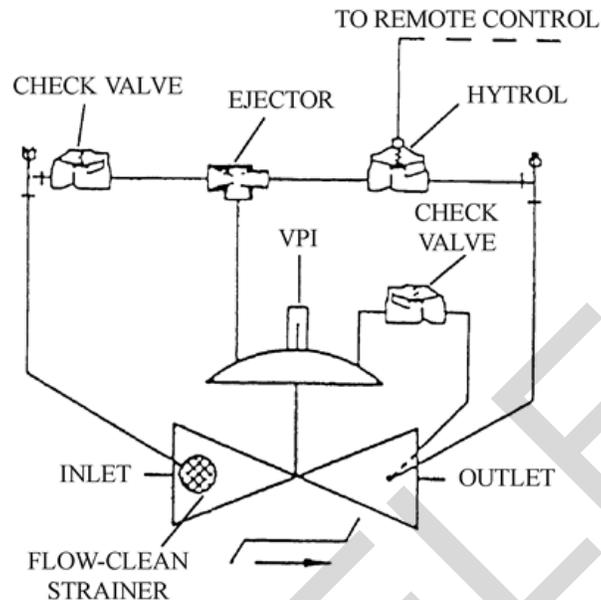
8-9.5.1 Inspection and Maintenance – Flame Arrestors.

- a. The tube bank must be removed and cleaned of foreign matter by immersing in an approved solvent solution, taking care not to damage the tube bundle. Gaskets must be inspected and replaced as necessary.
Frequency: Annually

8-9.6 High Level Shut-off Valve (HLSO).

High level shut-off valves are designed to shut off receipts into the tank when a predetermined level is reached.

Figure 8-5 External High Level Shut-off Valve



8-9.6.1 External High Level Shut-off Valves (HLSO).

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- a. External High Level Shut-off (HLSO) valves are installed in the receipt piping of tanks. Tanks are configured for the HLSO valve to close at the high alarm level or between the high and high-high alarm level. In most cases, these valves use hydraulic pressure from the upstream side of the fuel piping connected to the valve to open. The valves are equipped with flexible diaphragms and control pilots used to operate the valves. In other cases the valves are solenoid operated and require power to open.
- b. Hydraulic actuated valves are controlled by a separate float valve assembly. The float valve can be installed in a sensing chamber on the outside of the tank, or internally installed. The float of the float valve is buoyant in fuel and will rise up to activate the float valve when fuel in the tank reaches the predetermined high level.
- c. External float valve sensing chambers are usually accessible from stairs or a platform installed on the outside of tanks. Internal floats are installed in manway covers or tank nozzles at the top of tanks. Tubing from the inlet side of a hydraulic HLSO valve is routed to the float valve and back to both the outlet side of the HLSO valve and to the diaphragm of the HLSO valve. When the level float valve is activated it relieves hydraulic pressure from the diaphragm of the HLSO valve and causes the valve to close.
- d. Some newer hydraulic HLSOs are equipped with a solenoid valve that will activate to relieve pressure from the diaphragm of the HLSO valve and

cause it to close if the fuel in the tank reaches the high-high level. This solenoid is interlocked with the high-high level alarm. The solenoid feature is installed as a backup to the primary float valve closing feature.

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8-9.6.1.1 Inspection and Maintenance – External HLSO Valve.

- a. Activate the tank high-high level alarm and ensure the solenoid valve (if equipped) activates on the HLSO valve. Ensure the HLSO valve closes when the solenoid valve is activated.
Frequency: Quarterly
- b. Isolate, drain, and then vent the external float valve chamber (if equipped). Refill (either manually or via the storage tank product saver tank pump) the float chamber to test the float valve. Ensure the HLSO closes when the float is raised.
Frequency: Annually
- c. Lift the manual test lever of internally mounted float valve (if equipped). Ensure that the HLSO closes when the float of the float valve is raised.
Frequency: Annually

8-9.6.2 Internal HLSO Valve.

Internal HLSO valves are installed in the internal fill tube of tanks. Internal HLSO valves incorporate a float that closes the valve when the float rises. In some cases these valves also include a by-pass valve mechanism. When the level in the tank reaches a pre-determined height, approximately 90%, the float of the HLSO valve rises and closes the main valve. When the main valve closes at the 90% level the by-pass valve (if equipped) opens and allows approximately 5 gpm (0.3 lps) to enter the tank. If the level in the tank continues to rise and reaches the 95% level the by-pass valve will close and prevent additional fuel from entering the tank.

8-9.6.2.1 Inspection and Maintenance – Internal HLSO Valves.

- a. Inspect and test the high level shut-off valve and float mechanism, counter-weights, float rods, and floats to ensure the float mechanism is moving freely and functioning properly to close the high level shut-off valve. If valve is not equipped with a manual test mechanism the level of the tank must be raised to the high level shutoff valve set point in order to test the valve. Ensure valve is installed at a proper height.
Frequency: Annually

8-9.7 Mechanical Tape Gauges.

The mechanical tape gauge readout window is typically mounted in a convenient location on the side of the tank and is visible to the tank operator. On aboveground vertical storage tanks, the tape gauge readout device is typically mounted near the base

of the tank stairs. The other end of the tape is attached via a stainless steel cable or tape, enclosed in a conduit with sheaves and pulleys, either to a float that rides on the petroleum fuel surface inside the tank or to a weight that rests directly on top of the floating roof or pan. Note: When attached to a weight that rests on top of the floating roof or pan, the petroleum fuel level will not read below the setting of the floating roof or pan legs.

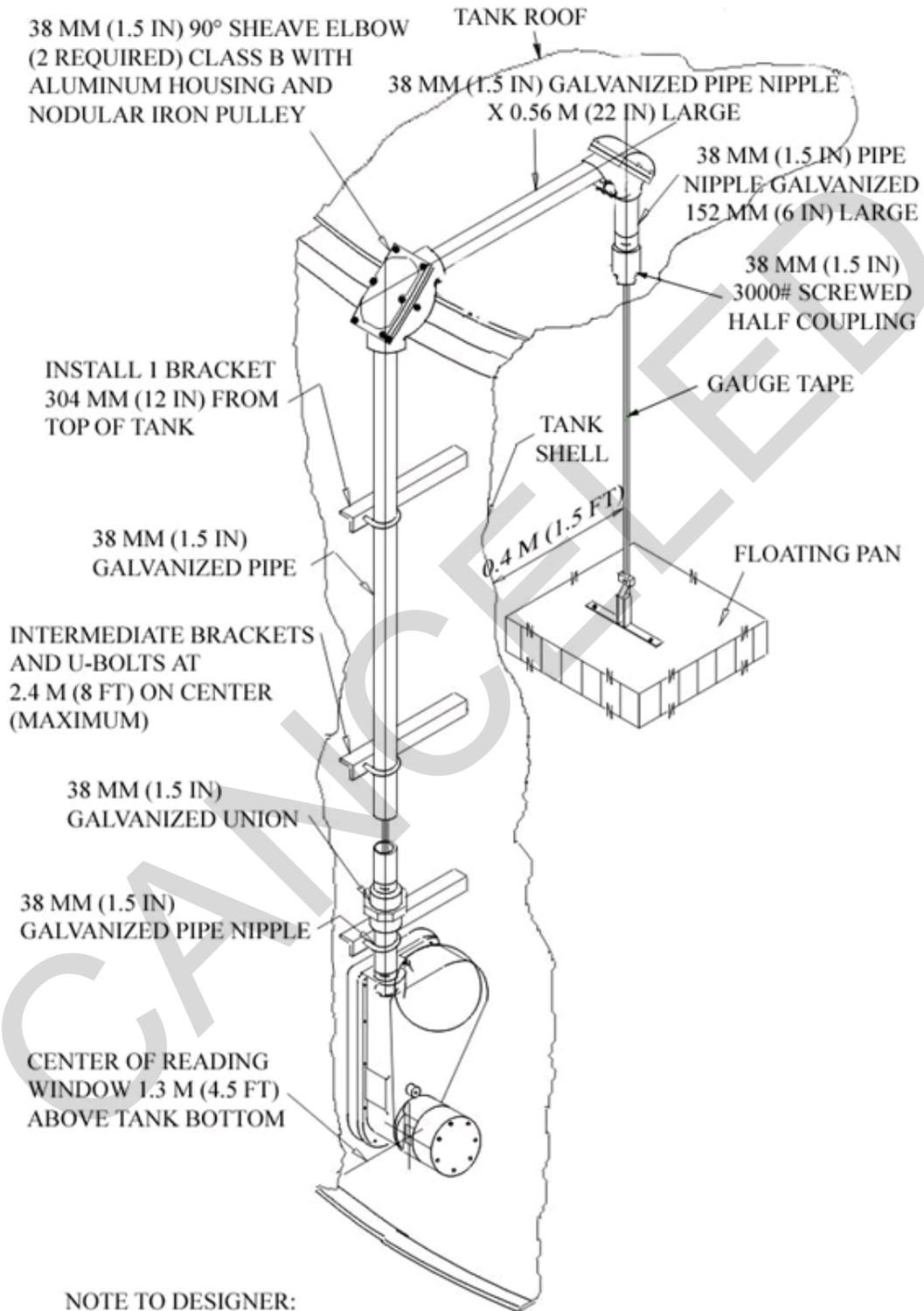
8-9.7.1 Inspection and Maintenance - Mechanical Tape Gauges.

- a. Visually check that a liquid level is indicated and that the measurement appears to be accurate.
Frequency: Daily
- b. Check the mechanical tape gauge against the automatic electronic tank gauge (if installed) or by manually gauging the tank for relative accuracy and proper working condition. Consult the manufacturer's operation and maintenance manual for additional maintenance and inspection requirements.
Frequency: Quarterly

8-9.8 Automatic Tank Gauges

Automatic Tank Gauges (ATG) are used to measure the fuel level in petroleum fuel tanks.

Figure 8-6 Mechanical Tape Gauge



NOTE TO DESIGNER:
PROVIDE EITHER A SERVO LEVEL GAUGE OR
MECHANICAL TAPE GAUGE BASED ON
USER REQUIREMENTS

8-9.8.1 Mechanically Operated Tape Gauge.

The gauge can be installed on the tank roof or the side of a tank. The level measurement is displayed using a mechanical dial and counter built into the gauge head. An incrementally perforated tape runs from the gauge head through a conduit down into the tank with a float attached at the end. The float moves up and down with the petroleum fuel level. Petroleum fuel level data is electronically transmitted by a level transmitter fitted to the gauge.

The end of the tape should never be attached directly to a floating roof or pan. This type of installation may result in damage to the gauge head or the tape. Existing installations that are currently attached directly to the floating roof or pan should be retrofitted by attaching the tape to a weight placed on top of the floating roof or pan. Varec recommends a ten pound (4.5 kg) weight, and Sand and Jurs recommends a six pound (2.7 kg) weight.

8-9.8.1.1 Inspection and Maintenance – Mechanically Operated Tape Gauge.

Refer to manufacturer's operation and maintenance manual for specific maintenance procedures and schedules associated with a specific model of mechanical float, tape gauge, and electronic level transmitter.

- a. Visually inspect the gauge to ensure the power is on, there are no warning alarms or lights and a liquid measurement is indicated and the tank level reading appears to be accurate.
Frequency: Daily
- b. Inspect gauge head for buildup of sediment.
Frequency: Quarterly
- c. Inspect tape conduit for deformations that would inhibit movement of tape up and down.
Frequency: Quarterly
- d. Gauge level accuracy must be checked against a hand dip measurement of the tank. Calibrate as required.
Frequency: Semi-annually
- e. Inspect float and guide cable through an opened manway or access cover. Verify that the guide wire is taut and free of kinks. Verify that the float is buoyant and free of sludge or sediment build up.
Frequency: Semi-annually
- f. Inspect power and control wires for damage.
Frequency: Semi-annually
- g. Inspect wire connection termination points for damage or loose connections.
Frequency: Semi-annually

- h. Lubricate moving parts of the gauge head with recommended lubricant.
Frequency: Annually

8-9.8.2 Magnetostrictive Probes.

Magnetostrictive probes are tank gauges that use floats to detect fuel and water levels in tanks. These gauges do not require a stilling well and are typically used on horizontal tanks.

Figure 8-7 Magnetostrictive Probe



8-9.8.2.1 Inspection and Maintenance – Magnetostrictive Probes.

Refer to manufacturer's operation and maintenance manual for specific maintenance procedures and schedules associated with a specific model of probe and electronic level transmitter.

- a. Visually inspect the gauge to ensure the power is on, there are no warning alarms or lights and a liquid measurement is indicated and the tank level reading appears to be accurate
Frequency: Daily
- b. Inspect probe assembly for buildup of sediment.
Frequency: Quarterly
- c. Inspect probe assembly and probe shaft for deformations that would inhibit movement of probe.
Frequency: Quarterly
- d. Level probe accuracy must be checked against a hand dip measurement of the tank. Calibrate as required.
Frequency: Semi-annually
- e. Verify that the probe float is buoyant and free of sludge or sediment build up.
Frequency: Semi-annually
- f. Inspect power and control wires for damage.
Frequency: Semi-annually

- g. Inspect wire connection termination points for damage or loose connections.
Frequency: Semi-annually

8-9.8.3 Servo Gauge.

Servo gauges are tank top mounted, requiring a stilling well for the gauge's float to follow the fuel level up and down the tank.

Figure 8-8 Servo Gauge



8-9.8.3.1 Inspection and Maintenance – Servo Gauge.

Refer to manufacturer's operation and maintenance manual for specific maintenance procedures and schedules associated with a specific model of servo gauge and electronic level transmitter.

- a. Visually inspect the gauge to ensure the power is on, there are no warning alarms or lights and a liquid measurement is indicated and the tank level reading appears to be accurate.
Frequency: Daily
- b. Inspect gauge head for buildup of sediment.
Frequency: Quarterly
- c. Gauge level accuracy must be checked against a hand dip measurement of the tank. Calibrate as required.
Frequency: Semi-annually

- d. Inspect float and guide cable through an opened manway or access cover. Verify that the guide wire is taut and free of kinks. Verify that the float is buoyant and free of sludge or sediment build up.
Frequency: Semi-annually
- e. Inspect power and control wires for damage.
Frequency: Semi-annually
- f. Inspect all wire connection termination points for damage or loose connections.
Frequency: Semi-annually
- g. Inspect stilling well. Ensure the stilling well is straight and vertical with no dents so that the float can move freely.
Frequency: Annually
- h. Lubricate moving parts of the gauge head.
Frequency: Annually

8-9.9 Level Alarms.

Alarms can include high-high, high, low, and low-low level alarms. On small or underground tanks the level alarms may be suspended inside the tank. On field-erected vertical tanks the alarm switches are typically mounted in chambers mounted to the outside of the tank.

8-9.9.1 Externally Mounted Level Alarms.

Externally mounted level alarm switches are installed in sensing chambers mounted to the outside of the tank. Manual valves are installed at the sensing chamber tank connection points. These valves are used to isolate the chambers in order to perform periodic maintenance and testing of the switches without increasing or decreasing the fuel level within the storage tank.

On newer installations, the product saver system pump is configured to supply fuel to the sensing chambers and to drain fuel back to the product saver tank to facilitate alarm switch testing. Vent valves are also provided on the sensing chambers.

8-9.9.2 Inspection and Maintenance – Externally Mounted Level Alarms.

- a. Test level alarm switches by isolating the chambers from the tank using the sensing chamber isolation valves. Vent and drain the chambers. Slowly pour product into the chambers through a funnel on top of the chamber to test the level switch at the specified level setting.
Frequency: Semi-annually

8-9.9.3 Internally Mounted Level Alarms.

Internal level alarms are suspended inside the tank.

8-9.9.4 Inspection and Maintenance – Internally Mounted Level Alarms.

- a. Test level alarm switches by activating manual testing levers, if equipped. If alarms switches are not equipped with manual testing levers, adjust the level of fuel in the tank to the alarm points in order to test the alarm switches. If it is not feasible to adjust the level of the fuel in the tank to all of the alarm set points, remove the alarm switches from the tank and test the alarms externally. Reinstall alarm switches in the tank once testing is complete.

Frequency: Annually

8-9.10 Product Saver Tanks.

Product saver tanks are used to remove water from tank bottoms and return useable fuel back to the tank. The product saver tank typically consists of a 55 gallon (208 liter) tank with a cone down bottom and removable top. The tank includes a sight glass with density ball to monitor the fuel to water interface. The tank is equipped with a water draw-off connection and either an electric pump or a hand pump to return useable fuel to the storage tank and/or pump water off to a portable container. Some product saver tanks are configured to pump fuel to the external high level switch chambers and external high level shut-off valve float chambers to facilitate testing those devices.

8-9.10.1 Inspection and Maintenance – Product Saver Tanks.

- a. Inspect the product saver tank to ensure all valves are working properly, sight level gauges with density balls are working properly and are not broken, and hand pumps or electric pumps are working properly and are not leaking.

Frequency: Quarterly

8-9.11 Sidestream Filtration Systems.

Sidestream filtration systems are used to filter or polish fuel stored in tanks. Typically, the system consists of a 100 gpm (6.3 lps) pump that draws fuel from the tank low suction line, which extends to the center sump, and then pumps the fuel through a 100 gpm (6.3 lps) filter separator back to the tank's fill line. A connection is sometimes provided downstream of the filter separator to pump fuel off to a tank truck or bowser. The filter separator will polish the fuel, but will also remove water from the bottom of the tank. The filter separator is equipped with a water level conductance probe and a float control pilot to shut the filter separator flow control valve if too much water is present in the filter separator sump. In this case, the product recovery system should first be utilized to draw as much water off the tank bottom as possible before the sidestream filtration operation is continued.

8-9.11.1 Inspection and Maintenance – Sidestream Filtration Systems

- a. Check filter separator vent tank (typically 5 gallon (19 liters), if incorporated) and ensure it is empty.
Frequency: Monthly
- b. Refer to [Section 6-1 Pipe Testing and Inspections](#) for inspection and maintenance requirements of piping.
- c. Refer to [Section 3-6.4 Basket Strainers](#) for inspection and maintenance requirements of basket strainers.
- d. Refer to [Section 3-8 Pumps](#) for inspection and maintenance requirements of fuel pumps.
- e. Refer to [Section 3-6.2 Filter Separators](#) for inspection and maintenance requirements of filter separators.
- f. Refer to [Section 4-4.2.2 Filter Separator Control Valves](#) for inspection and maintenance requirements of filter separator control valves.
- g. Refer to [Section 9-1.6 Grounding Systems](#) for inspection and maintenance requirements of grounding systems.
- h. Refer to [Section 9-1.9 Electronic Equipment](#) for inspection and maintenance requirements of control panels.

8-9.12 Fill Ports.

Fill ports are used to protect tank fuel receipt and vapor balance connection points. They are typically installed on underground and aboveground horizontal tanks. The fill ports can be installed in a pit installed above the tank (underground storage tanks) or on stands installed in close proximity to the tanks (aboveground storage tanks). They also provide a small volume of containment below the receipt connection points. In some cases the fill port is equipped with a small pump or valve that can be used to transfer fuel that collects in the fill port containment area into the receipt line of the respective tank.

8-9.12.1 Inspection and Maintenance - Fill Ports.

- a. Ensure fill port covers are installed and are not damaged or broken. Ensure fill port covers are identified by fuel type and are installed on the correct tank. Visually inspect the fill port spill bucket to ensure there are no cracks, budes, or holes. Ensure the spill bucket is clean of dirt, trash, water, and fuel.
Frequency: Daily
- b. Inspect drain valve in spill bucket and ensure it is in good condition. Ensure the caps installed on the receipt connection points are vapor tight and are not broken, cracked, or chipped. Ensure the poppet valve of the

vapor recovery port seals tightly and no vapor is escaping from the tank when the valve is closed.

Frequency: Monthly

- c. **11** Hydrostatically test fill-port to ensure containment is liquid-tight. This test may use opportune rainfall by holding rainwater in the fill-port containment area for one hour. Where evaporation is a concern, conduct the testing when this concern would be minimized, such as at night/early morning or during a time of year when this would not be as much of an issue. Record the water level at the start of the the 60 minute (minimum) hold period and if the water level drops by 1/8 inch or more, perform and record an investigation to determine the cause and any required repairs. Once repairs are completed, a new test must be completed. Refer to Appendix B for testing procedures and to use to document the testing. **11** Ensure secondary containment area of fill port is fuel tight. Ensure the manual transfer pump or drain valve is operational.

Frequency: 11 Every 3 years 11

8-9.13 Release Detection Monitoring.

Release detection is installed on aboveground and underground petroleum fuel storage tanks. Release detection measures vary based on the age and type of tank.

In addition to 40 CFR Part 280, host nation, state, and local regulations may have additional design, inspection, and maintenance requirements that may be more stringent than DoD or Federal guidance. Facility operators and maintainers must be familiar with the Installation's SPCC plan in order to comply with all inspection and recordkeeping requirements

8-9.13.1 Point Sensor – Dry.

Dry point sensors are installed at the lowest point within the space between the fueling system and secondary barrier. Dry point sensors send a signal to a monitoring panel indicating liquid detection. Dry point sensors may include float switches, or electrical resistor switches. A licensed and/or certified technician is required to troubleshoot or inspect dry point sensors for operation.

Underground and aboveground double-wall tanks (such as product recovery tanks) often have point sensor(s) installed through a connection on top of the tank that extends down near the bottom of the interstitial space between the primary and secondary tank shells. The sensor is used to determine if the primary tank is leaking into the interstitial space between the shells or if groundwater is leaking into the interstitial space. The point sensor is typically of the continuous surveillance type and provides an audible and visible alarm at the operator control panel.

8-9.13.1.1 Inspection and Maintenance – Point Sensor – Dry.

- a. Ensure the monitoring panel associated with the point sensor(s) is powered on and no alarms are present.
Frequency: Daily
- b. Ensure monitoring space is clear and free of debris and liquid.
Frequency: Monthly
- c. Test sensor and ensure it is functional.
Frequency: Annually

8-9.13.2 Point Sensor – Wet.

Wet point sensors are installed within liquid reservoirs that monitor the liquid filled space between the primary tank and secondary barrier (USTs only). A licensed and/or certified technician is required to troubleshoot or inspect wet point sensors for operation.

8-9.13.2.1 Inspection and Maintenance – Point Sensor – Wet.

- a. Ensure the monitoring panel associated to the wet point sensor(s) is powered on and no alarms are present.
Frequency: Daily
- b. Ensure level of monitoring fluid is within normal range.
Frequency: Monthly
- c. Test sensor and ensure it is functional.
Frequency: Annually

8-9.13.3 Point Sensor – Pressure/Vacuum.

Pressure/vacuum point sensors are installed at points within the space between a fueling system and secondary barrier. This space may be under pressure or a vacuum depending on the configuration. Pressure/vacuum point sensors send a signal to a monitoring panel indicating loss of pressure or loss of vacuum. A licensed and/or certified technician is required to troubleshoot or inspect pressure/vacuum point sensors for operation.

8-9.13.3.1 Inspection and Maintenance – Point Sensor – Pressure/Vacuum.

- a. Ensure the monitoring panel associated with the pressure/vacuum point sensor(s) is powered on and no alarms are present.
Frequency: Daily
- b. Test vacuum sensor for proper operation.
Frequency: Annually

8-9.13.4 Visual Leak Detection.

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- a. Visual leak detection systems include the use of tell-tale holes and leak detection ports.
- b. Reinforcement plate tell-tale holes are present in reinforcement plates used on steel storage tanks at pipe connection points and appurtenance connection points. The tell-tale holes allow for leaks that form in the interstitial space between the reinforcement plate and tank shell to be seen through visual inspection by leaking of fuel through the tell-tale hole. Never install plugs in reinforcement plate tell-tale holes.
- c. Leak detection ports (tell-tales) are present on storage tank structures with ring wall foundations and are located around the perimeter of the ring wall foundations or at a single collection point. Leak detection ports can be manually opened to inspect for leaks.

11

8-9.13.4.1 Inspection and Maintenance – Visual Leak Detection.

- a. Visually inspect leak detection ports (tell-tales) for signs of leaks. If there are debris or objects obstructing the view, appropriate measures must be taken to remove the debris or remedy the obstructions.
Frequency: During routine inspection of other components or monthly, whichever comes first.
- b. Visually inspect reinforcement plate tell-tale holes for signs of leaks. Ensure tell-tale holes have not been plugged by debris or a cap. Pack reinforcement plate tell-tales with white grease to prevent insect nesting and buildup of debris.
Frequency: Quarterly

8-9.14 Floating Suction Lines.

Floating suction lines are used to pull petroleum from a predetermined level below the petroleum liquid surface. The suction line is typically suspended by pontoon-type floats. A cable system connected to the suction arm moves a visual target external to the tank for visual confirmation that the arm is moving properly.

8-9.14.1 Inspection and Maintenance - Floating Suction Lines.

- a. Check external floating suction line position indicator to ensure floating suction line is moving freely as the level in the tank rises or falls.
Frequency: Quarterly
- b. Inspect cables, floats, and swing joint. Ensure interior of floats have not collected fuel. Ensure cables are securely fastened to anchor points and

are in good working order. Ensure the suction pipe flange used to support the swing joint is level and true and that swing joint moves freely up and down and does not bind.

Frequency: When tank is taken out of service for internal cleaning or inspection.

8-9.15 Foam Fire Protection Systems.

Aqueous Film Forming Foam (AFFF) systems are sometimes installed on petroleum fuel storage tanks. When equipped, AFFF spray nozzles are installed at the top of the tank and, when activated, spray foam into the interior vapor space of the tank. When the foam is sprayed it forms an aqueous film that floats at the top of the petroleum fuel and separates the petroleum fuel from atmospheric oxygen.

8-9.15.1 Inspection and Maintenance - Foam Fire Protection Systems.

Refer to UFC 3-601-02 for inspection and maintenance requirements of tank foam fire protection systems.

8-9.16 Heating Coils.

Some petroleum storage tanks in heavy fuel or lube oil service are equipped with heating coils or heaters to warm the petroleum and lower the viscosity for transfer operations. Coils may also be present on storage tanks for other types of petroleum in cold climates.

8-9.16.1 Steam Type Heating Coils.

Steam is a very effective means of heating heavy petroleum fuel and lube oils. Steam coils are typically installed in the bottom of tanks and can be in a variety of different configurations. Internal corrosion of the coils due to the presence of condensate in the heater coils or tubes is a primary problem in these systems. Depending on the type of heater used, this corrosion can lead to oil in the steam heating system or water in the petroleum. To avoid corrosion, steam coils must be shut off at the tank connections when not in use. Inactive coils must be plugged or removed from tanks. The flow of steam to the heating coil is typically controlled by an automatic temperature-regulating valve to prevent overheating the petroleum in the tank.

8-9.16.1.1 Inspection and Maintenance – Steam Type Heating Coils.

- a. Observe the regulating valve and check it against a thermometer to be sure that it controls the tank temperature within a safe range, usually not over 150 °F (65 °C) for No. 6 burner fuel oil. Steam traps must be inspected for proper operation to ensure condensate is evacuated from the steam coil.

Frequency: At each operation

- b. Pressure check heating coils to 10% above normal operating pressure.
Frequency: Annually
- c. Steam coils must be cleaned and inspected for visible signs of corrosion or wear when the tank is emptied and cleaned for inspection. All components of the steam heating coils, such as weld joints, support points, valves, temperature wells, control valves, and steam traps must be inspected and checked for proper operation and visible wear or damage. The coil may be carefully pressurized with steam and visually checked for leaks if necessary. Leaks or damage found must be repaired.
Frequency: When the tank is taken down for formal internal inspection or sooner if steam heating coil damage is suspected.

8-9.16.2 Thermal Fluid Type Heating Coils.

Thermal fluids are sometimes used instead of steam in tank heating coils for heavy lube oils and other fuel oils. Thermal fluids do not pose the corrosion problems associated with steam and condensate, but do require inspection and maintenance for proper operation. Thermal heating coils are typically installed in the bottom of the tank and can be in a variety of configurations. The flow of thermal fluid to the heating coil is typically controlled by an automatic temperature-regulating valve to prevent overheating the fuel oil in the tank.

8-9.16.2.1 Inspection and Maintenance – Thermal Fluid Type Heating Coils.

- a. Observe the regulating valve and check it against a thermometer to be sure that it controls the tank temperature within a safe range, usually not over 150 °F (65 °C) for No. 6 burner fuel oil. All external valves, fittings, and other components must be inspected for visible signs of leaks during operation.
Frequency: At each operation
- b. Pressure check heating coils to 10% above normal operating pressure.
Frequency: Annually
- c. When tanks are emptied and cleaned for inspection, the heating coils must be cleaned and inspected for visible signs of corrosion, wear, or damage. The coils can be pressurized and checked for leaks at that time with the thermal heating fluid at normal operating pressure, but at ambient temperature to alleviate possible burns to personnel. Leaks must be repaired.
Frequency: When the tank is taken down for formal internal inspection or sooner if thermal heating coil damage is suspected.

8-9.16.3 Electric Rod Type Heating.

Electric rod type heaters are sometimes used to heat liquids directly or they are inserted into sealed pipes that extend into tanks to indirectly heat the fluid. Typically, electric

heaters are controlled by a thermostat in conjunction with a thermometer for a visual check to regulate the heat in the tank and turn the electric heater on and off as required.

8-9.16.3.1 Inspection and Maintenance – Electric Rod Type Heating.

Refer to the manufacturer's operation and maintenance manual for additional maintenance requirements.

- a. Inspect heater to ensure no fluid leakage around the heater to tank connection and that the heater is performing properly.
Frequency: At each operation.

8-9.17 Stilling Wells.

Stilling wells are used to minimize movement of level and temperature sensing probes and floats in petroleum fuel tanks. Stilling wells are constructed of vertical pipe and are slotted with holes to ensure that the level of fuel in the stilling well matches the level of petroleum fuel in the tank.

8-9.17.1 Inspection and Maintenance - Stilling Wells.

- a. Stilling wells must be visually inspected to be vertically straight and free of dents or indentations. Sometimes tank stilling wells are made of bare carbon steel pipe. In these instances the stilling wells must be replaced with aluminum.
Frequency: At time of out of service internal inspection.
- b. Inspect floating seals inside stilling wells to ensure they are not worn and are sealing the inside of the stilling well property.
Frequency: At time of out of service internal inspection.

8-10 CONTAINMENT SYSTEMS.

Petroleum storage tanks have various types of secondary containment to protect surrounding areas from petroleum contamination. Secondary containment systems include metal enclosures, diked/bermed areas and remote impounding systems. Secondary containment systems can be made of metal, concrete, concrete with liner, brick, or earthen material equipped with an impervious liner.

Military services typically assign draining of containment areas to various organizations; in all cases, removing of water must be conducted in accordance with the Installation's SPCC or other stormwater pollution prevention plan to ensure only water without sheen is released. Secondary containment areas must be drained based upon local requirements or monthly, whichever comes first.

8-10.1 Inspection and Maintenance – Containment Systems (General).

- a. Inspect containment systems for cleanliness, if accessible.
Frequency: Daily
- b. Secondary containment systems degrade and will collect debris, which can clog drainage inlets or prevent drain valves from sealing properly. \1\ Hydrostatically test the drainage systems to include containment drain inlets, drain lines and containment drain valves to ensure the containment is liquid tight. This test may use opportune rainfall by holding rainwater in the containment system for one hour. Where evaporation is a concern, conduct the testing when this concern would be minimized, such as at night/early morning or during a time of year when this would not be as much of an issue. Record the water level at the start of a 60-minute (minimum) hold period and if the water level drops by 1/8 inch or more, perform and record an investigation to determine the cause and any required repairs. Once repairs are completed, a new test must be completed. Refer to [Appendix B](#) for testing procedures and to use to document the testing

American Concrete International (ACI) Standards 224R “Control of Concrete Cracking” and ACI’s Concrete Repair Manual are two standards that owners/operators can follow to maintain the integrity of the concrete secondary containment. /1/

Frequency: \1\ Every 3 years /1/

8-10.2 Concrete and Cement Brick Dike/Berm Walls and Floors.

Aboveground petroleum tanks that have containment system walls constructed of concrete or cement brick must be maintained and inspected to ensure containment system integrity.

8-10.2.1 Inspection and Maintenance – Concrete and Cement Brick Dike/Berm Walls.

- a. Inspect for vegetation that has taken root in seals or cracks. All vegetation must be removed in all cases to prevent penetration of seals, joints or cracks in the concrete.
Frequency: Daily
- b. Inspect walls constructed of bricks for signs of deterioration (e.g., spalling caused by freeze-thaw conditions, cracks, and joint cracks between bricks). Walls constructed of bricks must be patched immediately to prevent further penetration of the wall structure.
Frequency: Daily
- c. Inspect walls constructed of concrete for signs of deterioration (e.g., spalling caused by freeze-thaw conditions and cracks). Clean and seal

cracks with a fuel resistant sealant.

Frequency: Semi-annually

- d. Inspect seals and joints in concrete walls. Joint sealant that has retracted from the joint or become unbonded with the joints must be removed and replaced with fuel resistant sealant.

Frequency: Semi-annually

8-10.2.2 Inspection and Maintenance – Dike/Berm Floors.

- a. Inspect for vegetation that has taken root in seals or cracks. All vegetation must be removed in all cases to prevent penetration of seals, joints or cracks in the concrete.

Frequency: Daily

- b. Inspect floors made of concrete for signs of deterioration (e.g., spalling caused by freeze-thaw conditions and cracks). Clean and seal cracks with a fuel resistant sealant.

Frequency: Semi-annually

- c. Inspect joints and seals. Joint sealant that has retracted from the joint or become unbonded with the joints must be removed and replaced with a fuel resistant sealant.

Frequency: Semi-annually

8-10.3 Earthen Dike Walls.

Earthen dike wall secondary containment systems typically include sloped walls with a level surface at the top.

8-10.3.1 Inspection and Maintenance – Earthen Dike Walls.

- a. Inspect for vegetation that has taken root. All vegetation must be removed in all cases.

Frequency: Daily

- b. Prevent the growth of vegetation inside the containment area. Use fireproof chemicals for sterilization. Only herbicides approved by the Installation Environmental Office must be used.

Frequency: Monthly

- c. Inspect for signs of erosion. Inspections should be performed particularly after heavy rains or storms. Repair areas that have deteriorated due to erosion.

Frequency: Quarterly

8-10.4 Self-Diking or Vaulted Tank Containment.

Tanks built using self-diking or vaulted secondary containment features must meet NFPA 30 and in cases where the tank is used for dispensing to vehicles or watercraft,

the tank must meet requirements detailed in NFPA 30A. Additional requirements are specified in NFPA 1: Chapter 20, NFPA 1: Chapter 66, and UL 2085.

8-10.4.1 Inspection and Maintenance – Self-Diking or Vaulted Tank Containment.

- a. Secondary containment structures on self-diking or vaulted tanks must be inspected visually for integrity breaches with special attention given to pipe penetrations and interstitial drain valves.
Frequency: Daily

8-10.5 Flexible Membrane Liners.

Flexible Membrane Liners (FML) are sometimes installed under concrete in storage tank secondary containment areas and over earthen dikes used as secondary containment. Typically FML is installed over geotextile membranes and the FML is brought up and sealed to the concrete tank foundation on the inside of the secondary containment area and to concrete dike walls that enclose the perimeter of the secondary containment area. Pipe penetrations through the secondary containment area, such as piers and pipe supports, are also sealed to the FML, preventing product from seeping through the liner along the pipe.

8-10.5.1 Inspection and Maintenance – Flexible Membrane Liners.

- a. Remove vegetation growing in the gravel and dirt, taking note if the roots have penetrated the FML.
Frequency: Daily
- b. Visibly inspect FMLs where attached to ringwalls, dike walls, concrete piers and other projections for deterioration due to weather or wear and repair as necessary.
Frequency: Quarterly
- c. Visually inspect FMLs covered with smooth rock or gravel for bare spots where the gravel has been washed away due to storms or heavy rains for tears. Replace gravel taking care not to puncture the liner.
Frequency: Quarterly
- d. Visually inspect exposed FML for tears or punctures and repair.
Frequency: Quarterly

8-10.6 Pipe Penetrations.

Some pipe penetrations through containment walls incorporate a pipe sleeve through which the carrier pipe is placed. The carrier pipe is sealed to the pipe sleeve with a link-type mechanical compression seal at both ends. Boot seals between the end of the pipe sleeve and the carrier pipe are sometimes added as an additional containment measure.

In some cases the carrier pipe directly penetrates concrete containment paving and walls. In these cases, the space between the carrier pipe and the concrete paving or wall is sealed with fuel resistant sealant.

8-10.6.1 Inspection and Maintenance – Pipe Penetrations.

- a. Inspect boot seals and mechanical link-type seals for wear and cracking. Ensure the seals are in good working order to seal out water or retain the petroleum product as intended. Repair or replace defective boot and link-seals.

Frequency: Quarterly

- b. Inspect sealant between pipes and concrete walls, berms, and floors. Sealant that has retracted from the concrete or pipe surfaces must be removed and replaced with new fuel resistant sealant.

Frequency: Semi-annually

8-11 MISCELLANEOUS USE TANKS.

8-11.1 Miscellaneous Use Tanks.

Miscellaneous tanks include electric generator tanks, fire pump tanks, waste oil tanks, ballast water tanks, lube oil tanks, and others. In most cases standalone tanks are below 10,000 gallon (37,850 liter) capacity and fall into the shop fabricated category and are designed and built to UL 142, UL 2080 or UL 2085 standards. However, in some cases the tanks are large field erected tanks and fall into the vertical or cut and cover category. In some cases the tanks are integrated into the system or skid and are built to the skid manufacturer's specifications. This occurs with generator or fire pump belly tanks.

8-11.1.1 Inspection and Maintenance – Miscellaneous Use Tanks.

- a. Standalone aboveground tanks that fall into the vertical field erected category must follow the inspection and maintenance requirements listed in [Section 8-4 Field-Erected Tanks](#).
- b. Standalone tanks that fall into the shop fabricated tank category must follow the inspection and maintenance requirements listed in [Section 8-5 Shop-Fabricated Tanks](#).
- c. Standalone tanks that fall into the cut and cover category must follow the inspection and maintenance requirements listed in [Section 8-6 Underground Field-Constructed Tanks](#).
- d. Integrated tanks that are supplied as part of an equipment skid or system must follow manufacturer's inspection and maintenance recommendations.

8-11.1.2 Generator Tanks and Fire Pump Tanks.

These tanks typically hold diesel or kerosene-based fuel use with piston driven engines to operate electrical generators and fire water pumps.

8-11.1.3 Waste Oil Tanks.

Waste oil tanks store petroleum products that are not suitable for use or reclamation. This product is typical stored until appropriate quantities are accumulated for economical sale or disposal. Waste oil tanks take on many types of configurations, and for integrity testing and maintenance, are considered petroleum tanks.

8-11.1.4 Ballast Water Tanks.

Ballast water tanks are used to store water-fuel mixtures that are pumped from marine vessel fuel tanks.

8-11.1.5 Lube Oil Tanks.

Lube oil tanks are used to store and distribute lube oil for turbines and gears, hydraulic equipment and general mechanical lubrication.

8-11.1.6 Additive Tanks.

Additive tanks store bulk additives used to additize jet fuel. They are typically small aboveground tanks.

8-11.1.7 Heating Oil Tanks.

These tanks typically include heating coils which are used to preheat oil before it can be used. These tanks may be field erected tanks, shop fabricated, or cut and cover tanks.

8-11.1.7.1 Inspection and Maintenance – Heating Oil Tanks.

Refer to [Section 8-9.16 Heating Coils](#) for inspection and maintenance requirements of heating coils.

CHAPTER 9 ELECTRICAL SYSTEMS

9-1 ELECTRIC CONTROL SYSTEMS AND EQUIPMENT.

9-1.1 Scope and Limitations.

The intent of this section is to provide guidelines for maintenance of electrical equipment rated for up to 1,000V. The intended audience is electrical maintenance staff or electrical contractors who are engaged in performance of electrical maintenance. Electrical work must be completed by qualified/licensed electricians equipped with the proper PPE (e.g., Arc Flash, CPR, First Aid) for the type of work conducted. The recommended procedures are not intended to contradict electrical codes. The main objectives of this section are:

- To outline procedures to maintain optimal operating conditions of the electrical equipment.
- To establish a system for early detection of potential faults in electrical equipment in an effort to plan repair or replacement before catastrophic failure occurs.

If in the process of implementing the outlined procedures it is determined that more extensive testing is required, then such tests should be performed in accordance with the applicable codes. Due to safety concerns, the maintenance of equipment rated above 1,000V is not addressed. This equipment must be maintained only by specially trained personnel in accordance with manufacturer's recommendations.

9-1.2 Electrical Equipment.

Maintenance procedures for electrical equipment usually require enclosures to be opened, inspected and cleaned. This poses higher risk of injury than during normal operation and basic rules for electrical safety should be followed:

- Always follow approved lockout/tagout procedures.
- Never work alone when testing electrical equipment. A second person who is First Aid and CPR qualified should be present.
- Never work on energized equipment. Tests that require energized equipment should be performed by specially trained and licensed personnel.
- Use V-rated tools and V-rated gloves. V-rated tools are tools rated and tested for the maximum line-to-line voltage upon which work will be done. V-rated gloves are gloves rated and tested for the maximum line-to-line voltage upon which work will be done.
- Use appropriately rated Personal Protective Equipment (PPE) as indicated by arc flash hazard warning labels as required by NFPA 70E. If such labels are not installed, perform arc flash hazard analysis before

implementing electrical maintenance procedures to determine the appropriate level of PPE.

The preceding list is not exhaustive and does not intend to contradict safety requirements mandated by codes or regulations.

9-1.2.2 Inspection and Maintenance – Electrical Equipment.

- a. Electrical control systems include: deadman control; ground verification systems; EFSO operation; control panels, motor control, and pump start/stop buttons. These systems must be tested on a periodic basis to ensure proper operation and functionality. In addition, control system Uninterruptible Power Supplies (UPS) must be inspected and replaced as necessary.

Frequency: Quarterly

9-1.3 Power Cables.

The assessment of cable condition is performed mainly by visual inspections. Based on the observations, certain cables may be scheduled for dielectric testing. Visual inspection is usually done while inspecting the equipment to which the cable is connected. Moving or touching of the cables must only be done when the system is de-energized and locked out.

9-1.3.1 Inspection and Maintenance – Power Cables.

- a. Visual inspection: Verify that there are no sharp bends. Verify that the cable insulation is intact. Verify that cables are appropriately tagged or otherwise identified. Verify that all connections are tight and not corroded. Open manholes and handholes. Verify that they are not flooded, clogged with debris or infested by pests.

Frequency: Annually

- b. Insulation resistance test: This test measures the resistance of the insulation with an Insulation Resistance Tester. During the test, the cable will be disconnected from both ends. Acceptable test values are 100 megohms for cables rated between 120V to 1,000V. Insulation resistance testing for voltages higher than 1,000 V is to be performed by specialized testing company.

Frequency: As needed based on visual inspection

9-1.4 Motor Controls.

Motor control equipment generally refers to the following: across the line motor starters, reduced voltage auto transformer starters, wye delta starters, partial winding starters, solid state starters, reversing starters, and adjustable frequency drives. All motor control equipment has common components which can be classified as:

- a. Overcurrent and overload protective device – circuit breaker or fuse.
- b. Electromagnetic contactor.
- c. Control logic elements (e.g., relays, switches, pushbuttons).

The motor control equipment may be installed in a motor control center (MCC) or in a standalone enclosure dedicated to a single starter. Usually this equipment is installed in electrical rooms and is protected from the elements. However, standalone enclosures are sometimes located in close proximity to the driven equipment and are exposed to the elements. In such cases special attention should be paid to the physical condition of the enclosure. The maintenance of motor control equipment should be performed together with the maintenance of the motor.

