Kees Veltman
Director/Owner

Noria/Solinas klanten

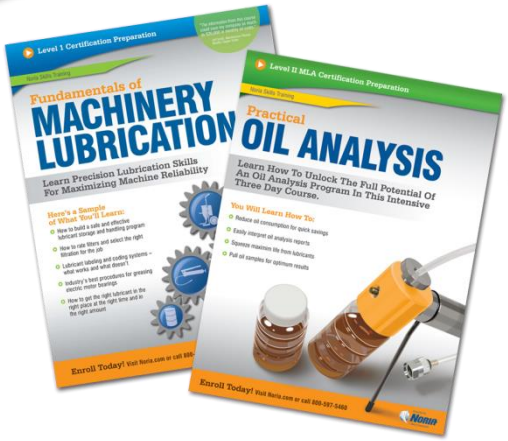
Solinas BENELUX BV

NORIA

Noria Corporation

The World Leader in Machinery Lubrication and Oil Analysis Education and Consulting

- Education & Training
- Consulting
- Magazine & Newsletters
- Conferences
- Online Resources
- Vendor Neutral



Is filtration off Lubrication oils necessary?

What we hear in the Industry, today.

ISO OIL RECOMMENDATIONS FOR:

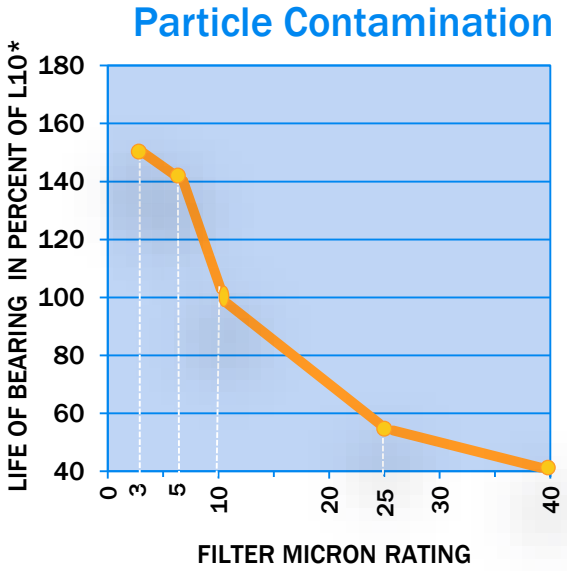
Oil Viscosity	ISO grade	Recommendation Filtration
32 cSt.	15/13/10	3 Micron
46 cSt.	16/14/11	5 Micron
68 cSt.	17/14/11	5 Micron
100 cSt.	18/15/13	5 Micron
150 cSt.	18/15/13	5 Micron
220 cSt.	19/16/14	10 Micron
320 cSt.	19/16/14	10 Micron
460 cSt.	19/16/14	10 Micron
680 cSt.	20/18/14	25 Micron

People say use 1, 3 or 10 Micron for everything or use depth filtration ?

REF: Schroeder, Pall, Hydac

Solinas BENELUX BV

Causes of Bearing Failures



*L10, or minimum life, refers to the number of hours at which 10% of the bearings will fail.

Lubrication Problems & Contamination

- Particles
- Water
- Air
- Low level oil/grease
- High level oil/grease
- Heat

Machine Life Extension - Particle Cleanliness

NEW CLEANLINESS LEVEL (ISO CODE)

CURRENT CLEANLINESS (ISO CODE)

	20/17		19/16		18/15		17/14		16/13		15/12		14/11		13/10		12/9		11/8		10/7	
26/23	5	3	7	3.5	9	4	>10	5	>10	6	>10	7.5	>10	9	>10	>10	>10	>10	>10	>10	>10	>10
	4	2.5	4.5	3	6	3.5	6.5	4	7.5	5	8.5	6.5	10	7	>10	9	>10	10	>10	>10	>10	>10
25/22	4	2.5	5	3	7	3.5	9	4	>10	5	>10	6	>10	7	>10	9	>10	>10	>10	>10	>10	>10
	3	2	3.5	2.5	4.5	3	5	3.5	6.5	4	8	5	9	6	10	7.5	>10	9	>10	>10	>10	>10
24/21	3	2	4	2.5	6	3	7	4	9	5	>10	6	>10	7	>10	8	>10	10	>10	>10	>10	>10
	2.5	1.5	3	2	4	2.5	5	3	6.5	4	7.5	5	8.5	6	9.5	7	>10	8	>10	10	>10	>10
23/20	2	1.5	3	2	4	2.5	5	3	7	3.5	9	4	>10	5	>10	6	>10	8	>10	9	>10	>10
	1.7	1.3	2.3	1.5	3	2	3.7	2.5	5	3	6	3.5	7	4	8	5	10	6.5	>10	8.5	>10	10
22/19	1.6	1.3	2	1.6	3	2	4	2.5	5	3	7	3.5	8	4	>10	5	>10	6	>10	7	>10	>10
	1.4	1.1	1.8	1.3	2.3	1.7	3	2	3.5	2.5	4.5	3	5.5	3.5	7	4	8	5	10	5.5	>10	8.5
21/18	1.3	1.2	1.5	1.5	2	1.7	3	2	4	2.5	5	3	7	3.5	9	4	>10	5	>10	7	>10	10
	1.2	1.1	1.5	1.3	1.8	1.4	2.2	1.6	3	2	3.5	2.5	4.5	3	5	3.5	7	4	9	5.5	10	8
20/17			1.3	1.2	1.6	1.5	2	1.7	3	2	4	2.5	5	3	7	4	9	5	>10	7	>10	9
			1.2	1.05	1.5	1.3	1.8	1.4	2.3	1.7	3	2	3.5	2.5	5	3	6	4	8	5.5	10	7
19/16					1.3	1.2	1.6	1.5	2	1.7	3	2	4	2.5	5	3	7	4	9	6	>10	8
					1.2	1.1	1.5	1.3	1.8	1.5	2.2	1.7	3	2	3.5	2.5	5	3.5	7	4.5	9	6
18/15							1.3	1.2	1.6	1.5	2	1.7	3	2	4	2.5	5	3	7	4.5	>10	6
							1.2	1.1	1.5	1.3	1.8	1.5	2.3	1.7	3	2	3.5	2.5	5.5	3.7	8	5
17/14									1.3	1.2	1.6	1.5	2	1.7	3	2	4	2.5	6	3	8	5
									1.2	1.1	1.5	1.3	1.8	1.5	2.3	1.7	3	2	4	2.5	6	3.5
16/13											1.3	1.2	1.6	1.5	2	1.7	3	2	4	3.5	6	4
											1.2	1.1	1.5	1.3	1.8	1.5	2.3	1.8	3.7	3	4.5	3.5
15/12													1.3	1.2	1.6	1.5	2	1.7	3	2	4	2.5
													1.2	1.1	1.5	1.4	1.8	1.5	2.3	1.8	3	2.2
14/11															1.3	1.3	1.6	1.6	2	1.8	3	2
															1.3	1.2	1.6	1.4	1.9	1.5	2.3	1.8
13/10																	1.4	1.2	1.8	1.5	2.5	1.8
																	1.2	1.1	1.6	1.3	2	1.6

