



# GAUGING MANUAL

Rev 1.7

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# Gaugers Summary

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The term gauging is used to describe the process of measuring the height of crude oil in a storage tank less than 2000 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

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When you report to work and before you proceed to a lease, you are responsible for conducting an equipment inspection. It must include the following:

All crude oil gauging, safety, and test equipment and supporting documentation is present, clean, operating correctly, properly stored in designated locations on the unit.

The gauger carrying tray contains:

- "modified" 16-inch clear barrel thief
- Wood back thermometer
- gauging tape and bob with grounding cable and clamp in good repair
- two clean, cone shaped, 167mL (6 in.) or 203 mL (8 in.) centrifuge tubes
- Tube of "KolorKut"
- Rags
- UL approved intrinsically safe flashlight
- two 16 ounce plastic bottles

The gauger pick up must contain:

- Working centrifuge and sample heater
- two additional clean, cone shaped, 167mL (6 in.) or 203 mL (8 in.) centrifuge tubes, and stoppers
- Hydrometers
- 1 3/8" hydrometer cylinder
- Disk (dial) thermometer
- Supply of solvent
- Ample clean rags
- 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 (H<sub>2</sub>S), Benzene, Propane, Butane, and Hydrocarbon Vapors.

The gauger equipment must contain:

- Mobile communication device - iPad

- Printer
- A supply of printer paper rolls
- Tank seals
- Black ball point pens
- Sharpened pencils with erasers
- Other forms and scratch pads

The gauger must be outfitted with:

- PPE per the WHA and location specific requirements

Notes - Matches, cigarette lighters, 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 Measurement Manager/Supervisor and/or EHS personnel prior to purchasing unapproved gauging and sampling equipment. This includes, but is not limited to, flashlights (with appropriate Hazard Classification rating), gauging tapes, gauging bobs, gauge poles, etc.**

### Working Gauge Tapes

Working gauge tapes will have their accuracy verified against a Reference Standard gauge tape traceable to the National Institute of Standards and Technology (NIST). The differences should not exceed the tolerances described in Table 1. The working tape used by gaugers should be checked quarterly against the reference standard. The results of this check must be recorded and maintained by the gauger in possession of the working gauge tape for the purposes of inspection. Gauge tapes used by third parties, such as independent contractors conducting gauging activities on facilities that require Hiland Crude personnel to operate, will be required to meet the accuracy standards in Table 1. The tape and bob assembly should be inspected daily or 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. Evidence of certification within the annual frequency will also be available for inspection. Portable electronic gauging devices shall not be used if the accuracy and repeatability does not meet the same standard for manual gauging equipment.

## **Reference Standard Tapes**

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.

Alternately, working tapes may also be verified or certified by a certifying body, such as a vendor of such equipment. These tapes are not to be used for general tank gauging purposes.

The certification frequency for the Reference Standard gauge tapes will be every five years.

Table 1

Tape Length/Gauge Height	Verification Tolerances	Verification Tolerances %
25 ft	1/32 in, 0.0025 ft	0.01%
50 ft	1/16 in, 0.005 ft	0.01%
66 ft	5/64 in, 0.0066 ft	0.01%
75 ft	3/32 in, 0.0075 ft	0.01%
100 ft	1/8 in, 0.01 ft	0.01%

## **Thermometer Inspection**

A designated Hiland Crude employee in your area will inspect all wood-back thermometers in the gauger kits regularly to ensure mercury columns are continuous and functioning. At least once per quarter this person compares the working thermometers to the area's master thermometer as an accuracy check assuring the working thermometer does not deviate more than +/- 0.5°F from the reading on the master thermometer. This check is made by placing the working thermometer and the master thermometer next to each other in a dry block calibrator set at a temperature close to ambient temperature. 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. An annual inspection must also be conducted by the designated Hiland Crude employee who will compare the working thermometers to the area's master thermometer at three temperatures within their normal operating range. Each comparison is subject to the same deviation of +/- 0.5°F. In the case that one of the working thermometers comparison's fail, then a new thermometer that passes the 3 point comparison to the master reference thermometer will 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 every five years. 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 in which it applies.

