

Bulk Oil Testing, Handling, and Storage Guidelines

API RECOMMENDED PRACTICE 1525
FIRST EDITION, JUNE 1997



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Manufacturing, Distribution and Marketing Department

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FOREWORD

This standard was developed to guide the management of certain operations in a manner that protects the environment and the safety of workers and the public. This standard is intended for petroleum terminal and tank facilities associated with the storage and distribution of petroleum lubricants. This standard may be used as a resource and management guide by those responsible for such facilities and by those working on their behalf. This standard is a compilation of industry knowledge, information, and management practices for all relevant aspects of bulk lubricant handling aggregated into an overview document comprising best practices. It is intended to be consistent with, but is not a substitute for, any applicable local, state, or federal regulations.

Some provisions in this standard, as indicated by the use of the word *shall*, are mandatory and have to be followed to meet the intent of this standard. Some provisions are recommended, as denoted by the word *should*, but are not mandatory. These provisions will need to be considered based on site-specific factors. Still other provisions are optional, as denoted by the word *may*. Typically, these will be given where a range of good options exists.

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Suggested revisions are invited and should be submitted to the director of the Manufacturing, Distribution and Marketing Department, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005.

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Bulk Oil Testing, Handling, and Storage Guidelines

1 Scope

The purpose of these guidelines is to provide recommended equipment and procedures for the proper handling of incoming and outgoing shipments of lubricants to prevent contamination and spillage, and to protect product quality. The guidelines cover receipt, storage, and shipment of finished lubricants in bulk, drum, or pail. A log detailing incoming and outgoing shipments is recommended.

This recommended practice provides general guidance on the proper handling of bulk oil. Application of all or part of the guidelines should be determined on a case-by-case basis.

2 Governmental Requirements and Reviews

Reviews should be conducted periodically to help ensure that the facility meets applicable federal, state, or local requirements. These reviews should include, but are not limited to the following:

- a. Spill Prevention Control and Countermeasure (SPCC) plans, 40 *Code of Federal Regulations* (CFR) 112 and other Environmental Protection Agency (EPA) requirements.
- b. Occupational Safety and Health Act (OSHA) requirements.
- c. Tank or vessel inspection records, registration, or files.
- d. Discharge or remediation permits.
- e. Air and water permits.
- f. Oil Pollution Act of 1990 (OPA 90) regulations and contingency plans.
- g. State and local emergency plans.
- h. 49 *Code of Federal Regulations* 195—Department of Transportation (DOT) Transportation of Hazardous Liquid by Pipeline regulations.
- i. Superfund Amendments and Reauthorization Act (SARA) Title III requirements.
- j. United States Coast Guard (USCG) requirements, 33 *Code of Federal Regulations* 154.
- k. Local or state Fire Marshall permits.

3 Definitions

3.1 For the purposes of this recommended practice, the following definitions apply:

3.1.1 may: indicates provisions that are optional and, consequently, are at the discretion of the designer or operator.

3.1.2 must: indicates important legal or safety considerations.

3.1.3 shall: indicates provisions that are mandatory to meet this API standard.

3.1.4 should: indicates provisions that are recommended but not mandatory. Implementation of these provisions will be made based on consideration of the following, as appropriate: (a) risk/benefit analysis, (b) company standards, (c) company experience, and (d) company philosophy.

3.1.5 underground tank: a buried container that has a capacity of more than 110 gallons (416 liters) and is used to store petroleum, additives, or other products for later use.

4 Facility and Equipment Standards

The following are recommendations for the tankage, lines, and testing equipment, and are intended to complement the general operating guidelines.

4.1 STORAGE TANKS

4.1.1 Tanks may be either above or below ground. Tanks should meet all federal, state, and local codes and requirements. Underground tank integrity testing should be done annually, and records of such testing should be maintained.

4.1.2 All tanks should be clearly marked with the product name, as well as any other information required by federal, state, and local laws.

4.1.3 All tanks, except cone-bottom tanks, should have a water draw-off at the lowest possible point within the tank.

4.1.4 All tanks should be designed to allow for sampling of the contents. A sample obtained through a pump or line is acceptable, provided adequate flushing procedures are used.

4.1.5 When changing tank service from one product type to another, the tank should be emptied completely and cleaned first. It is not necessary to clean between shipments that have the same grade and performance level.

4.1.6 The facility should be capable of storing line flushings. Disposal of line flushings should be in accordance with federal, state, and local laws.

4.1.7 Tanks should be designed so that their contents can be volumetrically measured/gauged in some manner.

4.1.8 All tanks should be designed so that the temperature of their contents can be monitored. Heating, if required to facilitate handling, should be carefully controlled to prevent product degradation.

4.2 LINES, PUMPS, METERS, AND HOSES

4.2.1 All lines should be clearly identified with the product name near the valve closest to the tank discharge or receiving point.

4.2.2 It is preferred that each product have separate lines, pumps, and meters.

4.2.3 In situations where a totally dedicated system for each product is not feasible, it may be acceptable to use limited common lines and a common pump/meter within each of the product groups. Common lines and pumps/meters should not be used for products in different groups (hydraulic oils, motor oils, gear oils, ATF).

4.2.4 Lines should have isolated valves close to the pump (manifold) and should be equipped with appropriate pressure-relief controls.

4.2.5 Schedule 40 carbon steel or stainless steel are the preferred materials for all lines carrying lube oils. Galvanized and PVC pipe are not recommended for lubricants. Most PVC pipe is manufactured for water service and is incompatible with hydrocarbons, especially low-viscosity products and synthetics.

