GAUGING MANUAL

Rev 1.8

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Gaugers Summary

The term gauging is used to describe the process of measuring the height of crude oil in a storage tank less than 5000 Bbls, as well as other related activities that determine both the quality and quantity of crude oil in the tank. A gauger's task is to determine both the quality and quantity of crude oil through gauging, sampling, gravity, temperature, and volume determination. Tank gauging is an essential element of inventory control, custody transfer, and leak detection operations.

Pre-departure Checks

When you report to work and before you proceed to a work location you are responsible for conducting an equipment inspection. All crude oil gauging, safety, and test equipment and supporting documentation is present, clean, operating correctly and properly stored in designated locations in the work vehicle. It must include the following:

*Note – See certified/approved equipment list provided by Local Management.
The gauger carrying tray contains:

- Thief used is a bottom-closure, core-type, clear-barrel, 16-in., 33-oz-capacity model "modified" with petcocks at the 4-in. and 8-in. marker levels with stinger set at 4-in.
- Woodback cup case with nonmercury thermometer with appropriate temperature range
- Gauging tape and brass plumb bob with grounding cable and clamp in good repair
- Hydrometer case with nonmercury thermo-hydrometers with appropriate temperature and gravity range
- Two 4oz glass sample bottles with lids
- Tube of water finding paste - "KolorKut"
- Rags

*Note – See certified/approved equipment list provided by Local Management.
The gauger work truck must contain:

- Working centrifuge and sample heater
- Two clean, certified 100mL (6 in.), 200-part (200%) short cone shaped, centrifuge tubes and stoppers
- Disk (dial) thermometer
- Supply of stoddard solvent
- Ample clean rags and diapers
- Metal fire can with lid
- Tank seals
- UL approved intrinsically safe headlamp/flashlight
- PPE per the WHA and location specific requirements
- Mobile communication device -iPad

- Printer
- A supply of printer paper rolls
- Electronic access to SDS Vault or SDS book containing information on properties, hazards, handling, and exposure to all products used for gauging and quality analysis to include Hydrogen Sulfide (H2S), Benzene, Propane, Butane, and Hydrocarbon Vapors.
- Gauger log
- Copy of current gauging equipment verification records
- Copy of current Hiland Crude gauging manual

Notes – Ear buds, smart watches, matches, cigarette lighters, E-cigs, vaping devices, cell phones and other non-intrinsically safe sources of ignition are not allowed on persons when performing gauging/sampling. All loose objects must be removed from the breast pockets of shirts, coats, or jackets. Extreme care must be taken while gauging or sampling tanks if it is raining or when ice, sleet or snow has the potential of collecting on stairways or tank roof.

Test Equipment Testing and Verification

Please consult with Local Technical Services Manager/Supervisor and/or EHS personnel prior to purchasing unapproved gauging and sampling equipment. See certified/approved equipment list. This includes, but is not limited to, flashlights (with appropriate Hazard Classification rating), gauging tapes, gauging bobs, gauge poles, etc.

Working Gauge Tape

The tape and bob assembly shall be inspected by gauger prior to each use to ensure that wear in the tape snap catch, bob eye, or bob tip does not introduce error during use. Defective tapes shall not be used. Working gauge tapes and bobs will have their accuracy verified against a reference standard gauge tape or other reference standard traceable to the National Institute of Standards and Technology (NIST) listed in the Reference Standard Gauge Tape section. Portable electronic gauging devices shall not be used if the accuracy and repeatability does not meet the same standard for manual gauging equipment. Working tapes and bobs shall be checked for accuracy when new, when repaired, and at least annually from the in-service date thereafter by comparison with a reference (e.g. a master tape). The tape and bob comparison, which is considered as verification, may be conducted either horizontally (with a known calibrated tension – API CH. 3.1 - Sec. A.5) or vertically (at normal operating tension) where a master tape is used. When comparing equipment to be used as a working tape/bob, the difference between the inscribed reference point of the working tape and the true length of the working tape/bob at that point shall not exceed ±1/16 inch for any distance from 0 ft to 125 ft. The comparison shall be verified at regular intervals throughout the working length of the tape/bob weight combination, with such intervals not to exceed 15 ft. Evidence of verification within the annual frequency shall be made available for inspection.

Reference Standard Gauge Tape

A new primary standard certified tape, purchased by a reputable manufacturer, should be put aside and protected from use and deterioration in order to serve as a master tape for the above checks. This tape shall be graduated in inches with 1/8 or 1/4 in. subdivisions. The uncertainty of the reference standard (e.g. a master tape) shall not exceed ± 0.01 inch for any distance between 0 to 100 ft. A master tape shall be recalibrated at least every five years. Certification shall be provided with the master tape. Master gauge tapes are currently certified with a tension applied to the tape in a horizontal position. The tension is normally 10 lb. for tapes up to 100 ft or 20 lb. for tapes greater than 100 ft. Master tapes used to compare a working tape in a vertical position shall be certified with a tension corresponding to the tension of working tape/bob in normal gauging operations. The cross-sectional area of the master tape shall be equal to that of the working gauge tape.