9-1.4.1 Inspection and Maintenance - Motor Controls.

- a. Verify the labeling is consistent with the drawings and specifications.
Frequency: Semi-annually
- b. Verify that pushbuttons are easy to operate and are not stuck. Verify that there is no grease accumulation around the seating.
Frequency: Semi-annually
- c. Verify that indicating lights are functional and replace as needed.
Frequency: Semi-annually
- d. Verify that electrical and mechanical interlocks operate according to the design intent. In case of key interlocks, ensure that the number of keys corresponds to the interlock intent. Having more keys than required defeats the intent of the interlocking and poses danger to the service personnel and equipment. If extra keys are found, they should be removed from the equipment.
Frequency: Semi-annually
- e. Inspect the enclosure for visible signs of corrosion.
Frequency: Interior annually/interior semi-annually
- f. Open the enclosure – be mindful of insects, rodents and reptiles, particularly if located outdoors. Look for signs of corrosion, dust accumulation, spider webs, etc. Clean the enclosure with compressed air and apply rust inhibitors and paint as needed.
Frequency: Annually
- g. Inspect the overcurrent protective devices for proper seating. Verify that rating is appropriate for the motor. Look for signs of attached wire and device overheating.
Frequency: Annually

- h. Inspect the arch shoots of contactors and clean as needed. Check that partitions are not burned.
Frequency: Annually
- i. Inspect contactors for abnormal wear. Check contacts for pitting, roughness and oxidation. Verify that contact gap, alignment and pressure are in accordance with manufactures recommendations.
Frequency: Annually
- j. When contactors are used, listen for the chatter of contacts or buzzing noise. These are indicative of a faulty contactor.
Frequency: Annually
- k. Verify that relays and switches are firmly seated in their bases and there are no signs of overheating or vibration.
Frequency: Annually
- l. Look for frayed or broken strands in the flexible control wiring and replace if such are found.
Frequency: Annually
- m. Perform a functional test of protective devices if they are equipped with self-testing circuits or switches.
Frequency: Annually
- n. Perform a functional test of all manual switches and verify proper operation against intended design logic. Replace switches and relays if operation is not satisfactory.
Frequency: Annually
- o. Perform insulation resistance test for the control wiring.
(Note: Testing of the control wires may require substantial down time. Therefore, this should only be performed on a case by case basis if there are reasons to suspect that the insulation of the control wiring is deteriorating.)
Frequency: As required

9-1.5 Panelboards.

Panelboards are used to control power supply to equipment, buildings, and structures.

9-1.5.1 Inspection and Maintenance – Panelboards.

Conduct the following actions to complete the inspection:

- a. Verify that there are no physical obstructions blocking access to the panelboard. Remove physical obstructions.
Frequency: Quarterly

- b. Inspect the enclosure and the surrounding area for water damage and corrosion.
Frequency: Annually
- c. Verify that all breakers are either in the “On” or the “Off” position. If there are tripped breakers, investigate the cause of the trip.
Frequency: Annually
- d. Verify that there is a breaker schedule. If there is no breaker schedule or the schedule is worn and out-of-date, create and post a new one.
Frequency: Annually
- e. Verify that the breaker operation matches the description on the panel schedule.
Frequency: Annually
- f. Observe breakers, wires and terminals for signs of overheating or short circuiting.
Frequency: Annually
- g. Verify that all breakers are firmly seated and locked in place by slightly shaking them.
Frequency: Annually
- h. Verify that all grounding wires are firmly connected to the grounding bar.
Frequency: Annually
- i. If a breaker malfunction is identified, leave breaker in the open position and replace as soon as possible. If a breaker cannot disconnect its circuit, the entire panelboard must be switched off using its main disconnecting means and locked out until the breaker is repaired.
Frequency: Annually

9-1.6 Grounding Systems.

Visual inspection of the integrity of the grounding should be performed together with the visual inspection of the grounded equipment, such as motors, motor control centers, piping, filter vessels, petroleum fuel tanks, and transformers. A typical facility will include two types of grounding systems: power grounding and static grounding. Power grounding provides a low-impedance path for the fault current in case of equipment, conductor, and raceway failures. Static grounding provides a path for static electricity discharge to dissipate static electricity build up on equipment.

9-1.6.1 Inspection and Maintenance – Power Grounding Systems.

- a. The connections to the grounding system must be surveyed and verified for continuity. If a connection is suspected to be loose, perform further testing. In some occasions, it is more cost effective to replace the suspected connection instead of performing diagnostic tests.
Frequency: Annually

- b. Measure the voltage between the equipment grounding conductor and the electrode grounding conductor (usually bare copper). Investigate test results above 3 VAC for a potential ground fault.
Frequency: Annually
- c. Measure the voltage between the chassis of the equipment and the electrode grounding conductor. Investigate if the readings exceed 2 VAC.
Frequency: Annually
- d. Facility ground resistance check: This type of testing is performed with a four lead, low resistance ohmmeter or digital ohmmeter. Recommended values are between 3 and 5 ohms. In no case should the grounding resistance be higher than 25 ohms.
Frequency: Every five years

9-1.6.2 Inspection and Maintenance – Static Grounding Systems.

- a. Inspect ground reels for corrosion. Ensure ground reels are securely mounted to a rigid base. Inspect clamps for serviceability. Replace clamp if jaws are deformed or corroded, spring is weak, or other defects are evident that would prevent a good connection. Inspect cable wires. Replace if more than one-third of the cable wires are broken.
Frequency: Quarterly
- b. The connections to the grounding system must be surveyed and verified for continuity. If a connection is suspected to be loose, perform further testing. In some occasions it is more cost effective to replace the suspected connection instead of performing diagnostic tests.
Frequency: Annually
- c. Resistance measurement on static grounds: Measure static ground resistance of new and damaged ground rods. Static ground with a resistance greater than 10,000 ohms will be removed or replaced. Static ground mechanically damaged will be repaired and retested.
Frequency: When observed to be physically damaged.

9-1.7 Electric Motors.

- a. Based on the operational parameters, motors can be classified as:
 - Induction (squirrel cage or asynchronous) motors: These are the most common type and widely used in pumps, fans and other industrial equipment.
 - Synchronous motors: These are usually relatively large (500 hp and above) and are used when constant speed is required regardless of the torque on the shaft or power factor correction needed.

- DC motors: These type of motors are rare in industrial applications and are used mainly in traction, cranes and sometimes in elevators.
- b. Depending on the applied voltage, motors can be:
- Low voltage (< 1,000V).
 - Medium voltage (2,300V to 6,000V). These motors are usually rated 300 hp to 15,000 hp (225 kW to 11.2 MW).
- c. Depending on the number of phases, motors are:
- Single phase: Usually small motors less than 10 hp (7.5 kW) and often less than 3 hp (2.2 kW).
 - Three phase: Most commonly used for industrial applications larger than 0.5 hp (375 W).
- d. The maintenance of synchronous and DC motors should be performed by specialized companies and in accordance with the written instructions of the motor manufacturer.

9-1.7.1 Inspection and Maintenance – Electric Motors.

Refer to manufacturer's operation and maintenance manual for specific maintenance procedures and schedules associated with a specific model of motor. Follow all applicable general maintenance and safety requirements listed in the manufacturer's operation and maintenance manual.

- a. Lubricate motor bearings and inspect for vibration and overheating.
Frequency: Quarterly
- b. Check for debris and other foreign material in the fan housing.
Frequency: Semi-annually
- c. Check motor ground wires. Ensure they are firmly connected to the housing or the junction box.
Frequency: Annually
- d. If the motor is installed in a hazardous location, verify that the seals of the connection boxes and conduits are intact.
Frequency: Annually

9-1.8 Lighting.

The purpose of the lighting maintenance is to ensure a relatively constant illumination level and lighting quality for internal and external lighting systems. Most often, the lighting maintenance involves lamp replacement. There are two possible approaches for regular lamp replacement:

1. Spot re-lamping is performed when the lamps in a light fixture are replaced on an as-needed basis. If there is more than one lamp in the light fixture, it is recommended to replace all of the lamps at the same time. This ensures more uniform light output and equal utilization of the lamps.
2. Group re-lamping involves simultaneous replacement of all lamps in a given area regardless of whether they are operational or not.

9-1.8.1 Inspection and Maintenance – Lighting.

- a. Verify proper operation of light switch, lighting contactor, photocell or timer as appropriate. If a lighting contactor is used, listen for the chatter of contacts or buzzing noise. These are indicative of a faulty contactor. Replace if required.
Frequency: Annually
- b. With the lights turned on, observe individual luminaires for flicker or lights turning on and off. The former is indicative of a faulty choke. The latter is indicative of a faulty starter. Replace the faulty components as required.
Frequency: Annually
- c. When light fixtures are located in hazardous areas, verify that the seals are intact and the hazardous rating of the fixture is maintained.
Frequency: Annually
- d. Thoroughly clean dust, bugs, and debris from the luminaires. Light solvents or cleaning agents may be used.
Frequency: Annually (in dusty areas the luminaires may require cleaning at shorter intervals)
- e. Re-Lamping: With the lights turned off, replace the lamps. In order to prevent accidental turning on of the lights, it is mandatory to switch off and lockout the breaker of the lighting circuit. Ensure the replacement lamps are the same type as those they are replacing. Verify the proper operation of all light fixtures after the lamp replacement.
Frequency: Annually or as required

9-1.9 Electronic Equipment.

Electronic equipment usually operates at voltages less than 120 V and does not have rotating components. As a result, electronic equipment tends to accumulate dust, which interferes with cooling. Overheating is the most likely cause for failure of electronic equipment.

9-1.9.1 Inspection and Maintenance - Electronic Equipment.

If the inspection and maintenance of the equipment does not require functional and operational testing, de-energize and lockout the power source to the equipment.

- a. Inspect the outside of the equipment enclosures for dust and evidence of corrosion. Vacuum clean the dust to ensure unobstructed air circulation.
Frequency: Annually
- b. Open the enclosure and vacuum clean the dust to ensure unobstructed air circulation. Pay particular attention to fans and air passages. If there is evidence of corrosion, verify that there is no water damage on printed circuit boards or contacts. If water or humidity damage is observed, the electronic components may not work properly and further testing is required.
Frequency: Annually
- c. Verify proper operation of the space heater if one is installed.
Frequency: Annually
- d. Check fans for proper operations and rotation.
Frequency: Annually
- e. Look for signs of overheating such as discoloration and charring.
Frequency: Annually
- f. Replace air filters.
Frequency: Annually or more frequently based on local environmental conditions.
- g. Verify connection tightness. Lightly pull wires on soldered and terminal screws and ensure the wires are not loose.
Frequency: Annually
- h. Verify that circuit boards are properly seated. Ensure that board locking tabs are fully engaged. Do not unplug and plug connectors to verify seating. This will wear out the pins. Unplug only if connector malfunction is suspected.
Frequency: Annually
- i. Observe wires for excessive strain, braiding, or wear due to vibration. Replace as required.
Frequency: Annually

9-2 CATHODIC PROTECTION SYSTEMS.

9-2.1 Cathodic Protection.

Cathodic protection must be maintained by appropriately trained personnel (NACE CP tester certified). Personnel must ensure the cathodic protection system is maintained in accordance with UFC 3-570-06 and the most stringent of applicable host nation, Federal, state or local regulations.

Cathodic protection systems are installed on underground piping systems, at the bottom of steel tanks, on underground steel tanks, and on marine pier and anchor systems.

Cathodic protection systems are used to prevent corrosion of these systems and are specifically designed for the system that they are intended to protect.

9-2.1.1 Inspection and Maintenance - Cathodic Protection.

- a. Inspect rectifiers in accordance with UFC 3-570-06.
Frequency: Every two months
- b. Inspect cathodic protection systems in accordance with UFC 3-570-06.
Frequency: Annually

9-2.2 Electrical Isolation.

Electrical isolation components and lightning surge arresters are installed on underground piping systems as part of a complete corrosion protection system.

9-2.2.1 Lightning Surge Arresters.

Lightning surge arresters are devices that protect dielectric insulating flanges from over-voltage transients. These transients are caused by lightning or AC fault currents. The arresters block AC and DC voltages up to a predetermined voltage threshold. Upon voltage exceeding the threshold, the arrester allows the current to safely pass around the insulating flange.

9-2.2.1.1 Inspection and Maintenance – Lightning Surge Arresters.

- a. Newer lightning surge arresters are designed to withstand unlimited surges at 50,000 amperes; however, manufacturers of older surge arresters may provide a maximum number of surge events that can occur before it must be replaced. If surge arresters include a maximum number of surge events, a spare arrester must be kept on hand. Refer to the surge arrester manufacturer's operation and maintenance manual for particular inspection instructions and parts. Inspect as part of an overall cathodic protection system inspection.
Frequency: Annually

9-3 CARD AND KEY LOCKS.

Card and proximity readers are used at Automated Fuel Service Station (AFSS) to activate the systems. Card and key lock system issues must be called into the Business System Modernization-Energy (BSME) Help Desk for all issues outside of the annual preventive maintenance visits.

9-3.1 Inspection and Maintenance - Card and Key Locks.

- a. Conduct operational check of card and key lock system and ensure that all features provided with the installed system are operational.
Frequency: Annually

9-4 LIGHTNING PROTECTION SYSTEMS.

Lightning protection systems are typically designed to 11V1/UFC 3-575-01. The systems include air terminals that are installed on top of buildings, canopies, or tall equipment. The air terminals are connected together with heavy-gauge copper or aluminum wires. These copper or aluminum wires are also attached to grounding loops or ground rods installed at the base of the building, canopy, or equipment.

9-4.1 Inspection and Maintenance – Lightning Protection Systems.

- a. Inspect air terminals to make sure they are securely attached to the roof of the building, canopy, or the piece of equipment. Check all connections between the air terminals and the grounding loop or grounding rods. Repair damaged or loose connections and perform continuity check after repairs.

Frequency: Annually

9-5 GROUND VERIFICATION SYSTEMS.

Ground verification systems are used in petroleum fuel truck and rail offloading and loading systems. The systems are used to verify that the trucks or rail cars are grounded. In most cases, the systems are interlocked with the receipt or issues controls and will prevent the receipt or issue system from operating if an acceptable ground connection between the truck or rail car and the fueling system is not detected.

9-5.1 Inspection and Maintenance – Ground Verification Systems.

- a. Conduct an operational check of the ground verification system and ensure that all features provided with the installed system are operational. Inspect the plug for corrosion, weakness, or loose nuts and replace if heavily dented or deformed.

Frequency: Quarterly

9-6 ELECTRONIC OVERFILL PROTECTION SYSTEMS.

Overfill protection systems are used on petroleum fuel truck and rail issue systems. In some cases, overfill protection switches are permanently installed on petroleum fuel trucks or rail cars. In other cases, probes from the system are applied to the trucks or rail cars at the time of petroleum fuel issue. The overfill protection systems are interlocked with petroleum fuel issues systems and will stop the issue process if a high petroleum fuel level is detected in a truck or rail car.

9-6.1 Inspection and Maintenance – Electronic Overfill Prevention Systems.

- a. Conduct operational check of overfill prevention system and ensure that all features provided with the installed system are operational.

Frequency: Quarterly

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CHAPTER 10 ALTERNATE POL FACILITIES

10-1 LIQUEFIED PETROLEUM GAS.

This section includes inspection and maintenance information related to Liquefied Petroleum Gas (LPG) storage and distribution systems. These systems differ from typical fuel systems due to the pressures involved and are covered by additional regulations. LPG systems must follow the equipment, installation and maintenance requirements listed in NFPA 58. Operation and maintenance manuals required for LPG systems by NFPA 58 must be developed for each installation.

10-1.1 Liquefied Petroleum Tanks.

Liquefied petroleum tanks are pressure vessels with typical maximum allowable working pressure of 250 psig. These tanks are built to ASME standards for non-fired pressure vessels. These tanks follow the requirements listed in NFPA 58 and API 2510.

10-1.1.1 Inspection and Maintenance – Liquefied Petroleum Tanks.

- a. Inspect fuel tank for leaks. If a leak is occurring, the odorizing agent of the gas should be detectable. Use a soap and water solution to spray on areas suspected of leaks. Systems that are found with leaks must be taken out of service.
Frequency: Monthly
- b. Test operation of emergency shutoff valves. Ensure the fusible link mechanism is attached properly to actuate in case of a fire and that it has not been by-passed, blocked, or damaged in any manner. Ensure the fusible link is not filled with debris or paint which could impact operation.
Frequency: Semi-annually
- c. Check settings of tank safety valves and calibrate if required.
Frequency: Every 5 Years

10-1.2 Liquefied Petroleum Pipelines.

Liquefied petroleum lines transfer liquefied petroleum gas between the delivery vehicle and the storage tanks, and between vaporizers and other equipment and storage tanks. These lines operate at the storage pressure of the tank.

10-1.2.1 Inspection and Maintenance – Liquefied Petroleum Pipelines.

- a. Conduct visual inspection of pipelines for potential damage and leak points. Use a soap and water solution to spray on areas suspected of leaks. Systems that are found with leaks must be taken out of service and repaired.
Frequency: Monthly

- b. Inspect coatings and markings on piping. Repair coating deterioration and replace labels that are fading and are difficult to read.
Frequency: Semi-annually

10-1.3 Liquefied Petroleum Vapor Lines.

Liquefied petroleum vapor lines are used to transfer vaporized petroleum gas between the delivery vehicle and the LPG tank and from the LPG tank to use points. Vapor transfer between the LPG tank and the delivery vehicle is at the tank operating pressure and transfer from the tank to the use points is typically at a reduced pressure.

10-1.3.1 Inspection and Maintenance – Liquefied Petroleum Vapor Lines.

- a. Inspect vapor lines for leaks. If leaks are occurring, the odorizing agent in the gas should be detectable. Use a soap and water solution to spray on areas suspected of leaks. Systems that are found with leaks must be taken out of service and repaired.
Frequency: Monthly
- b. Inspect coatings and markings on piping. Repair coating deterioration and replace labels that are fading and are difficult to read.
Frequency: Semi-annually

10-1.4 LPG Vaporizers.

At large use points, vaporizers are used to vaporize the pressurized liquid into gas for use.

10-1.4.1 Inspection and Maintenance – LPG Vaporizers.

- a. Inspect vaporizers for leaks. If leaks are occurring, the odorizing agent in the gas should be detectable. Use a soap and water solution to spray on areas suspected of leaks. Systems that are found with leaks must be taken out of service and repaired.
Frequency: Monthly
- b. The manufacturer maintenance schedules and recommendations provided with the LPG vaporizer must be followed.
Frequency: As required

10-1.5 Petroleum Gas Regulators.

Regulators are used to reduce the pressure of petroleum gas before it is used or transferred to the use point.

10-1.5.1 Inspection and Maintenance – Petroleum Gas Regulators.

- a. Inspect petroleum gas regulators for leaks. If leaks are occurring, the odorizing agent in the gas should be detectable. Use a soap and water solution to spray on areas suspected of leaks. Systems that are found with leaks must be taken out of service and repaired.

Frequency: Monthly

10-1.6 Liquefied Petroleum Gas Hoses.

Liquefied petroleum gas hoses are used to transfer liquid and vapor between LPG storage tanks and delivery vehicles.

10-1.6.1 Inspection and Maintenance – Liquefied Petroleum Gas Hoses.

- a. Inspect hoses for damage and leaks. If leaks are occurring, the odorizing agent in the gas should be detectable. Use a soap and water solution to spray on areas suspected of leaks. If leaks are detected from a hose discontinue use of the hose and remove it from service. Inspect for damage to outer cover that exposes reinforcement. Inspect for kinks or flattened areas, soft spots or bulges. Inspect couplings and ensure they have not slipped on the hose or been damaged.

Frequency: Annually

10-2 COMPRESSED NATURAL GAS (CNG).

This section includes inspection and maintenance information related to compressed natural gas systems. These systems used compressed gas at pressures up to 5,000 psig (34.5 MPa). CNG systems must follow the equipment, installation and maintenance requirements listed in NFPA 52. Operation and maintenance manuals required for CNG stations by NFPA 52 must be developed for each installation.

10-2.1 CNG Piping.

CNG piping is used between the natural gas source and the compressor. It is also used between the compressor and the CNG tubes or storage tanks and storage and the CNG dispenser. The lines vary from low pressure to high pressure. Some CNG lines may have pressure ratings as high as 5,000 psig (34.5 MPa).

10-2.1.1 Inspection and Maintenance – CNG Piping.

- a. Inspect CNG lines for leaks. Inspection of high-pressure CNG lines and equipment must be conducted using proper PPE including but not limited to safety glasses, a face shield, hard hat and fire resistant clothing. If leaks are occurring, the odorizing agent in the gas should be detectable. Use a soap and water solution to spray on areas suspected of leaks. Systems

that are found with leaks must be taken out of service and repaired.

Frequency: Daily

- b. Inspect coatings and markings on piping. Repair coating deterioration and replace labels that are fading and are difficult to read.

Frequency: Semi-annually

10-2.2 CNG Compressors.

Compressors are used to boost the pressure of natural gas from the supply pressure to the high-pressure tube storage pressure. The compressors include up to four stages of compression and are driven by electrical motors or natural gas engines. Designs of compressors and compressor drivers vary by manufacturers.

10-2.2.1 Inspection and Maintenance – CNG Compressors.

- a. Compressors will require maintenance based on the model included in the system. Consult the compressor manual for manufacturer's maintenance requirements.

Frequency: As required

10-2.3 CNG Storage.

High-pressure tubes or spherical storage tanks are used to store CNG at pressures of up to 5,000 psig (34.5 MPa). The tubes and tanks should be ASME stamped pressure vessels. The tubes are typically assembled in bundles of twenty (20).

10-2.3.1 Inspection and Maintenance – CNG Storage.

- a. Inspect CNG tubes and tanks for leaks. Inspection of high-pressure CNG lines and equipment must be conducted using proper PPE including but not limited to safety glasses, a face shield, hard hat and fire resistant clothing. If leaks are occurring, the odorizing agent in the gas should be detectable. Use a soap and water solution to spray on areas suspected of leaks. Systems that are found with leaks must be taken out of service and repaired.

Frequency: Daily

- b. Inspect coatings and markings on storage tubes or tanks. Repair coating deterioration and replace labels that are fading and are difficult to read.

Frequency: Semi-annually

- c. Check operation and calibration of safety valves on tubes and tanks.

Frequency: Every 3 years

10-2.4 CNG Dispensers

Dispensers (Vehicle Fuel Appliances) are used to transfer CNG between storage tubes or tanks and CNG vehicle storage tanks. The system uses a series of valves to cascade the compressed gas from the tubes or tanks into the vehicle storage tank.

10-2.4.1 Inspection and Maintenance – CNG Dispensers

- a. Dispensers are listed for service with CNG and will vary by manufacture. Consult the maintenance manual that was supplied with the system for manufacturer's maintenance required for the CNG dispenser.
Frequency: As required

10-2.5 CNG Dispenser Hoses.

Hoses and fill adaptors are used to make the connection between the CNG dispenser and the vehicle storage tank.

10-2.5.1 Inspection and Maintenance – CNG Dispenser Hoses.

- a. Inspect hoses for damage, leaks, and cracks. If leaks are occurring, the odorizing agent in the gas should be detectable. Use a soap and water solution to spray on areas suspected of leaks. If leaks are detected from a hose, discontinue the use of the hose and remove it from service.
Frequency: Monthly
- b. Test hoses for leaks following manufacturer recommended frequencies and procedures.
Frequency: As required

10-3 HYDRAZINE CHARGING UNITS.

Hydrazine is transferred from 55 gallon (208 liter) drums to small aircraft holding tanks by a closed system charging unit.

10-3.1 Inspection and Maintenance – Hydrazine Charging Units.

- a. Hydrazine charging units are self-contained factory fabricated systems. Refer to the manufacturer's maintenance manual that was provided with the system for required periodic maintenance.
Frequency: As required

10-4 JP-10.

JP-10 is a gas turbine fuel developed for missiles. Maintenance for JP-10 system components should follow maintenance requirements for fuel system components listed in this document.

10-5 OTTO.

Information on OTTO fuels is contained in Naval Sea Systems Command (NAVSEA) S6340-AA-MMA-010. Distribution of this document is restricted. Requests for information are handled by Naval Sea Systems Command.

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CHAPTER 11 SUPPORT FACILITIES

11-1 SECONDARY CONTAINMENT.

The military services assign responsibility for inspection, maintenance, and draining of secondary containment structures to various organizations (including contractors).

Those organizations or contractors must inspect and maintain secondary containment structures in accordance with military service-specific directives or applicable contract requirements. Refer to [Section 8-10 Containment Systems](#) for tank secondary containment inspection and maintenance procedures.

11-1.1 Fuel Truck \1\ and Rail Car /1/ Containment Areas.

Fuel truck \1\ and rail car /1/ containment areas such as refueler parking areas, refueler loading areas, and commercial truck offloading \1\ and loading areas, rail car loading and offloading /1/ areas are equipped with secondary containment. Typically these areas are provided with security fence and overhead lighting.

11-1.1.1 Inspection and Maintenance – Fuel Truck \1\ and Rail Car /1/ Containment Areas.

- a. Remove debris from around security fence.
Frequency: Monthly
- b. Inspect fence grounding points. Ensure connections are not loose or damage.
Frequency: Monthly
- c. Inspect the parking area for cracks in the concrete containment paving and curbs. Remove vegetation that may have established roots in the buildup of dirt or from exposed earth under cracks. Thoroughly clean and seal cracks with a fuel resistant sealant.
Frequency: Quarterly
- d. \1\ Secondary containment systems degrade and will collect debris which can clog drainage inlets or prevent drain valves from sealing properly. Hydrostatically test secondary containment and associated drainage systems to include containment concrete/sealant, drain inlets, drain lines and containment drain valves to ensure containment is liquid tight. This test may use opportune rainfall by holding rainwater in the containment system for one hour. Where evaporation is a concern, conduct the testing when this concern would be minimized, such as at night/early morning or during a time of year when this would not be as much of an issue. Record the water level at the start of a 60-minute (minimum) hold period and if the water level drops by 1/8 inch or more, perform and record an investigation to determine the cause and any required repairs. Once repairs are

completed, a new test must be completed. Refer [Appendix B](#) for testing procedures and to document the testing. /1/

Frequency: \1\ Every 3 years /1/

- e. Verify continuity of vehicle grounding system connections. If a connection is suspected to be loose, perform further testing. In some occasions it is more cost effective to replace the suspected connection instead of performing diagnostic tests.
Frequency: Annually
- f. Inspect pavement markings and vehicle movement lines for wear and fading. Repair faded or worn pavement markings.
Frequency: Annually
- g. Inspect security fence for wear and rust. Inspect barbed wire and ensure it is adequately secured to outriggers. Repair loose fencing components and coatings at areas that show rust.
Frequency: Annually
- h. Refer to [Section 9-1.8 Lighting](#) for inspection and maintenance requirements of area lighting.

11-1.2 Remote Spill Containment.

Fuel truck parking, loading and offloading areas \1\ and rail car loading and offloading areas, /1/ are typically equipped with remote containment basins. These basins are used to increase the overall containment volume of the system. The basins are constructed of concrete walls and a concrete floor.

11-1.2.1 Inspection and Maintenance – Remote Spill Containment.

- a. Inspect the remote containment basin for cracks in the concrete containment paving, walls, and curbs. Remove vegetation that may have established roots in the buildup of dirt or from exposed earth under cracks. Thoroughly clean cracks with a water spray or air jet. Seal cracks with a fuel resistant sealant.
Frequency: Quarterly
- b. If equipped, inspect spill containment sump pump for proper operation.
Frequency: Quarterly
- c. \1\ Secondary containment systems degrade and will collect debris which can clog drainage inlets or prevent drain valves from sealing properly. Hydrostatically test secondary containment and associated drainage systems to include containment concrete/sealant, drain inlets, drain lines and containment drain valves to ensure containment is liquid tight. This test may use opportune rainfall by holding rainwater in the containment system for one hour. Where evaporation is a concern, conduct the testing when this concern would be minimized, such as at night/early morning or

during a time of year when this would not be as much of an issue. Record the water level at the start of a 60-minute (minimum) period and if the water level drops by 1/8 inch or more, perform and record an investigation to determine the cause and any required repairs. Once repairs are completed, a new test must be completed. Refer [Appendix B](#) for testing. /1/.

Frequency: \1\ Every 3 years /1/

11-2 PROTECTIVE SHELTERS.

11-2.1 Pumphouse/Filter Buildings.

Pump and filter equipment is typically enclosed within a building or covered by a shelter. These buildings can be constructed of pre-engineered metal or concrete. The floors of these areas should provide secondary containment for the piping and equipment that is installed in the building or under the shelter.

11-2.1.1 Inspection and Maintenance – Pumphouse/Filter Buildings.

- a. Inspect the floor and containment curbs for cracks. Thoroughly clean cracks with a water spray or air jet. Seal cracks with a fuel resistant sealant.

Frequency: Annually

- b. Refer to \1\ UFC 3-110-03 /1/ for inspection and maintenance requirements of pumphouse and filter building roof systems.

11-2.2 Canopies.

Canopies are used to cover service station dispensers, containment basins, fuel truck loading and offloading equipment, and equipment installed in remote areas.

11-2.2.1 Inspection and Maintenance – Canopies.

- a. Inspect and maintain canopies in accordance with \1\ UFC 3-110-03 /1/.

11-3 SAFETY SHOWERS AND EYEWASH FOUNTAINS.

Emergency safety showers and eyewash fountains are installed around fueling areas and pumphouses. They are typically equipped with an activation alarm that energizes a strobe light and horn. In some cases emergency eyewash/showers are equipped with tempered water systems that supply warm water to the emergency eyewash/shower.

11-3.1 Inspection and Maintenance – Emergency Eyewash/Showers.

- a. Test operation of the emergency eyewash/shower by pushing on the activation handles. Ensure the water is not brown in color, due to rust in the piping or dirt seeping in from a hole in the buried piping. For systems

with tempered water, ensure that the water that is being supplied by the emergency eyewash/shower is between 60 and 100 °F (16 and 39 °C). For systems with a horn and strobe light, ensure that the horn and strobe light activate when the activation lever on the emergency eyewash/shower is pushed. For systems that interface with Installation or fire emergency systems, pre-coordinate before testing. At some Installations emergency eyewashes and showers act as EFSOs and are tied into the fire alarm systems.

Frequency: Weekly

- b. Inspect portable/package safety showers and eyewash stations for proper operation. Check fluid levels. Where tap water is used, fluid must be replaced monthly. Less frequent intervals of fluid change, as recommended by the manufacturer, are acceptable where a solution or water additive is used. Ensure packaged eyewash supplies are within the listed expiration date. Tags or labels must be attached to the unit or adjacent to it, indicating the fluid change schedule.

Frequency: Monthly

- c. Inspect the exterior coatings of permanently installed units and repair damaged coatings or rust.

Frequency: Quarterly

- d. For systems with tempered water systems inspect components of the water heater for correct operation and temperature control. Ensure that the safety valve on the hot water heater tank is not leaking.

Frequency: Semi-annually

- e. Inspect signage and labels on the emergency eyewash/shower. Replace missing labels or signage that has become loose. Signs that are faded must be replaced.

Frequency: Annually

11-4 FUELS LABORATORIES.

Fuels laboratories are typically equipped with ventilation hoods. These systems will be periodically inspected to ensure proper operation. Laboratories must comply with the general facility requirements of UFC 3-600-01 and NFPA 45.

11-4.1 Ventilation Hoods.

Ventilation hoods are used to prevent the buildup of flammable and noxious vapors inside of fuels laboratories. The hoods are typically equipped with sliding or rollup doors that can be used to reduce the opening area of the hood. Additional ventilation hood designs employed include laminar flow, elephant trunk and canopy hoods. The systems pull air from inside of the lab through the hood and exhausts outside of the lab through a ventilation stack. Fume hoods must comply with military service-specific directives

and/or 29 CFR 1910.1450, and ANSI (American National Standards Institute)/AIHA *Laboratory Ventilation Z9.5*.

11-4.1.1 Inspection and Maintenance – Ventilation Hoods

- a. Inspect the operation of the doors. Ensure that they close and open smoothly.
Frequency: Quarterly
- b. Inspect the lights inside of the hood to make sure they are operating properly. Replace light bulbs that are no longer working.
Frequency: Semi-annually
- c. Verify that all electrical equipment is properly classified in accordance with NFPA 70.
Frequency: Annually
- d. Inspect the ventilation system (ductwork, fans, etc.) for signs of disrepair and air leakage and ensure it is operational and pulling air through the hood. Inspect and assure that the lab hood air measuring device for assuring proper air flow is permanently attached and working properly. The ventilation hood must be inspected and ~~VI~~ approved by a service specific industrial hygienist or bioenvironmental engineer ~~VI~~ in accordance with OSHA, 29 CFR 1910.1450, and ANSI/AIHA *Laboratory Ventilation Z9.5*.
Frequency: Annually
- e. Verify negative pressure is present through the ventilation hood to the exhaust.
Frequency: Annually

11-5 OIL/WATER SEPARATORS.

Oil/water separators are used to remove water from oil/water mixtures. Oil/water separators are sized for a maximum flow rate and this maximum flow rate must not be exceeded. Inspections and maintenance must be conducted in accordance with the regulating authority for the particular location (e.g., Federal, host nation, state and local) and in accordance with the OEM specifications so as not to void warranty.

11-5.1 Inspection and Maintenance – Oil/Water Separators.

- a. Inspect the oil/water separator for the buildup of collected petroleum fuel or oil. Remove and properly dispose of accumulated petroleum fuel or oil.
Frequency: Quarterly or as needed based on precipitation events.

- b. Drain, clean, and inspect the interior of the oil/water separator. Ensure all divider plates and screens are in good working order. Replace or repair damaged components.
Frequency: Annually or more frequently based on local environmental conditions.

11-6 CRANES AND HOISTS.

Cranes and hoists are used inside of pumphouses and maintenance areas to assist in the removal and installation of petroleum fuel system components.

11-6.1 Inspection and Maintenance – Cranes and Hoists.

- a. Inspect cranes and hoists for smooth operation. If the crane or hoist is equipped with electronic controls, check power supply and operational control cords for nicks or damage. A crane service technician must correct binding that may prevent smooth operation and repair damage to power cords.
Frequency: Before each use
- b. Apply lubricant or grease to areas that require periodic greasing.
Frequency: Annually
- c. Military services-specific, host nation, state, and/or local regulations require cranes and hoists to be certified for operation. Follow the more stringent of military services-specific, host nation, state or local regulations.
Frequency: Annually

CHAPTER 12 FUEL FACILITY TEMPORARY DEACTIVATION OR CLOSURE

12-1 DEACTIVATION OF FUELING FACILITIES.

Prior to deactivation of a fuel facility, maintainers must contact the Installation's Environmental Office to review the requirements and coordinate to ensure that the deactivated facility remains in regulatory compliance throughout the deactivation period. Note: USTs deactivated for an extended period of time may be subject to closure notifications per Federal, state, and local requirements. Contact Installation Environmental Office for further information.

12-2 DEACTIVATED PETROLEUM FUEL TANKS

Deactivated petroleum fuel tanks that require ballast must be filled with a water or anti-corrosion solution to protect against floatation and overturning. Piping connections of tanks must be disconnected and blind flanged. Remaining active pressure relief systems attached to deactivated tanks must be reconnected to active tanks. Tanks must be labeled to indicate the present status of the tanks and the previous contents. Cathodic protection systems on deactivation tanks must continue to be used and maintained.

12-2.1 Inspection and Maintenance – Deactivated Petroleum Fuel Tanks.

- a. Inspect water or anti-corrosion level in tank. If level has dropped, investigate potential leak points such as blind flanges. Repair leaks that are detected and refill to appropriate level.
Frequency: Quarterly
- b. Check exterior coatings and labels. Repair peeling coatings and/or rusting areas and replace or repair labels which have become faded and difficult to read.
Frequency: Quarterly
- c. Inspect cathodic protection system on deactivated tanks for proper operation.
Frequency: Annually

12-3 DEACTIVATED PETROLEUM FUEL PIPELINES.

Deactivated petroleum fuel pipelines must be drained of fuel, vapor freed and isolated by the use of blind flanges, blanks, or spectacle blinds. Once the petroleum fuel pipeline is isolated it must be charged with nitrogen to a pressure of 10 psig (69 kPa), or as otherwise determined based on the size and thickness of the pipe material. Pipeline cathodic protection systems must remain in operation and in good working order throughout the deactivation period.

Inter-terminal pipelines regulated by the DOT must have a written deactivation plan describing the process to be used. The deactivation plan must be submitted to the

Installation Environmental Office and the Pipeline Regulatory Compliance Agency for review and approval prior to taking the inter-terminal pipeline out of service and reclassifying the pipeline into inactive status. Refer to 49 CFR 195 for additional information on closure of DOT regulated pipelines.

12-3.1 Inspection and Maintenance – Deactivated Petroleum Fuel Pipelines.

- a. Inspect the pressure of the nitrogen charge applied to the petroleum fuel pipeline with a pressure gauge. If the pressure of the charge has dropped investigate and repair leak points. Once leak points are repaired, recharge with nitrogen.
Frequency: Quarterly
- b. Check exterior coatings and labels. Repair peeling coatings and/or rusting areas and replace or repair labels which have become faded and are difficult to read.
Frequency: Quarterly
- c. Inspect cathodic protection system for proper operation.
Frequency: Annually

12-4 DEACTIVATED PETROLEUM FUEL PUMPS.

Deactivated petroleum fuel pumps must be disconnected from supply and discharge piping and the interior of the pumps must be treated with a light corrosion-inhibiting oil. The suction and discharge ports of the pump must be equipped with blind flanges or plugs.

12-4.1 Inspection and Maintenance – Deactivated Petroleum Fuel Pumps.

- a. Manually rotate pump through several rotations. Ensure that the pump turns freely.
Frequency: Quarterly
- b. Check exterior coatings. Repair peeling coatings and/or rusting areas and replace or repair labels which have become faded and are difficult to read.
Frequency: Quarterly
- c. Remove isolation flanges and recoat interior of pump with light corrosion-inhibiting oil.
Frequency: Annually

12-5 MISCELLANEOUS DEACTIVATED COMPONENTS.

Deactivated control valves and specialized components must be removed from piping and tanks. The connection ports of the removed components must be equipped with blind flanges, dust caps, or plugs in order to protect the internal surfaces and working parts of the components from environmental exposure. The pipe or tank connection

points of the removed components must also be equipped with blind flanges or plugs in order to protect the internal surfaces of the piping or tanks from environmental exposure. The removed components must be stored in a clean dry area protected from the elements.

12-5.1 Inspection and Maintenance – Miscellaneous Deactivated Components.

- a. Ensure that blind flanges are tight. Inspect exterior coatings and labels. Repair peeling coatings and/or rusting areas and replace or repair labels that have become faded and are difficult to read.
Frequency: Annually

12-6 TANKS AND PIPELINES.

Refer to Chapter 14 of UFC 3-460-01 for facility closure requirements.

12-7 DOCUMENTATION/RECORDKEEPING.

Refer to Section 14-3 of UFC 3-460-01 for inventory requirements of closed systems.

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APPENDIX A DLA ENERGY PROJECT PROGRAMING

A-1 PROJECT PLANNING STUDIES.

The Planning Study Program is a fence-to-fence analysis of Installation-level infrastructure holding DLA Energy capitalized fuel to identify deficiencies. They are scheduled in 5 year intervals. The program has three over-arching phases:

- Planning Study Site Visit. This phase involves an on-location site visit to identify deficiencies in the fuels infrastructure.
- Planning Study Design Package Development. This phase involves the creation and refinement of the report used to document deficiencies that will be compiled into projects for funding.
- Planning Study Construction Project. This phase involves the construction required to rectify deficiencies identified during the planning study site visit phase.

A-2 RECURRING MAINTENANCE MINOR REPAIR PROGRAM.

The DLA Energy Recurring Maintenance Program is a contract vehicle which provides quarterly, semi-annual, and annual maintenance service for capitalized Installation level real property. Also included is a minor repair and emergency response services for mission essential repairs of a non-technical nature within an established dollar amount. This program is currently executed by the United States Army Corps of Engineers (USACE); however, other executing agencies may be used to address recurring maintenance requirements not covered by this contract.

A-3 FILTER REPLACEMENT PROGRAM.

For facilities eligible for DLA Energy SRM Program, funds have been made available to purchase replacement filter separator cartridges and associated parts such as O-rings and gaskets. Refer to the current DLA Energy filter requisitioning policy document for further guidance in accordance with DLA Energy Instruction I-18, *Instructions for Requisition, Funding Requests, or Reimbursement of Filter/Coalescer Elements*.

A-4 DLA CENTRALLY MANAGED PROGRAMMING.

The Centrally Managed Program (CMP) manages regulatory, compliance, and best practice maintenance processes for deficiencies on assets that are common to all Services.

A-4.1 Tank Integrity Management Program.

The Tank Integrity Management Program for DLA Energy capitalized tanks uses industry standard API 653, *Tank Inspection, Repair, Alteration, and Reconstruction*

document or STI SP001, *Standard for the Inspection of Aboveground Storage Tanks*, as the basis of meeting regulatory requirements included in 40 CFR 112 *Oil Pollution Prevention* and state regulations. Many military tanks, such as cut and cover and mined styles, do not fit well into the API 653 standard so the code is applied to the maximum extent possible. It is the policy of DLA Energy to require professional engineering oversight of all inspection and repair programs.

DLA Energy sanctions the use of STI *Standard for the Inspection of Aboveground Storage Tanks*, SP001 as the inspection standard for small shop fabricated DLA Energy capitalize tanks, typically aboveground, horizontal, and up to 45,000 gallons in size. host nation standards, such as the German TUEV (Technischer Ueberwachungsverein [German safety and standards institution]), are addressed as an “add-on” to the base inspection program.

Military service-specific SCP identifies tanks coming due, are past due or are without a record of inspection and coordinates inspections with DLA Energy. Inspection frequencies are in accordance with applicable standards and codes.

A-4.2 Pipeline Integrity Management Program.

The Pipeline Integrity Management Program provides for the development of Pipeline Integrity Management Plans (PIMPs) and funds API 570 inspections of piping systems.

A-4.3 Pressure Vessel Integrity Management Program.

The Pressure Vessel Integrity Management Program provides for the physical inspection of pressure vessels (e.g., filter separators, micronic or cyclonic separators, relaxation chambers, and air eliminators tanks) in accordance with API 510. Its goal is to reduce the risk of failure, thereby reducing potential environmental damage and/or mission readiness consequences.

A-4.4 Cathodic Protection System Integrity Management Program.

The Cathodic Protection System Integrity Management Program provides for the annual inspection, repair and maintenance of cathodic protection systems. Cathodic protection is a form of corrosion protection applied to underground or underwater metallic structures. Cathodic protection usually works in conjunction with protective coatings on steel/stainless steel structures. Common applications include buried pipelines, underground fuel storage tanks, and the bottom of aboveground fuel storage tanks. Other applications include water storage tanks, and submerged pilings/fender piles on piers and wharves. Federal and state regulations require cathodic protection for many fuel related applications and UFC 3-570-06 requires cathodic protection for all metallic fuel containing structures in direct contact with soil and water.

Corrosion inhibitors are another form of corrosion control covered under this program. Corrosion inhibitors are used in areas where cathodic protection is not possible, usually due to space requirements. A typical inhibitor project would replace a failed or absent

cathodic protection system where anode replacement or installation is not economical or feasible. These systems follow the same guidelines and inspection cycle as cathodic protection systems.

A-4.5 Maritime Fuel Facilities/Piers Program.

The Maritime Fuel Facilities/Piers Program provides for the inspection and repair of piers. Routine pier inspections are conducted to identify, quantify, and document deficiencies observed on marine fuel facility structural, electrical, and mechanical systems. The results from inspections are utilized by professional engineers to assess a facility's overall condition and operational readiness (fit for purpose), and to produce maintenance plans and specifications for repairs.