Hydraulics and Diesel Engines	Rolling Element Bearings
Journal Bearings and Turbo Machinery	Gear Boxes and Other

Based on ISO 4406:99 - 4 micron range number has been omitted.

Sample New Bulk Oil ISO Cleanliness Codes

21/18	28/21
20/17	23/20
20/18	20/17
20/17	20/18

Sample New Drum Oil ISO Cleanliness Codes

~~20/17~~	17/14
21/18	20/17
~~20/18~~	15/12
21/18	20/17
21/18	23/20
14/11	14/11
21/18	20/17
21/18	21/18
17/14	18/15
14/11	23/20

REF: Monash, TU Electric

Life Extension Table for Setting ORS Dryness Targets

New Moisture Level (ppm)

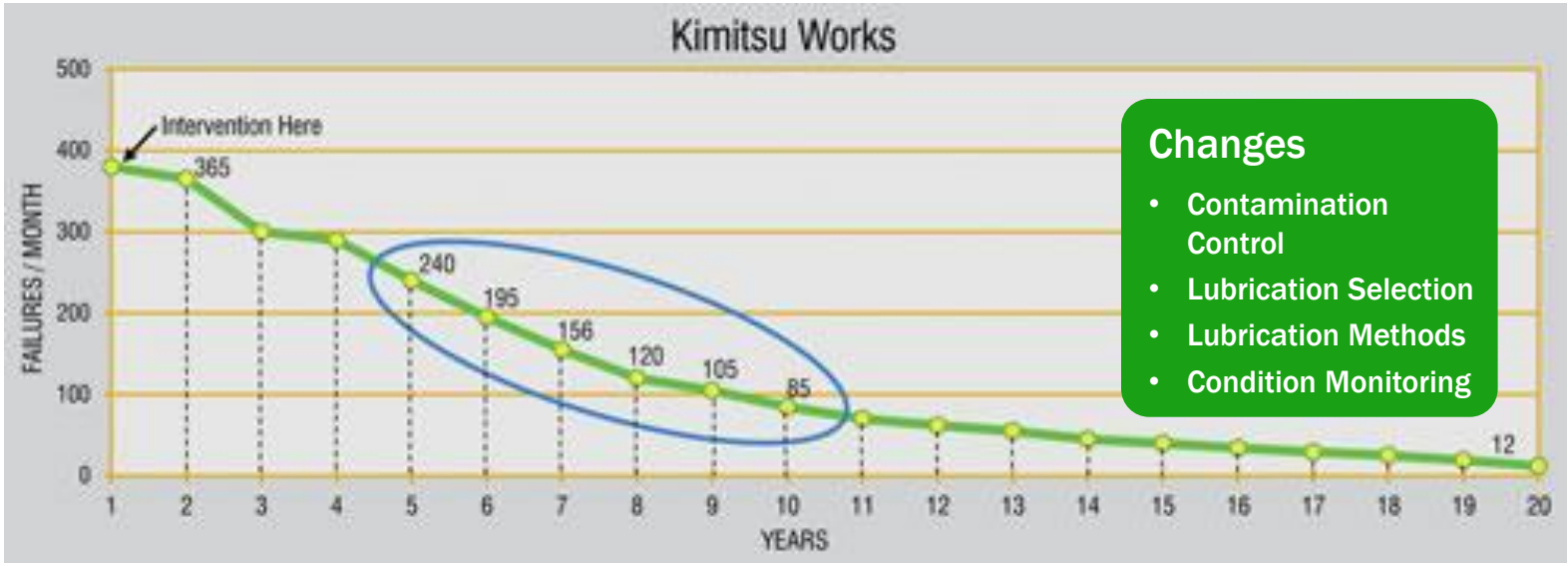
Current Moisture Level (ppm)	10,000		5,000		2,500		1,000		500		250		100		50	
	Rolling-Element	Journal	Rolling-Element	Journal	Rolling-Element	Journal	Rolling-Element	Journal	Rolling-Element	Journal	Rolling-Element	Journal	Rolling-Element	Journal	Rolling-Element	Journal
50,000	2.3	1.6	3.3	1.9	4.8	2.3	7.8	2.9	11.2	3.5	16.2	4.3	26.2	5.5	37.8	6.7
25,000	1.6	1.3	2.3	1.6	3.3	1.9	5.4	2.4	7.8	2.9	11.2	3.5	18.2	4.6	26.2	5.5
10,000			1.4	1.2	2.0	1.5	3.3	1.9	4.8	2.3	6.9	2.8	11.2	3.5	16.2	4.3
5,000					1.4	1.2	2.3	1.6	3.3	1.9	4.8	2.3	7.8	2.9	11.2	3.5
2,500							1.6	1.3	2.3	1.6	3.3	1.9	5.4	2.4	7.8	2.9
1,000									1.4	1.2	2.0	1.5	3.3	1.9	4.8	2.3
500											1.4	1.2	2.3	1.6	3.3	1.9
250													1.5	1.3	2.3	1.6
100															1.4	1.2

