INDUSTRIAL

CIX100

Understanding International Standards for Technical Cleanliness

EVIDENT

Easily Meet Industry Standards for Technical Cleanliness

The CIX100 technical cleanliness inspection system is a dedicated, turnkey solution designed to meet company and international standards for the cleanliness of manufactured components.

Standards demand detailed information about the nature of contamination in manufacturing. Get accurate and reliable particle data for all processes—from development to quality control—in one easy-to-use system.

Benefits of the CIX100 System:

- Reproducible imaging: protected fixed camera alignment
- Fast reporting: comes preloaded with industry standards
- High-quality images and accurate measurements: equipped with our renowned UIS2 objectives objectives
- Fast: distinguishes reflective (metallic) particles from non-reflective particles in a single scan with direct feedback, including live classification of all contaminants
- Minimize errors: intuitive reporting and software with fully automated analysis save time, are easy to use, and deliver reproducible results
- Improved reliability: measurement validation helps ensure accuracy
- Micron-level detection: can detect particles down to 2.5 µm
- Focused: Intuitive focus mapping and the focus on every frame option keep uneven filter papers in view for precise measurement
- Flexible: can be used as a digital microscope with optional material analysis solutions

International Cleanliness Standards

Most processing steps for cleanliness inspections are defined in company-specific and international standards. These definitions are specialized for different applications.

International cleanliness standards specify methods to evaluate the cleanliness of component parts, as well as methods to prepare the filter membrane samples. Company-specific cleanliness standards are usually a variation of an international standard.

The following international standards for technical cleanliness are predefined in our CIX100 system:

Standard	Mainly used for	Last revision	Page
ASTM E1216-11	Tape lift on surfaces	2016	4
ASTM F312-08*	Aerospace fluids	2016	5
DIN 51455	Mineral oil products	2020	6
IEST-STD-CC1246E*	Cleanliness for contamination-critical products	2013	7
ISO 4406	Fluid used in hydraulic systems	2021	8
ISO 4407	Hydraulic fluid systems	1991	10
ISO 4407	Hydraulic fluid systems	2002	11
ISO 11218	Hydraulic fluids	2017	12
ISO 12345	Fuel injection equipment	2013	13
ISO 14952	Launch vehicles and spacecraft	2003	14
ISO 16232 (A)	Components and systems of motor vehicles	2018	15
ISO 16232 (N)	Components and systems of motor vehicles	2018	18
ISO 16232 (V)	Components and systems of motor vehicles	2018	20
ISO 21018	Fluid used in hydraulic systems	2008	24
NAS 1638	Hydraulic fluids	1964	26
NF E 48-651	Hydraulic fluids	1986	27
NF E 48-655	Hydraulic fluids	1989	28
SAE AS4059	Hydraulic fluids in aerospace	2020	30
USP 788*	Particles in injections	2011	32
USP 789*	Particles in ophthalmic solutions	2018	33
VDA 19.1 (A)	Fluid circuits of automotive	2015	34
VDA 19.1 (N)	Fluid circuits of automotive	2015	36
VDA 19.1 (V)	Fluid circuits of automotive	2015	34
VDA 19.2	Particle traps	2015	38
VDI 2083-21*	Medical products in the manufacturing process	2019	42

(*) not pre-installed in CIX100 system but can be defined

The basic characteristics of these international standards are described on the following pages. This information will give you a primary understanding of each one. For the full details of a standard, please refer to the standards organization.

Note that there might be more than one cleanliness definition in a single standard. Some standards can be implemented using cumulative or differential size classes. Other standards describe further properties of the particles, such as the recognition of fibers based on the shape or the material property based on the reflection.

Standard ASTM E1216-11:2016

This standard describes the procedures for sampling particulate contamination on surfaces by application of a pressure sensitive tape to the surface followed by the removal of particulate contamination (tape lift method). The guideline includes the method for analyzing the tape resulting in the surface cleanliness index.

Specifics

- There is no definition of particle size and no size classification. This standard refers to the cleanliness standard ASTM F312-08, Method B "Maximum Feret Diameter".
- Results can be given in absolute numbers and as a Surface Cleanliness Index (SCI).

Particle Size Classification

The "Maximum Feret Diameter" x is measured for each particle. All particles are classified into the following differential bins:

Particle class name	Maximum Feret diameter of particle
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	x ≥ 100 µm

The absolute number of particles is counted for each class.

Extrapolation and Normalization

This absolute number of particles detected in the examined tape area will be extrapolated to an area of 1000 cm^2.

Contamination Levels

There is no definition of contamination levels.