A-4.6 Marine Loading Arm Program.

The Marine Loading Arm (MLA) Program provides for the inspection and repair of loading arms used in Defense Working Capital Fund (DWCF) loading/unloading operations at fixed real property energy infrastructure.

A-4.7 Underwater Hose Program.

Only underwater hoses used in Defense Working Capital Fund (DWCF) loading/unloading operations are eligible for DLA Energy SRM funds. This funding is provided by the Underwater Hose Program.

A-4.8 Dredging Program.

The Dredging Program provides funds for dredging projects. Deficiencies are identified by the Installation. Dredging of dedicated waterways used for vessel movement and delivery of DWCF products is eligible for DLA Energy funding consideration under this program. Dredging of shared-use waterways is cost shared based on a benefit assessment involving all users or in accordance with established Energy Infrastructure Facility Sustainment Model (FSM) rules.

A-4.9 Rails Program.

The Rails Program provides for the maintenance and sustainment of railcar loading/off-loading infrastructure and rail spurs from the Installation fence line. The program covers these systems when they are used for the DWCF fuel mission and coded for DLA Energy sustainment.

A-4.10 Demolition Program.

The Demolition Program provides funds for demolition projects when the real property is no longer required by DLA Energy or the applicable military service. Deficiencies are identified by the Installation. DLA Energy will fund demolition of real property infrastructure if the facility last contained DLA Energy owned product and for which DLA

Energy had SRM funding responsibility. DLA Energy may, depending on the situation, also fund facility demolition using Military Construction (MILCON) appropriation when the MILCON project involves demolition of existing energy infrastructure.

A-4.11 Automated Fuel Handling Equipment/Automatic Tank Gauging Program.

The Automated Fuel Handling Equipment (AFHE)/Automatic Tank Gauging (ATG) Program provides for installation and maintenance of automation systems. Professional engineering assessments, which are required by DLA Energy on capitalized fuel systems, are conducted under this program. These assessments improve overall fuel facility controls, improve inventory accountability, provide fail-safe engineering for spill prevention, increase efficiency, and execute routine maintenance.

This program supports automation programs for AFHE, Automated Fuel Service Station (AFSS), ATG, ATGR, Hydrant Automation Monitoring System (HAMS), Independent Alarm System (IAS), Overfill Protection Equipment (OPE) and Temperature Compensating Meter (TCM). The DLA Energy Installation Support Automation Branch coordinates with the military service-specific SCPs, the Space and Naval Warfare System Center (SPAWAR), and Installations to identify needed projects.

This program also supports automation maintenance programs for AFHE, ATG, IAS, AFSS, OPE, and Hydrant Fueling Automation Maintenance (HFAM). The life cycle maintenance support includes annual preventative maintenance and as-needed corrective maintenance support. Maintenance activities follow an annual cycle, are initiated after the warranty period, have an indefinite duration, and are reviewed annually. This program is also used to provide system support which includes on-call technical support, logistics support, configuration management, system enhancements and modifications.

Deficiencies are grouped into projects based on several factors such as geographic location and the preferences of the executing agents, military service-specific SCPs or other affected parties. Capital automation projects require the development of a Business Case Analysis (BCA), must be included in the Capital Budget 5-Year Plan, listed on the annual Master Operating Plan (MOP) and have the approval of a Capital Execution Package.

A-4.12 Leak Detection Program.

The Leak Detection Program is an Environmental managed and funded program to execute annual, biennial, and quarterly testing and monthly monitoring of DLA capitalized underground fuel storage and distribution systems worldwide for storage tanks, transfer and distribution piping, hydrant systems and ground fuel facilities. Testing is performed to meet environmental regulatory requirements and DLA best management practice testing requirements. The program encompasses leak detection testing, leak confirmation, location and/or inspection and rapid response of suspect leaks at DLA capitalized fuel facilities worldwide.

The Leak Detection program also includes support for permanently installed leak detection systems. This includes the maintenance, repair and certification of the permanently installed leak detection systems and the installation of new permanent leak detection systems at DLA capitalized fuel facilities worldwide.

A-5 REPAIR PROJECTS.

Provide adequate information for input of a deficiency into the DLA Energy Enterprise Business System (EBS) database. Required information for project development include: a cost estimate, justification, impact if not provided, and project description as well as an indication of the expected funding type. The funding types that are available include: Minor Construction (MC), Maintenance and Repair (MR), Maintenance (M) and Environmental (E).

A-6 CAPITALIZED ENVIRONMENTAL FUNDING.

DLA Energy also has an Environmental Managed and Funded Program for the development and revisions of environmental documents and will also support environmental compliance and restoration funding of capitalized fuel facilities for sampling and testing of petroleum, oil, and lubricants (POL) emissions and discharges, removal and disposal of POL wastes (except consumables), fees for spill cooperatives, permit fees, fines and penalties, spill cleanup, removal and disposal of POL wastes associated with facility maintenance projects and update of environmental compliance documents.

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APPENDIX B CONTAINMENT INTEGRITY TESTING CHECKLIST

Secondary Containment/Drainage System Integrity Testing					
UST Facility			Person Conducting Test		
Facility Name		Facility ID#	Tester's Name:		
Physical Address			Testing Company:		
City	State		City	State	
Testing Requirements					
Type of Test		<input type="checkbox"/> Code of practice developed by a nationally recognized association or independent testing			
Purpose of Test		<input type="checkbox"/> Notice of Alleged Violation			
		<input type="checkbox"/> Required Annual Test			
		<input type="checkbox"/> Post Repair Test			
Liquid Tight Test Procedure					
<ol style="list-style-type: none"> 1. Clean containment of any debris. 2. Visually exam containment area for problem areas (gaps, cracks, sealant failure, etc.) 3. Make sure drainage valve is completely closed, <i>IF</i> adding water. 4. Add water to observe standing water at a highest point within the containment area (or conduct this test after a rain event where water has filled the secondary containment area). 5. Ensure water is calm (i.e. it is not still raining), and mark and record the high water line (e.g. using a tape measure with 1/16-in increments). 6. Leave water in containment, undisturbed for one hour (i.e. no operations are taking place). 7. Compare the starting water level to the ending level: <ul style="list-style-type: none"> • If the water level is the same or changed less than 1/8th (vertical) inch, the containment passed the test. • If the water level has dropped 1/8th inch or more, an investigation must be conducted. 8. After the investigation, justify why this is not a leak or identify the leak and necessary repairs. 					
Test Data Table					
Test Date					
Containment Item ID No.					
Test Start Time					
Test End Time					
Test Beginning Water Level					
Test Ending Water Level					
Test Result (P/F)					
Comments:					
<p>I hereby certify that all the information contained in this report is true, accurate, and in full compliance with legal requirements. Maintain six (6) years of test records. (Two Test Periods)</p> <p style="text-align: center;">Tester's Signature: _____ Date: _____</p>					

Secondary Containment Drainage System Integrity Testing

General Guidance

Who must complete this form?

Any person or their authorized representative (such as a tester or contractor) that conducts the secondary containment liquid tight testing.

What sites must complete this testing?

All underground secondary containment drainage systems to include bulk fuel storage, aircraft fueling systems, truck and railcar loading & unloading areas, marine facilities, and ground vehicle fuel facilities.

Petroleum Equipment Institute (PEI) Recommended Practice 1200-17: *Recommended Practices for the Testing and Verification of Spill, Overfill, Leak Detection and Secondary Containment Equipment at Underground Storage Tank Facilities* is an acceptable protocol.

Instructions for Completing the Fill-Port Containment Integrity Form:

UST Facility Information: Enter name and complete address of the facility, and the permit identification number for the facility.

Person Conducting the Test: Enter the tester's name and their company (if not completed by site operator) including the city and state from which they operate.

2) Purpose of the Test: Indicate by checking the box why the test is being done. Note: Testing must occur after repairs or replacement of parts connected to secondary containment.

Liquid Tight Test Procedure: Please review the methodology (if this is the desired test) before conducting the test.

Test Data Table:

- 1) Test Date: Indicate the date YYYYMMDD the test was completed
- 2) Indicate the starting and ending time for each Fill-Port Containment being tested.
- 3) Indicate the starting and ending water level for each Fill-Port Containment being tested.
- 4) Indicate if the test passed (P) or failed (F).
- 5) Comments: Add any comments or notes, particularly if there were any failing results.

Tester's Signature: The person conducting the test must sign and date the test.

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APPENDIX C MAINTENANCE TABLE

Inspection and maintenance tasks listed below are the minimum required. Additional operation and maintenance tasks may be performed based on specific installation requirements set by facility command.

OM stands for Operator Maintenance, and SM stands for System Maintenance. See [Section 1-2](#) for more information on roles and responsibilities.

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
SIGNAGE AND MARKINGS					
Signage and Markings (Section 2-7)					
Signage and Markings	<ul style="list-style-type: none"> A. Check permanent signs and markings for adequacy and readability. Repair or replace deteriorated or illegible signs and markings. B. Inspect the location of Department of Transportation (DOT) regulated underground pipelines and ensure they are marked in accordance with 49 Code of Federal Regulations (CFR) 195.410. C. Check that all non-DOT regulated pipelines, tanks, valves, pumps, meters, and other equipment are marked in accordance with UFC 3-460-01. Section M 2-17 /1/. If markings are missing or insufficient, repair or add markings in accordance with UFC 3-460-01. D. Ensure petroleum fuel system Emergency Fuel Shutoff (EFSO) push buttons are properly identified at each location. Ensure that signage is properly secured and that the lettering is legible from 25 feet (7.5 meters) away and not faded. 	Monthly	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	E. Verify enough movable or temporary signs are maintained in good condition to serve anticipated needs; for example: "DANGER," "CLOSED TO TRAFFIC," "KEEP FLAMES AWAY," "MEN WORKING," "NO SMOKING," "DANGER NO OPEN FLAME OR IGNITION SOURCE BEYOND THIS POINT." Use bilingual signs when appropriate.	Annually	OM	OM	OM
FILTRATION					
Pre-Filter Vessels (Section 3-6.1)					
Pre-Filter Vessels	A. Open drains under flow conditions until clear fuel is observed from the drain valve.	Daily	OM	OM	OM
	B. Monitor differential pressure in filter cartridges. Chart differential pressure measurements from readings taken during normal operations.				
	C. Operate pre-filter isolation valves.	Quarterly	SM	SM	SM
	D. Replace filter cartridges when the acceptable maximum differential pressure is reached, the maximum in-service duration has passed, or the fuel becomes visibly dirty or discolored. Acceptable maximum differential pressure for a specific pre-filter is dependent on the system flow rate. The military service-specific SCP may extend in-service duration filter cartridge replacement period based on differential pressure for high throughput systems. Check expiration date of replacement filter cartridges before installation.	When differential pressure has reached the lower of manufacturer's recommendation or 20 psid (140 kPa), filter cartridge in-service period of 24 months has expired, or when fuel becomes visibly dirty or discolored.	SM	SM	SM
	E. Refer to Section 6-7.2 Differential Pressure Gauges for inspection	As required	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>and maintenance requirements of differential pressure gauges.</p> <p>F. Refer to Section 3-10.2 Automatic Air Vents for inspection and maintenance requirements of automatic air vents.</p> <p>G. Refer to Section 6-6.3 Thermal and Pressure Relief Valves for inspection and maintenance requirements of thermal and pressure relief valves.</p> <p>H. Conduct inspections of code rated vessels that meet the requirements of UFC 3-430-07</p>				
Filter Separators (Section 3-6.2)					
Filter Separators	<p>A. Open drain under flow conditions until clear fuel is observed from the drain valve.</p> <p>B. Monitor differential pressure of coalescer cartridges. The acceptable maximum differential pressure for a specific filter/separator is dependent on the system flow rate. Monitor and chart differential pressure measurements of filter separators from readings taken during normal operations. Investigate sudden drops or spikes in differential pressure measurement readings.</p>	Daily	OM	OM	OM
	<p>C. Operate filter separator isolation valves.</p> <p>D. Inspect components and check operation of water shutoff system.</p>	Quarterly	SM	SM	SM
	<p>E. Change coalescer cartridges. Refer to Section 3-6.2.2 Replacement of Coalescer Cartridges for general instructions</p>	Every 36 months or sooner if required by	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>on replacement of coalescer cartridges. Military service-specific SCP may extend the coalescer cartridge replacement frequency based on differential pressure if filters separators are used on high throughput systems. Check expiration date of replacement coalescer cartridges before installation.</p> <p>F. Inspect and clean separator cartridges at time of coalescer cartridge change in accordance with Section 3-6.2.3 Separator Cleaning. Worn or damaged separator cartridges must be replaced.</p>	differential pressure.			
	<p>G. Refer to Section 6-7.2 Differential Pressure Gauges for inspection and maintenance requirements of differential pressure gauges.</p> <p>H. Refer to Section 3-10.2 Automatic Air Vents for inspection and maintenance requirements of automatic air vents.</p> <p>I. Refer to Section 6-6.3 Thermal and Pressure Relief Valves for inspection and maintenance requirements of thermal and pressure relief valves.</p> <p>J. Refer to Section 4-4.2.2 Filter Separator Control Valves for inspection and maintenance requirements of filter separator control valves.</p> <p>K. Conduct inspections of code rated vessels that meet the requirements of UFC 3-430-07.</p>	As required	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
Basket Strainers (Section 3-6.4)					
Basket Strainers	A. Monitor and chart differential pressure measurements of basket strainers from readings taken during normal operations. Investigate sudden drops or spikes in differential pressure measurement reading.	Daily	OM	OM	OM
	B. Clean and inspect basket and strainer screen. Basket strainer isolation valves must be closed and the strainer body must be drained before removing the cover. After cleaning, the strainer screen must be inserted in the strainer body, and the head tightened and checked for leakage. If strainer is not equipped with means to measure differential pressure, unit must be opened monthly and inspection.	Semi-annually if basket strainer is equipped with means to measure differential pressure; otherwise monthly.	OM	OM	OM
	C. Refer to Section 6-7.2 Differential Pressure Gauges for inspection and maintenance requirements of differential pressure gauges.	As required	SM	SM	SM
Filter Separator Sump Heaters (Section 3-6.5)					
Filter Separator Sump Heaters	a. Inspect filter separator sump and drain line heater elements for proper operation per manufacturer's operation and maintenance manual. Ensure heater elements meet manufacturer's requirements by measuring resistance of heater elements with an ohm meter.	Semi-annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
METERS					
Positive Displacement Meters (Section 3-7.1)					
Positive Displacement Meters	A. Inspect counter head for unusual noises and smooth operation.	Monthly	OM	OM	OM
	B. Positive displacement meters must be inspected and calibrated semi-annually or when improper performance is suspected; when unusual sounds or register actions develop; or after repairs have been made which may affect performance. Positive displacement meters are satisfactory when the measurement error in the normal flow direction is within $\pm 0.3\%$ of actual quantity delivered (e.g., ± 1.8 gallons for a 600-gallon test (± 6.8 liters for a 2275-liter test)). Adjustment of the meter's register will be in accordance with manufacturer's instructions. Identify the next calibration date on meters (example: Mar 14 for March 2014). Use weather resistant label that will remain legible and affixed for at least one year.	Semi-annually or as required	SM	SM	SM
	C. Inspect temperature element operation of meters equipped with temperature compensation feature per manufacturer's operation and maintenance manual.				
Turbine Flow Meters (Section 3-7.2)					
Turbine Flow Meters	A. Turbine flow meters must be inspected and calibrated semi-annually or when improper performance is suspected, register actions develop, or after repairs have been made which may affect performance. Turbine flow meters	Semi-annually or as required	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>are satisfactory when the measurement error in the normal flow direction is within $\pm 0.5\%$ of actual quantity delivered (e.g., ± 3 gallons for a 600-gallon test (± 11 liters for a 2275-liter test)). Adjustment of the meter's register will be in accordance with the manufacturer's instructions. Identify the next calibration date on meters (example: Mar 14 for March 2014). Use weather resistant label that will remain legible and affixed for at least one year.</p> <p>B. Inspect temperature element operation of meters equipped with temperature compensation feature per manufacturer's operation and maintenance manual.</p>				
Orifice Flow Meters (Section 3-7.3)					
Orifice Flow Meters	<p>A. Refer to Section 6-7.2 Differential Pressure Gauges for inspection and maintenance requirements of differential pressure gauges.</p> <p>B. Refer to Section 6-7.4 Differential Pressure Transmitters for inspection and maintenance requirements of differential pressure transmitters.</p>	As required	SM	SM	SM
PUMPS					
Centrifugal Pumps (Section 3-8.1)					
Centrifugal Pumps	<p>A. Check for proper operations while pump is in use. Check suction and discharge pressure gauge for abnormal readings.</p> <p>B. Check for unusual noise, vibration, overheating of bearings or case.</p>	Quarterly	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	C. If equipped with lubricating oil charge, check oil level and adjust as necessary. D. Tighten or replace loose, missing or damaged nuts, bolts, or screws. E. Inspect suction and discharge isolation dampeners for misalignment and wear F. Inspect mechanical seals, if possible, for proper operating temperature, drips, leaks and dirt.				
	G. Check alignment, clearances, and rotation of shaft and coupler (requires removal of coupler shroud or cover). H. Lubricate pump bearings. I. If equipped with lubricating oil charge, drain old oil, and fill with new to full mark on sight indicator (also fill bulb).	Annually	SM	SM	SM
	J. Refer to Section 9-1.7 Electric Motors for inspection and maintenance requirements of electric motors.	As required	SM	SM	SM
Vertical Inline Pumps (Section 3-8.1.2)					
Vertical Inline Pumps	A. Check for proper operations while pump is in use. Check suction and discharge pressure gauges for abnormal readings. B. Check for unusual noise, vibration, overheating of bearings. C. Tighten or replace loose, missing or damaged nuts, bolts, or screws.	Quarterly	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	D. Inspect suction and discharge isolation dampeners for misalignment and wear.				
	E. Inspect mechanical seals, if possible, for proper operating temperature, drips, leaks and dirt.				
	F. Check alignment, clearances, and rotation of shaft and coupler (requires removal of coupler shroud or cover).	Annually	SM	SM	SM
	G. Lubricate pump bearings.				
	H. Refer to Section 9-1.7 Electric Motors for inspection and maintenance requirements of electric motors.	As required	SM	SM	SM
Vertical Turbine/Submerged Turbine Pumps (Section 3-8.1.3)					
Vertical Turbine/Sub- merged Turbine Pumps	A. Check for proper operations while pump is in use. Check discharge pressure gauge for abnormal readings.	Quarterly	SM	SM	SM
	B. Check for unusual noise, vibration, overheating of bearings or case.				
	C. If equipped with lubricating oil charge, check oil level and adjust as necessary.				
	D. Tighten or replace loose, missing or damaged nuts, bolts, or screws.				
	E. Inspect mechanical seals, if possible, for proper operating temperature, drips, leaks and dirt.				
	F. Inspect anti-rotation device for proper operation.	Semi-annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	G. Check alignment, clearances, and rotation of shaft and coupler (requires removal of coupler shroud or cover). H. Lubricate pump bearings. I. If equipped with lubricating oil charge, drain old oil, and fill with new oil to full mark on sight indicator (also fill bulb).	Annually	SM	SM	SM
	J. Refer to Section 9-1.7 Electric Motors for inspection and maintenance requirements of electric motors.	As required	SM	SM	SM
Sliding Vane Pumps (Section 3-8.2.1)					
Sliding Vane Pumps	A. Inspect pump for unusual noise, vibrations, and overheating of bearings and case. B. Inspect mechanical seals, if possible, for drips or leaks and dirt. C. Lubricate pump bearings.	Quarterly	SM	SM	SM
	D. Inspect pump and motor coupling for proper alignment. E. Refer to manufacturer's operation and maintenance manual for internal pressure relief testing and calibration procedures.	Annually	SM	SM	SM
	F. Refer to Section 3-8.4 Gearboxes for inspection and maintenance of reduction gearboxes. G. Refer to Section 9-1.7 Electric Motors for inspection and maintenance requirements of electric motors.	As required	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
Gear Pumps (Section 3-8.2.2)					
Gear Pumps	A. Inspect pump for unusual noise, vibrations, and overheating of bearings and case.	Quarterly	SM	SM	SM
	B. Inspect mechanical seals, if possible, for drips or leaks and dirt.				
	C. Lubricate pump bearings				
	D. Inspect pump and motor coupling for proper alignment.	Annually	SM	SM	SM
Gear Pumps	E. Refer to Section 3-8.4 Gearboxes for inspection and maintenance of reduction gearboxes.	As required	SM	SM	SM
	F. Refer to Section 9-1.7 Electric Motors for inspection and maintenance requirements of electric motors.				
Diaphragm Pumps (Section 3-8.2.3)					
Diaphragm Pumps	A. Inspect hose for cracks or dry rot.	Quarterly	SM	SM	SM
	B. Inspect compressed air connections for signs of leaks.				
C. Inspect compressed air hose coupling safety pins or safety wires for wear and damage. Replace damaged components.					
Diaphragm Pumps	D. Diaphragm pumps should have the internal diaphragm replaced if the pump shows decreased performance. Also check operation of actuator valve and ensure ball checks seat properly.	As required	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
Internal Combustion Drives (Section 3-8.3)					
Internal Combustion Drives	A. Refer to manufacturer's operation and maintenance manual for specific maintenance procedures and schedules associated with a specific model of internal combustion drive. Follow all applicable general maintenance and safety requirements listed in the manufacturer's operation and maintenance manual.	As required	SM	SM	SM
Gearboxes (Section 3-8.4)					
Gearboxes	A. Inspect gearboxes for signs of smoke near shaft connections or discoloration of the gearbox from overheating. B. Verify that the oil in the sight glass is not dark or appears to have foam. Adjust oil level if required.	Quarterly	SM	SM	SM
	C. Lubricate bearings per manufacturer's recommendations. D. Check motor and gear box and gear box and pump couplers for wear and alignment.	Semi-annually	SM	SM	SM
	E. Inspect gear alignment within gearbox. F. Replace lubricant oil in accordance with manufacturer's specifications and recommendations.	Annually	SM	SM	SM
HOSES					
Loading Fuel Hoses (Section 3-9.1)					
Loading Fuel Hoses	A. Visually inspect hoses for loose covers, cracks, brittle surface coatings, exposed wire braids, exposed reinforcement, flattening, kinks, and bulges or soft spots	Weekly	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	which might indicate broken or displaced reinforcement.				
	B. Pressurize hose to normal working pressure. Check flanged and threaded connections for leaks and inspect hose couplers for fluid seepage by pushing at the base of the coupling with your thumbs; a hose softened by fluid seepage must be replaced.	Monthly	OM	OM	OM
	C. Check for coupling slippage. Replace hose that shows signs of coupling slippage.	Quarterly	SM	SM	SM
	D. Refer to Appendix D, Section D-2.1 Loading Hose Hydrostatic Test for loading hose hydrostatic testing requirements and procedures.	Annually	SM	SM	SM
	E. Conduct test of fuel hose electrical resistivity using an electrostatic meter in accordance with NFPA 77 & API 2003.				
Offloading Fuel Hoses (Sections 3-9.2)					
Offloading Fuel Hoses	A. Visually inspect hoses for cracks brittle surface coatings, exposed wire braids, exposed reinforcement, flattening, kinks, and bulges or soft spots which might indicate broken or displaced reinforcement.	Weekly	OM	OM	OM
	B. Check flanged and threaded connections for leaks and inspect hose couplers for fluid seepage by pushing at the base of the coupling with thumbs; a hose softened by petroleum fluid seepage must be replaced. Damaged or leaking hoses must be replaced immediately or isolated and taken out of service.	Quarterly	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	C. Conduct test of offloading fuel hose electrical resistivity as directed in NFPA 77 and API 2003.	Annually	SM	SM	SM
AIR ELIMINATOR TANKS					
Air Eliminator Tanks (Section 3-10.1)					
Air Eliminator Tanks	A. Inspect operation of fuel level probes. Ensure probes operate correctly when the level of fuel in the tank rises to the level of the probe sensing unit. B. Remove the float vent valve from the air eliminator tank. Clean and inspect the sealing surfaces of the float vent valve. Ensure the float is buoyant in fuel and test the valve to ensure it closes properly.	Annually	SM	SM	SM
	C. Refer to Section 8-9.3 Tank Pressure/Vacuum Vents for inspection and maintenance requirements of pressure vacuum vents.	As required	SM	SM	SM
Automatic Air Vents (Section 3-10.2)					
Automatic Air Vents	a. Check for proper operation of the automatic air vent. Ensure the vent opens to allow air to escape and ensure the float of the vent is buoyant in petroleum fuel and rises to close the vent when the float is suspended in petroleum fuel.	Annually	SM	SM	SM
FUEL ADDITIVE INJECTORS					
Fuel Additive Injectors (Section 3-11)					
Fuel Additive Injectors	a. Inspect injectors to ensure they are operating properly.	When fuel system has flow through it, inspect weekly. When fuel system is sitting idle, inspect	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
		injectors monthly.			
	b. Calibrate injector to ensure proper additive to fuel ratio.	Annually	SM	SM	SM
CONTROL VALVES – TYPE II HYDRANT SYSTEM					
General System Control Valves (Section 4-3.2.1)					
General System Control Valves	A. Verify operating settings of valve. Valve adjustment must be in accordance with manufacturer's operation and maintenance manuals and final start-up and commissioning set points. Use of DoD standard set points should only be used as a reference starting point as pipe size and other hydraulic factors influence final system settings.	Quarterly	SM	SM	SM
	B. Remove and clean strainer installed in the petroleum fuel supply line to the pilot and main valve diaphragm. This strainer is provided to prevent clogging of the orifice in the supply line. Clogging of the screen will cause malfunctioning of the valve	Annually for unfiltered systems and as required for filtered systems.	SM	SM	SM
	C. Diaphragms must be removed and inspected for deterioration and breaks at the flexing joint. Damage is often caused by pipe scale, pipe tape, and thread sealant compound that collect above the diaphragm and become lodged between the diaphragm and bonnet of the valve. Damage may also be caused by a change of operational petroleum fuel type or grade (such as a change from JP-4 to JP-8).	Every 10 years	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
Refuel Control Valves (Section 4-3.2.5)					
Refuel Control Valves	A. Verify refuel control valve is set to maintain 100 psig (690 kPa) (typical operating pressure) as measured at the furthest hydrant outlet.	Quarterly	SM	SM	SM
	B. Verify pressure-reducing control will open at 5 psig (35 kPa) above normal operating pressure (typically 105 psig (725 kPa) as measured at the farthest hydrant outlet)				
	C. Verify refueling control valve opening rate is set between 15 and 20 seconds. The valve should open as quickly as possible without tripping the pressure differential control shut-off.				
	D. Verify operation of the excess flow shut-off function.				
	E. Verify operation of solenoid.				
	F. Refer to Section 4-3.2.1 General System Control Valves for additional inspection and maintenance requirements.	As required	SM	SM	SM
Pressure Relief Valves (Section 4-3.2.6)					
Pressure Relief Valves	A. Verify pressure relief valve will open at 10 psig (69 kPa) above normal inlet pressure to the refuel control valve.	Semi-annually	SM	SM	SM
	B. Refer to Section 4-3.2.1 General System Control Valves for additional inspection and maintenance requirements.	As required	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
Defuel Control Valves (Section 4-3.2.7)					
Defuel Control Valves	A. Verify the defuel control valve opens when the solenoid on the defuel control valve is energized.	Quarterly	SM	SM	SM
	B. Refer to Section 4-3.2.1 General System Control Valves for additional inspection and maintenance requirements.	As required	SM	SM	SM
Dual Rate-of-Flow Control Valves (Section 4-3.2.8)					
Dual Rate-of- Flow Control Valves	A. Verify dual rate-of-flow control valve is set to maintain a flow rate of 200 gpm (12.5 lps).	Quarterly	SM	SM	SM
	B. Verify check valve feature is operational.				
	C. Refer to Section 4-3.2.1 General System Control Valves for additional inspection and maintenance requirements.	As required	SM	SM	SM
Combination Dual Rate-of-Flow Control and Solenoid Valves (Section 4-3.3.1)					
Combination Dual Rate-of- Flow Control and Solenoid Valves	a. Verify valve is set to maintain a flow rate of 300 gpm (19 lps). b. Verify operation of check valve feature. c. Verify solenoid operation.	Quarterly	SM	SM	SM
	d. Refer to Section 4-3.2.1 General System Control Valves for additional inspection and maintenance requirements.	As required	SM	SM	SM
Dual Pressure Relief, Solenoid Shutoff, and Check Valves (Section 4-3.3.2)					
Dual Pressure Relief, Solenoid Shutoff, and	A. Verify high pressure relief control will open at 5 psig (35 kPa) above the refuel control valve pressure	Quarterly	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
Check Valves	<p>relief control set point (typically set at 110 psig (760 kPa)).</p> <p>B. Verify low pressure relief control will open at 5 psig (35 kPa) when refueling pumps are stopped.</p> <p>C. Verify closing speed provides a smooth, pulsation free operation.</p> <p>D. Verify operation of solenoid valve.</p>				
	E. Refer to Section 4-3.2.1 General System Control Valves for additional inspection and maintenance requirements.	As required	SM	SM	SM
CONTROL VALVES – TYPE III HYDRANT SYSTEM					
Non-Surge Check Valves (Section 4-4.2.1)					
Non-Surge Check Valves	<p>A. Verify main valve opening speed (typically 20 seconds). Adjust if required.</p> <p>B. Verify valve maintains 650 gpm (41 lps) flow rate (some instances 950 gpm (60 lps) flow rate). Adjust if required.</p> <p>C. Ensure the check valve function is operating properly.</p>	Semi-annually	SM	SM	SM
	D. Refer to Section 4-3.2.1 General System Control Valves for additional inspection and maintenance requirements	As required	SM	SM	SM
Filter Separator Control Valves (Section 4-4.2.2)					
Filter Separator Control Valves	A. Test FSCV emergency shut off solenoid under flow conditions and ensure that valve closes within 10 seconds of EFSO button activation. Coordinate with overall	Quarterly	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>EFSO test listed in Section 9-1.2.1 Inspection and Maintenance - Electrical Equipment.</p> <p>B. Operate test button (if installed) to ensure the FSCV closes at high water level. Physically press the test button, while recirculating fuel, and ensure the FSCV closes. Note: closing speed is a function of the number of open filters separators and the number of pumps operating. With all filters open and only one pump operating, the valve will close very slowly.</p>				
	<p>C. Verify valve maintains flow rate (typically 600 gpm (38 lps), operating range based on commissioning documentation). Adjust flow rate if required. Flow rate is determined by filter separator vessel gpm (lps) rating, or element flow rate, whichever is less. Use return venturi to measure and confirm flow rate during valve testing and adjustment.</p> <p>D. Ensure check valve function is operating properly.</p>	Semi-annually	SM	SM	SM
	<p>E. Test buoyancy of water level float. Remove the ball or float assembly and place it in a bucket of water. Correctly operating ball or float will float at the top of the water's surface.</p>	When coalescer cartridges are changed.	SM	SM	SM
	<p>F. Refer to Section 4-3.2.1 General System Control Valves for additional inspection and maintenance requirements.</p>	As required	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
Defuel/Flush Valves (Section 4-4.2.3)					
Defuel/Flush Valves	A. Ensure Solenoids A and B are de-energized with system in automatic mode and lead pump operating.	Quarterly	SM	SM	SM
	B. Ensure Solenoid A is energized and Solenoid B is de-energized to allow main valve to open and drop system pressure to 80 psig (550 kPa) (typical set pressure) with system in automatic mode and lead pump off.				
	C. Ensure Solenoid A is de-energized and Solenoid B is energized when system is in flush mode.				
	D. Ensure Solenoids A and B are de-energized when system is in tightness test mode.				
	E. Check opening and closing speed. Speed should be as fast as possible while still maintaining smooth operation.				
	F. Refer to Section 4-3.2.1 General System Control Valves for additional inspection and maintenance requirements.	As required	SM	SM	SM
Issue Venturi (Section 4-4.2.4)					
Issue Venturi	A. Ensure issue venturi DPTs are reading the same value within \pm 2% full scale.	Semi-annually	SM	SM	SM
	B. Refer to Section 6-7.4 Differential Pressure Transmitters for inspection and maintenance requirements of DPTs	As required	SM	SM	SM
Return Venturi (Section 4-4.2.5)					
Return Venturi	A. Ensure return venturi DPTs are reading the same value within \pm 2% full scale.	Semi-annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	B. Refer to Section 6-7.4 Differential Pressure Transmitters for inspection and maintenance requirements of DPTs.	As required	SM	SM	SM
Back Pressure Control Valves (Section 4-4.2.6)					
Back Pressure Control Valves	<p>A. Verify constant upstream pressure is maintained at the setpoint established and listed in the system commissioning documents. Adjust setting of BPCV as necessary.</p> <p>B. Ensure Solenoid A is energized and Solenoid B is de-energized while lead pump is operating in automatic mode.</p> <p>C. Ensure Solenoids A and B are de-energized prior to lead pump shutdown and system going to stand-by.</p> <p>D. Ensure Solenoids A and B are de-energized while system is in flush mode.</p> <p>E. Ensure that Solenoid A is de-energized and Solenoid B is energized while system is in tightness test mode.</p> <p>F. Verify closing speed control. Valve should close as fast as possible while still maintaining smooth operation.</p> <p>G. Check solenoid EFSO feature when equipped. Coordinate test with overall EFSO test listed in Section 9-1.2.1 Inspection and Maintenance - Electrical Equipment.</p>	Quarterly	SM	SM	SM
	H. Refer to Section 4-4.2.1 General System Control Valves for	As required	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	additional inspection and maintenance requirements.				
Pressure Control Valves (Section 4-4.2.7)					
Pressure Control Valves	<p>A. Ensure Solenoid A is energized and Solenoid B is de-energized while system is in automatic mode and lead pump is operating.</p> <p>B. Ensure Solenoids A and B are de-energized while system is in automatic mode and lead pump is off. Verify valve opens to maintain system pressure at 75 psig (515 kPa).</p> <p>C. Ensure Solenoid A is energized and Solenoid B is de-energized while system is in flush mode and lead pump is operating.</p> <p>D. Ensure Solenoids A and B are de-energized while system is in flush mode and pumps are off.</p> <p>E. Ensure Solenoids A and B are energized while system is in tightness test mode.</p> <p>F. Verify closing speed control. Valve should close as fast as possible while still maintaining smooth operation.</p>	Quarterly	SM	SM	SM
	G. Refer to Section 4-3.2.1 General System Control Valves for additional inspection and maintenance requirements.	As required	SM	SM	SM
Hydrant Control Valves (Section 4-4.2.8)					
Hydrant Control Valves	<p>A. Verify HCV maintains 45 psig (310 kPa) nozzle pressure at a flow of 50 to 600 gpm (3 to 38 lps).</p> <p>B. Verify HCV closes when nozzle pressure exceeds 50 psig (345 kPa).</p>	Quarterly	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	C. Verify HCV opening rate is set at a minimum of 20 seconds. D. Ensure HCV opens when the deadman control level is pressed. E. Verify HCV closes in five seconds maximum after the deadman lever is released.				
	F. Refer to Section 4-3.2.1 General System Control Valves for additional inspection and maintenance requirements.	As required	SM	SM	SM
Emergency Shut-off Valves (Section 4-4.2.9)					
Emergency Shut-off Valves	A. Ensure Solenoids A and B are energized under normal operations. B. Ensure Solenoids A and B are de-energized during emergency stop conditions. C. Test emergency stop function of the valve under flow conditions. Ensure the valve closes within 10 seconds of EFSO button activation. Coordinate test with overall EFSO test listed in Section 9-1.2.1 Inspection and Maintenance - Electrical Equipment . D. Verify differential control maintains a constant seven psig (48 kPa) differential pressure between the inlet and outlet of the valve. E. Ensure thermal relief function (ball check valve) relieves excess pressure when cover chamber pressure exceeds inlet pressure.	Quarterly	SM	SM	SM
	F. Refer to Section 4-3.2.1 General System Control Valves for additional inspection and maintenance requirements.				

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
CONTROL VALVES – TYPE IV AND V HYDRANT SYSTEMS					
Pantograph Control Valves (Section 4-5.2.12)					
Pantograph Control Valves	A. Verify PTCV maintains 55 psig (380 kPa) nozzle pressure at a flow of 50 to 600 gpm (3 to 38 lps).	Quarterly	SM	SM	SM
	B. Verify PTCV opens when the deadman control lever is pressed.				
	C. Verify PTCV closes in a maximum of 10 seconds after deadman lever is released.				
	D. Refer to Section 4-3.2.1 General System Control Valves for additional inspection and maintenance requirements.	As required	SM	SM	SM
Pantograph Pressure Control Valves (Section 4-5.2.13)					
Pantograph Pressure Control Valves	A. Verify PPCV opens at 75 psig (515 kPa).	Quarterly	SM	SM	SM
	B. Verify PPCV opening and closing speed are three seconds.				
Fixed Pantographs (Section 4-7.1.1)					
Fixed Pantographs	A. Place entire pantograph under static pump head pressure and check for leaks, ease of movement, and damaged grounding or bonding wire.	Monthly	OM	OM	OM
	B. Inspect wheels (if equipped) for warping, cracking, and uneven wear.	Quarterly	SM	SM	SM
	C. Inspect exposed piping and components for corrosion.				
	D. Refer to Section 4-7.3 Fueling Nozzles for inspection and maintenance requirements of fueling nozzle.	As required	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
\1\ Detachable /1/ Pantographs (Section 4-7.1.2)					
\1\ Detachable /1/ Pantographs	A. Place entire pantograph under static pump head pressure and check for leaks, ease of movement, and damaged grounding or bonding wire.	Monthly	OM	OM	OM
	B. Inspect exposed piping and components for corrosion. C. Lubricate wheels. D. Inspect wheels for warping, cracking and uneven wear.	Quarterly	SM	SM	SM
	E. Refer to Section 4-7.2 Hydrant Adapters for inspection and maintenance requirements of pantograph hydrant adapters. F. Refer to Section 4-7.3 Fueling Nozzles for inspection and maintenance requirements of fueling nozzles.	As required	SM	SM	SM
	HYDRANT ADAPTERS AND NOZZLES				
Hydrant Adapters (Section 4-7.1\2/1/)					
Hydrant Adapters	A. Inspect hydrant adapter for proper operation, damage, and wear. B. Test operation of dry break system.	Quarterly	SM	SM	SM
Fueling Nozzles (Section 4-7.1\3/1/)					
Fueling Nozzles	A. Inspect the condition of the dust cap at the aircraft adapter end and ensure it is in good working order. Dust caps must be attached to nozzles when they are not in use. B. Test leak resistance of poppet valve against full pump pressure. Unusual conditions found during this test indicate that repair is necessary and the nozzle must be removed from service.	\1\Monthly/1/	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>C. Inspect storage racks for moisture or dirt accumulation. Correct conditions that may be attributing to accumulation of moisture or dirt in the storage racks.</p> <p>D. Remove nozzle for inspection of content impinged upon the mesh screen. Clean and dry screens before nozzles are returned to service. If a strainer ball valve is installed upstream of the nozzle only the strainer in the strainer ball valve needs to be check. Nozzles should not be used while strainers are removed from upstream strainer ball valves.</p> <p>E. Tests nozzle interlocks. Ensure interlocks prevent release of fuel when the fueling nozzle is not properly connected. Adjust the seating of the poppet valve if required.</p> <p>F. Check the operation of the manual valve crank assembly for smooth and positive motion on a special test stand.</p>				
SUPPRESSORS					
Surge Suppressors (Section 4-7.114/1)					
Surge Suppressors	<p>A. Inspect for nitrogen leaks.</p> <p>B. Bladder pressure inside surge suppressors must be validated and recharged as needed with nitrogen. Some surge suppressors are also equipped with needle valves. Settings established in the startup and commissioning documents should be maintained. Adjust nitrogen charge per manufacturer's recommendations.</p>	Quarterly	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
HYDRANT SYSTEM PRODUCT RECOVERY					
Overfill Valve for Product Recovery Tanks (Section 4-8.1)					
Overfill Valve for Product Recovery Tanks	<p>A. Verify that a green light is illuminated on the pump control panel graphic display when OV is open.</p> <p>B. Ensure pressure reservoir bladder is charged with 13 to 15 psig (90 to 103 kPa) of nitrogen and that the reservoir holds fuel pressure.</p> <p>C. Verify that the OV closes when the control float is lifted (normally 95% full). Use the manual tester to lift the float. NOTE: When the float in the product recovery tank rises and the OV closes, the pressure in the pressure reservoir tank will decrease.</p> <p>D. Verify that a red light is illuminated and that an alarm is activated on the pump control panel graphic display when OV is closed. Alarm is activated by a limit switch installed on the OV.</p> <p>E. Ensure the pressure reservoir tank holds FTP deadhead pressure when the pump is deactivated.</p> <p>F. Open and clean reservoir inlet strainer.</p>	Semi-annually	SM	SM	SM
	<p>G. Refer to Section 6-6.3 Thermal and Pressure Relief Valves for inspection and maintenance requirements of thermal and pressure relief valves.</p>				

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
MARINE RECEIVING AND DISPENSING EQUIPMENT					
\\ Piers and Wharves Fuel Containment Systems (5-1.2) //					
\\ Piers and Wharves //	<p>\\</p> <p>A. Hydrostatically test the secondary containment and associated drainage systems to include containment concrete/sealant, drain inlets, drain lines and containment drain valves to ensure containment is liquid tight. This test may use opportune rainfall by holding rainwater in the containment system for one hour. Where evaporation is a concern, conduct the testing when this concern would be minimized, such as at night/early morning or during a time of year when this would not be as much of an issue. Record the water level at the start of the 60-minute (minimum) hold period. If the water level drops by 1/8 inch or more, perform and record an investigation to determine the cause and any required repairs. Refer to Appendix B for testing procedures and to document the testing.//.</p>	\\ Every 3 Years //	\\ SM //	\\ SM //	\\ SM //
Marine Receipt (5-2)					
Marine Receipt	A. Conduct a shore side inspection of the pier or wharf for signs of damage as soon as marine barge or tanker disembarks.	After each use	OM	OM	OM
	B. Inspect the ground switch used between the marine barge or tanker and the petroleum fuel receipt piping.	Monthly	OM	OM	OM
	C. Inspect mooring lines, cleats, bollards, bits, pulley blocks, steel wire ropes, and winches. Use				

