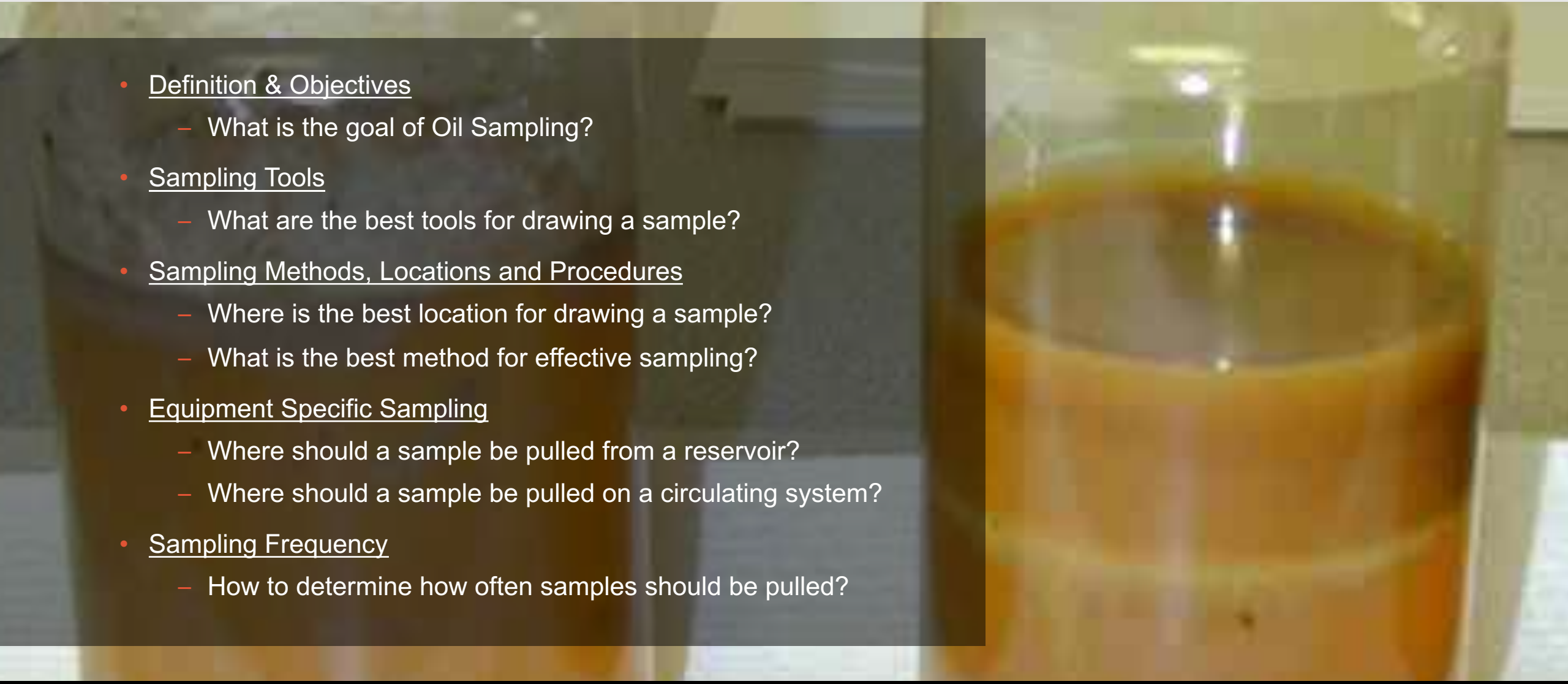
OIL SAMPLING
FUNDAMENTALS

LUBRICOLOGY

Outline



- Definition & Objectives
  - What is the goal of Oil Sampling?
- Sampling Tools
  - What are the best tools for drawing a sample?
- Sampling Methods, Locations and Procedures
  - Where is the best location for drawing a sample?
  - What is the best method for effective sampling?
- Equipment Specific Sampling
  - Where should a sample be pulled from a reservoir?
  - Where should a sample be pulled on a circulating system?
- Sampling Frequency
  - How to determine how often samples should be pulled?

Oil Sampling Defined

The process of taking a portion of oil from a tank, reservoir, or oil sump for the specific purpose of using it for Oil Analysis. This sample should best represent the oil working area in equipment or oil turbulent area in a tank or reservoir.

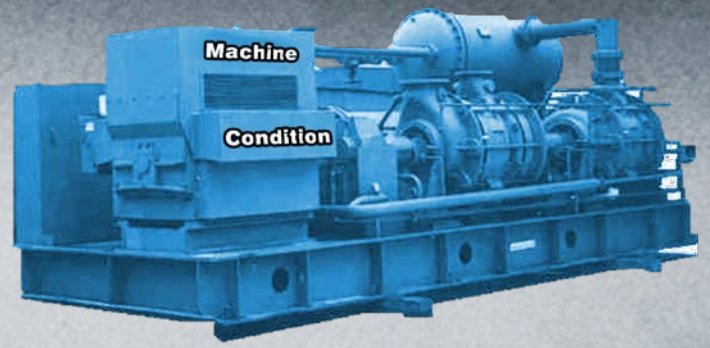
Oil Sampling – The Goal

- **Maximize data density**
  - Samples should reflect the current status of the lubricant and the machine. Samples should contain the most amount of representative data possible.

- **Minimize data disturbance**
  - Data disturbance or noise in the sample can produce false positives during testing and analysis. Following best practice for sample extraction, sample location and the correct oil analysis test slate will help reduce or eliminate data disturbance.

- **Sample at the proper frequency**
  - Sampling at the proper frequency will allow us to trend the data and identify problems associated with the lubricant or the machine not just when a limit is breached, but when an abnormal rate of change is acknowledged.