© Copyright Noria Corporation

REF: SKF, OSU, DT

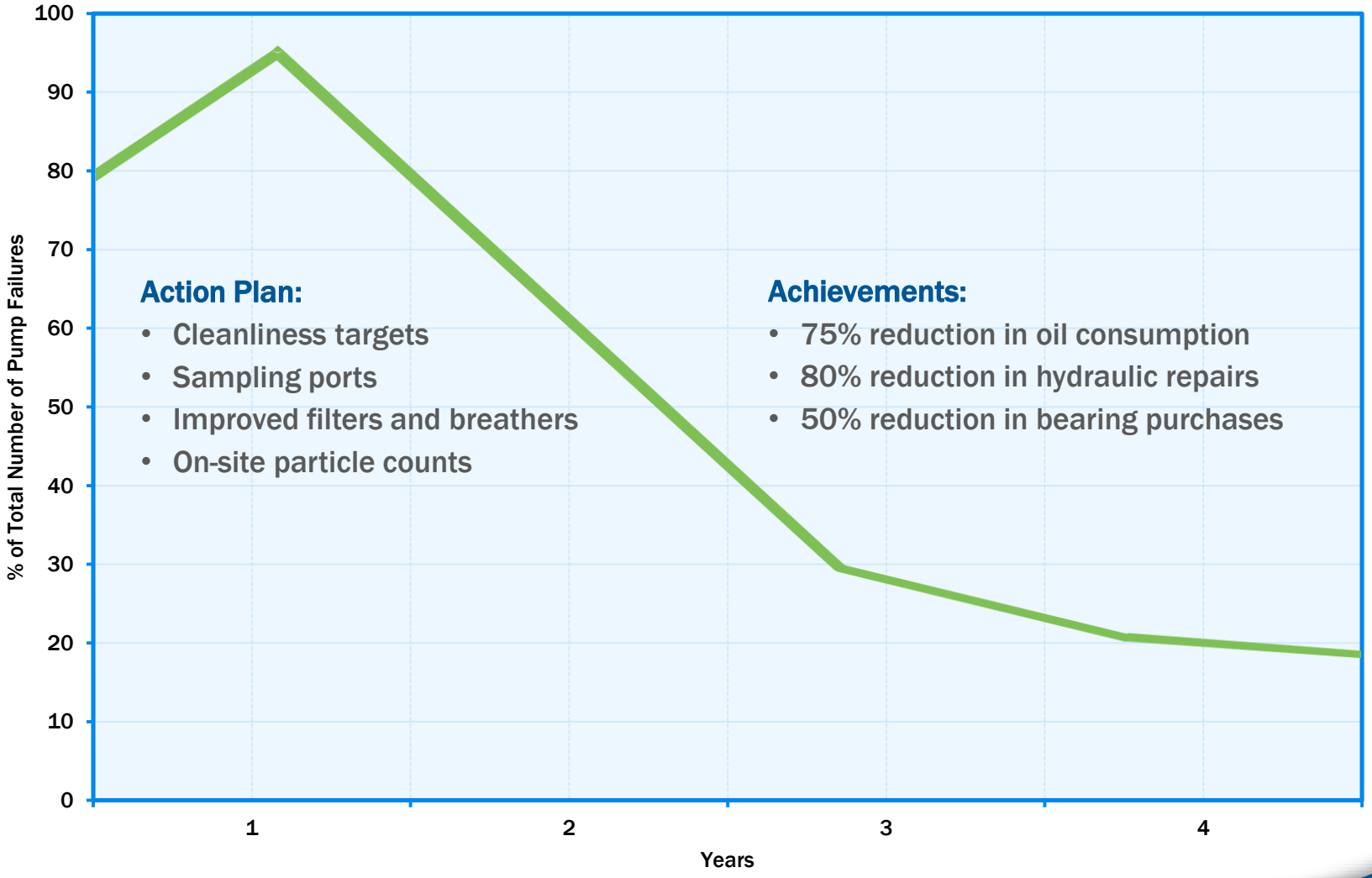
Is filtration off Lubrication oils necessary?

What we have seen in the Industry in a steel factory.



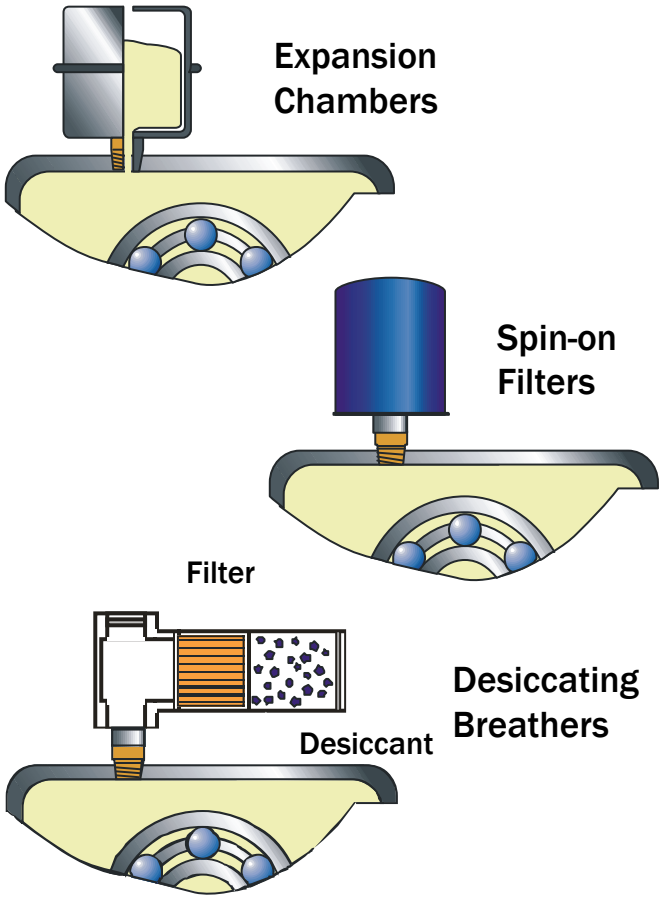
Is filtration off Lubrication oils necessary?