Note: No temperature correction is required, provided the working tape and the master tape are the same temperature and are made of materials with a similar coefficient of thermal expansion. Tapes of the same color will attain the same temperature, even in sunlight. However, black and white tapes have shown temperature differences of as much as 14.4 °F when exposed to direct sunlight. In such cases, the temperature difference, even if measured, would be uncertain due to variability of exposure along the length of each tape. Accordingly, calibrations in the laboratory or at least in shade are preferred when possible.

Working Thermometer

Thermometers that are used for intermittent service, such as tank gauging, shall be inspected by the gauger before each use, to verify the thermometer is not broken and the liquid column is still intact. On a quarterly basis, the woodback thermometer shall be verified against an NIST traceable master thermometer's accuracy at a single point, such as ambient temperature, or in a temperature-controlled source (e.g. temperature bath). The working thermometer should not deviate more than ± 0.5˚F from the reading on the master thermometer. If the temperature readings are not within the above deviation range of ± 0.5˚F, a new thermometer that has passed its inspection and verification against the master thermometer must be provided to the gauger. All comparisons will be documented and maintained in the area records and a copy must be maintained within close proximity of the working thermometer.

Reference Standard Thermometer

An ASTM Precision Primary Reference Standard glass-stem thermometer shall be used as reference standards. They shall be replaced or recertified annually. The reference standard thermometers should be handled and stored with care in order to minimize the likelihood of damage. To ensure the reference standard thermometers remain in good condition, their use should be restricted to verification or calibration of working devices. Replaced reference standard thermometers may still be used as a working thermometer if they are accurate but are not to be used as both the reference and working thermometer at the same time. The certification must be maintained in the area office and with the thermometer for which it applies.

Thermo-Hydrometers

Thermo-hydrometers shall be inspected by the gauger before each use, to verify the thermo-hydrometer is not broken and the thermo-hydrometer liquid column is still intact. Thermo-hydrometers used for custody transfer measurement shall be made of glass and meet ASTM E100/NIST specifications. Thermometers used with a hydrometer shall meet ASTM E100 specifications for precision thermometers No. 64F, for the US customary system of measurement units in degrees Fahrenheit. Once every quarter, the accuracy of the thermo-hydrometer's scale reading will be verified by comparison to a certified thermo-hydrometer. Any device with a hydrometer scale error exceeding ± 0.1˚API and/or a thermometer scale error exceeding ± 50% of smallest subdivision on thermometer shall not be used. All comparisons will be documented and maintained in the area records and a copy must be maintained within close proximity of the working hydrometer.

Centrifuge Tubes

Centrifuge tubes shall be certified 100mL (6 in.), 200-part (200%) short cone shaped. They shall be marked in %. Before initial use for Custody Transfer applications, the accuracy of the graduation marks on each tube shall be volumetrically verified or gravimetrically certified in accordance with ASTM E542, using either a primary standard or secondary standard. This is completed by a third-party laboratory. The accompanying certificate shall detail all verification points and quantify the results at each point.

Procedure for Gauging Tanks

Tank Gauging Summary

1. Ensure the conditions are safe.

    A. While at crude facilities, employees must continuously monitor for oxygen, combustible vapors, H2S and CO. Employee will move crosswind & upwind from gas source if personal gas detection device alarms. If this movement is not feasible, the employee should exit the tank battery until gases dissipate. The tank selected for the vent should be positioned the greatest distance from the purchase tank. Wind direction must be considered when selecting the vent tank.
    B. Prior to starting work fill out the appropriate safety paperwork including but not limited to the JSA/JHA/Safe Work Permit if applicable.
    C. If there is lightning or a severe thunderstorm approaching or already in the area, wait at minimum 30 minutes after last lightning strike within five miles of your location and you consider it safe to proceed (utilize "My Lightning Tracker" from the app store).
    D. Make sure the stairs and catwalk are safe.

E. If audible or visual alarms are identified on a producer's location, the employee is to leave the location immediately and contact their supervisor. Further contact with the producer must be made to investigate the nature of the alarm before Hiland Crude personnel are permitted to return to the location.

F. Employees are required to change out of soiled clothing if product contact has resulted in saturation through one or more layers or has contacted the employee's skin.

2. When arriving at the lease site, check that you:
   A. Are at the correct lease location.
   B. Know from which tanks you are authorized to remove crude.
   C. Note the wind direction by utilizing the windsock on the tank battery.

3. Walk around the tanks and thoroughly inspect the facility and all connecting pipelines for crude leaks. Check the valves on the recycle lines, production lines and sales lines. Be sure all valves on tanks that will be gauged are closed tightly and sealed or locked if it is a local or legal requirement. Inspect the gathering tanks for distortions or leaks. *Exception: It may be a producer's practice to leave equalizer valves open.* ***Hiland Crude*** *does not change the position of the equalizer valves*.

4. The producer's representative must close production and recycle valves. Exception: Prior arrangements may exist between Hiland Crude and the producer to close **only** the production valve and gather the crude if the recycle valve is already closed. Your supervisor will notify you of these prior arrangements. If these valves are not already closed and no prior arrangements exist, do not gauge the tank.

