

Bulk Oil Testing, Handling, and Storage Guidelines

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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, packaging and shipment of finished lubricants in bulk or packaged goods ranging from Intermediate Bulk Containers (IBCs) to pails. A log (whether electronic or hardcopy) detailing incoming and outgoing shipments is recommended and may be mandatory in some jurisdictions.

This recommended practice provides general guidance on the proper handling and packaging of bulk oil. Applicability 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 the current version of all applicable federal, state, or local requirements. Facilities performing international shipments must also comply with the current version of all applicable foreign or international legislation. 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. GENERAL

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 and/or contractual obligations.
- 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. **IBC (Intermediate bulk container):** A mobile storage device meant to be moved using a forklift, with a capacity of at least 200 USG. Also commonly known as a “minibulk”, “tote” or “cube”.
- 3.1.6. **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.
- 3.1.7. **bulk receiving** process of receiving into inventory lubricants sold by net weight or volume.
- 3.1.8. **bulk loading:** process of transferring product from fixed storage to a movable container whose capacity exceeds 55 USG.
- 3.1.9. **bulk delivery:** process of delivering product from a movable container to a customer or consignee’s bulk storage container.
- 3.1.10. **pump from movable storage:** process of transferring bulk product from movable storage devices (e.g. drum, IBC, bag-in-box or other movable storage device) whose capacity exceeds 55 USG.
- 3.1.11. **repackaging:** process of transferring product from one liquid container to another. This may be part of a rebranding operation. Note: In this context, “container” is not meant to indicate a seagoing container.
- 3.1.12. **packaged goods:** products not intended to be transferred into a fixed container (e.g. a bulk tank). Packaged goods include but are not limited to quart, pail, drum, kegs, bag-in-a-box and/or IBCs.
- 3.1.13. **viscosity comparator:** handheld, analog device used to determine viscosity using comparison to a known standard. Commonly known as a “visgage”, after one of the more widespread models of such a device.
- 3.1.14. **field water test:** a test for water content that can be conducted outside of a laboratory setting.
- 3.1.15. **dedicated system:** A system set up to exclusively handle or store a single product.
- 3.1.16. **product family group:** A system set up to handle product within a family of compatible product subfamily (a typical family would be Passenger Car Motor Oil (PCMO); a subfamily could involve a set of products sharing a common additive.) Examples include AW hydraulic oils, motor oils, gear oils, ATF, etc.
- 3.1.17. **common system:** A system set up to handle products across several families, including some incompatible products.

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3.1.18. **swing Tank:** A storage or blending vessel that is not dedicated to a single product.

3.1.19. **multicompartment tanker:** An over-the-road tanker or rolling stock that has the ability to store two or more product types.

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. FACILITY SECURITY

Bulk lubricant facility security should include consideration of potential vandalism or any other exposure to an act or incident that can result in contamination or loss of product. Depending on the volume lost to spillage, applicable regulations may require environmental remediation. Refer to the latest edition of American Petroleum Institute Standard 1164, *Pipeline SCADA Security*

4.2. BULK PLANT GUIDE

Each facility should have a bulk plant guide. The purpose of the bulk plant guide is to consolidate the bulk facility's master written procedures, forms, logs, calibration certificates and tables into a central system. It should be customized for each facility. All documents contained within the bulk plant guide should have a "revision date" to ensure that the latest version is being utilized. For facilities operating under a recognized Quality Management System, these should be considered as controlled documents. Such procedures and documents may be held electronically, and do not require storage as hard copies.

4.3. PROCEDURES

There should be written procedures in place for the following processes:

- Bulk receiving
- Bulk loading
- Bulk delivery
- Any field testing conducted or applicable ASTM methods
- Tank – physical and structural inspections
- Tank – Water inspections
- Flush handling
- Container filling (IBC, drum, keg and/or pail)
- Container inspections (IBC, drum, keg and/or pail)
- Site-specific safety protocols
- Gauge, meter or scale verification and/or calibration
- Waste management
- Corrective action protocols (including documentation of the determined root cause)

4.4. QUALITY ASSURANCE ISSUES

In order to minimize quality issues and promote a quality culture, a quality assurance issue tracking log should be maintained. The date, error, and corrective action that was taken should be documented in this log. The logging function is commonly held within the QMS software employed at a facility; use of such software is encouraged as a best practice. The facility management should conduct, as needed, meetings to discuss the issues with their employees.

4.5. CONDITION AND APPEARANCE OF BULK FACILITY

The bulk facility and vehicle(s)/vessel(s) should be clean, neat and well maintained. A good appearance is almost always a reflection of the actual quality assurance of a bulk facility. Plant safety and the environment may be improved by proper maintenance and housekeeping. Overall appearance may influence the perception of visitors and auditors.

4.6. STORAGE TANKS

4.6.1. 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 per any legally mandated schedule, or at least annually; records of such testing should be maintained. Some guidance is provided at

- <https://www.epa.gov/oil-spills-prevention-and-preparedness-regulations/tank-inspections> (and sublinks provided therein) as well as at
- https://www.epa.gov/sites/production/files/2014-04/documents/7_inspectionevaluation_testing_2014.pdf.

4.6.2. All tanks should be clearly marked with a product identifier (this may include a Tank Number) that can be tracked to invoicing records, the tank's capacity, as well as any other information required by federal, state, and local laws. It may be useful to ensure actual product names are used as identifiers at distributor and/or point-of-sale tanks.

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

4.6.3.1. Water draw-offs should be performed and documented at regular intervals, per written maintenance and upkeep instructions.

4.6.4. 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.

4.6.5. Tanks should be designed and built around established engineering principles. Therefore, adherence to standards such as API STD 650 13TH ED (2020) (*Welded Tanks for Oil Storage; Thirteenth Edition*)¹ or API STD 620 12TH ED (A1) (A2) (*Design and Construction of Large, Welded, Low-Pressure Storage Tanks; Twelfth Edition*)¹, as applicable, is strongly encouraged.

4.6.6. There should be a plan in place for both the internal and external inspection of all bulk storage tanks. Manways allow for the inspection of tanks and proper cleaning of those tanks when switching from one product to another and is another way to maintain product integrity. Tanks should be inspected, drained, and cleaned when needed. External inspections encompass the tank, as well as the surrounding area and all fittings immediately attached to the tank. All new tanks should have manways installed for ground level access. Entering a tank from the top is particularly dangerous. Cleaning the inside of a vessel must be performed in a safe manner. It is recommended using only qualified professionals with up-to-date training on "confined space" work to enter tanks. The integrity of spill containment facilities (e.g. berms) should be validated as part of the annual inspection.

4.6.7. It is recommended that any product handled in bulk be stored in a dedicated tank. Swing tanks are not recommended due to risk of commingling, which should always be avoided. Temporary storage tanks such as immobilized tank cars or transport trucks are not recommended. When changing tank service from one product type to another, the tank should be emptied completely and cleaned as part of the changeover process. However, this may be waived following a review of the compatibility of the new product with the previous contents. It is not necessary to clean between shipments of the same product but different batch numbers, unless there were any issues with either the last-contained batch or with the incoming batch, after inspection. If there is a formulation change, the tank may need to be cleaned.