Cleanliness Code

The result is given as absolute number for each size class or as the Surface Cleanliness Index (SCI). The surface cleanliness index is the sum of all detected particles. The absolute particle numbers are extrapolated and normalized and weighted according to a weight factor. The weight factor for the size class depends on the minimum particle size of the class:

Particle class	Maximum Feret diameter of particle	Weight factor
B	5 µm ≤ x < 15 µm	0
C	15 µm ≤ x < 25 µm	0
D	25 µm ≤ x < 50 µm	0
E	50 µm ≤ x < 100 µm	1
F	x ≥ 100 µm	4

Example: Surface Cleanliness Index (SCI): 3258 1/1000 cm^2

Standard: ASTM F312-08:2016*

This international standard defines the determination of the size distribution and quantity of particulate matter contamination from aerospace fluids.

Specifics

• The definition of the particle size can be selected according to the application.

Particle Size Classification

There are two definitions of particle size:

• Method A: Size is the "Equivalent Circle Diameter" of the particle

• Method B: Size is the "Maximum Feret Diameter" of the particle

The particle size x is measured for each particle. All particles are classified into the following differential bins:

Particle class name	Particle size
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	x ≥ 100 µm

The absolute number of particles is counted for each class.

Extrapolation and Normalization

This absolute number of particles can be extrapolated if the examined filter area differs from the flow-through area on the filter.

Contamination Levels

There is no definition of contamination levels.

Cleanliness Code

There is no definition of a resulting cleanliness code.

*not preinstalled in the CIX100 system but can be defined

Standard: DIN 51455:2020

This international standard specifies the code to be used in defining the quantity of solid particles in fluid mineral oil products. This standard refers to 100 ml of the filtered fluid.

Specifics

- Adjust the camera exposure time or the microscope illumination to get an image intensity of 70% of the possible image dynamics (histogram) for the white filter membrane.
- Intensity threshold for particle detection set to 70% or 85% of the value for the filter membrane.
- The inspection area must be a circle on the filter membrane with a diameter of 35 mm.
- The total area of all particles, including all non-classified parts on the filter membrane (filter occupancy), must be less than 7% of the inspected area (for 70% threshold) or 1% (for 85% threshold).

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are classified into the following cumulative bins:

Particle class name	Maximum Feret diameter of particle
B	$x \geq 5$ µm
C	$x \geq 15$ µm

The absolute number of particles is counted for each class.

Extrapolation and Normalization

A circular area with a 35 mm diameter (area is 962 mm^2) is examined and analyzed. This absolute number of particles must be extrapolated to the flow-through area of the filter. The final counting result must be normalized on an amount of filtered fluid of 100 ml.

Contamination Levels

The contamination level of each class is defined as:

Contamination level	Particles in 100 ml filtered oil	Contamination level	Particles in 100 ml filtered oil
1	$1 < n \leq 2$	16	$32{,}000 < n \leq 64{,}000$
2	$2 < n \leq 4$	17	$64{,}000 < n \leq 130{,}000$
3	$4 < n \leq 8$	18	$130{,}000 < n \leq 250{,}000$
4	$8 < n \leq 16$	19	$250{,}000 < n \leq 500{,}000$
5	$16 < n \leq 32$	20	$500{,}000 < n \leq 1{,}000{,}000$
6	$32 < n \leq 64$	21	$1{,}000{,}000 < n \leq 2{,}000{,}000$
7	$64 < n \leq 130$	22	$2{,}000{,}000 < n \leq 4{,}000{,}000$
8	$130 < n \leq 250$	23	$4{,}000{,}000 < n \leq 8{,}000{,}000$
9	$250 < n \leq 500$	24	$8{,}000{,}000 < n \leq 16{,}000{,}000$
10	$500 < n \leq 1{,}000$	25	$16{,}000{,}000 < n \leq 32{,}000{,}000$
11	$1{,}000 < n \leq 2{,}000$	26	$32{,}000{,}000 < n \leq 64{,}000{,}000$
12	$2{,}000 < n \leq 4{,}000$	27	$64{,}000{,}000 < n \leq 130{,}000{,}000$
13	$4{,}000 < n \leq 8{,}000$	28	$130{,}000{,}000 < n \leq 250{,}000{,}000$
14	$8{,}000 < n \leq 16{,}000$	29	$250{,}000{,}000 < n \leq 500{,}000{,}000$
15	$16{,}000 < n \leq 32{,}000$	30	$500{,}000{,}000 < n \leq 1{,}000{,}000{,}000$

Cleanliness Code

The contamination levels of the two particle classes are shown.

Example: 19/14

Standard: IEST-STD-CC1246E:2013*

The standard IEST-STD-CC1246E provides methods for specifying and determining product surface cleanliness levels for contamination-critical products and replaced the original cleanliness standard MIL-STD-1246.

This standard refers to 1000 cm^2 of wetted surface of the component.