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	UFC 4-150-08 as a guide when conducting inspections. Repair or replace damaged components as required.				
	<p>D. Refer to Section 6-1 Pipe Testing and Inspections for inspection and maintenance requirements of petroleum fuel pipelines installed above water surfaces. These pipelines are regulated under 33 CFR 154 and 156. Any additional requirements listed under 33 CFR 154 and 156 must also be followed.</p> <p>E. Refer to Section 5-5.1 Marine Transfer Hoses for inspection and maintenance requirements of petroleum fuel marine hoses.</p> <p>F. Refer to Section 5-4 Marine Loading Arms for inspection and maintenance requirements of petroleum fuel marine loading arms.</p> <p>G. Refer to Section 3-6.4 Basket Strainers for inspection and maintenance requirements of basket strainers.</p> <p>H. Refer to Section 3-7 Meters for inspection and maintenance requirements of petroleum fuel meters.</p> <p>I. Refer to Section 3-8.2 Positive Displacement Pumps for inspection and maintenance requirements of stripper pumps.</p> <p>J. Refer to Section 9-1.6 Grounding Systems for inspection and maintenance requirements of grounding systems.</p>	As required	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
Marine Issue (Section 5-3)					
Marine Issue	A. Inspect pier or wharf for signs of damage as soon as marine barge or tanker disembarks.	After each use	OM	OM	OM
	B. Inspect the ground switch between the fueling tanker/barge and the fuel system. C. Inspect mooring lines, cleats, bollards, bits, pulley blocks, steel wire ropes, and winches. Use UFC 4-150-08 as a guide when conducting inspections. Repair or replace damaged components as required.	Monthly	OM	OM	OM
	D. Refer to Section 6-1 Pipe Testing and Inspections for inspection and maintenance requirements of petroleum fuel pipelines installed above water surfaces. These pipelines are regulated under 33 CFR 154 and 156. Any additional requirements listed under 33 CFR 154 and 156 must also be followed. E. Refer to Section 3-6.4 Basket Strainers for inspection and maintenance requirements of basket strainers. F. Refer to Section 3-8 Pumps for inspection and maintenance requirements of marine loading and stripper pumps. G. Refer to Section 3-7 Meters for inspection and maintenance requirements of petroleum fuel meters. H. Refer to Section 5-5.1 Marine Transfer Hoses for inspection and maintenance requirements of petroleum fuel marine hoses.	As required	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>I. Refer to Section 5-4 Marine Loading Arms for inspection and maintenance requirements of petroleum fuel marine loading arms.</p> <p>J. Refer to Section 9-1.6 Grounding Systems for inspection and maintenance requirements of grounding systems.</p>				
Marine Loading Arms (Section 5-4)					
Marine Loading Arms	A. Check swivel for smooth operation. Check seals for signs of wear and discoloration which may indicate a seal or ball bearing failure.	Quarterly	SM	SM	SM
	B. Inspect ball bearings when accessible. Rough and/or uneven wear on the surface are indications of swivel joint failure	Annually	SM	SM	SM
	C. Conduct pressure test of marine loading arms in accordance with 33 CFR 156.170 <i>Equipment Tests and Inspections</i> , Section (f)(1).				
Marine Bulk Transfer Hoses (Section 5-5.1)					
Marine Bulk Transfer Hoses	A. Visually inspect transfer hoses. Transfer hoses must have no loose covers, kinks, bulges, soft spots, and no gouges, cuts or slashes that penetrate the hose reinforcement. Hoses must also have no external deterioration.	Before each use	OM	OM	OM
	B. Visually survey petroleum fuel marine hoses. Observe the general condition and look for fluid puddles, fine mists, physical damage such as jacket abrasion or deformation, and deteriorated joints. Use sense of smell to detect petroleum vapor. Look for improper hose handling that may	During each use	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	overstress the hose by stretching, relative movement, or kinking.				
	C. Refer to Appendix D, Section D-2.2 Marine and Underwater Transfer Hose Hydrostatic Test for marine transfer hose hydrostatic testing requirements and procedures.	Annually or not less than 30 days prior to the first transfer conducted past one year from the date of the last test and inspection.	SM	SM	SM
Underwater Hoses (Section 5-5.2)					
Underwater Hoses	A. Refer to Appendix D, Section D-2.2 Marine and Underwater Transfer Hose Hydrostatic Test for underwater hose hydrostatic testing requirements and procedures.	Annually or not less than 30 days prior to the first transfer conducted past one year from the date of the last test and inspection.	SM	SM	SM
Single Point Mooring Systems (Section 5-7.1)					
	A. Inspect and, if necessary, repair or replace all mooring hawsers or lines, deck hose, chain, chair stoppers, flange adaptors, gaskets or other gear used in mooring the marine tanker and in connecting hoses.	Monthly	OM	OM	OM
Single Point Mooring Systems	B. Inspect air-compressor for proper operation. C. Inspect navigation aids and mooring buoy, in accordance with NAVFAC MO-124 <i>Mooring Maintenance Manual</i> , for evidence of damage and possible movement or dragging by vessels, current or winds. D. Divers must conduct underwater inspections of mooring chains, shackles and anchors attaching buoys to bay/harbor floors.	Annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	E. Conduct overhaul of single point mooring buoys every 3 to 5 years. Single point mooring buoys must be brought ashore for repair in these instances.	Every 5 years	SM	SM	SM
Multi Point Mooring Systems (Section 5-7.2)					
Multi Point Mooring Systems	A. Inspect and, if necessary, repair or replace all mooring hawsers or lines, deck hose, chain, chair stoppers, flange adaptors, gaskets or other deck gear used in mooring the marine tanker and in connecting underwater hoses.	Monthly	OM	OM	OM
	B. Inspect navigation aids and mooring buoys, in accordance with NAVFAC MO-124 <i>Mooring Maintenance Manual</i> , for evidence of damage and possible movement or dragging by vessels, current or winds.	Annually	SM	SM	SM
	C. Divers must conduct underwater inspections of mooring chains, shackles and anchors attaching buoys to bay/harbor floors.				
SUBMERGED PIPING SYSTEMS					
Submerged Piping Systems (Section 5-8)					
Submerged Piping Systems	A. Inspect water above submerged pipelines and their seaward end for tell-tale petroleum fuel slicks indicating leakage from pipes or underwater hoses.	Weekly	OM	OM	OM
	B. If equipped, electrically check the cathodic protection rectifier for proper performance.	Six times each calendar year with intervals not exceeding 2½ months	SM	SM	SM
	C. Divers must inspect submerged pipe and hoses for signs of	Semi-annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	incipient failure or indications of rapid wear of parts subject to wave motion or abrasion on the ocean floor.				
	D. Conduct annual pipe test as specified in Appendix G – Petroleum Fuel Pipeline Pressure testing Guidelines and Criteria. Testing requirements of marine pipelines are regulated under 33 CFR 154 and 156, particularly 33 CFR 156 Section 170. E. Conduct cathodic protection tests on the protected pipeline as specified in Section 9.2.1 Cathodic Protection at least once each calendar year with intervals not exceeding 15 months between tests from consecutive years.	Annually	SM	SM	SM
Boom Reels (Section 5-9)					
Boom Reels	A. Visually inspect hydraulic drives and hose connections for leaks. B. Grease bearings. C. Inspected boom reel for signs of corrosion. Inspect breaking system and ensure it is in good working order.	Quarterly	SM	SM	SM
	D. Inspect boom for wear, rips, and tears. Repair or replace as required to ensure containment of petroleum fuel in the event of a spill.	Annually	SM	SM	SM
ON-BASE PIPELINES					
On-Base Pipelines (Section 6-1.1)					
On-Base Pipelines	A. Conduct petroleum fuel pipeline visual inspection of aboveground piping in accordance with Section 6-1.5 Pipeline Visual Inspection .	Monthly	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	B. Conduct line walk in areas of petroleum fuel piping in accordance with Section 6-1.6 Line Walk.	Conduct during transfer operations, or monthly, at a minimum	OM	OM	OM
	C. Conduct annual test as specified in Appendix G – Petroleum Fuel Pipeline Pressure Testing Guidelines and Criteria.	Annually	SM	SM	SM
	D. Conduct cathodic protection tests as specified in Section 9.2.1 Cathodic Protection on protected petroleum fuel pipelines at least once each calendar year, but with intervals not exceeding 15 months.	Annually	SM	SM	SM
	E. Conduct five year test as specified in Appendix G – Petroleum Fuel Pipeline Pressure Testing Guidelines and Criteria.	Every five years	SM	SM	SM
	F. Conduct petroleum fuel pipeline API 570 inspection in accordance with Section 6-1.9 API 570 Inspections.	Every 5 or 10 years depending on API class piping or in accordance with Pipeline Integrity Management Plan (PIMP).	SM	SM	SM
	G. Conduct petroleum fuel pipeline cleaning in accordance with Section 6-2 General Pipeline Cleaning.	As required to ensure fuel quality.	SM	SM	SM
INTER-TERMINAL PIPELINES					
Non-DOT Regulated (Section 6-1.2.1)					
Non-DOT Regulated	A. Conduct petroleum fuel pipeline volume check in accordance with Section 6-1.8 Volume Check.	Monthly	OM	OM	OM
	B. Conduct line patrol in areas of underground petroleum fuel pipeline in accordance with Section 6-1.7 Line Patrol.	Annually	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	C. Government operated inter-terminal petroleum fuel pipelines must follow the maintenance requirements listed in Section 6-1.1.1 for On-Base Pipelines .	As required	SM/OM	SM/OM	SM/OM
Aboveground Piping (Section 6-1.3)					
Aboveground Piping	A. Conduct petroleum fuel piping visual Inspection in accordance with Section 6-1.5 Pipeline Visual Inspection .	Weekly	OM	OM	OM
	B. Conduct petroleum fuel piping annual test as specified in Appendix G – Petroleum Fuel Pipeline Pressure Testing Guidelines and Criteria .	Annually	SM	SM	SM
	C. Conduct petroleum fuel piping API 570 inspection in accordance with Section 6-1.9 API 570 Inspections .	Every 5 or 10 years depending on API class piping or in accordance with Pipeline Integrity Management Plan (PIMP). Management Plan (PIMP).	SM	SM	SM
	D. Conduct cleaning of petroleum fuel piping in accordance with Section 6-2 General Pipeline Cleaning .	As required to ensure fuel quality.	SM	SM	SM
Double-Wall Piping (Section 6-1.4)					
Double-Wall Piping	A. Conduct petroleum fuel pipeline visual Inspection of aboveground piping in accordance with Section 6-1.5 Pipeline Visual Inspection .	Monthly	OM	OM	OM
	B. Conduct annual carrier pipe test as specified in Appendix G – Petroleum Fuel Pipeline Pressure Testing Guidelines and Criteria .	Annually	SM	SM	SM
	C. Conduct cathodic protection tests as specified in Section 9.2.1 Cathodic Protection on protected petroleum fuel pipelines at least				

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	once each calendar year, but with intervals not exceeding 15 months.				
	D. Conduct containment pipe test as specified in Appendix G – Petroleum Fuel Pipeline Pressure Testing Guidelines and Criteria.	Every three years	SM	SM	SM
	E. Conduct petroleum fuel pipeline API 570 inspection in accordance with Section 6-1.9 API 570 Inspections .	Every 5 or 10 years depending on API class piping or in accordance with Pipeline Integrity Management Plan (PIMP). Management Plan (PIMP).	SM	SM	SM
	F. Conduct petroleum fuel pipeline cleaning in accordance with Section 6-2 General Pipeline Cleaning .	As required to ensure fuel quality.	SM	SM	SM
MANUAL VALVES					
Plug Valves – Lubricated (Section 6-6.2.1)					
Plug Valves - Lubricated	A. Open and close valve to check for ease of operation.	Quarterly	SM	SM	SM
	B. Lubricate valve operator stems and all grease fittings.	Semi-annually	SM	SM	SM
	C. Inspect valve exterior for corrosion and tightness of bolts. Repaint/tighten as required.				
Plug Valves – Non-lubricated (Section 6-6.2.2)					
Plug Valves Non- Lubricated	A. Open and close valve to check for ease of operation. Adjust or replace packing as needed.	Quarterly	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	B. Inspect valve exterior for corrosion and tightness of bolts. Repaint and retighten as required.	Semi-annually	SM	SM	SM
Gate Valves (Section 6-6.2.3)					
Gate Valves	A. Open and close valve to check for ease of operation. Adjust or replace packing as needed.	Quarterly	SM	SM	SM
	B. Lubricate valve operator stem.	Semi-annually	SM	SM	SM
	C. Inspect valve exterior for corrosion and tightness of bolts. Repaint and retighten as required.				
Ball Valves (Section 6-6.2.4)					
Ball Valves	A. Open and close valve to check for ease of operation. B. Lubricate overhead ball valve chain operator gears. C. Adjust packing per manufacturer's specifications. D. Inspect valve exterior for corrosion and tightness of bolts. Repaint/tighten as required.	Quarterly	SM	SM	SM
	E. Refer to Section 6-6.2.10 Manual Valve Gear Operators for inspection and maintenance of gear operators if equipped.	As required	SM	SM	SM
Double Block and Bleed Valves (Section 6-6.2.5)					
Double Block and Bleed Valves	A. Open and close valve to check for ease of operation. B. Lubricate overhead valve chain operator gears if equipped.	Quarterly	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>C. Adjust packing per manufacturer's specifications.</p> <p>D. Inspect valve exterior for corrosion and tightness of bolts. Repaint and tighten as required.</p> <p>E. Operate the body cavity drain when valve is in closed position to ensure that the valve is closing properly.</p>				
	<p>F. Remove bottom drain plug and drain valve.</p>	Annually	SM	SM	SM
	<p>G. Refer to Section 6-6.2.10 Manual Valve Gear Operators for inspection and maintenance of gear operators if equipped.</p> <p>H. Some double block and bleed valves are equipped with integrated pressure/thermal relief valves. Refer to Section 6-6.3 Thermal and Pressure Relief Valves for inspection and maintenance requirements of pressure/thermal relief valves.</p>	As required	SM	SM	SM
Butterfly Valves (Section 6-6.2.6)					
Butterfly Valves	<p>A. Open and close valve to check for ease of operation. Ensure that lever operators and locking mechanisms are in place and working properly.</p> <p>B. Adjust packing per manufacturer's specifications as needed. If butterfly valves are leaking or not shutting off flow, tightening the gland flange to tighten the stem packing or remove the valve from service and replace the seats as necessary.</p> <p>C. Inspect valve exterior for corrosion and tightness of bolts. Repaint and retighten as required</p>	Quarterly	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
Globe Valves (Section 6-6.2.7)					
Globe Valves	A. Open and close valve to check for ease of operation. B. Adjust packing per manufacturer's specifications as needed. C. Inspect valve exterior for corrosion and tightness of bolts. Repaint/tighten as required	Quarterly	SM	SM	SM
Check Valves (Section 6-6.2.8)					
Check Valves	A. Use external test lever to make sure the valve is not sticking if equipped. If a check valve is suspected of not checking and cannot be serviced in place, it must be removed from the piping system and serviced in a shop. B. Inspect valve exterior for corrosion and tightness of bolts. Repaint and retighten as required.	Quarterly	SM	SM	SM
Line Blanks, Ring Spacers, and Spectacle Blinds (Section 6-6.2.9)					
Line Blanks, Ring Spacers, and Spectacle Blinds	A. Inspect exposed side of spectacle blinds. The exposed side must be kept clean and free of corrosion. B. Spectacle blinds should be inspected to ensure they are installed with the correct orientation for the desired flow or no-flow condition.	Quarterly	SM	SM	SM
Manual Valve Gear Operators (Section 6-6.2.10)					
Manual Valve Gear Operators	A. Lubricate gear driven operators and check for smooth operation	Quarterly	SM	SM	SM
RELIEF VALVES					
Thermal and/or Pressure Relief Valves (Section 6-6.3)					
	A. Thermal and pressure relief valves must be inspected for signs of leak-by. Inspect relief valves for	Monthly	OM	OM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
Thermal and Pressure Relief Valves	<p>leaks by visually inspecting downstream flow indicators (if installed) for flow. If no flow indicators are installed listen for possible leaks. If suspect: isolate and test the relief valve; check opening pressure; and verify re-seating. Malfunctioning valves must be repaired or replaced.</p> <p>B. Ensure manual isolation valves installed upstream and downstream of thermal and pressure relief valves are open with valve handles are removed, wired open or locked.</p>				
	<p>C. Inspect valve exterior of thermal and pressure relief valves for corrosion. Repaint as required. Information plates attached to thermal and pressure relief valves must not be painted over.</p>	Quarterly	SM	SM	SM
	<p>D. Verify thermal and pressure relief valve setting by consulting as-built and historical data.</p> <p>E. Thermal and pressure relief valves must be validated for proper calibration by isolating the valve and using the test connection provided on the piping in conjunction with a hand pump and portable reservoir. The operating pressure must be checked against the set pressure listed on the stamped information plate attached to the valve. The operating pressure must be adjusted to the stamped set pressure if necessary.</p>	Annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
SEMI-AUTOMATIC VALVES					
Fire Valves (Section 6-6.4.1)					
Fire Valves	A. Ensure the fusible link mechanism is attached properly to actuate in case of a fire and that it has not been by-passed, blocked, or damaged in any manner. Ensure the fusible link is not filled with debris or paint which could impact operation. \1\ Maintain fusible links per manufacturer's recommendation./1/	Quarterly	SM	SM	SM
	B. Check the closing mechanism to ensure that it closes the valve properly.	Annually	SM	SM	SM
Fusible Line Butterfly Valves (Section 6-6.4.2)					
Fusible Line Butterfly Valves	A. Ensure the fusible link mechanism is attached properly to actuate in case of a fire and that it has not been by-passed, blocked, or damaged in any manner. Ensure the fusible link is not filled with debris or paint which could impact operation. \1\ Maintain fusible links per manufacturer's recommendation./1/	Quarterly	SM	SM	SM
	B. Test the operation of spring closure unit. Ensure that the spring actuator closes the valve and that the valve closes securely against the seat.	Annually	SM	SM	SM
	C. Refer to Section 6-6.2.6 Butterfly Valves for additional inspection and maintenance requirements of butterfly valves.	As required	SM	SM	SM
AUTOMATIC VALVES					
Truck Fill Valves (Section 6-6.5.1)					
	A. Verify TFV maintains 35 psig (240 kPa) nozzle pressure at a flow	Quarterly	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
Truck Fill Valves	<p>range of 50 to 600 gpm (3 to 38 lps).</p> <p>B. Verify TFV closes rapidly when outlet pressure exceeds control set point.</p> <p>C. Verify TFV opens when the deadman control lever is pressed.</p> <p>D. Verify TFV closes after the deadman control lever is released.</p> <p>E. If equipped, verify operation of solenoid connected to grounding verification system. Ground verification system should energize solenoid when an acceptable ground is detected by the ground verification unit.</p> <p>F. Systems that have overflow protection systems must be inspected and maintained concurrently with the inspection and maintenance of TFVs.</p>				
	<p>G. Refer to Section 4-3.2.1 General System Control Valves for additional inspection and maintenance requirements.</p>	As required	SM	SM	SM
Motor Operators (Section 6-6.6)					
Motor Operators	<p>A. Visually inspect motor operators to ensure smooth movement during opening and closing operation and adjust, if necessary, to ensure that they are opening and closing fully. Listen for and investigate unusual noises during operation.</p> <p>B. Lubricate mechanical overrides (if equipped).</p>	Quarterly	SM	SM	SM
	<p>C. Refer to Section 9-1.7 Electric Motors for inspection and</p>	As required	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	maintenance requirements of electric motors				
PRESSURE/VACUUM INSTRUMENTATION					
Pressure and Pressure/Vacuum Gauges (Section 6-7.1)					
Pressure and Pressure/ Vacuum Gauges	A. Check operation of gauge. Ensure gauge is indicating pressure of the system.	Monthly	OM	OM	OM
	B. Clean outside of gauge glass.	Quarterly	SM	SM	SM
	C. Inspect liquid filled gauges for leakage, refill/replace as needed.	Semi-annually	SM	SM	SM
	D. Conduct calibration check by comparing readings of the process gauge with the readings of a certified master calibration gauge which has been calibrated within the last year. The process gauge and the master calibration gauge must be connected to the same pressure source for testing. Verify accuracy of gauge is within $\pm 2\%$ of full scale. Calibrate gauge if required.	Annually	SM	SM	SM
Differential Pressure Gauges (Section 6-7.2)					
Differential Pressure Gauges	A. Verify proper operation of differential gauge in accordance with gauge manufacturer's procedures.	Monthly	SM	SM	SM
	B. Clean outside of gauge glass.	Quarterly	OM	OM	OM
	C. Conduct calibration check by comparing readings of the differential process gauge with the readings of a certified differential master calibration gauge which has been calibrated within the last year. The differential process gauge and the differential master calibration gauge must be connected to the same pressure source for testing. Verify accuracy	Annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>of gauge is within $\pm 2\%$ of full scale. Calibrate if required.</p> <p>D. Some differential pressure gauges have a small gauge protection filter located at the high pressure inlet of the gauge that must be checked and replaced as needed. Filters need to be replaced if the indicator is moving slow or sluggishly inside the sight glass or if the sight glass is dirty. Refer to manufacturer's operation and maintenance manual for filter replacement procedure.</p>	Annually for inspections and maximum 5 years of service between filter replacements.	SM	SM	SM
Pressure Transmitters (Section 6-7.3)					
Pressure Transmitters	<p>A. Inspect the exterior of the transmitter enclosure for accumulated oil, dust, and dirt. Clean if required.</p> <p>B. Check that both enclosure caps are fully threaded onto the enclosure, compressing the O-ring between the cap and the enclosure. The O-ring must not be cracked, broken, or otherwise damaged.</p> <p>C. Inspect the display viewing glass for cleanliness and damage. Replace the enclosure cap assembly if the glass is damaged or missing. No accumulation of dust, dirt, or water (condensate) should be present inside the enclosure.</p> <p>D. Inspect transmitter and mounting bracket hardware for tightness. Tighten loose hardware as necessary.</p> <p>E. Inspect for loose, bent, or cracked sensing lines. Replace damaged sensing lines.</p>	Quarterly	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	F. Check operation of transmitter. Ensure transmitter is indicating accurate pressure of the system.				
	G. Bleed sensing lines between the transmitter and the main line to ensure they are clean and free of suspended solids and air.	Semi-annually	SM	SM	SM
	<p>H. Check that all wire connections inside enclosure are tight.</p> <p>I. Pressure Transmitters (PTs) and Pressure Indicating Transmitters (PITs) must be calibrated mechanically and electrically with test equipment and adjusted if applicable. The presence of air in the sensing line of a pressure transmitter is a common cause for failure. Conduct calibration check by comparing readings of the PT or PIT with the readings of a certified master calibration gauge which has been calibrated within the last year. The PT or PIT and the master calibration gauge must be connected to the same pressure source for testing. Verify accuracy of PT or PIT gauge is within $\pm 2\%$ of full scale. Calibrate in accordance with manufacturer's operation and maintenance manual if required.</p>	Annually	SM	SM	SM
Differential Pressure Transmitters (Section 6-7.4)					
Differential Pressure Transmitters	<p>A. Inspect the exterior of the transmitter enclosure for accumulated oil, dust, and dirt. Clean as required.</p> <p>B. Check that both enclosure caps are fully threaded onto the enclosure, compressing the O-ring between the cap and the enclosure. The O-ring must not</p>	Quarterly	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>be cracked, broken, or otherwise damaged.</p> <p>C. Inspect the display viewing glass for cleanliness and damage. Replace the enclosure cap assembly if the glass is damaged or missing. No accumulation of dust, dirt, or water (condensate) should be present inside the enclosure.</p> <p>D. Inspect transmitter and mounting bracket hardware for tightness. Tighten loose hardware as necessary.</p> <p>E. Inspect for loose, bent, or cracked sensing lines. Replace damaged sensing lines.</p> <p>F. Check operation of transmitter. Ensure transmitter is indicating accurate pressure of the system</p>				
	<p>G. Bleed sensing lines between the transmitter and the main line to ensure they are clean and free of suspended solids and air.</p>	Semi-annually	SM	SM	SM
	<p>H. Check that all wire connections inside enclosure are tight.</p> <p>I. DPTs must be calibrated mechanically and electrically with test equipment and adjusted, if applicable. The presence of air in sensing lines of differential pressure transmitters is a common cause for failure. Conduct calibration check by comparing readings of the DPT with the readings of a certified differential master calibration gauge which has been calibrated within the last year. The DPT and the differential master</p>	Annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	calibration gauge must be connected to the same pressure source for testing. Verify accuracy of DPT is within $\pm 2\%$ of full scale. Calibrate in accordance with manufacturer's operation and maintenance manual if required.				
FLEXIBLE BALL JOINTS					
Flexible Ball joints (Section 6-8)					
Flexible Ball Joints	A. Lubricate ball joints and inspect for wear and stress.	Monthly	SM	SM	SM
THERMOMETERS					
Dial Thermometer (Section 6-9.1)					
Dial Thermometer	A. Inspect thermometer for cracked face and proper operational condition. Replace if damaged.	Quarterly	SM	SM	SM
	B. Check accuracy of thermometer against calibrated master thermometer. Ensure process and calibrated master thermometer are reading the same heat source. Verify accuracy of thermometer is within $\pm 2\%$ of full scale. Calibrate process thermometer if required.	Annually	SM	SM	SM
PIPE COATINGS					
Aboveground Piping and Equipment Coatings (Section 6-10.1)					
Aboveground Piping and Equipment Coatings	A. Visually inspect coatings for signs of deterioration, corrosion or damage. Repair damaged or deteriorated coatings	Quarterly	SM	SM	SM
UNDERGROUND FUEL PITS					
Isolation Valve Pits (Section 6-11.1)					
Isolation Valve Pits	A. Isolation valve pits should be inspected to ensure that the pits are dry and clean and that all	Monthly, or more often	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>components within the pit are clean and in good working order. Maintain seals and boot seals as appropriate. Obtain necessary confined space entry permits before entry. Inspect the pit for signs of fuel or water. Water or fuel should be removed from the pit as soon as possible and the source of water infiltration or fuel leak determined.</p> <p>B. Check for cracks in concrete and check piping penetrations through pit wall or bottom to ensure that mechanical seals and boot seals are in good working condition and are allowing no seepage of water into the pits. Make note of cracks in concrete and schedule maintenance as necessary. Check for fuel leaks at all flanged and other piping connections. Check for rusted or deteriorated ladders or grating platforms that might make entry unsafe. Check pit lids for proper sealing. Check rolling pit covers for ease of operation and signs of deterioration, damage or corrosion. Make sure required locks are in place and locking mechanisms are not broken.</p>	based on local conditions			
Hydrant Fuel Pits (Section 6-11.2)					
Hydrant Fuel Pits	<p>A. Hydrant fuel pits must be inspected to ensure that they are dry and clean and that all fueling components within the pit are clean and in good working order. Obtain necessary confined space entry permits before entry. Inspect the pit for fuel or water. Fuel or water found in the pit must be sumped out as soon as possible.</p> <p>B. Check pipe penetrations through pit walls or bottom to ensure that mechanical and boot seals are in</p>	Monthly, or more often based on local conditions	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>good working condition and are allowing no water seepage into the pits.</p> <p>C. Check for fuel leaks at all flanged and pipe connections.</p> <p>D. Check pit lids to ensure that seals are in good working order and are preventing water entry into the pits.</p> <p>E. Inspect hydrant fuel pit bonding cables for corrosion and ensure electrical continuity between bonded equipment.</p>				
High Point Vent Pits (Section 6-11.3)					
High Point Vent Pits	<p>A. Inspect high point vent pits to ensure they are dry and free of water and other debris and that pit and piping components are leak free and in good working condition. Inspect the pit for fuel or water. Fuel or water found in the pit must be sumped out as soon as possible.</p> <p>B. Check pipe penetrations through pit walls or bottom to ensure that mechanical and boot seals are in good working condition and are allowing no water seepage into the pits.</p> <p>C. Check pit lid seals for deterioration and replace as necessary.</p> <p>D. Ensure that high point vent valves, quick-disconnect couplings or pit lids are lockable and that locking mechanisms are in good working order.</p>	Monthly	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	E. Inspect high point vent pit bonding cables for corrosion and ensure electrical continuity between bonded equipment.				
Low Point Drain Pits (Section 6-11.4)					
Low Point Drain Pits	<p>A. Inspect low point drain pits to ensure they are dry and free of water and other debris and that all pit and piping components are leak free and in good working condition. Inspect the pit for fuel or water. Fuel or water found in the pit must be sumped out as soon as possible.</p> <p>B. Check pipe penetrations through pit wall or bottom to ensure that mechanical seals and boot seals are in good working condition and are allowing no water seepage into the pits.</p> <p>C. Check pit lid seals for deterioration and replace as necessary.</p> <p>D. Ensure that low point vent valves, quick-disconnect couplings or pit lids are lockable and that locking mechanisms are in good working order.</p> <p>E. Inspect low point drain pit bonding cables for corrosion and ensure electrical continuity between bonded equipment.</p>	Monthly	OM	OM	OM
Lateral Control Pits (Section 6-11.5)					
Lateral Control Pits	A. Inspect lateral control pits to ensure they are dry and free of water and other debris and that all pit and piping components are leak free and in good working condition. Inspect the pit for fuel or	Monthly	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>water. Fuel or water found in the pit must be sumped out as soon as possible.</p> <p>B. Check pipe penetrations through pit wall or bottom to ensure that mechanical seals and boot seals are in good working condition and are allowing no water seepage into the pit.</p> <p>C. Check pit lid seals for deterioration and replace as necessary.</p> <p>D. Check for fuel leaks at all flanged and other piping connections.</p> <p>E. Ensure that pit lids are lockable and that locking mechanisms are in good working order.</p> <p>F. Inspect lateral control pit bonding cables for corrosion and ensure electrical continuity between bonded equipment.</p>				
MINOR PIPING EQUIPMENT					
Low Point Drains (Section 6-12.1)					
Low Point Drains	A. Visually inspect low point drains. Ensure that quick-disconnect dust caps are in place and that valves are locked closed.	Weekly	OM	OM	OM
	B. Operate low point drains when system is not under operating pressure. If there is an absence of sufficient line pressure close the low point drain and pressurize the system. Once adequate pressure is available, continue draining until the piping fuel sample is clear and bright with no visible water.	Monthly or as required by local conditions. Verify low point drains are closed after maintenance	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
High Point Vents (Section 6-12.2)					
High Point Vents	A. Inspect high point vents. If fuel leaks are observed they should be repaired as soon as possible. Ensure that quick-disconnect dust caps are in place and that high point vent valves are locked.	Weekly	OM	OM	OM
Sight Flow Indicators (Section 6-12.3)					
Sight Flow Indicators	A. Verify there are no leaks around pipe connection fittings and glass seals. Also check glass for indications of cracks.	Daily or at each use	OM	OM	OM
ELECTRONIC RELEASE DETECTION MONITORING					
Rope Sensor Systems (Section 6-13.1.1)					
Rope Sensor System	A. Ensure the monitoring panel associated with the rope sensor(s) is powered on and no alarms are present.	Daily	OM	OM	OM
	B. Test rope sensor system and ensure it is functional.	Annually	SM	SM	SM
Point Sensor - Dry (Section 6-13.1.2)					
Point Sensor - Dry	A. Ensure the monitoring panel associated with the point sensor(s) is powered on and no alarms are present.	Daily	OM	OM	OM
	B. Ensure monitoring space is clear and free of debris and liquid.	Monthly	OM	OM	OM
	C. Test sensor and ensure it is functional.	Annually	SM	SM	SM
Visual Monitoring (Section 6-14.1)					
Visual Monitoring	A. Visually inspect ports for signs of leaks. Remove debris or foreign objects obstructing the view.	Weekly	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
FILLING STATION DISPENSERS					
Dispenser Nozzles (Section 7-2)					
Dispenser Nozzles	A. Inspect dispenser nozzle spout. Ensure it is tight, round, has no cracks, or excessive wear. Inspect automatic shutoff hole. Ensure the hole is open and free of obstructions. Inspect nozzle hold-open latch. Ensure the latch is straight, moves freely, and the return spring operates correctly. Inspect body of nozzle. Ensure the body is in good condition and that the valve stem is clean and free of fuel. Inspect the nozzle to hose connection and ensure it is clean and free of fuel.	Daily	OM	OM	OM
	B. Dispenser nozzle handles must be inspected for an expiration date established by the manufacturer. Nozzles must be replaced before the indicated expiration date.	Monthly	OM	OM	OM
	C. Test automatic shutoff feature and ensure it is operating properly. Test automatic shutoff at all nozzle hold-open latch positions	Annually	SM	SM	SM
Dispenser Hoses (Section 7-3)					
Dispenser Hoses	A. Inspect dispenser hoses and hose whips for gouges, cuts, blisters, or outside wear that may lead to rupture during use. Replace hose or hose whips that show signs of wear. Inspect connection points of hoses and hose whips to the dispenser, breakaways, swivels, and the nozzle and ensure the connection points are clean and free of fuel.	Daily	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
Breakaways (Section 7-4)					
Breakaways	A. Inspect breakaways for loose connections and signs of damage to poppets. Ensure breakaways are clean and free of fuel.	Daily	OM	OM	OM
	B. Inspect breakaway for an expiration date established by the manufacturer. Breakaways must be replaced before the indicated expiration date	Monthly	OM	OM	OM
Swivels (Section 7-5)					
Swivels	A. Inspect swivel for loose connections and signs of damage. Ensure swivel rotates easily and is clean and free of fuel.	Daily	OM	OM	OM
	B. Inspect swivel for expiration date established by manufacturer. Swivels must be replaced before the indicated expiration date.	Monthly	OM	OM	OM
Hose Retriever (Section 7-6)					
Hose Retriever	A. Test hose retriever and ensure it is operating correctly and supporting the hose.	Monthly	OM	OM	OM
Dispenser Cabinet (Section 7-7)					
Dispenser Cabinet	A. Inspect outside of cabinet and ensure it is free of damage. Inspect for fuel stains on the concrete island around the cabinet and on the outside of the cabinet. Ensure the cabinet is free of dirt and fuel. B. Open both sides of the cabinet and inspect the inside of the cabinet. Ensure the inside of the cabinet and all of the components	Monthly	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	inside the cabinet are clean and free of fuel.				
	C. Ensure door panels and locks operate easily. Inspect anchor bolts of cabinet to dispenser island and ensure the bolts are in good condition.	Annually	SM	SM	SM
Dispenser Meters (Section 7-8)					
Dispenser Meters	A. Inspect meter and ensure meter is clean and free of fuel. Ensure calibration mechanism is sealed.	Monthly	OM	OM	OM
	B. Since moving parts inside meters are subject to wear, periodic calibration is necessary. Meters must be recalibrated utilizing a certified 5 gallon (20 liter) prover can or other approved method. Meters are considered satisfactory for further operation when the error does not exceed $\pm 0.2\%$ of actual quantity delivered.	Annually	SM	SM	SM
Dispenser Filters (Section 7-9)					
Dispenser Filters	A. Inspect filter and ensure filter is clean and free of fuel and that filter is labeled with a legible installation date.	Monthly	OM	OM	OM
	B. Replace dispenser filters annually or when a change in flow rate is noted.	Annually or as needed	SM	SM	SM
Dispenser Strainer (Section 7-10)					
Dispenser Strainers	A. Inspect and clean strainers. Inspect strainer cover gasket for cracks, distortion, and dry rot. If breaks are detected in strainer mesh, replace the strainer.	Annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
GROUND FUEL PIPING					
Ground Vehicle Fuel Piping (Section 7-11)					
Ground Vehicle Fuel Piping	A. Visually inspect aboveground lines for leaks. Shut down systems that are found with leaks and repair.	Daily	OM	OM	OM
	B. Visually inspect leak detection systems installed on underground piping. Inspections include line leak detectors and leak detection sensors installed in transition sumps and dispenser sumps. Perform leak testing on pressurized underground piping with installed leak detection equipment and record results.	Monthly	SM	SM	SM
	C. Test leak detection systems installed on underground piping used for ground vehicle petroleum fuel products. Underground leak detection systems include discrete detection sensors installed in transition and dispenser sumps, and line leak detectors installed at the outlet of pumps used to supply pressurized liquid petroleum fuel to underground lines. Repair faulty components. Execution of this work may require state certification or license.	Annually	SM	SM	SM
	D. Conduct service station aboveground piping annual test as outlined in Appendix G – Petroleum Fuel Pipeline Pressure Testing Guidelines and Criteria. Execution of this work may require state certification or license.				
	E. Conduct service station underground piping annual test outlined in Appendix G – Petroleum Fuel Pipeline Pressure Testing Guidelines and Criteria.				