4.6.7.1. Commingling - Products from different companies should not be commingled, even if the products are similar.

Note: Under some circumstances, mixing different oils with different additive systems may cause adverse reactions or interactions. Additionally, there may be commercial or contractual restrictions that prohibit commingling different products from different companies. Therefore, as a rule, oils should not be mixed, unless full disclosure is made to all parties involved. Note that at the installer level, commingling may impact the end-user's product warranty.

¹ Or any superseding edition following publication of this Standard.

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4.6.8. The facility should be capable of storing line flushings. It is recommended that all flush be documented. The volume of flush generated is part of the chain of custody of the product and written records will assist in management of bulk inventory. Disposal of all flush should be in accordance with federal, state, and local laws. API recommends the following guidelines for flushing:

Oil Product Family	Recommended Flushing Volume (percent)
Motor Oils	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 100 percent of common volume when changing from one grade to another within this group
Gear Oils	<ul style="list-style-type: none"> • 100 percent of common volume when changing grades within a product family. Example: SAE 85W-140 to SAE 80W-90
ATF	<ul style="list-style-type: none"> • 300 percent of common volume when following any dyed product, or until no tint from dye can be seen
Turbine Oils	<ul style="list-style-type: none"> • 100 percent of common volume when changing from one grade to another

4.6.9. Outside these guidelines, consult with local Quality Assurance department for instructions.

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

4.6.11. Tanks should be designed to avoid the ingress of water.

4.6.12. 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.

4.6.13. All tanks should provide suitable protection from ultraviolet (UV) light to prevent product degradation where relevant. Users of IBCs should be mindful of this issue when storing product outdoors.

4.6.14. IBCs used for permanent bulk storage should be dedicated to a single product.

4.6.15. IBCs that have been previously used to handle lubricant products containing zinc, should not be used to store zinc-sensitive products.

4.7. LINES, PUMPS, METERS, AND HOSES

4.7.1. All lines should be clearly identified with the product's name (or a suitable identifier) near the valve closest to the tank discharge or receiving point.

4.7.2. It is strongly recommended that each product have dedicated lines, hoses, pumps, and meters. As a minimum, each product family group should have its own hose, pump and meter. Only trained personnel should be allowed to use or operate a piece of equipment that is shared between products.

4.7.3. 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 family groups. Common lines and pumps/meters should not be used for products in different product family groups. Only trained personnel should be allowed to use or operate a piece of equipment that is shared between products.

4.7.4. Two or more lines should not share a manifold (i.e. they should not be hard-piped to a common pipe) unless the manifold is completely flushable and a system is in place to prevent two different valves from being opened up at the same time. Lock-out/tag-out procedures are recommended in these cases. Lines should have isolated valves close to the pump (manifold) and should be equipped with appropriate pressure-relief controls.

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- 4.7.5. 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. Galvanized pipes may leach or flake zinc. Most PVC pipe is manufactured for water service and is incompatible with hydrocarbons, especially low-viscosity products and synthetics.
- 4.7.6. It is recommended that all pipes are properly supported. Bracketry, mounting and any other relevant techniques are encouraged. Use of hose in lieu of proper piping should be avoided.
- 4.7.7. It is recommended that dry breaks are utilized in order to help reduce spillage and may result in improved bulk plant appearance, reduced product loss, and increased safety. Spill-containment provisions are mandatory in some jurisdictions.
- 4.7.8. All common 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. All pipe and hose ends should be protected from contamination with proper plugs/caps.
- 4.7.9. All scales and meters should be routinely and regularly verified or calibrated (as applicable) and should comply with NIST as well as any city, county, state, federal, and/or other applicable regulations. Records of calibration and/or verification should be maintained.
- 4.7.10. 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. However, such equipment must be chosen carefully, since some lubricant additives are subject to capture by fine filters.
- 4.7.11. To maintain good housekeeping, drip pans should be used where the hoses are coupled. They should be emptied promptly. Spill kits may also be used, but only if drip pans are unable to contain a spill or are unavailable. In some jurisdictions, reporting to environmental authorities must take place if spills exceed a threshold volume.
- 4.7.12. All hoses used within the facility should be dedicated to a specific product family group and identified to reflect that service.
- 4.7.13. A schematic drawing of the bulk plant facilities indicating tank sizes, products, lines, pumps, and other pertinent information is recommended. It should be reviewed and/or updated at least annually.

4.8. PRODUCT TESTING EQUIPMENT

There should be a written, detailed procedure for all test methods.

Where a dedicated laboratory with calibrated instrumentation is unavailable, the following practices may be of use:

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

- a. Clean, dry, and clear BOTTLES that can be used when making visual comparisons to reference samples for color, water, and contamination. Users of glass bottles should be mindful of safety hazards from breakage.
- b. REFERENCE SAMPLE – A sample of the product to compare with product handled at the facility. The reference sample may be an actual sample set aside or the last product sample retain from the last bulk shipment (if the shipment was considered to be within specification). If using a sample set aside, it should not be used beyond a specified date.
- c. A VISCOSITY COMPARATOR to measure product viscosity grade. (This is used for viscosity grade identification only. This is not an accurate measure of viscosity.) The calibration certificate should be maintained.
- d. HANDHELD DEVICE REFERENCE CHECK. There should be a control sample of verified viscosity used to validate the accuracy of the viscosity comparator. The handheld device should be checked quarterly against the control sample and results documented.
- e. WATER TESTING for water contamination. There are alternate methods of administering this test such as soldering iron, metal container (spoon or micro tray) under flame, provided no flammable materials are in

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sample being tested. For environments that are not conducive to heat or flame, a water testing paste may be used.

- f. An explosion-proof DROPLIGHT to inspect 55-gallon drums for internal cleanliness.
- g. MIRROR for internal drum inspections (swivel mirrors are frequently available at automotive supply stores)
- h. THERMOMETER – When using a meter to fill containers 55 gallons or less, the oil must be temperature compensated to net gallons at 60° F/15.56° C using suitably calibrated thermometers.
- i. HYDROMETER: If filling containers 55 gallons or less by weight, use of a hydrometer will assist in determining API gravity.
- j. SAMPLING APPARATUS such as a vacuum type sample pump with tubing, sample thief or sample bellows to secure representative samples from storage tanks or other containers.
- k. Any ADDITIONAL LABORATORY EQUIPMENT that may be necessary to complete ASTM tests on products that are blended on site.
- l. ZINC TEST KIT: Used to establish absence of Zinc in containers intended for storage of Zinc-sensitive products.

4.9. PERSONAL SAFETY EQUIPMENT

Personnel must follow a written safety program that complies with appropriate governmental regulations and recommended company safety policies. In particular, safety equipment is strongly recommended to protect employees. Appropriate safety equipment may include the following:

- a. Hardhat.
- b. Safety shoes.
- c. LEL meters for H₂S monitoring.
- d. Protective eyewear.
- e. Fire extinguisher.
- f. Solvent-impervious gloves.
- g. Long-sleeved clothing and/or coveralls featuring some reflective strips. Fire-resistant clothing (e.g. made of NOMEX) is recommended and may be mandated in some jurisdictions.
- h. Fall protection devices (harnesses, etc.)
- i. Face shield.
- j. Coveralls.
- k. Air supply (where relevant.)
- l. Respirator.
- m. Any company-mandated equipment, as identified in procedures.