What we have seen in the Industry at NIPPON Steel.

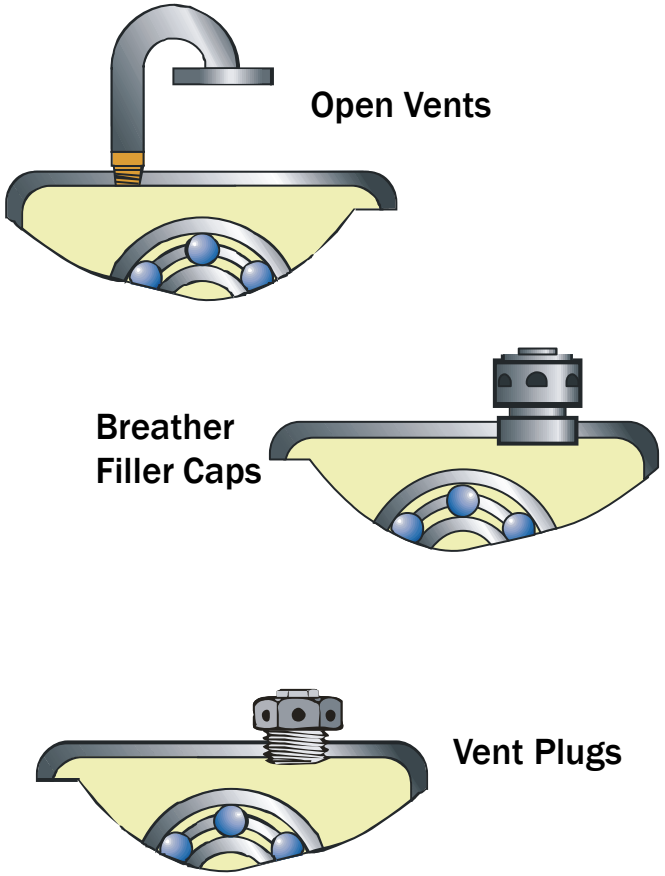


Tank and Sump Ventilation

Good, Protective Ventilation

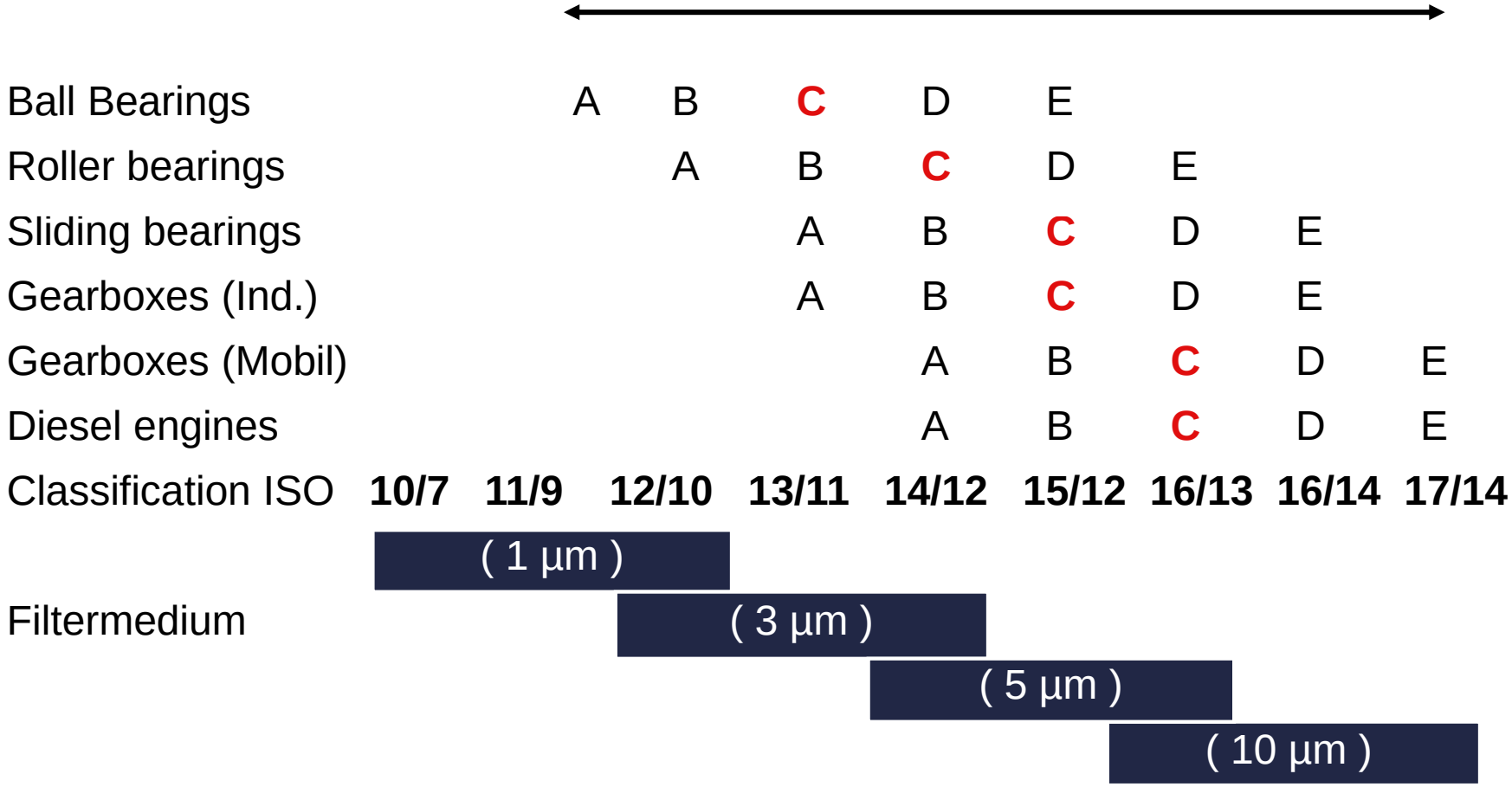


Poor, Ingression-Prone Vents



REF: JCF, Trico

Lubrication recommendations with:



REF: Schroeder, Pall, Hydac

Solinas BENELUX BV

How do we measure fluid contamination?

Structure of ISO-Code:
amount of dirt particles in a **100 ml** sample larger than these specified sizes:

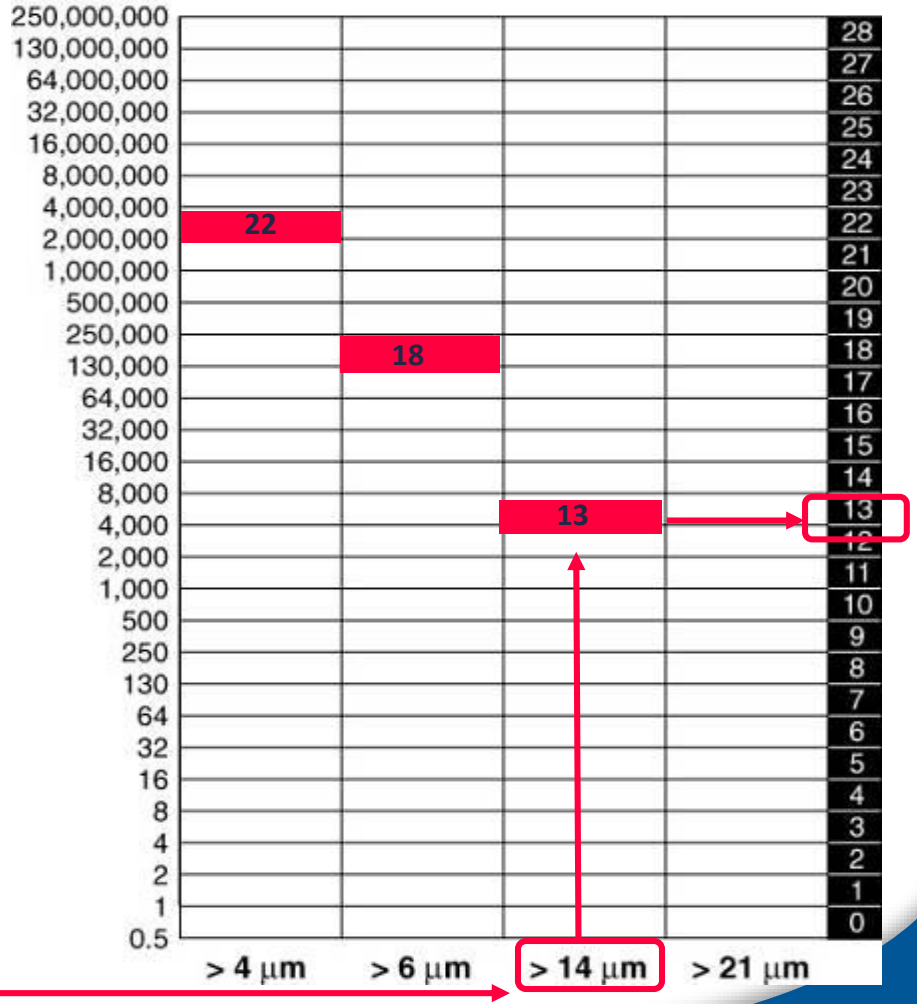
4µm / 6µm / 14µm / 21µm

larger than 4µm = 2,234,000

larger than 6µm = 1,720,000

larger than 14µm = 4,250

ISO Code = 22 / 18 / 13



Mass Density perspective of cumulative particulates