4.2.6 All lines and hoses at bulk loading racks should be designed to drain-dry, and/or procedures should provide for line flushing using pigs, inert gas, or air if it is safe to do so.

4.2.7 All scales and meters should be routinely and regularly calibrated and should comply with city, county, state, federal, and other applicable regulations. Records of calibration should be maintained.

4.2.8 Loading and filling lines should contain a strainer of 60-mesh or finer, to protect the pump. Small micron-size screens may be required to meet cleanliness requirements.

4.2.9 To maintain good housekeeping, drip pans should be used where the hoses are coupled.

4.2.10 All hoses used within the facility should be dedicated to a specific product group and identified to reflect that service.

4.2.11 A schematic drawing of the bulk plant facilities indicating tank sizes, products, lines, pumps, and other pertinent information is recommended.

4.3 PRODUCT TESTING EQUIPMENT

For facilities handling bulk lubricants, the following equipment should be available to perform basic product tests:

- a. Clean, dry, and clear glass or plastic bottles that can be used when making visual comparisons to reference samples for color, water, and contamination.
- b. A handheld device to measure product viscosity grade. (This is used for viscosity grade identification only. This is not a measure of accurate viscosity.)
- c. A soldering iron to run crackle tests for water contamination.
- d. An explosion-proof droplight to inspect 55-gallon drums for internal cleanliness.

e. A sample thief to secure representative samples from storage tanks or other containers.

f. Any additional laboratory equipment that may be necessary to complete ASTM tests on products that are blended on site.

4.4 PERSONAL SAFETY EQUIPMENT

Safety equipment is recommended to protect employees. Appropriate safety equipment may include the following:

- a. Hardhat.
- b. Protective eyewear.
- c. Fire extinguisher.
- d. Solvent-impervious gloves.
- e. Long-sleeved clothing and/or coveralls.
- f. Safety belts.
- g. Personnel should follow a written safety program that includes appropriate governmental regulations and recommended company safety policies.

4.5 TRAINING RECORDS

Records should be maintained to document training provided to employees who handle loading or packaging of lubricants.

5 Sampling and Testing

General sampling and testing guidelines are located in Appendixes B and C.

6 Storage

6.1 GENERAL

6.1.1 All bulk oil products should be stored in dedicated tanks.

6.1.2 Clearly mark tanks as to contents, disclosing product name, and viscosity.

6.1.3 Beginning and ending balances should be recorded.

6.1.4 Tanks should be designed so that samples may be taken.

6.1.5 Tanks should be designed so that the temperature of the contents can be monitored.

6.2 COMMINGLING

6.2.1 Products from different companies should not be commingled, even if the product is similar.

Note: Under some circumstances, mixing different oils with different additive systems may cause adverse reactions. Additionally, there may be commercial or contractual restrictions that prohibit commingling different products from different companies. Therefore, as a general rule, oils should not be mixed, unless full disclosure is made to all parties involved.

6.2.2 Tanks should be drained and flushed between similar products from different companies.

6.2.3 Tanks should be drained and flushed between different grades of the same product.

6.2.4 Tanks should be cleaned between different products or product groups.

7 Unloading Procedures

7.1 BEFORE UNLOADING TRUCKS

7.1.1 Properly position the truck for unloading; secure the brakes, and chock the tires.

7.1.2 Carefully check delivery documents to verify the products and quantities to be unloaded. If multiple products are included in separate compartments, take special care to avoid possible cross-contamination. A Bulk Receiving/Batch Log (see Appendix A) should be maintained for each product received.

7.1.3 Obtain a sample, per sampling instructions (see Appendix B). Complete the identification label, attach it to the sample bottle, and submit the sample to the laboratory.

7.1.4 Gauge the receiving tank to verify that there is enough room for the product to be unloaded. The quantity of the product to be unloaded should not exceed safe tank height, which is considered to be 90 percent of tank capacity.

7.1.5 Upon release by the laboratory, or verification that the shipment conforms to acceptance criteria, connect the ground strap to the trailer and prepare to unload the truck.

7.1.6 All unloading should be performed in accordance with applicable safety procedures and governmental regulations.

7.1.7 Inspect hoses for integrity and the absence of contaminants. Faulty hoses should not be used. Hoses used for unloading other products, or hoses that are dirty, should be flushed prior to use.

7.1.8 Before unloading, lines and valves must be set to direct the product to the proper tank. Piping systems with common lines, pumps, or manifolds should be flushed to displace any prior product (see Table 1).

Note: All trucks/trailers have emergency or hydraulic valves that must be opened before unloading can begin. Operator must ensure the dome hatch is not obstructed, which could cause the trailer to implode.

7.2 DURING UNLOADING

7.2.1 Once pumping has begun, inspect the system for possible leaks. If any leaks are noted, the unloading should be discontinued while the leak is repaired. Drip pans should be used to collect or contain any spillage.

7.2.2 During pumping, observe the pressure level on the pump discharge. An unusually low or high pressure may indicate that the pump suction is obstructed, or that the dome cover or valves are improperly open. Also, check the receiving tank to verify that the product from the trailer has been directed to the correct tank. If any anomalies are noted, all pumping operations should be shut down until the matter is understood and resolved.

7.3 AFTER UNLOADING

7.3.1 Once the trailer is empty, close the bottom valve, pump the suction valve, and turn off the pump. When possible, particularly when receiving lines to storage tanks are not product specific, blowing receiving lines with inert gas and/or ball will clear product from lines into receiving tank. Then, close all remaining valves, beginning at the receiving tank and ending at the pump discharge.

