EATON | Vickers

Target Cleanliness Worksheet

Systemic Contamination Control

Target Cleanliness Worksheet

1. SET A TARGET

Eaton Recommended Cleanliness Code Chart

PUMPS PRESSURE	<140 BAR <20000 PSI	140 - 210 BAR 2000 - 3000 PSI	210+BAR 3000+PSI
Fixed Gear	20/18/15	19/17/15	18/16/13
Fixed Vane	20/18/15	19/17/14	18/16/13
Fixed Piston	19/17/15	18/16/14	17/15/13
Variable Vane	19/17/15	18/16/14	17/15/13
Variable Piston	18/16/14	17/15/13	16/14/12

VALVES PRESSURE	<210 BAR <3000 PSI	210+BAR 3000+PSI
Directional (solenoid)	20/18/15	19/17/14
Pressure Control (modulating)	19/17/14	19/17/14
Flow Controls (standard)	19/17/14	19/17/14
Check Valves	20/18/15	20/18/15
Cartridge Valves	20/18/14	19/17/14
Screw-In Valves	18/16/13	17/15/12
Prefill	18/16/13	17/15/12
Load-Sensing Directional Valves	18/16/13	17/15/12
Hydraulic Remote Controls	18/16/13	17/15/12
Proportional Directional (throttle valves)	18/16/13	17/15/12*
Proportional Pressure Controls	18/16/13	17/15/12*
Proportional Cartridge Valves	18/16/13	17/15/12*
Proportional Screw-In Valves	18/16/13	17/15/12
Servo Valves	16-14-11*	15/13/10*

ACTUATORS PRESSURE	<140 BAR <2000 PSI	140 - 210 BAR 2000 - 3000 PSI	210+BAR 3000+PSI
Cylinders	20/18/15	20/18/15	20/18/15
Vane Motors	20/18/15	19/17/14	18/16/13
Axial Piston Motors	19/17/14	18/16/13	17/15/13
Gear Motors	20/19/17	20/18/15	19/17/14
Radial Piston Motors	20/18/14	19/17/13	18/16/13
Swash Plate Design Motors	18/16/14	17/15/13	16/14/12*

HYDROSTATIC TRANSMISSIONS PRESSURE	<210 BAR <3000 PSI	140 - 210 BAR 2000 - 3000 PSI	210+BAR 3000+PSI
Hydrostatic Transmissions (in-loop fluid)	17/15/13	16/14/12*	16/14/11*
BEARINGS			
Fixed Gear	20/18/15	19/17/15	18/16/13
Fixed Vane	20/18/15	19/17/14	18/16/13
Fixed Piston	19/17/15	18/16/14	17/15/13
Variable Vane	19/17/15	18/16/14	17/15/13
Variable Piston	18/16/14	17/15/13	16/14/12

* Requires precise sampling practices to verify cleanliness levels.

How to Set a Target Cleanliness Level

Using the Eaton Recommended Cleanliness Code Chart, determine the cleanest fluid (lowest code) required by any component in the system. All components that draw fluid from a common reservoir should be considered to be part of the same system even if their operations are independent or sequential (i.e. a central power unit running several different machines). The pressure rating for the system is the maximum system pressure achieved by the machine during a complete cycle of operation.

STEP TWO:

For any system where the fluid is not 100% petroleum oil, set the target one Range Code cleaner for each particle size.

Example: If the cleanest code required was 17/15/13 and water glycol is the system fluid, the target becomes 16/14/12.

STEP THREE:

If any of the following condition are experienced by the machine or system, set the target cleanliness one level lower for each particle size.

- Frequent cold starts at less than 0°F (-18C°)
- Intermittent operation with fluid temperatures over 160°F (70°C)
- High vibration or high shock operation

Again, looking at the example above, if this system was expected to intermittently operate about 70°C, the target cleanliness would become 15/13/11.

Using this three step procedure, the system target cleanliness code for the system is now set.

TEST STANDS

Target cleanliness level for test stands should be one range code cleaner, for each particle size, than the code for the most sensitive condition and component to be tested. Example: Variable piston pump tested at 170 bar (2500 psi) cleanliness level should be 17/15/13 so the TEST STAND cleanliness level should be at least 16/14/12.

FLUID CONDITIONING

Proper fluid condition is essential for long and satisfactory life of hydraulic components and systems. Hydraulic fluid must have the correct balance of cleanliness, materials and additives for protection against wear of components, elevated viscosity and inclusion of air. Eaton supports and recommends the hydraulic Systems Standards For Stationary Industrial Machinery advanced by the American National Standards Institute; ANSI(NFPA/JIC) T2.24, 1-1991. Key elements of the Standard, as well as other vital information on the "Guide To Systemic Contamination Control," available from your local Eaton distributor.

