

UNDERSTANDING ISO CODES

The ISO cleanliness code is used to quantify particulate contamination levels per milliliter of fluid at 3 sizes 4 μ [c], 6 μ [c], and 14 μ [c]. The ISO code is expressed in 3 numbers (ie 19/17/14). Each number represents a contaminant level code for the correlating particle size. The code includes all particles of the specified size and larger. It is important to note that each time a code increases the quantity range of particles is doubling.

ISO 4406 Chart		
Range Code	Particles per milliliter	
	More than	Up to/including
24	80000	160000
23	40000	80000
22	20000	40000
21	10000	20000
20	5000	10000
19	2500	5000
18	1300	2500
17	640	1300
16	320	640
15	160	320
14	80	160
13	40	80
12	20	40
11	10	20
10	5	10
9	2.5	5
8	1.3	2.5
7	0.64	1.3
6	0.32	0.64

Sample 1 (see photo 1)

Particle Size	Particles per ml*	ISO 4406 Code range	ISO Code
4 μ [c]	151773	80000~160000	24
6 μ [c]	38363	20000~40000	22
10 μ [c]	8229		
14 μ [c]	3339	2500~5000	19
21 μ [c]	1048		
38 μ [c]	112		

Sample 2 (see photo 2)

Particle Size	Particles per ml*	ISO 4406 Code range	ISO Code
4 μ [c]	492	320 ~ 640	16
6 μ [c]	149	80 ~ 160	14
10 μ [c]	41		
14 μ [c]	15	10 ~ 20	11
21 μ [c]	5		
38 μ [c]	1		

Photo 1

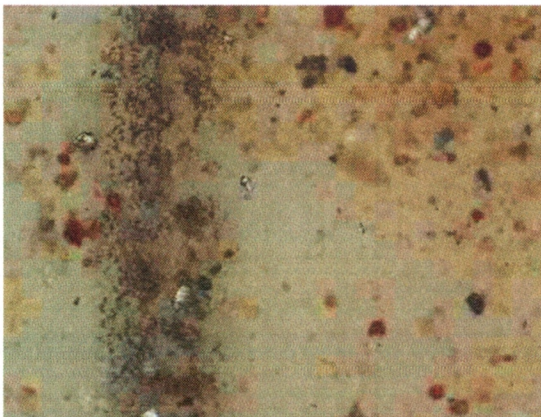
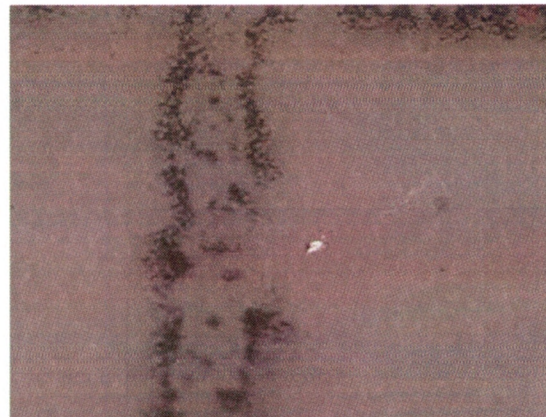


Photo 2



TARGET ISO CLEANLINESS CODES

When setting target ISO fluid cleanliness codes for hydraulic and lubrication systems it is important keep in mind the objectives to be achieved. Maximizing equipment reliability and safety, minimizing repair and replacement costs, extending useful fluid life, satisfying warranty requirements, and minimizing production down-time are attainable goals. Once a target ISO cleanliness code is set following a progression of steps to achieve that target, monitor it, and maintain it justifiable rewards will be yours.

Set the Target.

The first step in identifying a target ISO code for a system is to identify the most sensitive on an individual system, or the most sensitive component supplied by a central reservoir. If a central reservoir supplies several systems the overall cleanliness must be maintained, or the most sensitive component must be protected by filtration that cleans the fluid to the target before reaching that component.

Other Considerations

Table 1 recommends conservative target ISO cleanliness codes based on a several component manufacturers guidelines and extensive field studies for standard industrial operating conditions in systems using petroleum based fluids. If a non-petroleum based fluid is used (i.e. water glycol) the target ISO code should be set one value lower for each size (4 μ [c]/6 μ [c]/14 μ [c]). If a combination of the following conditions exists in the system the target ISO code should also be set one value lower:

- Component is critical to safety or overall system reliability.
- Frequent cold start.
- Excessive shock or vibration.
- Other Severe operation conditions.