7.3.2 Bleed any pressure from the lines before disconnecting the suction hose. Connections should be released slowly to avoid possible discharge due to pressure buildup. Hoses should be capped/plugged before they are returned to storage areas.

7.3.3 Cap the trailer outlet valve, disconnect the ground strap, return the drip pan, and remove the wheel chocks. Release the truck.

7.3.4 Record receiving tank volumes (gauge readings) on the Bulk Receiving/Batch Log (see Appendix A).

8 Loading Procedures

8.1 GENERAL

8.1.1 Truck operators should be DOT qualified per all federal, state, and local regulations.

Table 1—Recommended Flushing Volumes for Common Systems

Oil Product Group	Recommended Flushing Volume (percent).
Motor Oils	100 percent of common (pump and line) volume when changing grades within a product family (example: HD SAE 30 to HD SAE 15W-40). 200 percent of common volume when changing from PCMO to HD or vice versa.
Hydraulic Oils	100 percent of common volume when changing from one grade to another within this group.
Gear Oils	100 percent of common volume when changing grades within a product family (example: SAE 85W-140 to SAE 80W-90).
ATF	300 percent when following any dyed product, or until no red tint can be seen.
Turbine Oils	100 percent of common volume when changing from one grade to another.

8.1.2 Truck operators should comply with all applicable loading site safety precautions and regulations. Loading site personnel should clearly post these safety precautions if appropriate.

8.1.3 Transport trailers and local bulk delivery equipment must have tight-sealing loading domes.

8.1.4 Tank compartments should be steam-cleaned and dried prior to loading if they contained any corrosive or flammable products, glycol, or any non-petroleum products during the previous load. Special products, such as active sulfur-containing products, must be handled in segregated systems, or stringent flushing procedures must be followed. Even trace amounts of such products in engine oils, turbine oils, hydraulic oils, and so forth, can cause catastrophic component failure.

8.1.5 The carrier is usually responsible for cleaning or flushing compartments; however, the loading facility must verify that the truck meets cleanliness requirements.

8.1.6 Loading into a retained product that is already on-board is generally not acceptable.

8.1.7 In the absence of sealed markers, or tank strappings, or both, the quantity of the product to be loaded should be determined by meter or scale.

8.2 BEFORE LOADING TRUCKS

8.2.1 Inspect each compartment to ensure it is empty and free of contaminants.

8.2.2 Use an MSA-type gas tester to test each compartment for gasoline or other combustible gases.

8.2.3 Verify that the product to be loaded matches shipping documents or loading instructions.

8.2.4 Line up the appropriate storage tank lines, pumps, and so forth. The system must be flushed to clear any common lines of possible contaminants.

8.3 DURING LOADING

8.3.1 Open valves, start the pump, and begin loading. Watch for unusually high or low pressures. High pressure could indicate a closed discharge valve or frozen pipe. Low pressure could indicate a plugged strainer or closed suction.

8.3.2 Check the system for any leaks. If leaks are detected, shut down the pumping and make the necessary repairs. Any spillage must be contained.

8.3.3 Verify that the product is being received in the truck, and that the product level in the storage tank is decreasing. If any anomalies are observed, pumping must be discontinued until the situation is investigated and resolved.

8.4 AFTER LOADING

8.4.1 Close valves and shut down the pump. Disconnect the loading arm or hose. Samples should be taken from the middle of each compartment and submitted for specified testing.

8.4.2 The truck should be released only after sample approval.

8.4.3 The truck should be gauged or weighed to verify the volume of the loaded product. Confirm that the valves are closed and the outlets are capped.

8.4.4 Seals should be used on compartments for security. If a seal is used, the seal number should be recorded on the Bill of Lading.

9 Packaging

9.1 GENERAL

The guidelines in this section were devised to set some recommendations for distributors who package products from bulk storage into drums and/or pails. These guidelines are not meant to replace more restrictive instructions or requirements from packaging equipment manufacturers or finished lubricant manufacturers.

9.1.1 Drums or pails should be filled in an area that is free of dust and moisture.

9.1.2 Fill lines should be flushed between products in accordance with flushing guidelines. (See 7.1.8.)

9.1.3 Records should be kept to reflect the product filled, date, time, quantity, and source of the product (storage tank ID or trailer). A retained or inventory sample of the product to be packaged will aid in responding to consumer complaints or possible field contamination.

9.1.4 Never commingle. Adequate, separate storage should be available for each brand or grade of lubricant that is handled. If supply source (terminals) have to be changed, empty the tank completely, even if the new source will supply the same brand and product.

Note: Under some circumstances, there may be adverse reactions when mixing different oils with different additive systems. There may also be commercial or contractual restrictions that prohibit commingling different products from different companies. Therefore, as a general rule, oils should not be mixed unless full disclosure is made to all parties involved.

9.1.5 Avoid manifold, reel, or line mixing from one type of product to another. Follow flushing guidelines whenever common lines are used.

9.1.6 Use current and complete product information labels. The information in the labels must be sufficient to trace the product to lot numbers and retained samples.

9.1.7 Samples from each fill run should be retained. The following information should be retained with the sample for a reasonable period of time:

- a. Product name and manufacturer code number.
- b. Date packaged.
- c. Batch number and reference number.

Information and sample should be retained for a minimum of 6 months.

9.2 DRUMS

9.2.1 Painted surfaces shall be of sufficient thickness and quality to prevent rusting of the drum's external surface after 6 months of outside storage.

9.2.2 Interior shall be completely dry and free of rust and other foreign material.

9.2.3 All drums shall be structurally sound and free of leaks.

9.2.4 In addition, reconditioned drums should meet the following conditions:

- a. Chine (drum rim) shall be tight and to original contour.