5. Proceed to the gauger's platform on top of the tank catwalk. Before climbing the tank catwalk stairs, static electricity must be discharged by touching the bare hand or wrist and gauge tape to the stair rail or another metal tank fixture that is grounded to the earth. The brass gauging bob is not a sufficient grounding device. When going up or down tank steps do not run, step on each tread, and always maintain three points of contact. UNDER NO CIRCUMSTANCES, is an employee allowed on the roof of a tank.

6. Employee must identify the tank to be purchased and identify an additional tank on the battery from which to vent the tank battery. The tank selected for the vent should be positioned the greatest distance from the purchase tank. Wind direction must be considered when selecting the vent tank. The employee must again verify wind direction and place themselves upwind from the thief hatch of the vent tank. With the employee's arm fully extended and employee's face looking away from the hatch upwind the employee unlatches/releases the seal of the thief hatch, making sure to fully open the thief hatch. Do not utilize the produced water tank as the vent tank. The employee must move away, crosswind or upwind from the vented product. This may require the employee to leave the catwalk pending wind conditions. If no wind is present,

the employee must exit the tank battery catwalk until the venting has ceased. The employee must allow the tank to vent for a minimum of 5 minutes. If sustained venting from the tank to be gauged/sampled does not cease, the employee will exit the tank battery and contact their supervisor. If sustained venting ceases after 5 minutes, the employee can then approach the vent and if no personal gas monitor alarms exist, the employee can proceed to the tank to be gauged/sampled and open thief hatch.

7. After making sure that the thermometer has no breaks in the liquid column, lower the woodback cup-case thermometer on a cotton cord, through the tank's thief hatch, holding the thermometer at the furthest point from the tank shell to the midpoint of the oil volume to be gathered. To expedite temperature equilibration, repeatedly raise and lower thermometer 1 ft at desired level and see Table 1 below for the required immersion time per API gravity in minutes.

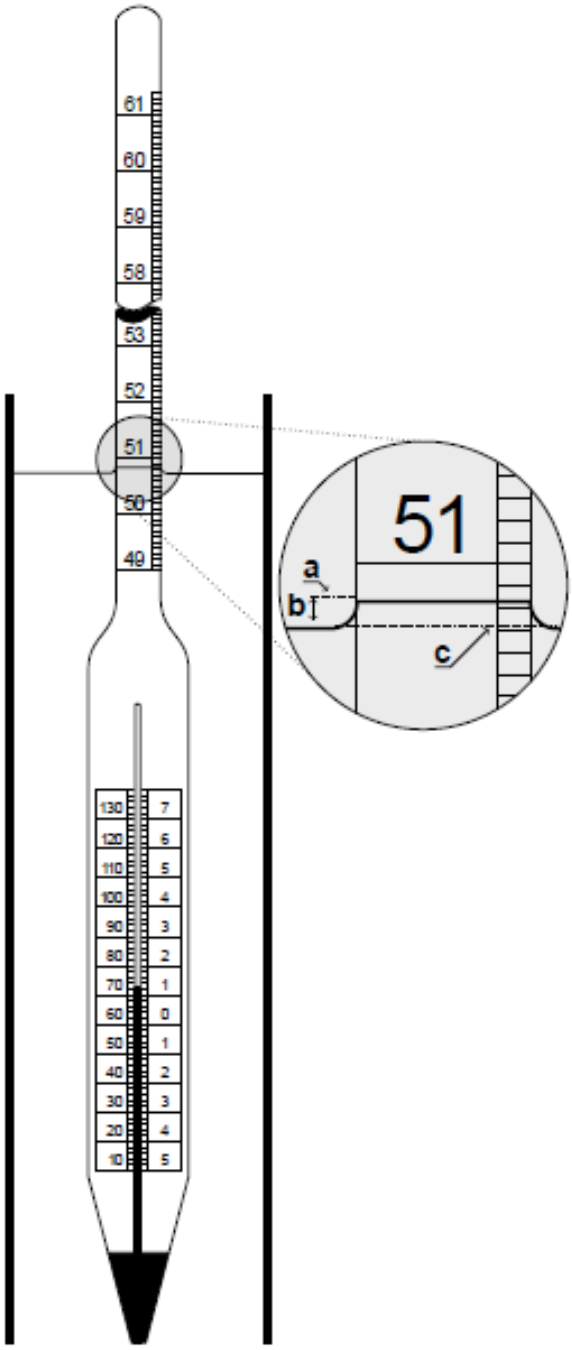
Table 1—Recommended Immersion Times for Woodback Cup-Case Assembly

	Recommended Immersion Time (minutes)	
API Gravity at 60 °F	In Motion	Stationary
>50	5	10
40–49	5	15
30–39	12	25
20–29	20	45
<20	45	80

8. Take an upper sample from the middle of the upper one-third of the tank contents using a bottom closure modified clear barrel thief. Transfer the upper sample into a 4 oz. glass sample bottle by pouring the crude oil through the modified thief's #2 sample petcock. Secure the sample bottle lid and place it in the gauger's tray for testing later.

9. Take a middle sample from the mid-point of the middle third of the tank contents.

   A. Hang the modified thief vertically on the tank thief hatch.
   B. Insert a thermohydrometer into the thief within two API gravity divisions below its expected settled position. Release it with a slight spin and ensure it floats freely from the sides of the thief. Remove any air bubbles and allow the temperature to stabilize, for light crude oils allow 3-5 minutes.
   C. Determine the temperature and API gravity of the oil and record the readings to the nearest 1˚F, and 0.1-degree API. Pour remaining liquid back into the tank.



