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Sampling Procedure

For General System Condition
(In Particular General System ISO Code)

Document S061024
Version IV

1. Introduction

This procedure draws on information from **ISO 4021 – Hydraulic fluid power – Particulate contamination analysis – Extraction of fluid samples from lines of an operating system.**

Please consult **ISO 4021** for a more comprehensive description of the method used. This guide is not intended to replace **ISO 4021** but should be used in conjunction with it.

*If your oil analysis reports solid contamination levels in accordance with **ISO 4406-1999,** then your sample should be obtained in this manner for it to be valid.*

Since the particle count is the most sensitive of all analysis methods, it is imperative the sample is obtained in the correct manner from the correct location.

The ISO code of a sample obtained from the return line will be significantly different than that obtained from the correct location.

If this procedure is followed correctly this sample will be an exceptional representation of the **"General System Operating Condition".** Therefore, the information obtained from other routine oil analysis techniques to monitor the **"General System Operating Condition"** will be greatly enhanced using this same sample.

The most common technique for routine oil analysis is spectrometry (ICP). This technique is limited to determining the elements that are either dissolved or that make up particles less than 3µm in size, above which the rate diminishes. (depending on the technique, 8 to 10µm is considered by many as the maximum useful level of detection)

When reviewing spectrometry limitations, settling rates for various size particles, filtration influences and others, the concentration of particles detectable by spectrometry is unlikely to be affected by using this same sample obtained in accordance with **ISO 4021**. The sample will be more representative and reliable than any other obtained throughout the system.

NOTE 1: This method is for ***routine*** analysis of the **"General System Operating Condition".** Where a problem exists and investigative analysis is being conducted then samples being obtained for "**Wear Debris Analysis" (WDA) or Ferrography** should be obtained from a recognized sample point downstream of the suspect component in the return line.

NOTE 2: Whilst ISO 4021 refers to "Hydraulic Fluid Power" this same method applies equally to all other lubrication systems.

2. SAFETY

a. OPERATING AND NON-OPERATING HYDRAULIC and LUBRICATION SYSTEMS ARE POTENTIALLY DANGEROUS.

b. ENSURE ALL SITE SAFETY PROCEDURES INCLUDING RISK IDENTIFICATION ARE FOLLOWED AND ONLY TRAINED COMPETENT PERSONNEL ARE AUTHORISED TO OBTAIN SAMPLES.

c. ENSURE ALL EQUIPMENT TO BE SAMPLED IS FITTED WITH THE CORRECT AND APPROVED FITTINGS.

d. ENSURE THE TRAINED AND COMPETENT PERSONNEL ARE SUPPLIED WITH THE NECESSARY APPROVED APPARATUS TO OBTAIN THE SAMPLES.

2. Preferred Method of Sampling - DYNAMIC

The preferred method of sampling from any type of equipment (hydraulic system, gearbox, or turbine circuit) is dynamic sampling to obtain a representative sample of the system fluid in circulation. (ie: the cleanliness of the actual fluid being circulated, not that lying in a dead area of the reservoir or box)

The sample shall be drawn from a position in the system where the flow is normally turbulent.

Recommended sampling positions are:

a. Downstream of pumps
b. Upstream of filters
c. Immediately upstream of contaminant sensitive components

NOTE: When monitoring system condition and cleanliness on an ongoing basis, a single sample point should be used. Obtaining the sample from the same location and in the same manner will ensure all results are representative for comparison and trend analysis purposes.

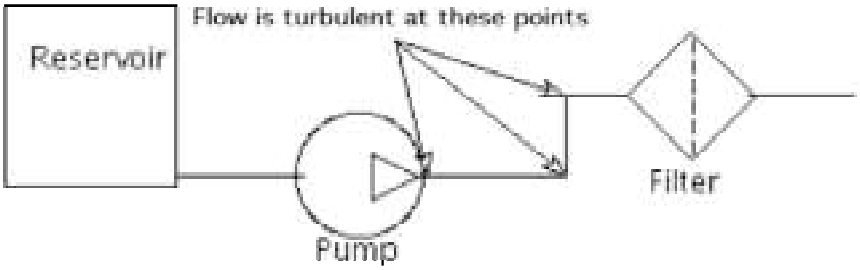
Flow line mounted sample points are preferred to manifold mounted points.