4.10. TRAINING

4.10.1. A quality assurance training program should involve operators, drivers, and other applicable employees. New employees must be properly trained when they are hired.

4.10.2. The frequency of training may be monthly, but as a minimum, at least quarterly.

4.10.3. It is recommended that the quality assurance training program cover the following areas, when applicable:

- Bulk lubricants receiving and delivery
- Proper equipment handling
- Product specific knowledge
- Product compatibilities
- Flushing
- Lubricant and antifreeze/Coolant testing
- Sampling procedures
- Packaging procedures
- Log completion
- Preventing product contamination and commingling
- Proper hose storage and cap/plug use
- Protecting nozzles and stingers from contamination
- Quality Assurance Variance Tracking Log
- Safety Procedures
- Quality Assurance program
- Potential hazards of Complacency in relation to Quality Assurance

4.10.4. Safety aspects must be built into operating procedures and should be called out with either special fonts and/or color.

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- 4.10.5. There should be proper documentation of the training. Records should be maintained for all employees involved in bulk handling and packaging as it relates to operational procedures.
- 4.10.6. The quality assurance training program must comply with all applicable federal, state, and local laws and regulations.
- 4.10.7. The quality assurance training is essential to build competency in the “Product Chain of Custody,” from product receipt to product delivery to the customer.

5. Sampling

For in-depth information on manual sampling of petroleum and petroleum products, consult the most recent edition of **Manual of Petroleum Measurement Standards** Chapter 8.1, *Standard Practice for Manual Sampling of Petroleum and Petroleum Products* and Chapter 18.1, *-Custody Transfer Section 1-Measurement Procedures for Crude Oil Gathered from Lease Tanks by Truck*.

5.1. PERSONNEL SAFETY PRECAUTIONS

While sampling, employees must be wearing the appropriate personal protective equipment. The suggestions of section 4.9 are not exhaustive and should be supplemented if warranted.

5.2. SAMPLING PROCEDURES—BULK TANKS

- 5.2.1. Report to the tank to be sampled, with relevant sampling materials.
 - 5.2.1.1. 5-gallon container
 - 5.2.1.2. Sample container and cap/stopper (4 fl oz minimum)
 - 5.2.1.3. Label and writing implement
- 5.2.2. Open the valve carefully and drain enough oil into a 5-gallon container to purge the valve and line.
- 5.2.3. Keep the valve open slightly and fill the sample container. Keep the bottle capped unless a sample is being taken.
- 5.2.4. Flush the sample container with oil to remove any contaminants. Drain the flush oil into the 5-gallon container.
- 5.2.5. Refill the sample container with fresh oil. Do not disrupt the flow of the product when taking the sample.
- 5.2.6. Turn the valve off.
- 5.2.7. Fill the handheld viscosity measuring device with oil from the sample bottle, run the test later, or utilize the appropriate QC procedures.
 - 5.2.7.1. The handheld device must be clean so it will not contaminate the sample.
- 5.2.8. 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.
- 5.2.9. Put the lid on the sample container.
- 5.2.10. Label the sample as follows: Product name and code number, if any, date received, reference number and date.
- 5.2.11. Batch number.
- 5.2.12. Name of the person taking the sample.
- 5.2.13. Store the sample per company protocols. Items to consider for inclusion in protocols would include:

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5.2.13.1. The volume to be retained should be defined in the sampling protocol. In most contexts, 4 fl oz shall be considered a minimum.

5.2.13.2. The minimum retention time is 6 months.

5.2.13.3. In all cases, customer and regulatory requirements must be taken into consideration.

5.2.13.4. OEMs may require longer retention periods.

5.3. SAMPLING TANK TRUCKS AND RAILCARS FROM THE HATCH

5.3.1. 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, using a dome tent if necessary.

5.3.2. Open the dome hatch's hold-down bolts slowly, beginning at the hinged side; this allows for any possible pressure buildup to subside. Some jurisdictions will require that the nuts be released in a set pattern.

5.3.3. Open the dome hatch.

5.3.4. If stratification is a concern, a COLIWASA-type device may be useful. In other circumstances, any device specified in company procedures is acceptable.

5.3.5. Draw the sample as indicated in company procedures.

5.3.6. Clean the sampling device and the sample pitcher before using them again.

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

5.4. SAMPLING TANK TRUCKS FROM THE MANIFOLD/BOTTOM

5.4.1. Ensure the manifold is free of dirt or debris. Flush the manifold as required

5.4.1.1. If dealing with multiple compartments, the order of offloading should go from most sensitive to least sensitive (as defined by Quality Assurance guidance). For example, a hydraulic oil is likely to be offloaded before a motor oil.

5.4.2. Open the manifold slowly: this allows for any possible pressure buildup to subside.

5.4.3. Draw the sample as indicated in company procedures.

5.4.4. Clean the sampling device and the sample pitcher before using them again.

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

5.5. SAMPLING DRUMS AND IBCS

Drums and IBCs of product 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 or IBCs, the following procedure should be used.

5.5.1. Inspect the appearance of the drum or IBC. Check for rust, leaks, or bulges or evidence of crumpling. 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/IBC still cannot be opened, it should be sent back to the generator. If the drum/IBC is bulged, it is either pressurized, or has been in the past. Extreme caution should be taken in such a situation, and additional personal protective equipment should be worn. If the drum/IBC is crumpled, it has likely been subjected to intense freeze/thaw activity and is likely to be contaminated with water or small debris.

5.5.1.1. It may be advisable to simply dispose of bulging or crumpled drums or IBCs, using relevant safety protocols.

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5.5.1.2. Depressurizing a drum/IBC should only be attempted by trained personnel.

5.5.1.3. If the product is flammable, the drum/IBC should be grounded before opening.

5.5.2. Loosen the large bung slowly. If there is a hissing sound, the drum/IBC is under pressure.

5.5.2.1. If a worker trained for work on a pressurized drum is available, the following steps are recommended:

- a. Stop and place a fireproof blanket over the top.
- b. Remove the bung slowly under this protective blanket. This will provide protection from spray if the bung comes off quickly.
- c. Remove the large bung.

5.5.3. Sampling should take place per company protocols. A COLIWASA device may be useful if stratification is suspected.

5.5.4. Clean the sampling device before using it again.

5.5.5. Prepare and affix a label to the bottle and submit it to the lab with the appropriate paperwork. Return samples to the facility's designated location.

5.6. SAMPLING—GENERAL CONCLUSIONS

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

5.6.2. Clearly label each sample with the product name, viscosity, source, date, compartment number, and storage tank identification. Tightly seal and retain this sample for a minimum of 6 months, or longer if mandated by internal protocols.