Note: To obtain the observed API gravity of an opaque crude, read (a) 50.8°API, the top of the meniscus; and then subtract (b) 0.1°API, the height of the meniscus to find (c) 50.7°API, the actual liquid surface level.

Figure 1

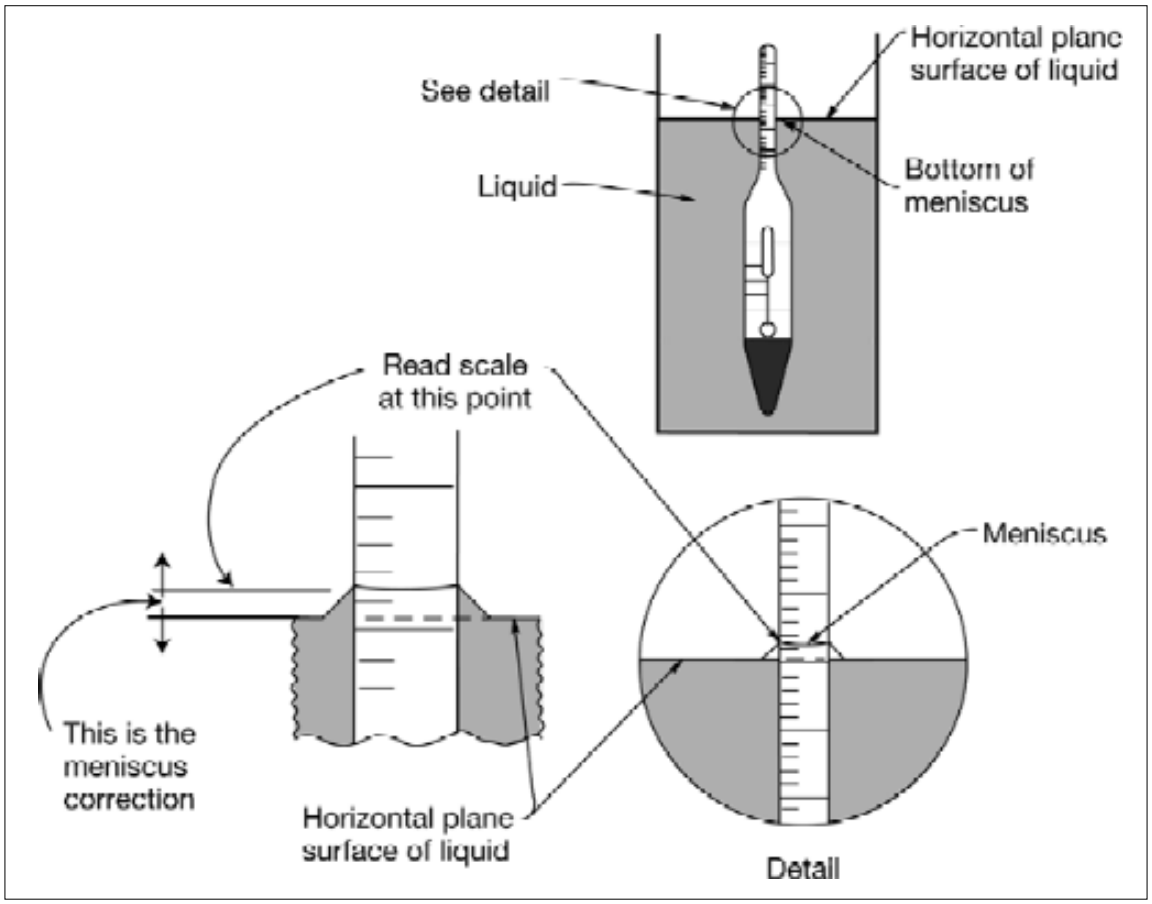


Figure 2

10. Take lower sample from the bottom of the tank contents using a bottom closure modified clear barrel thief with the trip rod extended 4 inches to take the outlet and crude merchantability samples simultaneously. Thief as described is commonly used for a twelve-inch tank outlet only, anything greater or less than twelve inches must be compensated accordingly, see figure 3.

11. Lower the thief to the tank bottom to obtain an outlet and clearance sample to determine if the tank's water bottom height satisfies the merchantability conditions. Remove from the tank and position the thief, now filled with the outlet sample, between a good light source and a level line of sight. Examine the contents to locate the free water and sediment height tank level. The total height is the sum of the distance where the "cut" line crosses the thief's linear scale plus the length the thief's tension rod is extended. Transfer the outlet sample to a second 4oz glass sample bottle by pouring the crude oil through the thief's #2 sample cock. Secure the lid on the glass sample bottle and place into gauger tray.