## **Hydrometers**

Hydrometers used for custody transfer measurement shall be made of glass and meet ASTM E100 specifications. Once every quarter, the accuracy of the hydrometer's scale reading will be verified by comparison to a certified hydrometer. Any device with a scale error greater than 0.1°API 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.

Thermometers used with a hydrometer shall meet ASTM E1 specifications for precision thermometers No. 64F, for the US Customary system of measurement units in the area of use. Thermometers inside a thermohydrometer shall meet ASTM E100 specifications.

## **Centrifuge Tubes**

Centrifuge tubes shall be either 167mL (6 in.) or 203 mL (8 in.) types. They shall be marked in mL or %. 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**

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## Tank Gauging Summary

1. Ensure the conditions are safe.
  - A. While at crude facilities, employees must continuously monitor for oxygen, combustible vapors, H<sub>2</sub>S and CO. Employee will move upwind from gas source if personal gas detection device alarms. If movement upwind is not feasible, the employee should exit the tank battery until gas dissipates. 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 until the weather improves and you consider it safe to proceed.
  - D. Make sure the ladders 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 Kinder Morgan personnel are permitted to return to 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 wind sock 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 overflow lines, transfer lines and draw-off lines. Be sure all valves 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. Be sure that the valve on the incoming flow line to the tank is closed, and additionally sealed if this is a local practice. The producer's representative must close this valve. Exception: Prior arrangements may exist between Hiland Crude and the producer to close the valve and gather the crude. Your supervisor will notify you of these prior arrangements. If the valve is not closed and no prior arrangements exist, do not pick up the crude oil.
  
  5. Proceed to the gauger's platform on top of the tank. Before climbing the tank, static electricity must be discharged by grounding the bare hand 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 keep at least one hand on the railing. **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, but not fully opening the hatch to begin the venting process. The employee must move away, up or side wind 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 after 5 minutes, sustained venting from the tank to be gauged/sampled has not ceased, the employee will exit the tank and contact their supervisor. If sustained venting from the tank to be gauged/sampled ceases after 5 minutes, the employee can then

approach the vent and if no personal gas monitor alarms, the employee can fully open the thief hatch of the vent tank and proceed to the tank to be gauged/sampled.

7. After making sure that the thermometer has no breaks in the mercury column, lower the wood back (cup-case) thermometer on a cotton cord through the tank's thief hatch, holding the thermometer at least 12 inches from the side of the tank shell to the midpoint of the oil volume to be gathered. To expedite temperature equilibration, raise and lower the thermometer through a distance of 2 feet and see the Table 1 below for the required immersion time per API gravity in minutes.

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

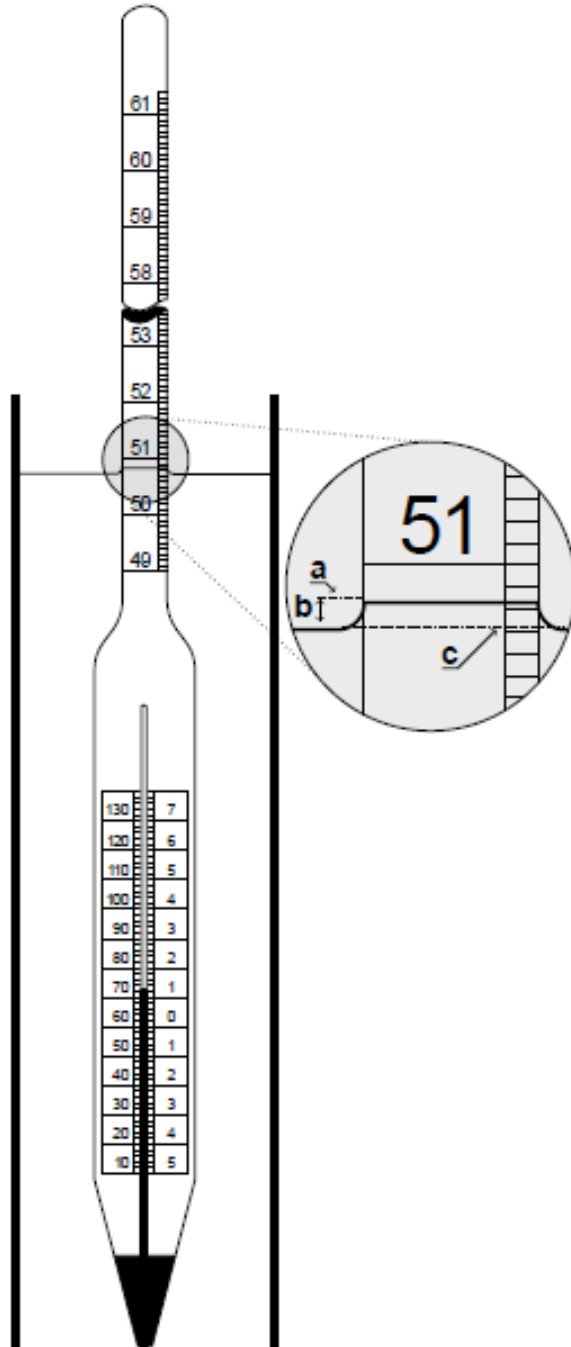
API Gravity at 60 °F	Recommended Immersion Time (minutes)	
	In Motion	Stationary
>50	5	10
40–49	5	15
30–39	12	25
20–29	20	45
<20	45	80