Particle Size Classification

The "Maximum Feret Diameter" x is measured for each particle. All particles are classified into the following differential bins:

Particle class name	Maximum Feret diameter of particle
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	100 µm ≤ x < 250 µm
G	250 µm ≤ x < 500 µm
H	500 µm ≤ x < 750 µm
I	750 µm ≤ x < 1,000 µm
J	1,000 µm ≤ x < 1,250 µm
K	x ≥ 1,250 µm

The absolute number of particles is counted for each class.

Extrapolation and Normalization

This absolute number of particles can be extrapolated if the examined filter area differs from the flow-through area on the filter. The final counting result must be normalized on a wetted surface area of 1000 cm^2.

Contamination Levels

The contamination level is defined by the maximum particle number for each class as:

Contamination level	Particles per 1000 cm^2 wetted surface area									
	Class B	Class C	Class D	Class E	Class F	Class G	Class H	Class I	Class J	Class K
25	19	2	1	0	0	0	0	0	0	0
50	141	17	6	1	0	0	0	0	0	0
100	1519	186	67	9	1	0	0	0	0	0
200	-	2949	1069	154	15(*1)	0	0	0	0	0
300	-	-	6433	926	92	2(*2)	0	0	0	0
400	-	-	-	3583	359	8(*3)	0	0	0	0
500	-	-	-	10719	1073	25	1	0	0	0
750	-	-	-	-	8704	205	7	1	0	0
1000	-	-	-	-	-	983	33	3	1	0

*1: No particle larger 200 µm allowed

*2: No particle larger 300 µm allowed

*3: No particle larger 400 µm allowed

Cleanliness Code

The result is the largest contamination level of all particle classes.

It is written with the name "IEST-STD-CC1246E (Level xxx)" of the cleanliness standard combined with the maximum contamination level.

Example: IEST-STD-CC1246E (Level 200)

*not preinstalled in the CIX100 system but can be defined

Standard: ISO 4406:2021

This international standard specifies the code to be used in defining the quantity of solid particles in the fluid used in a given hydraulic fluid power system.

Specifics

- This standard refers to 1 ml of the filtered fluid.
- The results are based on cumulative counts.

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are classified into the following cumulative bins:

Particle class name	Maximum Feret diameter of particle
B	$x \geq 5$ µm
C	$x \geq 15$ µm

The absolute number of particles is counted for each class.

Extrapolation and Normalization

This absolute number of particles can be extrapolated if the examined filter area differs from the flow-through area on the filter. The final counting result must be normalized on an amount of hydraulic fluid of 1 ml.

Contamination Levels

The contamination level of each class is defined as:

Contamination level	Particles in 1 ml fluid	Contamination level	Particles in 1 ml fluid
0	$0 < n \leq 0.01$	15	$160 < n \leq 320$
1	$0.01 < n \leq 0.02$	16	$320 < n \leq 640$
2	$0.02 < n \leq 0.04$	17	$640 < n \leq 1{,}300$
3	$0.04 < n \leq 0.08$	18	$1{,}300 < n \leq 2{,}500$
4	$0.08 < n \leq 0.16$	19	$2{,}500 < n \leq 5{,}000$
5	$0.16 < n \leq 0.32$	20	$5{,}000 < n \leq 10{,}000$
6	$0.32 < n \leq 0.64$	21	$10{,}000 < n \leq 20{,}000$
7	$0.64 < n \leq 1.3$	22	$20{,}000 < n \leq 40{,}000$
8	$1.3 < n \leq 2.5$	23	$40{,}000 < n \leq 80{,}000$
9	$2.5 < n \leq 5$	24	$80{,}000 < n \leq 160{,}000$
10	$5 < n \leq 10$	25	$160{,}000 < n \leq 320{,}000$
11	$10 < n \leq 20$	26	$320{,}000 < n \leq 640{,}000$
12	$20 < n \leq 40$	27	$640{,}000 < n \leq 1{,}300{,}000$
13	$40 < n \leq 80$	28	$1{,}300{,}000 < n \leq 2{,}500{,}000$
14	$80 < n \leq 160$	>28	$n \geq 2{,}500{,}000$

Cleanliness Code

The contamination levels of the two particle classes are shown. To relate counts obtained with an automatic particle counter, the code is stated in a three-part form with the first part described with "-".

Example: -/19/14

Fast, Reliable Technical Cleanliness Process Control in Manufacturing Industries

Reliable

Seamlessly integrated hardware and software result in a durable, high-throughput system that delivers reliable and accurate data.

Standard: ISO 4407:1991

This international standard defines methods of determining the solid particle contamination of hydraulic fluids used in hydraulic fluid power systems.

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are classified into the following differential bins:

Particle class name	Maximum Feret diameter of particle
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	x ≥ 100 µm

The absolute number of particles is counted for each class.

Extrapolation and Normalization

This absolute number of particles can be extrapolated if the examined filter area differs from the flow-through area on the filter. The final counting result must be normalized on an amount of hydraulic fluid of 100 ml.

Contamination Levels

There is no definition of contamination levels.