IMPORTANT:

SAMPLES SHALL NOT BE TAKEN FROM DEAD ENDS.

SAMPLES SHALL NOT BE TAKEN BY DISCONNECTING FLOW LINES, CRACKING JOINTS OR DRAINING HOSES.

Where possible all samples should be obtained from a dedicated sample point fitted in a turbulent location in the High Pressure Circuit before the filter.



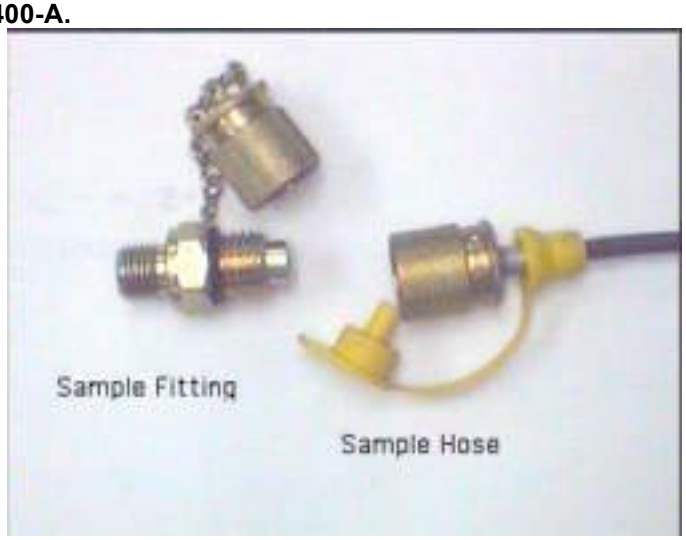
3. Sample Points and Apparatus.

Where possible quick disconnect couplings which meet the guidelines laid down in ISO 4021 shall be fitted.

The type and part number is dependent on the system pressure available so an adequate sample flow rate can be obtained.

The preferred sample fittings are:

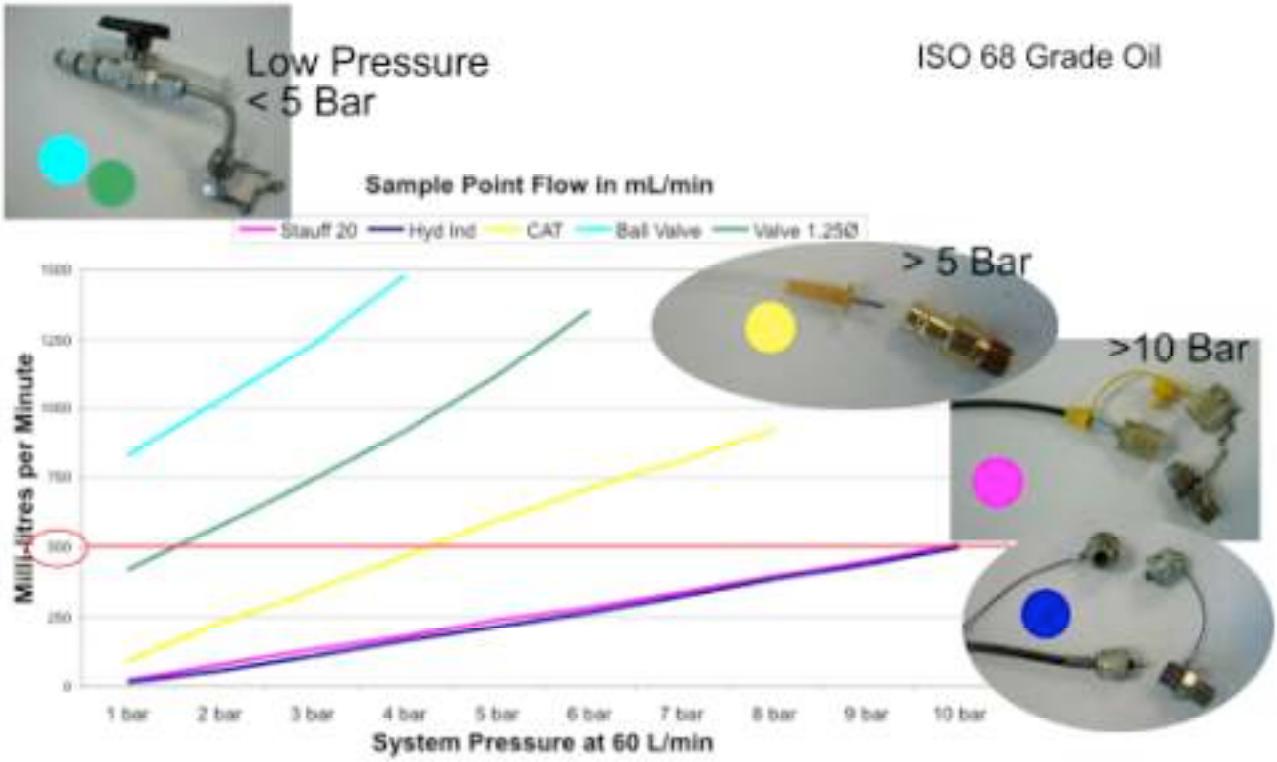
a.) A **Stauff** type test point, part number **SMK20-1/4NPT-PD** is acceptable on systems with pressure in excess of 10 Bar. The part number of the sample hose to suit is **SMS-20-400-A.**



b.) Where there is little pressure available a small ball valve of not less than 1.25 mm nominal bore may be used. (eg: gear box circulating loop)

In all cases the flow from the sample valve must provide a flow rate of 500 mL/min. The flow rate should therefore be capable of filling a standard 250 ml sample bottle in less than 30 seconds.

c.) Dust and safety caps shall be provided for all terminations.



The above chart shows the various flow rates available from a number of different fittings. It also illustrates that it is not possible to standardize on a single sample point across site.

4. Sample Bottles

Dedicated sample bottles shall be used at all times. These bottles shall only be used once. They shall not be cleaned and reused. Samples obtained in bottles other than those approved (such as soft drink bottles) should not be used.

Whilst ISO 4021 refers to sample bottles with a 250ml capacity it is recognized that the standard sample bottle in the industry is in the order of 100 to 120ml. (glass bottles are also specified but practicality has won out over idealism with plastic bottles being the order of the day.)

Therefore fill rates for this sized bottle will be approximately 1/2 that noted for the larger 250ml size.

The need for super clean ISO accredited bottles is unlikely to be justified unless you have systems operating at ISO -/10/8 or better. The impact of ISO super clean bottles on samples obtained from equipment in general industry is unlikely to be quantifiable.

The reason for specifying 250ml was so any sampling error and inadvertent sample contamination is diluted throughout this amount rather than being concentrated in just the 100ml.

Standard analysis and automatic particle counting is conducted on a small portion of the 80ml sample contained within the 100ml bottle. However, if you are performing a microscopic particle count you will need to ensure you have a full 100ml of fluid in the bottle, to process the filter membrane.

5. Representative Sampling

a.) The system should operate for not less than 30 mins. (even longer if the system capacity is very large)

b.) The system should be at operating temperature.

This is to ensure there is an even distribution of contaminant in the circulating fluid, thus providing a more accurate picture as to the condition and cleanliness of the fluid circulating in the system under normal operation.

