



FLUID **DYNAMICS**

Lubricant and Manufacturing Sustainability

1 (800) 237-1862

Contamination Types, Causes and Consequences

Contamination Type	Description	Cause	Consequences
Solid contamination	<ul style="list-style-type: none"> - Wear metals: iron, copper, tin zinc, etc. - Fibers, rubber particles, paint particles 	<ul style="list-style-type: none"> - Internal wear - Outside contamination - Oil ageing 	<ul style="list-style-type: none"> - Abrasive wear and failure - Valve blockage - Decreased fluid service life
Liquid contamination	<ul style="list-style-type: none"> - Coolants - Water - Steam 	<ul style="list-style-type: none"> - Air moisture - Leaking cooling system, seals - Process water/steam 	<ul style="list-style-type: none"> - Corrosion - Change in oil effectiveness and properties - Process water/steam
Gel-like contamination	<ul style="list-style-type: none"> - Additive Separation - Oil ageing/varnish - Oil contamination and/or blending 	<ul style="list-style-type: none"> - Oil ageing/varnish - Oil contamination and/or blending 	<ul style="list-style-type: none"> - Increased friction and temperature - Decrease in valve, seal and bearing life - Blockage of filter elements
Gaseous contamination	<ul style="list-style-type: none"> - Air - Process gases 	<ul style="list-style-type: none"> - Mixtures 	<ul style="list-style-type: none"> - Oxidation - Localized overheating of oil

Understanding ISO:4406 Contamination Codes

The ISO cleanliness code (per ISO4406) is used to determine the presence of particle contamination per milliliter of fluid at 3 sizes: 4 microns, 6 microns and 14 microns. ISO codes are expressed as three separate numbers (example: 18/16/13) with each number corresponding to a contamination level for the designated particle size. Each number contains the particle count for that specified size and larger. Each time a code increases by one, the quantity of that range of particles doubles.

Determining the ISO:4406 Code		
ISO Code	Particles per Milliliter	
	More Than	Up to and Including
24	80,000	160,000
23	40,000	80,000
22	20,000	40,000
21	10,000	20,000
20	5,000	10,000
19	2,500	5,000
18	1,300	2,500
17	640	1,300
16	320	640
15	160	320
14	80	160
13	40	80
12	20	40
11	10	20
10	5	10

Cleanliness Level Required by a System			
Type:	Low/Medium Pressure (Under 2,000 psi)	High Pressure (2,000-2,999 psi)	Very High Pressure (3,000 psi)
Pumps			
Fixed Gear or Fixed Vane	20/18/15	19/17/14	18/16/13
Fixed Piston	19/17/14	18/16/13	17/15/12
Variable Vane	18/16/13	17/15/12	N/A
Variable Piston	18/16/13	17/15/12	16/14/11
Valves			
Check Valve	20/18/15	20/18/15	19/17/14
Directional and Standard Flow	20/18/15	19/17/14	18/16/13
Cartridge	19/17/14	18/16/13	17/15/12
Proportional	17/15/12	17/15/12	16/14/11
Servo	16/14/11	16/14/11	15/13/10
Actuators			
Cylinder, Vane Motors, Gear Motors	20/18/15	19/17/14	18/16/13
Piston Motors, Swash Plate Motors	19/17/14	18/16/13	17/15/12
Hydrostatic Drives	16/15/12	16/14/11	15/13/10

Cleanliness Level Required by a System			
Type:	Low/Medium Pressure (Under 2,000 psi)	High Pressure (2,000-2,999 psi)	Very High Pressure (3,000 psi)
Bearings			
Journal Bearings	17/15/12	N/A	N/A
Industrial Gearboxes	17/15/12	N/A	N/A
Ball Bearings	15/13/10	N/A	N/A
Roller Bearings	16/14/11	N/A	N/A