5.6.3. 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.

5.6.4. When packaging any product:

- a. Record the package date on each label that is used.
- b. A sample should be taken from a drum or a pail for each batch that has been packaged.
- c. The first drum (or pail) in a packaging run should be tested to ensure compliance with flushing requirements and product integrity.
- d. Identify if sample was taken from a drum or a pail and retain sample as required. At a minimum, 4 oz samples should be collected. Retains should be kept for a minimum of 6 months.
- e. At the end of the retain period, retain samples should be disposed of in accordance with local practice. It is recommended that they be treated as recovered lubricating oil.

6. Testing – Field

6.1. APPEARANCE

(Observable Characteristics in Sample) - The sample should be visually inspected for the following: Free water, Sediment, Hazy appearance, Particles, Color (shall match the reference sample), Any other unusual characteristics. If any of the above are observed, purge 10 gallons and retest. If appearance is still abnormal, call supplier personnel.

6.2. VISCOSITY

Viscosity should be run on all samples using a handheld viscosity measuring device – per manufacturer's instructions.

6.3. WATER

Crackle testing should be performed per company work instructions, if required. If a lab facility running more robust testing (e.g. Karl Fischer testing) is available, such testing is preferable.

6.4. OTHER TESTING

There may be other types of required ASTM Testing. Such testing should follow the applicable ASTM test method.

6.5. CERTIFICATE OF ANALYSIS—FINISHED LUBRICANTS

Distributors should request a Certificate of Analysis on finished lubricants, listing the results of testing for all the properties defined by the product specification. Requesting a Certificate of Analysis from the supplier is considered a best practice.

Alternatively, a Certificate of Compliance may be suitable, but is not as strong as a Certificate of Analysis. A Certificate of Compliance is a statement that all relevant testing has been successfully completed, without itemizing the tests or results.

Appropriate ASTM tests for each of the following tests might be available and are recommended:

- 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. CCS.
- m. API Gravity and/or density.
- n. Other as compared to a reference specification.

Any other contracted properties shall also appear on a Certificate of Analysis.

7. Bulk Receiving Procedures

7.1. BULK RECEIVING - BEFORE UNLOADING TRUCKS

If required by the receiving facility, direct the truck to a weighing scale. After weighing, direct the truck to the offload site.

7.1.1. Properly position the truck for unloading; secure the brakes and chock the tires. 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, product family group, or general products received. It should include the following:

- a. Date.
- b. Supply point.
- c. Bill of lading/invoice number.
- d. Person receiving the product.
- e. Quantity received.
- f. Quantity flushed.
- g. Confirmation/documentation that a retain sample was taken and compared to a reference.

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- 7.1.2. Obtain a sample from each compartment, per sampling instructions (see Section 5). Complete the identification label, attach it to the sample bottle, compare to a reference sample or submit the sample to a laboratory.
- 7.1.3. 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, plus the current contents of the tank (if any), should not exceed safe tank height, which is considered to be 90 percent of tank capacity.
- 7.1.4. Upon release by the laboratory or verification that the shipment conforms to acceptance criteria with reference sample comparison, connect the ground strap to the trailer and prepare to unload the truck.
- 7.1.5. All unloading must be performed in accordance with applicable safety procedures and governmental regulations.
- 7.1.6. It is recommended that product is unloaded with a product-dedicated pump and hose system or a product family group pump and hose system. It is acceptable to use the carrier's pump and hose system to unload but there may be an increase in generated flushings. This may be mitigated if the "last-contained" for the carrier's hose and pump are known and documented.
- 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 thoroughly flushed prior to use. All flush should be documented.
- 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 common manifolds should be flushed to displace any prior product.
 - 7.1.8.1. Common manifolds are not acceptable unless the manifold is completely flushable and a system is in place to prevent two different valves from being opened up at the same time.
- 7.1.9. The flush volume should be documented. 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 crumple or implode.

7.2. BULK RECEIVING - DURING UNLOADING

NOTE: Receiving facility staff must supervise this operation. Truck drivers must have control of their equipment.

- 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.
- 7.2.3. 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.
 - 7.2.3.1. The impact on any receiving tank shall also be addressed.

7.3. BULK RECEIVING - AFTER UNLOADING

- 7.3.1. Once the trailer has transferred the required amount, 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 a 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.

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- 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. After being flushed and emptied, 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. If required by the facility, the truck should be directed to a scale.
- 7.3.4. Record receiving tank volumes (gauge readings) on a Bulk Receiving/Batch Log (see Appendix A for an example of such a log).

8. Bulk Loading and Delivery Procedures

8.1. GENERAL

- 8.1.1. Truck operators should be DOT qualified per all federal, state, and local regulations.
- 8.1.2. Truck operators should be fully trained on the operation of their equipment.
- 8.1.3. Truck operators should comply with all applicable loading site safety precautions and regulations. Loading site personnel should clearly post these safety precautions if appropriate.
- 8.1.4. Loading domes on transport trailers and local bulk delivery equipment must seal tightly and must be checked regularly for leakage.
- 8.1.5. Prior to loading, tank compartments should be cleaned using appropriate methods that may include steam cleaning, diesel flushing, or hot water surfactant wash.
 - 8.1.5.1. Cleaning is especially recommended if the tank compartments contained any corrosive or flammable products, glycol, products of an incompatible class (e.g. motor oil and gear oil) or any non-petroleum products during the previous load, or if tank compartments are to receive sensitive products.
 - 8.1.5.2. Special products, such as active sulfur-containing products, must be handled in segregated systems; otherwise, 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.
 - 8.1.5.3. Ensure any condensation issues are addressed by diesel flush or base oil flush.
- 8.1.6. The carrier is usually responsible for cleaning or flushing compartments; however, the loading facility must verify that the truck meets cleanliness requirements. Safe practices must be employed to perform inspections on receipt.
- 8.1.7. Where feasible, loading from the bottom is recommended. This provides the benefit of diluting any heels as part of the loading process.
- 8.1.8. Loading into a residual product that is already on-board is generally not acceptable.
- 8.1.9. In the absence of sealed markers, or tank strappings, or both, the quantity of the product to be loaded should be determined by a calibrated meter or scale.
- 8.1.10. Lubricants should not be carried on any bulk vehicle/vessel that handles any gasoline, middle distillate, turbine fuel, chemical, solvent, glycol-based products, or anything other than a lubricant.
- 8.1.11. Lubricants should not be carried on a bulk vehicle/vessel at the same time as any gasoline, middle distillate, turbine fuel, chemical, solvent, glycol-based products, or anything other than a lubricant.
- 8.1.12. Without prior cleaning or flushing, lubricants should not be hauled in any IBC that has been used to handle any gasoline, middle distillate, turbine fuel, chemical, solvent, glycol-based products, or anything other than a lubricant.

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8.1.13. Bulk Loading with protection from inclement weather or windblown debris is essential to protect the product from environmental contamination. Customers must be assured that the products they receive in bulk have been loaded properly. Inclement weather includes rain, snow, drizzle, sleet, freezing rain, high wind, hail, blowing dust, sand, etc.