6. Obtaining Sample

a.) Clearly label the bottle to show the identity of the sample.

b.) Remove all dust caps and clean all connections.

c.) Connect the sample tube and adjust the flow so it is great enough to fill a 250ml bottle in less than 30 secs.

d.) Allow not less than 500ml of fluid to drain to waste to flush the connection and sample hose.

e.) Remove the lid from the sample bottle and without interrupting the flow (do not shut off the flow) direct the stream of fluid into the bottle. Collect half a bottle, refit the lid, shake the bottle to flush it out and then dispose of the to waste. Repeat this procedure 1 or 2 times. (do not close of the flow during this process)

f.) When the bottle has been flushed obtain the final sample by directing the stream into the bottle from about 25mm or less from the mouth of the bottle.

Care must be taken for the sample hose not to come in contact with the opening of the bottle.

Appropriate precautions should be taken in dusty environments to avoid ingression of airborne contamination.

The utmost care must be taken to ensure no external contamination is introduced into the sample being obtained as this will distort the result and void the sample result.

Fill the bottle to about 80% of its capacity and immediately replace the cap.

g.) Terminate the flow, remove the sample hose and replace all dust caps.

7. Static Sampling (systems without a pressure circuit)

Static sampling should only be employed when:

- You need to determine the cleanliness level of fluids stored in tanks and drums.
- On gearboxes and equipment which use lubricating oil but no circulating pump is provided.

NOTE: This method is not to be substituted in place of DYNAMIC sampling. If the system has a pressure system, a sample point should be installed and sampled dynamically.....not take a static sample just because of the absence of a sample point.

a. General Requirements

If it is, say, a gearbox, the unit should be at operating temperature.

Samples should be obtained from a point where the fluid is turbulent from midpoint between the bottom and surface of the fluid level.

(ie: if a sample valve is provided, the draw off point should be as close as practical to the midway point between the bottom and top of the fluid level.)

Samples should not be obtained from drain plugs.

If a suction pump and hose (vampire pump) is employed, care must be taken when inserting the tube so that external ingression of contamination is not introduced or else a there will be a false indication of the fluid cleanliness.

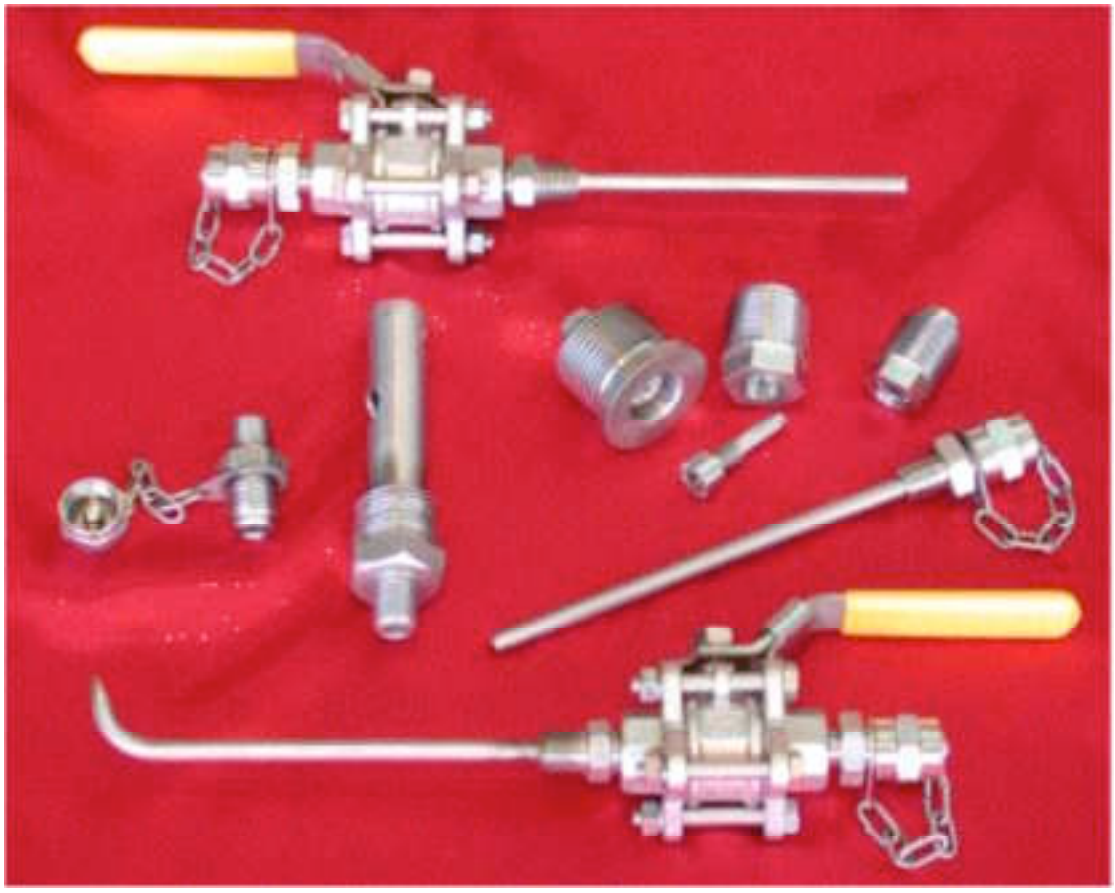
If ongoing monitoring of a machine is required then permanent sample points shall be installed.