- b. Head shall be smooth and free of dents and welds, and shall conform to original contour.

- c. Plugs shall be clean, free of worn or damaged threads, equipped with new gaskets, and capable of providing a leak-proof closure.

- d. Flanges shall be free of worn or damaged threads. Threads shall be clean and the face of the flange shall be smooth and capable of providing a leakproof closure. Closure shall permit sealing.

9.3 TOTES

General cleanliness and handling procedures for totes should reflect a similar common-sense approach to drums or pails. However, bulk totes should be treated as tank storage for the loading, flushing, and commingling of products.

10 Record Keeping

Refer to Appendix A for some examples of basic reports required for lubricant receipt, handling, and shipment. These reports represent a minimum level of record keeping. There are more sophisticated computer programs that are available for record keeping and tracking.

APPENDIX A—SAMPLE RECORD KEEPING FORMS

TANK READINGS

Date: _____

[illegible]

Signature _____

Date _____

Page of Pages

TOTE TRACKING FORM

Serial Number _____

Customer _____

Gallon Capacity _____

Location _____

Manufacturer _____

Department _____

Date Purchased _____

Product in Use _____

[illegible]

Comments:

PACKAGING LOG

Product Name _____

Code # _____

[illegible]

BULK RECEIVING/BATCH LOG

Product Name _____

Code # _____

[illegible]

[illegible]

DOCUMENTATION CHECKLIST FOR STANDARDS AND PROCEDURES FOR BULK HANDLING AND PACKAGING

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bulk Lube Loading, Customer Pick-Up												
Is it ensured that tank compartments that contained any corrosive or flammable products, glycol, or any nonpetroleum products on the previous load have been steam-cleaned and dried prior to loading?												
Is it ensured that tank compartments are clean, dry, and free from rust, scale, dust, and liquid?												
Is it ensured that no retained product remains in any of the compartments to be loaded?												
Are there steps showing how each compartment will be loaded and in what order?												
Are there documented procedures for sampling of bulk oil shipments prior to receipt?												
Does adequate documentation exist to demonstrate that these procedures are being followed?												
Bulk Operating Standards												
Is it ensured that a minimum 4-oz. sample is secured from each compartment and placed in a clean, dry, and clear container for visual comparisons and retention?												
Is it ensured that any suspected contamination is reported immediately to the customer service department for further instructions?												
Is it ensured that each sample is labeled with product name, product code, date received, supply point, invoice number, and batch number?												
Is it ensured that all unloading hoses are inspected to be sure that they are free of contaminants?												
Is it ensured that the receiving tank has been gauged to make certain it has sufficient room to accept the new product?												
Is it ensured that where limited common lines are utilized, flushing requirements are followed for both unloading and loading/filling?												
Product Testing Equipment												
Is there a documented procedure for sampling storage tanks?												
Packaging Standards												
Is it ensured that records are maintained that allow tracing of product(s) back to supply points?												
Training Records												
Is the training of employees documented?												
Meter Calibration												
Is a procedure in place, and are all meters calibrated and documented at a minimum of an annually scheduled basis?												
Filling of Containers												
Is a proper label used and all filling information documented?												
Is a procedure in place, and are all meters/scales calibrated and documented at a minimum of an annually scheduled basis?												
Testing												
Is testing equipment available, and is a log kept with all test results?												

APPENDIX B—SAMPLING

B.1 Personnel Safety Precautions

B.1.1 While sampling, employees should be wearing the appropriate personal protective equipment, which may include the following items:

- a. A hardhat.
- b. Protective eyewear.
- c. A respirator.
- d. Solvent-impervious gloves.
- e. Other company specified equipment.

Additional equipment, such as a face shield, coveralls, or breathing air supply may be required, depending on the circumstances and materials to be sampled.

B.2 Sampling Procedures—Bulk Tanks

B.2.1 Open the valve carefully and drain enough oil into the 5-gallon container to purge the valve and line.

B.2.2 Keep the valve open slightly and fill the sample container. Keep the bottle capped unless a sample is being taken.

B.2.3 Flush the sample container with oil to remove any contaminants.

B.2.4 Refill the sample container with fresh oil. Do not disrupt the flow of the product when taking the sample.

B.2.5 Turn the valve off.

B.2.6 Fill the handheld viscosity measuring device with oil from the sample bottle, run the test later, or utilize the appropriate QC procedures.

- a. The device must be clean so it will not contaminate the sample.
- b. Leave an air space for expansion in the sample container to prevent rupture. Taking the sample for the viscosity measurement should leave ample expansion room.

B.2.7 Put the lid on the sample container.

B.2.8 Label the sample as follows:

- a. Product name and code number, if any.
- b. Date received.
- c. Reference number and date.
- d. Batch number.
- e. Name of the person taking the sample.

B.3 Sampling Tank Trucks and Railcars Using a COLIWASA or Equivalent Sampling Device

B.3.1 Clear the dome hatch of snow or any other materials that could contaminate the oil when the manway is opened. Protect the oil from rainwater.

B.3.2 Open the dome hatch's hold-down bolts slowly, beginning at the hinged side; this allows for any possible pressure buildup to subside.

B.3.3 Open the dome hatch.

B.3.4 Adjust the sampling device to the open position. The ball valve must be open so that the liquid can enter the tube. A sampling device is a long tube with a check valve that allows representative samples of the total load to be taken.

B.3.5 Insert the sampling device carefully into the liquid material in the tank truck or railcar. This must be done slowly and carefully to obtain a representative sample.

