

Recommended Practices for the Storage and Dispensing of Diesel Exhaust Fluid (DEF)



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FOREWORD

These *Recommended Practices for the Storage and Dispensing of Diesel Exhaust Fluid (DEF)* have been prepared as an industry service by the Petroleum Equipment Institute. The text represents the consensus views of the PEI DEF Committee, comprised of the following members:

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1. INTRODUCTION

1.1 Background. In 2000, the United States Environmental Protection Agency (EPA) published Tier 2 emission standards that set common emission limitations for all light-duty vehicles, light-duty trucks and medium-duty vehicles regardless of the fuel that they use. The Tier 2 standards require new diesel vehicles, produced in model years 2009 and after, to meet an average oxides of nitrogen (NOx) emission level of 0.07 grams per mile. In 2001, the EPA published a rule setting requirements for new heavy-duty highway engines and vehicles produced after January 1, 2010. The heavy-duty diesel engine NOx standard for 2010 is 0.20 grams per brake horsepower-hour. Manufacturers plan to meet these requirements by optimizing engine designs for low emissions and adding high-efficiency after-treatment of exhaust. Diesel engine and vehicle manufacturers have examined the use of several different types of NOx reduction technologies in order to meet these requirements. One technology, selective catalytic reduction (SCR) using diesel exhaust fluid (DEF), has been chosen by nearly all diesel engine manufacturers because it can achieve as high as 90 percent NOx conversion efficiency. SCR technology uses DEF added to the exhaust stream to promote these efficiencies.

Additional diesel engine markets, including off-highway, stationary power, rail and marine applications will be following similar mandates.

1.2 Purpose. The purpose of this document is to provide recommended practices for the installation and operation of DEF storage and dispensing equipment that will preserve its quality and prevent releases into the environment.

1.3 Scope. The recommended practices in this document apply to the storage, handling, and dispensing of DEF at motor-fuel-dispensing facilities, repair/maintenance garages, and service centers. It is limited to storage containers that use a pump and/or meter to dispense DEF.

This document does not address activities involving DEF at manufacturing locations and bulk-storage terminals, or during transportation to motor-fuel-dispensing facilities, repair/maintenance garages, and service centers. Sampling and testing procedures for determining the compliance of DEF with specifications are not included. Dispensing of DEF into motor vehicles from portable single-use containers is not covered.

This document is not meant to provide an interpretation of regulatory or legislative requirements related to the storage or dispensing of DEF, nor does it endorse or recommend particular equipment, suppliers, or manufacturers. The inclusion of procedures for the installation of equipment or devices is not meant to imply that such equipment or devices should always be used. Nothing in this document is intended to discourage the development and implementation of new installation methods, materials, and procedures.

1.4 Sources. The procedures and practices outlined in this document constitute a synthesis of standards and recommendations published by government agencies, standard-setting organizations, DEF suppliers, equipment manufacturers, and facility operators. In instances where there were disparities or omissions in the material available, the PEI DEF Committee included its own consensus recommendations based on practical experience.

1.5 Use of Other PEI Recommended Practices. For installations of DEF storage systems, the user of this document should refer to PEI/RP100, *Recommended Practices for Installation of Underground Liquid Storage Systems* or PEI/RP200, *Recommended Practices for Installation of Aboveground Storage Systems for Motor-Vehicle Fueling* for additional guidance.

1.6 Importance of Competent Installers and Service Technicians. The installation and service of DEF storage systems is a new and complex field and requires a wide range of construction knowledge and experience. In addition to proper design, reliance on installers who possess both the experience and the integrity to insist on doing the job properly constitutes the greatest protection against system failure and liability exposure.

Written instructions alone will not convert an incompetent or under-supervised installer into a competent craftsman. The ability to recognize and react to unexpected and abnormal conditions that may be encountered during an installation job requires experience and skill. Training is essential to improving the skills of installers and the quality of installations.

1.7 Written Plans and Specifications. To solicit bids properly, obtain required permits, and provide guidance for installers, facility owners who are preparing DEF-system projects should provide a written scope of the proposed work together with concise specifications and construction plans. These documents should adequately describe the property and indicate the size and location of system components. Clearly specify all material and equipment to be used as well as appropriate dimensions

and construction details. Installation checklists may be developed from the plans and specifications. Checklists provide a convenient and effective tool for planning, implementing, and documenting the required work.

1.8 Unexpected Conditions. Even well-planned DEF storage-system installations may require revision during construction. Through consultation with an experienced installer, the owner can anticipate the range of contingencies that might occur. Experienced installation personnel can anticipate, detect, and adapt to unexpected conditions.

2. DEFINITIONS

When used in this document, the terms listed below have the following meanings:

2.1 Authority Having Jurisdiction (AHJ). The organizations, office, and individuals responsible for approving equipment, materials, installations, or procedures.

2.2 Breakaway. A valve installed on the hose between the nozzle and dispenser that will pull apart if a motorist drives away with the nozzle inserted in the fill pipe of the DEF tank. The valve prevents spillage of fluid from the separated ends of the hose and protects the dispenser from damage.

2.3 British Standard Pipe Parallel (BSPP). The British standard connection using parallel threads and an elastomeric seal to join pipes and fittings.

2.4 British Standard Pipe Taper (BSPT). The British standard connection using tapered threads to join pipes and fittings.

2.5 Class I, Division 1. Part of a classification system used by the *National Electrical Code* (NFPA 70) to describe the fire or explosion hazard present in a specific area. A Class I, Division 1 location is a location in which:

- ignitable concentrations of flammable gases or vapors can exist under normal operating conditions
- ignitable concentrations of such gases or vapors may exist frequently because of repair or maintenance operations or because of leakage
- breakdown or faulty operation of equipment or processes might release ignitable concentrations of flammable gases or vapors and might also cause simultaneous failure of electric equipment.

2.6 Class I, Division 2. Part of a classification system used by the *National Electrical Code* (NFPA 70) to describe the fire or explosion hazard present in a specific area. A Class I, Division 2 location is a location:

- in which volatile flammable liquids or flammable gases are handled, processed, or used, but in which the liquids, vapors, or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems, or in case of abnormal operation of equipment
- in which ignitable concentrations of gases or vapors are normally prevented by positive mechanical ventilation and which might become hazardous through failure or abnormal operation of the ventilating equipment
- that is adjacent to a Class I, Division 1 location, and to which ignitable concentrations of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air and effective safeguards against ventilation failure are provided.

2.7 Creep. An industry term describing the migration by capillary action of DEF through small gaps in seemingly tight joints and fittings. (See also Meter Creep.)