8.2. BEFORE LOADING TRUCKS

8.2.1. As a rule of thumb, each compartment should be clean, dry and odor-free. Inspect each compartment to ensure it is empty and free of contaminants. Some products may also require inspection for latent moisture.

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

8.2.3. Gaskets and other seals should be checked for integrity.

8.2.4. Verify that the product to be loaded matches shipping documents or loading instructions. Line up the appropriate storage tank lines, pumps/meters and so forth. Meters and scales used for bulk loading must be annually calibrated on a scheduled basis to ensure the volume accuracy that a customer expects; some jurisdictions may require more frequent calibration. A log containing the calibration documentation should be available. Stickers (with an expiration date) on the meters and/or scales are acceptable if a reminder file has been established.

8.2.5. All trucks used for bulk deliveries should have one or more pumping systems. If the truck ever hauls more than one product family group, additional pumping systems should be on that truck.

8.2.6. Dedicated pumping equipment is always recommended. Alternatively, use of product family group pumps, meters, and hoses for each product family group on all delivery routes is acceptable. An exception to this, is for HDMO and PCMO, which may be handled with the same pumping system on trucks. Proper flushing between products is always required.

8.2.7. Truck meters must be calibrated annually; some jurisdictions may require more frequent calibration. A log and/or reminder system must be maintained.

8.2.8. Proper flushing of the truck compartments, pumps, meters, and hoses is required, in order to maintain product integrity. Documentation of flush gallons is recommended. All pumping systems must be completely flushable. Common manifolds are not acceptable unless the manifold is completely flushable, and a system is in place to prevent two different valves from being opened up at the same time.

8.2.9. Dedicated lines are required from each delivery truck compartment to the delivery truck pump. It is recommended that bulk product is loaded and delivered based on characteristic similarities. Low-zinc or zinc-free products shall not be pumped with the same pump used for motor oil products unless the system has been properly cleaned, flushed, and documented.

8.2.10. A permanent flush oil compartment is recommended. A portable flush oil container on board the delivery vehicle/vessel is acceptable, such as a pail, drum, etc. The flush volumes should be posted on the delivery vehicle/vessel.

8.2.11. Records of bulk loading and deliveries must be maintained and documented. Examples of common records include a binder, notebook (hardcopy or electronic), or individual daily sheets. All records must be kept on file in order to be able to maintain and prove the correct product was loaded and delivered.

8.2.12. The last product hauled in a compartment must be known and documented in order to provide Product Chain of Custody and to provide information on which to base the flushing procedure for the next load.

8.2.13. The system must be flushed (flush volume should be documented) to clear any common lines of possible contaminants.

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8.2.14. Proper handling procedures should at least

- a. include a dedicated list, by product family group, for bulk loading,
- b. avoid use of excessive hose,
- c. document flush volumes,
- d. ensure all systems are labelled with the proper flush volumes,
- e. ensure use of proper flushing procedures,
- f. adhere to proper flushing practices.

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 in compliance with applicable local, state and/or federal regulations.

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.

8.4.2. Where possible, samples should be drawn from the manifold ("bottom") of the truck or railcar. To avoid any contamination from residue in the manifold, 5 gallons should be collected into a pail prior to collecting the sample. Failing this, samples should be taken from the middle of each compartment and submitted for specified testing. Properly label the sample. Some means should be implemented to document whether the sample was from "top" or "bottom" (manifold). Visually compare sample to a product reference sample. Store samples per company protocols. The guidelines of Section 5 (Sampling) should be followed.

8.4.3. The truck should be released only after sample approval.

8.4.4. 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.

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

8.5. BULK DELIVERY

8.5.1. It is critical that the vehicle(s)/vessel(s) are properly unloaded in order to protect product purity and the Product Chain of Custody. It is recommended that there be detailed, written Bulk Delivery Procedures. The delivery procedures should be:

- a. customized,
- b. complete and proper,
- c. understood,
- d. and properly used.

8.5.2. The unloading procedures should include language addressing:

- a. flush volumes,
- b. flush oil storage and handling,
- c. Reference sample usage (if retaining samples at customer site),

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- d. use of the Bulk Loading and Delivery Logbook,
- e. verification that the product being unloaded is the correct product to deliver,
- f. verification that the compartments being unloaded are correct according to the delivery ticket,
- g. physical inspection of the customer's tank to be certain it will hold the product being delivered,
- h. obtaining customer's signature (when required),
- i. proper hose storage.

8.5.3. The unloading procedures must be readily available in every vehicle/vessel, and include the use of dedicated product or product family group hoses, when required.

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. Comprehensive written procedures for empty container inspection (prior to filling) should be posted or available near the container filling site. The procedure(s) must cover all types of containers that are filled and must include provisions for rejecting improper containers. Applicable personnel must be proficient in the procedures and they may be asked to demonstrate their knowledge and usage of the procedure. The cleanliness of the interiors of containers is essential to protect product quality. Contamination is totally unacceptable. The appearance of containers is an indication of quality, and to create a favorable impression for the Lubricants industry. Drums are one of the most visible brand identification packages. If new containers (including drums) are properly stored, they are rarely a problem and are relatively easy to inspect. Reconditioned drums require much more comprehensive inspections. Severely dented, rusted, or poorly painted drums make a poor impression on the customer and interior contamination could cause costly losses.

9.1.1.1. All empty container inspection procedures should:

- Be understood (be able to demonstrate proficiency),
- Be properly used,
- Include provisions for rejecting nonconforming containers,
- Cover every container type that is filled,
- Specify interior and exterior inspections for all containers.

9.1.2. Containers must be protected from contamination when being filled. Products should be filled under cover. If filling containers outside, the operation should not be performed during inclement weather. Inclement weather includes rain, snow, drizzle, sleet, freezing rain, hail, high wind, blowing dust, sand, etc.

9.1.2.1. Drums should never be stored directly on the ground or pavement.

9.2. EMPTY DRUM STORAGE

9.2.1. It is preferred that empty drums are stored inside. If drums are stored outside, they must be stored so that it is impossible for rainwater or rising water in a low-lying area to contaminate them. The preferred outdoor drum storage method is setting them upside down on pallets, making sure that the bungs are at least hand-tight.

9.2.2. **Drum covers:** It is acceptable to store the empty drums upright outside if they are properly protected with drum covers.

9.2.2.1. It is recommended that rubber drum covers not be used if pallets are stacked on top of them: The covers are likely to tear and water may then accumulate on the drum. Then, since the cover inhibits the evaporation of the water from the top of the drum, the water stays on top of the drum longer, which causes more damage to the drum label and product inside the drum (or accelerated internal rusting for empty drums).

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9.2.2.2. Metal drum covers may be blown off the top of drums. Provisions must be made to prevent this. Typically, metal drum covers are used if drum pallets are to be stacked on top, and rubber drum covers are used if nothing is to be stacked on top of the drums.