B.3.6 When the sampler reaches the bottom, push down to force the valve to a closed position.

B.3.7 Remove the sampler. During removal, wipe the outside clean to prevent dripping. Transfer the entire contents into a clean sample pitcher. Release the liquid in the sampling device slowly to avoid spillage. Transfer the entire contents of the pitcher into a clean sample bottle.

B.3.8 Clean the sampling device before using it again.

B.3.9 Prepare a label, affix it to the bottle, and submit it to the lab along with the appropriate paperwork.

B.4 Sampling Drums

B.4.1 Drums received directly from a manufacturer for resale will not usually require special testing since the manufacturer certifies that the product conforms to specification. If samples are required from drums, the following procedure should be used.

B.4.1.1 Inspect the drum's appearance. Check for rust, leaks, or bulges. If the large bung is rusted and cannot be easily opened, spray it with spray penetrant, wait two minutes, and try again. If the drum still cannot be opened, it should be sent back to the generator. If the drum is bulged, it is either pressurized, or has been in the past. Extreme caution should be taken with a drum of this type, and additional personal protective equipment should be worn.

B.4.1.2 Loosen the large bung slowly. If there is a hissing sound, the drum is under pressure. Stop and place a blanket over the top. Remove the bung slowly under this protective blanket. This will provide protection from spray if the bung comes off quickly. Remove the large bung.

B.4.1.3 Place the sampling pan on the drum. Place the bottle in its holder.

B.4.1.4 Adjust the sampling device to the open position.

B.4.1.5 Insert the sampling device carefully into the drum through the bung hole. This must be done slowly and carefully to obtain a representative sample.

B.4.1.6 When the sampling device reaches the bottom, adjust it to the closed position.

B.4.1.7 Remove the sampler. Transfer the material contents to the sample bottle and screw on the bottle cap. Release the liquid in the sampling device slowly to avoid spillage.

B.4.1.8 Clean the sampling device before using it again.

B.4.1.9 Prepare and affix a label to the bottle and submit it to the lab with the appropriate paperwork. Return samples to the central location.

B.5 Sampling—General Conclusions

B.5.1 Upon receipt or shipment of any bulk oil, obtain a sample from each compartment prior to unloading.

B.5.2 Clearly label each sample with the product name, viscosity, source, date, compartment number, and storage tank identification. Tightly seal and retain this sample as required.

B.5.3 Record the following information in a permanent ledger or computer file:

- a. Register number.
- b. Date.
- c. Beginning and ending inventory in the storage tank.
- d. The delivery carrier.
- e. Product source.

B.5.4 When packaging any product, record the package date on each label that is used. A sample should be taken from a drum or a pail for each batch that has been packaged. Identify if sample was taken from a drum or a pail and retain sample as required.

APPENDIX C—TESTING GUIDELINES

C.1 Observable Characteristics in Sample

The sample should be visually inspected for the following:

- a. Free water.
- b. Sediment.
- c. Hazy appearance.
- d. Particles.
- e. Color (must match the reference sample).
- f. Any other unusual characteristics.

If any of the above are observed, purge 10 gallons and retest. If appearance is still abnormal, call supplier personnel.

C.2 Viscosity and Water

C.2.1 Run viscosity on all samples using a handheld viscosity measuring device.

C.2.2 Run crackle test for water. Other types of testing, such as dielectric strength, may be used if equipment is available.

C.3 Certificate of Analysis—Finished Lubricants

C.3.1 Distributors should request a Certificate of Analysis on finished lubricants showing all or part of the following test results. Appropriate ASTM tests for each of the following tests might be available and are recommended for use:

- a. Odor.
- b. Appearance.
- c. Color.
- d. Crackle.
- e. Flash.
- f. Pour point.
- g. Viscosity at 100°C.
- h. Viscosity at 40°C.
- i. Additive metals (as appropriate)—Ca, Si, P, Zn, Mg, and so forth.
- j. Viscosity index.
- k. Demulsibility.
- l. Other as compared to a reference specification.

APPENDIX D—RECOMMENDATIONS FOR HANDLING AND STORAGE OF LUBRICATING OIL ADDITIVES

D.1 General

D.1.1 Lubricating oil additives are concentrated organic chemicals that have a high degree of purity. If subjected to overheating, certain types of additives are susceptible to thermal decomposition. In some cases, chemical decomposition might occur if the additives are contaminated with small amounts of rust, copper, or water.

D.1.2 If normal procedures and hygienic practices are observed, personnel handling these materials will experience no discomfort or harm. The following suggestions should be considered for the safe handling of oil additives.

D.2 Precautions Against Damage to Lubricant Additives

D.2.1 WHAT TO AVOID

D.2.1.1 Do not use high-pressure steam for heating under any circumstances.

D.2.1.2 Do not permit additives to come into contact with copper or brass heater coils, or other chemicals.

D.2.1.3 Do not continuously operate steam heating coils in additive storage tanks.

D.2.1.4 Do not permit water to get into additives.

D.2.1.5 Do not use leaking heater coils.

D.2.1.6 Do not use wet air for agitation.

D.2.2 WHAT TO DO

D.2.2.1 Use hot oil or hot water heating coils if possible. If these are not available use a minimum amount of steam at atmospheric pressure.

D.2.2.2 Use iron or stainless steel heating coils exclusively.

D.2.2.3 Keep storage tanks in a heated room if possible. Otherwise, use instantaneous type heaters that are large enough for satisfactory pumping at a maximum heater surface temperature of 250°F (121°C). Steam pressure should not exceed 15 pounds per square inch (1 kilogram per square centimeter).