Target Cleanliness Worksheet

SYSTEMIC CONTAMINATION CONTROL WORKSHEET

Company Name _____ Date _____

Company Address _____

Contact Person _____ Title _____

Type of Machine (System) _____

SETTING A TARGET CLEANLINESS LEVEL

STEP ONE:

Maximum Operating Pressure _____ Pump Flow _____

Total System Volume (including lines and actuators) _____

Most Sensitive Component

Pump Type _____ Target Cleanliness __/__/__

STEP TWO:

Fluid Type and Brand _____

Fluid Adjustment? _____ Yes _____ No

STEP THREE:

Operating Temperatures _____ F° (min) _____ F°(max)

Intermittent Fluid Temperatures Above 70°C (160°F)? _____ Yes _____ No

Frequent Cold Starts at Less Than -18°C (0°F)? _____ Yes _____ No

High Vibration or Shock? _____ Yes _____ No

System Stress Adjustment? _____ Yes _____ No

FINAL SYSTEMIC CONTAMINATION CONTROL TARGET CLEANLINESS _____/_____ / _____

CONTAMINATION CONTROL DEVICE PLACEMENT

Return Line Flow _____ Max L/min (GPM) _____ Min L/min (GPM) Pressure _____Max bar (psi)

Pressure Line Flow _____ Max L/min (GPM) _____ Min L/min (GPM) Pressure _____Max bar (psi)

Recirculation Line Flow _____ Max L/min (GPM) _____ Min L/min (GPM) Pressure _____Max bar (psi)

Pressure Filter Model # _____ C _____

Return Filter Model # _____ C _____

Recirculating Filter Model # _____ C

Replacement Element Model Numbers

Return Line _____

Pressure Line _____ Analysis Done By _____

Recirculating Loop _____ Title _____

Reservoir Vent Breather Filter # _____

2. BUILD TO ACHIEVE TARGET

Filter Placements

This chart helps select the grade of Eaton medium, and the filter placement(s) that will achieve the required target cleanliness. It assumes the system will experience "average" ingression and that maintenance of the system will be consistent with current technology. If in operation the system is running dirtier than expected, corrective actions should be initiated. Suggested corrective actions are:

1. Check the indicator to see if the filters are on by-pass.
2. Check the sources of ingression and correct problems.
3. Check that the filters are positioned properly to see maximum fluid flow.
4. Consider using a finer grade of Vickers filter.
5. Add a filter to the system.

Target Cleanliness	Full flow pressure line or return line	Full flow pressure line and return line	Pressure line (or return line) and recirculating loop at 20% of system fluid volume per minute	Pressure line plus return line plus recirculating loop	Recirculating loop at 20% of system volume per minute	Recirculating loop at 10% of system volume per minute
	Recommended filter placements for fixed volume pumps	Recommended filter placements for high ingression systems with fixed volume pumps	Recommended filter placements for systems with variable volume pumps	Recommended filter placements for high ingression systems with variable volume pumps	Recommended filter placements for systems with fixed or variable volume pumps	Recommended filter placements for low ingression systems with fixed or variable volume pumps
14/12/10		03	03	03		
15/13/11		03	03	05		
16/14/12	03	05	05	05	03	
17/15/13	03	05	05	05 or 10	03	03
18/16/14	05	10	05 or 10	10	05	03
19/17/15	05 or 10	10	10	10	05 or 10	05

Note: All systems need a reservoir with 3 micron air breather filtration.

C-Pak System Cleanliness Ratings

CODE	NUMBER OF TIMES PUMP FLOW PASSES THROUGH FILTER(S) (SEE NOTE 1)	TYPICAL ISO 4406 CLEANLINESS LEVEL ACHIEVED (SEE NOTE 2)
03	2.0	14/12/10
	1.5	15/13/11
	1.0	16/14/12
	.5	17/15/13
05	2.0	16/14/12
	1.5	17/15/13
	1.0	18/16/14
	.5	19/17/15
10	2.0	18/16/14
	1.5	19/17/15
	1.0	20/18/15
	.5	21/19/16

Note 1

# OF PASSES THROUGH FILTER OF MAXIMUM PUMP FLOW	TYPICAL FILTER PLACEMENTS
2.0	Full flow pressure and return
1.5	Full flow pressure or return and recirculation loop
1.0	Full flow pressure or return line
0.5	Recirculation loop sized to 15% of system volume per minute

Note 2

Cleanliness level achieved is affected by percentage of system flow that passed through the filters, filter housing integrity, element performance and contamination ingression and generation rates. For more detailed assistance, please contact your local Eaton Distributor.

3. CONFIRM ACHIEVEMENT OF TARGET

Vickers Fluid Analysis Kit
Part Number 894276
(Standard Report)

Vickers Fluid Analysis Kit
Part Number 894277
(Standard Report plus
Spectographic)

Vickers Sampling Pump
Part Number 894279
(Not Shown in Picture)

Fluid Analysis Report
Includes the Following:

- Photomicrograph
- Particle count information
- Cleanliness code and comparison to target
- Viscosity and comparison to target
- Water content and comparison to target
- Trend information of previous two samples
- Comments and recommendation

Recommended System Sampling Frequency Chart

SYSTEMS WITH TARGET CLEANLINESS 17/15/12 OR LOWER

SYSTEM PRESSURE	<140 BAR (2000 PSI)	140 - 210 BAR (2000 - 3000 PSI)	>210 BAR 3000 PSI
8 hours or less operation per day	4 months	3 months	3 months
Over 8 hours of operation per day	3 months	2 months	2 months

SYSTEMS WITH TARGET CLEANLINESS 18/16/13 OR HIGHER

SYSTEM PRESSURE	<140 BAR (2000 PSI)	140 - 210 BAR (2000 - 3000 PSI)	>210 BAR 3000 PSI
8 hours or less operation per day	6 months	4 months	4 months
Over 8 hours of operation per day	4 months	3 months	3 months

INITIAL COMMISSIONING OR MAJOR REBUILD

Large system (2000 liters (530 USgal) or more) and systems with servo valves:

- Sample fluid before start-up
- Sample fluid during first day running
- Sample fluid after one week
- Sample fluid after one month

Other systems:

- Sample fluid during first day running
- Sample fluid after one month

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Printed in USA
Document No. V-FIFI-MS002-E
Supersedes 578
June 2004