9.2.3. Tarps may be used but tend to allow water ingress.

9.2.4. Other options may be investigated through Web search. The recommended search term is “barrel accessories”.

9.3. IBC STORAGE

9.3.1. **EMPTY OR FILLED IBCs.** It is preferred that IBCs are stored inside. IBCs are considered properly stored if they are stored outside and they are properly designed for outside storage or have some other form of protection from direct sunlight. IBCs properly designed for outside storage (UV protection, etc.) may be stored outside without cover

9.4. PAILS AND KEGS

9.4.1. **EMPTY OR FILLED PAILS AND KEGS** should be properly stored inside a warehouse or in a non-leaking trailer. Empty containers must be properly protected to prevent dust and other contaminants from settling into the containers. Turning them upside down on a clean surface, covering them with polyethylene, or loosely covering the open containers with a new lid could accomplish this. Lids must be stored inside prior to use, such that dust or any other contamination cannot settle on them.

9.5. STORAGE OF BULK FILLS

9.5.1. **FILLED DRUMS** must be properly stored, inside or outside. It is preferred that filled drums are stored inside. If drums are stored outside, they must be stored so that it is impossible for rainwater or rising water in a low-lying area to contaminate them. Also, they must not be stored directly on the pavement or ground.

9.5.1.1. Storing drums outside exposes the product to unfavorable conditions that can affect product quality, such as:

- a. Drum markings and labels may fade and become unreadable under the influences of sun, rain and wind.
- b. Corrosion can obliterate drum markings rendering the product unidentifiable, making it necessary to dispose of unused oil.
- c. Seams of containers may weaken due to extreme periods of hot and cold temperatures, which cause the metal to expand and contract.
- d. Extreme periods of hot and cold temperature may affect product quality.
- e. Dirt and rust may accumulate inside the chime/chine and around the bungs. This would result in contamination of product when the drum is opened for use. Water may get into the drum around the bungs and contaminate the product.
- f. Drums standing upright can collect water or condensed moisture inside the drum. Water may be drawn into the bungs, even when the bungs are drawn tight and the tamperproof seals are in place, due to expansion and contraction of the drum.
- g. Filled drums may be stored upright outside if they are properly protected with drum covers, subject to section 9.2.2.
- h. Lubricants such as aircraft engine, aircraft hydraulic, transformer, refrigeration, synthetic, etc. should never be stored outside under any condition.

9.6. RECONDITIONED DRUMS

9.6.1. The use of reconditioned drums is not encouraged but may be adequate in some circumstances. Suitable quality protocols must be applied when receiving reconditioned drums. The Organization handling the Bulk product must ensure the

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reconditioner(s) perform reliably when delivering reconditioned drums. The Organization must also have an inspection checklist to validate incoming reconditioned drums at time of receipt.

9.6.2. New and reconditioned (recon) drums should meet any specified requirements, including but not limited to:

- a. Correct height,
- b. Correct gauge,
- c. Correct diameter over rolling hoops,
- d. Correct quality,
- e. Correct colors (should be compared to brand color paint chips/color panel),
- f. Free of external rust,
- g. Free of internal rust and debris,
- h. Non-lined,
- i. Non-corrugated,
- j. Without excessive dings or dents,
- k. New gaskets (or used ones if clean, elastic, and free from any cracks, cuts, or other defects) on all bungs,
- l. New and reconditioned drums should be inspected internally with a droplight and mirror,
- m. Painted surfaces shall be sufficiently robust to withstand extended outdoor exposure.

9.6.3. In addition, reconditioned drums should meet the following specified requirements:

- a. Chine/chime (drum rim) shall be tight and to original contour.
- b. Head shall be smooth, 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 leakproof 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.
- e. Without visible old labels.
- f. Outside surface shall be stripped of old paint prior to painting.

9.7. INVENTORY CONTROL AND STOCK ROTATION

9.7.1. There should be an organized First-In, First-Out (FIFO) inventory system to bring the oldest product to the front of the pick line so that it will be sold first. The implementation of an electronic inventory management system, ideally tied to an Enterprise Resource Planning (ERP) System, is recommended as a Best Practice. FIFO is vital to keeping the warehouse stock current because specifications change and containers age. In addition, some products may have a limited shelf life leading to performance degradation. Stock should be routinely inspected for products nearing or past their expiration date, and it is a recommended best practice to remove these items and place them in a quarantine area for further assessment and disposition as required. Shelf Life should be verified with manufacturer recommendations.

9.7.2. IBCs, as a minimum, should be kept in the same product family group, for next product filling. If the next product to be filled into the IBC is not in the same product family group as the previous product, then the IBC should be cleaned, flushed, and inspected prior to filling. IBCs that have previously contained products with zinc cannot be used for zinc sensitive products, regardless of the cleaning/flushing that may be done. General cleanliness and handling procedures for IBCs should be equivalent to that taken for drums or pails. However, IBCs should be subject to the same care as tank storage for the loading and flushing, in order to prevent commingling of products, which should always be avoided.

9.8. FILLING OPERATIONS

9.8.1. Fill lines should be flushed between products in accordance with flushing guidelines. All containers must be filled on a net volume (gallon or liter) or net weight basis. Scales are more accurate and are the preferred filling method. The U.S. Department of Commerce, National Institute of Standards and Technology, National Office of Weights and Measures, establishes 60° F (15.56°C) as the temperature for measuring the net volume of petroleum products. The applicable Filling Weight and Volume Tables are available in the American Petroleum Institute - API - *Manual of Petroleum Measurement Standards* - Chapter 11 - Physical Properties Data – Section 1 – 1.1.8.5 *Correction of Volume to 60° F Against API Gravity at 60° F For Generalized Lubricating Oils* - Table 6D. The applicable Filling Weight and Volume Tables must be readily available and used.

9.8.1.1. API gravity, and/or specific gravity, and/or density shall appear on a Bill of Lading per contracted terms. Contracted terms shall also specify a temperature at which measurements must be made. Some jurisdictions may mandate the temperature and/or method requirements, in which case the seller and carrier must provide the correct information.

9.8.2. It is the Distributor's responsibility to meet the requirements of all applicable federal, state provincial and local laws and regulations. These can vary widely from state-to-state (province-to-province). All states (and/or provinces) have Laws governing Weights and Measures (Many US States adopt the provisions of NIST-Handbook 130, which is published annually).

9.8.3. When filling with a scale: Temperature adjustments do not have to be made. Scales are generally more accurate than meters. Formula changes could affect the gravity and there may be slight variations in the gravity from batch to batch. Therefore, one must use the correct pounds per gallon (or kilogram per liter) and adjust for variations in product API gravity.

9.8.4. When filling with a flow meter: Temperature affects the volume when filling on a per-gallon (per-liter) metered basis. Product temperature must be measured, and adjustments must be made in order to determine the exact net gallons (liters). Once the temperature has been measured, using the applicable table created from the American Petroleum Institute - API - *Manual of Petroleum Measurement Standards* - Chapter 11 - Physical Properties Data – Section 1 – 1.1.8.5 *Correction of Volume to 60° F Against API Gravity at 60° F For Generalized Lubricating Oils* - Table 6D. Formula changes could affect the gravity and there may be slight variations in the gravity from batch to batch. As a recommended best practice, volumetric values should be correlated to mass.

