CERTIFICATION EXAM REFERENCE MATERIAL

Filtration

$$Beta\ ratio = \beta = \frac{Particles\ upstream}{Particles\ downstream}$$

$$Efficiency = \frac{\beta - 1}{\beta} x\ 100$$

ISO Solid Contaminant Code: ISO 4406:2017

Counts/ml, Cumulative

ISO Class	Particles/ml	
0	0	0.01
1	0.01	0.02
2	0.02	0.04
3	0.04	0.08
4	0.08	0.16
5	0.16	0.32
6	0.32	0.64
7	0.64	1.3
8	1.3	2.5
9	2.5	5
10	5	10
11	10	20
12	20	40
13	40	80
14	80	160
15	160	320
16	320	640
17	640	1,300
18	1,300	2,500
19	2,500	5,000
20	5,000	10,000
21	10,000	20,000
22	20,000	40,000
23	40,000	80,000
24	80,000	160,000
25	160,000	320,000
26	320,000	640,000
27	640,000	1,300,000
28	1,300,000	2,500,000
x28	2,500,000	

Emissivity values of common materials

Material	Emissivity*
Aluminium, polished	0.05
Aluminium, rough surface	0.07
Aluminium, strongly oxidized	0.25
Asbestos board	0.96
Asbestos fabric	0.78
Asbestos paper	0.94
Asbestos slate	0.96
Brass, dull, tarnished	0.22
Brass, polished	0.03
Brick, common	0.85
Brick, glazed, rough	0.85
Brick, refractory, rough	0.94
Bronze, porous, rough	0.55
Bronze, polished	0.10
Carbon, purified	0.80
Cast iron, rough casting	0.81
Cast iron, polished	0.21
Charcoal, powdered	0.96
Chromium, polished	0.10
Clay, fired	0.91
Concrete	0.54
Copper, polished,	0.01
Copper, commercial burnished	0.07
Copper, oxidized	0.65
Copper, oxidized to black	0.88
Electrical tape, black plastic	0.95
Enamel **	0.90
Formica	0.93
Frozen soil	0.93
Glass	0.92
Glass, frosted	0.96
Gold, polished	0.02
Ice	0.97
Iron, hot rolled	0.77
Iron, oxidized	0.74
Iron, sheet galvanized, burnished	0.23
Iron, sheet, galvanized, oxidized	0.28
Iron, shiny, etched	0.16

Material	Emissivity*
Iron, wrought, polished	0.28
Lacquer, Bakelite	0.93
Lacquer, black, dull	0.97
Lacquer, black, shiny	0.87
Lacquer, white	0.87
Lampblack	0.96
Lead, gray	0.28
Lead, oxidized	0.63
Lead, red, powdered	0.93
Lead, shiny	0.08
Mercury, pure	0.10
Nickel, on cast iron	0.05
Nickel, pure polished	0.05
Paint, silver finish**	0.31
Paint, oil, average	0.94
Paper, black, shiny	0.90
Paper, black, dull	0.94
Paper, white	0.90
Platinum, pure, polished	0.08
Porcelain, glazed	0.92
Quartz	0.93
Rubber	0.93
Shellac, black, dull	0.91
Shellac, black, shiny	0.82
Snow	0.80
Steel, galvanized	0.28
Steel, oxidized strongly	0.88
Steel, rolled freshly	0.24
Steel, rough surface	0.96
Steel, rusty red	0.69
Steel, sheet, nickel plated	0.11
Steel, sheet, rolled	0.56
Tar paper	0.92
Tin, burnished	0.05
Tungsten	0.05
Water	0.98
Zinc, sheet	0.20

*Emissivities of almost all materials are measured at 0°C but do not differ significantly at room temperature.
**Paint, silver finish is measured at 25°C and Paint, enamel at 27°C

Reliability analytics:

$$MTTF = \frac{Total\ time\ in\ operation}{\#\ failures}$$

$$MTTR = \frac{Total\ of\ repair\ time}{\#\ repairs}$$

Normal distribution:

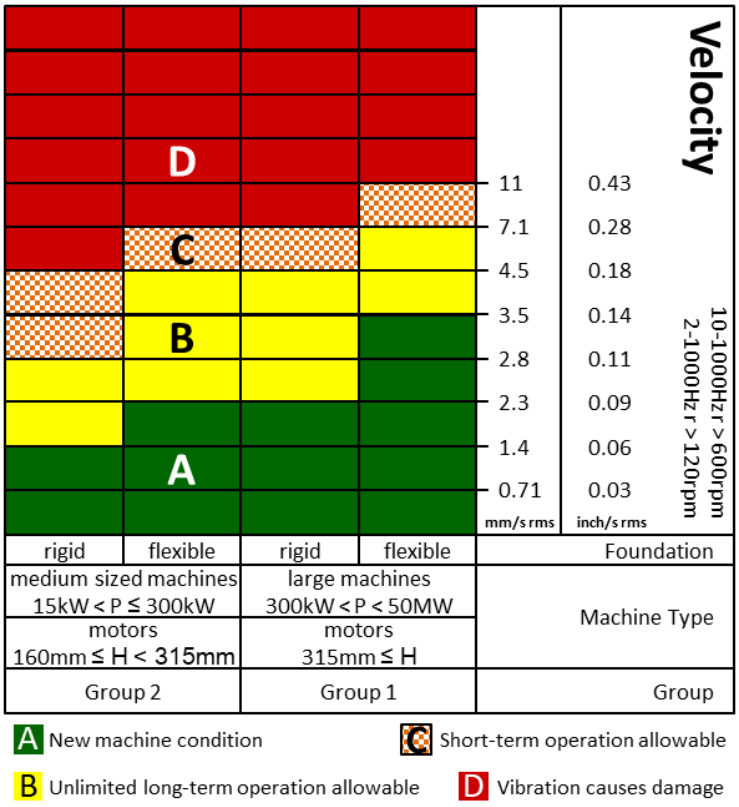
$$Mean = \mu = \frac{1}{N}\sum_{i=1}^{N} x_i$$

$$Standard\ deviation = \sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2}$$

N is the number of samples (e.g. machines that have failed)
x_i is the value of each individual sample (each of the failure times)

Confidence interval	Percentage
σ	68.3%
2 σ	95.4%
3 σ	99.7%
4 σ	99.93%
5 σ	99.999%
6 σ	99.9999998%

ISO 10816-3 Vibration Severity Chart



ISO 10816-3 Vibration Severity Chart