Oil Sampling – The Goal



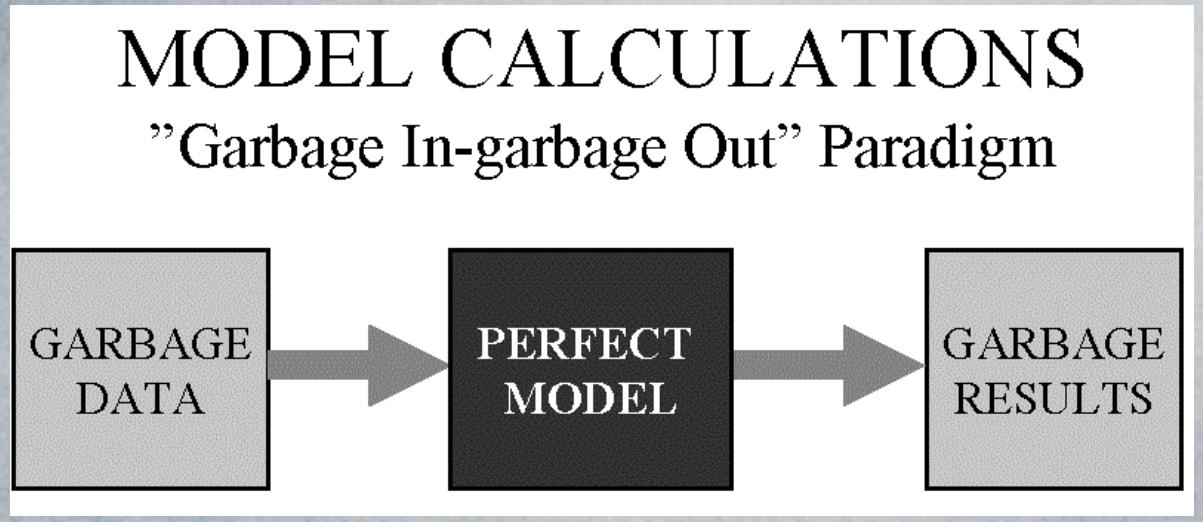
Must Reflect:

- Lubricant condition
- Machine condition

While Maintaining:

- Safe environment
- Sample integrity
  - Method
  - Tools
  - Handling

Garbage In = Garbage Out
(Oil Sampling) = (Oil Analysis)



- Poor planning
- Poor execution
- Poor oil analysis reports
- Improper corrective actions

OIL SAMPLING TOOLS

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Oil Sampling Ports

- Hydraulic sample ports are used on smaller tanks or pipes.
- Pipe installation should be on an elbow with flow coming toward the port.

This style of test port ***can*** be installed in a pressurized port up 5000PSI.

Pitot Tube Sampling

- Sample tubes (pitot) are used for non-pressurized applications.
- Used for reaching turbulent zones of oil in larger reservoirs.
- Complete assembly consists of a sample port, sampling tube and an optional swivel.
- Various lengths and thread configurations to meet the application needs
- Available in fixed or universal configurations
- Stainless Steel options.

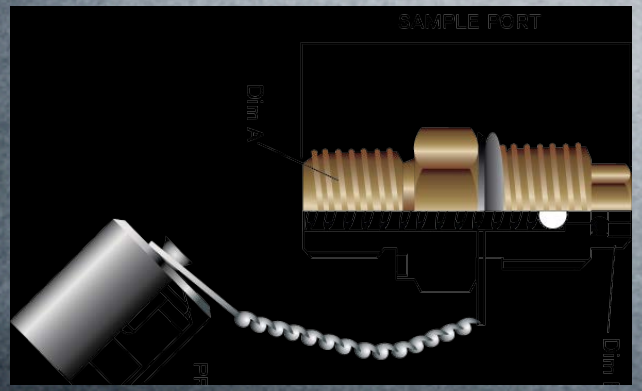
Level Gauge & Pitot Tube Sampling

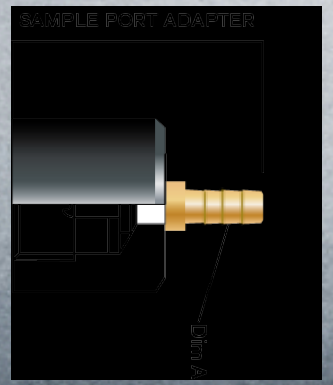
- Providing multiple solutions in one port.
- Existing level gauge is removed and replaced with a modified sampling unit.

Vacuum Pump

- A vacuum pump is used to extract sample from non-pressurized and drum sampling. Care must be taken to ensure that the internals of the pump are kept in good condition and not contaminated with oil, dirt, water, etc.

Sample Port Adapter





- Sample port adapters are use to open the ball valve in the sample ports allowing fluid to flow through.
- Black caps indicate high flow valves.

OIL SAMPLING METHODS

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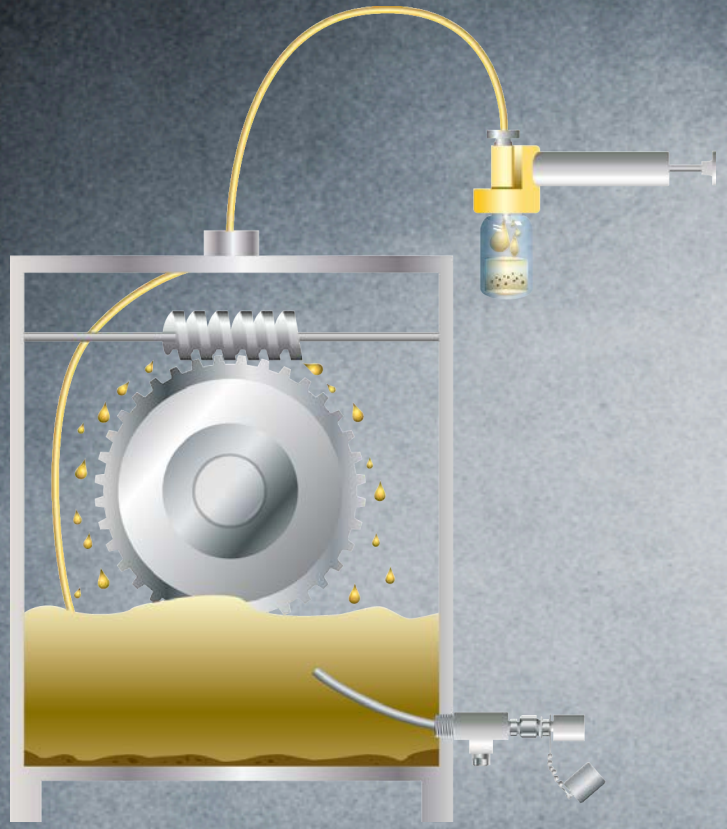
Improper Oil Reservoir Sampling

- Are there safety issues with this type of method?
- Are there concerns with contamination ingression during sampling?
- Is the sample consistent each time it is taken?