9.8.5. Applicable personnel must be proficient in determining net weight or net volume.

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

9.8.6.1. 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, oils shall not be mixed unless full disclosure and agreement is made to all parties involved.

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

9.8.8. Samples from each fill run should be retained. A retain sample should be taken from every container batch with a new, transparent, sample bottle. The sample bottle should hold sufficient volume for all tests required in a facility's QA/QC protocols and leave extra volume for a minimum 6 months' retention time. Every sample must be carefully taken and properly labeled. Samples should be visually compared to a Reference Sample. This information should be documented in the Batch Filling Log. The use of glass containers is not recommended due to possibilities of breakage. Sample bottles should not be reused. New sample containers and lids must be stored in a proper manner, in order to prevent dust or other contamination. Batch retain samples should be stored for a minimum of six months in a low-light environment for protection against ultraviolet light. Fill retains should be retained for a minimum of 6 months.

9.8.8.1. Sample bottles should be labeled with the following information:

- a. Product name and manufacturer code number.

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- b. Date packaged.
- c. Batch number and reference number.
- d. Fill retains should be traceable to a bill of lading or a drum/IBC fill batch.

9.9. ACCURACY OF METERS AND SCALES

9.9.1. Meters and scales used for container filling must be calibrated on a scheduled basis in order to ensure the volume accuracy that a customer expects, or that is legally required. A routine meter and/or scale calibration program is necessary for proper inventory control and general best business practices. If a meter or scale is determined to be out of tolerance, all measurements since the previous calibration should be reviewed and corrective actions be taken, including at the customer level.

9.9.2. At point of sale, meters and scales must be annually calibrated on a scheduled basis to ensure the volume accuracy that a customer expects; some jurisdictions may require more frequent calibration. A log containing the calibration documentation should be available. Quarterly reference checks are recommended to mitigate the time elapsed since the previous formal calibration.

9.9.3. Stickers (with an expiration date) on the meters and/or scales are acceptable in lieu of a log system. A formal follow-up system can be used to ensure that future calibrations are performed when required.

9.9.4. It is essential to utilize the most accurate method possible when filling drums, pails, kegs and IBCs. Accurate measurements aid in effective inventory management. At a minimum, labels should contain the following: batch number, fill date, product name, product code number, filling facility, company identification, container size.

9.9.4.1. Some or all this information may be encoded into one of the pieces of information above, e.g. a batch code may identify the filling facility.

9.10. TRACEABILITY

9.10.1. In order to properly trace a product's Chain of Custody, records should be kept to reflect the following: fill date, product, last Bill of Lading number or last bulk batch number, number of packages filled, package size, fill run batch number, sample taken-Initials, corrected meter volume or fill weight, temperature (°F or °C) of oil (or API Gravity/density/specific gravity), volume flushed between products (gallons/liters flushed), Viscosity by viscosity comparator or direct measurement (e.g. by ASTM D445) (viscosity in cSt), Appearance Test result (visual pass/fail), Person packaging and testing.

9.10.2. On receipt of bulk product, the receiving facility should assign a new batch number. This is especially necessary if the incoming product is being commingled in a receiving tank.

9.10.3. A retained or inventory sample of the product to be packaged will aid if responding to consumer complaints or possible field contamination.

9.10.4. The use of sequence numbers is recommended in order to protect the Product Chain of Custody.

9.11. LABELS

9.11.1. Product containers must meet the high standards and the value of the recognized different brand images. It is recommended that labels not be reproduced and/or customized. They should be original.

9.11.2. Obsolete product labels shall not be used. An obsolete label may misrepresent the product that is in the container and may violate regulations and/or laws. The specifications may be wrong and/or the real contents may not be the same as described on the obsolete label. If a customer receives product with an obsolete label showing an outdated specification, he/she could believe that an inferior product is being supplied to them.

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- 9.11.3. The Distributor site is responsible for ensuring that current, representative labels are being used. This is particularly relevant for bulk tanks owned/operated by the Distributor. In addition, the Distributor shall keep current versions of any SDS relevant to inventory.
- 9.11.4. The labels must be kept in a well-organized fashion.
- 9.11.5. The labels should be printed as needed; this prevents accumulating old labels that may become obsolete.
- 9.11.6. At least one of the container labels should be applied to every container prior to filling in order to help avoid errors in the filling area. This simple procedure will help ensure that the correct product is filled in the correctly identified container in the event the employee is called away to another task.
- 9.11.7. If more than one batch of a product is packaged in one day, the later batch(es) should have a different Batch Number.
- 9.11.8. Use current and complete product information labels. The information on the labels must be sufficient to trace the product to lot numbers and retained samples.
- 9.11.9. IBCs should have proper labels if delivered and left at the customer's location. Terms of Sale should identify the customer's responsibilities regarding IBC storage and maintenance.

10. Recommendations for Handling and Storage of Lubricating Oil Additives

10.1. GENERAL

- 10.1.1. Lubricating oil additives are chemicals and/or chemical mixtures created to impart specific properties to a finished lubricant. 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. Some of these materials are potentially hazardous, and the precautions of section D.1.2 must be observed
- 10.1.2. If normal procedures and hygienic practices are observed, personnel handling these materials will experience no discomfort or harm. Personnel handling additives must be trained to read and understand Safety Data Sheets (SDS) and have access to the Personal Protective Equipment described in the SDS for each additive (or additive package). The following suggestions should be considered for the safe handling of oil additives.

10.2. PRECAUTIONS AGAINST DAMAGE TO LUBRICANT ADDITIVES

10.2.1. What To Avoid

- 10.2.1.1. Do not use high-pressure steam for heating under any circumstances.
- 10.2.1.2. Do not permit additives to come into contact with copper or brass heater coils, or other chemicals.
- 10.2.1.3. Do not continuously operate steam heating coils in additive storage tanks.
- 10.2.1.4. Do not permit water to get into additives.
- 10.2.1.5. Do not use leaking heater coils.
- 10.2.1.6. Do not use wet air for agitation.
- 10.2.1.7. Do not leave an additive tank unattended while it is being heated, and/or agitated.

10.2.2. What To Do

- 10.2.2.1. Use hot oil or hot water heating coils if possible. If these are not available use a minimum amount of steam at atmospheric pressure.
- 10.2.2.2. Use iron or stainless-steel heating coils exclusively. Many other coil materials can have an adverse effect on the additives.

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10.2.2.3. 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).

10.2.2.4. Minimize exposure to moisture by all means possible.

10.2.2.5. Inspect the heating coils frequently.

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

10.3. PRECAUTIONS AGAINST INJURY TO PERSONNEL

10.3.1. What To Avoid

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

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

10.3.1.3. Do not permit fumes from the stored additives to accumulate.

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

10.3.2. What To Do

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

10.3.2.2. Use outside gauges on storage tanks.

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

10.3.2.4. Avoid contact with skin and require full use of required personal protective equipment.

10.4. STORAGE TANKS

10.4.1. Additives should be stored in small tanks (with a 10,000-to 25,000-gallon capacity) located inside 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 typical for petroleum oil installations but is recommended to prevent the accumulation of water if it enters despite other precautions.