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>Execution of this work may require state certification or license.</p> <p>F. Refer to Section 2.7 Signage and Markings for inspection and maintenance requirements of ground vehicle petroleum fuel pipe markings.</p> <p>G. Refer to Section 6-10.1 Aboveground Piping and Equipment Coatings for inspection and maintenance requirements of ground vehicle petroleum fuel pipe coatings.</p>	As required	SM	SM	SM
Emergency Shutoff Valves (Shear Valves) (Section 7-12)					
Emergency Shutoff Valves (Shear Valves)	<p>A. Inspect stabilizer bar to ensure that it is securely mounted below the base of the dispenser. Inspect the mounting bolts that secure the emergency shutoff valve to the stabilizer bar.</p> <p>B. Inspect fusible link and ensure it is not obstructed. Ensure valve body is clean and free of fuel.</p>	Monthly	OM	OM	OM
	<p>C. Inspect mechanical links of the valve for correct operation. Conduct test of valve to ensure it operates correctly. Execution of this work may require state certification or license.</p>	Annually	SM	SM	SM
Dispenser Sumps (Section 7-13)					
Dispenser Sumps	<p>A. Inspect for signs of water, fuel, trash, and debris inside sumps. Remove and properly dispose of collected water, fuel, trash, and debris. Visually inspect penetration fittings. If fuel or water is detected investigate the source and repair.</p>	Monthly	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	B. Inspect sump pipe transition fittings for tears, cracks, or other signs of deterioration. Check hose clamp seals to ensure they are securely tightened.	Quarterly	SM	SM	SM
	C. Test dispenser sumps and ensure they are liquid tight by using vacuum, pressure, or liquid testing in accordance with 40 CFR 280, Section 43.	Every three years	SM	SM	SM
Transition Sumps (Section 7-14)					
Transition Sumps	A. Inspect for signs of water, fuel, trash, and debris inside sumps. Remove and properly dispose of collected water, fuel, trash, and debris. Visually inspect penetration fittings. If fuel or water is detected investigate the source and repair.	Monthly	OM	OM	OM
	B. Inspect sump pipe transition fittings for tears, cracks, or other signs of deterioration. Check hose clamp seals to ensure they are securely tightened.	Quarterly	SM	SM	SM
	C. Test sumps and ensure they are liquid tight by using vacuum, pressure, or liquid testing in accordance with 40 CFR 280, Section 43.	Every three years	SM	SM	SM
DISPENSER PUMPS					
Remote Dispenser Pumps (Section 7-15.1)					
Remote Dispenser Pumps	A. Refer to Section 7-19.1.2 Automatic Line Leak Detector for maintenance and inspection requirements of automatic line leak detectors installed on submersible turbine pumps.	As required	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	B. Refer to Section 3-8.1.3 Vertical Turbine/Submerged Turbine Pumps for inspection and maintenance requirements of remote dispenser pumps.				
Self-Contained Dispenser Pumps (7-15.2)					
Self-Contained Dispenser Pumps	<p>A. Inspect self-contained dispenser pump v-belt drives for proper tension and excess wear. Replace belt as recommended by manufacturer.</p> <p>B. Inspect pump body. Ensure pump body is clean and free of fuel. Inspect air eliminator. Ensure air eliminator is clean and free of fuel and that the vent tube is not obstructed.</p>	Monthly	SM	SM	SM
EFSO SYSTEMS					
EFSO Systems (Section 7-16)					
EFSO Systems	A. Check the operation of the EFSO system by activating the fueling system and then pressing each of the EFSO buttons. Ensure that each button disables power to all of the dispensers and fuel pumps installed at the service station.	Quarterly	SM	SM	SM
	B. Refer to Section 2-7 Signage and Markings for inspection and maintenance requirements of EFSO pushbutton signs.	As required	SM	SM	SM
VAPOR RECOVERY					
Stage I Vapor Recovery (Section 7-17)					
Stage I Vapor Recovery	A. Inspect vapor recovery hoses for gouges, cuts or outside wear that may result in vapor leaks	Daily or before each use	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	B. Inspect caps and camlock fittings for tightness and leaks.	Quarterly	SM	SM	SM
	C. Refer to Section 7-11 Ground Vehicle Fuel Piping for inspection and maintenance requirements of Stage I vapor recovery piping.	As required	SM	SM	SM
Vapor Burners (Section 7-17.3)					
Vapor Burners	<p>A. Inspect vapor burners to ensure that the pilot flame system is operating properly. Fans, duct work, and dampeners must also be inspected to ensure proper air to fuel vapor mixtures allow for complete burns.</p> <p>B. Inspect burner knock out pots for condensed fuel vapors and water if equipped.</p> <p>C. Inspect thermowells and gas detection monitors for operability.</p>	Quarterly	SM	SM	SM
ELECTRONIC RELEASE DETECTION MONITORING					
Point Sensor - Dry (Section 7-19.1.1)					
Point Sensor - Dry	A. Ensure the monitoring panel associated with the point sensor(s) is powered on and no alarms are present.	Quarterly	OM	OM	OM
	B. Ensure monitoring space is clear and free of debris and liquid	Monthly	OM	OM	OM
	C. Test sensor and ensure it is functional.	Annually	SM	SM	SM
Automatic Line Leak Detector (Section 7-19.1.2)					
Automatic Line Leak Detector	A. Ensure the monitoring panel associated with the detector(s) is powered on and no alarms are present.	Daily	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	B. Simulate a 3 gallons per hour leak at 10 pounds per square inch; the automatic line leak detector must activate within one hour. A licensed and/or certified technician is required to, test, troubleshoot, or calibrate for operation.	Annually	SM	SM	SM
Visual Monitoring (Section 7-20.1)					
Visual Monitoring	A. Visually inspect at inspection ports for signs of leaks. Remove debris or foreign objects obstructing the view.	Weekly	OM	OM	OM
STORAGE TANKS					
Aboveground Field-Erected Tanks (Section 8-4)					
Aboveground Field-Erected Tanks	A. Visually inspect for evidence of leaks; shell distortions; signs of settlement; corrosion, condition of tank foundation, condition of coating, insulation systems, and appurtenances. Inspection must include all components and equipment located inside the containment area such as piping, pipe supports, containment valves, and product saver tanks. Items noted during the inspection will be documented for follow-up action by an authorized inspector. See Appendix F for the Field-Erected Tank Monthly Inspection Checklist.	Monthly	OM	OM	OM
	B. Visually inspect chime to ringwall sealant. Seal should be maintained in good working order to prevent corrosion of the underside of the tank bottom.				
	C. Visually inspect the exterior of the tank for leaks, corrosion, or irregularities such as tilting,	Annually	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>settling, or out-of-roundness. Give special attention to seams and anchor bolts. Visual inspection must include all components and equipment located inside the tank containment area such as piping, pipe supports, containment valves, and product saver tanks. Retain records of inspections reports for five years. See Appendix F for the Field-Erected Tank Annual Inspection Checklist.</p>				
	<p>D. Perform a formal in-service external inspection of the tank in accordance with API 653 or STI SP001 to evaluate the tank for conditions which may affect the operational integrity of the storage tank, including minimum shell thickness measurements. This inspection must be performed by an applicable certified inspector. Inspection must include all components and equipment located inside the tank containment area such as piping, pipe supports, containment valves, and product saver tanks.</p>	<p>Every five years or as required by an appropriately certified tank inspector in the previous API 653 or STI SP001 inspection report.</p>	SM	SM	SM
	<p>E. Perform an out-of-service API 653 or STI SP001 inspection to evaluate the tank for conditions which may affect the operational integrity of the tank floor, shell, roof and floating roof or pan. API 653 or STI SP001 provides a checklist to be used as part of the assessment. This inspection must be performed by an appropriately certified API 653 or STI SP001 inspector. Inspection must include all components and equipment located inside the tank containment area such as piping, pipe supports, containment valves, and product saver tanks</p>	<p>Every ten years or as recommended by an appropriately certified tank inspector in the previous API 653 or STI SP001 inspection report.</p>	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
Geodesic Dome Roofs (Section 8-4.2)					
Geodesic Dome Roofs	A. Conduct external inspection of geodesic dome roofs, where accessible, for corrosion of tank-to-shell bolts, gasket connections, visible signs of corrosion, apparent roof leaks, clogging or deterioration of vent screens, and damage to the structure or panels.	Monthly	OM	OM	OM
	B. Conduct internal inspection of geodesic dome roofs from the floating roof, where accessible, for corrosion of tank-to-shell bolts, gasket connections, visible signs of corrosion, apparent roof leaks, clogging or deterioration of vent screens, and damage to the structure or panels.	Annually	OM	OM	OM
Foundations (Section 8-4.3)					
Foundations	A. Inspect visible components of tank foundations for signs of erosion due to heavy rains, wash-down, etc. and repaired as necessary. Also inspect tank foundations for structural cracks, signs of settlement, spalling, or general deterioration. Remove vegetation found around the tank foundation.	Monthly	OM	OM	OM
Aboveground Shop Fabricated Tanks (Section 8-5.1)					
Aboveground Shop Fabricated Tanks	A. Monthly External Inspection (Identified as P in \1\STI SP001/1/): Visually inspect for exterior signs of corrosion or coating deterioration. Visually inspect weld seams, tank-to-saddle connections, tank supports, tank anchors, foundation and anchor bolts, overfill valves and alarms, normal vents, emergency vents, leak detection probe or water/petroleum accumulation in the interstice on double-walled tanks, leaking valves, fittings, or	Monthly	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>components, spill containment systems and release prevention barriers. Leaking valves, fittings or components must be repaired immediately or immediately removed from service and isolated to prevent further discharge. Any irregularities, (e.g., missing valve handles, bolts, nuts, screens) will be assessed for priority and repaired as soon as possible or as required depending on the nature of the defect (See Appendix E for an example of the STI SP001 Standard Monthly Inspection Checklist).</p>				
	<p>B. Annual External Inspection (Identified as P in \1\STI SP001/1/): A more detailed examination of the tank and appurtenances must be performed on an annual basis (See Appendix E for an example of the STI SP001 Standard Annual Inspection Checklist).</p>	Annually	OM	OM	OM
	<p>C. Formal External Inspection (Identified as E in \1\ STI SP001 /1/): A formal external inspection as defined in STI SP001 <i>Standard for the Inspection of Aboveground Storage Tanks</i> must be conducted by certified STI SP001 inspector.</p> <p>D. Formal Internal Inspection (Identified as I in \1\ STI SP001 /1/): A formal internal inspection as defined in STI SP001 <i>Standard for the Inspection of Aboveground Storage Tanks</i> must be performed by a certified STI SP001 inspector.</p> <p>E. Leak Test (Identified as L in \1\ STI SP001 /1/): A leak test as defined in STI SP001 <i>Standard for the Inspection of Aboveground</i></p>	As established by SCP based on tank size and category listed in \1\ STI SP001 /1/	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p><i>Storage Tanks</i> must be performed in accordance with STI SP001 <i>Standard for the Inspection of Aboveground Storage Tanks.</i></p>				
Self-Diking or Vaulted Tanks (Section 8-5.2)					
Self-Diking or Vaulted Tanks	<p>A. Monthly External Inspection (Identified as P in 11 STI SP001 1/1): Visually inspect for exterior signs of corrosion or coating deterioration. Visually inspect weld seams, tank-to-saddle connections, tank supports, tank anchors, foundation and anchor bolts, overfill valves and alarms, normal vents, emergency vents, leak detection probe or water/petroleum accumulation in the containment area, leaking valves, fittings, or components. Leaking valves, fittings or components must be repaired immediately or immediately removed from service and isolated to prevent further discharge. Any irregularities, (e.g., missing valve handles, bolts, nuts, screens) will be assessed for priority and repaired as soon as possible or as required depending on the nature of the defect (See Appendix E for an example of the STI SP001 Standard Monthly Inspection Checklist).</p>	Monthly	OM	OM	OM
	<p>B. Annual External Inspection (Identified as P in 11 STI SP001 1/1): A more detailed examination of the tank and appurtenances must be performed annually. (See Appendix E for an example of the STI SP001 Standard Annual Inspection Checklist).</p>	Annually	OM	OM	OM
	<p>C. Formal External Inspection (Identified as E in 11 STI SP001</p>	As established by SCP based	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p><i>/1/</i>): A formal external inspection as defined in STI SP001 <i>Standard for the Inspection of Aboveground Storage Tanks</i> must be conducted by certified STI SP001 inspector.</p> <p>D. Formal Internal Inspection (Identified as I in <i>11</i> STI SP001 <i>/1/</i>): A formal internal inspection as defined in STI SP001 <i>Standard for the Inspection of Aboveground Storage Tanks</i> must be performed by a certified STI SP001 inspector.</p> <p>E. Leak Test (Identified as L in <i>11</i> STI SP001 <i>/1/</i>): A leak test as defined in STI SP001 <i>Standard for the Inspection of Aboveground Storage Tanks</i> must be performed in accordance with STI SP001 <i>Standard for the Inspection of Aboveground Storage Tanks</i>.</p>	on tank size and category listed in <i>11</i> STI SP001 <i>/1/</i>			
Rectangular Concrete-Encased Tanks (Section 8-5.3)					
Rectangular Concrete-Encased Tanks	<p>A. Monthly External Inspection (Identified as P in <i>11</i> STI SP001 <i>/1/</i>): Visually inspect tank supports, anchors and anchor bolts, overfill valve and alarms, normal vent, emergency vent, leaking valves, fittings or other components. In addition the exterior concrete must be visually inspected for cracking, degradation, excessive calcareous deposits or signs of damage. Leaking valves, fittings or components must be repaired immediately or isolated to prevent further discharge. Any other deficiencies or irregularities noted must be repaired as soon as possible or as required depending on the nature of the defect (See Appendix E for an example of the</p>	Monthly	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	STI SP001 Standard Monthly Inspection Checklist).				
	B. Annual External Inspection (Identified as P in 11 STI SP001 1/1): A more detailed examination of the tank and appurtenances must be performed on an annual basis (See Appendix E for an example of the STI SP001 Standard Annual Inspection Checklist).	Annually	OM	OM	OM
	C. Formal External Inspection (Identified as E in 11 STI SP001 1/1): A formal external inspection must be conducted by certified STI SP001 inspector.		SM	SM	SM
	D. Formal Interior Inspection (Identified as I in 11 STI SP001 1/1): A modified formal internal inspection as defined in manufacturer's instructions or STI SP001 <i>Standard for the Inspection of Aboveground Storage Tanks</i> must be performed on concrete-encased tanks by a certified STI SP001 inspector if the tank interior is accessible.	As established by SCP based on tank size and category listed in 11 STI SP001 1/1			
Underground Single-walled Shop-Fabricated Tanks (Section 8-5.4.1)					
Underground Single-walled Shop-Fabricated Tanks	A. Monthly External Inspection (Identified as P in Table 8- 11 1/1): Ensure all tank port covers are present, are in good condition, and seated firmly on the correct tank. Inspect tank stick gauge and ensure markings are legible and that the stick gauge is not warped or broken. Inspect tank for water using ATG or stick gauge with water-finding paste. Remove water found in tank. Open and inspect tank-top containment sumps and ensure no fuel or water is collected in the sumps. Check	Monthly	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	for and remove obstructions in tank fill pipe.				
	<p>B. Annual External Inspection (Identified as P in Table 8-111/1/1): Inspect electrical connections and junction boxes in underground sumps and access ports on tank. Ensure boxes are sealed, and that boxes, conduit, and electrical fittings are not corroded. Inspect submerged turbine pumps if present. Ensure pumps are in good condition and that pumps and fittings show no signs of leaking. Inspect tank top containment sumps for cracks, holes, and budes. Ensure tank top containment sump electrical and pipe penetrations are intact and secured. For double-walled piping systems that drain into the tank top containment sump, ensure interstitial space of piping is open and that sump sensor is properly mounted at the bottom of the sump. Ensure tank top containment sump lid gasket and seals are in good condition. Inspect road access covers. Ensure covers are in good condition, that all bolts are present and that handles and lift mechanism is in good condition as applicable. Inspect concrete installed over tank and ensure there is no significant cracking.</p>	Annually	SM	SM	SM
	<p>C. Tank Tightness Test (Identified as T in Table 8-111/1/1): Perform test in accordance with 40 CFR 280, Section 43.</p>	As established by SCP based on tank size and release detection type listed in Table 8-111/1/1.	SM	SM	SM
	<p>D. Formal Internal Inspection (Identified as I in Table 8-1): A formal modified internal inspection</p>	As established by SCP based on tank size and	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>in accordance with STI SP001 <i>Standard for the Inspection of Aboveground Storage Tanks</i> must be conducted by a certified STI SP001 inspector if the interior is accessible. The inspector will need to supplement and/or adapt portions of STI SP001 to evaluate the specific concerns of an underground tank. Check the tank for settlement and ensure that the tank slopes towards the water drain.</p>	<p>release detection type listed in Table 8-111/1/ or as recommended by an STI SP001 certified tank inspector in the previous inspection report.</p>			
	<p>E. Test tank-top containment sumps and ensure they are liquid tight by using vacuum, pressure, or liquid testing in accordance with 40 CFR 280, Section 43.</p>	<p>Every three years</p>	<p>SM</p>	<p>SM</p>	<p>SM</p>
<p>Underground Double-walled Shop-Fabricated Tanks (Section 8-5.4.2)</p>					
<p>Underground Double-walled Shop-Fabricated Tanks</p>	<p>A. Monthly External Inspection (Identified as P in Table 8-112/1/): Ensure all tank port covers are present, are in good condition, and seated firmly on the correct tank. Inspect tank stick gauge and ensure markings are legible and that the stick gauge is not warped or broken. Inspect tank for water using ATG or stick gauge with water-finding paste. Remove water found in tank. Open and inspect tank-top containment sumps and ensure no fuel or water is collected in the sumps. Check for and remove obstructions in tank fill pipe.</p>	<p>Monthly</p>	<p>OM</p>	<p>OM</p>	<p>OM</p>
	<p>B. Annual External Inspection (Identified as P in Table 8-112/1/): Inspect electrical connections and junction boxes in underground sumps and access ports on tank. Ensure boxes are sealed, and that boxes, conduit, and electrical fittings are not corroded. Inspect</p>	<p>Annually</p>	<p>SM</p>	<p>SM</p>	<p>SM</p>

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>submerged turbine pumps if present. Ensure pumps are in good condition and that pumps and fittings show no signs of leaking. Inspect tank top containment sumps for cracks, holes, and budes. Ensure tank top containment sump electrical and pipe penetrations are intact and secured. For double-walled piping systems that drain into the tank top containment sump, ensure interstitial space of piping is open and that sump sensor is properly mounted at the bottom of the sump. Ensure tank top containment sump lid gasket and seals are in good condition. Inspect road access covers. Ensure covers are in good condition, that all bolts are present and that handles and lift mechanism is in good condition as applicable. Inspect concrete installed over tank and ensure there is no significant cracking.</p>				
	<p>C. Formal Internal Inspection (Identified as I in Table 8-112/11): A formal modified internal inspection in accordance with STI SP001 <i>Standard for the Inspection of Aboveground Storage Tanks</i> must be conducted by a certified STI SP001 inspector if the interior is accessible. The inspector will need to supplement and/or adapt portions of STI SP001 to evaluate the specific concerns of an underground tank. Check the tank for settlement and ensure that the tank slopes towards the water drain.</p>	<p>As established by SCP based on tank size and release detection type listed in Table 8-112/11 or as recommended by an STI SP001 certified tank inspector in the previous inspection report.</p>	SM	SM	SM
	<p>D. Test tank-top containment sumps and ensure they are liquid tight by using vacuum, pressure, or liquid</p>	<p>Every three years</p>	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	testing in accordance with 40 CFR 280, Section 43.				
Underground Field-Constructed Tanks (Cut and Cover Tanks) (Section 8-6)					
Underground Field- Constructed Tanks	A. Check the level gauge records and interstitial monitoring ports to determine if the tank is leaking.	Daily	OM	OM	OM
	B. Apply field-erected tank monthly external inspection to the maximum extent possible. Visually inspect tank and appurtenances for evidence of leaks, shell distortions, signs of corrosion, and settlement at accessible locations. Items noted during the inspection will be documented for follow-up action by an authorized inspector (See Appendix E for the Field-Erected Tank Monthly Inspection Checklist).	Monthly	OM	OM	OM
	C. Check tank under static storage conditions for 24 hours using existing inventory management system to determine if petroleum losses are occurring. If leakage is noted, further investigation must be conducted in accordance with Military service-specific guidelines.				
	D. Apply field-erected tank annual external inspection to the maximum extent possible. Visually inspect tank and appurtenances for evidence of leaks, shell distortions, signs of corrosion, and settlement at accessible locations. Visually inspect pump/equipment vaults for leaks and cracking in concrete walls and floors. Retain records of inspections reports for five years (See Appendix F for the Field-Erected Tank Annual Inspection Checklist).	Annually	SM	SM	SM
	E. Perform a modified out-of-Service API 653 internal inspection to evaluate the tank for conditions which may affect the operational integrity of the tank floor, shell, columns and	Every ten years or as recommended by an appropriately certified tank	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>roof by certified API 653 inspector. API 653 provides a checklist to be used as part of the assessment; however the certified API 653 inspector must modify this checklist to incorporate specific needs of underground field-constructed tanks.</p>	<p>inspector in the previous API 653 inspection report.</p>			
Tank Cleaning (Section 8-7)					
Tank Cleaning	<p>A. Conduct Tank Cleaning: Unless otherwise mandated by operational concerns or military service directives, schedule and conduct tank cleaning based upon the frequency listed below. After cleaning tanks must be stenciled in accordance with Section 8-8.1 Tank Stenciling Requirements.</p>	<p>a. Air Force – Tanks above 20,000 gallon (75,700 liters) in capacity - Every 10 years unless required more frequently due to fuel quality issues. Contact AFPET and AF Fuel SME for deviations on schedule. Schedule changes are typically accepted based on TO 42B1-1 requirements.</p> <p>b. Air Force – Tanks 20,000 gallon (75,700 liters) in capacity and under - During out of service inspection cycle unless required more frequently due to potential fuel quality issues.</p> <p>c. Army, Navy, U.S. Marine Corps – During out-of-service inspection cycle unless required more frequently due to potential</p>	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
		fuel quality issues.			
Aluminum Honeycomb Floating Pan (Section 8-9.1.1)					
Aluminum Honeycomb Floating Pan	A. Visually inspect pan guide/anti-rotation cables and centering of pan.	Monthly	OM	OM	OM
	B. Visually inspect pan grounding cables for proper attachment and wear or binding.				
	C. Visually inspect for buckling or damage to the pan.				
	D. Inspect grounding cables for proper attachment and wear or binding.	Annually	SM	SM	SM
	E. Inspect all floating roof penetration seals, such as ladder seals, stilling well seals, and other seals to ensure that they are in good working condition.				
F. Clean and inspect perimeter tank/pan seals.	At time of out of service internal inspection	SM	SM	SM	
G. Refer to Section 8-9.1.5 Floating Roof and Pan Pressure/Vacuum Vents for inspection and maintenance requirements of floating pan pressure/vacuum vents.	As required	SM	SM	SM	
H. Refer to Section 8-9.1.6 Floating Roof and Pan Legs for inspection and maintenance requirements of floating pan legs.					
Steel Floating Pan (Section 8-9.1.2)					
Steel Floating Pan	A. Visually inspect pan guide/anti-rotation cables and centering of pan.	Monthly	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>B. Visually inspect pan grounding cables for proper attachment and wear or binding.</p> <p>C. Visually inspect for buckling or damage to the pan.</p> <p>D. Visually inspect for damage or deflection in the rolling ladder (if equipped).</p>				
	<p>E. Inspect grounding cables for proper attachment and wear or binding.</p> <p>F. Inspect all floating pan penetration seals, such as gauge well seals to ensure that they are in good working condition.</p> <p>G. Inspect gauge wells for abrasions that might indicate out of roundness, or improper centering.</p> <p>H. Inspect vertical ladder for abrasions that might indicate out of roundness, or improper centering (if equipped).</p> <p>I. Inspect for damage or deflection in the rolling ladder (if equipped).</p>	Annually	SM	SM	SM
	<p>J. Clean and inspect perimeter tank/pan seals.</p>	At time of out of service internal inspection	SM	SM	SM
	<p>K. Refer to Section 8-9.1.5 Floating Roof and Pan Pressure/Vacuum Vents for inspection and maintenance requirements of floating pan pressure/vacuum vents.</p> <p>L. Refer to Section 8-9.1.6 Floating Roof and Pan Legs for inspection and maintenance requirements of floating pan legs.</p>	As required	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
Pontoon Floating Pan (Section 8-9.1.3)					
Pontoon Floating Pan	A. Visually inspect pan guide/anti-rotation cables or pipes and centering of pan. B. Visually inspect pan grounding cables for proper attachment and wear or binding. C. Visually inspect for buckling or damage to the pan. D. Visually inspect for damage or deflection in the rolling ladder (if equipped).	Monthly	OM	OM	OM
	E. Inspect pontoons for standing liquid and presence of strong vapors. F. Remove mechanical gauge float cover and ensure float is securely fastened to gauge tape. Check gauge tape for ease of movement. G. Inspect for damage or deflection in the rolling ladder (if equipped). H. Inspect vertical internal ladder and internal ladder/pan seals for abrasions that might indicate out of roundness, or improper centering (if equipped). I. Inspect gauge wells and gauge well/pan seals for abrasions that might indicate out of roundness, or improper centering. J. Inspect steel floating pan coatings for corrosion. Touch up with compatible coating if required (aluminum pans do not require coatings).	Annually	SM	SM	SM
	K. Clean and inspect perimeter tank/pan seals.	At time of out of service internal inspection	SM	SM	SM
	L. Refer to Section 8-9.1.5 Floating Roof and Pan Pressure/Vacuum Vents for inspection and maintenance requirements of	As required	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	floating pan pressure/vacuum vents. M. Refer to Section 8-9.1.6 Floating Roof and Pan Legs for inspection and maintenance requirements of floating pan legs.				
Floating Roof (Section 8-9.1.4)					
Floating Roofs	A. Visually inspect the center primary roof drain system is water-free B. Visually inspect anti-rotation pipes/roof guides and centering of roof. C. Visually inspect grounding cables for proper attachment and wear or binding. D. Visually inspect for buckling or damage to the roof. E. Visually inspect for standing water on roof deck. F. Visually inspect for damage or deflection in the rolling ladder (if equipped).	Monthly	OM	OM	OM
	G. Ensure that the drip-tight plug is placed in the roof drain opening. H. Ensure that the roof drain valve is closed. The drain valve is kept in the closed position except after each rain or snowfall when it is opened just long enough to drain the roofline. Tanks with retrofitted geodesic domes or metal roofs may have had the floating roof drain line removed, so before opening the roof drain valve ensure the roof drain line has not been removed.	Annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>I. Inspect pontoons for standing liquid and presence of strong vapors.</p> <p>J. Remove mechanical gauge float cover and ensure float is securely fastened to gauge tape. Check gauge tape for ease of movement.</p> <p>K. Ensure emergency drain (if equipped) is not blocked with debris.</p> <p>L. Inspect for damage or deflection in the rolling ladder (if equipped).</p> <p>M. Inspect vertical internal ladder and internal ladder/roof seals for abrasions that might indicate out of roundness, or improper centering (if equipped).</p> <p>N. Inspect gauge wells and gauge well/roof seals for abrasions that might indicate out of roundness, or improper centering.</p> <p>O. Inspect the floating roof coating for corrosion. Touch up with compatible coating if required.</p>				
	<p>P. Clean and inspect perimeter tank/pan seals.</p>	<p>At time of out of service internal inspection</p>	<p>SM</p>	<p>SM</p>	<p>SM</p>
	<p>Q. Refer to Section 8-9.1.5 Floating Roof and Pan Pressure/Vacuum Vents for inspection and maintenance requirements of floating roof pressure/vacuum vents.</p> <p>R. Refer to Section 8-9.1.6 Floating Roof and Pan Legs for inspection and maintenance requirements of floating roof legs.</p>	<p>As required</p>	<p>SM</p>	<p>SM</p>	<p>SM</p>

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
Floating Roof and Pan Pressure/Vacuum Vents (Section 8-9.1.5)					
Floating Roof and Pan Pressure/Vacuum Vents	A. Inspect the floating roof or pan pressure/vacuum vent to ensure that the seats and retaining straps or guides are in good working order and that the pressure/vacuum vent is not stuck to its seats, but instead lift easily off of its seats and reseats properly. Inspect gaskets for wear and replace as required. Refer to the manufacturer's operation and maintenance manual provided with the floating roof or pan for additional guidance on servicing the pressure/vacuum vent.	At time of out of service internal inspection	SM	SM	SM
Floating Roof and Pan Legs (Section 8-9.1.6)					
Floating Roof and Pan Legs	A. Inspect the floating roof or pan legs and tank bottom striker plates for wear; inspect the seals where the legs penetrate the floating roof or pan for leaks; inspect the low leg position stops to make sure they are securely fastened to the legs and will stop the floating roof or pan at the low position; inspect the leg keeper straps to make sure they are securely fastened to the legs to prevent the legs from falling off or through the floating roof or pan; inspect the threaded keeper caps or high position locking mechanisms to ensure they are in proper working order for securing the floating roof or pan in the high position. Refer to the maintenance manual provided with the floating roof or pan for additional guidance on floating roof or pan legs and associated hardware.	At time of out of service internal inspection	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
Secondary Tank Bottoms (Section 8-9.2)					
Secondary Tank Bottoms	<p>A. Tanks designed with secondary tank bottoms should have tell-tale devices (leak detection ports) to allow for monitoring of the tank's floor integrity. The tell-tale devices are typically configured as valves or inspection ports to allow for visual monitoring of liquid that may be present between the foundation and the tank floor. The presence of water would indicate a breach in the foundation seals or flooring while the presence of petroleum would indicate integrity loss in the tank floor. Open and check tell-tale valves or inspection ports. Verify the absence of water or petroleum.</p>	Monthly	OM	OM	OM
Tank Pressure/Vacuum Vents (Section 8-9.3)					
Tank Pressure/ Vacuum Vents	<p>A. On underground shop fabricated tanks, ensure tank pressure/vacuum vent is present and that the riser pipe is securely supported and vertical.</p>	Annually	OM	OM	OM
	<p>B. Inspect vent settings. Pressure and vacuum settings for pressure/vacuum vents are usually specified on the vent nameplate or in the manufacturer's manual for the vent.</p> <p>C. Clean the pressure/vacuum vent. Information on the type of pressure/vacuum vent and procedures for the removal of covers, hoods and/or pallet removal and reinstallation should be found in the manufacturer's operation and maintenance manual. Before removing the pallets, brush all accumulations from the protecting</p>	Annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>screens, the pallets, and all surfaces of the valve. Brush the screens from inside the valve so that dirt and other objects fall to the outer sides. Remove heavy loading weights prior to removing the pallet assembly. Remove deposits or foreign matter using reasonable care not to damage diaphragms or seats.</p> <p>D. Inspect gaskets, seats, diaphragm, pallet stems and stem guides. Check all mating surfaces which must be free of nicks, cuts, cracks or deposits that might interfere with the proper seating or tightness of the valve. Test the pallets to ensure they move freely up and down over the full range of travel.</p>				
Emergency Vents (Section 8-9.4)					
Emergency Vents	<p>A. Inspect emergency vents for external damage, such as dents, rusting, severe pitting or obstruction by other equipment, piping or conduits.</p> <p>B. Remove the vent, if possible, and inspect the seals and diaphragms for cracking or breakdown. Inspect retaining cables to ensure they are fastened to the vent and the manway or tank. Inspect guides to ensure emergency vents can function properly and re-seat.</p> <p>C. Verify that emergency vents have not been removed or modified. Emergency vents should not be replaced with ATGs, manual sample ports, level alarms, etc.</p> <p>D. Tanks that are equipped with manways for emergency vents must be inspected for appropriate type, length, number of bolts, and lift clearance of the manway in accordance with UL 142 Standard</p>	Annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<i>for Steel Aboveground Tanks for Flammable and Combustible Liquids, Section 8 and 9.</i>				
Flame Arrestors (Section 8-9.5)					
Flame Arrestors	A. The tube bank must be removed and cleaned of foreign matter by immersing in an approved solvent solution, taking care not to damage the tube bundle. Gaskets must be inspected and replaced as necessary.	Annually	SM	SM	SM
External High Level Shutoff Valves (HLSO) (Section 8-9.6.1)					
External High Level Shutoff Valves (HLSO)	A. Activate the tank high-high level alarm and ensure the solenoid valve (if equipped) activates on the HLSO valve. Ensure the HLSO valve closes when the solenoid valve is activated.	Quarterly	SM	SM	SM
	B. Isolate, drain, and then vent the external float valve chamber (if equipped). Refill (either manually or via the storage tank product saver tank pump) the float chamber to test the float valve. Ensure the HLSO closes when the float is raised. C. Lift the manual test lever of internally mounted float valve (if equipped). Ensure that the HLSO closes when the float of the float valve is raised.	Annually	SM	SM	SM
Internal HLSO Valve (Section 8-9.6.2)					
Internal HLSO Valves	A. Inspect and test the high level shut-off valve and float mechanism, counter-weights, float rods, and floats to ensure the float mechanism is moving freely and functioning properly to close the high level shut-off valve. If valve is not equipped with a manual test mechanism the level of the tank must be raised to the high level	Annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	shutoff valve set point in order to test the valve. Ensure valve is installed at a proper height.				
Mechanical Tape Gauges (Section 8-9.7)					
Mechanical Tape Gauges	A. Visually check that a liquid level is indicated and that the measurement appears to be accurate.	Daily	OM	OM	OM
	B. Check the mechanical tape gauge against the automatic electronic tank gauge (if installed) or by manually gauging the tank for relative accuracy and proper working condition. Consult the manufacturer's operation and maintenance manual for additional maintenance and inspection requirements	Quarterly	SM	SM	SM
Automatic Tank Gauges					
Mechanically Operated Tape Gauge (Section 8-9.8.1)					
Mechanically Operated Tape Gauge	A. Visually inspect the gauge to ensure the power is on, there are no warning alarms or lights and a liquid measurement is indicated and the tank level reading appears to be accurate.	Daily	OM	OM	OM
	B. Inspect gauge head for buildup of sediment.	Quarterly	SM	SM	SM
	C. Inspect tape conduit for deformations that would inhibit movement of tape up and down.				
	D. Gauge level accuracy must be performed against a hand dip measurement of the tank. Calibrate as required.	Semi-annually	SM	SM	SM
E. Inspect float and guide cable through an opened manway or access cover. Verify that the guide wire is taut and free of kinks.					

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	Verify that the float is buoyant and free of sludge or sediment build up. F. Inspect power and control wires for damage. G. Inspect wire connection termination points for damage or loose connections.				
	H. Lubricate moving parts of the gauge head	Annually	SM	SM	SM
Magnetostrictive Probes (Section 8-9.8.2)					
Magnetostric tive Probes	A. Visually inspect the gauge to ensure the power is on, there are no warning alarms or lights and a liquid measurement is indicated and the tank level reading appears to be accurate.	Daily	OM	OM	OM
	B. Inspect probe assembly for buildup of sediment. C. Inspect probe assembly and probe shaft for deformations that would inhibit movement of probe.	Quarterly	SM	SM	SM
	D. Level probe accuracy must be performed against a hand dip measurement of the tank. Calibrate as required. E. Verify that the probe float is buoyant and free of sludge or sediment build up. F. Inspect power and control wires for damage. G. Inspect wire connection termination points for damage or loose connections.	Semi-annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
Servo Gauge (Section 8-9.8.3)					
Servo Gauge	A. Visually inspect the gauge to ensure the power is on, there are no warning alarms or lights and a liquid measurement is indicated and the tank level reading appears to be accurate.	Daily	OM	OM	OM
	B. Inspect gauge head for buildup of sediment.	Quarterly	SM	SM	SM
	C. Gauge level accuracy must be performed against a hand dip measurement of the tank. Calibrate as required.		SM	SM	SM
	D. Inspect float and guide cable through an opened manway or access cover. Verify that the guide wire is taut and free of kinks. Verify that the float is buoyant and free of sludge or sediment build up.	Semi-annually			
	E. Inspect power and control wires for damage.				
	F. Inspect all wire connection termination points for damage or loose connections.				
	G. Inspect stilling well to be straight and vertical with no dents so that the float can move freely.	Annually	SM	SM	SM
	H. Lubricate moving parts of the gauge head.				
Level ALARMS					
Externally Mounted Level Alarms (Section 8-9.9.1)					
Externally Mounted Level Alarms	A. Test level alarm switches by isolating the chambers from the tank using the sensing chamber isolation valves. Vent and drain	Semi-annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	the chambers. Slowly pour product into the chambers through a funnel on top of the chamber to test the level switch at the specified level setting.				
Internally Mounted Level Alarms (Section 8-9.9.3)					
Internally Mounted Level Alarms	A. Test level alarm switches by activating manual testing levers, if equipped. If alarms switches are not equipped with manual testing levers, adjust the level of fuel in the tank to the alarm points in order to test the alarm switches. If it is not feasible to adjust the level of the fuel in the tank to all of the alarm set points, remove the alarm switches from the tank and test the alarms externally. Reinstall alarm switches in the tank once testing is complete.	Annually	SM	SM	SM
PRODUCT SAVER TANKS					
Product Saver Tanks (Section 8-9.10)					
Product Saver Tanks	A. Inspect the product saver tank to ensure all valves are working properly, sight level gauges with density balls are working properly and are not broken, and hand pumps or electric pumps are working properly and are not leaking.	Quarterly	SM	SM	SM
SIDESTREAM FILTRATION SYSTEMS					
Sidestream Filtration Systems (Section 8-9.11)					
Sidestream Filtration Systems	A. Check (typically 5 gallon (19 liters), if incorporated) filter separator vent tank and ensure it is empty.	Monthly	OM	OM	OM
	B. Refer to Section 6-1 Pipe Testing and Inspections for inspection and	As required	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>maintenance requirements of piping.</p> <p>C. Refer to Section 3-6.4 Basket Strainers for inspection and maintenance requirements of basket strainers.</p> <p>D. Refer to Section 3-8 Pumps for inspection and maintenance requirements of fuel pumps.</p> <p>E. Refer to Section 3-6.2 Filter Separators for inspection and maintenance requirements of filter separators.</p> <p>F. Refer to Section 4-4.2.2 Filter Separator Control Valves for inspection and maintenance requirements of filter separator control valves.</p> <p>G. Refer to Section 9-1.6 Grounding Systems for inspection and maintenance requirements of grounding systems.</p> <p>H. Refer to Section 9-1.9 Electronic Equipment for inspection and maintenance requirements of control panels.</p>				
FILL PORTS					
Fill Ports (Section 8-9.12)					
Fill Ports	<p>A. Ensure fill port covers are installed and are not damaged or broken. Ensure fill port covers are identified by fuel type and are installed on the correct tank. Visually inspect the fill port spill bucket to ensure there are no cracks, budes, or holes. Ensure the spill bucket is clean of dirt, trash, water, and fuel</p>	Daily	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	B. Inspect drain valve in spill bucket and ensure it is in good condition. Ensure the caps installed on the receipt connection points are vapor tight and are not broken, cracked, or chipped. Ensure the poppet valve of the vapor recovery port seals tightly and no vapor is escaping from the tank when the valve is closed.	Monthly	SM	SM	SM
	C. 11 Hydrostatically test fill-port to ensure containment is liquid-tight. Where evaporation is a concern, conduct the testing when this concern would be minimized, such as at night/early morning or during a time of year when this would not be as much of an issue. Record the water level at the start of the 60-minute (minimum) hold period. If the water level drops by 1/8 inch or more, perform and record an investigation to determine the cause and any required repairs. Once repairs are completed, a new test must be completed. Refer to Appendix B for testing procedures and to use to document the testing. 11 Ensure secondary containment area of fill port is fuel tight. Ensure the manual transfer pump or drain valve is operational.	11 Every 3 Years 11	SM	SM	SM
LEAK DETECTION					
Point Sensor - Dry (Section 8-9.13.1)					
Point Sensor - Dry	A. Ensure the monitoring panel associated with the point sensor(s) is powered on and no alarms are present.	Daily	OM	OM	OM
	B. Ensure monitoring space is clear and free of debris and liquid	Monthly	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	C. Test sensor and ensure it is functional	Annually	SM	SM	SM
Point Sensor - Wet (Section 8-9.13.2)					
Point Sensor - Wet	A. Ensure the monitoring panel associated to the wet point sensor(s) is powered on and no alarms are present.	Daily	OM	OM	OM
	B. Ensure level of monitoring fluid is within normal range.	Monthly	SM	SM	SM
	C. Test sensor and ensure it is functional.	Annually	SM	SM	SM
Point Sensor – Pressure/Vacuum (Section 8-9.13.3)					
Point Sensor – Pressure/ Vacuum	A. Ensure the monitoring panel associated with the pressure/vacuum point sensor(s) is powered on and no alarms are present.	Daily	OM	OM	OM
	B. Test vacuum sensor for proper operation	Annually	SM	SM	SM
Visual Leak Detection (Section 8-9.13.4)					
Visual Leak Detection	A. Visually inspect leak detection ports (tell-tales) for signs of leaks. If there are debris or objects obstructing the view, appropriate measures must be taken to remove the debris or remedy the obstructions.	During routine inspection of other components or monthly, whichever comes first.	OM	OM	OM
	B. Visually inspect reinforcement plate tell-tale holes for signs of leaks. Ensure tell-tale holes have not been plugged by debris or a cap. Pack reinforcement plate tell-tales with white grease to prevent insect nesting and buildup of debris	Quarterly	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
FLOATING SUCTION LINES					
Floating Suctions Lines (Section 8-9.14)					
Floating Suction Lines	A. Check external floating suction line position indicator to ensure floating suction line is moving freely as the level in the tank rises or falls.	Quarterly	SM	SM	SM
	B. Inspect cables, floats, and swing joint. Ensure interior of floats have not collected fuel. Ensure cables are securely fastened to anchor points and are in good working order. Ensure the suction pipe flange used to support the swing joint is level and true and that swing joint moves freely up and down and does not bind.	When tank is taken out of service for internal cleaning or inspection	SM	SM	SM
HEATING COILS					
Steam Type Heating Coils (Section 8-9.16.1)					
Steam Type Heating Coils	A. Observe the regulating valve and check it against a thermometer to be sure that it controls the tank temperature within a safe range, usually not over 150 °F (65 °C) for No. 6 burner fuel oil. Steam traps must be inspected for proper operation to ensure condensate is evacuated from the steam coil.	At each operation	OM	OM	OM
	B. Pressure check heating coils to 10% above normal operating pressure.	Annually	SM	SM	SM
	C. Steam coils must be cleaned and inspected for visible signs of corrosion or wear when the tank is emptied and cleaned for inspection. All components of the steam heating coils, such as weld joints, support points, valves, temperature wells, control valves, and steam traps must be	When the tank is taken down for formal internal inspection or sooner if steam heating coil damage is suspected.	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	inspected and checked for proper operation and visible wear or damage. The coil may be carefully pressurized with steam and visually checked for leaks if necessary. Leaks or damage found must be repaired.				
Thermal Fluid Type Heating Coils (Section 8-9.16.2)					
Thermal Fluid Type Heating Coils	A. Observe the regulating valve and check it against a thermometer to be sure that it controls the tank temperature within a safe range, usually not over 150 °F (65 °C) for No. 6 burner fuel oil. All external valves, fittings, and other components must be inspected for visible signs of leaks during operation.	At each operation	OM	OM	OM
	B. Pressure check heating coils to 10% above normal operating pressure.	Annually	SM	SM	SM
	C. When tanks are emptied and cleaned for inspection, the heating coils must be cleaned and inspected for visible signs of corrosion, wear, or damage. The coils can be pressurized and checked for leaks at that time with the thermal heating fluid at normal operating pressure, but at ambient temperature to alleviate possible burns to personnel. Leaks must be repaired.	When the tank is taken down for formal internal inspection or sooner if thermal heating coil damage is suspected.	SM	SM	SM
Electric Rod Type Heating (Section 8-9.16.3)					
Electric Rod Type Heating	A. Inspect heater to ensure no fluid leakage around the heater to tank connection and that the heater is performing properly.	At each operation	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
STILLING WELLS					
Stilling Wells (Section 8-9.17)					
Stilling Wells	<p>A. Stilling wells must be visually inspected to be vertically straight and free dents or indentations. Sometimes tank stilling wells are made of bare carbon steel pipe. In these instances the stilling wells must be replaced with aluminum.</p> <p>B. Inspect floating seals inside stilling wells to ensure they are not worn and are sealing the inside of the stilling well property.</p>	At time of out of service internal inspection	SM	SM	SM
CONTAINMENT SYSTEMS					
Containment Systems (General) (Section 8-10.1)					
Containment Systems (General)	A. Inspect containment systems for cleanliness, if accessible.	Daily	OM	OM	OM
	B. Secondary containment systems degrade and will collect debris which can clog drainage inlets or prevent drain valves from seating properly. 11 Hydrostatically test the drainage systems to include containment drain inlets, drain lines and containment drain valves to ensure the containment is liquid tight. This test may use opportune rainfall by holding rainwater in the containment system for one hour. Where evaporation is a concern, conduct the testing when this concern would be minimized, such as at night/early morning or during a time of year when this would not be as much of an issue. Record the water level at the start of the 60-minute (minimum) hold period. If the water level drops by 1/8 inch or more, perform and record an investigation to determine the	11 Every 3 years/ 11	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>cause and any required repairs Record the water level at the start of the 60 minute (minimum) hold period. If the water level drops by 1/8 inch or more, perform and record an investigation to determine the cause and any required repairs. Refer to Appendix B for testing procedures and to use to document the testing</p> <p>American Concrete International (ACI) Standards 224R "Control of Concrete Cracking" and ACI's Concrete Repair Manual are two standards that owners/operators can follow to maintain the integrity of the concrete secondary containment./1/</p>				
Concrete and Cement Brick Dike/Berm Walls and Floors (Section 8-10.2)					
Concrete and Cement Brick Dike/Berm Walls and Floors	<p>A. Inspect for vegetation that has taken root in seals or cracks. All vegetation must be removed in all cases to prevent penetration of seals, joints or cracks in the concrete.</p> <p>B. Inspect walls constructed of bricks for signs of deterioration (e.g., spalling caused by freeze-thaw conditions, cracks, and joint cracks between bricks). Walls constructed of bricks must be patched immediately to prevent further penetration of the wall structure.</p>	Daily	OM	OM	OM
	<p>C. Inspect walls constructed of concrete for signs of deterioration (e.g., spalling caused by freeze-thaw conditions and cracks). Clean and seal cracks with a fuel resistant sealant.</p> <p>D. Inspect seals and joints in concrete walls. Joint sealant that has retracted from the joint or</p>		Semi-annually	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	become unbonded with the joints must be removed and replaced with fuel resistant sealant.				
Dike/Berm Floors (Section 8-10.2.2)					
Dike/Berm Floors	A. Inspect for vegetation that has taken root in seals or cracks. All vegetation must be removed in all cases to prevent penetration of seals, joints or cracks in the concrete.	Daily	OM	OM	OM
	B. Inspect floors made of concrete for signs of deterioration (e.g., spalling caused by freeze-thaw conditions and cracks). Clean and seal cracks with a fuel resistant sealant. C. Inspect joints and seals. Joint sealant that has retracted from the joint or become unbonded with the joints must be removed and replaced with a fuel resistant sealant.	Semi-annually	SM	SM	SM
Earthen Dike Walls (Section 8-10.3)					
Earthen Dike Walls	A. Inspect for vegetation that has taken root. All vegetation must be removed in all cases.	Daily	OM	OM	OM
	B. Prevent the growth of vegetation inside the containment area. Use fireproof chemicals for sterilization. Only herbicides approved by the Installation Environmental Office must be used.	Monthly	OM	OM	OM
	C. Inspect for signs of erosion. Inspections should be performed particularly after heavy rains or storms. Repair areas that have deteriorated due to erosion.	Quarterly	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
Self-Diking or Vaulted Tank Containment (Section 8-10.4.)					
Self-Diking or Vaulted Tank Containment	A. Secondary containment structures on self-diking or vaulted tanks must be inspected visually for integrity breaches with special attention given to pipe penetrations and interstitial drain valves.	Daily	OM	OM	OM
Flexible Membrane Liners (Section 8-10.5)					
Flexible Membrane Liners	A. Remove vegetation growing in the gravel and dirt, taking note if the roots have penetrated the FML.	Daily	OM	OM	OM
	B. Visibly inspect FMLs where attached to ringwalls, dike walls, concrete piers and other projections for deterioration due to weather or wear and repair as necessary.		SM	SM	SM
	C. Visually inspect FMLs covered with smooth rock or gravel for bare spots where the gravel has been washed away due to storms or heavy rains for tears. Replace gravel taking care not to puncture the liner.	Quarterly			
	D. Visually inspect exposed FML for tears or punctures and repair.				
Pipe Penetrations (Section 8-10.6)					
Pipe Penetrations	A. Inspect boot seals and mechanical link-type seals for wear and cracking. Ensure the seals are in good working order to seal out water or retain the petroleum product as intended. Repair or replace defective boot and link-seals.	Quarterly	SM	SM	SM
	B. Inspect sealant between pipes and concrete walls, berms, and floors. Sealant that has retracted from the concrete or pipe surfaces must be removed and replaced with new fuel resistant sealant.	Semi-annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
ELECTRICAL CONTROL SYSTEMS AND EQUIPMENT					
Electrical Equipment (Section 9-1.2)					
Electrical Equipment	A. Electrical control systems include: deadman control; ground verification systems; EFSO operation; control panels, motor control, and pump start/stop buttons. These systems must be tested on a periodic basis to ensure proper operation and functionality. In addition, control system Uninterruptible Power Supplies (UPS) must be inspected and replaced as necessary.	Quarterly	SM	SM	SM
Power Cables (Section 9-1.3)					
Power Cables	A. Visual inspection: Verify that there are no sharp bends. Verify that the cable insulation is intact. Verify that cables are appropriately tagged or otherwise identified. Verify that all connections are tight and not corroded. Open manholes and handholes. Verify that they are not flooded, clogged with debris or infested by pests.	Quarterly	SM	SM	SM
	B. Insulation resistance test: This test measures the resistance of the insulation with an Insulation Resistance Tester. During the test, the cable will be disconnected from both ends. Acceptable test values are 100 megaohms for cables rated between 120V to 1000V. Insulation resistance testing for voltages higher than 1000 V are to be performed by specialized testing company.	As needed based on visual inspection	SM	SM	SM
Motor Controls (Section 9-1.4)					
Motor Controls	A. Verify that the labeling is consistent with the drawings and specifications. B. Verify that pushbuttons are easy to operate and are not stuck. Verify	Semi-annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>that there is no grease accumulation around the seating Verify that indicating lights are functional and replace if required.</p> <p>C. Verify that indicating lights are functional and replace as needed.</p> <p>D. Verify that electrical and mechanical interlocks operate according to the design intent. In case of key interlocks, ensure that the number of keys corresponds to the interlock intent. Having more keys than required defeats the intent of the interlocking and poses danger to the service personnel and equipment. If extra keys are found, they should be removed from the equipment.</p>				
	<p>E. Inspect the enclosure for visible signs of corrosion.</p>	<p>Interior annually/ exterior semi-annually</p>	<p>SM</p>	<p>SM</p>	<p>SM</p>
	<p>F. Open the enclosure – be mindful of insects, rodents and reptiles, particularly if located outdoors. Look for signs of corrosion, dust accumulation, spider webs, etc. Clean the enclosure with compressed air and apply rust inhibitors and paint as needed.</p> <p>G. Inspect the overcurrent protective devices for proper seating. Verify that rating is appropriate for the motor. Look for signs of attached wire and device overheating.</p> <p>H. Inspect the arch shoots of contactors and clean as needed. Check that partitions are not burned.</p> <p>I. Inspect contactors for abnormal wear. Check contacts for pitting, roughness and oxidation. Verify that contact gap, alignment and</p>	<p>Annually</p>	<p>SM</p>	<p>SM</p>	<p>SM</p>