Cleanliness Code

There is no definition of a resulting cleanliness code.

Standard: ISO 4407:2002

This international standard defines methods of determining the solid particle contamination of hydraulic fluids used in hydraulic fluid power systems.

Specifics

The results can be based on differential or on cumulative counts.

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are either classified into the following differential bins:

Particle class name	Maximum Feret diameter of particle
A	2 µm ≤ x < 5 µm
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	x ≥ 100 µm

Or all particles are classified into the following cumulative bins:

Particle class name	Maximum Feret diameter of particle
A	x ≥ 2 µm
B	x ≥ 5 µm
C	x ≥ 15 µm
D	x ≥ 25 µm
E	x ≥ 50 µm
F	x ≥ 100 µm

The absolute number of particles is counted for each class.

Extrapolation and Normalization

This absolute number of particles can be extrapolated if the examined filter area differs from the flow-through area on the filter. The final counting result must be normalized on an amount of hydraulic fluid of 100 ml.

Contamination Levels

There is no definition of contamination levels.

Cleanliness Code

There is no definition of a resulting cleanliness code.

Standard: ISO 11218:2017

This international standard specifies a cleanliness classification for hydraulic fluids in airplanes, helicopters, and space vehicles. Requirements for this standard are specified in SAE AS4059A.

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are classified into the following differential bins:

Particle class name	Maximum Feret diameter of particle
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	x ≥ 100 µm

The absolute number of particles is counted for each class.

Extrapolation and Normalization

This absolute number of particles can be extrapolated if the examined filter area differs from the flow-through area on the filter. The final counting result must be normalized on an amount of hydraulic fluid of 100 ml.

Contamination Levels

The contamination level is defined by the maximum particle number for each class as:

Contamination level	Particles in 100 ml fluid				
	Class B	Class C	Class D	Class E	Class F
00	125	22	4	1	0
0	250	44	8	2	
1	500	88	16	3	1
2	1,000	178	32	6	
3	2,000	356	63	11	2
4	4,000	712	126	22	4
5	8,000	1,425	253	45	8
6	16,000	2,850	506	90	16
7	32,000	5,700	1,012	180	32
8	64,000	11,400	2,025	360	64
9	128,000	22,800	4,050	720	128
10	256,000	45,600	8,100	1,440	256
11	512,000	91,200	16,200	2,880	512
12	1,024,000	182,400	32,400	5,720	1,024

Cleanliness Code

The result is the largest contamination level of all particle classes. It is written with the name “AS4059” of the cleanliness standard and the maximum contamination class and level.

Example: AS4059 Class 11F

Standard: ISO 12345:2013

This international standard is concerned with the assessment of the cleanliness of the fuel injection equipment as originally supplied to the engine manufacturer.

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are classified into the following differential bins:

Particle class name	Maximum Feret diameter of particle
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	100 µm ≤ x < 150 µm
G	150 µm ≤ x < 200 µm
H	200 µm ≤ x < 400 µm
I	400 µm ≤ x < 600 µm
J	600 µm ≤ x < 1,000 µm
K	x ≥ 1,000 µm

The absolute number of particles is counted for each class.

Extrapolation and Normalization

This absolute number of particles can be scaled if the area of the filter that is scanned differs from the flow-through area on the filter.

Contamination Levels

There is no definition of contamination levels.

Cleanliness Code

The combination of particle class and number of particles results in a cleanliness code.

Example: B52171/C11072/D5412/E1199/F181/G50/H47/I2/J2/K0

Standard: ISO 14952:2003

This international standard defines analytical methods to verify the cleanliness level for parts and components used in space fluid systems. It can be used to determine the cleanliness level of precision-cleaned parts and components used in ground support equipment, launch vehicles, and spacecraft. Requirements for this standard are specified in ISO 5884.

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are classified into the following differential bins:

Particle class name	Maximum Feret diameter of particle
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	x ≥ 100 µm

The absolute number of particles is counted for each class.

Extrapolation and Normalization

This absolute number of particles can be scaled if the scanned filter area differs from the flow-through area on the filter. The final counting result must be normalized to a wetted surface area of 1000 cm^2.

Contamination Levels

There is no definition of contamination levels.

Cleanliness Code

There is no definition of a resulting cleanliness code.

Standard: ISO 16232-10:2007 (A)

This international standard defines the rules and the forms of expression and presentation of the results of measurements of particulate cleanliness of components for the fluid circuits of motor vehicles. It also defines the levels of contamination of these components. This standard refers to 1000 cm^2 of wetted surface of the component.

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are classified into the following differential bins:

Particle class name	Maximum Feret diameter of particle
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	100 µm ≤ x < 150 µm
G	150 µm ≤ x < 200 µm
H	200 µm ≤ x < 400 µm
I	400 µm ≤ x < 600 µm
J	600 µm ≤ x < 1,000 µm
K	x ≥ 1,000 µm

The size classes B, C, and D are optional.
The absolute number of particles is counted for each class.