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 16 ounce plastic bottle by pouring the crude oil through the modified thief's #2 sample cock. Secure the cap on the plastic bottle and place it in the gauger's tray for later testing.

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

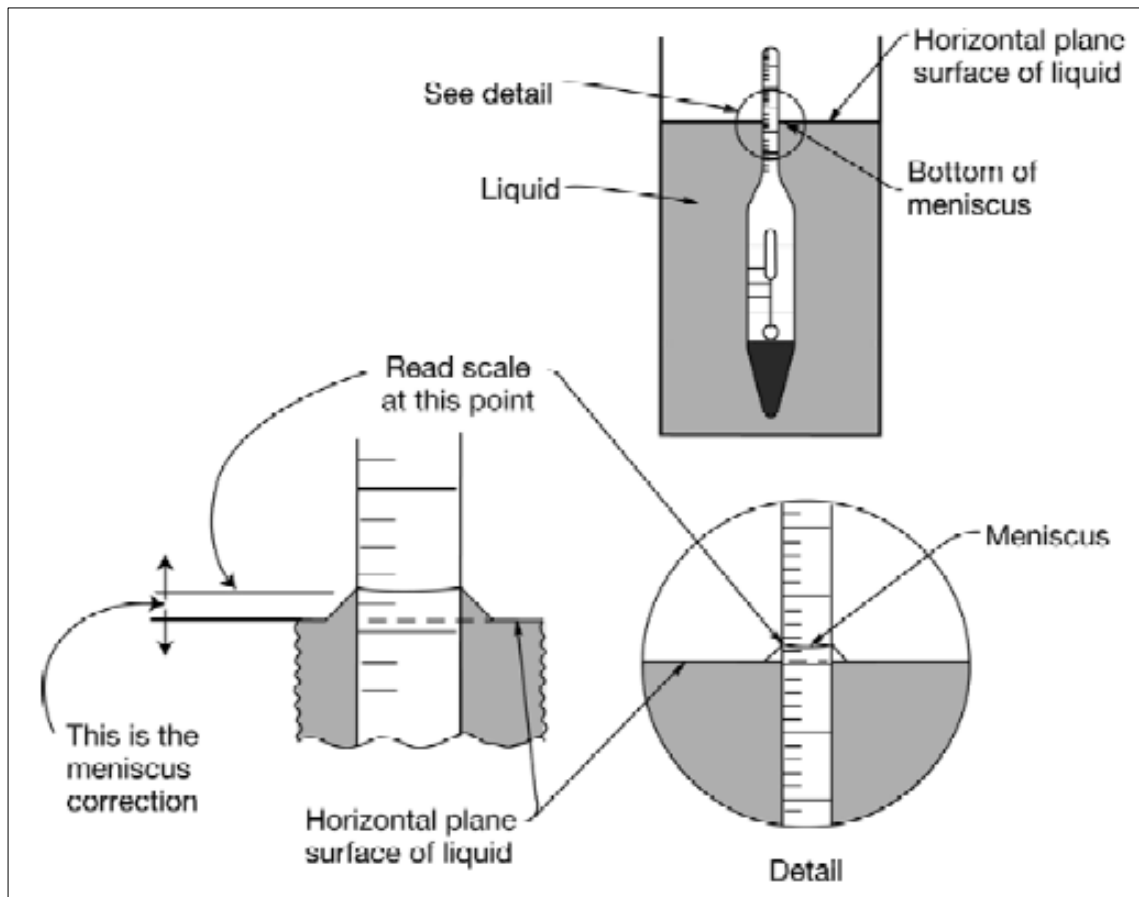
- A. Hang the modified thief vertically on the tank thief hatch, test the sample.
- B. Insert a thermohydrometer into the thief about two API gravity divisions below its expected settled position. Release it with a slight spin and ensure it floats freely from the side of the thief. Remove any air bubbles and allow the temperature to stabilize, generally 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.
- D. 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 4—Reading the Meniscus