Drain Sampling

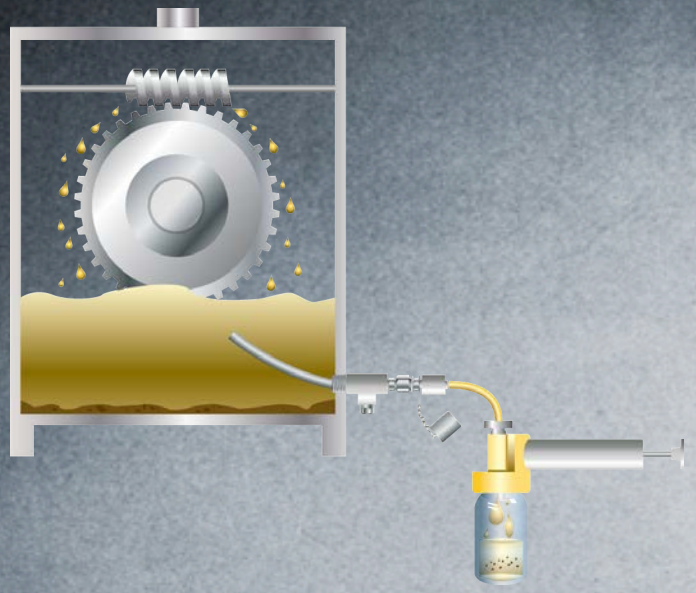
Method	Pros	Cons
Drain Sampling	• Inexpensive • No installation required • Suitable for testing homogenous properties	• Accessibility issues • Risky when sampling during operation • Tough to get representative sample • Requires significant flushing

Drop Tube Sampling



Method	Pros	Cons
Drop Tube Sampling	• Cost effective	• Exposes open system to environment • Difficult to ensure consistent location • Risk of tube getting caught in system while sampling

Sampling Port / Pitot Tube Sampling



Method	Pros	Cons
Drop Tube Sampling	• Cost effective	• Exposes open system to environment • Difficult to ensure consistent location • Risk of tube getting caught in system while sampling

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OIL SAMPLING PORT / PITOT TUBE INSTALLATION METHODS

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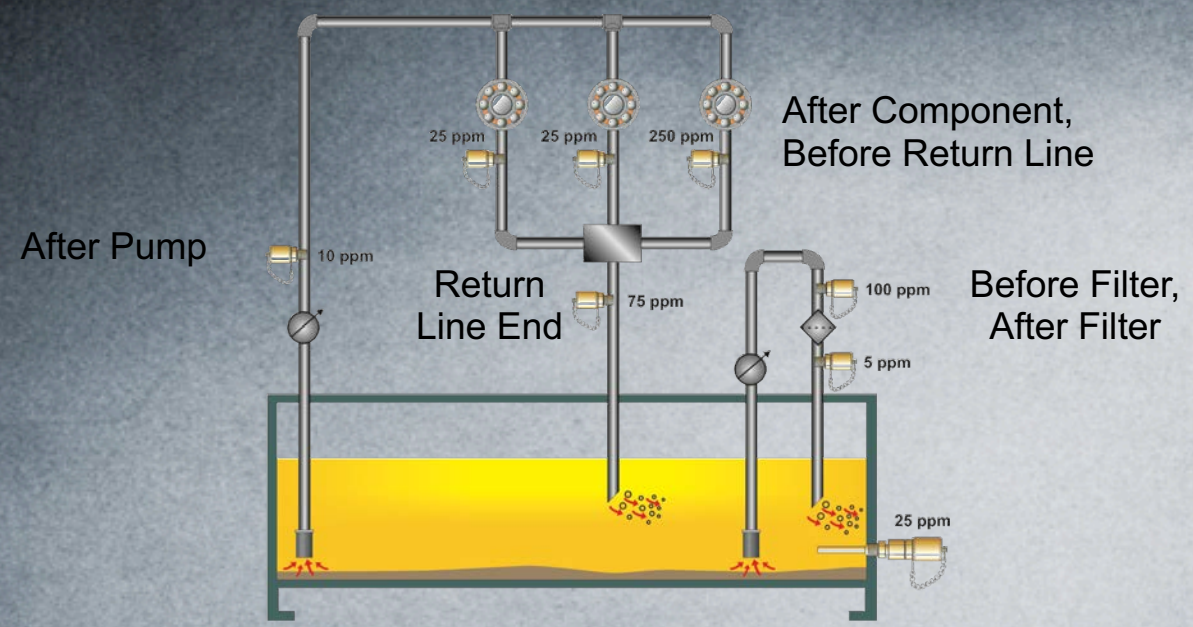
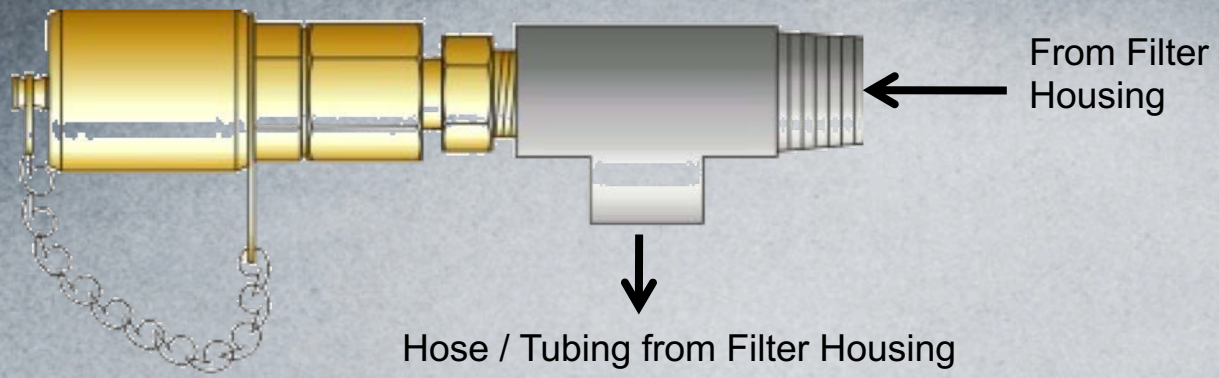
Circulating Systems Installation



- Installation of forced lubrication system require the sample port installed after the component.
- Direction of the path of flow must be known along with installation of the sample port in a turbulent area.

Hydraulic Method

Pressurized Filtration System



- Hose or tubing from the fluid flow exit of the filter housing is removed and replaced by a hydraulic tee and appropriate hardware.
- Sample port is installed so that the flow of the fluid is directed at the Sample port.
  - This creates a turbulent zone for samplings and removes the opportunity of particle fly-by which is common in laminar flow installations.