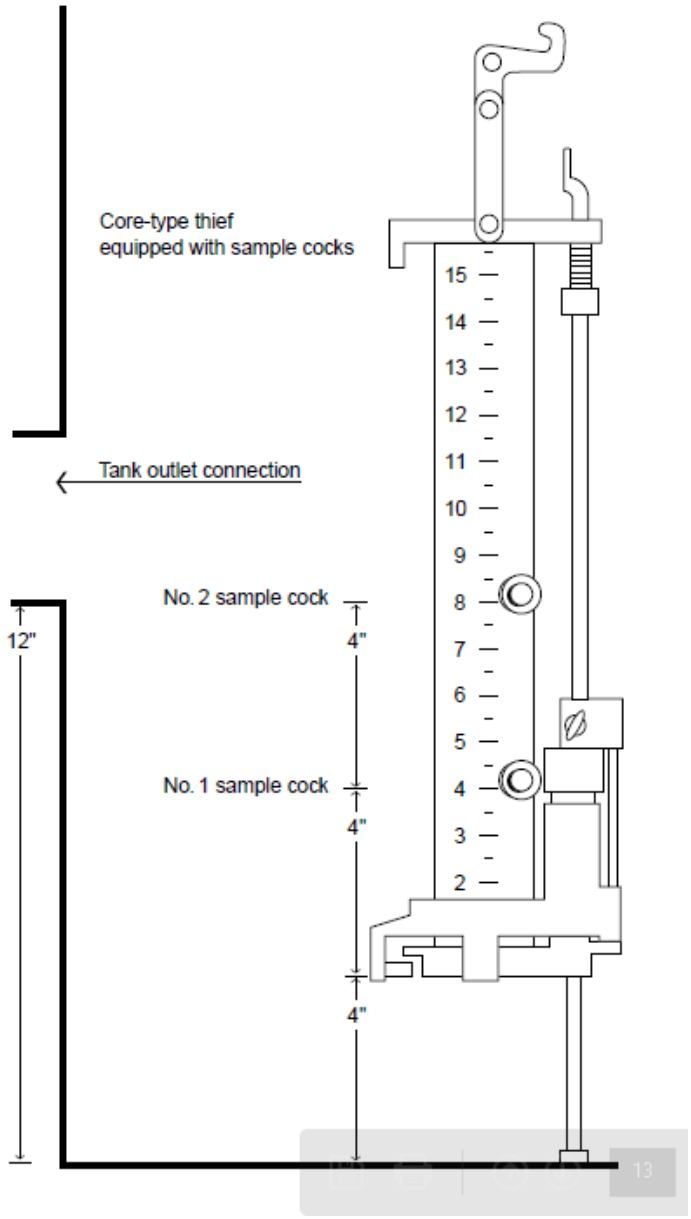


Figure 3

Note: If the free water and sediment height tank level cannot be seen clearly in the modified thief, hook the thief containing the outlet sample to the inside of the tank access hatch lip and proceed to read the opening gauge. At the same time you read this gauge, verify the tank's water bottom height using water finding paste.

12. Take the tank's opening gauge.

A. If necessary, prepare the gauge tape by coating the tape bob with water finding paste. Place a small amount of water finding paste from the tip of the gauge tape upward over the tape swivel to about the 12-inch mark on the tape.

B. Attach grounding cable to the gauger platform handrail. Using an innage tape and bob, lower the gauge tape at the reference point maintaining contact with the thief hatch to avoid a discharge of static electricity.

C. Unwind the tape slowly until the bob touches the tank bottom or datum plate lightly: ensure the bob remains in the vertical position. Utilize the tank's reference height if available to assist with accurate measurement. Use care in spooling or unspooling gauge line so that you do not cut your fingers.

D. Withdraw the tape from the tank until the liquid cut is observed, read the tape's scale at the liquid cut and note this reading. Manual gauging shall require obtaining either two consecutive gauge readings that are identical or three consecutive readings within an absolute range of 1/4 inch unless a different measurement increment has been agreed to between Hiland Crude and the customer. Repeat the procedure until a reportable gauge is obtained.

E. If the tank water/impurities bottom height does not meet the required merchantability requirements below the bottom of the field tank's outlet line, 'reject' the tank. Enter all data gathered from gauging process and reason for refusal into remarks section of the reject ticket.

F. After you have completed the opening gauge, clean the gauge tape and bob thoroughly before putting it away.

G. All thief hatch covers must be closed and latched when not in use.

13. Return to the vehicle with all equipment and perform the S&W centrifuge test to confirm the oil is merchantable before you break the tank's sales valve seal.

14. Accept or Reject the oil. See 'Oil Refusal Procedure' on page 14 for more information.

15. If the quality of the crude oil meets the requirements of merchantable oil, break and remove the seal on the tank's sales valve to the pipeline. Enter the number of 'Seal Off' on the ticket.

16. Slowly open the tank valve and go to the lease pump skid. Check the skid for any sign of leaks, oil level of pump and motor, condition of the drive belt, and the fuel level of the engine if applicable.

17. Start the lease pump. Check for leaks. If the pump is required to start on a timer, start the pump to check for proper operation, then set the timer.

If a producer representative is present to witness the custody transfer, obtain their signature to attest the 1st (top) gauge and associated quality tests and lease descriptive data on the ticket.

Closing out the Tank

When the tank levels reach a low enough level to activate the low-level shutdown switch in the level pot, the pumps will shut down.

1. Close the lease tank sales valve.

2. Inspect the pump and lease tank connections and make sure no leaks have occurred in the tank and piping area. Isolate and inspect pump per local operating procedures.