2.8 Crystallization. The white deposit formed when water evaporates from DEF.

2.9 Diesel Exhaust Fluid (DEF). An aqueous urea solution manufactured from technically pure urea and pure water without the addition of any other substances. Its quality specifications are defined in Clause 5 of ISO 22241-1. DEF is a NO_x-reduction agent that is injected into the exhaust of diesel engines equipped with SCR converters. DEF is the same as AUS32, as defined in ISO 22241-1.

2.10 Dispenser. A dispenser is a device that controls the transfer of DEF into a motor vehicle or container and may be equipped with hanging hardware.

2.11 Drum. A cylindrical container, typically 55 gallons, used for transporting and storing DEF.

2.12 Handbook 44. The publication issued annually by the National Institute of Standards and Technology (NIST) that provides specifications, tolerances, and other technical requirements for weighing and measuring devices.

2.13 Hanging Hardware. A generic term for all liquid-containing components from the outlet fitting of the dispenser up to and including the dispensing nozzle. Typical hanging-hardware components include dispensing hoses, swivels, breakaways, and nozzles.

2.14 Intermediate Bulk Container (IBC). A container, typically 275 to 330 gallons, used for transport and storage of fluid and bulk materials. Same as a tote.

2.15 International Fire Code (IFC). A model fire code developed by the International Code Council (ICC).

2.16 International Organization for Standardization (ISO). A non-governmental standard-setting body established to promote the development of standardization and related activities.

2.17 Listed. A designation for products certified and published in a database by a nationally recognized testing laboratory (NRTL).

2.18 Meter Creep. An event where the dispenser-meter register indicates an increase in volume when the pump is on, even though no product is being dispensed.

2.19 Material Safety Data Sheet (MSDS). A document containing information and instructions on materials present in the workplace.

2.20 Mini-Bulk System. A turnkey storage and dispensing system that arrives at a site fully assembled and includes all required vents, valves, and appurtenances. It may be pre-wired, insulated, and/or provide secondary containment.

2.21 National Electrical Code (NEC). Also known as NFPA 70.

2.22 National Pipe Thread (NPT). The U.S. standard for tapered threads used to join pipes and fittings.

2.23 Nozzle. A device typically consisting of a spout, handle, and operating lever, attached to the end of a dispensing hose and used for controlling the flow of DEF.

2.24 Selective Catalytic Reduction (SCR). An emission-reduction technology that uses DEF with a catalytic converter to reduce NO_x in diesel-engine exhaust.

2.25 Shelf Life. The period of time, starting with the completion of production, in which DEF, stored under specific conditions, remains within the specifications defined in ISO 22241-1:2006(E), Table 1.

2.26 Storage Tank. A vessel having a liquid capacity that exceeds 330 gallons.

2.27 Tote. A container, typically between 275 and 330 gallons, used for transport and storage of fluids and bulk materials. Same as an intermediate bulk container (IBC).

2.28 Turnover. The time required to use the volume of DEF stored in a tank.

2.29 Urea. An organic compound with the chemical formula (NH₂)₂CO. Also known as carbamide.

3. DEF CHARACTERISTICS

3.1 General. DEF is a clear, colorless, non-toxic, non-flammable, non-combustible liquid. It is made up of 32.5 percent urea with the balance distilled or deionized water. Urea and water are completely miscible and do not separate in storage. DEF has a specific gravity of 1.09 at 68°F and weighs approximately 9.08 lbs/gallon.

DEF is NOT:

- a motor fuel
- a fuel additive
- a flammable or combustible liquid
- a volatile organic compound
- a hydrocarbon liquid
- a liquid that requires Stage I or Stage II vapor recovery
- a substance currently regulated by the federal government.

There are no federal storage, dispensing, or disposal requirements for DEF.

3.2 Quality Requirements. The quality requirements for DEF are specified in ISO 22241-1 and DIN 70070. The introduction of any impurities can degrade DEF quality and affect the performance of the SCR system. These specifications must be maintained during storage and dispensing. See Appendix A for details on DEF quality characteristics.

The American Petroleum Institute (API) has established the Diesel Exhaust Fluid Certification Program. It is a voluntary program that certifies and monitors the quality of DEF intended for use in SCR-equipped diesel trucks and passenger cars. DEF marketers participating in the program can display the API DEF Certification

Mark to show that they have met ISO 22241-1 quality requirements. See Figure 3-1.

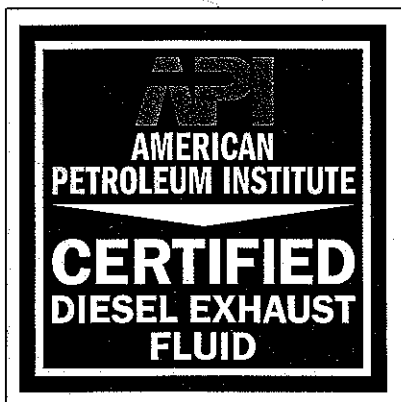


FIGURE 3-1. *The API Diesel Exhaust Fluid Certification Mark.*

3.3 Storage Temperatures.

3.3.1 High Storage Temperatures. The storage temperature of DEF affects the rate of degradation of DEF quality. Store DEF at lower temperatures to extend its shelf life. Prolonged storage at temperatures above 77°F (25°C) can impair the quality of DEF and reduce its shelf life. However, temporary exposure to higher temperatures does not necessarily affect DEF quality. When exposed to high temperatures while stored in dispensers, hoses, and nozzles between dispensing events, DEF does not degrade significantly because of the relatively short exposure time.

3.3.2 Low Storage Temperatures. DEF freezes at 12°F (-11°C). To avoid freezing, maintain storage temperatures above 12°F. Freezing does not affect the quality of DEF, and frozen DEF that has warmed above 12°F can be used as soon as it liquefies.

When DEF freezes, it increases approximately 7 percent in volume and can cause fully-filled, closed containers and equipment to rupture. After thawing, any equipment where freezing has occurred should be inspected for damage that could lead to equipment failure or leakage. Repair or replace any damaged components or systems before dispensing DEF.

To avoid quality degradation when heating DEF, do not allow the local temperature of any heated surface in contact with DEF to exceed 77°F.

Do not use any additives to depress the freezing point of DEF. Additives of any type must not be used in DEF.

3.4 Shelf Life. The quality of DEF will degrade more rapidly as the temperature rises. The quality of DEF based on temperature exposure is measured by its alkalinity. Temperature control is more critical at sites with infrequent DEF turnovers. These sites may not be able to meet the product quality requirements of ISO 22241-1 after an extended period of storage. Consult the DEF provider regarding the product shelf life and quality of DEF based on local storage conditions.

3.5 Crystallization. When DEF is left to dry on an exposed surface, the water in the DEF will evaporate. As evaporation occurs, crystals will form. These crystals can commonly be seen on DEF-dispensing nozzle spouts and in the dispensing area. DEF crystals will dissolve when exposed to DEF or water. Crystallization may be a sign of a leak.