Extrapolation and Normalization

This absolute number of particles can be scaled if the scanned area of the filter differs from the flow-through area on the filter. The final counting result must be normalized to a wetted surface area of 1000 cm^2.

Contamination Levels

The contamination level is defined by the maximum number of particles for each class as:

Contamination level	Particles per 1000 cm^2 wetted surface area
00	0
0	0 < n ≤ 1
1	1 < n ≤ 2
2	2 < n ≤ 4
3	4 < n ≤ 8
4	8 < n ≤ 16
5	16 < n ≤ 32
6	32 < n ≤ 64
7	64 < n ≤ 130
8	130 < n ≤ 250
9	250 < n ≤ 500
10	500 < n ≤ 1,000
11	1,000 < n ≤ 2,000

Contamination level	Particles per 1000 cm^2 wetted surface area
12	2,000 < n ≤ 4,000
13	4,000 < n ≤ 8,000
14	8,000 < n ≤ 16,000
15	16,000 < n ≤ 32,000
16	32,000 < n ≤ 64,000
17	64,000 < n ≤ 130,000
18	130,000 < n ≤ 250,000
19	250,000 < n ≤ 500,000
20	500,000 < n ≤ 1,000,000
21	1,000,000 < n ≤ 2,000,000
22	2,000,000 < n ≤ 4,000,000
23	4,000,000 < n ≤ 8,000,000
24	8,000,000 < n ≤ 16,000,000

Cleanliness Code

The combination of particle class and contamination level results in a cleanliness code. The prefix “A” indicates the normalization on wetted surface.

Example: A (B15/C13/D12/E10/F7/GH5/IJ0/K00)

Standard: ISO 16232-10:2018 (A)

This international standard defines the rules and the forms of expression and presentation of the results of measurements of particulate cleanliness of components and systems of motor vehicles. It also defines the levels of contamination of these components. This standard refers to 1000 cm^2 of wetted surface of the component.

Specifics

- Adjust the camera exposure time or the microscope illumination to get an image intensity of 55% of the possible image dynamics (histogram) for the white filter membrane.
- Intensity threshold for particle detection set to 70% of the value for the filter membrane, which results in an upper threshold of 38.5% (~40%) of the image dynamics.

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are classified into the following differential bins:

Particle class name	Maximum Feret diameter of particle
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	100 µm ≤ x < 150 µm
G	150 µm ≤ x < 200 µm
H	200 µm ≤ x < 400 µm
I	400 µm ≤ x < 600 µm
J	600 µm ≤ x < 1,000 µm
K	1,000 µm ≤ x < 1,500 µm
L	1,500 µm ≤ x < 2,000 µm
M	2,000 µm ≤ x < 3,000 µm
N	x ≥ 3,000 µm

The size classes B, C, and D are optional.
The absolute number of particles is counted for each class.

Extrapolation and Normalization

This absolute number of particles can be extrapolated if the examined filter area differs from the flow-through area on the filter. The final counting result must be normalized on a wetted surface area of 1000 cm^2.

Contamination Levels

The contamination level is defined by the maximum number of particles for each class as:

Contamination level	Particles per 1000 cm^2 wetted surface area	Contamination level	Particles per 1000 cm^2 wetted surface area
00	0	12	2,000 < n ≤ 4,000
0	0 < n ≤ 1	13	4,000 < n ≤ 8,000
1	1 < n ≤ 2	14	8,000 < n ≤ 16,000
2	2 < n ≤ 4	15	16,000 < n ≤ 32,000
3	4 < n ≤ 8	16	32,000 < n ≤ 64,000
4	8 < n ≤ 16	17	64,000 < n ≤ 130,000
5	16 < n ≤ 32	18	130,000 < n ≤ 250,000
6	32 < n ≤ 64	19	250,000 < n ≤ 500,000
7	64 < n ≤ 130	20	500,000 < n ≤ 1,000,000
8	130 < n ≤ 250	21	1,000,000 < n ≤ 2,000,000
9	250 < n ≤ 500	22	2,000,000 < n ≤ 4,000,000
10	500 < n ≤ 1,000	23	4,000,000 < n ≤ 8,000,000
11	1,000 < n ≤ 2,000	24	8,000,000 < n ≤ 16,000,000

Cleanliness Code

The combination of particle class and contamination level results in a cleanliness code. The prefix “A” indicates the normalization on wetted surface.

Example: A (B15/C13/D12/E10/F7/GH5/IJ0/KLMN00)

Standard: ISO 16232-10:2007 (N)

This international standard defines the rules and the forms of expression and presentation of the results of measurements of particulate cleanliness of components for the fluid circuits of motor vehicles. This standard refers to the number of particles per component.