D.2.2.4 Minimize exposure to moisture by all means possible.

D.2.2.5 Inspect the heating coils frequently.

D.2.2.6 Use mechanical stirrers. If air must be used, take all possible precautions to reduce the moisture content.

D.3 Precautions Against Injury to Personnel

D.3.1 WHAT TO AVOID

D.3.1.1 Do not permit personnel to be directly exposed to vapors from the additives, especially when the additives are heated.

D.3.1.2 Do not store additives in tanks where gauging must be done through a direct opening.

D.3.1.3 Do not permit fumes from the stored additives to accumulate.

D.3.1.4 Do not permit an additive to come into direct contact with the skin.

D.3.2 WHAT TO DO

D.3.2.1 Require that fresh air masks be worn if exposure to additive fumes is unavoidable.

D.3.2.2 Use outside gauges on storage tanks.

D.3.2.3 Provide adequate dry air ventilation in places where fumes might collect.

D.3.2.4 Require the use of protective clothing and skin cream when contact with an additive might be expected.

D.4 Storage Tanks

D.4.1 Additives should be stored in small tanks (with a 10,000-to-25,000 gallon capacity) located inside of a building. Tanks should also be tall and narrow, rather than wide and low. Tank vents should be equipped with some means of drying the incoming air in order to avoid moisture condensation and the gradual accumulation of water. Ideally, tanks should have cone bottoms with a suction line at the lowest part of the cone. This is not normal for petroleum oil installations, but is recommended to prevent the accumulation of water, if it enters in spite of other precautions.

D.4.2 A regular schedule of inspection should be followed and if necessary, tanks should be cleaned. Heat should not be applied to stored additives except when it is necessary for pumping, and then only exhaust steam or hot water should be used. The use of suction or line type heaters is recommended.

D.5 Blending Equipment

Ideally, additives and oil should be blended at 125°F (52°C), but not above 150°F (66°C). Mechanical mixing is recommended. If air agitation must be used for mixing, adequate precautions should be taken to ensure that the air is dry.

Compressed air may contain substantial quantities of moisture and should be specially dried before using.

D.6 Specific Unloading Precautions

Experience indicates that under certain time and temperature conditions, the intermixing of chemical additives that are currently being supplied for treating motor oils and gear lubricants can cause incompatibility. This is evidenced by deposits on the bottom of storage tanks. Deposit problems can stem from the unloading and handling of the concentrated chemicals, therefore, precautions should be followed to prevent unnecessary deposit formation in additive unloading lines and storage tanks.

D.7 Bulk Shipment and Storage of Additives

D.7.1 Bulk delivery of additives has many advantages over drum delivery, such as lower cost, less storage space, and eas-

ier handling. However, different equipment and operating methods are required.

All of the benefits of bulk delivery and storage can be obtained without sacrificing any of the quality of drum storage, if proper initial planning and control are used during the actual operation.

Lubricant additives are concentrated organic chemicals that must depend on some degree of chemical activity for their effectiveness. This means they are necessarily sensitive to heat, moisture, contact with other chemicals and additives, and to catalysts that promote their activity. It is important that overheating, water contamination, and contact with copper or brass heater coils and fittings be avoided. This sensitivity is greatly reduced when the additives are blended into base oils in the recommended percentages.

The following is designed to assist in the conversion from drum to bulk storage and to unload bulk shipments into existing storage. Further information regarding equipment or installation design should be provided to answer specific questions.

Table D-1—Recommendations for Handling and Storage of Lubricating Oil Additives

Fire and Explosion Hazard Data	Flash Point (method) 152°C PMCC	Classification n/a
Temperature Recommendations	Unloading	
	Pumping temperature	122°F (50°C)
	Maximum temperature ^a	158°F (70°C)
	Storage	
	Maximum temperature for long-term storage	113°F (45°C)
Equipment Recommendations	Blending	
	Maximum base oil temperature for mechanical or in-line mixing	158°F (70°C)
	Type of pump	Positive displacement
	Type of transfer line	Ball launched, insulated, steam traced using 225°F (107°C) stream max.
Heat Source	Transfer line size	2 to 3 inches (5 to 8 cm)
	Type	Steam 225°F (107°C) max.
	Storage	Suction heater recommended
Viscosity Data	cSt	SUS
	77°F (25°C)	3,384
	104°F (40°C)	1,290
	212°F (100°C)	93
Pour Point	12°F (-11°C)	

Notes:

- As a minimum, use of neoprene or nitrile rubber gloves, and safety glasses or chemical splash goggles is recommended. The Material Safety Data Sheet should be consulted for specific information including health and safety when handling the product.
- Cold temperature storage—if product has been stored below its pour point temperature, it should be heated to 70°F (21°C) before using.

^aHolding the material in excess of this temperature could cause chemical degradation. To avoid localized overheating, use steam for heating and tracing only when the material is in motion.

D.7.1.1 When Loading

- a. All rail tank cars should be cleaned.
- b. All road tankers should be inspected for cleanliness.
- c. The unloading valves and steam lines should be inspected for leaks.

D.7.1.2 When The Tank Car or Road Tanker Arrives at Its Destination

- a. It should be weighed immediately. If weighing scales are not readily available, the liquid level should be gauged and temperatures of the contents should be obtained. Make sure the tank car is on level track. Upon request, a procedure should be provided for calculating the net volume or weight of material from this data.
- b. The gross weight should be compared with that shown on the shipping papers. If the weights fail to agree within 0.5 percent, the tank car or road tanker should be weighed a second time. If the weights still fail to agree, the supplier should be contacted. The shipment should not be unloaded until further instructions are received.
- c. The top hatch cover should be opened and top, center, and bottom samples should be removed for a quality check. The cover should then be closed until the quality is approved. The samples should be retained for as long as is practical (one year is recommended). If the test results are not acceptable, the supplier's office should be contacted immediately for further instructions.