3.6 Creep. Creep is typically evidenced by crystallization of DEF at joints where it has migrated by capillary action through small gaps in seemingly tight joints and fittings. When the DEF reaches the surface of the component and is exposed to air, the water evaporates and leaves a crystalline residue.

The incidence of creep with tapered threaded connections can be reduced by using pipe sealant especially intended for use with DEF. Follow the equipment or material manufacturer's instructions regarding preparation and application. Thread seal tape should not be used with DEF.

4. MATERIAL COMPATIBILITY

4.1 General. All components that are used for the storage and handling of DEF must be made from compatible materials. Use of materials incompatible with DEF may degrade and reduce their integrity, which can lead to leaks. The use of incompatible materials will contaminate and degrade the DEF, may cause it to fail ISO quality standard 22241-1, and potentially damage SCR systems.

4.2 Determining Compatibility. All equipment used to store and dispense DEF must be constructed and operated to prevent product contamination or unintended release. Materials recommended for tanks, containers, piping, dispensers, and associated equipment, as listed in ISO 22241-3 and/or DIN 70070 are included in Table 4-1.

**TABLE 4-1
EXAMPLES OF RECOMMENDED MATERIALS**

Highly alloyed austenitic Cr-Ni-steels and Cr-Ni-Mo-steels, for example in accordance with EN 10088-1, EN 10088-2 and EN 10088-3 (i.e. 1.4541 and 1.4571), or stainless steel 304 (S30400), 304L (S30403), 316 (S31600) and 316L (S31603) in accordance with ASTM A240, ASTM A276 and ASTM A312
Titanium
Ni-Mo-Cr-Mn-Cu-Si-Fe alloys, e.g. hastelloy c/c-276
Polyethylene, free of additives
Polypropylene, free of additives
Polyisobutylene, free of additives
Perfluoroalkoxyl-alkane (PFA), free of additives
Polyfluoroethylene (PFE), free of additives
Polyvinylidene fluoride (PVDF), free of additives
Polytetrafluoroethylene (PTFE), free of additives
Copolymers of vinylidene fluoride and hexafluoropropylene, free of additives
Viton®

Any material or manufacturing process with uncertain compatibility with DEF shall be tested by the manufacturer. The test conditions should reflect the intended temperature range and contact time in service in order to evaluate material degradation and possible influences on the product quality as specified in ISO 22241-1.

Examples of materials not currently recommended for use with DEF in ISO 22241-3:2008(E) are shown in Table 4-2.

**TABLE 4-2
EXAMPLES OF MATERIALS NOT RECOMMENDED**

Materials forming compounds as a result of reaction with ammonia, which may negatively interfere with the SCR converter system: carbon steels, zinc coated carbon steels, mild iron
Non ferrous metals and alloys: copper, copper alloys, zinc, lead
Solders containing lead, silver, zinc or copper
Aluminum, aluminum alloys
Magnesium, magnesium alloys
Plastics or metals coated with nickel

Any material not listed in Table 4-1 should be tested to ensure that it is compatible with DEF. The lists of materials in Tables 4-1 and 4-2 should be used for guidance only.

5. EQUIPMENT

5.1 General. All equipment used to store and dispense DEF must be constructed of compatible materials and operated to prevent contamination of DEF or unintended release.

Do not use any equipment with DEF that was formerly used to store or dispense any fuels or other liquids. All equipment in use with DEF shall be dedicated to DEF service and not used for storage or handling of other products or materials.

5.2 Storage Systems.

5.2.1 General. Storage systems come in various configurations, including the following:

- Bulk Tanks (See Section 5.2.2)
 - Aboveground Storage Tanks (AST)
 - Underground Storage Tanks (UST)
- Mini-Bulk Storage Systems (See Section 5.2.3)
- Drums and Totes (See Section 5.2.4)

See the respective sections for discussions about each system.

5.2.2 Bulk Tanks. This section describes installation procedures used with aboveground and underground DEF storage tanks.

5.2.2.1 Location. Tank location should be determined after taking into consideration the type of dispensing system (pressure or suction) that will be used at the facility, workplace safety, the potential effects of aboveground and underground leaks, truck access for loading, and the chances and consequences of impact from vehicles.

In general, tanks should be situated as far as possible away from drains, ditches, or watercourses to prevent leaks and spills from migrating off site.

When choosing the site for a tank, make sure that the vent line is not near any sources of airborne contamination. Air is drawn into the tank through the vent line to replace the volume of DEF that is pumped out to vehicles. Potential sources of contamination include entrained water droplets, fumes from a nearby stack or exhaust, and blowing particulate matter.

The tank fill location should be accessible to the largest expected delivery truck. DEF suppliers can provide information regarding their delivery-access requirements.

5.2.2.2 Installation of Aboveground Storage Tanks (ASTs). ASTs for DEF may be installed at any location that is convenient. Tanks should be located close to the point of use to minimize the length of distribution lines.

Consult PEI/RP200 for AST installation practices.

Although there are no federal regulations governing the storage of DEF, for ASTs with a volume greater than 350 gallons it is recommended that secondary containment be considered.

5.2.2.3 Installation of Underground Storage Tanks (USTs). When preparing to install a UST, confirm that the area is free of existing underground obstacles. Check for the presence of abandoned tanks, active and unused piping, water and sewer lines, and electrical conduit. Check "as built" drawings and confer

with contractors and personnel familiar with the site before breaking ground.

The excavation should provide adequate room for the placement of the tank, piping, and associated equipment. Use care to avoid undermining the foundations of existing structures. When installing the tank, follow the manufacturer's instructions.

Underground tanks used for DEF storage must meet all applicable codes and regulations and should be double-walled or have secondary-containment capacity with monitoring. At a minimum, the inner wall, which is in direct contact with DEF, must be constructed of recommended materials discussed in Section 4. The outer tank or secondary containment can be constructed of any material that is non-corrosive with DEF and protects the outer surface of the tank from corrosive soil and groundwater conditions. The inner tank and the outer containment shall be liquid-tight.

Consult PEI/RP100 for UST installation practices.

5.2.2.4 Vent Lines. Open storage-tank vent lines can provide a pathway for contamination to reach DEF in aboveground and underground storage.

Atmospheric vents should be equipped with a cap and screen to keep out water, insects and debris. The vents are always open and allow any pressure or vacuum developed in the tank to equalize with the atmosphere. The vent line should be sized according to the larger of the tank inlet or outlet.

A pressure/vacuum valve on the top of the vent line can reduce the chance of foreign material blocking the vent line or reaching stored DEF. Consult the tank manufacturer for pressure and vacuum settings.

If a tank or mini-bulk is located indoors, piping the vent outside should be considered.