3. Before climbing to the top of the tank all safety requirements observed in the Tank Gauging Summary must also be observed when closing a tank. When going up or down tank steps do not run, step on each tread, and maintain three points of contact. At the top of the tank, determine the temperature of the liquid remaining in the tank in accordance with section 7 under the Tank Gauging Summary. Attach the grounding cable to the gauger platform handrail. Using an innage tape and bob, lower the gauge tape at the reference point maintaining contact with the thief hatch to avoid a discharge of static electricity. Manual gauging shall require obtaining either two consecutive gauge readings that are identical or three consecutive readings within an absolute range of 1/4 inch. Take and record your temperature reading. Return any excess oil from the process to the tank. Record the results, close the hatch, and wipe up any crude oil drips.

4. All thief hatch covers must be closed and latched when not in use. Return all equipment to the gauger's tray or truck storage.

5. Place a seal on the field tank's outlet valve and remove seals from production valve and recycle valve as applicable. Note: Do not remove producer's seals or seals from a regulatory agency.

6. Complete the run ticket by entering the closing gauge and temperature, and the 'Seal On' on the ticket.

7. Proofread the ticket thoroughly to ensure all sections to be recorded are complete and accurate.

8. Obtain the signature of the lease operator, if present.

9. Leave a copy of the run ticket in the mailbox at the lease site.

Before leaving any location, complete 360 walkaround of pickup, ensure path forward is clear, check that tools are secure, all equipment is in its proper storage area, all compartments are closed and there is nothing under work vehicle.

Re-Starts

In the event the tank pump has shut down and the tank has not been fully pumped, then the lease pump went down for some reason other than low level. Attempt to determine the reason the pump went down. The pump may have gone down due to electrical power failure, high or low pipeline pressure, etc., and no maintenance or repair is necessary. If no issues are apparent, the gauger may initiate a restart. Make a note stating the date, time and reason for restart.

Refusing a Tank

Oil Refusal Policy

No Crude will be accepted for gathering and/or transportation except merchantable Crude which is properly settled and contains a total average of not more than one half percent (0.5%) of sediment, water, and other impurities.

Provided:

A. Water may not be allowed to exceed two tenths of one percent (0.2%). The level of sediment, water and other impurities must be at least 4 inches below the sales valve or lower.
B. Crude oil must not exceed (120°) Fahrenheit unless management approval is received.
C. Reject Crude shipments having API gravity greater than 48 degrees API or less than 31 degrees API unless management approval is received.
D. Viscosity, pour point, initial boiling point, and other characteristics are such that it will not qualify as merchantable crude.
E. The reference height for the tank has been verified and is up to date.

Hiland Crude Special Handling for Nonconforming H2S Wells

Hiland Crude is willing to consider handling lease connected wells with levels of H2S that do not conform to Hiland Crude's quality specifications on a case-by-case basis provided it can do so safely and maintain the quality of the common stream. It is the producer's responsibility to determine H2S existence at all production tank batteries and post signage required by law.

Producers shall also supply bottled breathing air as required at the site with sufficient length of supply line for Hiland Crude employees to safely perform the necessary operations to initiate delivery of the crude into Hiland Crude's system. Hiland Crude's H2S specification is 10 PPM.

The process Hiland Crude will follow to determine if the tank(s) can be pumped into Hiland Crude's gathering system is the following:

1. Hiland Crude gaugers wear a personal gas monitor that is designed to detect levels of H2S greater than 10 ppm.

2. If the personal gas monitor registers readings indicating the tank is higher than 10 ppm, the gauger will immediately leave area and notify supervisor. After supplied air is brought on location and proper PPE is donned then tank can be tested at the thief hatch using a H2S pump method.

3. If the testing registers an H2S level between 10ppm and 100ppm, Hiland Crude may accept the oil into the gathering system. If Hiland Crude elects not to accept the oil into the system due to potential degradation of the common stream, a turn down fee will be charged, and the producer will be notified of the rejection.

If the testing registers an H2S level greater than 100 ppm, Hiland Crude can reject the oil and charge a turndown fee and the producer will be notified of the rejection.

4. Gaugers will record the result of the test in the notes section of their iPad.

5. Locations with known H2S concentrations of 100 ppm or greater require management approval for access (tanks with H2S concentrations of 100 ppm or greater are not normally bought, but if or when they are, the following will be required). When approval is received, all proper safety equipment and PPE must be used, including either a full face-piece pressure demand SCBA certified by NIOSH for a minimum service life of thirty minutes or a combination full face-piece pressure demand supplied-air respirator (SAR) with auxiliary self-contained air supply. Employees are also required to work in pairs using the “buddy” system. One employee works on the catwalk and the second is at the ground level with a clear view of the employee working the tank. The “buddy” system consists of the following:

At least one employee located outside of the Immediately Dangerous to Life and Health (IDLH) atmosphere. IDLH is any condition that would pose an immediate or delayed threat to life, cause irreversible adverse health effects, or interfere with an individual’s ability to escape unaided from a space. For H2S, an IDLH is any atmosphere with H2S concentrations of 100 ppm or greater.

Quality Testing

Perform the field tests with care and record the results in the appropriate fields of the run ticket and the logbook.