Examples of suggested items:

Tema Hydraulic Coupling, Series 2500
(Fit hose tail for tube and pump)

Tema Hydraulic Coupling
(Mount on gearbox)

Ball Valve (1/4") Ensure a safety/dust cap is installed.



Examples of static sample points. (Reference: Pacific Power/PALL/Daryl Kelly)

If no permanent sample point is fitted to the tank or gearbox then a "vacuum" suction pump sampling device will be required.

The pump and equipment should be in a clean condition and in good operating order.

Examples of using a vampire pump in conjunction with permanent fittings, including a modified dipstick.
(Ref: Pacific Power/PALL/Daryl Kelly)

b. Equipment Required

Suction hoses and bottles should not be reused. A new hose and bottle should be used for each sample obtained.

c. Obtaining Sample

i. Clearly label the bottle to show the identity of the sample.

ii. Ensure area around opening or access to reservoir is thoroughly cleaned before opening the access point to the fluid.

iii. Fit new bottle and hose to vacuum pump.

iv. A dedicated sample fitting should be used where possible. If not remove fitting, breather, fill point etc to allow access to tank and insert tube to a point midway into the tank or gearbox.

v. Care must be taken for the sample hose not to become contaminated whilst carrying out the operation. The bottle shall be flushed as in using the dynamic method.

vi. Appropriate precautions should be taken in dusty environments to avoid ingression of airborne contamination.

The utmost care must be taken to ensure no external contamination is introduced into the sample being obtained as this will distort the result and void the sample result.

vii.. If obtaining the sample from a permanent draw off point ensure that at least 500mL of fluid is drawn off to flush the draw off port and valve assembly.

viii. Fill the bottle to about 80% of its capacity, remove it from the pump and immediately replace the cap.

ix. Replace the fitting, breather or whatever means was used to access the fluid and dispose of the sample hose.

8. Completion

The sample should either be taken to an appropriate area or returned to the laboratory to carry out the analysis.

It is good practice to note on the sample bottle how and from where the sample was obtained. Knowing where the sample comes from allows interpretation of the ISO code to be much more useful. (As highlighted earlier, the ISO code of a sample obtained from the correct location can be significantly different to that of one obtained from the return line or reservoir.)

References:

ISO 4021
ISO 4066-1999
Pall Corporation
Pacific Power
Daryl Kelly
Bob Trask – Boyne Smelters Ltd
Stauff – Test Fittings

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