5.2.2.5 Anti-Siphon Valves and Pressure-Regulator Valves for Suction Systems. A solenoid valve or a spring-loaded anti-siphon valve should be installed above the level of the DEF on ASTs where the DEF level can be at a higher elevation than the supply piping or

the dispenser. The valve will prevent a potential leak in the piping from creating a siphon that could cause a product release. Pressure-regulating valves must be used directly under the dispenser for suction pumps that are located below the level of the fluid.

5.2.2.6 Overfill Protection. Tanks should be equipped with overfill protection to prevent the release of DEF.

5.2.3 Mini-Bulk Storage System. Turnkey storage and dispensing systems shall be installed per manufacturer's instructions.

5.2.4 Drums and Totes. Drums and totes used to store DEF should be located where they are convenient for dispensing DEF to vehicles, while being out of the way of vehicle and foot traffic. If a seal is broken upon receipt, the drum or tote should not be used.

Drums and drum pumps should be stabilized to ensure against tipping and overturning. Drums with drum pumps that are partially filled can become unstable and are more likely to overturn.

5.3 Connectors and Connections.

5.3.1 General. Connectors with similar sizes and thread pitches can mistakenly be assembled, resulting in a leaking connection and damaged components. Use special care not to mix connectors of different kinds. Make sure that all connectors used with DEF are designed for DEF service. Do not force fittings together to make a connection.

5.3.2 Pumps, Piping, and Dispensers. Connectors for DEF pumps, underground and aboveground piping, filters, and the piping inside dispensers must be constructed of compatible materials and make a tight, leak-free connection. Follow the manufacturer's instructions for installation.

5.3.3 Hanging Hardware. Hanging hardware components are subject to considerable wear during routine operation and require more maintenance than enclosed components. It is recommended that BSPP threaded fittings be utilized to provide an easily changed, leak-free connection. Sealing compound or thread tape must not be used with BSPP connections. Use the recommended installation torque.

This recommendation does not exclude the use of other connection technologies.

5.4 Pumps. Supply pumps should be designed for use with DEF and sized according to the individual application. They should be capable of delivering DEF at a minimum rate of five gallons per minute for each dispensing nozzle when all nozzles are in operation if automatic nozzles are chosen.

For commercial and retail operations refer to flow rates in Section 5.9.

5.5 Piping. A well-designed piping installation minimizes the length of piping, improves operation, and facilitates maintenance and testing. Follow local codes, designer's plans and specifications, and adhere to the installation instructions provided by the piping and component manufacturers.

Non-metallic piping and components used in above-ground DEF service should have high melting points and adequate strength and durability. Some plastic compounds that are suitable for DEF may not be compatible with petroleum products. They should be avoided at locations where they could come in contact with petroleum from a routine operation or a spill.

See PEI/RP100 and PEI/RP200 for details on piping installation and use.

5.6 Sealants. Use a sealant on tapered threads to prevent leakage and creep. Follow the equipment manufacturer's recommendations for sealants on threads. Thread seal tape should not be used with DEF.

5.7 Dispensers. When installing dispensers:

- Where low temperatures are expected, dispensing equipment, including hanging hardware, should be insulated, heated, or located in a temperature-controlled enclosure to prevent DEF from freezing.
- Where high ambient temperatures are common, consider insulating the dispenser or putting it in a location where it is out of direct sun to maximize shelf life of DEF.
- On pressure systems, a shear valve should be installed on the product inlet line where it enters the dispenser to prevent liquid release in case of an accident.
- When mounting dispensers directly to the island, install sumps to prevent leaks and spills from migrating off site.
- Install posts, bollards, or bumpers to protect dispensers from vehicle impact.

5.8 Hoses and Hose Assemblies. DEF hose and assemblies should be manufactured and assembled according to Rubber Manufacturers Association (RMA) standards and/or National Association of Hose and Accessories Distributors (NAHAD) guidelines. Hoses used for retail sales should not allow meter creep.

DEF hoses and assemblies are not required to have a static wire unless operated in Class I, Division 1 areas.

5.8.1 Swivels. Swivels facilitate the dispensing of DEF by reducing the twisting and bending stresses on hoses created by positioning the nozzle during dispensing and when hung up after use.

Swivels should be leak-free and rotate and flex freely to prevent hoses from tangling and kinking. Connections between swivels and hoses and nozzles should be secure and leak-free.

5.8.2 Breakaways. A breakaway should be installed on the hose between the dispenser and the nozzle. In case of a drive-off, a breakaway can prevent serious and expensive damage to the dispenser. It can also reduce the damage to the nozzle and the DEF tank fillneck on the vehicle.

5.8.3 Hose Retractors. Hose retractors may be installed to keep hoses from kinking and tangling and help prevent damage when hoses are not in use.

5.9 Nozzles. DEF nozzle spouts and fillnecks are specified in ISO 22241-4.

DEF nozzle spouts are nominally 19 mm in diameter and designed to fit uniquely into the fillneck of the DEF tank on board trucks and passenger cars.

Nozzles used for vehicle filling should be equipped with an automatic shutoff to prevent overfilling the vehicle's DEF tank. The nozzle flow rate should be between 5 and 10 gallons per minute. Limiting the highest flow rate to 10 gallons per minute reduces the chance of spills and spitbacks while dispensing. Maintaining the lowest flow rate above 5 gallons per minute will ensure that the automatic shutoff will operate under most conditions.

To prevent misfilling, some nozzles are equipped with a magnet interface which interacts with the magnet ring of the DEF fillneck. If the nozzle is accidentally inserted into a fuel tank or other container, the magnet interface will prevent the nozzle valve from fully opening. The nozzle will not fully operate unless it is properly inserted into the fillneck of a vehicle's DEF tank that is equipped with a magnet interface. This feature also prevents the

nozzle from being left in the open position between uses.

DEF nozzles without the magnet interface are also available. These nozzles can be used to fill onboard DEF tanks as well as other containers with or without magnets in their fillneck. Care must be taken to make sure that DEF is not dispensed into the diesel fuel tank on vehicles.

Another type of nozzle utilized to prevent misfilling incorporates a tight seal between the nozzle spout and a unique adaptor in the fillneck. The nozzle does not permit flow until it is properly inserted into its mating adaptor. Both the nozzle spout and the adaptor provide a tight seal until they are mated.

5.10 Meters. Meters measure and indicate the volume of DEF dispensed. For retail sales, use only meters and registration devices for DEF that have a National Type Evaluation Program (NTEP) Certificate of Compliance issued by the National Conference on Weights and Measures (NCWM).

Garages and fuel-dispensing facilities not engaged in retail sales are exempt from the preceding requirements.

5.11 Bulk Fill Connections. Locate the bulk DEF fill connection either on or in close proximity to the storage tank.

Keep tank fittings clean and dry to promote a leak-tight, contamination-free connection during deliveries.