10. Use a modified thief to take the outlet and crude merchantability samples simultaneously. Using a thief as described with the trip rod extended 4 inches which is commonly used for a twelve inch tank outlet only, anything greater or less than twelve inches must be compensated accordingly, see figure 1 below.

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 16 ounce plastic bottle by pouring the crude oil through the thief's #2 sample cock. Secure the cap on the plastic bottle and place it in the gauger's tray.

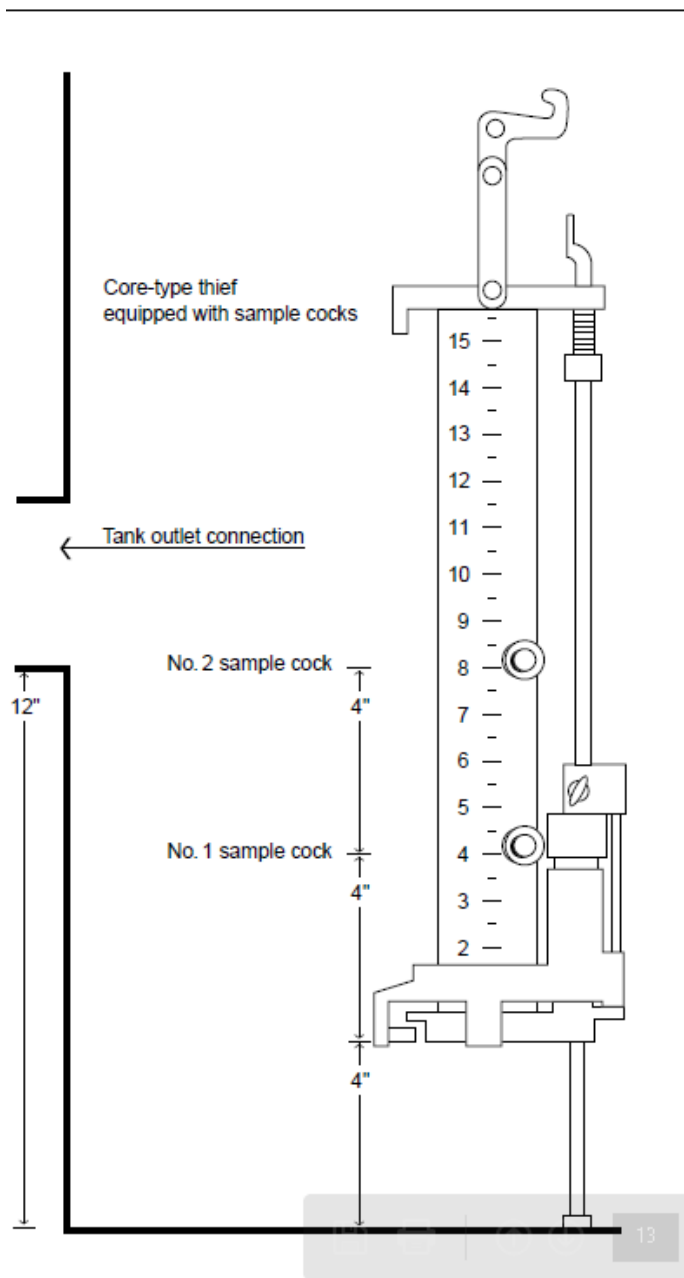


Figure 1

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 hand rail. 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. 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 not this reading. The reported gauge will be determined by three consecutive readings within a range of  $\frac{1}{4}$  inch. Repeat the procedure until a reportable gauge is obtained.

E. If the tank water bottom height does not meet the required merchantability requirements below the bottom of the field tank's outlet line, 'turn down' the tank.

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

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 seal. After completing the test return the excess crude oil to the tank.

14. Accept or Reject the oil See 'Oil Refusal Procedure' on page 13 for more information.

15. If the quality of the crude oil meets the requirements of merchantable oil.

A. Break and remove the seal on the tank valve to the pipeline. Enter the number of 'Seal Off' on ticket.

B. 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 engine, condition of the drive belt, and the fuel level of the engine if applicable.

16. 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 his 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 pumps down to approximately the 1' 6" level, the lease pump will shut down due to low level shutdown switch in the level pot.

1. Close the lease tank outlet valve.
2. Record the time "off".
3. Place a seal on the field tank's outlet valve and record the seal number.
4. Inspect the pump and lease tank connections and make sure no leaks have occurred in the tank area.
5. 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 keep at least one hand on the railing. 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 hand rail. 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. Take two innage closing gauges to the nearest ¼" or until consistent measurements are obtained and unless a different measurement increment has been agreed to between KM and the customer. Return any excessive oil from the sampling process to the tank. Record the results, close the hatch, and wipe up any crude drips.
6. All thief hatch covers must be closed and latched when not in use. Return all equipment to the gauger's tray or truck storage.
