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Gaugers Summary

The term gauging is used to describe the process of measuring the height of the crude in a storage tank, as well as other related activities that determine both the quality and quantity of crude in the tank. A gauger’s task is to determine both the quality and quantity of crude oil through gauging, sampling, and 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 lease, you are responsible for conducting an equipment inspection. It must include the following:

All crude oil gauging, 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
- 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

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

Test Equipment Testing and Verification

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.

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>
<thead>
<tr>
<th>Tape Length/Gauge Height</th>
<th>Verification Tolerances</th>
<th>Verification Tolerances %</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 ft</td>
<td>1/32 in, 0.0025 ft</td>
<td>0.01%</td>
</tr>
<tr>
<td>50 ft</td>
<td>1/16 in, 0.005 ft</td>
<td>0.01%</td>
</tr>
<tr>
<td>66 ft</td>
<td>5/64 in, 0.0066 ft</td>
<td>0.01%</td>
</tr>
<tr>
<td>75 ft</td>
<td>3/32 in, 0.0075 ft</td>
<td>0.01%</td>
</tr>
<tr>
<td>100 ft</td>
<td>1/8 in, 0.01 ft</td>
<td>0.01%</td>
</tr>
</tbody>
</table>

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

Tank Gauging Summary

1. Be sure the conditions are safe.
   
   A. Prior to starting work fill out the appropriate safety paperwork including but not limited to the JSA/JHA.
   
   B. 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.
   
   C. Make sure the ladders and catwalk are safe.

2. When you arrive at the lease site, check that you:
   
   A. Are at the right 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.

6. Standing upwind, open the tank gauge access hatch cautiously and refer to L-O&M procedure 190 for safety the requirements during the tank gauging and sampling processes.

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

<table>
<thead>
<tr>
<th>API Gravity at 60°F</th>
<th>Recommended Immersion Time (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In Motion</td>
</tr>
<tr>
<td>&gt;50</td>
<td>5</td>
</tr>
<tr>
<td>40–49</td>
<td>5</td>
</tr>
<tr>
<td>30–39</td>
<td>12</td>
</tr>
<tr>
<td>20–29</td>
<td>20</td>
</tr>
<tr>
<td>&lt;20</td>
<td>45</td>
</tr>
</tbody>
</table>

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. Determine the temperature and API gravity of the oil and record the readings to the nearest 1°F, and 0.1 degree API.
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
D. Pour remaining liquid back into the tank.

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.

10. 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.
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.
11. 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. 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.

   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 ¼ 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.

12. 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.

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

14. 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.

15. 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. At the top of the tank, determine the temperature of the liquid remaining in the tank, and take two innage closing gauges to the nearest ¼” or until consistent measurements are obtained. Return any excessive oil from the sampling process to the tank. Record the results, close the hatch, and wipe up any crude drips.

6. 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.

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, etc., and no maintenance or repair is necessary. If no issues are apparent, the gauger may initiate a 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 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 H2S level greater than 100 ppm, Hiland will reject the oil and charge a turn down fee and the producer will be notified of the rejection.
Quality Testing

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 8. If the sample temperature is not within 15 °F then reinitiate the procedure beginning with step 4.
7. 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](image)

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

<table>
<thead>
<tr>
<th>Volume (%)</th>
<th>Read to Nearest (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-0.2</td>
<td>0.05</td>
</tr>
<tr>
<td>0.2-1.0</td>
<td>0.10</td>
</tr>
<tr>
<td>&gt;1.0</td>
<td>0.20</td>
</tr>
</tbody>
</table>
Paraffin 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

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 for several reasons; to maintain a clean appearance on our customer’s locations, and also to help identify small drips that later may become big 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. Be sure the discharge pump valve is closed. (This should have been done after the last tank closing)
3. Open all valves on the suction side of the pump. 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 damage.
4. Open the discharge valve of the pump.
5. Start the pump.
6. Slowly close the bypass valve on the suction side of the pump while watching the pressure gauge.
7. Verify your setting on the Murphy kill. This device is designed to kill the pump if the pressure is too high or too low. If you have questions about the proper settings for the Murphy kill, contact your supervisor. The Murphy kills should be tested by turning the set point to force a kill signal to be sent to the pump. Make sure that your equipment is working properly.
8. Observe. While the pump is running, watch for leaks or signs of anything abnormal. If you have questions or concerns, shut the pump off and isolate it. Repair problems on the spot if possible or notify your supervisor.