Avoid integrating the DEF fill connection with an existing motor-fuel fill-point location. DEF spills may damage motor-fuel fill-pipe materials and cross-contamination could occur.

Tank delivery fittings should be physically compatible with delivery-hose fittings. The truck-hose fitting should lock firmly on the tank fitting and provide a safe, leak-free delivery.

5.11.1 Fill Boxes and Spill Containers. A fill box or a spill container provides a protected location where the fill connectors for USTs and ASTs can be kept away from damage and dirt. A well-designed fill box or spill container can protect fittings from the weather, prevent product contamination, and minimize releases into the environment.

To prevent unauthorized access, keep fill boxes and spill containers closed and locked, except during deliveries. The cover should form a liquid-

tight seal with the fill-box or spill-container lip to prevent the entry of rain or stormwater runoff.

Fill boxes and spill containers for DEF should be identified with product tags and pavement or cover markings.

5.12 Filters. Filters protect DEF product quality by removing small particles that can affect the performance of SCR systems on vehicles. An in-line filter will collect particulate matter before it reaches the vehicle tank.

5.13 Tank-Level Monitoring. Automatic tank-level monitoring systems should use level-detection methods and probes designed for DEF.

If a gauge stick is used to measure product level, it must be designed and dedicated for use with DEF. Gauge sticks used to measure fuel levels in other facility tanks will contaminate DEF and must not be used.

5.14 Release Detection.

5.14.1 General. The purpose of release detection is to provide an early warning of the loss of integrity in any part of the system that routinely contains product.

DEF storage and piping is not regulated by underground or aboveground storage tank rules, but keeping track of inventory and using release-detection techniques to verify tank integrity can detect small releases which, if undetected, could result in larger losses of DEF.

5.14.2 Tanks. Acceptable tank release-detection methods include the following:

- Automatic tank gauging
- Inventory control combined with periodic tightness testing
- Manual tank gauging
- Interstitial monitoring
- Statistical inventory reconciliation

If a leak in the tank system is detected, remove the tank from service. Determine the cause of the leak and repair it.

5.14.3 Piping. Acceptable release-detection methods for piping include the following:

- Automatic line-leak detection (pressurized piping systems only)
- Periodic piping tightness testing

- Interstitial monitoring (double-walled piping)
- Statistical inventory reconciliation
- Under-dispenser check valve (suction systems only)

If a leak in the piping system is detected, do not dispense any DEF until the cause of the leak is determined and repaired.

5.14.4 Sumps. Liquid sensors installed in sumps for dispensers and submerged pumps can provide an indication of component leakage. If the liquid-sensor alarm goes off, do not dispense any DEF until the cause of the alarm is found and resolved.

5.15 Oil/Water Separators. Some motor-fuel-dispensing facilities and repair garages are equipped with an oil/water separator that processes spills and runoff from paved areas. The purpose of the separator is to remove oil and grease from effluent before it goes to the storm sewer. Oil and petroleum motor fuels do not dissolve in water and will float on the surface if allowed time to separate. DEF is completely water soluble and will pass through a separator without being captured. Oil/water separators cannot be relied on to capture any DEF from runoff or spills.

Lube bay drains in garages may be equipped with a grit or grease trap to capture petroleum products. As with separators, these traps are not effective for collecting DEF.

5.16 Preparation for First Fill. DEF needs to meet stringent quality requirements, so it is important that new installations can deliver on-specification product from the very beginning. Before the first fill and initial use of a DEF storage and dispensing system, installers and operators must ensure that tanks and dispensing equipment, including pumps, piping, meters, hoses, and nozzles, are clean and free of contaminants.

6. REGULATIONS

6.1 General. DEF is a material that may be unfamiliar to members of the regulatory community. To properly apply regulations, it is important to understand the characteristics of DEF and how those characteristics affect regulators' areas of jurisdiction.

Ensure that the equipment to be installed meets all applicable regulatory requirements before beginning an

installation. Approvals may be required from building-code officials, state and local environmental agencies, zoning boards, fire marshals, or similar authorities. Consult with the local authority having jurisdiction (AHJ) before plans are finalized and construction is initiated.

6.1.1 Fire-Safety Regulations. As a non-flammable material, DEF presents storage and operating conditions that are different from those of motor fuels. To apply the proper fire codes it is necessary to understand which codes apply to DEF systems and which do not.

NFPA 30 applies to the storage and handling of flammable and combustible liquids in bulk and does not apply to activities at motor-fuel-dispensing facilities or repair garages. In addition, DEF does not burn, so the requirements of NFPA 30 do not apply to DEF storage or dispensing.

NFPA 704, which is a standard identification system that defines what is commonly called the "fire diamond," provides a system of easily understood hazard identification ratings that are used by emergency personnel to identify the risks posed by hazardous materials. Although DEF does not present a risk to firefighters, some jurisdictions may require the fire diamond to be displayed. If required, the ratings for DEF are Health: 1, Flammability: 0, Reactivity: 0. These ratings indicate that DEF presents minimal hazards. Refer to the DEF manufacturer's MSDS for additional information.

The IFC has comprehensive requirements for the storage and use of hazardous materials. DEF, using the IFC hazardous materials classification criteria, is neither a physical- nor health-hazard material and is not regulated by the requirements in Chapter 27 of the IFC.

NFPA 30A applies to any motor-fuel-dispensing facility or repair garage where liquid fuels are handled. At locations where only diesel fuel is handled, components of DEF dispensing and storage systems do not have to be listed by a NRTL under NFPA codes, and NFPA 30A does not apply. At those locations, DEF dispensing systems can be installed adjacent to diesel-fuel dispensers.

If gasoline is dispensed at a motor-fuel-dispensing facility or repair garage, then electrical components located in the shaded areas shown in Figure 6-1 are in a Class I, Division 2 area which is a hazardous (classified) location. NFPA 30A requires that the following components must be listed in classified

locations: fuel-storage tanks, flexible connectors, leak-detection devices, fuel-dispensing devices, emergency shutoff (shear) valves, remote pumps for fuels, fueling hoses and dispenser nozzles, and emergency breakaway devices. Components in these categories that are not listed cannot be used in classified locations.

A DEF dispensing system at a facility where gasoline is dispensed that is outside the shaded area in Figure 6.1 does not need to have listed equipment.

The NEC applies to electrical wiring systems and electrical utilization equipment. It is universally adopted throughout the United States. The NEC applies to DEF storage and dispensing systems. With respect to DEF, the NEC establishes the rules by which pumps, switches, controls, heaters, and other electric components are installed and designates appropriate wiring methods. Those systems in Class I, Division 1 areas will need to be explosion-proof and use explosion-proof wiring methods.