7. Complete the run ticket by entering the closing gauge, the time "off", and the "on" seal number.
8. Proof read the ticket thoroughly to ensure all sections to be recorded are complete and accurate.
9. Obtain the signature of the lease operator, if present.
10. Leave a copy of the run ticket in the mailbox at the lease site.
11. Before leaving, walk around the pickup, check that tools are secure; all equipment is in its proper storage area, nothing is left under the pickup, and all compartments are closed.

### **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 suction. Attempt to determine the reason the pump

went down. The pump may have gone down due to electrical power failure, fuel supply interruption, tc., and no maintenance or repair is necessary. If no issues are apparent, the gauger may initiate a restart.

## Refusing a Tank

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### Oil Refusal Policy

No Crude will be accepted for gathering and/or transportation except merchantable Crude which is properly settled and contains 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%). This water level must be above four inches (4") below the sales valve.
- B. Crude oil must not exceed (120°) Fahrenheit.
- C. Gravity, viscosity, pour point, initial boiling point, and other characteristics are such that it will not qualify as merchantable crude.
- D. Reject Crude shipments having API gravity greater than 48 degrees API or less than 31 degrees API.

### 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 Producers responsibility to determine H2S existence at all production tank batteries and placed 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's system. Hiland's H2S specification is 10 PPM.

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

1. Hiland Crude gaugers wear a personal H2S detector that is designed to detect levels of H2S greater than 10 ppm.
2. If the personal H2S detector registers indicating the tank is higher than 10 ppm, the gauger will then test the tank at the thief hatch using a H2S Draeger Tube method
3. If the Draeger tube registers an H2S level between 10ppm and 100ppm, Hiland may accept the oil into the gathering system. If Hiland 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.

4. If the Draeger tube registers a H<sub>2</sub>S level greater than 100 ppm, Hiland can reject the oil and charge a turn down fee and the producer will be notified of the rejection.

5. Gaugers will record the result of the test in the notes section of their Ipad.

6. Locations with known H<sub>2</sub>S concentrations of 100 ppm or greater require management approval for access (tanks with H<sub>2</sub>S 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 employee is located 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 H<sub>2</sub>S an IDLH is any atmosphere with H<sub>2</sub>S concentrations of 100 ppm or greater.