Hydraulic Method

Standard Operating Procedure – Pressurized System

	Title: Oil Sampling Procedures	Page No. 4 of 9

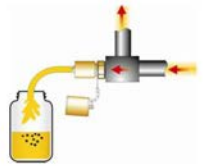
STEPS	AWARENESS

Oil Sampling from Pressurized System using Sample Valves

NOTE:

A high level of cleanliness must be maintained on sampling equipment and sample containers to prevent contamination of oil sample. To prevent unnecessary contamination of bottle and sample oil, sample bottles must remain closed until ready for use. Equipment must have been in normal operation for at least one hour prior to collecting oil sample

1. Obtain sample bottle with label that corresponds to the sample ID tag on the equipment test port
2. Clean oil for make-up purposes of system top-up (small reservoirs only)
3. Ensure new sample hose is installed on sample-port adapter
4. CLEAN sample point or orifice with lint free cloth.
5. REMOVE sample port protective cap
6. INSTALL Sample port adapter and flushing hose into high-pressure sampling pump
7. Install Flushing bottle on the high-pressure sampler
8. Screw sample port adapter onto the sample port until fluid flows and the port and associated fitting are thoroughly flushed *(see flushing requirements)*
9. Remove sample port adapter
10. Replace flushing bottle with the sample bottle ensuring that the sample bottle cap does not get contaminated.
11. Reinstall sample port adapter and extract fluid to a 3/4 filled level. (80 ml sample)
12. REMOVE sample adapter from sample port
13. Remove and carefully cap sample bottle
14. Re-install protective cap on the test port
15. Clean up any spilled lubricant
16. Dispose of the sample tube



General Tips:

Oil Condition
Perform Visual inspection and report to Oil Analysis Program Coordinator

0		Normal
1		Acceptable
2		Caution
3		Concern

Labels require the following information:

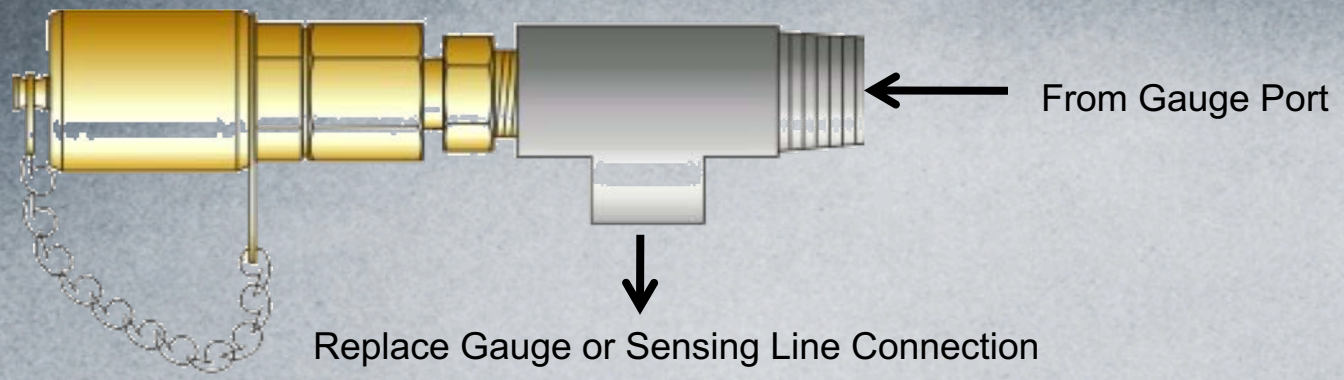
- Equipment code
- Date sample(s) taken
- Additional comments
- Sample location (valve number, if tagged)
- Name of person taking sample

Visual Inspection

Severity Code	Cloudiness Appearance	Free Water Appearance	Sediment Appearance	Odour Appearance	Colour Change Appearance
0	Normal	None	None	Normal	Normal
1	Hazy	Sight	Few Specs	Abnormal	Slight Darkening
2	Cloudy	Puddling	Layer	Pungent	Darkening
3	Heavy Clouding	Layer	Heavy Layer	Foul	Abnormal