AMOUNT OF DIRT IN ONE YEAR FLOWING THROUGH THE A SYSTEM AT 120 LPM WITH A SYSTEM CONTAMINATION LEVEL OF ISO 23/21/18 (NEW OIL DELIVERED IN 210 LITER DRUMS.) THIS WOULD BE UNFILTERED OR WIRE SCREEN OR PAPER ELEMENT PERFORMANCE LEVELS.

TOTAL DIRT = 238 KILO IN A YEAR

AMOUNT OF DIRT IN ONE YEAR FLOWING THROUGH THE SYSTEM AT 120 LPM WITH A SYSTEM CONTAMINATION LEVEL OF ISO 18/16/13 (NEW OIL DELIVERED IN PLASTIC TOTES UP TO 1325 LITER CAPACITY.) THIS WOULD BE 5 MICRON DEPTH FILTER PERFORMANCE. BETA = 1000.

TOTAL DIRT = 9 KILO IN A YEAR

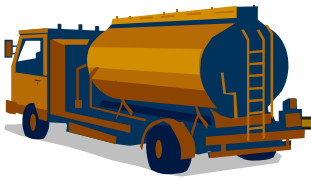
KEEPING THE SYSTEM 5 CLASSES CLEANER TO 18/16/13. THIS WILL RESULT IN 31.5 TIMES LESS DIRT FLOWING THROUGH THE SYSTEM.