10.4.2. 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 coils should be used. The use of suction or line type heaters is recommended.

10.5. BLENDING EQUIPMENT

Ideally, additives and oil should be blended at a temperature consistent with the additive's thermal tolerances, as specified by the additive supplier. Mechanical mixing is recommended. Recirculation pumps are another means of mixing. 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 effectively dried before using.

10.6. 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.

10.7. BULK SHIPMENT AND STORAGE OF ADDITIVES

- 10.7.1. Bulk delivery of additives has many advantages over drum delivery, such as lower cost, less storage space, and easier handling. However, different equipment and operating methods are required.
- 10.7.2. 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.
- 10.7.3. Lubricant additives are complex mixtures of chemicals that must depend on some degree of chemical activity for their effectiveness. This means they are necessarily sensitive to heat, moisture, light, contact with other chemicals and additives, and to catalysts that promote their activity. It is important to avoid overheating, water contamination, and contact with copper or brass heater coils and fittings. This sensitivity is greatly reduced once the additives are blended into finished products at the required percentages.

10.8. RECEIPT OF BULK ADDITIVES

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.

10.8.1. When a Tank Car or Road Tanker Arrives at Its Destination

- 10.8.1.1. At time of offload, the wheels to the carrying vessel must be chocked, and grounding cables must be applied.
- 10.8.1.2. 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 by the additive supplier for calculating the net volume or weight of material from this data.
- 10.8.1.3. The gross weight shall be compared with that shown on the shipping papers. If the weights fail to agree within contracted tolerances, 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.
- 10.8.1.4. The top hatch cover should be opened (with protection from weather and windblown debris) and inspected for the presence of seals. Damaged or missing seals should be reported to the supplier. If the seals are present and sound, the hatch should be opened and top, center, and bottom samples should be drawn for a quality check. The cover should then be closed until the quality is approved. The samples should be retained for a minimum of 6 months. If the test results are not acceptable, the supplier's office should be contacted immediately for further instructions.

10.8.2. When Unloading Rail Tank Cars

- 10.8.2.1. Steam coil procedures are out of scope for the API Bulk Oil Testing, Handling, and Storage guidelines. Refer to the railroad and railroad car companies' suggested practices or corporate procedures.
- 10.8.2.2. 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 and should be requested and consulted before transfer is attempted. 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.
- 10.8.2.3.** The unloading pump should be of the positive displacement type and should be as close to the car as possible (see
- 10.8.2.4. **Figure 10-1**). 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.
- 10.8.2.5. 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.
- 10.8.2.6. When the car is empty, the hatch cover should be put back in place, following any regulated practices if applicable. 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.

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10.8.3. Unloading Road Tankers

10.8.3.1. 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.

10.8.3.2. 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.

10.8.4. Other considerations

10.8.4.1. 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.

10.8.4.2. 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.

10.9. STORING IN BULK

10.9.1. Additives in bulk should be stored in cylindrical steel tanks (see

10.9.2. **Figure 10-1**). 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.

10.9.3. 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.

10.9.4. Ideally, an individual tank should be used for only one type of product—for example, motor oil additives and gear lubricant additive tanks should be in designated, segregated service. If it is decided to change the contents of a tank, then the tank must be thoroughly cleaned before the new product is added.

10.9.5. 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, but only by personnel with confined-space work training.

10.9.6. 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 localized overheating. To ensure that the additive is uniformly warm, the tank should be circulated periodically from the bottom outlet.

10.9.7. A suction heater (enveloped bayonet heater) that consists of 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 the temperature specified by the additive supplier. Heating coils should be made of iron, rather than copper or brass,

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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.

10.9.8. A regular schedule of inspections of additive tanks for deposits and general cleanliness should be followed. Tanks should be cleaned when necessary. Inventory controls will assist in turning tanks and thus minimize the presence of deposits, dust or moisture.

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

10.9.10. 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.

10.10. BEST PRACTICES TO MAINTAIN ADDITIVE INTEGRITY

10.10.1. Do not apply steam directly to the additive.

10.10.2. Do not use copper or brass heating coils or fittings. Use iron heating coils.

10.10.3. 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).

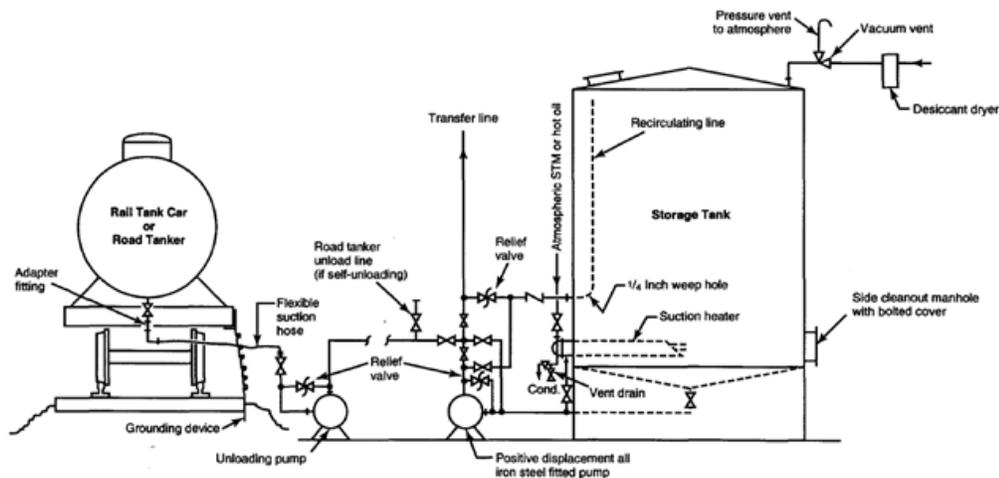
10.10.4. Do not permit water to get into the additives. Use air dryers on the tank air inlet vent when humid conditions are present. Frequently inspect all heating coils for leaks.

10.10.5. Mechanical agitation is preferred to air agitation for blending purposes. If air agitation is used, the air must be dry.

10.10.6. Clean transfer lines after use.

10.10.7. 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 10-1 Typical Tank Car Unloading and Storage System

11. 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 FORMS

Sample Form 5
DOCUMENTATION CHECKLIST FOR STANDARDS AND
PROCEDURES FOR BULK HANDLING AND PACKAGING

Bulk Lube Loading, Customer Pick-Up	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Is it ensured that tank compartments that contained any corrosive or flammable products, glycol, or any non-petroleum 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 residual 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	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
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 comparison 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	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Is there a documented procedure for sampling storage tanks?												

Packaging Standards	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Is it ensured that records are maintained that allow tracing of product(s) back to supply points?												

Training Records	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Is the training of employees documented?												

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Meter Calibration	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Is a procedure in place, and are all meters calibrated and documented at a minimum of an annually scheduled basis?												

Filling of Containers	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
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	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Is calibrated testing equipment available, and is a log kept with all test results?												