After the tank has emptied, the pump will shut off from a low level kill signal send from a level switch in the volume pot.

1. Close the pump discharge valve if it is not equipped with a MOV.
2. Close the tank load out valve. Place the seal and record the number.
3. Inspect the pump skid and piping for any signs of leak. Inspect absorbent pads on the pump skid and change if necessary.
Timers

There are 3 types of timers consisting of Mechanical, Digital, and Triangle Programmed that are currently in operation.

**Mechanical Timer: Intermatic Model T1975**

There are a total of 4 trippers between each hour. Each tripper is 15 minutes. The VFD needs to be set to REMOTE.

**Scheduling ONs and OFFs**

**ON Time**
1. Press the tripper(s) into dial at the desired time(s) operation is required. All the trippers should be pressed from the schedule start to the stop time.
2. Turn the dial clock-wise and align the exact time-of-day (the time now at the very moment the switch is being put into operation) to the “TIME” arrow on insulator.
3. Do not use the skipper wheel.
4. The pumps now need to be tested for proper operation and examined for signs of leaks. Please see “Testing the Pumps” below.

**OFF Time**
1. First tripper in the raised position turns off the load for 10-14 minutes. Each additional pin lengthens the time by 15 minutes.

**Testing the Pumps**

1. Rotate the timer clockwise until the dial comes to a point where you have the pins pressed. The pump should start up.
2. Let the pump run for two (2) minutes and check for leaks or problems with the equipment.
3. If there are no indications of problems, rotate the dial clockwise back to the current time (see item “2.” under “ON Time” above). The pump should now shut down. The pump is now ready to start at the scheduled time.

**Digital Timer: Tork Model E201B**

The MODE button will be used to navigate through the screen.

**Scheduling ONs and OFFs**

**ON Time**
1. Press MODE and MAN will pop up for manual mode.
2. Press MODE. Use the Hour and Min buttons to set the time. Press ENTER then MODE.
3. The screen should be on date setting. Use the Month, Date, Year button to set the DATE. Press ENTER then MODE.

4. The screen will display “dSt” (daylight savings time) make sure the ON is set. If it is turned OFF, Press DEL/PREV button to toggle the setting, set to ON. Press ENTER then MODE.

5. You will be on Channel 1. Timer may be set on channel 1 or channel 2 Press CH1/CH2 to change to channel 2

6. Press HOUR and MIN and set the time required for timer to start the pump.

7. Press EVENT to set desired event (ON/OFF). Make sure it is on the “ON” position for timer. Press ENTER.

8. The screen will now display another screen to schedule another event (either another start or stop time).

9. Press MODE to go back to main menu.

10. The pumps now need to be tested for proper operation and examined for signs of leaks. Please see “Testing the Pumps” below.

OFF Time

1. Press MODE and you will be on MANUAL

2. Press MODE. Use the Hour and Min buttons to set the time. Press ENTER then MODE.

3. Use the Month, Date, Year button to set the DATE. Press ENTER then MODE.

4. The screen will display “dSt” (daylight savings time) make sure the ON is set. If it is turned OFF, Press DEL/PREV button to toggle the setting, set to ON. Press ENTER then MODE.

5. The first scheduled pump start time will be listed. It should show “ON” in the left corner of the screen. Press ENTER.

6. You will be at the second scheduled event. The STOP/ OFF-TIME for the pump will be set here. Press HOUR and MIN and set the time required for timer to operate (turn off).

7. Press EVENT to set desired event (ON/OFF). Switch to the “OFF” position press ENTER.

8. Press MODE to go back to main menu.

Testing the Pumps

1. Verify the VFD is set to REMOTE

2. On the menu press the channel 1 overwrite button (CH1/OVR1)

3. Will now have a red light come on. Run pump for two (2) minutes; check for leaks and proper pump operation.

4. Press the channel 1 overwrite button (CH1/OVR1) to shut the pump off. The pump is ready to start at the scheduled time.

**Allen Bradley (Triangle Programmed) Timers**

For the timer to operate the VFD needs to be set to REMOTE. The timers for these VFDs are built into the programming; therefore, the VFD controls will need to be used to set the timer.
Scheduling ONs and OFFs

ON Time
1. Press left or right arrows to navigate through the screen until you see 14 in the bottom left corner.
2. Select PAR (parameter). This will be on the bottom of the screen. Press the corresponding button below.
3. Type 54 and press ENTER.
4. Set the time for timer to operate (will be in military time. Example: 14 will be 2pm) and press ENTER.
5. Press the left or right arrow until the port in the left corner of the screen reads 00. You are now back in the main screen.
6. The pumps now need to be tested for proper operation and examined for signs of leaks. Please see “Testing the Pumps” below.