Schroeder INDUSTRIES

Comprehensive Filtration Approach

FLOW CAPACITY
SHOULD BE 100-200 Ltr./min.
WITH MATCHING TRUCK
CONNECTOR & PUMP BYPASS
CAPABILITY

Transfer from delivery container



ISO 20/18/15

5 micron & 3 micron
Two stage filters

Insure a high integrity breather and tight tank penetrations and couplings are implemented.

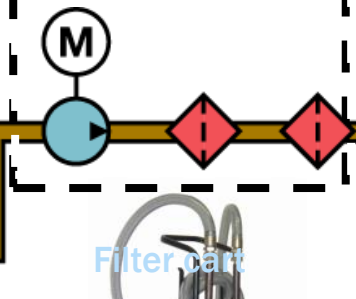
Window to process monitoring contamination and water content.

Particle Counter

Staged transfer fluid from storage to system

Insure access covers Tightened with uniform Bolt clamp loads.

Off-Line Filter Loop



Fluid Storage Tank
ISO 16/14/12

Gearbox
ISO 18/15/13

Filter cart

time of off-line loop determined as result of received cleanliness level. Cycle

Process fluid-clean to target ISO level minus one.

Schroeder INDUSTRIES

Solinas BENELUX BV

Can we filtrate high viscosity's?

Filterelements give resistance.

With high viscosity we have to consider:

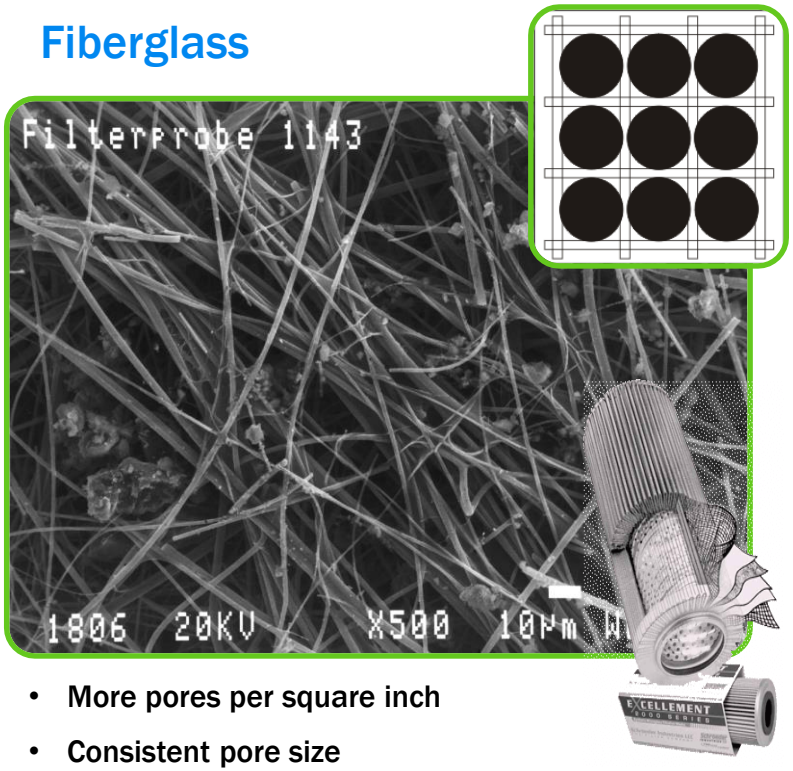
- **Flowrate → reduce**
- **Pore size → increase**
- **Filter element → bigger surface**
- **Oil temperature → heating up →**

- **Start-up temperature**

Solinas BENELUX BV

Filter Media Determines Filter Integrity

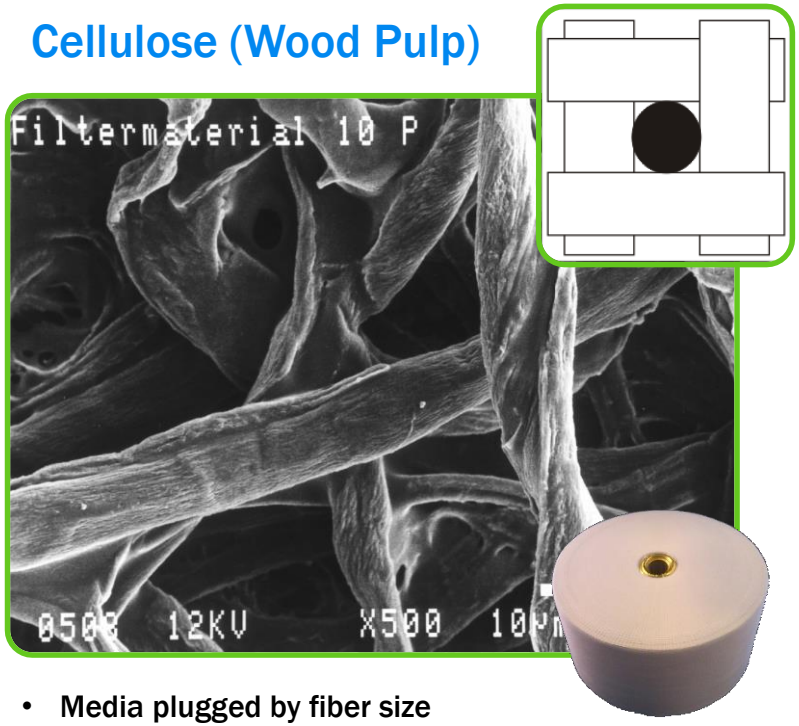
Fiberglass



- More pores per square inch
- Consistent pore size
- Higher dirt-holding capacity
- Tolerant to high temperatures

Remark: Filters block only by particles with the same size as the pore size

Cellulose (Wood Pulp)