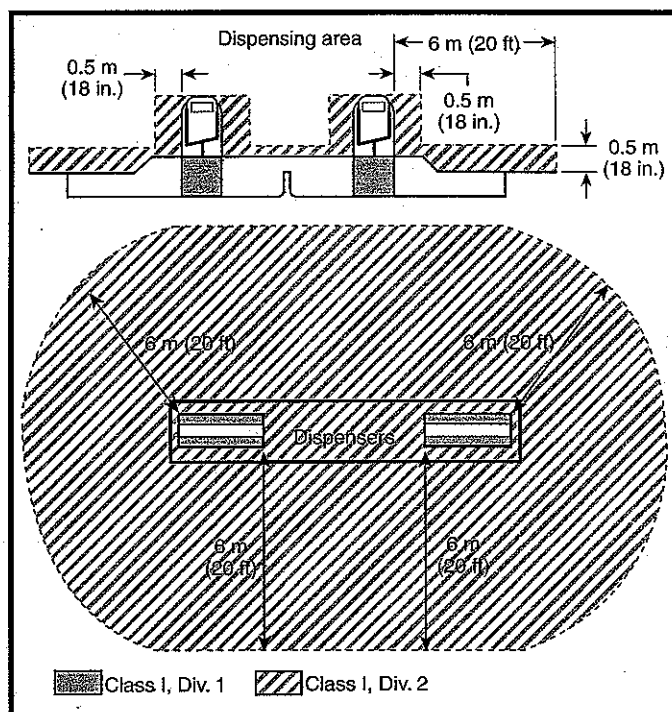


FIGURE 6-1. Diagram from NFPA 30A¹. Shaded and crosshatched areas show where listed components must be used. State and local fire codes may differ. Consult the local AHJ for details.

¹ Reproduced with permission from NFPA 30A, Motor Fuel Dispensing Facilities and Repair Garages, Copyright ©2008, National Fire Protection Association, Quincy, MA 02169. This is not the complete and official position of the NFPA on the referenced subject, which is represented only by the standard in its entirety.

6.1.2 Weights and Measures. National and state weights and measures standards as found in *Handbook 44* apply to meters, registers, and point-of-sale devices that are used to dispense DEF for sale.

Individual states and local jurisdictions may have more stringent requirements. We have not attempted to describe or interpret specific regulations or requirements in this document. Contact the local weights and measures officials for further details.

6.1.2.1 NTEP Approval. Weights and measures department officials in most states require that meters used in trade be traceable to an NTEP Certificate of Compliance issued by the NCWM. To perform evaluations, NTEP uses a system of product families to evaluate equipment that is similar. The certificate indicates that the manufacturer has received approval for a similar device from that model family after a thorough evaluation to standards in NCWM Publication 14.

For integrated DEF dispensing systems that are similar to retail motor-fuel dispensers, the NTEP Certificate of Conformance is issued for the complete dispensing system. At non-integrated DEF dispensing systems, both the meter and register are required to have NTEP certification.

NTEP certificates indicate what products the meter is certified to measure and the range of acceptable flow rates. DEF has characteristics similar to liquid-urea fertilizer used in agriculture, so DEF meters are included in the "Clear Liquid Fertilizers" product family. The NTEP certificate might mention this general product family or specifically state that the meter is intended for use with "urea" or "diesel exhaust fluid." If a Certificate of Conformance for a meter does not specify that the meter is certified to measure these products, then the meter is not considered suitable for sales of DEF.

6.1.3 Tanks. ASTs and USTs containing DEF are not regulated by federal storage tank rules. See Appendix B for EPA's response to questions from states regarding the regulatory status of underground storage tanks containing DEF. Check with the state and local AHJs regarding any special requirements.

7. MAINTENANCE

7.1 General. Regular maintenance of DEF equipment is necessary to ensure proper functioning of storage and dispensing systems and to maintain product quality. Many maintenance practices used with fuel-dispensing systems are applicable to DEF equipment, but special care must be taken to ensure surfaces that come in contact with DEF are kept clean to prevent any possible contamination.

7.2 Nozzles. Nozzles are subjected to considerable abuse during routine operation. Inspect nozzles for signs of wear, leakage, and potential failure.

Small amounts of DEF clinging to nozzle spouts after use can evaporate and leave a crystalline residue. It will dissolve with the next use of the nozzle and will not affect DEF quality. The spout can be cleaned with a clean, lint-free rag.

If the automatic shutoff port at the tip of the spout becomes plugged, it can prevent the nozzle from operating. To clean the port, immerse it in DEF or distilled water to dissolve the accumulation and wipe the spout with a clean, lint-free rag.

7.3 Hoses and Hose Assemblies. Inspect hoses for signs of wear that could cause product leakage or failure. Hose fittings should make a tight, leak-free connection at each end. Repair leaky connections and replace defective hoses and hose assemblies. Check for kinks that restrict flow. Swivels should be leak-free and move easily.

When hoses are not in use, they should not rest on the pavement or hang down on the side of the pump island where they can be damaged by traffic. If the dispenser is equipped with a hose retractor, make sure that it does not kink or abrade the hose.

7.4 Dispensers. Dispensers should be kept free of dirt and residue that could affect the quality of DEF. Keep the boot where the nozzle is stored free of contaminants. Grease and dirt can accumulate in the boot, allowing contaminants to adhere to the nozzle spout when it is hung up.

Check inside the dispenser housings for leaks. Repair leaks and clean up any accumulated DEF.

7.4.1 Filters. Replace in-line DEF filters when the maximum dispensing rate begins to drop. It is an indication that the pressure drop across the filter has increased to the point that the filter is becoming blocked.

7.4.2 Meter Calibration. All states require weights and measure officials to periodically verify retail meters for accuracy. Maintenance personnel also check meter accuracy to ensure proper operation. Meter accuracy is determined by dispensing DEF into a calibrated proving can and noting the volume shown on the meter register. If necessary, the meter is adjusted to bring it into tolerance.

Each time a meter is calibrated, a volume of DEF is generated. This DEF must be properly managed and cannot be discarded into the storm sewer or where it could possibly reach surface water or groundwater. If the DEF is to be returned to the supplier, store it in a closed, leak-free container.

If the DEF used for meter proving is to be returned to the supply tank, proper care and handling are required to ensure that the DEF does not become contaminated and made unfit for use. Use the following guidelines:

- To prevent contamination of the DEF, all components that come in contact with it while proving the meter must be clean, dry, and free of any foreign materials. Use a clean, dry, lint-free rag to wipe down surfaces. Rags should be used only once to prevent the transfer of contaminants.
- The proving can must be fabricated of a material compatible with DEF. See the list of recommended materials in Table 4-1. DEF proving cans are typically made of stainless steel that is compatible with DEF.
- Proving cans previously used for petroleum products or any liquid other than DEF cannot be used for calibrating DEF meters. Before beginning the calibration process, confirm with weights and measures or maintenance personnel that the proving can has been used only in DEF service.
- Proving cans must be clean and free of any possible contamination. If necessary, before use, wipe the inside of the proving can to remove any foreign material.
- Any components used for returning the DEF to the storage tank must be made of compatible materials and cleaned prior to use. Between uses they should be kept in a sealed bag or container to prevent the introduction of contaminants.