OFF Time
1. Press left or right arrow to navigate through the screen. Select 14 bottom left corner.
2. Select PAR (parameter). This will be on the bottom of the screen. You will need to press the corresponding button below.
3. Type 55 and press ENTER.
4. Set the time for timer to operate (will be in military time. Example: 23 is 11pm) and press ENTER.
5. Press the left or right arrow until the port in the left corner of the screen reads 00. You are now back in the main screen.

Testing the Pumps
1. On the VFD, click the control knob from “REMOTE” to “HAND” The pump should start immediately.
2. Allow the pump to run for two (2) minutes; check for leaks and proper pump operation.
3. On the VFD, click the control knob back to “REMOTE” The pump should now shut down. The pump is now ready to start at the scheduled time.

How to verify and change time on Allen Bradley VFD (Triangle programmed)
1. Press folder bottom on bottom left of keypad
2. Scroll right until you get to properties
3. Scroll down to date and time
4. Press 5 to enter
5. Verify the date and time and change if necessary

ABB Drives (They look like the World Wide Hyundai Drives)

STEP 1: Click CONFIGURATION.
STEP 2: Click on the **USERNAME** box, and then enter in the number 1 then press **ENTER**.

STEP 3: Click on the **PASSWORD** box, and then enter in the numbers **3211** then press **ENTER**.

STEP 4: Then click on **LOGIN**.

STEP 5: Up and the top right, click on **AUTO CONFIG**.

STEP 6: At the top left, you will see a switch, click on the switch to toggle it’s mode to 1. **(It will point to the mode it is in).**

STEP 7: You will see **Period 1 START** and **Period 1 STOP**, aka your **ON** and **OFF** times. Click on the **HR** box, and set it to the hours, then press **ENTER**. Do the same for your **MIN** boxes.

STEP 8: Click on **MAIN**.

STEP 9: Click on the switch in the top left until it points at **AUTO**. Click on **DRIVE SPD SETPOINT** and select what **HZ** you want and press **ENTER**.

At this point you’re good to go. You can also press the **SYSTEM** button and navigate to the Time/Date to set the Current Time of Day.

**Hyundai Drives**

**Step 1:** Press **UP** and **DOWN** arrows at the same time.

**Step 2:** Use the **DOWN** arrow to scroll down and choose **SET TIME/DATe** by pressing **ENTER**.

**Step 3:** Select **TIME** with **ENTER** and set the current time of day, using the **UP** and **DOWN**, **LEFT**, and **RIGHT ARROW** keys to change the time. It is in **HOURS: MINUTES: SECONDS** and it is in **MILITARY TIME (24 hour)** format.

**Step 4:** Once finished setting the **TIME**, press **ENTER** to save your time. Then choose **DATE** by pressing the **DOWN** arrow key once and pressing **ENTER**. Repeat **Step 3**, by using the **ARROW** keys to correctly set the current date. Once finished, press **ENTER** to save it.

**Step 5:** Press **ESC** repeatedly until you are back at the **Main Menu Screen**.

**Step 6:** Now there are two **SELECT** buttons at the top left, press the bottom **SELECT** button once. **This brings you into the Menu.**

**Step 7:** Scroll down with the **DOWN** arrow key, until you get to **AUTO RUN SCHEDULE**, then press **ENTER**.

**Step 8:** Press **ENTER** again, to select **NUM. OF EVENTS**. And then press **UP** arrow one time to change it to 1. Then press **ENTER**.
**STEP 9:** You will see **ON** and **OFF** times. Press **ENTER** to select either one, and change the time with the **ARROW** keys, and then press **ENTER** again to save.

**STEP 10:** Once finished, press **ESC** repeatedly till you’re back at the **MAIN MENU**. Then press the **AUTO** button, you will see the word **AUTO** appear in the top right corner of the screen. And you’re finished!

**Side Note** ~ Sometimes the VFD doesn’t respond to the time that you set. To fix this, you must set both your **ON** and **OFF** times, to a later time than the Current time of day at that moment. And then **POWER CYCLE** the drive. You may then set the timer to whatever times you want and it should work.