Hydraulic Method

Pressurized Gauge Installation Method

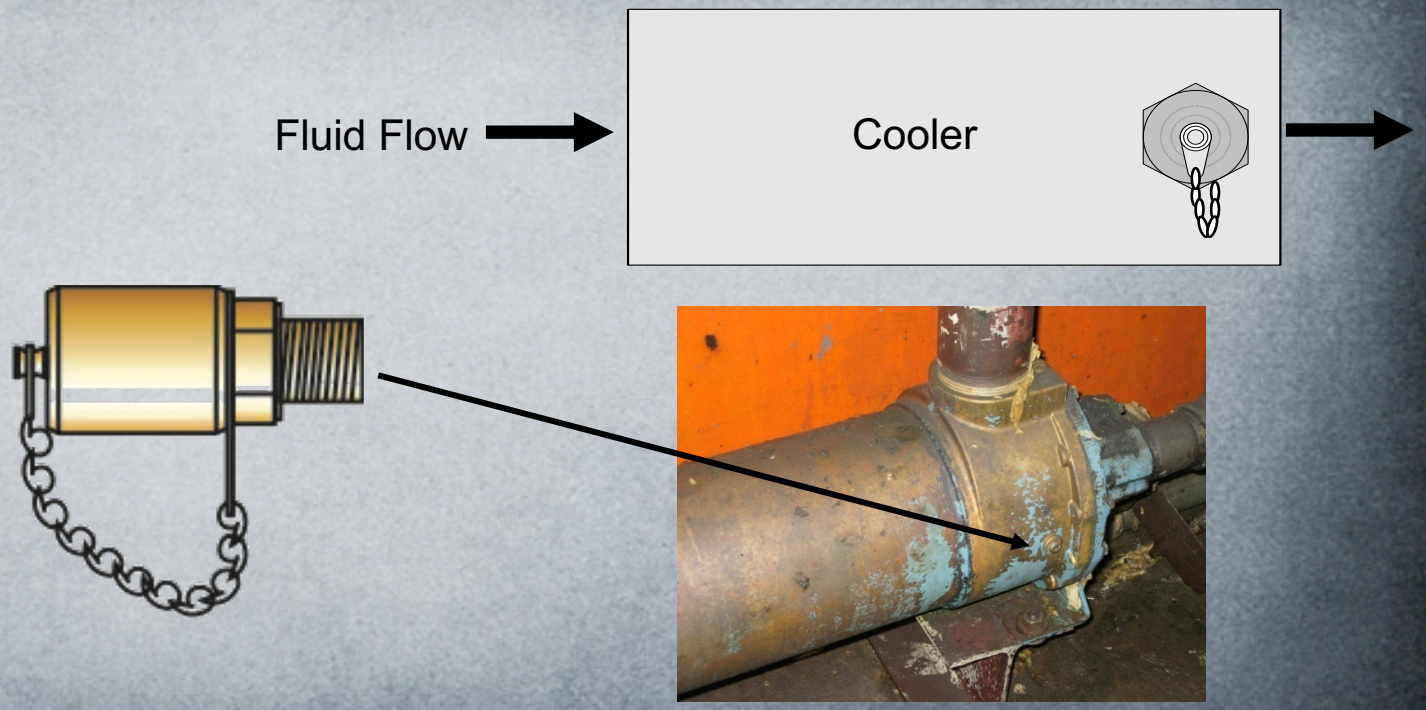


- Hose, tubing or the pressure gauge from the main system pressure port is removed and replaced by a hydraulic tee and appropriate hardware.
- Sample port is installed so that the flow of the fluid is directed at the Sample port.
  - This creates a turbulent zone for sampling and removes the opportunity of particle fly-by which is common in laminar flow installations.

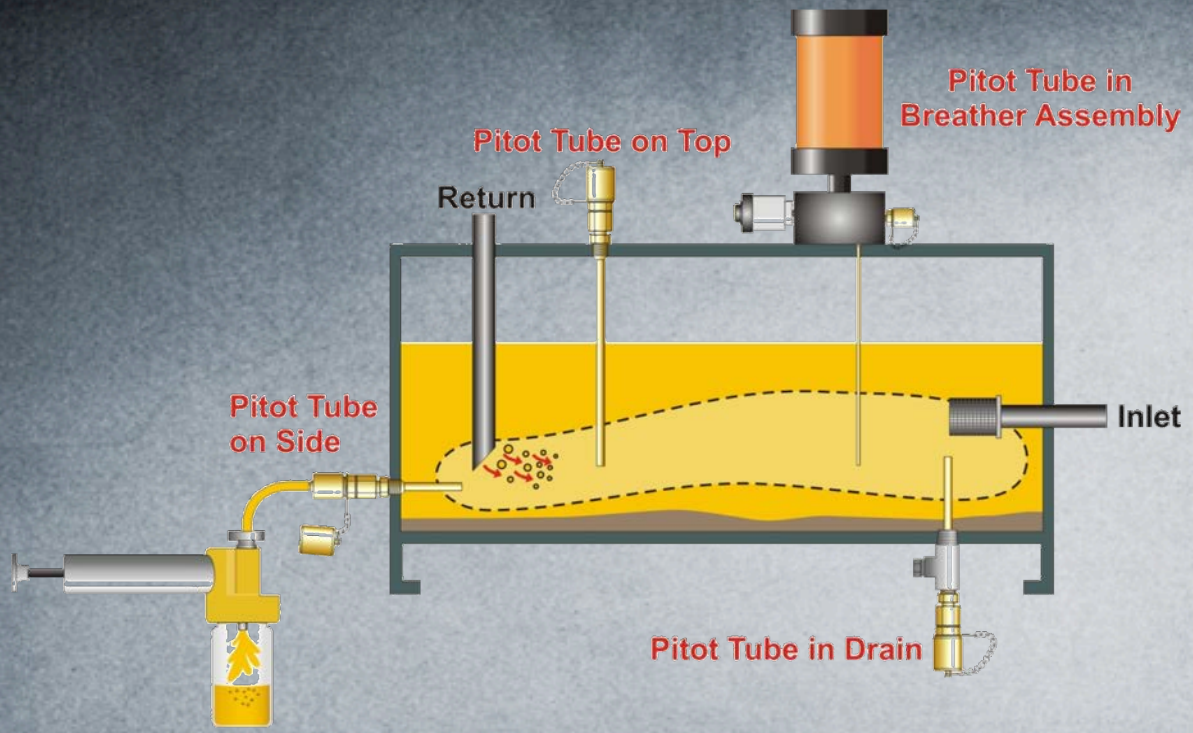
Hydraulic Method

Pressurized Cooler Installation

- Remove cooler pressure port plug (if equipped) and replace with the appropriate size of hydraulic sample port.



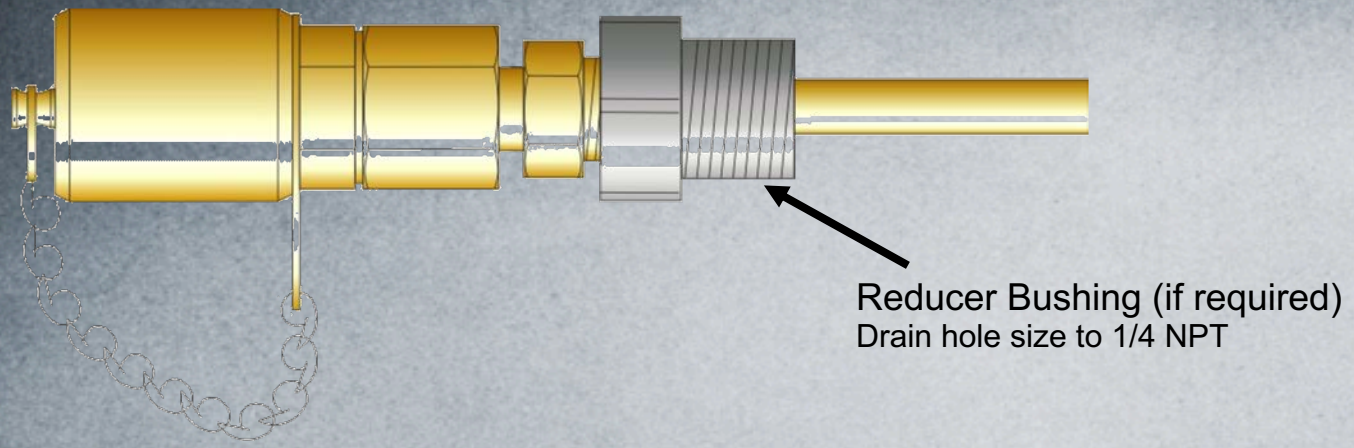
Hydraulic Reservoir Installation



- Installation in a hydraulic reservoir require the pitot tube to be installed at approximately ½ the height of the liquid level in a turbulent area. Watch for baffles internally.