D.7.1.3 When Unloading Rail Tank Cars

- a. Steam coil procedures are not applicable to the API Bulk Oil Testing, Handling, and Storage guidelines. Refer to the railroad and railroad car companies' suggested practices or corporate procedures.
- b. The additive in the tank car should be heated to a temperature no higher than is necessary for easy pumping. Handling recommendations for each product are available upon request. Many additives may be easily pumped at lower temperatures. Should higher temperatures be required, it is recommended that the supplier be contacted for further information.
- c. The unloading pump should be of the positive displacement type, and should be as close to the car as possible (see Figure D-1). Ordinarily, it should be sizeable enough to maintain a pumping rate of 53 gallons per minute (gpm) (200 liters/minute) against a pressure of 100 pounds per square inch gauged (7 kilograms per square centimeter). If the unloading line is less than 3 inches (80/90 millimeters) in diameter, or is comparatively long, a larger pump may be useful if the unloading time must be minimized. The hose on the pump's suction side should be at least the same diameter size as the unloading valve on the tank car, and preferably 3-to-4 inches (80/90 or 102/114 millimeters) in diameter.

d. Different types and sizes of connection from the tank car may be found. The types of thread or flange should be determined before shipment is received so that proper connecting devices will be available.

e. When the car is empty, the hatch cover should be put back in place, and the valves should be closed to prevent contamination on the return trip. Blow out the steam coils and leave the caps off. Replace the cap on the bottom outlet.

D.7.1.4 Unloading Road Tankers

- a. The supplier normally loads road tankers at such a temperature that no heating is necessary at the destination, unless more than 8 hours in transit is required during winter conditions. If heating is required, tankers equipped with heating coils should be employed. When this is the case, all precautions should be observed, such as those listed under the instructions for handling rail tank cars.
- b. In many areas, road tankers are equipped with their own pumps or compressors for unloading. After confirming the quality and quantity of the material, the road tanker is unloaded through a clean discharge hose by pumping or pressurizing. If the road tanker does not have its own unloading equipment, facilities similar to those described for unloading rail tank cars are recommended.

D.7.1.5 General

- a. In general, motor oil additives are incompatible with gear oil additives and viscosity improvers. For this reason, it is important to avoid contaminating one with the other. The ideal situation would be to use separate unloading lines for each additive product. However, if this is not practical, a two-line system is satisfactory, provided that the proper precautions are taken. One line should be for motor oil inhibitors and detergents, and the other for gear lubricant additives or viscosity improvers. In many circumstances, such as in cold climates where transfer lines are outside, a heat-traced and insulated line may be used. If such equipment is considered, the supplier should be contacted for precautionary measures.
- b. It is also important that all of the unloading and transfer lines be completely empty when the unloading is completed. A method known as ball purging has been developed for emptying lines. Ball purging is performed by inserting a rubber sphere into the transfer line when the unloading is finished. This sphere may contain a liquid (usually oil) and its diameter is slightly larger than that of the transfer line. The sphere is blown through the line with dry compressed air. A pressure of 28 pounds per square inch gauged (2.0 kilograms per square centimeter) is normally sufficient. It has been found that this method will effectively clean the lines so that another product of the same type (such as two different motor oil additives) may be put through without fear of contamination. However, it is recommended that separate lines be used for gear oil additives, viscosity improvers, and motor oil additives.

D.7.1.6 Storing in Bulk

- a. Additives in bulk should be stored in cylindrical steel tanks (see Figure D-1). Preferably, these tanks should be tall and narrow. Advantages of these tanks when compared to short, wide tanks are: 1) more precise measurement of content, and 2) savings in the area that is required.
- b. However, height and diameter dimensions are not critical if other considerations are decisive. In either situation, the storage tank should be equipped with an accurate gauging device that can be read from the vicinity of the control switch on the pump.
- c. Ideally, an individual tank should be used for only one type of product—either motor oil additives or gear lubricant additives. If it is decided to change the contents of the tank, then the tank must be thoroughly cleaned before the new product is added.
- d. It is good practice to have the tank bottom constructed so that it can be completely emptied by draining. This can be done with: (1) a well in a flat bottom, (2) a sloping bottom, or 3) a cone-shaped bottom. It is also good practice to have a manhole in the side of the tank to permit entry into the tank for cleaning purposes.
- e. The transfer pump should be of the positive displacement type. It is suggested that this pump also be used as a circulating pump, which will help prevent any one particular part of the additive from being overheated. To insure that the additive is uniformly warm, the tank should be circulated periodically from the bottom outlet.
- f. A suction heater (enveloped bayonet heater) that is saturated steam at atmospheric pressure, or preferably a warm oil-heating system, should be used to warm the additive when necessary. The heater skin temperature should not exceed 215°F. Heating coils should be made of iron, rather than copper or brass, and should not have mechanical joints inside the tank. To prevent localized overheating, precautions should be

taken to ensure that the steam is never turned on unless the pump is running and the additive is in motion.

- g. A regular schedule of inspections of additive tanks for deposits and general cleanliness should be followed. Tanks should be cleaned when necessary.