## Quality Testing

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

In compliance with the API Manual of Petroleum Measurement Standards (MPMS), (Chapter 10 - "Determination of Water and/or Sediment in Crude Oil by the Centrifuge Method (Field Procedure), Hiland uses the 200 ml cone-shaped centrifuge tube procedure.

To determine the (S&W):

1. Fill each of the two tubes with exactly 50 mL (100 parts) of the sample.
2. Fill each tube with the solvent solution to the 100-mL (200-part) mark.
3. Plug each tube tightly and invert 10 times.
4. Insert the tubes in a pre-heater. Heat the contents to a test temperature of 140 °F ±5 °F.

5. Place the properly heated tubes in the centrifuge machine, in a balanced condition, and spin for 5 minutes.

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.

Note: If the sample temperature is within 15 °F then go to step 7. If the sample temperature is not within 15 °F then reinitiate the procedure beginning with step 4.

7. Hold the tube in an upright (vertical) position. Read and record the volume of water and sediment at the bottom of each tube.

8. Reheat the tubes to the initial test temperature and return them, to the centrifuge. Spin for an additional 5 minutes. Repeat the step until two consecutive consistent readings are obtained.

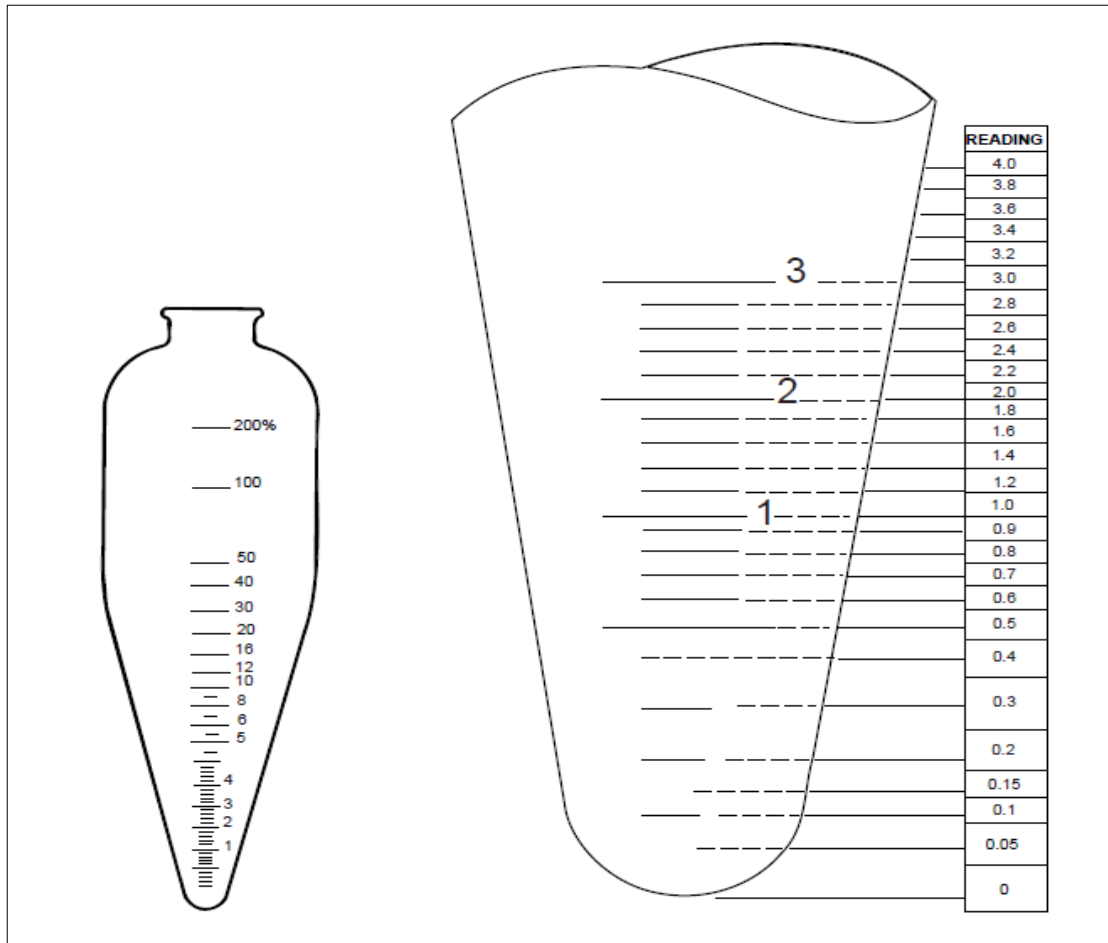
Note: For the test to be considered valid, a clear interface shall be observed between the oil layer and the separated water/sediment layer. No emulsions should be present immediately above the oil and water/sediment interface. A test is comprised of TWO TUBES of the SAME SAMPLE. Compare the readings of the two tubes. If the difference is greater than one subdivision on the centrifuge tube, the test is invalid and shall be repeated.