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are classified into the following differential bins:

Particle class name	Maximum Feret diameter of particle
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	100 µm ≤ x < 150 µm
G	150 µm ≤ x < 200 µm
H	200 µm ≤ x < 400 µm
I	400 µm ≤ x < 600 µm
J	600 µm ≤ x < 1,000 µm
K	x ≥ 1,000 µm

The size classes B, C, and D are optional.
The absolute number of particles is counted for each class.

Extrapolation and Normalization

This absolute number of particles can be scaled if the scanned area of the filter differs from the flow-through area on the filter. The final counting result must be normalized to the number of washed parts.

Contamination Levels

The number of particles is the final result. A contamination level is not defined.

Cleanliness Code

The combination of particle class and number of particles results in a cleanliness code. The prefix “N” indicates normalization to washed parts.

Example: N (B52171/C11072/D5412/E1199/F181/G50/H47/I12/J2/K0)

Standard: ISO 16232-10:2018 (N)

This international standard defines the rules and the forms of expression and presentation of the results of measurements of particulate cleanliness of components and systems of motor vehicles. This standard refers to the number of particles per component.

Specifics

- Adjust the camera exposure time or the microscope illumination to get an image intensity of 55% of the possible image dynamics (histogram) for the white filter membrane.
- Intensity threshold for particle detection set to 70% of the value for the filter membrane, which results in an upper threshold of 38.5% (~40%) of the image dynamics.

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are classified into the following differential bins:

Particle class name	Maximum Feret diameter of particle
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	100 µm ≤ x < 150 µm
G	150 µm ≤ x < 200 µm
H	200 µm ≤ x < 400 µm
I	400 µm ≤ x < 600 µm
J	600 µm ≤ x < 1,000 µm
K	1,000 µm ≤ x < 1,500 µm
L	1,500 µm ≤ x < 2,000 µm
M	2,000 µm ≤ x < 3,000 µm
N	x ≥ 3,000 µm

The size classes B, C, and D are optional.
The absolute number of particles is counted for each class.

Extrapolation and Normalization

This absolute number of particles can be extrapolated if the examined filter area differs from the flow-through area on the filter. The final counting result must be normalized on the number of washed parts.

Contamination Levels

The number of particles is the final result. A contamination level is not defined.

Cleanliness Code

The combination of particle class and number of particles results in a cleanliness code. The prefix “N” indicates the normalization on washed parts.

Example: N (B52171/C11072/D5412/E1199/F181/G50/H47/I12/J2/KLMN0)

Standard: ISO 16232-10:2007 (V)

This international standard defines the rules and the forms of expression and presentation of the results of measurements of particulate cleanliness of components for the fluid circuits of motor vehicles. It also defines the levels of contamination of these components. This standard refers to 100 cm^3 of wetted volume of the component.

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are classified into the following differential bins:

Particle class name	Maximum Feret diameter of particle
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	100 µm ≤ x < 150 µm
G	150 µm ≤ x < 200 µm
H	200 µm ≤ x < 400 µm
I	400 µm ≤ x < 600 µm
J	600 µm ≤ x < 1,000 µm
K	x ≥ 1,000 µm

The size classes B, C, and D are optional.
The absolute number of particles is counted for each class.

Extrapolation and Normalization

This absolute number of particles can be extrapolated if the examined filter area differs from the flow-through area on the filter. The final counting result must be normalized on a wetted volume of 100 cm^3.

Contamination Levels

The contamination level of each class is defined as:

Contamination level	Particles per 100 cm^3 wetted volume
00	0
0	0 < n ≤ 1
1	1 < n ≤ 2
2	2 < n ≤ 4
3	4 < n ≤ 8
4	8 < n ≤ 16
5	16 < n ≤ 32
6	32 < n ≤ 64
7	64 < n ≤ 130
8	130 < n ≤ 250
9	250 < n ≤ 500
10	500 < n ≤ 1,000
11	1,000 < n ≤ 2,000

Contamination level	Particles per 100 cm^3 wetted volume
12	2,000 < n ≤ 4,000
13	4,000 < n ≤ 8,000
14	8,000 < n ≤ 16,000
15	16,000 < n ≤ 32,000
16	32,000 < n ≤ 64,000
17	64,000 < n ≤ 130,000
18	130,000 < n ≤ 250,000
19	250,000 < n ≤ 500,000
20	500,000 < n ≤ 1,000,000
21	1,000,000 < n ≤ 2,000,000
22	2,000,000 < n ≤ 4,000,000
23	4,000,000 < n ≤ 8,000,000
24	8,000,000 < n ≤ 16,000,000

Cleanliness Code

The combination of particle class and contamination level results in a cleanliness code. The prefix "V" indicates the normalization on wetted volume.