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>pressure are in accordance with manufactures recommendations.</p> <p>J. When contactors are used, listen for the chatter of contacts or buzzing noise. These are indicative of a faulty contactor.</p> <p>K. Verify that relays and switches are firmly seated in their bases and there are no signs of overheating or vibration.</p> <p>L. Look for frayed or broken strands in the flexible control wiring and replace if such are found.</p> <p>M. Perform a functional test of protective devices if they are equipped with self-testing circuits or switches.</p> <p>N. Perform a functional test of all manual switches and verify proper operation against intended design logic. Replace switches and relays if operation is not satisfactory.</p>				
	<p>O. Perform insulation resistance test for the control wiring. (NOTE: Testing of the control wires may require substantial down time. Therefore, this should only be performed on a case by case basis if there are reasons to suspect that the insulation of the control wiring is deteriorating.)</p>	As required	SM	SM	SM
Panelboards (Section 9-1.5)					
Panelboards	<p>A. Verify that there are no physical obstructions blocking access to the panelboard. Remove physical obstructions</p>	Quarterly	OM	OM	OM
	<p>B. Inspect the enclosure and the surrounding area for water damage and corrosion.</p>	Annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>C. Verify that all breakers are either in the “On” or the “Off” position. If there are tripped breakers, investigate the cause of the trip.</p> <p>D. Verify that all breakers are either in the “On” or the “Off” position. If there are tripped breakers, investigate the cause of the trip.</p> <p>E. Verify that the breaker operation matches the description on the panel schedule.</p> <p>F. Observe breakers, wires and terminals for signs of overheating or short circuiting.</p> <p>G. Verify that all breakers are firmly seated and locked in place by slightly shaking them.</p> <p>H. Verify that all grounding wires are firmly connected to the grounding bar.</p> <p>I. If a breaker malfunction is identified, leave breaker in the open position and replace as soon as possible. If a breaker cannot disconnect its circuit, the entire panelboard must be switched off using its main disconnecting means and locked out until the breaker is repaired.</p>				
Grounding Systems (Section 9-1.6.1)					
Power Grounding Systems	A. The connections to the grounding system must be surveyed and verified for continuity. If a connection is suspected to be loose, perform further testing. In some occasions, it is more cost effective to replace the suspected	Annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>connection instead of performing diagnostic tests.</p> <p>B. Measure the voltage between the equipment grounding conductor and the electrode grounding conductor (usually bare copper). Investigate test results above 3 VAC for a potential ground fault.</p> <p>C. Measure the voltage between the chassis of the equipment and the electrode grounding conductor. Investigate if the readings exceed 2 VAC.</p>				
	<p>D. Facility ground resistance check: This type of testing is performed with a four lead, low resistance ohmmeter or digital ohmmeter. Recommended values are between 3 and 5 ohms. In no case should the grounding resistance be higher than 25 ohms</p>	Every five years	SM	SM	SM
Grounding Systems (Section 9-1.6.2)					
Static Grounding Systems	<p>A. Inspect ground reels for corrosion. Ensure ground reels are securely mounted to a rigid base. Inspect clamps for serviceability. Replace clamp if jaws are deformed for corroded, spring is weak, or other defects are evident that would prevent a good connection. Inspect cable wires. Replace if more than one-third of the cable wires are broken.</p>	Quarterly	SM	SM	SM
	<p>B. The connections to the grounding system must be surveyed and verified for continuity. If a connection is suspected to be loose, perform further testing. In some occasions it is more cost effective to replace the suspected</p>	Annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	connection instead of performing diagnostic tests.				
	C. Resistance measurement on static grounds: Measure static ground resistance of new and damaged ground rods. Static ground with a resistance greater than 10,000 ohms will be removed or replaced. Static ground mechanically damaged will be repaired and retested.	When observed to be physically damaged.	SM	SM	SM
Electric Motors (Section 9-1.7)					
Electric Motors	A. Lubricating motor bearings and inspect for vibration and overheating.	Quarterly	SM	SM	SM
	B. Check for debris and other foreign material in the fan housing	Semi-annually	SM	SM	SM
	C. Check motor ground wires. Ensure they are firmly connected to the housing or the junction box. D. If the motor is installed in a hazardous location, verify that the seals of the connection boxes and conduits are intact.	Annually	SM	SM	SM
Lighting (Section 9-1.8)					
Lighting	A. Verify proper operation of light switch, lighting contactor, photocell or timer as appropriate. If a lighting contactor is used, listen for the chatter of contacts or buzzing noise. These are indicative of a faulty contactor. Replace if required. B. With the lights turned on, observe individual luminaries for flicker or lights turning on and off. The former is indicative of a faulty	Quarterly	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	choke. The latter is indicative of a faulty starter. Replace the faulty components as required. C. When light fixtures are located in hazardous areas, verify that the seals are intact and the hazardous rating of the fixture is maintained.				
	D. Thoroughly clean dust, bugs, and debris from the luminaire. Light solvents or cleaning agents may be used.	Annually (in dusty areas the luminaries may require cleaning at shorter intervals)	SM	SM	SM
	E. Re-Lamping: With the lights turned off, replace the lamps. In order to prevent accidental turning on of the lights, it is mandatory to switch off and lockout the breaker of the lighting circuit. Ensure the replacement lamps are the same type as those they are replacing. Verify the proper operation of all light fixtures after the lamp replacement.	Annually or as required	SM	SM	SM
Electronic Equipment (9-1.9)					
Electronic Equipment	A. Inspect the outside of equipment enclosures for dust and evidence of corrosion. Vacuum clean the dust to ensure unobstructed air circulation. B. Open the enclosure and vacuum clean the dust to ensure unobstructed air circulation. Pay particular attention to fans and air passages. If there is evidence of corrosion, verify that there is no water damage on printed circuit boards or contacts. If water or humidity damage is observed, the electronic components may not work properly and further testing is required.	Annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>C. Verify proper operation of the space heater if one is installed.</p> <p>D. Check if fans for proper operations and rotation.</p> <p>E. Look for signs of overheating such as discoloration and charring.</p> <p>F. Replace air filters.</p> <p>G. Verify connection tightness. Lightly pull wires on soldered and terminal screws and ensure the wires are not loose.</p> <p>H. Verify that circuit boards are properly seated. Ensure that board locking tabs are fully engaged. Do not unplug and plug connectors to verify seating. This will wear out the pins. Unplug only if connector malfunction is suspected.</p> <p>I. Observe wires for excessive strain, braiding, or wear due to vibration. Replace as required.</p>				
CATHODIC PROTECTION SYSTEMS					
Cathodic Protection (Section 9-2.1)					
Cathodic Protection	A. Inspect rectifiers in accordance with UFC 3-570-06	Every two months	SM	SM	SM
	B. Inspect cathodic protection systems in accordance with UFC 3-570-06	Annually	SM	SM	SM
Lightning Surge Arresters (Section 9-2.2.1)					
Lightning Surge Arresters	A. Newer lightning surge arresters are designed to withstand unlimited surges at 50,000 amperes; however, manufacturers of older surge arresters may provide a maximum number of surge events that can occur before	Annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>it must be replaced. If surge arresters include a maximum number of surge events, a spare arrester must be kept on hand. Refer to the surge arrester manufacturer's operation and maintenance manual for particular inspection instructions and parts. Inspect as part of an overall cathodic protection system inspection.</p>				
Card and Key Locks (Section 9-3)					
Card and Key Locks	<p>A. Conduct operational check of card and key lock system and ensure that all features provided with the installed system are operational.</p>	Annually	SM	SM	SM
Lightning Protection Systems (Section 9-4)					
Lightning Protection Systems	<p>B. Inspect air terminals to make sure they are securely attached to the roof of the building, canopy, or the piece of equipment. Check all connections between the air terminals and the grounding loop or grounding rods. Repair damaged or loose connections and perform continuity check after repairs.</p>	Annually	SM	SM	SM
Ground Verification System (Section 9-5)					
Ground Verification System	<p>A. Conduct an operational check of the ground verification system and ensure that all features provided with the installed system are operational. Inspect the plug for corrosion, weakness, or loose nuts and replace if heavily dented or deformed.</p>	Quarterly	SM	SM	SM
Electronic Overfill Protection Systems (Section 9-6)					
Electronic Overfill	<p>A. Conduct operational check of overfill prevention system and</p>	Quarterly	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
Protection Systems	ensure that all features provided with the installed system are operational.				
ALTERNATE POL FACILITIES					
Liquefied Petroleum Tanks (Section 10-1.1)					
Liquefied Petroleum Tanks	A. Inspect fuel tank for leaks. If a leak is occurring, the odorizing agent of the gas should be detectable. Use a soap and water solution to spray on areas suspected of leaks. Systems that are found with leaks must be taken out of service.	Monthly	OM	OM	OM
	B. Test operation of emergency shutoff valves. Ensure the fusible link mechanism is attached properly to actuate in case of a fire and that it has not been bypassed, blocked, or damaged in any manner. Ensure the fusible link is not filled with debris or paint which could impact operation.	Semi-annually	SM	SM	SM
	C. Check settings of tank safety valves and calibrate if required	Every 5 years	SM	SM	SM
Liquefied Petroleum Pipelines (Section 10-1.2)					
Liquefied Petroleum Pipelines	A. Conduct visual inspection of pipelines for potential damage and leak points. Use a soap and water solution to spray on areas suspected of leaks. Systems that are found with leaks must be taken out of service and repaired.	Monthly	OM	OM	OM
	B. Inspect coatings and markings on piping. Repair coating deterioration and replace labels that are fading and are difficult to read.	Semi-annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
Liquefied Petroleum Vapor Lines (Section 10-1.3)					
Liquefied Petroleum Vapor Lines	A. Inspect vapor lines for leaks. If leaks are occurring, the odorizing agent in the gas should be detectable. Use a soap and water solution to spray on areas suspected of leaks. Systems that are found with leaks must be taken out of service and repaired.	Monthly	OM	OM	OM
	B. Inspect coatings and markings on piping. Repair coating deterioration and replace labels that are fading and are difficult to read.	Semi-annually	SM	SM	SM
LPG Vaporizers (Section 10-1.4)					
LPG Vaporizers	C. Inspect vaporizers for leaks. If leaks are occurring, the odorizing agent in the gas should be detectable. Use a soap and water solution to spray on areas suspected of leaks. Systems that are found with leaks must be taken out of service and repaired.	Monthly	OM	OM	OM
	D. The manufacturer's maintenance schedules and recommendations provided with the LPG vaporizer must be followed.	As Required	SM	SM	SM
Petroleum Gas Regulators (Section 10-1.5)					
Petroleum Gas Regulators	A. Inspect petroleum gas regulators for leaks. If leaks are occurring, the odorizing agent in the gas should be detectable. Use a soap and water solution to spray on areas suspected of leaks. Systems that are found with leaks must be taken out of service and repaired.	Monthly	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
Liquefied Petroleum Gas Hoses (Section 10-1.6)					
Liquefied Petroleum Gas Hoses	A. Inspect hoses for damage and leaks. If leaks are occurring, the odorizing agent in the gas should be detectable. Use a soap and water solution to spray on areas suspected of leaks. If leaks are detected from a hose discontinue use of the hose and remove it from service. Inspect for damage to outer cover that exposes reinforcement. Inspect for kinks or flattened areas, soft spots or bulges. Inspect couplings and ensure they have not slipped on the hose or been damaged.	Monthly	OM	OM	OM
CNG Piping (Section 10-2.1)					
CNG Piping	A. Inspect CNG lines for leaks. Inspection of high-pressure CNG lines and equipment must be conducted using proper PPE including but not limited to safety glasses, a face shield, hard hat and fire resistant clothing. If leaks are occurring, the odorizing agent in the gas should be detectable. Use a soap and water solution to spray on areas suspected of leaks. Systems that are found with leaks must be taken out of service and repaired.	Daily	OM	OM	OM
	B. Inspect coatings and markings on piping. Repair coating deterioration and replace labels that are fading and becoming difficult to read.	Semi-annually	SM	SM	SM
CNG Compressors (Section 10-2.2)					
CNG Compressors	A. Compressors will require maintenance based on the model included in the system. Consult the compressor manual for maintenance requirements	As Required	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
CNG Storage (Section 10-2.3)					
CNG Storage	A. Inspect CNG tubes and tanks for leaks. Inspection of high-pressure CNG lines and equipment must be conducted using proper PPE including but not limited to safety glasses, a face shield, hard hat and fire resistant clothing. If leaks are occurring, the odorizing agent in the gas should be detectable. Use a soap and water solution to spray on areas suspected of leaks. Systems that are found with leaks must be taken out of service and repaired.	Daily	OM	OM	OM
	B. Inspect coatings and markings on storage tubes or tanks. Repair coating deterioration and replace labels that are fading and becoming difficult to read.	Semi-annually	SM	SM	SM
	C. Check operation and calibration of safety valves on tubes or tanks.	Every 3 years	SM	SM	SM
CNG Dispensers (Section 10-2.4)					
CNG Dispensers	A. Dispensers are listed for service with CNG and will vary by manufacturer. Consult the maintenance manual that was supplied with the system for manufacturer's maintenance required for the CNG dispenser.	As Required	SM	SM	SM
CNG Dispenser Hoses (Section 10-2.5)					
CNG Dispenser Hoses	A. Inspect hoses for damage, leaks, and cracks. If leaks are occurring, the odorizing agent in the gas should be detectable. Use a soap and water solution to spray on areas suspected of leaks. If leaks are detected from a hose, discontinue the use of the hose and remove it from service.	Monthly	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	B. Test hoses for leaks following manufacturer recommended frequencies and procedures.	As required	SM	SM	SM
Hydrazine Charging Units (Section 10-3)					
Hydrazine Charging Units	A. Hydrazine charging units are self-contained factory fabricated systems. Refer to the manufacturer's maintenance manual that was provided with the system for required periodic maintenance.	As Required	SM	SM	SM
SUPPORT FACILITIES					
Fuel Truck 1and Rail1 Containment Areas (Section 11-1.1)					
Fuel Truck Containment Areas	A. Remove debris from around security fence. B. Inspect fence grounding points. Ensure connections are not loose or damage.	Monthly	OM	OM	OM
	C. Inspect the parking area for cracks in the concrete containment paving and curbs. Remove vegetation that may have established roots in the buildup of dirt or from exposed earth under cracks. Thoroughly clean and seal cracks with a fuel resistant sealant.	Quarterly	SM	SM	SM
	D. 1 Secondary containment systems degrade and will collect debris which can clog drainage inlets or prevent drain valves from sealing properly. Hydrostatically test secondary containment and associated drainage systems to include containment concrete/sealant, drain inlets, drain lines and containment drain valves to ensure containment is liquid tight. This test may use opportune rainfall by holding	1 Every 3 Years 1	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>rainwater in the containment system for one hour. Where evaporation is a concern, conduct the testing when this concern would be minimized, such as at night/early morning or during a time of year when this would not be as much of an issue. Record the water level at the start of the 60-minute (minimum) hold period. If the water level drops by 1/8 inch or more, perform and record an investigation to determine the cause and any required repairs. Once repairs are completed, a new test must be completed. Refer Appendix B for testing procedures and to document the testing. <i>/1/</i>.</p> <p>E. Verify continuity of vehicle grounding system connections. If a connection is suspected to be loose, perform further testing. In some occasions it is more cost effective to replace the suspected connection instead of performing diagnostic tests.</p> <p>F. Inspect pavement markings and vehicle movement lines for wear and fading. Repair faded or worn pavement markings.</p> <p>G. Inspect security fence for wear and rust. Inspect barbed wire and ensure it is adequately secured to outriggers. Repair loose fencing components and coatings at areas that show rust.</p>				
	<p>H. Refer to Section 9-1.8 Lighting for inspection and maintenance requirements of area lighting</p>	As required	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
Remote Spill Containment (Section 11-1.2)					
Remote Spill Containment	<p>A. Inspect the remote containment basin for cracks in the concrete containment paving, walls, and curbs. Remove vegetation that may have established roots in the buildup of dirt or from exposed earth under cracks. Thoroughly clean cracks with a water spray or air jet. Seal cracks with a fuel resistant sealant.</p> <p>B. If equipped, inspect spill containment sump pump for proper operation.</p>	Quarterly	SM	SM	SM
	<p>C. 11 Secondary containment systems degrade and will collect debris which can clog drainage inlets or prevent drain valves from sealing properly. Hydrostatically test secondary containment and associated drainage systems to include containment concrete/sealant, drain inlets, drain lines and containment drain valves to ensure containment is liquid tight. This test may use opportune rainfall by holding rainwater in the containment system for one hour. Where evaporation is a concern, conduct the testing when this concern would be minimized, such as at night/early morning or during a time of year when this would not be as much of an issue. Record the water level at the start of the 60-minute (minimum) hold period. If the water level drops by 1/8 inch or more, perform and record an investigation to determine the cause and any required repairs. Once repairs are completed, a</p>	11 Every 3 Years 11			

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	new test must be completed. Refer Appendix B for testing. /1/.				
Pumphouse/Filter Buildings (Section 11-2.1)					
Pumphouse/ Filter Buildings	A. Inspect the floor and containment curbs for cracks. Thoroughly clean cracks with a water spray or air jet. Seal cracks with a fuel resistant sealant.	Annually	SM	SM	SM
	B. Refer to UFC 11 3-110-03 /1/ for inspection and maintenance requirements of pumphouse and filter building roof systems	As required	SM	SM	SM
Canopies (Section 11-2.2)					
Canopies	A. Inspect and maintain canopies according to UFC 11 3-110-03 /1/.	As required	SM	SM	SM
Emergency Eyewash/Showers (Section 11-3)					
Emergency Eyewash/ Showers	A. Test operation of the emergency eyewash/shower by pushing on the activation handles. Ensure water is not brown in color, due to rust in the piping or dirt seeping in from a hole in the buried piping. For systems with tempered water, ensure that water that is being supplied by the emergency eyewash/shower is between 60 and 100 °F (16 and 39 °C). For systems with a horn and strobe light, ensure that the horn and strobe light activate when the activation lever on the emergency eyewash/shower is pushed. For systems that interface with Installation or fire emergency systems, pre-coordinate before testing. At some Installations emergency eyewashes and showers act as EFSOs and are tied into the fire alarm systems.	Weekly	11OM/1/	11OM/1/	11OM/1/

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	B. Inspect portable/packaged safety showers and eyewash stations for proper operation. Check fluid levels. Where tap water is used, fluid must be replaced monthly. Less frequent intervals of fluid change, as recommended by the manufacturer, are acceptable where a solution or water additive is used. Ensure packaged eyewash supplies are within the listed expiration date. Tags or labels must be attached to the unit or adjacent to it, indicating the fluid change schedule.	Monthly	\11OM/1/	\11OM/1/	\11OM/1/
	C. Inspect the exterior coatings of permanently installed units and repair damaged coatings or rust.	Quarterly	SM	SM	SM
	D. For systems with tempered water systems inspect components of the water heater for correct operation and temperature control. Ensure that the safety valve on the hot water heater tank is not leaking.	Semi-annually	SM	SM	SM
	E. Inspect signage and labels on the emergency eyewash/shower. Replace missing labels or signage that has become loose. Signs that are faded must be replaced	Annually	SM	SM	SM
Ventilation Hoods (Section 11-4.1)					
Ventilation Hoods	A. Inspect the operation of the doors. Ensure that they close and open smoothly.	Quarterly	SM	SM	SM
	B. Inspect the lights inside of the hood to make sure they are operating properly. Replace light bulbs that are no longer working.	Semi-annually	SM	SM	SM
	C. Verify that all electrical equipment is properly classified in	Annually	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	<p>accordance with NFPA 70 <i>National Electrical Code</i>.</p> <p>D. Inspect the ventilation system (ductwork, fans, etc.) for signs of disrepair and air leakage and ensure it is operational and pulling air through the hood. Inspect and assure that the lab hood air measuring device for assuring proper air flow is permanently attached and working properly. The ventilation hood must be inspected and approved by a service specific industrial hygienist or bioenvironmental engineer in accordance with OSHA, 29 CFR 1910.1450 <i>Occupational Exposure to Hazardous Chemicals in Laboratories</i>, and ANSI/AIHA <i>Laboratory Ventilation Z9.5</i>.</p> <p>E. Verify negative pressure is present through the ventilation hood to the exhaust.</p>				
Oil/Water Separators (Section 11-5)					
Oil/Water Separators	<p>A. Inspect the oil/water separator for the buildup of collected petroleum fuel or oil. Remove and properly dispose of accumulated petroleum fuel or oil.</p>	Quarterly or as needed based on precipitation events	SM	SM	SM
	<p>B. Drain, clean, and inspect the interior of the oil/water separator. Ensure all divider plates and screens are in good working order. Replace or repair damaged components.</p>	Annually or more frequently based on local environmental conditions.	SM	SM	SM
Cranes and Hoists (Section 11-6)					
Cranes and Hoists	<p>A. Inspect cranes and hoists for smooth operation. If the crane or hoist is equipped with electronic controls, check power supply and operational control cords for nicks or damage. A crane service</p>	Before each use	OM	OM	OM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	technician must correct binding that may prevent smooth operation and repair damage to power cords.				
	B. Apply lubricant or grease to areas that require periodic greasing. C. Military services-specific, host nation, state, and/or local regulations require cranes and hoists to be certified for operation. Follow the more stringent of military services-specific, host nation, state or local regulations.	Annually	SM	SM	SM
FUEL FACILITY TEMPORARY DEACTIVATION OR CLOSURE					
Deactivated Fuel Tanks (Section 12-2)					
Deactivated Fuel Tanks	A. Inspect water or anti-corrosion level in tank. If level has dropped, investigate potential leak points such as blind flanges. Repair leaks that are detected and refill to appropriate level.	Quarterly	SM	SM	SM
	B. Check exterior coatings and labels. Repair peeling coatings and/or rusting areas and replace or repair labels which have become faded and difficult to read.				
	C. Inspect cathodic protection system for proper operation.	Annually	SM	SM	SM
Deactivated Pipelines (Section 12-3)					
Deactivated Pipelines	A. Inspect the pressure of the nitrogen charge applied to the petroleum fuel pipeline with a pressure gauge. If the pressure of the charge has dropped investigate and repair leak points. Once leak points are repaired, recharge with nitrogen. B. Check exterior coatings and labels. Repair peeling coatings and/or rusting areas and replace or repair labels which have	Quarterly	SM	SM	SM

ITEM	PARAGRAPH	FREQUENCY	Army	Navy/ USMC	Air Force
	become faded and are difficult to read.				
	C. Inspect cathodic protection system for proper operation.	Annually	SM	SM	SM
Deactivated Pumps (Section 12-4)					
Deactivated Pumps	A. Manually rotate pump through several rotations. Ensure that the pump turns freely. B. Check exterior coatings. Repair peeling coatings and/or rusting areas and replace or repair labels which have become faded and difficult to read.	Quarterly	SM	SM	SM
	C. Remove isolation flanges and recoat interior of pump with light corrosion-inhibiting oil.	Annually	SM	SM	SM
Miscellaneous Deactivated Components (Section 12-5)					
Miscellaneous Deactivated Components	A. Ensure that blind flanges are tight. Inspect exterior coatings and labels. Repair peeling coatings and/or rusting areas and replace or repair labels that have become faded and are difficult to read.	Annually	SM	SM	SM

Note: Follow manufacturer's recommendation and published operation and maintenance manuals for items and equipment not discussed in this document.

APPENDIX D MAINTENANCE PROCEDURES

D-1 D-1 FILTER SEPARATOR COALESCER CARTRIDGE REPLACEMENT AND SEPARATOR CARTRIDGE CLEANING.

D-1.1 Coalescer Cartridge Replacement in Vertical Filter Separator.

- a. Drain the filter separator completely.
- b. Raise the cover. CAUTION: Do not touch new coalescer cartridges or the separator cartridges with your bare hand. The oil on your hand will cause damage to the water-removal capability of these components.
- c. Where there is an outer separator cartridge, remove, clean (D-1.3), and set it aside for reuse.
- d. Remove and discard the old coalescer cartridges in an approved manner. Coordinate disposal of coalescer cartridges with Installation Environmental Office.
- e. Check the adapter gasket and adapter to make sure the gasket and adapter threads are clean.
- f. Complete the installation of the coalescer cartridge assemblies by lowering each of the coalescer cartridge assemblies onto one of the deck plate nipples. Make sure that each of the coalescer cartridge assemblies is screwed down onto its deck plate nipple and the gasket is seated properly and seals tightly. Next, apply the procedures in items (1) through (6) below:
 1. Replace the cover gasket with a new gasket of the same grade and manufacturer as the old one.
 2. Swing the cover back into place, lowering the lifting handle as you do so.
 3. Swing the eyebolts up into place and tighten the nuts using the crisscross method. Do this so that the cover gasket and cover are seated properly. When tightening cover bolts and nuts, use a torque wrench. Tighten nuts just enough to prevent leaking through the dome cover seal (refer to manufacturer's instructions for torque requirements) and to eliminate possible damage to the vessel.
 4. Close the manual water drain valve.
 5. Slowly fill the separator. Filling a filter separator must take a minimum of ten minutes to perform. Conduct slow filling by use of the slow fill valve on the filter separator, if equipped, or by filling all of the filter separators on a system at one time. Slow filling is the

only authorized method of refilling an empty filter separator. This slows buildup of static electricity in fuel, reducing the possibility of a spark igniting the explosive atmosphere inside the vessel. In most cases, coalescer elements cannot be grounded or bonded to dissipate the static electric charge that is generated during filling.

6. Pressurize the vessel to inspect all gaskets and screwed connections for leaks; tighten all loose connections.
- g. Note: Remember, once a system is opened for any reason it must be sampled before aircraft are serviced.
- h. Notify the facility supervisor that the filter separator is ready to be put back into service and is awaiting QC flushing and sampling. (This is necessary to ensure the fuel meets quality requirements.)
- i. After the coalescer cartridges have been replaced and the filter separator is ready to be put back into service, follow the steps below:
 1. Stencil the filter separator in accordance with Section 3-6.2.4.
 2. Set up and keep a logbook or wall chart in the maintenance shop. Record the following information in this book or chart: pumphouse facility number; filter separator number; month and year replacement coalescer cartridges were installed; serial number of the coalescer cartridges; number of coalescer cartridges; and manufacturer's coalescer cartridge lot number, if available.

D-1.2 Coalescer Cartridge Replacement in Horizontal Filter Separator.

- a. After the vessel has been drained thoroughly, remove the head flange bolts and open the vessel. For the original KMU-416/F modification kit, use the following method:
 1. Starting with the bottom (left) coalescer cartridge, loosen the 0.5-inch (12.7-millimeter) nut on the adapter mounting rod. Slowly drain the fuel trapped in the manifold by loosening the bottom coalescer cartridge.
 2. After the fuel has been drained from the manifold, remove the fifteen coalescer cartridges on the outlet side of the manifold.
 3. To remove the coalescer cartridge hold-down plate, use a screwdriver for leverage to pry the seals outward from the cartridge. The O-ring seals on the cartridge mounts may be removed more easily by applying a slight twisting motion instead of a direct pull.
 4. Loosen and remove the Victaulic coupling from the inlet pipe, sliding the sealing gasket down on the manifold pipe section. Be sure to use a static bonding wire.

5. Remove the manifold. This requires two people to slide the manifold forward, using the protruding coalescer cartridge hold-down rods as handles to help in removing the manifold. CAUTION: Have a container available to place the manifold in and catch fuel that might spill out of the manifold. Dispose of the used coalescer cartridges in an approved manner. Do not allow fuel-soaked coalescer cartridges to be left in the area or disposed of in a manner that can create a safety or fire hazard. Be careful when handling used coalescer cartridges because they are toxic and combustible or flammable, depending on the fuel's flashpoint.
 6. Remove the separator cartridges and follow the steps outlined in Section D-1.3 when cleaning.
 7. Clean the inside of the filter separator with rags.
 8. Install new coalescer cartridges and cleaned separator cartridges on the manifold and reinstall the manifold.
 9. Align and bolt in the Victaulic coupling.
 10. Replace cover and tighten bolts using the crisscross method. Tighten nuts just enough to prevent leaking through the dome cover seal (refer to manufacturer's instructions for torque requirements) to eliminate possible damage to the vessel.
- b. For modified KMU-416/F (300 gallons per minute (1135 liters per minute) kits with nine additional coalescer cartridges on the back side of the manifold, remove only the bottom front six coalescer cartridges instead of all fifteen. This will balance the manifold, and make it easier to remove. Remove the manifold from the vessel.
 - c. For KMU-417/F kits (600 gallons per minute (2271 liters per minute), leave all coalescer cartridges in place when removing the manifold. This provides balance and lets you remove the manifold easily.

D-1.3 Separator Cartridge Cleaning, Repairing, and Handling.

- a. Cleaning: Separator cartridges, when new, operate in a satisfactory manner, but after processing millions of gallons of fuel that contain additives and contaminants they gradually become less effective. Every time the coalescer cartridges are changed the separator cartridges should be inspected and cleaned according to the following procedure:
 1. Connect a water hose to a hot water supply. Attach a nozzle to the hose and direct a high-velocity stream of water at a downward angle against the outer surface of the separator cartridge. Hold the separator cartridge assembly vertically by the end to avoid touching the cartridge surface. Begin at the top and work downward along

the length of the separator cartridge. Rotate the separator cartridge slowly so the entire surface is subject to the jet of hot water. Repeat as necessary until the separator cartridge is clean.

2. After cleaning, shake excess water from the separator cartridge and allow the remaining water to evaporate, or use clean, dry, oil-free compressed air. Air quality must be very clean. If the air quality is doubtful, do not use.
 3. After each separator cartridge is dry, hold it horizontally and pour tap water onto the cartridge from a height of 1 to 2 inches (25 to 50 millimeters) above the cartridge. Pour water along the entire length of the separator cartridge while slowly rotating the cartridge. Under test, observe the way the water appears on the surface of the separator cartridge. If the water soaks through the separator cartridge instead of beading up or rolling off, the cartridge must be recleaned.
 4. The Teflon or nylon coating of the separator cartridge must be visually inspected for small cuts and breaks. Small breaks in the Teflon or nylon coating of the separator cartridge can be repaired for temporary service by patching with a fuel-resistant sealant, epoxy adhesive, or epoxy-base putty. If major holes appear in the Teflon or nylon coating of the separator cartridge, rendering it impracticable to repair, the separator cartridge should be replaced.
- b. Installation and Handling: Just before installing separator cartridges, agitate the cartridges briefly in a container of clean fuel to flush off all remaining water. (Use the same type of fuel being filtered). Extra care must be taken during installation to ensure separator cartridges are not damaged. Separator cartridges must be installed very carefully to prevent physical damage to the Teflon or nylon coating. When installing the separator cartridge assembly, the securing nut should not be over torqued, as this can damage the cartridge assembly.

D-2 D-2 HOSE HYDROSTATIC TEST.

D-2.1 Loading Hose Hydrostatic Test.

- a. Prior to hydrostatic test of fuel loading hose, determine the maximum allowable pressure rating of attached valves, meters, or swivels to prevent possible injury to personnel or damage to the equipment. It may be necessary to remove the fueling hose prior to testing.
- b. Test fluid may be water or liquid petroleum fuel with a flash point of 100 °F (37.7 °C) or more. If liquid petroleum fuel is used as the test medium, the test should be conducted in a place where contamination of adjacent waters will not occur if there is spillage.

- c. Provide blind flanges, nipples, valves, pressure gauges, and pumps of appropriate size and rating for the test to be performed.
- d. Lay the hose out flat and straight, uniformly supported.
- e. Fill the hose with test fluid, expel all air and raise the pressure to 10 psig (69 kPa).
- f. Hold the pressure for at least five minutes. During the test interval, measure the length of the hose, end-of-rubber to end-of-rubber. Record the measured length as original length.
- g. If the hose is maintaining 10 psig, raise the pressure to the lower of 1.5 times the pump deadhead pressure or the maximum allowable working pressure of the hose and hold the pressure for a minimum of 15 minutes. Measure the length of the hose, end-of rubber to end-of-rubber and record the measured length as test pressure length.
- h. During the test the hose must not burst, bulge, leak, or abnormally distort under static liquid pressure.
- i. Calculate the elongation as a percentage of original length versus test pressure length. If the elongation of the hose exceeds 15% it is an indication that there is a serious internal weakness and the hose should be removed from service and retired.

D-2.2 Marine and Underwater Transfer Hose Hydrostatic Test.

- a. Hydrostatic testing of marine and underwater petroleum fuel transfer hose must meet the requirements of 33 CFR 156, Section 170.
- b. Prior to hydrostatic test the hose must meet the following requirements:
 - 1. Have no unrepaired loose covers, kinks, bulges, soft spots or other defects which would permit the discharge of fuel through the hose material, and no gouges, cuts, or slashes that penetrate the first layer of the hose reinforcement.
 - 2. Have no external deterioration and, to the extent internal inspection is possible with both ends of the hose open, no internal deterioration.
- c. Test fluid may be water or liquid petroleum fuel with a flash point of 100 °F (37.7 °C) or more. If liquid petroleum fuel is used as the test medium, the test should be conducted in a place where contamination of adjacent waters will not occur if there is spillage.

- d. Provide blind flanges, nipples, valves, pressure gauges, and pumps of appropriate size and rating for the test to be performed.
- e. Lay the hose out flat and straight, uniformly supported.
- f. Fill the hose with test fluid, expel all air and raise the pressure to 10 psig (69 kPa).
- g. Hold the pressure for at least five minutes.
- h. If the hose is maintaining 10 psig, raise the pressure to 1.5 times the maximum allowable working pressure of the hose and hold the pressure for a minimum of 15 minutes.
- i. During the test the hose must not burst, bulge, leak, or abnormally distort under static liquid pressure.

CANCELLED

APPENDIX E TANK INSPECTION CHECKLISTS

STI SP001 MONTHLY INSPECTION CHECKLIST

General Inspection Information:

Inspection Date: _____	Prior Inspection Date: _____	Retain Until Date: _____
Inspector Name (print): _____	Title: _____	
Inspector's Signature: _____		
Tanks Inspected (ID #'s): _____		
Regulatory facility name and ID number (if applicable) _____		

Inspection Guidance:

- This checklist is intended as a model. Locally developed checklists are acceptable as long as they are substantially equivalent (as applicable). Inspections of multiple tanks may be captured on one form as long as the tanks are substantially the same.
- For equipment not included in this Standard, follow the manufacturer recommended inspection/testing schedules and procedures.
- The periodic AST Inspection is intended for monitoring the external AST condition and its containment structure. This visual inspection does not require a Certified Inspector. It must be performed by an owner's inspector per paragraph 4.1.2 of the standard.
- Upon discovery of water in the primary tank, secondary containment area, interstice, or spill container, remove promptly or take other corrective action. Inspect the liquid for regulated products or other contaminants and dispose of properly.
- Non-conforming items important to tank or containment integrity require evaluation by an engineer experienced in AST design, a Certified Inspector, or a tank manufacturer who will determine the corrective action. Note the non-conformance and corresponding corrective action in the comment section.
- Retain the completed checklists for at least 36 months.
- **After severe weather (snow, ice, wind storms) or maintenance (such as painting) that could affect the operation of critical components (normal and emergency vents, valves), an inspection of these components is required as soon as the equipment is safely accessible after the event.**

ITEM	STATUS	COMMENTS/DATE CORRECTED
Tank and Piping		
1	Is tank exterior (roof, shell, heads, bottom, connections, fittings, valves, etc.) free of visible leaks? Note: If "No", identify tank and describe leak and actions taken. <input type="checkbox"/> Yes <input type="checkbox"/> No	

ITEM		STATUS	COMMENTS/DATE CORRECTED
2	Is the tank liquid level gauge legible and in good working condition?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
3	Is the area around the tank (concrete surfaces, ground, containment, etc.) free of visible signs of leakage?	<input type="checkbox"/> Yes <input type="checkbox"/> No	
4	Is the primary tank free of water or has another preventative measure been taken? NOTE: Refer to paragraph 6.10 and 6.11 of the standard for alternatives for Category 1 tanks. N/A is only appropriate for these alternatives.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
5	For double-wall or double bottom tanks or CE-ASTs, is interstitial monitoring equipment (where applicable) in good working condition?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
6	For double-wall or double bottom tanks or CE-ASTs, is interstice free of liquid? Remove the liquid if it is found. If tank product is found, investigate possible leak.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
Equipment on Tank			
7	If overfill equipment has a "test" button, does it activate the audible horn or light to confirm operation? If battery operated, replace battery if needed.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
8	Is overfill prevention equipment in good working condition? If it is equipped with a mechanical test mechanism, actuate the mechanism to confirm operation.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
9	Is the spill container (spill bucket) empty, free of visible leaks and in good working condition?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
10	Are piping connections to the tank (valves, fittings, pumps, etc.) free of visible leaks? Note: If "No", identify location and describe leak.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
11	Do the ladders/platforms/walkways appear to be secure with no sign of severe corrosion or damage?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
Containment (Diking/Impounding)			
12	Is the containment free of excess liquid, debris, cracks, corrosion, erosion, fire hazards and other integrity issues?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
13	Are dike drain valves closed and in good working condition?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	

STI SP001 Annual Inspection Checklist

General Inspection Information:

Inspection Date: _____	Prior Inspection Date: _____	Retain Until Date: _____
Inspector Name (print): _____	Title: _____	
Inspector's Signature: _____		
Tanks Inspected (ID #'s): _____		
Regulatory facility name and ID number (if applicable) _____		

Inspection Guidance:

- This checklist is intended as a model. Locally developed checklists are acceptable as long as they are substantially equivalent (as applicable).
- For equipment not included in this Standard, follow the manufacturer recommended inspection/testing schedules and procedures.
- The periodic AST Inspection is intended for monitoring the external AST condition and its containment structure. This visual inspection does not require a Certified Inspector. It must be performed by an owner's inspector per paragraph 4.1.2 of the standard.
- Remove promptly standing water or liquid discovered in the primary tank, secondary containment area, interstice, or spill container. Before discharge to the environment, inspect the liquid for regulated products or other contaminants and disposed of it properly.
- In order to comply with EPA SPCC (Spill Prevention, Control and Countermeasure) rules, a facility should regularly test liquid level sensing devices to ensure proper operation (40 CFR 112.8(c)(8)(v)).
- Non-conforming items important to tank or containment integrity require evaluation by an engineer experienced in AST design, a Certified Inspector, or a tank manufacturer who will determine the corrective action. Note the non-conformance and corresponding corrective action in the comment section.
- Retain the completed checklists for at least 36 months.
- Complete this checklist on an annual basis supplemental to the owner monthly-performed inspection checklists.
- **Note: If a change has occurred to the tank system or containment that may affect the SPCC plan, the condition should be evaluated against the current plan requirement by a Professional Engineer knowledgeable in SPCC development and implementation.**

ITEM	STATUS	COMMENTS/DATE CORRECTED
Tank Foundation/Supports		
1	Free of tank settlement or foundation washout? <input type="checkbox"/> Yes <input type="checkbox"/> No	
2	Concrete pad or ring wall free of cracking and spalling? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
3	Tank supports in satisfactory condition? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	

ITEM		STATUS	COMMENTS/DATE CORRECTED
4	Is water able to drain away from tank if tank is resting on a foundation or on the ground?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
5	Is the grounding strap between the tank and foundation/supports in good condition?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
Tank Shell, Heads and Roof			
6	Free of visible signs of coating failure?	<input type="checkbox"/> Yes <input type="checkbox"/> No	
7	Free of noticeable distortions, buckling, denting, or bulging?	<input type="checkbox"/> Yes <input type="checkbox"/> No	
8	Free of standing water on roof?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
9	Are all labels and tags intact and legible?	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Tank Manways, Piping, and Equipment			
10	Flanged connection bolts tight and fully engaged with no sign of wear or corrosion?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
Tank Equipment			
11	Normal and emergency vents free of obstructions?	<input type="checkbox"/> Yes <input type="checkbox"/> No	
12	Normal vent on tanks storing gasoline equipped with pressure/vacuum vent?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
13	Are flame arrestors free of corrosion and are air passages free of blockage?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
14	Is the emergency vent in good working condition and functional, as required by manufacturer? Consult manufacturer's requirements. Verify that components are moving freely (including long-bolt manways).	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
15	Is interstitial leak detection equipment in good condition? Are windows on sight gauges clear? Are wire connections intact? If equipment has a test function, does it activate to confirm operation?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	

ITEM		STATUS	COMMENTS/DATE CORRECTED
16	<p>Are all valves free of leaks, corrosion and other damage? Follow manufacturers' instructions for regular maintenance of these items. Check the following and verify (as applicable):</p> <p><input type="checkbox"/> Anti-siphon valve <input type="checkbox"/> Check Valve <input type="checkbox"/> Gate Valve <input type="checkbox"/> Pressure regulator valve <input type="checkbox"/> Expansion relief valve <input type="checkbox"/> Solenoid valve <input type="checkbox"/> Fire valve <input type="checkbox"/> Shear valve</p>	<p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A</p>	
17	Are strainers and filters clean and in good condition?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
Insulated Tanks			
18	<p>Free of missing Insulation? Insulation free of visible signs of damage? Insulation adequately protected from water intrusion?</p>	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
19	Insulation free of noticeable areas of moisture?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
20	Insulation free of mold?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
21	Free of visible signs of coating failure?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
Tank/Piping Release Detection			
22	Is inventory control being performed and documented if required?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
23	Is release detection being performed and documented if required?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	

APPENDIX F TANK INSPECTION CHECKLISTS

Field Erected Tank Monthly Inspection Checklist

General Inspection Information:

Inspection Date: _____	Retain Until Date: _____ (36 months from inspection date)
Prior Inspection Date: _____	Inspector Name: _____
Tanks Inspected (ID #'s): _____	

Item	Task	Status	Comments
1.	Inspect the reinforcement plate weep holes for signs of fuel and remove pipe plugs if installed.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
2.	Inspect all tank bottom tell tales and monitoring wells. Remove any water if present.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
3.	For tanks equipped with floating-roof ensure the center primary roof drain system is free of water, the drip-tight plug is placed in the roof drain opening, and drain valve is closed.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
4.	Inspect floating roof systems for:		
	4.1. Inspect the roof for buckling or damage.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
	4.2. Inspect for standing water on the roof deck.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
	4.3. Ensure the roof drain system is water-free.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
	4.4. Check the floating roof guides.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
	4.5. Visually inspect the roof for centering.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
5.	Check the product recovery system for; proper pump operation; sight glass is clear; float assembly is functioning.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	

Item	Task	Status	Comments
6.	Ensure the ladders, platforms, handrails, and stairs are secured to the structure and inspect for signs of corrosion.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
7.	Visually check the exterior of the tank (i.e., welds, plates, bolts, fill ports, appurtenances) for leaks, corrosion.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
8.	Visually inspect tank foundation berms for signs of erosion, and irregularities such as tilting, settling, out-of-roundness, and growth of vegetation.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
9.	Visually inspect tank concrete ring wall foundations for cracks or signs of settlement.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
10.	Inspect and clean the protective screens at pressure and vacuum ports and tank exterior.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
11.	Inspect the manual liquid level gauge for proper operation. If installed verify manual gauge to the ATG.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
12.	If applicable; inspect swing lines for fraying and operability.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
13.	Check all signs and markings for adequacy and readability.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
14.	If additional maintenance actions are required, compile list of discrepancies and submit for correction.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	

Additional Comments:

Field Erected Tank Annual Inspection Checklist

General Inspection Information:

Inspection Date: _____	Retain Until Date: _____	(36 months from inspection date)
Prior Inspection Date: _____	Inspector Name: _____	
Tanks Inspected (ID #'s): _____		

Item	Task	Status	Comments
1.	Pack the reinforcement plate weep holes with white grease to prevent water and/or dirt infiltration	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
2.	Inspect floating roof seals for:		
	2.1. Inspect and clean perimeter tank seals.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
	2.2. Roof guide cables for wear, fraying, and corrosion.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
	2.3. Roof grounding cables for binding and secure attachment.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
	2.4. Inspect the ladder for damage and deflection (if equipped).	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
	2.5. Check interior shell for abrasions that may indicate shell out of roundness or improper centering.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
	2.5.1. If abrasions are discovered, inspect seals for wear.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
	2.6. Check floating roof for corrosion, apply touch up with compatible coating.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
	2.7. Inspect pontoons for standing liquid and presence of vapors.	<input type="checkbox"/> Ye* <input type="checkbox"/> No <input type="checkbox"/> N/A	
3.	Ensure the ladders, platforms, handrails, and stairs are secured to the structure and inspect for signs of corrosion.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	

Item	Task	Status	Comments
4.	Visually check the exterior of the tank (i.e., welds, plates, bolts, appurtenances) for leaks, corrosion, or irregularities such as tilting, settling, or out-of-roundness.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
5.	Inspect, clean, and repair tank vacuum and pressure vents as follows:		
	5.1. Clean seating surfaces of pallets and valve seats carefully with an approved suitable cleaning solvent.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
	5.2. Inspect seating surfaces for damage or undue wear.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
6.	Inspect and clean the protective screens at pressure and vacuum ports and tank exterior.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
7.	Remove mechanical gauge float cover and ensure float is securely fastened to gauge tape. Check gauge tape for ease of movement.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
8.	Check all signs and markings for adequacy and readability.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
9.	If additional maintenance actions are required, compile list of discrepancies and submit for correction.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	

Additional Comments:

APPENDIX G PETROLEUM FUEL PIPELINE PRESSURE TESTING GUIDELINES AND CRITERIA

G-1 INTRODUCTION.