9. Calculating and reporting.

For 100-mL tubes: read and record the volume of water and sediment in each tube. Add the readings together and report the sum as the percentage of water and sediment.

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 6 - Reading a 200-Part Centrifuge Tube**

**Table 1 - Procedure for Reading a 200-Part Cone-Shaped Tube**

<b>Volume (%)</b>	<b>Read to Nearest (%)</b>
0.0-0.2	0.05
0.2-1.0	0.10
>1.0	0.20

Table 4—Expression of Results for 100-mL Tubes and 200-Part Tubes

100-mL Tubes Volume of water and/or sediment (mL)		200-Part Tubes Volume of water and/or sediment (%)		Read and Recorded 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
0.025	0.025	0.050	0.050	0.050
0.025	0.050	0.050	0.100	0.075
0.050	0.050	0.100	0.100	0.100
0.050	0.075	0.100	0.150	0.125
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

NOTE 1 100-mL Tubes—If the total water and/or sediment volume for both tubes is less than 0.025 % (0.0125 mL), the water and sediment volume shall be read and recorded as 0.000 % (0.000 mL).

NOTE 2 200-Part Tubes—If the total water and/or sediment average percentage for the two tubes is less than 0.050 %, the water and sediment volume shall be read and recorded as 0.000 %.

## Paraffinic Crude

If the crude is highly paraffinic, the crude may give the appearance of having a higher S&W content. Perform the centrifuge test twice at the 140° F level which is usually sufficient to permit the paraffin particles to dissolve in the crude, or until you have two consecutive readings that are in agreement.

## 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. However, a demulsifier can only be used with the consent of the area scheduler. A demulsifier should be mixed according to the manufacture's recommendations and should never add to the volume of sediment and water determined. The ratio of demulsifier to solvent should be recorded in order to be able to duplicate results if necessary.

# Pump Operation

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After obtaining all of the information about the tank of oil, and it has been determined that the oil is acceptable, the following steps are required to ship the oil down the pipeline.

1. Inspect the pump and related piping - look for any signs of leaks. Look for settling of the pump skid or riser. Be sure to wipe any oil residue out of the skid. This is important; to maintain a clean appearance on our customer's locations, and also to help identify small drips that later may become bigger problems. Any leaks or settling should be dealt with immediately or reported to your supervisor. Do not run a pump that has signs of problems.
2. Verify the flow path from the pump to the selected tank. Verify the pump bypass valve is open on the suction side, failure to complete will result in pump overpressure and could result in damage to the pump.
3. Make sure to walk entire pipeline from tank to riser checking for leaks, settling, and that all valves are locked or sealed in the appropriate position. Ensure the getty box is closed and sealed.
4. Verify your setting on the Murphy kill. This device is designed to kill the pump if the pressure is too high or too low.
5. Prior to starting pump make sure to check that the gear oil on the power end of the pump is at a safe level.
6. Start the pump. Follow local practices to engage the pump if is not currently engaged. Bleed pump 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 and isolate it. Notify your supervisor.
8. Upon satisfactory inspection of pump operation observe for a few more minutes, and inspect location one final time.