Example: V (B12/C10/D9/E6/F4/GH2/IJ0/K00)

Fast, Reliable Technical Cleanliness Process Control in Manufacturing Industries

Intuitive

Dedicated, easy-to-use workflows minimize user action and provide reliable data — independent of the operator and experience level. User-friendly tools make it easy to revise inspection data.

Standard: ISO 16232-10:2018 (V)

This international standard defines the rules and the forms of expression and presentation of the results of measurements of particulate cleanliness of components and systems of motor vehicles. It also defines the levels of contamination of these components. This standard refers to 100 cm^3 of wetted volume of the component.

Specifics

- Adjust the camera exposure time or the microscope illumination to get an image intensity of 55% of the possible image dynamics (histogram) for the white filter membrane.
- Intensity threshold for particle detection set to 70% of the value for the filter membrane, which results in an upper threshold of 38.5% (~40%) of the image dynamics.

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are classified into the following differential bins:

Particle class name	Maximum Feret diameter of particle
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	100 µm ≤ x < 150 µm
G	150 µm ≤ x < 200 µm
H	200 µm ≤ x < 400 µm
I	400 µm ≤ x < 600 µm
J	600 µm ≤ x < 1,000 µm
K	1,000 µm ≤ x < 1,500 µm
L	1,500 µm ≤ x < 2,000 µm
M	2,000 µm ≤ x < 3,000 µm
N	x ≥ 3,000 µm

The size classes B, C, and D are optional.
The absolute number of particles is counted for each class.

Extrapolation and Normalization

This absolute number of particles can be extrapolated if the examined filter area differs from the flow-through area on the filter. The final counting result must be normalized on a wetted volume of 100 cm^3.

Contamination Levels

The contamination level of each class is defined as:

Contamination level	Particles per 100 cm^3 wetted volume
00	0
0	0 < n ≤ 1
1	1 < n ≤ 2
2	2 < n ≤ 4
3	4 < n ≤ 8
4	8 < n ≤ 16
5	16 < n ≤ 32
6	32 < n ≤ 64
7	64 < n ≤ 130
8	130 < n ≤ 250
9	250 < n ≤ 500
10	500 < n ≤ 1,000
11	1,000 < n ≤ 2,000

Contamination level	Particles per 100 cm^3 wetted volume
12	2,000 < n ≤ 4,000
13	4,000 < n ≤ 8,000
14	8,000 < n ≤ 16,000
15	16,000 < n ≤ 32,000
16	32,000 < n ≤ 64,000
17	64,000 < n ≤ 130,000
18	130,000 < n ≤ 250,000
19	250,000 < n ≤ 500,000
20	500,000 < n ≤ 1,000,000
21	1,000,000 < n ≤ 2,000,000
22	2,000,000 < n ≤ 4,000,000
23	4,000,000 < n ≤ 8,000,000
24	8,000,000 < n ≤ 16,000,000

Cleanliness Code

The combination of particle class and contamination level results in a cleanliness code. The prefix “V” indicates the normalization on wetted volume.

Example: V (B12/C10/D9/E6/F4/GH2/IJ0/KLMN00)

Standard: ISO 21018:2008

This international standard specifies the code to be used in defining the quantity of solid particles in the fluid used in a given hydraulic fluid power system. This standard refers to 1 ml of the filtered fluid.

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are classified into the following cumulative bins:

Particle class name	Maximum Feret diameter of particle
B	$x \geq 5$ µm
C	$x \geq 15$ µm

The absolute number of particles is counted for each class.

Extrapolation and Normalization

This absolute number of particles can be extrapolated if the examined filter area differs from the flow-through area on the filter.

Contamination Levels

The contamination level of each class is defined as:

Contamination level	Particles in 1 ml fluid	Contamination level	Particles in 1 ml fluid
0	$0 < n \leq 0.01$	15	$160 < n \leq 320$
1	$0.01 < n \leq 0.02$	16	$320 < n \leq 640$
2	$0.02 < n \leq 0.04$	17	$640 < n \leq 1{,}300$
3	$0.04 < n \leq 0.08$	18	$1{,}300 < n \leq 2{,}500$
4	$0.08 < n \leq 0.16$	19	$2{,}500 < n \leq 5{,}000$
5	$0.16 < n \leq 0.32$	20	$5{,}000 < n \leq 10{,}000$
6	$0.32 < n \leq 0.64$	21	$10{,}000 < n \leq 20{,}000$
7	$0.64 < n \leq 1.3$	22	$20{,}000 < n \leq 40{,}000$
8	$1.3 < n \leq 2.5$	23	$40{,}000 < n \leq 80{,}000$
9	$2.5 < n \leq 5$	24	$80{,}000 < n \leq 160{,}000$
10	$5 < n \leq 10$	25	$160{,}000 < n \leq 320{,}000$
11	$10 < n \leq 20$	26	$320{,}000 < n \leq 640{,}000$
12	$20 < n \leq 40$	27	$640{,}000 < n \leq 1{,}300{,}000$
13	$40 < n \leq 80$	28	$1{,}300{,}000 < n \leq 2{,}500{,}000$
14	$80 < n \leq 160$	>28	$n \geq 2{,}500{,}000$