G-1.1 Scope.

This appendix contains general criteria and standard guidelines for Petroleum, Oil, and Lubricant (POL) pipeline pressure testing. These procedures are based on current codes and criteria in addition to field experience and best management practices. This appendix clarifies the requirements for the procedures, frequency, duration, and test pressures for POL pipeline integrity testing. This appendix also provides a consistent definition of many of the terms used for pressure testing guidelines and procedures. In addition, an overall criteria list surrounding pipeline pressure testing is provided, along with a statement on the impact to the guidance given.

G-2 PIPELINE PRESSURE TESTING GUIDELINES.

G-2.1 Introduction.

G-2.1.1 Best Management Practice.

Testing criteria is to be adopted on a best management practice basis, with overall guidelines and minimum criteria established for a broad range of piping, with exceptions and special cases noted where required.

G-2.1.2 Regulations.

host nation, Federal, state and local regulations with jurisdiction must be followed when more stringent than criteria outlined herein.

G-2.1.3 New Pipelines.

Testing of new pipelines, segments of existing pipelines after major repairs, or segment replacement must be in accordance with current piping codes and UFGS specifications.

G-2.1.4 Existing Pipelines.

Testing of existing pipelines must be in accordance with site specific criteria developed to provide integrity management consistent with the published guidelines and the procedures stated in Sections G-2.2 thru G-2.5.

G-2.2 GENERAL REQUIREMENTS.

G-2.2.1 Aboveground Pipe Testing.

Aboveground pipe testing should be based on the premise that it can be visually inspected on a regular basis, and is observable during the testing process. Overwater or near

overwater piping is a special case and should receive a higher level of integrity testing due to the consequence of failure (and in some cases higher risk of failure due to increased corrosion).

G-2.2.2 Underground Pipe Testing.

Underground pipe testing should be based on the premise that it cannot be visually inspected during the test. The testing program needs to address greater safety factors, frequency of testing, and procedures to minimize the impact of temperature change of fuel during testing to assure integrity of testing.

G-2.2.3 Overall Testing Methodology Criteria.

The following items apply to all integrity pressure testing.

- a. A job-specific written procedure (pressure test plan) must be used when performing a pressure test. Detailed procedures must be developed to address safety, procedural, and equipment issues for each pipeline segment.
- b. Periodic testing must determine both long term safety of operation, as well as determining if the pipeline is currently leaking.
- c. Preferred testing is via increasing pressure to a level consistent with reasonably predictable peak pressures, plus a comfort factor that reflects time between testing, future risk of failure, and consequence of failure.
- d. Integrity testing using a fuel inoculant (e.g. tracer additive) can be considered in certain cases. In order to qualify as an integrity test, the procedure should utilize a pressure consistent with integrity management principles, instead of the minimum pressure required to conduct the test.
- e. Integrity testing using a third-party certified, National Work Group on Leak Detection Evaluations (NWGLDE) listed, short duration proprietary procedure is acceptable in principle. Selected method must be certified for system parameters such as pipe size and liquid volume. To qualify as an integrity test the procedure must utilize a pressure consistent with integrity management principles, instead of the minimum pressure required to conduct the test. Alternatively, a lower pressure third-party certified leak test can be conducted after a strength test meeting the requirements of Section G-2.2.11 has been conducted.

G-2.2.4 Test Fluid.

Test fluid should be the system fuel such as DF-2, JP-5, JP-8, or F-76 when testing is within normal ANSI Class 150 ranges, and stress does not exceed 50% of Specified Minimum Yield Stress (SMYS) of the pipe. Table G-2.1 provides examples of maximum test pressures for a selection of frequently used carbon and stainless steel pipe based on

SMYS calculations (pipe only, not flanges, components). Testing with fuel with a pressure that induces a yield greater than 50% of SMYS is possible but factors such as pipe location (off-base or on-base) and proximity to occupied structures must be carefully considered. The method of calculating the pipe pressure properties for off base pipelines may require a slight variation and therefore should use the appropriate design code.

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Table G-1 /1/ Pipe Properties

Pipe Size (D) x (t)	Material	SMYS / allowable stress (S) psi (kPa)	Max Design Pressure psi (kPa) (note 1)	Pressure @ SMYS psi (kPa) (note 1)	Pressure @ 50% of SMYS psi (kPa)
8.625 dia. x .322	ASTM A 53/A 53M, Type S Grade B	35,000/20,000 (241,316.5/137,895.)	1,539 (10611.0)	2,614 (18022.9)	1,307 (9011.4)
10.75 dia. x .365	ASTM A 53/A 53M, Type S Grade B	35,000/20,000 (241,316.5/137,895.)	1,396 (9625.1)	2,376 (16381.0)	1,188 (8191.0)
12.75 dia. x .375	ASTM A 53/A 53M, Type S Grade B	35,000/20,000 (241,316.5/137,895.)	1,205 (8308.1)	2,058 (14189.4)	1,029 (7094.7)
14.00 dia. x .250	ASTM A 358/A 358M, Grade 304L	25,000/16,700 (172,368.9/115,142.)	605 (4171.3)	892 (6150.0)	446 (3075.1)
16.00 dia. x .250	ASTM A 358/A 358M, Grade 304L	25,000/16,700 (172,368.9/115,142.)	528 (3640.4)	781 (5384.8)	390 (2689.0)
20.00 dia. x .250	ASTM A 358/A 358M, Grade 304L	25,000/16,700 (172,368.9/115,142.)	422 (2909.6)	625 (4309.2)	312 (2151.2)

Note 1: $P = 2SEt/D$, $E=1$ for seamless and ERW pipe (ASME B31.3 Barlow equation). Consult ASME B31.3 and/or API 570 for other pipe materials, quality factors and wall thickness

G-2.2.5 Exceptions to Test Fluid.

Testing with water should be limited as much as possible to high pressure testing (greater than 450 psig (3102.6 kPa), testing over water, testing at high pressures outside of military property, and where mandated by regulatory jurisdiction (when waiver cannot be obtained). Testing with JP-8 which has a minimum flash point of 100 °F (37.8 °C) may require special permission when regulations permit testing with the fuel only when the associated flash point is above 120 °F (48.9 °C). Testing of motor gasoline lines must use potable water due to its low flash point and associated safety concerns.

G-2.2.6 Thermal Relief and Surge Considerations.

All testing programs need to consider system pressures that may be developed by thermal relief valve settings and possible dynamic transient surge (water hammer) conditions. Testing at a pressure less than these potential conditions will not provide adequate assurances of system integrity.

Pressure relief valve settings should be confirmed prior to pressurization to ensure correct test pressure and relief valve operation.

G-2.2.7 Dynamic Surge.

Evaluate the maximum surge pressure for systems known to have dynamic surge potential. The test pressure must be such that the qualified maximum operating pressure is high enough to support predictable surge pressure. (Under ASME B31.3 max surge = 133% of qualified maximum allowable operating pressure, under ASME B31.4 max surge = 110% of qualified maximum operating pressure).

G-2.2.8 System Components.

Testing programs need to consider all components within the test segments, such as strainers, sight glasses, meters, pressure gauges, pressure transmitters, check valves, instrumentation fittings and filter separators. Testing at 150% of the maximum operating pressure may overpressure system components and must be accordingly considered. Removal of lower pressure components from test segments by valve closure or blinding should be considered rather than reducing test pressure. In accordance with API RP 1110, these components should be identified with information from the component manufacturer such as maximum operating pressure, serial numbers, and other pertinent information. These components and manufacturer's information should be listed in the pressure test plan.

Special consideration must be given to systems having non-standard fittings such as mitered elbows, orange peel reducers, stab-in connections, and similar. Note that under ASME B31.3, some of these fittings are acceptable when operation pressure results in stress less than 20% of SMYS.

G-2.2.9 Pressure Test Plan.

For all pressure class systems, a specific plan must be developed for pressure testing. For pressure class systems greater than ANSI Class 150, prepare a very detailed site specific engineering evaluation and code documentation to assure adequate and safe pressure testing. Some systems can contain more than one class of flange, so the pressure test plan must be based on the lowest class of flange present. For OCONUS locations, confirm pressure class of non-ASME components. Some OCONUS locations may incorporate a lower pressure class of flanges/components.

Any test section that includes an elevation difference of over 100 feet (30.5 meters) requires a pressure versus elevation plot and associated calculations to ensure that the lower points in the piping are not over pressurized and the highest points are subjected to the proper test pressure. These calculations and plot must be included in the pressure test plan.

G-2.2.10 Conventional Leak Test.

A conventional leak test as used in this report is a temperature compensated and volume/pressure change reconciled pressure test at not less than 150% of pump

deadhead pressure by a qualified individual/organization with API 1110 developed procedures.

G-2.2.11 Strength Test.

A strength test as used in this report is a pressure test at not less than the greater of 150% of pump deadhead pressure or thermal pressure relief valve resultant pressure, including cascade, conducted with a calibrated pressure gauge, for a duration of not less than four (4) hours. The strength test does not attempt to reconcile pressure change with fuel temperature change as required by the conventional leak test. As a result, low volume leaks may go unrecognized when conducting this test.

G-2.2.12 US Coast Guard Criteria for Marine Pipelines.

Testing of lines under USCG criteria needs to carefully consider required test pressure, and jurisdiction of testing (i.e., how much of system). Testing to 150% of “tanker rail” pressure may not be high enough. USCG rules require consideration of either pump deadhead pressure, safety shutoff, or over pressure thermal relief settings as the basis for the 150% test. Commonly this may result in a test pressure requirement of 225 psig (1550 kPa). Another factor with USCG jurisdiction systems is possible deadhead pressure when pumping to tankers, which may exceed tanker offload pressures, and thus may require a test pressure higher than 225 psig (1550 kPa). The governing worst case scenario may be the dynamic surge possible when outloading with terminal pumps and a pier side emergency stop valve is rapidly closed.

G-2.2.13 Off-Base Systems.

Receipt pipelines from or connected to commercial off-base systems must be tested at a pressure that recognizes deviations or maximum system capability within flange ratings, which are normally much higher than pressures from normal receipt operations. Many off-base pipelines are constructed to ANSI Class 300 standards and connect to ANSI Class 150 systems at the point of pipeline ownership change. Discussions with off-base pipeline operators is important to determine operating characteristics, including pump deadhead pressure, safety shutdown considerations, and protection of lower pressure class piping. Federal regulations (49 CFR 195) mandate that a means of “over pressure prevention” is required if a higher pressure class pipeline is connected to a lower pressure class pipeline.

An overpressure condition can be caused by rapidly closing a Base valve, or startup of a receipt operation against a closed Base valve.

G-2.2.14 Minimum Test Pressure.

The test pressure for all pipelines subject to pump discharge pressure must not be less than 100 psig (689.4 kPa). The test pressure for pump suction lines may be between 50 psig (344.7 kPa) to 100 psig (689.4 kPa).

G-2.2.15 Maximum Test Pressures.

G-2.2.15.1 General Requirements.

Ensure that the flanges are stamped with B16.5, otherwise the flange may not conform to B16.5. Additionally, prior to testing, verify that all the nuts and bolts are properly engaged with sufficient threads past the nut.

G-2.2.15.2 ASME B16.5 Flange Ratings.

Test must not exceed test pressures permitted by ASME B16.5 (Flange Ratings) as follows:

- Carbon Steel, ANSI Class 150: 450 psig (3102.6 kPa)
- Stainless Steel, ANSI Class 150, with 304 or 304/304L flanges: 425 psig (2930.3 kPa)
- Stainless Steel, ANSI Class 150, with 304L flanges: 350 psig (2413.2 kPa)
- Carbon Steel, ANSI Class 300: 1050 psig (7239.5 kPa)
- No ANSI Class Flange: As noted by code authority

G-2.2.16 Service Station Piping.

Service station piping is considered a special case and is discussed in Section G-2.5, with separate criteria for integrity testing.

G-2.2.17 Non-metallic Piping.

Systems containing non-metallic piping such as fiberglass or coaxial flexible systems must be evaluated for pressure rating, or practical pressure limits based on historical failures of these types of piping systems.

G-2.2.18 Small Bore Piping.

Small bore piping, less than 4 inches (100 mm) in diameter, typically leading to and from small fuel tanks should be run aboveground. Inspection of these lines is required per Service Station Piping as discussed in Section G-2.5. Do not remove paint as part of the visual inspection. If the piping is in a containment area, such as a tank dike, the piping is not required to be pressure tested. In addition, if the piping cannot be pressure tested due to no means (tank valve) of isolation, a visual inspection for exterior pipe corrosion will satisfy integrity requirements. //

G-2.3 DEPARTMENT OF DEFENSE (DoD) PETROLEUM FUEL PIPELINES.

G-2.3.1 General.

Consistent with API 570, underground systems should undergo periodic pressure tests above normal operating pressures, whereas fully inspectable aboveground piping should undergo periodic pressure testing at normal operating pressure. Note that the Service Control Points can authorize deviations and alternate equivalent testing methodologies from these criteria. Section G-5 provides a summary of pipeline pressure testing guidelines.

G-2.3.2 On-Base Aboveground Piping Annual Test.

The test pressure for the annual test must not be less than pump deadhead pressure, the pressure resulting from thermal relief valve settings, or 100 psig (689.4 kPa) (whichever is greater) for a duration of two hours minimum. The duration of the test may extend longer to allow time to inspect the entire aboveground piping section being tested. When piping is not subject to pump discharge pressures a minimum test pressure of 100 psig (689.4 kPa) is required for the annual test. The pressure for the annual test may be reduced to 50 psig (344.7 kPa) for systems not subject to pump discharge pressure that contain threaded components. All components undergoing the annual test must be visually inspected for leaking during the test. Addition or withdrawal of fuel during the annual test is permitted due to loss of pressure from valve seat bypass or to prevent overpressure (thermal gain). On-Base aboveground piping does not require a five year test, as long as annual testing is conducted.

G-2.3.3 On-Base Single-Wall Underground Piping Annual Test.

G-2.3.3.1 Pressure Testing Options.

The options to complete the test include:

- a. Annual Option 1: The test pressure for the annual test must not be less than pump deadhead pressure, or the pressure resulting from thermal relief valve settings (whichever is greater) for duration of two hours minimum. Perform accurate pressure and ambient temperature monitoring. All instrumentation should be of sufficient quality to Ensure accurate test data collection. The pressure change, if any, must be within a small range and/or reconciled with fuel temperature change. To minimize the effect of changing temperature, the fuel should be allowed to reach equilibrium, and testing is to occur at time of day with little solar influence or rapid temperature change. The acceptable pressure deviation or pressure change criteria are to be established by the Service Control Point. The allowable pressure change is to be based on installation's location, size of system, and historical testing results.

- b. Annual Option 2: Perform annual test at not less than pump deadhead pressure or the pressure resulting from thermal relief valve settings (whichever is greater), with third-party certified NWGLDE listed leak test. By doing annual third-party certified test at NOT LESS THAN the pump deadhead pressure or the pressure resulting from thermal relief valve settings (whichever is greater), the requirement for a five-year test is waived.

G-2.3.4 On Base Double-Wall Underground Carrier Piping Annual Test.

Test the carrier pipe using piping test methods, as applicable, as described in Section G-2.3.3 ~~V1V1/~~. After testing, confirm that there is no product at all low point locations in the secondary containment system. If the “double wall” system cannot be tested for both pressure integrity and presence of fuel leaks or water intrusion the system must be treated as a single-walled pipe and the requirements listed in section G-2.3.6 for the five-year test must be conducted in addition to the tests required in this section.

G-2.3.5 ~~V1~~ On /1/ Base Double-Walled Underground Containment Piping Test.

Interstitial Breach of Integrity testing must take place at three to five year intervals, depending on regulatory requirements and local practice.

The containment pipe of a double-wall pipe system must have the ability to be checked for leakage thru low point check points. In addition, the annular space between the containment pipe and the carrier pipe must have the ability to be air-tested for the presence of hydrocarbon vapor with a calibrated atmospheric meter. Most secondary containment piping is equipped with test ports at each end and may be equipped with low point drains.

In the event that the pipeline is located in a jurisdiction that requires double wall systems, and the secondary system fails, then the system will be considered out of compliance. The system should then either be repaired or taken out of service.

G-2.3.5.1 Interstitial Breach of Integrity Testing Three-to-Five-Year Test.

Conduct a containment interstitial space breach of integrity test per manufacturer's instructions. This test pressure is normally 5-10 psig (34.4-68.9 kPa) and held for two hours. The test could be a vacuum test if leaks are suspected as a safe alternative. All test equipment should be calibrated and suitable for the low pressure. A failure of the containment pipe test and a successful carrier pipe test would indicate defective end seals (depending on the type of containment piping: i.e.: FRP, SS, CS, etc.) or a breach in the wall of the containment pipe. The acceptable pressure deviation or pressure change criterion is 0%.

G-2.3.6 On Base Single-Wall Underground Piping Five-Year Test.

G-2.3.6.1 Test Pressure.

The test pressure for the five-year pressure test must be 150% of pump deadhead pressure minimum (including elevation difference from base of tank to pump plus full tank fuel level). Preferably, perform a pump deadhead test to confirm peak pressure, and adjust for fuel level in tank. Reasonable consideration should be taken to assure that selected test pressure is not less than 110% of pressures resulting from thermal pressure relief valve settings, which may be much higher than pump deadhead pressure (such as Type III Hydrant Systems).

G-2.3.6.2 Pressure Testing Options.

The options to complete the test include:

- a. Five-year Option 1: Perform a strength test and conventional leak test at not less than 150% of pump deadhead or at 110% of the pressure resulting from thermal relief valve settings (whichever is greater). The testing must be executed by a qualified individual/organization experienced with using procedures meeting API 1110 procedures and performing pressure/temperature compensation calculations. Test duration must be a minimum of four hours for the strength test and four hours for the conventional leak test. The conventional leak test must immediately follow the strength test. A thorough visual inspection during the strength test should identify leaking flanges, instrument fittings, relief lines, valve stems, valve seats, etc. These deficiencies should be corrected prior to the conventional leak test by removing the components, installing flange skillets, plugging, or other methods of isolation or repair.
- b. Five-year Option 2A: Perform a four hour strength test at not less than 150% of pump deadhead pressure or 110% of the pressure resulting from thermal relief valve settings (whichever is greater), and monitor calibrated gauges for potential leak causing pressure decay. Immediately follow the strength test by a third-party certified NWGLDE listed leak test at a pressure consistent with the certification of the system, and optimum for testing (generally 120 psig (827.4 kPa) to 150 psig (1034.1 kPa)).
- c. Five-year Option 2B: Pressurized to the test pressure, and hold the pressure for two hours prior to a third-party certified test. Next, perform a third-party certified NWGLDE listed leak test at a pressure not less than 150 % of pump deadhead pressure or 110% of the pressure resulting from thermal relief valve settings (whichever is greater).

If the pipeline has been tested ANNUALLY by a third-party certified test at a pressure NOT LESS THAN pump deadhead pressure or the pressure resulting from thermal relief valve settings (whichever is greater), the requirement for a five-year test is waived.

G-2.3.7 Third Party Certified “Leak Detection” Systems.

Monthly testing with permanently installed proprietary vendor third-party certified “leak detection” systems that have received listing by the NWGLDE organization can be substituted for on base underground single-walled piping five year test as noted in Sections G-2.3.6.2(e) and G-2.3.3.1(b). Test must be conducted at NOT LESS THAN the pump deadhead pressure or the pressure resulting from thermal relief valve settings (whichever is greater). These systems are required to receive annual re-certification by the equipment vendor.

G-2.3.8 Off-Base Transfer or Supply Pipeline Annual Test.

An engineering assessment must be made to determine appropriate annual test pressure. In most cases, provide annual pump deadhead pressure test as noted for on-base pipeline systems in Section G-2.3.3, so long as flange ratings are not exceeded. Note that this will result in portion of the piping on longer pipelines being subject to test pressures considerably higher than normal operating pressures and thus is most appropriate when the system is constructed as an ANSI Class 150 system with a maximum allowable operating pressure of 275 psig (1896.1 kPa), and maximum test pressure of 450 psig (3102.6 kPa). For systems of higher ANSI pressure class construction and operating characteristics, a testing program must be developed and consider actual operating pressures along the pipeline, type of development along pipeline, age of system, history of cathodic protection, results from in-line intelligent pigging program and test liquid (fuel or water).

G-2.3.9 Off-Base Transfer or Supply Pipeline Five Year Test.

An engineering assessment must be made to determine appropriate five-year test pressure, or equivalent means of integrity management. Perform five-year test regime as follows:

- a. Provide five-year strength and conventional leak test at a pressure higher than operating conditions **only** when required by state or Federal regulations or Service Control Point. Particular attention needs to be given to actual test pressures based on pipeline pumping operations, elevation changes along the pipeline, surge potential and type of development and population density along the pipeline. Test media (water or fuel) must be determined in accordance with regulatory and criteria documents. Testing with fuel is the preferred method.
- b. Test methods as noted in Section G-2.3.6 for on-base pipeline systems can be considered, and must be coordinated with the Federal, state, and local regulations, and the Service Control Point.
- c. For piggable off base pipelines, the use of in-line intelligent pigging on periodic basis (10 years maximum) to monitor corrosion and mechanical damage can significantly improve integrity management and eliminate the

need for a 5-year pressure test regime, except when required by state or local regulatory body. Note that a written integrity management plan using in-line intelligent pigging has resulted in some regulatory bodies waiving the need for a 150% pump deadhead pressure test.

- d. Note that under 49 CFR 195.452, if a pipeline is located in a “High Consequence Area,” use of intelligent pigging on a five year increment is mandatory, (when the pipeline is considered regulated) and recommended otherwise, as a powerful threat assessment approach. The five year smart pigging interval will satisfy the need to perform a five-year pressure test, and has the added advantage of not resulting in testing of a pipeline with fuel at pressures far above normal operating pressure.

G-2.4 MARINE PIPELINES.

This section applies to areas under direct United States Coast Guard (USCG) jurisdiction, and Outside Continental United States (OCONUS) Installations with over-the-water fuel transfers.

G-2.4.1 33 CFR 154 and 33 CFR 156.

Marine facilities (or installation components that fall under marine conditions) must be tested in accordance with USCG regulations 33 CFR 154 and 33 CFR 156.

G-2.4.2 Piping Over Water.

Piping over water and not having a secondary containment system should consider testing with water when testing is above the maximum normal operating pressure. Pressure testing at maximum normal operating pressure may be with fuel. Where testing with fuel the use of spill containment booms around the test area is encouraged.

G-2.4.3 Tanker Offload Pressure.

The test pressure for the annual pressure test must be not be less than 150% of maximum delivery tanker pressure at the tanker rail before loading arm or hose, taking into consideration the pressure relief valve setting or high pressure cut off switch setting. It is recommended that the test pressure be not less than 225 psig (1551.3 kPa) based on most tankers’ shutdown pressure setting of 150 psig (1034.1 kPa).

G-2.4.4 Barge Offload Pressure.

The test pressure for the annual pressure test must not be less than 150% of maximum delivery barge pressure at the barge rail before loading arm or hose, taking into consideration the pressure relief valve setting or high pressure cut off switch setting. It is recommended that the test pressure be not less than 175 psig (1206.6 kPa) based on most barges’ shutdown pressure setting of 115 psig (792.9 kPa).

G-2.4.5 Issue Pressure.

When issuing to tankers and barges is possible, issue test pressure must be evaluated. The issue test pressure must consider the deadhead pressure of installation pumps, the static elevation difference, and the dynamic surge caused by pier emergency stop valves. It is possible for the issue test pressure to exceed the tanker/barge offload test pressure. When such conditions exist, use the issue test pressure for all piping, loading arm and hoses up to the point of connection to the receiving tanker/barge.

G-2.4.6 Aboveground Marine Piping Annual Test.

The test pressure for the annual pressure test must be derived from paragraphs G-2.4.3, G-2.4.4 and G-2.4.5 for duration of two hours minimum. All components must be visually inspected for leaking. Addition or withdrawal of fuel during testing is permitted due to loss of pressure from valve seat bypass or to prevent overpressure (thermal gain). Addition or withdrawal of fuel during testing is only permitted if entire system is aboveground. If any portion of the piping is underground and cannot be visually inspected, underground pipeline testing procedures must apply.

G-2.4.7 Underground Marine Piping Annual Test.

The options to complete the test include:

- a. Annual Option 1: Perform a strength test and conventional leak test at a pressure derived from paragraphs G-2.4.3, G-2.4.4, or G-2.4.5 as appropriate. The testing must be executed by a qualified individual/organization experienced using procedures meeting API 1110 procedures and performing pressure/temperature compensation calculations. Test duration must be a minimum of four hours for the strength test and four hours for the conventional leak test. The leak test must immediately follow the strength test. A thorough visual inspection during the strength test should identify leaking flanges, instrument fittings, relief lines, valve stems, valve seats, etc. These deficiencies should be corrected prior to the conventional leak test by removing the components, installing flange skilllets, plugging, or other methods of isolation or repair.
- b. Annual Option 2: Conduct a two hour pressure soak at a pressure derived in paragraphs G-2.4.3, G-2.4.4, or G-2.4.5 as appropriate, and monitor calibrated gauges for potential leak causing pressure decay, followed by third-party certified NWGLDE listed leak test, at the same pressure, with the permission of the USCG Captain of the Port (COTP). Note: During a pressure soak, the tester blocks in the pressure and does not allow for volume change. During the test, pressure is relieved to prevent over-pressurizing if required.

G-2.5 SERVICE STATION PIPELINES.

G-2.5.1 General Requirements.

Due to the multiple types of piping system materials, single or double-wall pipe, piping components (line leak detectors, leak detection systems), fiberglass and coaxial piping, small bore piping (2 inch and less) and low operating pressures (less than 50 psig (344.7 kPa)), the annual and 5-year testing requirements as described in Section G-2.3 do not translate well for this type of system. Wherever possible, the requirements of state or host nation rules must be utilized to satisfy pipe integrity investigation to maintain consistency on regulated tank and connected piping installations. When specific state or host nation rules are lacking, the piping integrity must be considered. The use of a third-party certified NWGLDE listed leak test (see NWGLDE website, many vendors and systems are approved) may be appropriate. Even when tanks are aboveground, if underground piping is used to service dispensers, the use of a NWGLDE vendor and procedure is still appropriate.

G-2.5.2 Service Station Aboveground Piping Annual Test.

The test pressure for the annual pressure test must be not less than pump deadhead pressure for duration of two hours minimum. All components must be visually inspected for leaking. Addition or withdrawal of fuel during testing is permitted due to loss of pressure from valve seat bypass or to prevent overpressure (thermal gain). Note that in very small systems receiving fuel from delivery vehicle pump, observation of the receipt line under pressure is sufficient when there is no means (tank valve) to otherwise test the receipt line. When a small system consists of a suction withdrawal from the tank, with closely positioned dispenser with pump, and the suction line cannot be tested when there is no means (tank valve) of isolation, a visual inspection for exterior pipe corrosion will satisfy integrity requirements.

G-2.5.3 Service Station Underground Piping Annual Test.

The test pressure for the annual pressure test must be not less than pump deadhead pressure for duration of two hours minimum unless being tested in combination with an attached UST. The test procedure must be as required and approved by the host nation, state or local regulatory jurisdiction.

G-2.5.4 Service Station Combined Aboveground and Underground Annual Test.

When testing aboveground and underground piping together due to configuration of system, use of a third-party certified and NWGLDE procedure is encouraged, or utilizes a pump deadhead pressure test only when the underground piping is in secondary containment. The test must include a check of secondary containment for fuel after the pressure test.

G-3 CRITICAL TERM DEFINITION.

G-3.1 Introduction.

This section provides guidance on the definition of terms normally used in developing pressure testing documentation. Several of the guidance/criteria documents use poorly defined terms. Table G-3.1 summarizes what can be determined or inferred from the available information. Unfortunately, mixing the definition of the terms, or applying them too loosely may result in inappropriate conclusion

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Table G-2 /1/ Definition of Terms

Item	Term	Abbreviation For	Definition and Commentary
A	MOP, MAOP	“Colloquial version” Maximum Operating Pressure, or Maximum Allowable Operating Pressure	Must be the worst case sustained internal pressure under the worst combination of internal and external pressure at a given point on a pipeline, and must consider deadhead of pumping, static head, and resultant pressure from thermal relief conditions (and cascade). Some exceptions apply depending on frequency and duration. Pressure must be supported by a qualifying hydrostatic test at 125% (B31.4) or 150% (B31.3). Does not include transient pressure, such as a surge event, which can exceed (to a limit) MOP under many codes.
B	MAWP	Maximum Allowable Working Pressure API 570 §3.1.49	“The maximum internal pressure permitted in the piping system for continued operation at the most severe condition of coincident internal or external pressure and temperature (minimum or maximum) expected during service. It is the same as the design pressure, as defined in ASME B31.3 and other code sections, and is subject to the same rules relating to allowances for variations of pressure or temperature or both.”
C	NOP	“Colloquial version” Normal Operating Pressure	Generally considered the pressure of dynamic operations, such as the pressure gauge on a pump discharge, or the pressure at any point on a pipeline taking into consideration elevation and pressure gradient.
D		From ASME B31.4 § 400.2	“ <i>internal design pressure</i> : internal pressure used in calculations or analysis for pressure design of a piping component (see para. 4-1.2.2): Comment: Internal design pressure must be not less than maximum steady state operating pressure.
E	MOP	Maximum Operating Pressure defined under 40 CFR 195 § 195.2	“ <i>Maximum operating pressure (MOP)</i> means the maximum pressure at which a pipeline or segment of a pipeline may be normally operated under this part.” (Similar to ASME B31.4 definition for NOP)

Item	Term	Abbreviation For	Definition and Commentary
F	NOP	NOP from ASME B31.4 § 400.2	<i>"maximum steady state operating pressure:</i> Maximum pressure (sum of static head pressure, pressure required to overcome friction losses, and any back pressure) at any point in a piping system when the system is operating under steady state conditions.
G	MAWP	Maximum Allowable Working Pressure 33 CFR 154.500	"(b) The maximum allowable working pressure (MAWP) for each hose assembly must be more than the sum of the pressure of the relief valve setting (or the maximum pump pressure when no relief valve is installed) plus the static head pressure of the transfer system, at the
H		design pressure API 570 § 3.1.18	"The pressure at the most severe condition of coincident internal or external pressure and temperature (minimum or maximum) expected during service."
I		overwater piping API 570 § 3.1.60	"Piping located where leakage (liquid or solids) would result in discharge into streams, rivers, bays, etc., resulting in a potential environmental incident." <i>(Note, does not require pipe to be physically over the water)</i>

G-4 CRITERIA SURROUNDING PIPELINE PRESSURE TESTING.

G-4.1 INTRODUCTION.

This section provides the current criteria for pipeline pressure testing and the discussion of its applicability to the Department of Defense POL pipelines and methods of testing and determination for integrity assessment. Tables G-4.1 and G-4.2 lists the criteria and provides a discussion of its applicability to the guidelines stated in Section G-2.

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Table G-2 /1/ Military Requirements

Item		Issue - Parameter	Testing Requirement															
i	1	Testing Requirement – UFGS 33 52 43	<p>UFGS Specification Section 33 52 43 “Aviation Fuel Distribution Systems,” May 2011. This specification is to be used for new piping or major renovated piping systems. Extract of pressure testing requirements follows:</p> <p>3.2.2.4 Hydrostatic Test</p> <p>Hydrostatically test product piping with the system operating fuel. Test at the corresponding pressures identified in Table 2 for the corresponding product piping material type. Maintain the pressure within the piping for 4 hours with no leakage or reduction in gauge pressure. If leaks are discovered, repair the leaks accordingly and retest.</p> <p style="text-align: center;">Table 2. Hydrostatic Test Pressures</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Product Piping Material Type</th> <th style="text-align: center;">Min Test Pressure</th> <th style="text-align: center;">Max Test Pressure</th> </tr> </thead> <tbody> <tr> <td>Carbon Steel</td> <td style="text-align: center;">2930 kPa 425 psig</td> <td style="text-align: center;">3103 kPa 450 psig</td> </tr> <tr> <td>Stainless Steel (1)</td> <td style="text-align: center;">2758 kPa 400 psig</td> <td style="text-align: center;">2930 kPa 425 psig</td> </tr> <tr> <td>Stainless Steel (2)</td> <td style="text-align: center;">2241 kPa 325 psig</td> <td style="text-align: center;">2413 kPa 350 psig</td> </tr> <tr> <td>Aluminum</td> <td style="text-align: center;">1724 kPa 250 psig</td> <td style="text-align: center;">1896 kPa 275 psig</td> </tr> </tbody> </table> <p>Notes: 1. Grade F304 Flanges Used 2. Grade F304L Flanges Used</p>	Product Piping Material Type	Min Test Pressure	Max Test Pressure	Carbon Steel	2930 kPa 425 psig	3103 kPa 450 psig	Stainless Steel (1)	2758 kPa 400 psig	2930 kPa 425 psig	Stainless Steel (2)	2241 kPa 325 psig	2413 kPa 350 psig	Aluminum	1724 kPa 250 psig	1896 kPa 275 psig
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Aluminum	1724 kPa 250 psig	1896 kPa 275 psig																
	2	Waivers and Deviations to Criteria	The Air Force, Army, and Navy Criteria specialists (Service HQ) are able to grant waivers or deviations.															
	3	Comment and Recommendation	<p>Pressures stated in the UFGS were derived from ASME B16.5. Water can be used and easily disposed of if the piping is new and no part of it has ever had fuel in it, and it can be thoroughly drained from the pipeline.</p> <p>ASTM B31.3 permits testing with fuels having a flash point of 120 °F (48.9 °C). Testing with fuel is acceptable in special cases (i.e., when draining of water is not obtainable). Obtain waiver for testing with JP-8 (100° minimum flash point) when needed.</p>															

Notes:

1. Pump deadhead pressure is the maximum pressure at no flow with fuel level at or near high condition in source tank. For the purposes of the pressure determination, do not use normal operating pressure. Dead head pressure is normally 10% to 25% above normal operating pressure. Determine deadhead pressure by starting pump and slowly closing discharge valve and reading the maximum discharge pressure. Do not operate at no flow for more than a minute.
2. Most thermal pressure relief valves associated with pump discharge piping in the pumphouse in particular must be set above pump deadhead otherwise they would discharge every time the pump deadheads. Normally they should be set a minimum of 10% above system deadhead pressure. If system testing is only to pump deadhead, it is not as high as the relief valve settings. For annual testing this is generally considered acceptable. For periodic integrity testing (i.e. five-year test), the test pressure should exceed the thermal relief valve pressure, in order to provide a valid strength test. This is the case with a five-year test at 150% of pump

deadhead. As thermal relief most likely is 10%-20% above pump deadhead, a test at 150% above deadhead will be above peak pressure of thermal relief valves.

3. ANSI Class 150 systems may be tested to the limit of flanges, per ASME B16.5 as follows:

Pipe Class and Material	Maximum Operating Pressure	Maximum Test Pressure
Class 150 Carbon Steel	285 psig 1965.0 kPa	450 psig 2102.6 kPa
Class 150 Stainless Steel (with 304 or 304/304L flanges)	275 psig 1896.1 kPa	425 psig 2930.3 kPa
Class 150 Stainless Steel (with 304L flanges)	230 psig 1585.8 kPa	350 psig 2413.2 kPa

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Table G-3 /1/ Commercial and Industrial Guidelines

ITEM	ISSUE - PARAMETER	TESTING REQUIREMENT
A	1	Testing protocol & Requirement – API 570
	2	Test Pressure Criteria and duration- aboveground piping.
	3	Test Pressure Criteria, modified systems
	4	Pressure Testing Alternatives
		<p>API 570 Piping Inspection Code, Third Edition (11-2009)</p> <p>The majority of API 570 addresses aboveground piping. API 570 5.8 states "Pressure tests are not normally conducted as a part of routine inspection", but when performed, must be completed in accordance with ASME B31.3 requirements.</p> <p>8.2.7 covers pressure testing after making system repairs or modifications that include welding of the pipe, in accordance with ¶5.8. When pressure testing is not practical, certain NDE steps may be substituted for the pressure test so long as other installation requirements are met.</p> <p>5.8.5 Addresses special cases: "Appropriate NDE must be specified and conducted when a pressure test is not performed after a major repair or alteration. Substituting NDE procedures for a pressure test after an alteration is allowed only after the engineer and inspector have approved the substitution. For cases where UT is substituted for radiographic inspection, the owner/user must specify industry-qualified UT shear wave examiners or the application of ASME B31 Code Case 179/181, as applicable, for closure welds that have not been pressure tested and for welding repairs identified by the engineer or inspector.</p>

ITEM	ISSUE - PARAMETER	TESTING REQUIREMENT								
5	Test Pressure Criteria and duration- underground piping (Section 9 specifically deals with underground piping)	<p>9.3.7 Indicates that a pressure test may be used as an integrity management tool in lieu of other methods. The pressure test is a leak test at not less than 110% of the maximum operating pressure, at an interval shown in Table 9-1 for a cathodically protected system and at ½ the interval for an underground system that is not cathodically protected.</p> <p>The test must be 8 hours in duration, with the first 4 hours to stress the system, and the last 4 hours being the actual data collection period.</p> <p>If the pressure drops more than 5% over the course of the test, an investigation must be conducted, including internal and external evaluation of corrosion.</p>								
6	Comment:	Table 5 below is primarily the intervals indicated for smart pigging or direct excavation, when deemed important for determining integrity of system, but is also used for the intervals for pressure testing as noted above.								
7	Table 5 from API 570	<p>Table 5—Frequency of Inspection for Buried Piping Without Effective Cathodic Protection</p> <table border="1" data-bbox="820 856 1304 995"> <thead> <tr> <th>Soil Resistivity (ohm-cm)</th> <th>Inspection Interval (years)</th> </tr> </thead> <tbody> <tr> <td><2,000</td> <td>five</td> </tr> <tr> <td>2000 to 10,000</td> <td>10</td> </tr> <tr> <td>>10,000</td> <td>15</td> </tr> </tbody> </table>	Soil Resistivity (ohm-cm)	Inspection Interval (years)	<2,000	five	2000 to 10,000	10	>10,000	15
Soil Resistivity (ohm-cm)	Inspection Interval (years)									
<2,000	five									
2000 to 10,000	10									
>10,000	15									
8		API 570 9.3.7 also recognizes the use of other testing procedures including temperature corrected volumetric, pressure, and addition of a tracer inoculant.								
9	Comment and Interpretation	<p>API 570 supports the premise that a leak, pressure or hydrostatic test provides satisfactory investigation into the integrity of underground piping. Note that API 2611 (draft) calls for 150% testing of MOP, not 110% of MOP as in API 570. This may be a result of pressure testing of terminal piping that may not be done to a standard as high as in a refinery.</p> <p>Lacking other evidence (such as leak history) or direct knowledge on pipe surface condition from excavation or smart pigging, use of pressure/leak testing is the appropriate degree of investigation necessary. Use of smart pigging, LRUT, or excavation is not a mandatory API requirement. As API 570 does not clearly identify what is “maximum operating pressure”. This document defines it to be the greater of maximum system deadhead, or thermal relief valve setting.</p>								
10	Test Fluid	5.8.1 states that test fluid must be water, unless damage may occur due to freezing, or unless contamination presents unacceptable environmental risk. If tested with fuel, the flash point must be 120 °F (48.9 °C) or greater.								