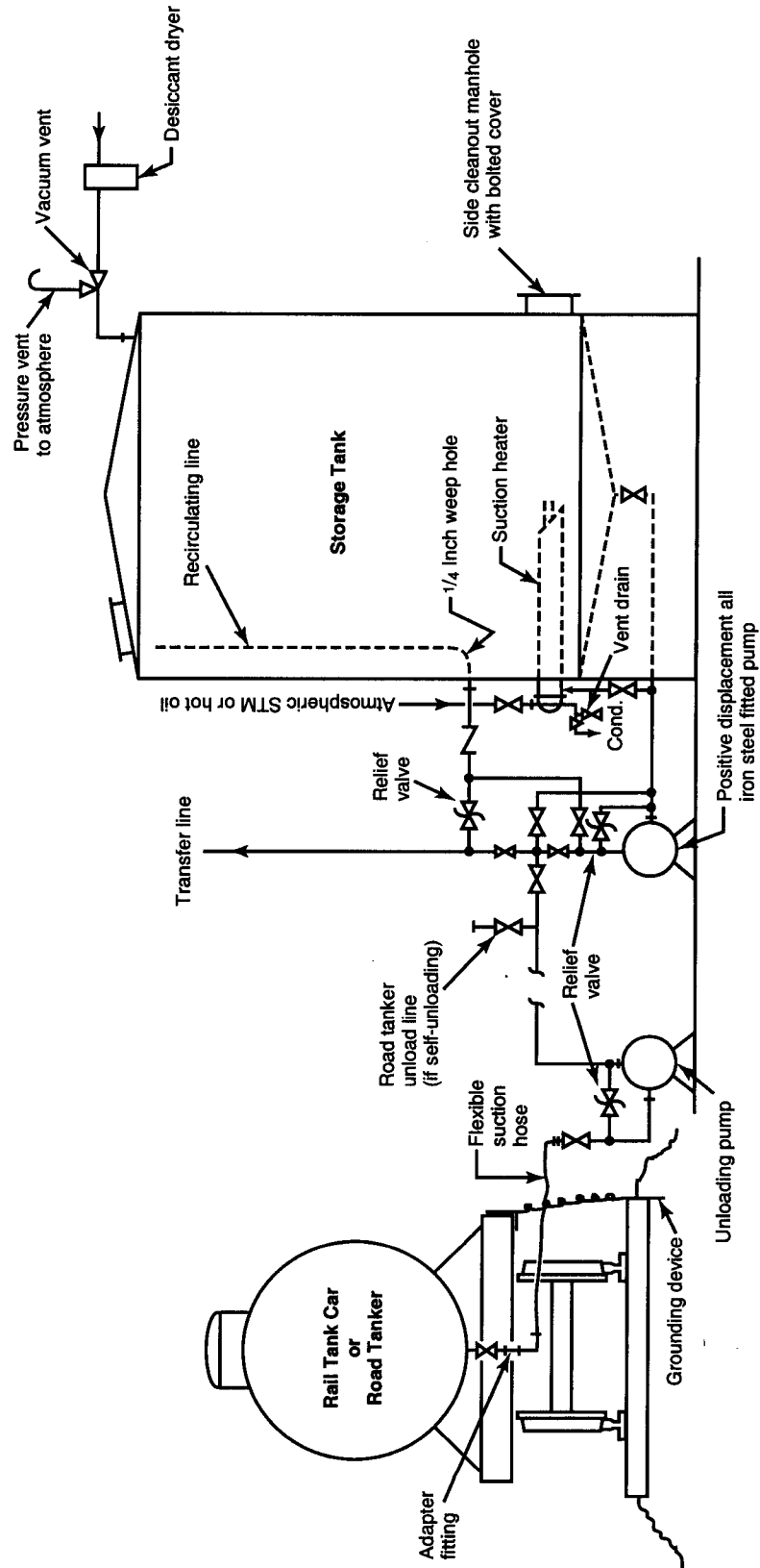
- h. Again, it should be emphasized that the steam is never applied directly to the additive, only indirectly by means of heating coils.

- i. At the top of the tank, there should be an air vent equipped with an air dryer using silica gel or quicklime to prevent entry of moisture and subsequent accumulation of water. This might not be necessary in dry climates, or if the storage tank is protected from temperature extremes by insulation, or if it is located in a heated building.

D.7.2 Observance of the Conditions That Are Summarized Below Will Result in Additives Maintaining Their Original Quality

- a. Do not apply steam directly to the additive.
- b. Do not use copper or brass heating coils or fittings. Use iron heating coils.
- c. Do not continuously operate heating coils in storage tanks. Use them only when an additive is being pumped and the additive is in motion. Maximum additive storage temperatures should be about 113°F (45°C).
- d. Do not permit water to get into the additives. Use air dryers on the tank air inlet vent when humid conditions are present. Frequently inspect all heating coils for leaks.
- e. Mechanical agitation is preferred to air agitation for blending purposes. If air agitation is used, the air must be dry.
- f. Clean transfer lines after use.
- g. Inspect tanks frequently, and clean them when necessary.

Proper care at all times will reduce the cost of using additives in bulk and will help alleviate additive handling, storage, and blending problems.



Note:
If rail siding or road tanker location is close to the storage tank, the same pump may be used for both unloading and transfer.

Figure D-1—Typical Tank Car Unloading and Storage System

APPENDIX E—STANDARD PRACTICE FOR MANUAL SAMPLING OF PETROLEUM AND PETROLEUM PRODUCTS

For information on manual sampling of petroleum and petroleum products, consult the most recent edition of Chapter 8.1 (Manual Sampling of Petroleum and Petroleum Products) and Chapter 18.1 (Measurement Procedures for Crude Oil Gathered from Small Tanks by Truck) of the *API Manual of Petroleum Measurement Standards*.

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