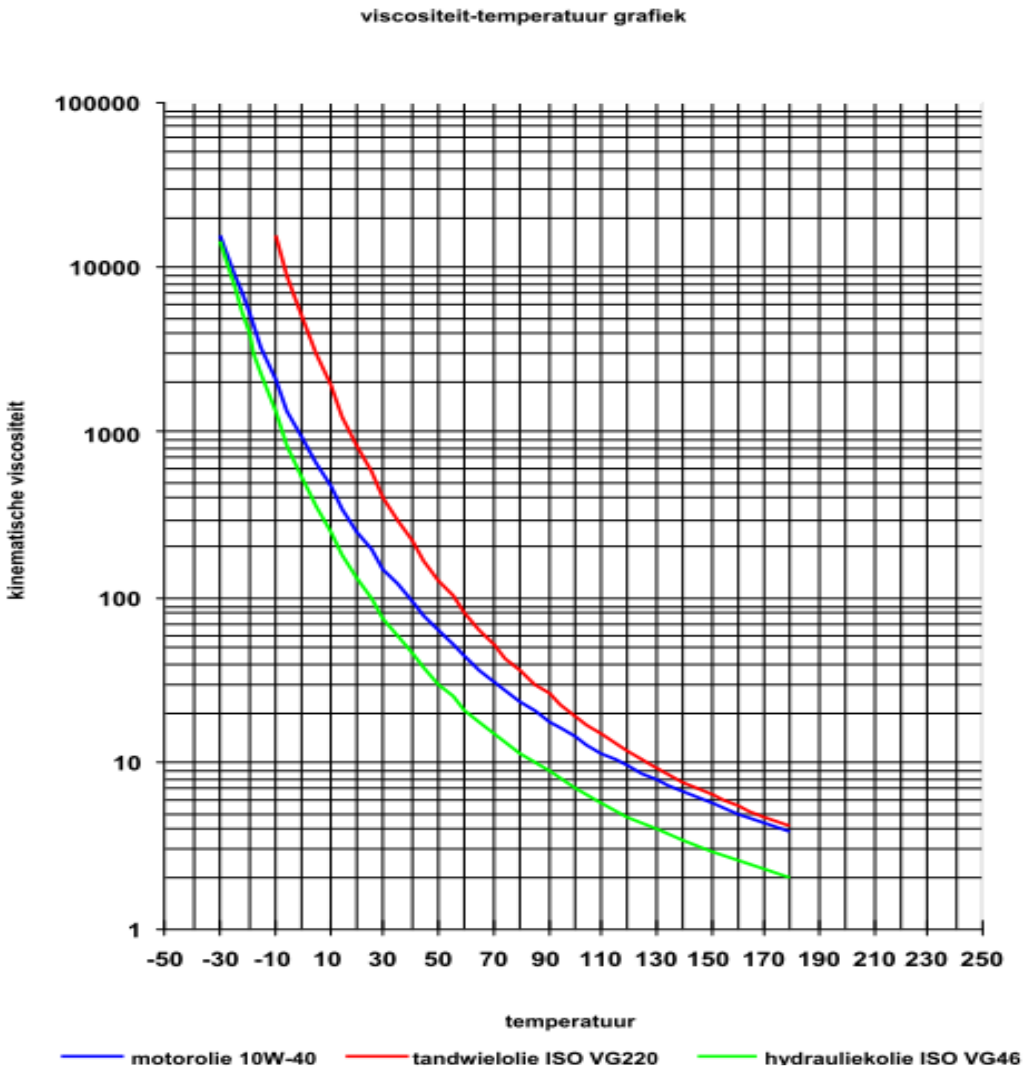
- Media plugged by fiber size
- Inconsistent porosity
- Absorbs water
- Subject to fatigue, high temperature and chemical degradation (e.g., from oils with high acid numbers)
- Media begins to fail after 300 hours in diesel engine service

REF: Internormen, Donaldson, Schroeder, Kleenoil

Solinas BENELUX BV

How important is temperature

	motorolie 10W-40	tandwielolie ISO VG220	hydrauliekolie ISO VG46
VI:	156	100	109
temp, °C			
-30	15821		14502
-20	5312		3961
-10	2089	15720	1343
0	937	5055	541
10	468	1921	251
20	256	838	131
30	151	409	74.6
40	94.8	220	46.0
50	62.9	128	30.2
60	43.7	79.7	20.9
70	31.6	52.4	15.1
80	23.6	36.2	11.4
90	18.1	26.0	8.80
100	14.3	19.4	7.00
110	11.5	14.9	5.69
120	9.46	11.7	4.72
130	7.90	9.44	3.98
140	6.70	7.75	3.41
150	5.75	6.47	2.96
160	4.99	5.48	2.59
170	4.38	4.71	2.30
180	3.87	4.09	2.05



Solinas BENELUX BV

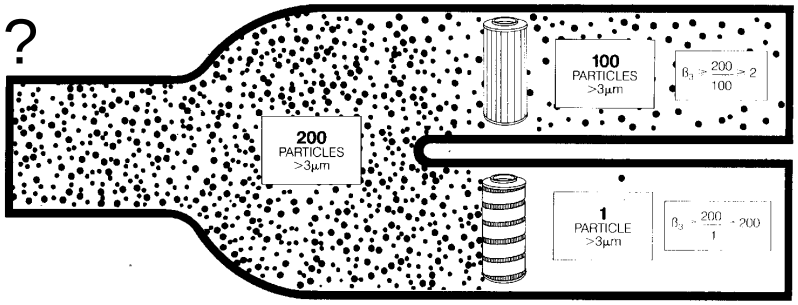
Filtration Classification, following ISO 16889 in 1999