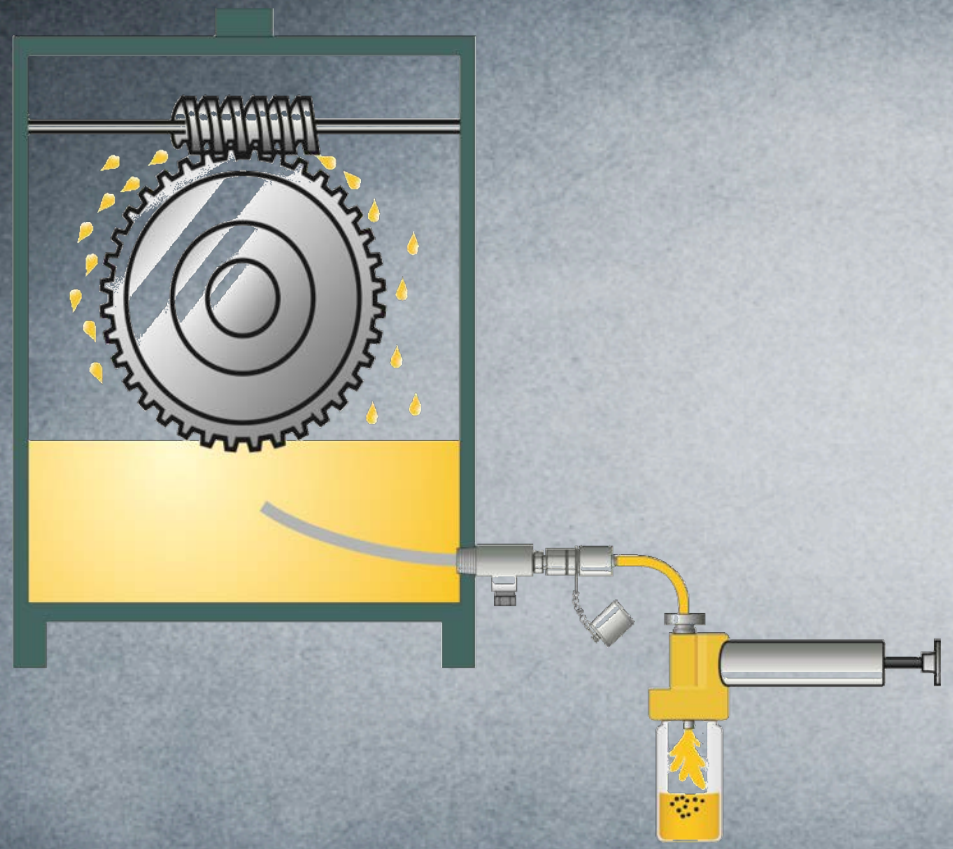
Gearbox Housing Installation

Using an Alternate or Second Drain Port



- Standard sample tube assembly
  - Use universal sample port if a substantial bend is required.

Gearbox Housing Installation



Installation of the Pitot Tube

- These units are field fit to ensure the tube end is off the bottom of the reservoir and in an area where oil is circulating.
- Caution is required to ensure tube assembly does not interfere with internal gearing.

Standard Operating Procedure – Non-Pressurized System

	Title: Oil Sampling Procedures	Page No. 5 of 9

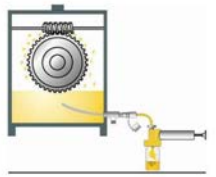
STEPS	AWARENESS

Oil Sampling from Non-Pressurized System using Sample Valves

NOTE:

A high level of cleanliness must be maintained on sampling equipment and sample containers to prevent contamination of oil sample. To prevent unnecessary contamination of bottle and sample oil, sample bottles must remain closed until ready for use. Equipment must have been in normal operation for at least one hour prior to collecting oil sample

1. Obtain sample bottle with label that corresponds to the sample ID tag on the equipment test port
2. Clean oil for make-up purposes of system top-up (small reservoirs only)
3. Ensure new sample hose is installed on sample port adapter
4. Install hose assembly into the vacuum pump
5. Install flushing bottle unto the assembly
6. CLEAN sample point or orifice with lint free cloth.
7. REMOVE sample port protective cap
8. INSTALL Sample port adapter and flush port and associated fitting (see flushing requirements) using the vacuum pump
9. Remove sample port adapter
10. Replace flushing bottle with the sample bottle ensuring that the sample bottle cap does not get contaminated.
11. Reinstall sample port adapter and extract fluid to a 3/4 filled level. (80 ml sample)
12. REMOVE sample adapter from sample port
13. Remove and carefully cap sample bottle
14. Re-install protective cap on the test port
15. Clean up any spilled lubricant
16. Dispose of the sample tube



Oil Condition
Perform Visual inspection and report to Oil Analysis Program Coordinator

0		Normal
1		Acceptable
2		Caution
3		Concern

Labels require the following information:

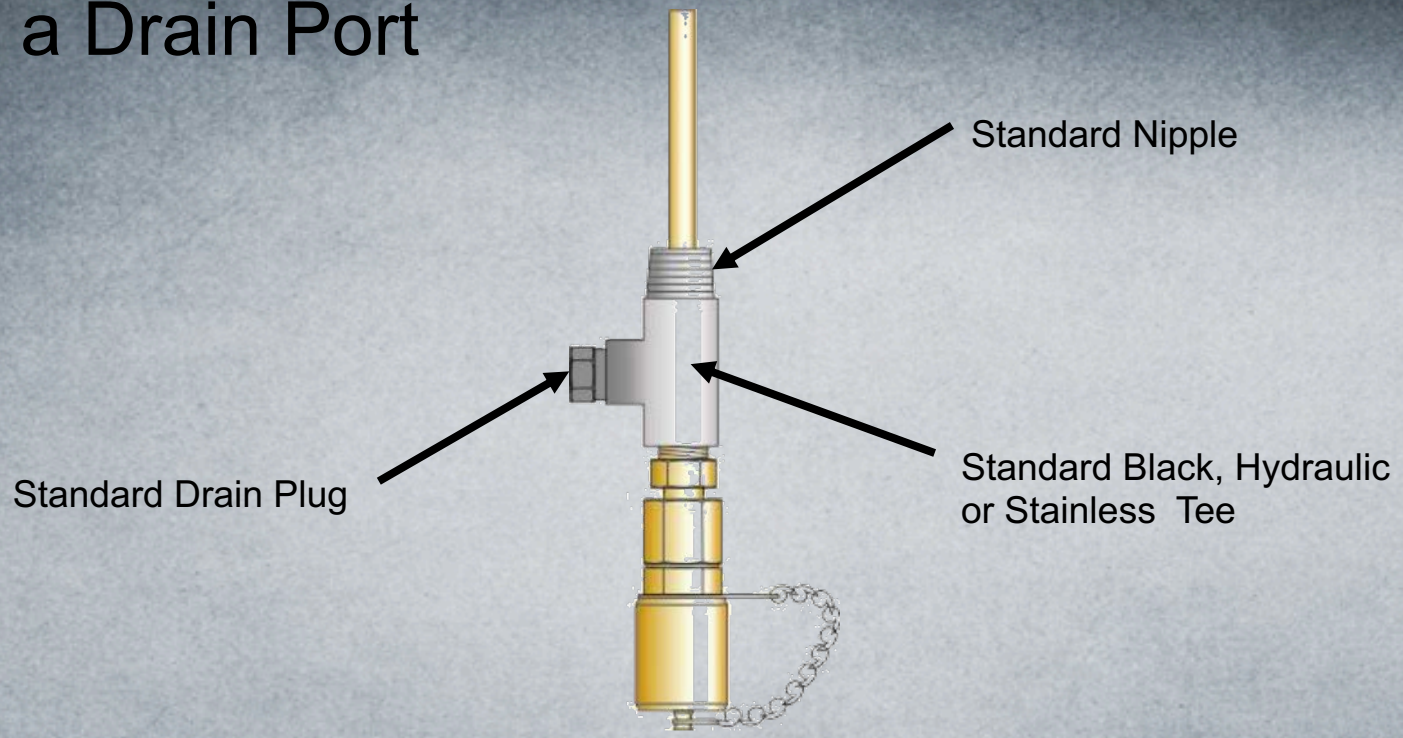
- Equipment code
- Date sample(s) taken
- Additional comments
- Sample location (valve number, if tagged)
- Name of person taking sample