- After calibration, the empty proving can should be wiped and capped to prevent the introduction of contaminants during transit and storage.

7.5 Fill Boxes and Spill Containers. Fill boxes and spill containers should be kept clean and dry. Remove any dirt and debris that has collected in the fill box and spill container. Remove any accumulated liquid in the fill box and spill container by swabbing it out with an absorbent rag. Use a clean, dry, lint-free rag to remove any dirt or liquid from the fill connection.

Fill caps should be firmly attached to the fill riser except during deliveries. Inspect the cap to make sure that it is in good condition and makes a tight seal with the fill pipe.

The fill box or spill container cover should be kept closed except during deliveries. It should make a tight connection to prevent rain or stormwater runoff from entering the fill box or spill container.

The fill box or spill container should be clearly identified with DEF markings. Make sure that a DEF identification tag or similar device is securely attached to the fill pipe to prevent the accidental introduction of motor fuel.

7.6 Vents. Inspect the tank-vent outlet for accumulation of DEF crystals and potential blockage.

8. QUALITY ASSURANCE/ QUALITY CONTROL

The ISO specifications for DEF are stringent, and proper storage and dispensing techniques are key to ensuring that DEF delivered to vehicles is on-specification. To ensure DEF quality, know your supplier. Purchase DEF and equipment only from suppliers who can provide documentation that the product meets ISO specifications.

9. SPILL CLEANUP AND DISPOSAL

In case of a DEF spill, consult your DEF supplier's MSDS for guidance on cleanup. Dispose in accordance with all applicable federal, state, and local regulations.

Spilled or released DEF should not be discarded into storm sewers or where it could possibly reach surface water or groundwater.

10. LABELING AND CUSTOMER EDUCATION

Proper labeling and educating customers about proper dispensing practices can reduce the chance of misfilling incidents. Customers who are unfamiliar with DEF may unintentionally try to dispense DEF or diesel fuel into the wrong tank on a vehicle, which can cause damage to the engine or emission-control system.

Diesel fuel or gasoline cannot be easily dispensed into DEF tanks because the dispensing-nozzle spout diameters for those products are too large to fit in DEF fillnecks. Conversely, the DEF nozzles will fit into the fillneck of diesel or gasoline fuel tanks and DEF can be dispensed into the tank. DEF nozzles equipped with a magnet interface will not fully operate unless properly inserted into a DEF fillneck.

DEF dispensing equipment should be clearly labeled to avoid confusion with fuel dispensing equipment. Dispensers or dispensing locations should be clearly identified as "DEF" or "Diesel Exhaust Fluid" and marked with a sign such as:

⚠ CAUTION

AVOID ENGINE DAMAGE

**DO NOT DISPENSE DEF INTO
FUEL TANK**

FOR FILLING DEF TANKS ONLY

APPENDIX A

DEF QUALITY CHARACTERISTICS

Characteristics	Specification Limits	Units of Measure
Urea	31.8 – 33.2	% by weight
Alkalinity as NH ₃	max. 0.2	% by weight
Biuret	max. 0.3	%
Insolubles	max. 20	mg/kg
Aldehyde	max. 5	mg/kg
Phosphate (PO ₄)*	max. 0.5	mg/kg
Aluminum	max. 0.5	mg/kg
Calcium*	max. 0.5	mg/kg
Iron*	max. 0.5	mg/kg
Copper*	max. 0.2	mg/kg
Zinc*	max. 0.2	mg/kg
Chromium*	max. 0.2	mg/kg
Nickel*	max. 0.2	mg/kg
Magnesium*	max. 0.5	mg/kg
Sodium*	max. 0.5	mg/kg
Potassium*	max. 0.5	mg/kg
Density at 20°C	1087.0 – 1093.0	kg/m ³
Refractive index at 20°C	1.3814 – 1.3843	(-)
Identity	identical to reference	(-)

* Contents have to be analytically checked for non-dedicated containers prior to filling.

NOTE 1: The analytical methods are defined in DIN V 70071 (version of June 2005).

NOTE 2: Also see ISO 22241-1 Table 1.

NOTE 3: The analytical methods are defined in ISO 22241-2.

APPENDIX B

EPA LETTER OF CLARIFICATION



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

SEP 22 2009

OFFICE OF
SOLID WASTE AND
EMERGENCY RESPONSE

MEMORANDUM

SUBJECT: Regulatory Status of Underground Diesel Exhaust Fluid Tanks

FROM: Carolyn Hoskinson, Director
Office of Underground Storage Tanks

TO: EPA UST/LUST Regional Program Managers
State UST Program Managers

This memorandum responds to questions from states on the regulatory status of underground storage tanks (USTs) containing diesel exhaust fluid (DEF). Specifically, states have asked whether EPA regulates USTs containing DEF under the federal UST regulations in 40 CFR Part 280. According to these regulations, an UST is regulated if it contains petroleum or hazardous substances; however, a number of UST systems are excluded from the Part 280 requirements. One of the exclusions applies to "[a]ny UST system that contains a *de minimis* concentration of regulated substances" (§280.10(b)(5)). The regulations do not specify a *de minimis* quantity, but do allow the implementing agency to determine *de minimis* concentrations on a case-by-case basis.

DEF is a 32.5 percent aqueous solution of urea used in Selective Catalytic Reduction (SCR) technology as one way to reduce nitrogen oxide emissions from heavy-duty diesel engines, as required by EPA's "2007 Heavy-Duty Highway Rule." Although aqueous urea is neither petroleum nor a hazardous substance, the DEF solution may contain a small amount of ammonia, which is a regulated substance. According to DEF manufacturers, any amount of ammonia present in DEF is considered to be a contaminant. To address this contamination concern, the industry has set a very strict limit on the maximum amount of ammonia allowed in solution. The international standard for DEF allows no more than 0.2 percent by weight of alkalinity, measured as ammonia, to be present in solution. Although 0.2 percent is the maximum allowed limit according to the international standard, manufacturers indicate that the actual amount of ammonia in solution should be much less than 0.2 percent, and ideally there should be no ammonia in solution. Since EPA expects that the presence of ammonia in a DEF UST will be minimal, it is EPA's view that DEF USTs meet the *de minimis* exclusion and thus are not regulated as hazardous substance USTs under the federal UST regulations.