In compliance with the API Manual of Petroleum Measurement Standards (MPMS), (Chapter 10.4 - "Determination of Water and/or Sediment in Crude Oil by the Centrifuge Method (Field Procedure), Hiland Crude LLC uses the 6” short-cone 200-part tubes certified in accordance with ASTM E542. (SOURCE: API 10.4 Section 7.2) centrifuge tube procedure.

To determine the amount of water and sediment in a crude oil sample via the centrifuge method:

1. Invert sample bottles a minimum of 10 times, then proceed to fill each of the two tubes with exactly 50 mL (100 parts) of the sample.
2. Fill each tube with stoddard solvent to the 100-mL (200-part) mark.
3. Plug each tube tightly with a stopper and invert a minimum of 10 times.
4. Insert the tubes in a pre-heater. Heat the contents to a test temperature of 140 °F ±5 °F. Verify the temperature of the contents of the tube utilizing a sample thermometer.
5. Place the tubes in opposite trunnion cups in the centrifuge and spin the tubes for at least 5 minutes at a minimum relative centrifugal force of 500g.
6. Immediately after the centrifuge comes to rest, use a sample thermometer to verify that the sample temperature is within 15 °F of the test temperature, taking care not to disturb the oil/water interface.
7. Note: If the sample temperature is within 15 °F, proceed to step 8. If the sample temperature is not within 15 °F, then adjust temperature setting of centrifuge and reinitiate the procedure beginning with step 4.
8. Verify the oil/water interface is clear, distinct and readable, and no identifiable layer (such as emulsion or congealed paraffin) is present above the interface in each tube. If the interface is unclear, highly paraffinic or there is an additional layer above the interface, accomplish one or more of the following actions:

    A. Without agitation, repeat the procedure from Step 4.
    B. Without agitation, repeat the procedure from step 4 using a test temperature of 160 °F +/- 5 °F.
    C. Reinitiate the test from the beginning with new samples from the same source.

9. Hold the tube in an upright (vertical) position. Read and record the volume of water and sediment at the bottom of each tube.
10. Reheat the tubes to the initial test temperature and return them to the centrifuge. Spin for an additional 5 minutes. Again use a sample thermometer to verify that the sample temperature is within 15 °F of the test temperature. If the sample temperature is not within 15 °F, then adjust temperature setting of centrifuge and repeat this step. Repeat the step until two consecutive consistent readings are obtained. Note: For the test to be considered valid, a clear interface shall be observed between the oil layer and the separated water/sediment layer. No emulsions should be present immediately above the oil and water/sediment interface.
11. Calculating and reporting for 200-part tubes: the percentage of water and sediment is the average, to three decimal places of the values read directly from the two tubes.