Visual Inspection

Severity Code	Cloudiness Appearance	Free Water Appearance	Sediment Appearance	Odour Appearance	Colour Change Appearance
0	Normal	None	None	Normal	Normal
1	Hazy	Sight	Few Specs	Abnormal	Slight Darkening
2	Cloudy	Puddling	Layer	Pungent	Darkening
3	Heavy Clouding	Layer	Heavy Layer	Foul	Abnormal

Gearbox Housing Installation I

Maintaining a Drain Port



- This method does not require the pitot tube to be removed to drain the lubricant.

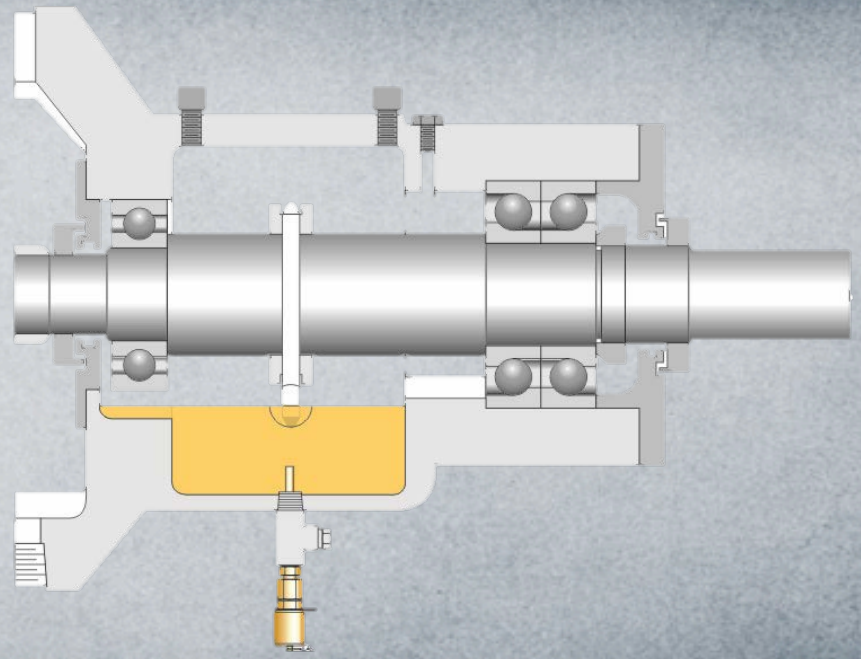
Gearbox Housing Installation II

Sampling Gearboxes
with a Gearbox Kit

Pump Housing Method

Drain Plug

- Ensure pitot tube end is located off the bottom of the housing but no higher than ½ the level of the fluid during operation.



Standard Operating Procedure – Bearing Housings without Sampling Devices

	Title: Oil Sampling Procedures	Page No. 6 of 9

STEPS	AWARENESS

Sampling Oil from Small Reservoirs (Bearing Housings)

NOTE:

A high level of cleanliness must be maintained on sampling equipment and sample containers to prevent contamination of oil sample. To prevent unnecessary contamination of bottle and sample oil, sample bottles must remain closed until ready for use. Equipment must have been in normal operation for at least one hour prior to collecting oil sample

1. Obtain sample bottle that will hold the entire contents of the reservoir or bearing housing with label attached that corresponds to the ID tag on the equipment
2. Provide clean oil for refilling the reservoir or bearing housing
3. CLEAN drain plug with lint free cloth.
4. Remove sample bottle cap ensuring that the sample bottle cap does not get contaminated.
5. Remove drain plug ensuring that all lubricant in is captured in the sample bottle (do not include drips or oils that run after main stream of lubricant flow is obtained)
6. Carefully cap sample bottle
7. Clean up any spilled lubricant
8. Replace drain plug and refill bearing housing or reservoir to the correct level

Oil Condition
Perform Visual inspection and report to Oil Analysis Program Coordinator

0		Normal
1		Acceptable
2		Caution
3		Concern

Labels require the following information:

- Equipment code
- Date sample(s) taken
- Additional comments
- Sample location (valve number, if tagged)
- Name of person taking sample

Visual Inspection

Severity Code	Cloudiness Appearance	Free Water Appearance	Sediment Appearance	Odour Appearance	Colour Change Appearance
0	Normal	None	None	Normal	Normal
1	Hazy	Sight	Few Specs	Abnormal	Slight Darkening
2	Cloudy	Puddling	Layer	Pungent	Darkening
3	Heavy Clouding	Layer	Heavy Layer	Foul	Abnormal

55 Gallon Drum Kit

Sampling Stored Oil

Standard Operating Procedure – 55 Gallon Tank

	Title: Oil Sampling Procedures	Page No. 7 of 9

STEPS	AWARENESS

Sampling Oil in a Drum or Reservoir without a Test Port

NOTE:

A high level of cleanliness must be maintained on sampling equipment and sample containers to prevent contamination of oil sample. To prevent unnecessary contamination of bottle and sample oil, sample bottles must remain closed until ready for use. Equipment must have been in normal operation for at least one hour prior to collecting oil sample

1. CLEAN area around bung of oil drum or the cap of the reservoir with acceptable solvent and WIPE clean with lint free cloth.
2. Ensure new sample hose is installed into the vacuum pump (enough hose to sample half way from the top and bottom of the reservoir/drum
3. Install flushing bottle unto the assembly
4. UNSCREW bung/cap and PLACE the bung/cap in a new plastic bag
5. INSTALL hose into the port being careful not to contaminate or contact the sides.
6. Flush hose and associated fitting (see flushing requirements) using the vacuum pump
7. Replace flushing bottle with the sample bottle ensuring that the sample bottle cap does not get contaminated.
8. Extract fluid to a 3/4 filled level. (80 ml)
9. REMOVE hose from the drum/reservoir
10. Remove and carefully cap sample bottle
11. Replace bung/cap

Oil Condition
Perform Visual inspection and report to Oil Analysis Program Coordinator

0		Normal
1		Acceptable
2		Caution
3		Concern

Labels require the following information:

- Equipment code
- Date sample(s) taken
- Additional comments
- Sample location (valve number, if tagged)
- Name of person taking sample

Visual Inspection

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Summary – Sampling Methods

Best Practices

- Ensure machines are running and at operating temperature.
- Sample in turbulent area that are representative of critical load zones.
- Install permanently mounted hardware for consistent sampling Ex. Pitot Tubes, test ports, etc.
- Flushed sampling valves and sampling hardware.
- Keep the bottles clean.
- Sampled at proper frequency.
- Samples forwarded to lab immediately.
- Follow safety procedures.

Not So Good Practices

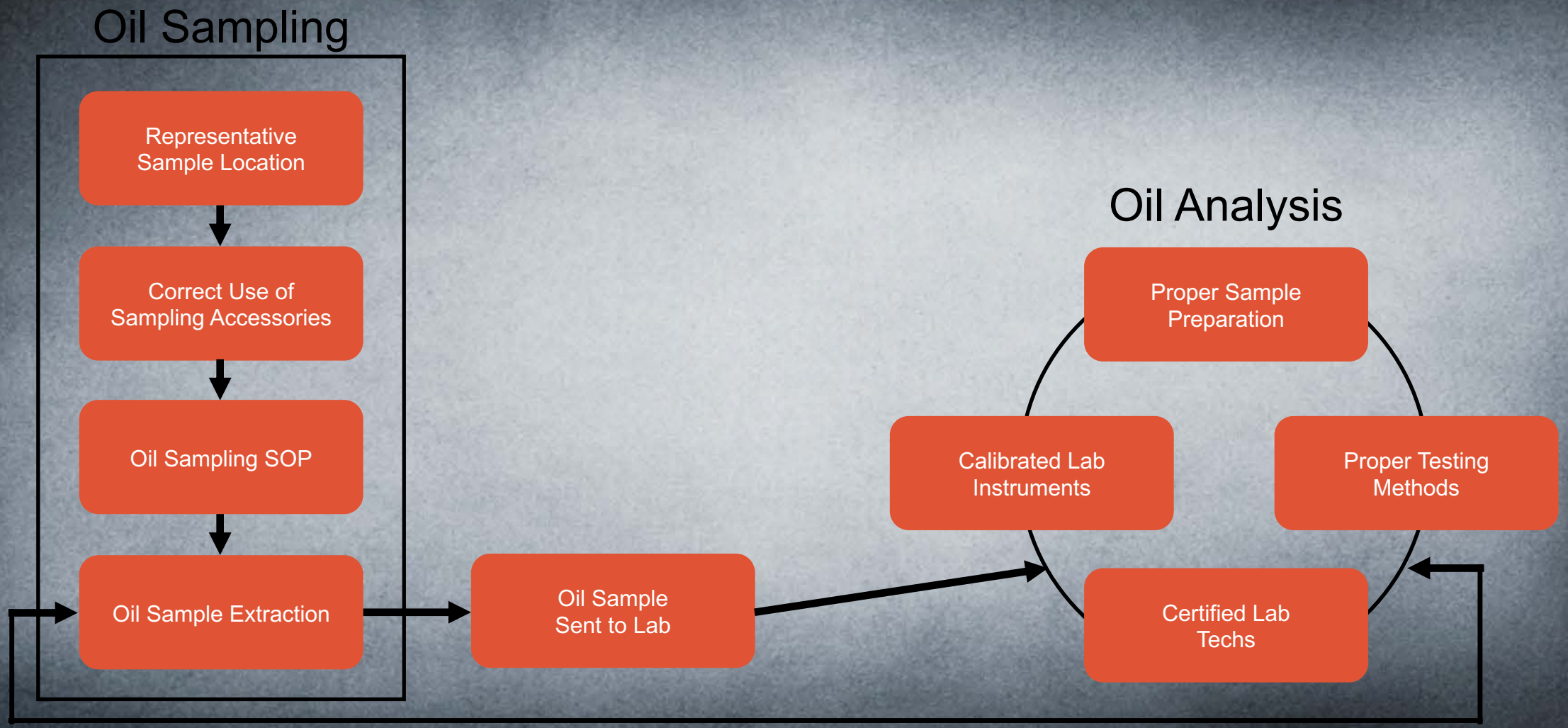
- Sampling systems that are not running or not at typical operating temperatures.
- Sampling from drain port.
- Sampling with a drop-tube.
- Inconsistent sampling points and methods.
- Sampling shortly after oil changes.
- Using tubing more than once causing cross contamination of oil.
- Sampling without adequate flushing.
- Waiting too long before sending samples to the lab.

Frequency Factors

Frequency depends on many factors but one of the most important is to base the frequency on the equipment criticality from an RCM or similar analysis.

- **Environmental Severity**
  - High dust and moisture
  - High loads, pressures and speeds
  - High running temperature
  - Duty cycle, shocks, or vibration
  - Chemical or radiation contamination
- **Economic Penalty of Failure**
  - Safety risk
  - Downtime cost
  - Repair cost
  - Mission criticality

The Roadmap to Success



TRICO

Need Help?

- Choosing hardware
- Installation
- Training

Talk to Trico – the team behind Lubricology

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