APPENDIX B: EPA LETTER OF CLARIFICATION continued

In addition, EPA expects USTs storing DEF will be both compatible and secondarily contained. International standards for DEF set strict requirements for compatibility in order to avoid product contamination caused by materials in the storage tank system degrading into the DEF and also to prevent releases due to corrosion. Further, manufacturers recommend that underground DEF tank systems use secondary containment technologies with interstitial monitoring. EPA expects that owners and operators of DEF USTs will generally follow these industry, manufacturer, and international standards for the storage of DEF in USTs.

If in the future EPA finds that ammonia released from DEF USTs endangers human health and the environment, EPA may revisit the *de minimis* exclusion analysis contained in this memorandum. It is important to note that some states may choose to be more stringent than federal regulations and require DEF USTs to fully comply with state UST regulations.

If you have any questions about this interpretation, please contact Andrea Barbery at barbery.andrea@epa.gov or 703/603-7137.

cc: OUST Management
OUST Regional Liaisons
Kathy Nam, OGC

APPENDIX C PUBLICATION REFERENCE

Many of the recommendations contained in this publication have been derived from the standards and recommended practices of other industry organizations. Listed below are the names, addresses, telephone numbers, and websites of selected industry organizations, followed by the titles of their publications, which have some relation to the installation of DEF dispensing equipment.

NOTE: Links to download or purchase many of the references listed below can be found at www.pei.org/RP1100.

■ **AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)**

25 West 43rd Street, 4th Floor, New York, NY 10036.
(212) 642-4900. www.webstore.ansi.org
ANSI/ASME B1.20.1-1983, *Pipe Threads, General Purpose (Inch)*, 2006.

■ **API**

1220 L Street NW, Washington, D.C. 20005-4070.
(202) 682-8375. www.apidef.org
API, *Diesel Exhaust Fluid Certification Program Overview*, February 2009.

■ **CEFIC - EUROPEAN CHEMICAL INDUSTRY COUNCIL**

Avenue E. van Nieuwenhuysse, 4 box 1
B-1160 Brussels. + 32 2 676 72 11, www.cefic.be
Cefic, AUS 32, *AUTOMOTIVE GRADE UREA, AUS 32 According to DIN 70070, Quality Assurance Guidance Document*, 2008.

■ **INTERNATIONAL CODE COUNCIL**

Publications, 4051 West Flossmoor Road, Country Club Hills, Illinois 60478-5795. (888) 422-7233.
www.iccsafe.org
International Code Council, *International Fire Code*, 2009.

■ **INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)**

1, ch. de la Voie-Creuse, Case postale 56, CH-1211 Geneva 20, Switzerland. +41 22 749 01 11,
www.iso.org
International Organization for Standardization, ISO 22241-1, *Diesel engines – Nox reduction agent AUS 32- Part 1: Quality requirements*, First Edition, 2006.
International Organization for Standardization, ISO 22241-2, *Diesel engines – Nox reduction agent AUS 32- Part 2: Test methods*, First Edition, 2006.

International Organization for Standardization, ISO 22241-3, *Diesel engines – Nox reduction agent AUS 32-Part 3: Handling, transportation and storage*, First Edition, 2008.

International Organization for Standardization, ISO 22241-4, *Diesel engines – Nox reduction agent AUS 32- Part 4: Refilling interface*, First Edition, 2009.

■ **NAHAD**

105 Eastern Avenue, Suite 104, Annapolis, Maryland 21403. (410) 263-1014. www.nahad.org
NAHAD, NAHAD 500, *Industrial Hose Assembly Specification Guidelines*, 2005.
NAHAD, NAHAD 600, *Composite Hose Assembly Specification Guidelines*, 2005.
NAHAD, NAHAD 800, *Fluoropolymer Hose Assembly Specification Guidelines*, 2005.

■ **NATIONAL CONFERENCE ON WEIGHTS AND MEASURES (NCWM)**

1135 M Street, Suite 110, Lincoln, Nebraska 68508.
(402) 434-4880. www.ncwm.net/publications
NCWM, Publication 14, *Administrative Policy*, 2009.
NCWM, Publication 14, *Measuring Devices, Technical Policy, Checklists and Procedures*, 2009.

■ **NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)**

Weights and Measures Division, 100 Bureau Drive, Stop 2600, Gaithersburg, Maryland 20899-2600.
(301) 975-6478. www.nist.gov
NIST Handbook 44, *Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices*, 2009.

■ **NATIONAL FIRE PROTECTION ASSOCIATION**

1 Batterymarch Park, P.O. Box 9101, Quincy, Massachusetts 02169-7471. (800) 344-3555.

www.nfpa.org

National Fire Protection Association, NFPA 30A, *Code for Motor Fuel Dispensing Facilities and Repair Garages*, 2008.

National Fire Protection Association, NFPA 70, *National Electrical Code*, 2008.

■ **PETROLEUM EQUIPMENT INSTITUTE**

P.O. Box 2380, Tulsa, Oklahoma 74101-2380.

(918) 494-9696. www.pei.org

Petroleum Equipment Institute, *Petroleum Equipment LEXICON*, Terms Used in Petroleum Marketing Operations, 1995.

Petroleum Equipment Institute, RP100-05, *Recommended Practices for Installation of Underground Liquid Storage Systems*, 2005.

Petroleum Equipment Institute, RP200-08, *Recommended Practices for Installation of Aboveground Storage Systems for Motor-Vehicle Fueling*, 2008.

Petroleum Equipment Institute, RP900-08, *Recommended Practices for Inspection and Maintenance of UST Systems*, 2008.

■ **RUBBER MANUFACTURERS ASSOCIATION**

1400 K Street, NW, Suite 900, Washington, D.C. 20005. (202) 682-4800. www.rma.org.

Rubber Manufacturers Association, RMA IP-2, *Hose Handbook*, Seventh Edition, 2003.

■ **U.S. DEPARTMENT OF LABOR, OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION**

Frances Perkins Building, 200 Constitution Avenue NW, Room S2317, Washington, D.C. 20210.

(202) 693-2000. www.osha.gov

Occupational Safety and Health Administration, Title 29, Code of Federal Regulations (CFR), Part 1910, *Occupational Safety and Health Standards*.

■ **U.S. ENVIRONMENTAL PROTECTION AGENCY**

Ariel Rios Building, 1200 Pennsylvania Avenue, NW, Washington, D.C. 20460. (202) 272-0167.

www.epa.gov

U.S. Environmental Protection Agency, Title 40, Code of Federal Regulations (CFR), Parts 80 and 86, *Control of Air Pollution From New Motor Vehicles: Tier 2 Motor Vehicle Emissions Standards and Gasoline Sulfur Control Requirements*, February 10, 2000.

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