Recommended* Target ISO Cleanliness Codes and media selection for systems using petroleum based fluids per ISO4406:1999 for particle sizes 4 μ [c] / 6 μ [c] / 14 μ [c]

	Pressure	Media	Pressure	Media	Pressure	Media
	< 140 bar	β_x [c] = 1000	212 bar	β_x [c] = 1000	> 212 bar	β_x [c] = 1000
	< 2000 psi	(β_x = 200)	3000 psi	(β_x = 200)	> 3000 psi	(β_x = 200)
Pumps						
Fixed Gear	20/18/15	22 μ [c] (25 μ)	19/17/15	12 μ [c] (12 μ)	-	-
Fixed Piston	19/17/14	12 μ [c] (12 μ)	18/16/13	12 μ [c] (12 μ)	17/15/12	7 μ [c] (6 μ)
Fixed Vane	20/18/15	22 μ [c] (25 μ)	19/17/14	12 μ [c] (12 μ)	18/16/13	12 μ [c] (12 μ)
Variable Piston	18/16/13	7 μ [c] (6 μ)	17/15/13	5 μ [c] (3 μ)	16/14/12	7 μ [c] (6 μ)
Variable Vane	18/16/13	7 μ [c] (6 μ)	17/15/12	5 μ [c] (3 μ)	-	-
Valves						
Cartridge	18/16/13	12 μ [c] (12 μ)	17/15/12	7 μ [c] (6 μ)	17/15/12	7 μ [c] (6 μ)
Check Valve	20/18/15	22 μ [c] (25 μ)	20/18/15	22 μ [c] (25 μ)	19/17/14	12 μ [c] (12 μ)
Directional (solenoid)	20/18/15	22 μ [c] (25 μ)	19/17/14	12 μ [c] (12 μ)	18/16/13	12 μ [c] (12 μ)
Flow Control	19/17/14	12 μ [c] (12 μ)	18/16/13	12 μ [c] (12 μ)	18/16/13	12 μ [c] (12 μ)
Pressure Control (modulating)	19/17/14	12 μ [c] (12 μ)	18/16/13	12 μ [c] (12 μ)	17/15/12	7 μ [c] (6 μ)
Proportional Cartridge Valve	17/15/12	7 μ [c] (6 μ)	17/15/12	7 μ [c] (6 μ)	16/14/11	5 μ [c] (3 μ)
Proportional Directional	17/15/12	7 μ [c] (6 μ)	17/15/12	7 μ [c] (6 μ)	16/14/11	5 μ [c] (3 μ)
Proportional Flow Control	17/15/12	7 μ [c] (6 μ)	17/15/12	7 μ [c] (6 μ)	16/14/11	5 μ [c] (3 μ)
Proportional Pressure Control	17/15/12	7 μ [c] (6 μ)	17/15/12	7 μ [c] (6 μ)	16/14/11	5 μ [c] (3 μ)
Servo Valve	16/14/11	7 μ [c] (6 μ)	16/14/11	5 μ [c] (3 μ)	15/13/10	5 μ [c] (3 μ)
Bearings						
Ball Bearing	15/13/10	5 μ [c] (3 μ)	-	-	-	-
Gearbox (industrial)	17/16/13	12 μ [c] (12 μ)	-	-	-	-
Journal Bearing (high speed)	17/15/12	7 μ [c] (6 μ)	-	-	-	-
Journal Bearing (low speed)	17/15/12	7 μ [c] (6 μ)	-	-	-	-
Roller Bearing	16/14/11	7 μ [c] (6 μ)	-	-	-	-
Actuators						
Cylinders	17/15/12	7 μ [c] (6 μ)	16/14/11	5 μ [c] (3 μ)	15/13/10	5 μ [c] (3 μ)
Vane Motors	20/18/15	22 μ [c] (25 μ)	19/17/14	12 μ [c] (12 μ)	18/16/13	12 μ [c] (12 μ)
Axial Piston Motors	19/17/14	12 μ [c] (12 μ)	18/16/13	12 μ [c] (12 μ)	17/15/12	7 μ [c] (6 μ)
Gear Motors	20/18/14	22 μ [c] (25 μ)	19/17/13	12 μ [c] (12 μ)	18/16/13	12 μ [c] (12 μ)
Radial Piston Motors	20/18/15	22 μ [c] (25 μ)	19/17/14	12 μ [c] (12 μ)	18/16/13	12 μ [c] (12 μ)
Test Stands, Hydrostatic						
Test Stands	15/13/10	5 μ [c] (3 μ)	15/13/10	5 μ [c] (3 μ)	15/13/10	5 μ [c] (3 μ)
Hydrostatic Transmissions	17/15/13	7 μ [c] (6 μ)	16/14/11	5 μ [c] (3 μ)	16/14/11	5 μ [c] (3 μ)

*Depending upon system volume and severity of operating conditions a combination of filters with varying degrees of filtration efficiency might be required (i.e. pressure, return, and off-line filters) to achieve and maintain the desired fluid cleanliness.

Example

		ISO Code	Comments
Operating Pressure	156 bar, 2200 psi		
Most Sensitive Component	Directional Solenoid	19/17/14	recommended baseline ISO Code
Fluid Type	Water Glycol	18/16/13	Adjust down one class
Operating Conditions	Remote location, repair difficult		Adjust down one class, combination
	High ingress rate	17/15/12	of critical nature, severe conditions