ITEM		ISSUE - PARAMETER	TESTING REQUIREMENT
	11	Comment and Interpretation	<p>JP-8 (100 °F (37.8 °C) flash point) is regularly used in the military for pipeline pressure and hydrotesting due to the greater risk of product contamination from testing with water. JP-5 (140 °F (60 °C) flash point) meets the criteria. The military has accepted the risk of using JP-8 for testing.</p> <p>Need to confirm state requirements as well to see if a waiver is needed. Some states, such as CA, mandate water but have permitted using JP-5 on some tests.</p>
B	1	Testing protocol & Requirement – API RP 2611	<p>API RP 2611 1st Edition, June 01, 2011, <i>Terminal Piping Inspection – Inspection of In-Service Terminal Piping Systems</i>. <i>Note, the document is in response to the industry needing a companion to API 570 that better reflects operating conditions, risk and consequence of terminal operations, as compared to refinery operations covered under API 570.</i></p>
	2	Test Pressure Criteria and duration- aboveground piping.	<p>API RP 2611 5.5.5 states that leak testing is not a stand-alone integrity test, but should be performed in conjunction with other integrity tests such as corrosion under insulation and wall thickness analysis.</p>
	3	Test Pressure Criteria and duration - underground piping.	<p>§ 7 addresses the overall assessment of underground piping and stresses use of both knowledge of the age and history of a system, cathodic testing and coating testing procedures, but does not specifically call for pressure testing. However pressure testing is noted as a viable means of integrity assessment, with little stated on its pressure levels or duration. The frequency of testing is dependent on a variety of factors noted, and ranges from 5 to 25 years.</p>
	4	Frequency of Inspection	<p>Table 6-1 in API RP 2611 is primarily the intervals indicated for smart pigging or direct excavation, when deemed important for determining integrity of system, but is also used for the intervals for pressure testing as noted.</p>
	5	Comment and interpretation	<ul style="list-style-type: none"> • API RP 2611 supports the premise that a leak, pressure or hydrostatic test provides satisfactory investigation into the integrity of underground piping. • Lacking other evidence (such as leak history) or direct knowledge on pipe surface condition from excavation, use of pressure/leak testing is an appropriate degree of investigation necessary. Use of smart pigging, Long-Range Ultrasonic testing (LRUT), or excavation is not a mandatory API requirement. <p>As API RP 2611 does not clearly identify what is “maximum operating pressure”. This document defines it to be the greater of maximum system deadhead, or thermal relief valve setting.</p>
C	1	Testing protocol & Requirement -ASME B31.3	<p>ASME B31.3 Process Piping, 2012</p>

ITEM	ISSUE - PARAMETER	TESTING REQUIREMENT
2	Test Pressure Criteria and Duration	<p>345.4.2 states that pipe must be tested to not less than 1.5 times the maximum design pressure. "Design Pressure is the most severe combination of internal and external pressure expected during service" (ASME B31.3 Par 301.2.1).</p> <p>Note that the test pressure is limited to the maximum rating for flange testing per ASTM B16.5, Flanges. Per 345.2.2, the minimum test duration for examination of connections and joints is 10 minutes. Most systems will take longer to physically inspect. 345.2.1 (b) permits the use of a pneumatic test at up to 25 psig (172.4 kPa) to find major leaks, prior to the liquid hydrotesting.</p>
3	Comment and Interpretation	<p>ASME B31.3 was written for new piping installation into a new, or modified system. It was not written for periodic integrity testing. Several codes, such as API 570, reference ASME B31.3 as the governing document for pressure testing in certain circumstances.</p>
4	Test Fluid	<p>345.4.1 states that test fluid must be water, unless damage may occur due to freezing, or unless contamination presents unacceptable environmental risk. If tested with fuel, the flash point must be 120 °F (48.9 °C) or greater.</p>
5	Comment and Interpretation	<p>JP-8 (100 °F (37.8 °C) flash point) is regularly used in the military for pipeline pressure and hydrotesting due to the greater risk of product contamination from testing with water. JP-5 (140 °F (60 °C) flash point) meets the criteria.</p>
6	Closure Weld Testing	<p>345.2.3 Addresses testing of closure welds (tie-in welds). So long as the components/piping being installed into the system have been pre- tested, the final closure or tie-in weld need not be leak tested provided the weld is examined in-process in accordance with 344.7 and passes with 100% radiography or 100% ultrasonic examination in accordance with 344.6.</p>
7	Comment and Interpretation	<p>This paragraph is important as it validates not hydrotesting an existing system, when a change or repair is made, so long as more rigorous examinations are made of the tie-in weld, and the new components are pretested.</p>
8	Testing of Vessels and piping together	<p>345.4.3 addresses the testing of vessels and pipe together so long as the following is met:</p> <p>If the test pressure of the pipe is equal or less than test pressure of the vessel, testing to the piping test pressure is permitted.</p> <p>If the test pressure of the pipe exceeds the test pressure of the vessel, combined testing is permitted at the vessel test pressure, provided the owner approves of the reduced test pressure, and the pressure is not less than 77% of the piping test pressure calculated in accordance with 345.4.2(b)</p>
9	Comment and Interpretation	<p>Testing together simplifies many testing scenarios.</p>

ITEM		ISSUE - PARAMETER	TESTING REQUIREMENT
D	1	Testing protocol & Requirement - ASME B31.4	ASME B31.4 Pipeline Transportation for Liquid Hydrocarbons – 2012 Although commonly applied to cross country pipelines, ASME B31.4 can also be applied to connected terminals, in lieu of ASME B31.3, although there is no particular advantage in doing so.
	2	Test Pressure Criteria and duration	<p>437.4.1 states that piping systems operated at a hoop stress of more than 20% of Specified Minimum Yield Strength (SMYS) must be proof tested to not less than 1.25 times the internal design pressure at that point per 401.2.2. The test duration is not less than 4 hours.</p> <p>401.2.2 "Internal Design Pressure" is not less than the steady state operating pressure at that location, or static pressure when higher.</p> <p>Per 437.4.1(2) if the line undergoing testing is not fully inspectable for leaks, the proof test must be followed by a leak test at not less than 1.10 times the internal design pressure, for not less than an additional 4 hours.</p>
	3	Comment and Interpretation	This piping code was written for long transportation pipelines with potential large grade and hydraulic grade changes. Once placed in operation these lines have a greater predictable operating pressure range, thus the less conservative 1.25 test as compared to ASME B31.3 with a 1.5 times pressure test.
	4	Test Fluid	<p>437.1.1(c) Test fluid must be water, except liquid petroleum that does not vaporize rapidly may be used provided:</p> <p>The pipeline is outside of a city and populated area, and is not underwater.</p> <p>All buildings within 300 ft (91.5 meters) of the pipeline are unoccupied during the test when the pressure produces a hoop stress exceeding 50% of SMYS.</p>
	5	Comment and Interpretation	JP-8 (100 °F (37.8 °C) flash point) meets the criteria of permissible petroleum for testing.
	6	Tie-in Weld Testing	437.1.4 Addresses testing of closure welds (tie-in welds). So long as the components/piping being installed into the system have been pre-tested, the final closure or tie-in weld need not be leak tested provided the weld is examined in- process and passes with 100% radiography or 100% ultrasonic examination in accordance with 434.8.5(a)(4).
	7	Comment and Interpretation	This paragraph is important as it validates not hydrotesting an existing system, when a change or repair is made, so long as more rigorous examinations are made of the tie-in weld, and the new components are pretested.
E	1	Testing Protocol & Requirement - 49 CFR 195	Subpart E – Pressure Testing

ITEM		ISSUE - PARAMETER	TESTING REQUIREMENT
	2	Test Pressure Criteria and duration	§ 195.304 "...maintain for 4 hours at a pressure equal to 125%, or more, of the operating pressure and, in the case of a pipeline that is not visually inspected for leakage during the test for at least an additional 4 continuous hours at a pressure equal to 110% or more, of the maximum operating pressure . (Nov. 4, 1998).
	3	Comment and Interpretation	<p>"Maximum Operating Pressure is defined in § 195.2 "Definitions" as: <i>Maximum operating pressure (MOP)</i> means the maximum pressure at which a pipeline or segment of a pipeline may be normally operated under this part.</p> <p>B31.4 uses the term "maximum internal design pressure" as the basis for design, as well as the starting point for the 125% test pressure.</p> <p>B31.4 further states that the maximum internal design pressure must not be less than the steady state operating pressure at any point on a pipeline.</p> <p>Taking the above into consideration, the design engineer may use steady state operating pressure or deadhead pressure as the basis for the 125% pressure test. Presumably, if the steady state pressure is used, there must be operational controls that are failsafe in not permitting a pipeline to deadhead at a higher pressure than steady state pressure.</p> <p>For typical short military pipelines this report recommends using deadhead as the basis for any pressure testing due to any means of preventing a dead head (such as startup) is an unrealistic expectation.</p>
	4	Test Fluid	§195.306 Requires water to be used for testing but permits the use of a flammable liquid if the pipeline is not offshore and is outside of cities and populated areas, the fluid does not rapidly vaporize, and if the test pressure results in a hoop stress greater than 50% of SMYS, all buildings must be unoccupied within 300 feet (91 meters) of the pipeline under test, and there is continuous communication along the entire test section.
	5	Comment and Interpretation	The use of water and fuel as a test medium is similar in nature to ASME B31.3, except an actual flash point of the fuel is not noted.
F	1	Testing protocol & Requirement - 33CFR Part 154 and Part 156	33 CFR Part 154 Facilities Transferring Oil or Hazardous Material in Bulk 33 CFR Part 156 Oil and Hazardous Material Transfer Operations (i.e., USCG regulations for ports)
	2	Test Pressure Criteria and duration- aboveground piping and equipment.	<p>§156.170, Equipment Tests and Inspections, (c)(iii) requires that hose and loading arms not burst at 1½ times the Maximum Allowable Working Pressure (MAWP).</p> <p>The Operations Manual must indicate per §154.310(a)(16) "The maximum allowable working pressure (MAWP) of each loading arm, transfer pipe hose assembly required to be tested by §156.170 of this chapter, including the maximum relief valve setting (or maximum system pressure when relief valves are not provided) for each transfer system."</p>

ITEM	ISSUE - PARAMETER	TESTING REQUIREMENT
3	Test Pressure Criteria and duration-	§156.170 (f)(1) Requires the tests to have been accomplished within the last 12 months prior to a transfer ¶(h) permits alternative compliance testing when approved by the Captain of the Port (COTP). §154.105 "Definitions" defines "Marine Transfer Area" to be the part of the waterfront area between the vessel and the first valve inside a containment required by 40 CFR 112 or 49 CFR 195, or if no containment area, to the valve on the receiving tank.
4	Comment and Interpretation	<p>The requirements for testing of piping and systems under USCG jurisdiction is not clear, and requires a read of various sections as noted above.</p> <p>Traditionally the maximum over the water transfer pressure is limited to 150 psig (1034.1 kPa) by agreement or mandate of the COTP. This does vary.</p> <p>Traditionally the maximum over the water transfer pressure at government facilities is 100 psig (689.4 kPa). This has been attributed to tradition or in some cases, the contract maximum under the MSLC tanker contracts, but has not been verifiable.</p> <p>Traditionally the required test pressure in many ports has been 150 psig x 150% = 225 psig (1034.1 kPa x 150% = 1551.3 kPa). This however can be deficient when a variety of factors and system features could lead to a higher surge pressure that is within the capability of a properly tested ANSI Class 150 system.</p> <p>It is clear testing is required annually.</p> <p>It is not clear what the duration or test standard requirement is.</p> <p>Traditionally the test is for one hour, with procedures left up to the local region and owner.</p> <p>Consideration must be given to issue to ships and barges operations having higher deadhead conditions than a delivery tanker, thus hydrotesting must be accomplished to a higher pressure.</p>
5	Test Fluid	§156.170 (c)(iv) The test medium does not need to be water.
6	Comment and Interpretation	This paragraph is discussing the testing of hoses, which is normally done above deck, within a contained area, thus testing with fuel is possible if deemed appropriate. This paragraph should not be considered a justification to test over the water piping with fuel. That decision is best made based on the risk of failure and consequential spill to the water.

G-5 PIPELINE PRESSURE TESTING GUIDELINES AND CRITERIA SUMMARY TABLE

Pipeline Pressure Testing Guidelines and Criteria SUMMARY TABLE				
Pipe Location/Test	Basis of Test Pressure	Duration	Type of Testing	Comments
USCG/Marine Service, Over water/aboveground - Annual Pressure Test	150% of highest delivery pressure (relief valve or pressure switch)	2 hr	100% observation for leaks (1)	225 psig (1551.3 kPa) test suggested in most cases (based on tankers with 150 psig (1034.1 kPa) relief/shutdown) or 175 psig (1206.6 kPa) (based on barges with 115 psig (792.9 kPa) relief/shutdown). Also, the issue pressure must be calculated as this pressure may exceed offload pressures.
USCG/Marine Service, Underground - Annual Pressure Test	150% of highest delivery pressure (relief valve or pressure switch)	2 hr (min)	Accurate pressure monitor, reconcile temperature-pressure change (2) 5-year Option 1 testing meets criteria. 5-year Option 2B acceptable with permission of the USCG COTP	225 psig (1551.3 kPa) test suggested in most cases (based on tankers with 150 psig (1034.1 kPa) relief/shutdown) or 175 psig (1206.6 kPa) (based on barges with 115 psig (792.9 kPa) relief/shutdown). Also, the issue pressure must be calculated as this pressure may exceed offload pressures.
Base Piping, Aboveground - Annual	Greater of pump deadhead, or PSV setting/cascade	2 hr	100% observation for leaks (1)	Suggest not less than 50-100 psig (344.7-689.4 kPa) for pump suction lines not subject to discharge pressure.
Base Piping, Underground - Annual (Annual Option 1)	Greater of pump deadhead, or PSV setting/cascade	2 hr (min)	Accurate pressure monitoring, pressure change, if any, must be within small range and or reconciled with fuel temperature change (2)	To minimize effect of changing temperature, fuel should be allowed to reach equilibrium, and testing occur at time of day with little solar influence or rapid temperature change.
Base Piping, Underground - Annual (Annual Option 2)	Test at greater of deadhead or PSV setting/cascade using third-party certified procedure	Per certs	Third-party certified and NWGLDE listed and DLA-E approved procedure (6)	If conducted every year this procedure, with lower pressure testing also satisfies the 5-year 150% testing requirement.
Base Piping, Double Wall Underground – Annual (with air testable and low point checking secondary containment capability) (8)	Test carrier pipe using USCG or non-USCG annual piping (as applicable)	Per above	Per above procedure selected	After testing, confirm no product at all low points in secondary containment system. Every 5 years provide secondary containment integrity test per manufacturer's instructions, normally a 2 hour 10-15 psig (68.9-103.4 kPa) test.
Base Piping, Underground - (5-year Option 1)	Greater of 150% of deadhead or 110% of PSV setting/cascade	8 hr	Precision temperature and pressure measurement and reconciliation of temperature-pressure change (3)	Minimum 4 hour analysis period over test cycle.
Base Piping, Underground - (5-year Option 2A)	Strength test at greater of 150% of deadhead or 110% of PSV setting/cascade, followed by third-party certified leak test	4 hr strength	Strength (4) Leak – Third-party certified and NWGLDE listed (5)	Acceptable even when 150% strength test pressure is above leak test pressure.

Pipeline Pressure Testing Guidelines and Criteria				
SUMMARY TABLE				
Pipe Location/Test	Basis of Test Pressure	Duration	Type of Testing	Comments
Base Piping, Underground - (5-year Option 2B)	Test at greater of 150% of deadhead or 110% of PSV setting/cascade using third-party certified leak test	2 hr soak	2 hr "soak" at test pressure to bring to equilibrium, followed by third-party certified and NWGLDE listed (5) (10)	Generally appropriate only when the 150% test pressure is within the third-party certified test protocol limits.
Base Piping, Underground - with in- situ leak detection system	Per third-party certification, scheduled for testing on monthly frequency minimum	Per certs	Third-party certified and NWGLDE listed (5)	Annual recertification required.
Off Base, Underground - Annual	Greater of pump deadhead, or PSV setting/cascade	2 hr	Accurate pressure monitor, reconcile temperature-pressure change (2)	Actual test pressure needs to be validated and to consider resultant pressure along entire pipeline, test media (flash point restrictions), and density/type of population.
Off Base, Underground - Annual (Alternative)	Leak test	Per certs	Leak – Third-party certified and NWGLDE listed (5)	An engineering review required to determine appropriate test pressure.
Off Base, Underground - 5-year	Higher than operating-deadhead conditions, but must be assessed. In some cases use of high pressure shutdown is acceptable. (may be up to 150%)	Per reg	Precision temperature and pressure measurement and reconciliation of temperature-pressure change (3)	Only required when mandated by regulations. (Not a normal requirement) Consider intelligent pigging as integrity management tool (7).
Off Base, Underground - 5-year -Alternative	Equal to or higher than operating-deadhead conditions, but must be assessed. In some cases use of high pressure shutdown is acceptable.	Per reg	Strength (4) Leak – Third-party certified and NWGLDE listed (5)	Only required when mandated by regulations or Service Control Point. (Not a normal requirement) Consider intelligent pigging as integrity management tool (7).
Service Station, Above and Underground - Annual or Periodic	Pump deadhead, or per state Regulations	Per reg	If all aboveground, visual. If above and underground, precision test as required/approved by local/state regulatory jurisdiction (9)	Meet UST regulations.

Pipeline Pressure Testing Guidelines and Criteria				
SUMMARY TABLE				
Pipe Location/Test	Basis of Test Pressure	Duration	Type of Testing	Comments
<ol style="list-style-type: none"> 1. Visual test, maintain pressure over duration and inspect 100% of system for weeps and leaks. 2. Acceptable pressure deviation or pressure change criteria established by Service Control Point, taking into consideration installation location, size of system, and historical testing results. 3. A conventional pressure test as used in this Table is a temperature compensated and volume/pressure change leak test at not less than 150% of pump deadhead by a qualified individual/organization with API 1110 developed procedures. Use of the California State Fire Marshall's procedure is acceptable, but not necessarily conclusive in all cases. 4. A strength test as used in this Table is a pressure test at not less than 150% of pump deadhead, conducted with a calibrated pressure gauge, for a duration of not less than 4 hours, but does not attempt to reconcile pressure change with fuel temperature change as is required by conventional pressure test. Low volume leaks may go unrecognized. To qualify for integrity testing, a strength test must be followed by a conventional leak test. 5. Integrity testing using a third-party certified and National Work Group on Leak Detection Evaluations (NWGLDE) listed short duration proprietary procedures are acceptable in principle. Selected method must be certified for system parameters such as pipe size and liquid volume. To qualify as an integrity test the procedure must utilize a pressure consistent with integrity management principles, not just a minimum pressure required to conduct the test. Alternatively, a lower pressure third-party certified leak test can be conducted after a strength test. 6. Note that a third-party certified NWGLDE listed procedure, if conducted every year at not less than greater of pump deadhead or PSV settings is an acceptable means of meeting the 5-year testing requirement (without requiring a 5-year 150% test). 7. For piggable off base pipelines, the use of in-line intelligent pigging on periodic basis (10 years maximum) to monitor corrosion and mechanical damage can significantly improve integrity management and eliminate the need for any 5-year testing regime, except when required by local or state regulatory body. 8. If secondary containment is not air pressure testable and capable of being checked at all low points for liquid, the primary carrier piping system must be tested using any one of the appropriate underground pipe testing methods. 9. Due to the myriad of piping system materials, single or double wall pipe, and piping components (line leak detectors, leak detection systems), fiberglass and coaxial piping, the annual and 5-year testing requirements do not translate well for this type of system, with small bore piping (2" and less) and low operating pressures (less than 50 psig (344.7 kPa)), thus use of a certified testing procedure and company is more appropriate. Even when tanks are aboveground, if underground piping used to service dispensers, the use of UST testing organizations still is appropriate. 10. It is the intent that the 2-hour "soak" permit the piping segment under test be visually inspected for leaks and weeps, and to stretch to test pressure, thus improving testing accuracy. This 2-hour soak can be coincident with a similar purpose procedure of the testing organization, 				

APPENDIX H TANK CLEANING GUIDANCE

This Appendix provides minimum standards for safe entry, inspection, and cleaning guidance of liquid petroleum fuel tanks for DoD personnel.

H-1 RESPONSIBILITY.

Military services will comply with their respective safety equipment certification (e.g., respirator) and task training certification (e.g., confined space entry, tank cleaning, medical) programs.

H-2 COORDINATION.

Coordinate with facility agencies (i.e., tank operators, Installation Environmental Office, Installation Safety Office, local fire department, and military service-specific headquarters), when applicable, to facilitate lowering product levels in tanks, alternate tank use during cleaning, hot work permits, disposal of waste, and coordination of safety related procedures (i.e., egress, rescue, and fire).

H-3 TANK CLEANING PREPARATION.

H-3.1 Unless superseded by Military service-specific directives, the following guidance details the minimum requirements for tank preparation prior to cleaning.

H-3.2 Secure (e.g., fence, rope, tape) and clear the work areas of all non-essential personnel. Isolate tank openings by establishing a perimeter of 50 feet (15.2 meters) and post warning signs (e.g., Do Not Enter Tank Entry in Progress) to identify the work being accomplished. If the area is subject to high foot or vehicle traffic; tank cleaning team members should be posted to ensure that unauthorized personnel and vehicles do not enter the established perimeter.

H-3.3 Consider projected weather conditions to ensure a safe working environment throughout the cleaning process. The potential of electrical storms, severe weather, or changes in the direction may produce hazardous conditions that could impact the cleaning process.

H-3.4 Remove all ignition sources from surrounding areas.

H-3.5 Move all flame-producing devices to a designated safe area prior to entry.

H-3.6 Inspect equipment and tools for serviceability and hazards. Complete necessary adjustments and calibrations prior to entry. Cleaning equipment and tools should be placed upwind of tank openings and at the highest elevation possible to minimize hazards. Cleaning equipment and tools should never be placed in an area lower than the surrounding terrain.

H-3.7 Inspect grounding and bonding cable connection points, wires, and clips for serviceability. In addition, check wire and connections for electrical continuity with an ohmmeter. Replace damaged and broken items prior to beginning tank cleaning operations.

H-3.8 Turn off cathodic protection systems prior to disconnecting pipelines from tanks.

H-3.9 Verify PPE is in proper working order.

H-3.10 Test the area around the tank for explosive vapors using a combustible gas detector before equipment is started which may be a source of ignition.

H-3.11 Ensure an emergency shower/eyewash is available and serviceable in the immediate area. Portable emergency eyewash units are acceptable if approved by the facility's authorizing agency.

H-4 TANK PREPARATION.

H-4.1 Isolate the tank to ensure product does not reenter the tank once draining procedures have commenced.

H-4.2 Tank isolation must be conducted in accordance with military service or contract lockout/tagout procedures. Ensure tank isolation is established to prevent product from reentering the tank.

H-4.3 Lockout/tagout all electrical equipment and necessary valves. Isolate all piping by removing valves and installing blind flanges, spectacle blinds, or skillet flanges to prevent fuel or vapors from returning to the tank.

H-4.4 Blind and spectacle flanges must be able to withstand any pressure the system is able to produce. If spectacle blinds are used, insert the blind between the tank valve and the flange nearest the tank.

H-4.5 No valve or piping is to be disconnected from any tank component until it is verified that the line has been emptied of product and a bonding cable has been installed between pipe flanges.

H-4.6 Tanks with floating roofs or pans pose additional inspection requirements. All applicable military service directives or industry standards will apply when inspecting floating roofs or pans (e.g. harness, confined space, atmospheric testing).

H-4.7 Qualified personnel must visually inspect the floating roof or pan to ensure the roof or pan is safe for inspection. Personnel will ensure the roof or pan support legs and sleeves (to the extent possible) have the ability to support the roof or pan.

H-4.8 Inspect the roof or pan pontoons, buoyant foam panels, and seals for fuel and water and drain as necessary to facilitate vapor and gas freeing of the tank space.

H-4.9 Qualified personnel must inspect anti-rotation pipes and guide cables to ensure proper function as the roof or pan descends.

H-4.10 Floating roof or pan leg pins must be placed in the high roof or pan position to allow for maximum space under the roof or pan to facilitate tank cleaning operations.

H-4.11 If the tank has a double bottom, a qualified individual must inspect the bottom annular space to ensure the space is free of petroleum product or vapors.

H-4.12 Ensure tank operators or responsible organizations have removed petroleum from the tank to the lowest point possible using installed pumps. Extra precautions such as gravity flow and reduced pumping rates must be considered to ensure the floating roof or pan settles and rests on legs as the fuel level drops below the high leg position of the roof or pan. If applicable use secondary pumps (i.e., air-operated, double-diaphragm pumps, explosion proof electric) to remove remaining petroleum fuel once the petroleum fuel level drops below the installed pumps suction point. Secondary pumps must be located upwind of the tank and at least 50 feet (15.2 meters) from the farthest manhole or vent.

H-5 VAPOR FREEING.

H-5.1 The tank must be ventilated using air-operated eductors, such as COPIS or Lamb air movers. The roof and shell manhole covers must be removed to allow air to circulate freely by natural ventilation to aid in removing vapors. Do not use air moving systems that would blow air into the tank.

H-5.2 Consider local conditions when placing ventilating equipment. Ventilation discharge locations must be selected to maximize diffusion of vapors into the surrounding air. This will minimize the possibility of a flammable mixture forming at ground level. Position ventilating equipment to push vapor through roof manholes.

H-5.3 Petroleum vapors are heavier than air and usually accumulate in the bottom of tanks. Blowing air into a tank can dilute the vapors, but it may take longer for the vapor-air ratio to drop to an acceptable level. Eductor-type air movers with a flexible oil-proof hoses inserted near the bottom of the tank will remove vapors in a shorter period of time.

H-5.4 The primary goals of tank preparation prior to entry are to eliminate sources of ignition and reduce the amount of fuel sludge. A near vapor free work area will drastically reduce the possibility of hazardous conditions (toxicity, asphyxiation, fire, explosion) inside the tank and in the surrounding area.

H-5.5 Eductors must be operated for at least one hour or until LEL and oxygen are within safe limits. Test the tank for LEL and oxygen immediately prior to entry and throughout the operation to ensure a safe atmosphere.

H-5.6 The interior of the tank is considered an explosive atmosphere until all sludge and loosely adhering rust and scale has been removed, regardless of the type of petroleum stored.

H-5.7 All personnel entering the tank prior to and during cleaning must wear authorized PPE including supplied air respirator (SAR) with emergency egress SCBA until the tank is declared hazard-free in accordance with military service-specific directives.

H-5.8 Before entry to the tank without PPE, the LEL reading must be zero, oxygen levels between 19.5% and 23.5%, and lead, benzene, and other toxic material levels within safe limits. Refer to API Standard 2015 for additional information.

H-5.9 The tank being cleaned will be considered leaded unless positive proof exists that the tank has never contained leaded fuel, or the tank has been coated.

H-5.10 Vapors will be present as long as petroleum product, scale, or sludge are inside the tank. Operate air eductors continuously until all these materials have been removed.

H-6 ATMOSPHERIC TESTING.

H-6.1 Tank entrants will follow military services directives detailing specific safety, medical, certification, and testing procedures for confined spaces and safe atmospheric standards.

H-6.2 Personnel will not enter a tank without proper respiratory protection unless the LEL is zero, the oxygen level is within tolerances (19.5% to 23.5%), and the facility's authorized agency has determined that airborne benzene and other toxic vapors are within permissible exposure limits. Personnel may enter the tank when vapor levels are below 10% of LEL if they are equipped with approved SAR with emergency SCBA.

H-6.3 Provided personnel are wearing appropriate PPE based upon the current LEL, toxicity, and oxygen levels, eductors may be shutdown while workers are in the tank if the eductors impair the ability of personnel to communicate.

H-6.4 If vapor levels cannot be reduced below the 10% LEL, or in some cases below 20% LEL, the following situations may exist:

H-6.4.1 Insufficient time has passed to reduce vapor concentrations (which in turn can affect facility mission requirements and maintenance costs).

H-6.4.2 The amount of remaining fuel and solid sludge has not been reduced to an appropriate level.

H-7 TANK CLEANING.

H-7.1 All entrants must be equipped with approved PPE. In addition, the entry supervisor (or Military service equivalent) must be aware of equipment that is used inside the tank and ensure equipment (where applicable) is explosion proof, has ground fault interrupters and is bonded to the tank. If pressure washers are used, the washer nozzle must be electrically bonded to the tank.

H-7.2 Tanks must be cleaned from the outside first. Ventilation and vapor readings at the manhole must continue during cleaning from the outside. Entry is authorized once the flammable atmosphere tester registers 10% LEL or less. Since vapors will be present as long as fuel, scale, or sludge remains inside the tank, continue forced ventilation until all such material has been removed.

H-7.3 Maintain an uninterrupted air supply until all persons are out of the tank and have removed their facepieces. Personnel who are inside the tank while wearing PPE that detect an odor (such as petroleum products) must leave the tank immediately and not re-enter until the cause has been determined and equipment repaired or replaced.

H-7.4 Unless otherwise directed by military service-specific directives, continue testing for explosive vapors at fifteen-minute intervals while personnel are in the tank. Stirring sludge releases vapors and increases the vapor concentration. Remove puddles of fuel-water sludge to keep vapor readings below 20% LEL.

H-7.5 Personnel will continue to remove sludge from the tank by scraping the bottom of the tank and 3 feet (0.9 meters) up the sides of the tank until all loosely adhering rust and scale have been removed.

H-7.6 Wash down the remainder of the tank with high-pressure hoses. Include the metal supports, braces, the upper portion of horizontal tanks, and the decks (tops) of vertical tanks. Wash these areas until the water pumped out of the tank is clean.

H-7.7 Water discharged from the tank must be contained and disposed of as instructed by the authorized facility environmental agency.

H-7.8 Remaining non-recoverable sludge residue and deposits may be removed by several different methods, including, but not limited to:

H-7.8.1 Wash brush, squeegee, and sweep material (i.e., sludge, deposits) into portable containers.

H-7.8.2 Spray or wash down material with water hose streams and remove by pump or vacuum. If additional liquids are needed to reduce tank material (e.g., sludge,

deposits) the use of diesel, solvent, or approved chemicals can be used in accordance with military service-specific directives.

H-7.9 Use of solvents and soap can create additional undesired reactions if used incorrectly, the tank cleaning team must only use approved substances in accordance with manufacturer's instructions.

Solvents and soaps reactions can range from polymerization (depletion of inhibitor or excessively high temperature), saponification (creation of hard soap forming a layer on the tank requiring acid cleaning or even removal by hydroblasting), or drying/hardening (formation of hard debris that is no longer soluble, requiring treatment with a solvent).

H-7.10 Once washing is completed, allow the floor to dry. When interior tank vapor readings are 0% of the LEL on unleaded tanks, personnel may enter the tank without protective equipment if the testing required by API Standard 2015 has been done, and the facility's authorized agent determines that airborne benzene and other toxic vapors are below the permissible exposure limits.

A clean dry tank that has been ventilated overnight will provide the best atmosphere for entry without protective gear.

H-7.11 Pipes used for center poles and braces, pontoons, and leaking bottoms are potential sources of explosive vapors even after the tank is cleaned. In as little as one to two hours a safe tank may reach the explosive range because of these sources. While unprotected personnel are in the tank, take hazardous atmosphere readings at least every fifteen minutes. Where pontoon-type floating roofs or pans are installed in aboveground tanks, check each pontoon with a hazardous atmosphere tester.

H-7.12 Petroleum products irritate and burn the skin and may cause serious discomfort and injury. Promptly remove clothing that becomes splashed with sludge or fuel to prevent contact with the skin. Before continuing work, wash the affected area with soap and water (if a small area), or shower and put on a fresh change of clothing. Clothing contaminated by petroleum products must be kept away from any source of ignition.

H-7.13 Unless a full-face respirator is worn, wear goggles during scraping and spreading loose absorbent material. If hands are frequently wet with fuel and it is not practical to wear protective gloves, the hands may be coated with commercial non-greasy cream that gives the desired protection. NOTE: If work site has contained leaded gasoline, approved protective gloves or other impermeable gloves must be worn throughout the operation.

H-7.14 Keep manholes and adjacent areas clear of equipment or material that would hamper rescue operations in an emergency situation.

H-8 MATERIAL TREATMENT AND DISPOSAL.

Residue (i.e., sludge, deposits) will be treated and disposed of in accordance with Military service-specific environmental directives or contract requirements.

H-9 RETURNING TANK TO SERVICE.

H-9.1 The tank cleaning team supervisors must inspect the tank after cleaning to evaluate the condition of the tank for any follow-on repairs.

H-9.2 Once the inspection is complete and any necessary work completed, the tank must be brought back into service by reinstalling all valves, piping, and manhole covers using new non-asbestos gasket material compatible with the product being stored. The gasket thickness must not be less than the thickness of the gasket that is being replaced.

H-9.3 Refer to UFC 3-460-03 Section 8-8, "Returning to Service after Formal Out of Service Inspection/Repair," for maximum fuel line velocities for initial fills of petroleum fuel tanks that will be returned to service.

H-9.4 Petroleum fuel tanks must be stenciled before they are returned to service after cleaning. Refer to UFC 3-460-03 Section 8-8.1, "Stenciling Requirements."

H-10 TANK CLEANING EQUIPMENT AND PROTECTIVE CLOTHING.

H-10.1 Tank cleaning equipment must meet the following requirements:

H-10.1.1 All electrical equipment and conductors used within 50 feet (15.2 meters) of petroleum pipes or storage tanks, or where a hazardous accumulation of flammable vapors may exist, will be NFPA 70 for Class 1, Division 1, Group D (or higher) (or Class 1, Zone 0, or Zone 1) locations. The maximum temperature rating will be "T2D" – 419 °F (215 °C), as defined in the NEC for use in hazardous (explosive) areas.

H-10.1.2 Hazardous atmosphere detectors must meet military service requirements.

H-10.1.3 Air movers will be of the eductor type capable of educting vapors from the tank, and will be either air-driven or explosion-proof electrically operated. Electrically operated air movers must meet the minimum requirements of NFPA 70 for Class 1, Division 1, Group D (or higher) (or Class 1, Zone 0, or Zone 1) locations.

H-10.2 Tank cleaning personnel must be equipped and trained to use protective clothing (i.e., impervious coveralls, gloves, footwear, head coverings, faceshields) that is compliant with safety related military service directives.

H-10.2.1 The tank cleaning team will review the Safety Data Sheets of the petroleum product to select the type of respirator that is applicable with the type of tank

and petroleum product used. Caution must be exercised to select a respirator that will not deteriorate or corrode when exposed to the petroleum product or solvents used in the tank cleaning process.

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APPENDIX I /1/ ACRONYMS

ACRONYMS

A4A	Airlines for America
AFCEC	Air Force Civil Engineering Center
AFHE	Automated Fuel Handling Equipment
AFI	Air Force Instruction
11AFMAN	Air Force Manual /1/
AFSS	Automated Fuel Service Station
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
AST	Aboveground Storage Tank
ATG	Automatic Tank Gauge
AWS	American Welding Society
BIA	Bilateral Infrastructure Agreement
BPCV	Back Pressure Control Valve
BSME	Business System Modernization-Energy
CFR	Code of Federal Regulations
CMP	Centrally Managed Program
CNG	Compressed Natural Gas
CP	Cathodic Protection
CPR	Cardiopulmonary Resuscitation
CRA	Pressure-Reducing Control

CRL	Pressure-Relief Control
DBB	Double Block and Bleed
D/FV	Defuel/Flush Valve
DLA	Defense Logistics Agency
DoD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
DPT	Differential Pressure Transmitter
DWCF	Defense Working Capital Fund
EBS	Enterprise Business System
EFSO	Emergency Fuel Shutoff
EI	Energy Institute
ESO	Emergency Shut-Off
WFDWG	Fuels Discipline Working Group <i>11</i>
FML	Flexible Membrane Liner
FPS	Feet per Second
FSCV	Filter Separator Control Valve
GPM	Gallons Per Minute
HAMS	Hydrant Automation Monitoring System
HCV	Hydrant Control Valve
HDBK	Handbook
HFAM	Hydrant Fuels Automation Maintenance
HNFA	host nation Funded Construction Agreements
HQUSACE	Headquarters, U.S. Army Corps of Engineers

IAS	Independent Alarm System
IAW	In Accordance With
LCP	Lateral Control Pit
LEL	Lower Explosive Limit
LNG	Liquefied Natural Gas
LPS	Liter per Second
MIL	Military
MILCON	Military Construction
MLA	Marine Loading Arm
MOGAS	Motor Gasoline
MPS	Meter per Second
NACE	National Association of Corrosion Engineers
NATO	North Atlantic Treaty Organization
NAVFAC	Naval Facilities Engineering Command
NAVOSH	Navy Occupational Safety & Health
NAVSEA	Naval Sea Systems Command
NEC	National Electrical Code
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
OM	Operator Maintenance
OMES	Operation, Maintenance, Environment, and Safety Plan
OMSI	Operation and Maintenance Support Information
PCV	Pressure Control Valve
PEI	Petroleum Equipment Institute

PIT	Pressure Indicating Transmitter
PHMSA	Pipeline and Hazardous Material Safety Administration
PLC	Program Logic Controller
POL	Petroleum, Oil, and Lubricant
RP	Recommended Practice
SAE	Society of Automotive Engineers
SCP	Service Control Point
SOFA	Status of Forces Agreements
SM	System Maintenance
SME	Subject Matter Expert
SPAWAR	Space and Naval Warfare Systems Center
SPCC	Spill Prevention Control and Countermeasures
SRM	Sustainment, Restoration, and Modernization
STANAG	Standardization Agreement
STI	Steel Tank Institute
STD	Standard
TM	Technical Manual
TO	Technical Order
UFC	Unified Facility Criteria
UFGS	Unified Facilities Guide Specification
UL	Underwriters Laboratory
UPS	Uninterruptible Power Supply
USAF	United States Air Force
USAFE	United States Air Force Europe

UST Underground Storage Tank
VCI Vapor Corrosion Inhibitors/1/

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APPENDIX J /1/ REFERENCES

AMERICAN NATIONAL STANDARDS INSTITUTE

ANSI/AIHA Laboratory *Ventilation Z9.5*

AMERICAN PETROLEUM INSTITUTE

API Manual of Petroleum Measurement Standards

API RP 2003, *Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents*

API RP 1110, *Recommended Practice for the Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids, or Carbon Dioxide*

API Specification 6D, *Specifications for Pipeline and Piping Valves*

API STD 510, *Pressure Vessel Inspection Code: In-service Inspection, Rating, Repair, and Alteration*

API STD 570, *Piping Inspection Code: In-Service Inspection, Rating, Repair, and Alteration of Piping Systems*

API STD 607, *Fire Test for Quarter-turn Valves and Valves Equipped with Nonmetallic Seats*

API STD 650, *Welded Steel Tanks for Oil Storage*

API STD 653, *Tank Inspection, Repair, Alteration, and Reconstruction*

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

ASME Section IX, *Boiler and Pressure Vessel Code*

AMERICAN SOCIETY FOR TESTING AND MATERIALS

ASTM D975, *Standard Specification for Diesel Fuel Oils*

ASTM F1449, *Standard Guide for Industrial Laundering of Flame, Thermal, and Arc Resistant Clothing*

ASTM 5798 *Standard Specification for Fuel Ethanol (Ed75-Ed85) for Automotive Spark-Ignition Engines*

ASTM 6751, *Standard Specification for Biodiesel Fuel Stock (B100) for Middle Distillate Fuels*

AMERICAN WATER WORKS ASSOCIATION

AWWA C203 *Coal-Tar Protective Coatings and Linings for Steel Water Pipelines—Enamel and Tape—Hot Applied*

AWWA C209, *Standard for Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines*

AWWA C210 *Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines*

AWWA C213 *Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines*

AWWA C215 *Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines*

AWWA C216 *Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines*

AWWA C217 *Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines*

DEPARTMENT OF ENERGY

DOE/GO-102016, *Handbook for Handling, Storing, and Dispensing E85 and Other Ethanol-Gasoline Blends*

FEDERAL SPECIFICATION

L-C-530C *Coating, Pipe, Thermoplastic Resin*

DEPARTMENT OF DEFENSE

DoD Standard Design AW 78-24-27, *Standard Fueling Systems; Aboveground Vertical Steel Tanks with Floating Pan and Fixed Roofs*

DoD Standard Design AW 78-24-28 *Pressurized Hydrant Fueling System*

DoD 4140.25-M Volume V, *Management of Bulk Petroleum Products, Storage, and Distribution Facilities*

ARMY CORPS OF ENGINEERS

EM 385-1-1, *Safety and Health Requirements Manual*

UNITED STATES MILITARY DETAIL SPECIFICATION SHEET

MIL-DTL-24441/29, *Paint, Epoxy-Polyamide, Green Primer, Formula 150, Type IV*

MIL-DTL-24441/31, *Paint, Epoxy-Polyamide, White, Formula 152, Type IV*

UNITED STATES MILITARY PERFORMANCE SPECIFICATION

MIL-PRF-4556 *Coating Kit, Epoxy, For Interior of Steel Fuel Tanks*

UNITED STATES MILITARY STANDARD

MIL-STD-3004, *Quality Assurance/Surveillance for Fuels, Lubricants and Related Products*

MIL-STD-3007, *Standard Practice for Unified Facilities Criteria and Unified Facilities Guide Specifications*

AIR FORCE

AFI 23-204 *Organizational Fuel Tanks*

AFI 32-1065, *Grounding Systems*

AFMAN 91-203, *Air Force Consolidated Occupational Safety Standards I/II*

T.O. 37-1-1, *General Operation and Inspection of Installed Fuel Storage and Dispensing Systems*

United States Air Force Europe (USAFE) Volume 1 *General Description and Operation*

USAFE Volume 2 *Maintenance and Repair, Standardization Agreement (STANAG) 3609 Standards for Maintenance of Fixed Aviation Fuel Receipt, Storage and Dispensing Systems*

NAVY

NAVFAC MO-124, *Mooring Maintenance Manual*

NATIONAL ASSOCIATION OF CORROSION ENGINEERS

NACE RP 0402, *Field-Applied Fusion-Bonded Epoxy (FBE) Pipe Coating Systems for Girth Weld Joints: Application, Performance, and Quality Control*

NATIONAL FIRE PROTECTION ASSOCIATION

NFPA 1, *Fire Code*

NFPA 10, *Standard for Portable Fire Extinguishers*

NFPA 30, *Flammable and Combustible Liquids*

NFPA 30A, *Code for Motor Fuel Dispensing Facilities and Repair Garages*

NFPA 45, *Standard on Fire Protection for Laboratories using Chemicals*

NFPA 52 *Vehicular Gaseous Fuel Systems Code*

NFPA 58, *Liquefied Petroleum Gas Code*

NFPA 70, NEC, National Electrical Code

NFPA 70, NEC, Article 501, *Class I Locations for Class I liquids*

NFPA 70E, *Standard for Electrical Safety in the Workplace*

NFPA 77, *Recommended Practice on Static Electricity*

NFPA 2112, *Standard on Flame-Resistant Garments for Protection of Industrial Personnel Against Flash Fire*

NFPA 2113, *Selection, Care, Use, and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel Against Short-Duration Thermal Exposures from Fire*

PETROLEUM EQUIPMENT INSTITUTE

PEI/RP900, *Recommended Practices for Inspection and Maintenance of UST Systems*

STEEL TANK INSTITUTE

STI *Standard for the Inspection of Aboveground Storage Tanks*, SP001

UNDERWRITERS LABORATORY

UL 58, *Standard for Steel Underground Tanks for Flammable and Combustible Liquids*

UL 142, *Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids*

UL 1316 *Glass-Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products, Alcohols, and Alcohol-Gasoline Mixtures*

UL 2080 *Standard for Fire Resistant Tanks for Flammable and Combustible Liquids*

UL 2085, *Standard for Protected Aboveground Tanks for Flammable and Combustible Liquids*

UNIFIED FACILITIES CRITERIA

UFC 3-110-03, *Roofing*

UFC 3-430-07, *Operations and Maintenance: Inspection and Certification of Boilers and Unfired Pressure Vessels*

UFC 3-460-01, *Design: Petroleum Fuel Facilities*

UFC 3-570-06, *Operation and Maintenance: Cathodic Protection Systems*

UFC 3-575-01, *Lightning and Static Electricity Protection Systems*

UFC 3-600-01, *Fire Protection Engineering for Facilities*

UFC 3-601-02, *Operation and Maintenance: Inspection, Testing, and Maintenance of Fire Protection Systems*

UFC 4-150-07, *Maintenance and Operation: Maintenance of Waterfront Facilities*

UFC 4-150-08, *Inspection of Mooring Hardware*

UFC 3-159-03, *Design: Mooring*

UNIFORM FIRE CODE

UFC Article 52, *Motor Vehicle Fuel Dispensing Stations: Public and Private Operations*

UFC Article 79 *Flammable and Combustible Liquids*

UNIFIED FACILITIES GUIDANCE SPECIFICATIONS

UFGS 09 97 13.15, *Low VOC Polysulfide Interior Coating of Welded Steel Petroleum Fuel Tanks*

UFGS 09 97 13.17, *Three Coat Epoxy Interior Coating of Welded Steel Petroleum Fuel Tanks*

UFGS 09 97 13.27, *Exterior Coating of Steel Structures*

UFGS 33 08 55, *Commissioning of Fuel Facility Systems*

UFGS 33 52 23.15, *Welding for POL Service Piping*

UFGS 33 52 43.11, *Aviation Fuel Mechanical Equipment*

UFGS 33 52 43.12, *Aviation Fuel Pantographs*

UFGS 33 52 43.13, *Aviation Fuel Piping*

UFGS 33 52 43.14, *Aviation Fuel Control Valves*

UFGS 33 52 43.23, *Aviation Fuel Pumps*

UFGS 33 52 43.28, *Filter Separator, Aviation Fueling System*

UFGS 33 52 80, *Liquid Fuels Pipeline Coating System*

UFGS 33 57 55, *Fuel Components (Non-Hydrant)*

CODE OF FEDERAL REGULATIONS

29 CFR 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories*

29 CFR 1910, Subpart P / OSHA 3080, *Hand and Power Tools*

33 CFR Part 154, *Facilities Transferring Oil or Hazardous Materials in Bulk*

33 CFR Part 156, *Oil and Hazardous Material Transfer Operations*

40 CFR Part 112, *Oil Pollution Prevention*

40 CFR Part 280, *Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks*

49 CFR Part 195, *Transportation of Hazardous Liquids by Pipeline*