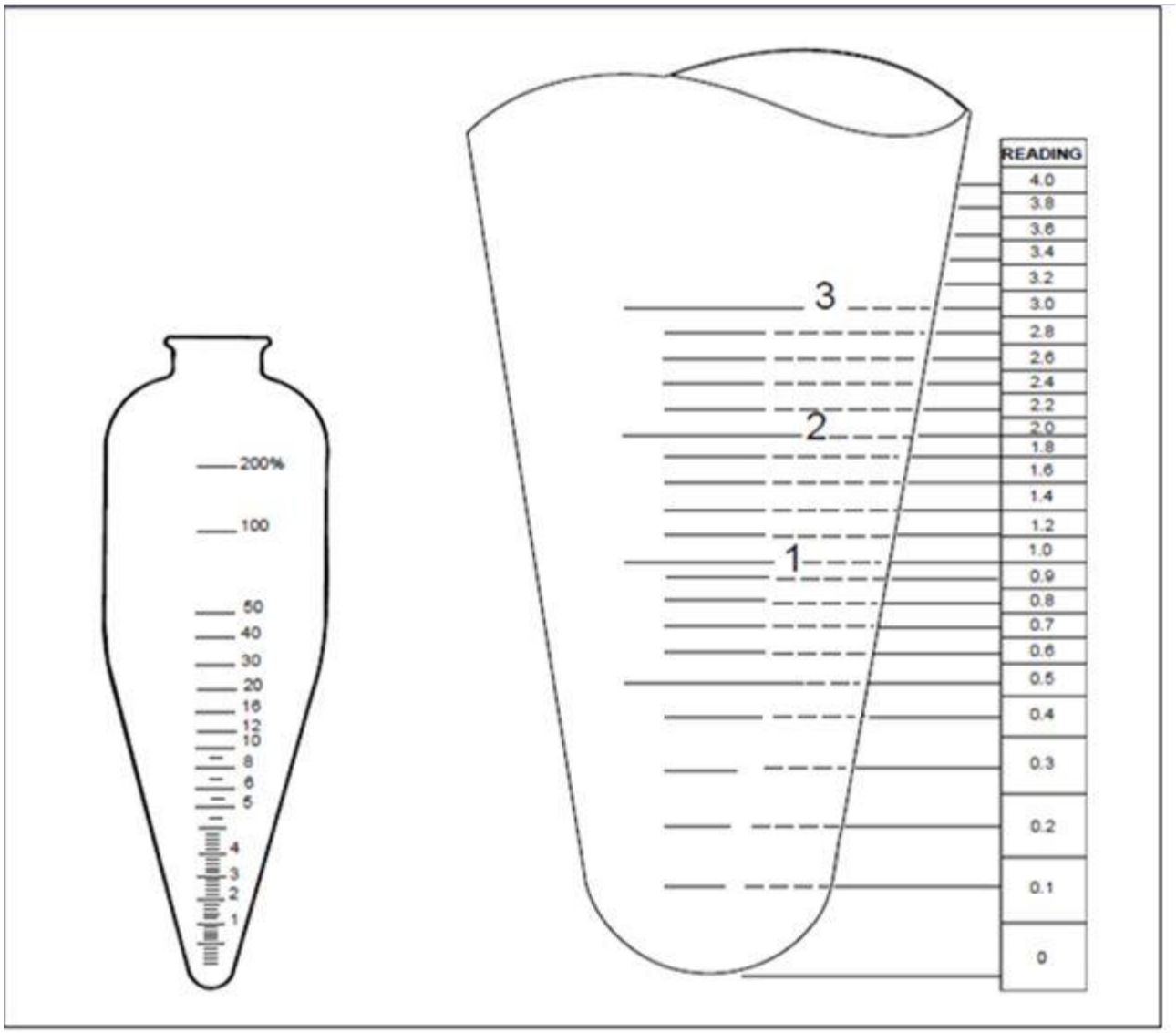


Figure 4 - Reading a 200-Part Centrifuge Tube

Table 2 - Procedure for Reading a 200-Part Cone-Shaped Tube

Volume (%)	Read to Nearest (%)
0.0-0.2	0.05
0.2-2.0	0.10
>2.0	0.20

Table 3-Calculation and Reporting of Test Results

100 mL Tubes Volume of Water and/or Sediment (mL)		200-part Tubes Volume of Water and/or Sediment (Parts)		Reported Total Water and/or Sediment
Tube 1	Tube 2	Tube 1	Tube 2	(%)
<0.0125	<0.0125	<0.025	<0.025	0.000
<0.0125	0.025	<0.025	0.050	0.025
<0.0125	0.050	<0.025	0.100	0.050
0.025	0.025	0.050	0.050	0.050
0.025	0.050	0.050	0.100	0.075
0.025	0.075	0.050	0.150	0.100
0.050	0.050	0.100	0.100	0.100
0.050	0.075	0.100	0.150	0.125
0.050	0.100	0.100	0.200	0.150
0.075	0.075	0.150	0.150	0.150
0.075	0.100	0.150	0.200	0.175
0.100	0.100	0.200	0.200	0.200
0.100	0.150	0.200	0.300	0.250
0.150	0.150	0.300	0.300	0.300

NOTE 1 100 mL Tubes—If the total water and/or sediment volume for both tubes is less than 0.0125 mL, the sediment and water volume shall be recorded as 0.000 %.

NOTE 2 200-part Tubes—If the total water and/or sediment volume for both tubes is less than 0.025 parts, the sediment and water volume shall be reported as 0.000 %.

Demulsifiers

If there is not a clean break between the oil layer and the water-sediment residue, ask your supervisor about the use of a demulsifier agent. A demulsifier aids in breaking water away from the crude molecules. If a demulsifier is determined to be needed, contact your supervisor and refer to API 10.4 Section 6.

Pump Operation

After verifying merchantability of the crude oil and determining that it is acceptable, use the following guide to start up pumps and ship the oil down the pipeline:

1. Inspect all Hiland Crude assets and equipment. Ensure all Hiland Crude assets are clean and properly maintained. Check for settling of the pump skid(s) and risers along with any signs of leaking or seepage on the pump, suction, and discharge headers. If any issues are discovered, immediately notify your supervisor and DO NOT RUN THE EQUIPMENT. In addition, before opening the tank sales valve, ensure that the truck loading box valve or “getty box valve” is closed and sealed. If the valve is open, DO NOT OPEN THE TANK and contact the customer.

2. Verify that no Lockout/Tagout exists on Hiland Crude Equipment. Spot check for any leaks and verify that all valves are in the proper position.

3. Verify the flow path from the pump(s) to the selected tank. Ensure that there is an open flow path from the tank to the pump, from the pump to the discharge header, and verify that there is a pressure relief system to prevent the pump from over pressuring. Failure to ensure open flow path will result in pump over pressuring and can result in damage to Hiland Crude equipment.

4. Verify that the murphy gauge kills are adjusted to proper levels. The murphy gauge is designed to shut off the pump if pipeline pressure is too high or too low. Low murphy kills should be adjusted to a level slightly above the 0 PSI mark, and high murphy kills should be adjusted per local and state policies and requirements.

5. Prior to starting the pump(s), make sure to check that the gear oil on the power end is at a safe level if applicable, and trained to do so.

6. Start the pump(s). Follow local practices to engage the pump(s) if not currently engaged. Bleed air out of pump(s) as needed.

7. While the pump is running, watch for leaks or signs of anything abnormal such as vibration. If you have questions or concerns, shut the pump off, isolate it and notify your supervisor.

8. Upon satisfactory inspection of pump operation, observe for a few more minutes and inspect location one final time. Replace absorbent pads on the pump skid as needed.