* Nominal filtration ➔ Factory set
* Absolute filtration ➔ ?
* Beta filtration ➔

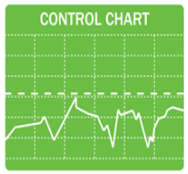
$\beta_x \geq 25$

$\beta_x \geq 200$

$\beta_x \geq 1000$



$$\beta_x = \frac{n_{Upstream} \geq X\ \mu m}{n_{downstream} \geq X\ \mu m}$$

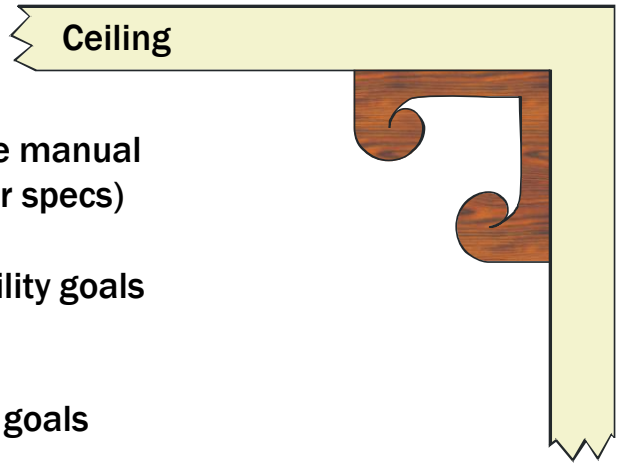


1. **Set Cleanliness Targets**
   Target cleanliness level should reflect reliability goals.
2. **Take Specific Actions to Achieve Targets.**
   Reduce ingression & Improve filtration.
3. **Measure Contaminant Levels Frequently**
   What gets measured gets done (Step 2)
   Post control charts of measured results

Solinas BENELUX BV

Step No. 1 – Set Target Cleanliness Levels

- ✓ **Set targets for all lubricating oils like you do for hydraulic fluids.**
- ✓ **Use vendor specifications as ceiling levels only.**
- ✓ **Set life extension (benefit-driven) targets, for example: significantly cleaner than before.**
- ✓ **Consider machine design, application and operating influences.**
- ✓ **<u>Make it a personal decision</u>, because you are the one paying the cost of failure, not the machine supplier, not the oil supplier, not the filter supplier, not the bearing supplier or your oil analysis lab.**

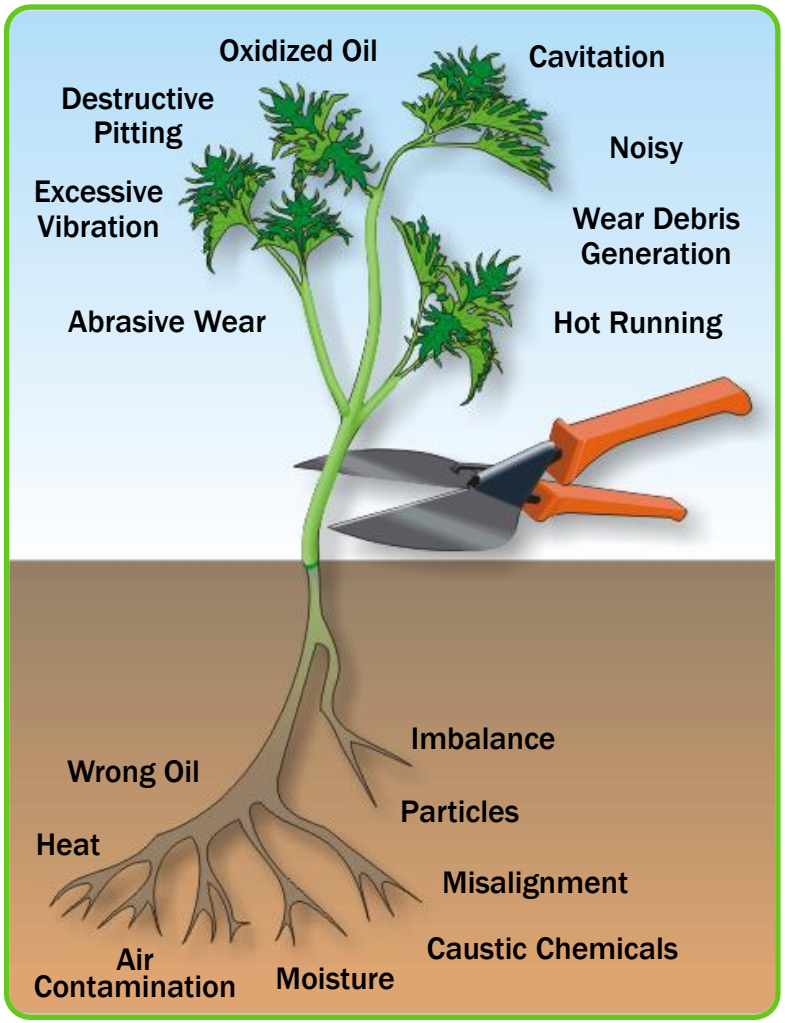


Machine	ISO
Ball bearing	16/13/11
Roller bearing	17/14/12
Journal bearing	18/15/12
Industrial gear box	18/15/12
Mobile gear box	18/16/13
Diesel engine	18/16/13
Steam turbine oils	18/14/11
Paper machine oils	18/14/11

Example Base Cleanliness Targets for Lubricating Oils

REF: JCF, Pall, Exxon, Schroeder, Kleenoil

Remember: Are You Pulling Your Weeds Out by their Roots?



Cutting Here Means the 4-R Treatment

- Repair
- Replace
- Rebuild
- Remove

Problem Repeats

Pulling Here Means The 5-I Treatment

- It's clean
- It's dry
- It's cool
- It's aligned and balanced
- It's well oiled

Problem Eliminated

REF: JCF

C. Verolmelaan 130
1322 ZB Uithoorn
The Netherlands

Telephone: 0031 (0) 297 522552
Email: Solinas@Solinas.nl
Skype: info.solinas

www.solinas.nl / www.solinas.be / www.machinedokter.nl