Cleanliness Code

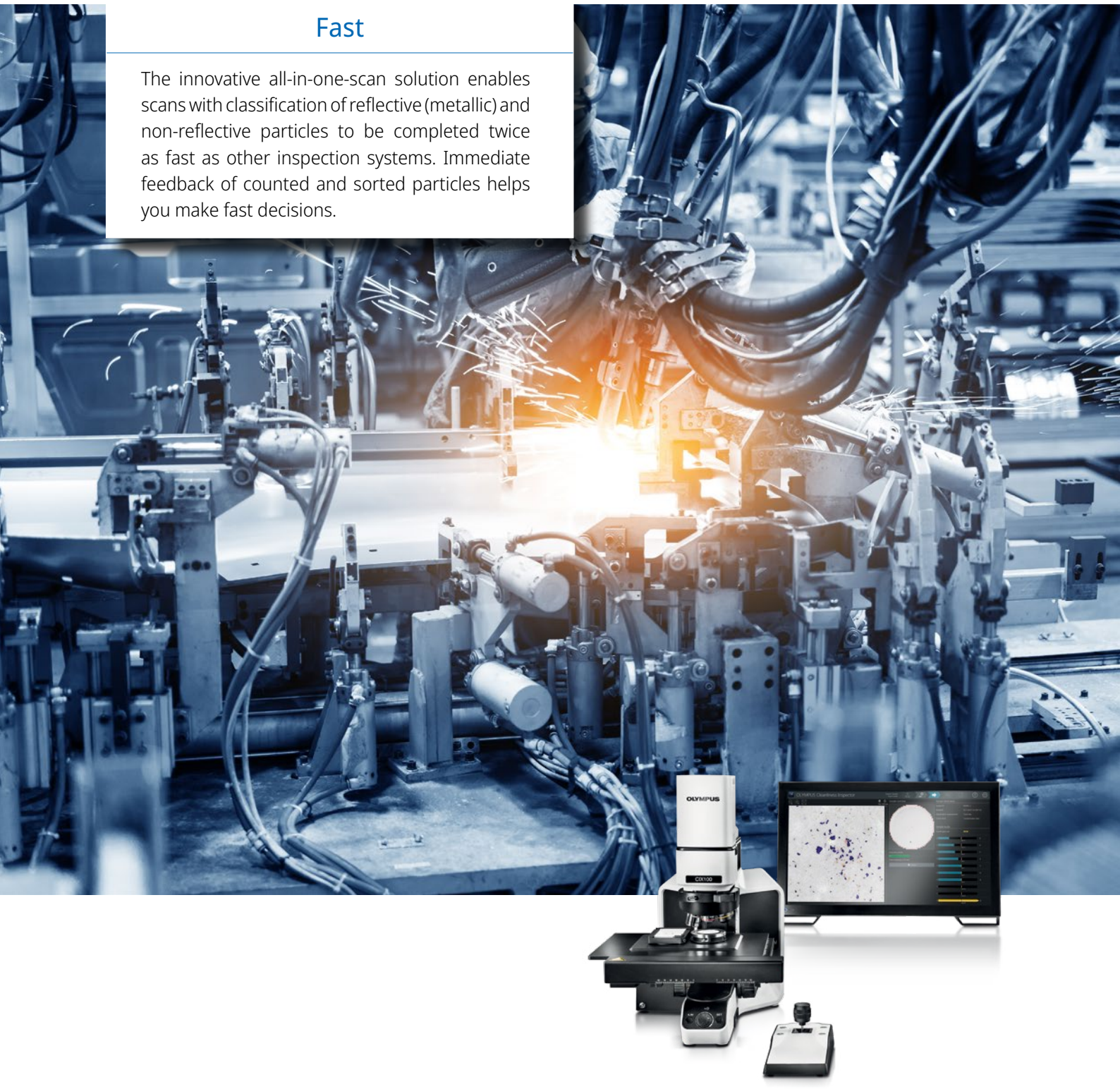
The contamination levels of the two particle classes are shown.

Example: 19/14

Fast, Reliable Technical Cleanliness Process Control in Manufacturing Industries

Fast

The innovative all-in-one-scan solution enables scans with classification of reflective (metallic) and non-reflective particles to be completed twice as fast as other inspection systems. Immediate feedback of counted and sorted particles helps you make fast decisions.



Standard: NAS 1638:1964

This international standard defines cleanliness classes for particulate contamination of hydraulic fluids. Please note that NAS 1638 has been invalid for new products since May 2001.

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are classified into the following differential bins:

Particle class name	Maximum Feret diameter of particle
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	x ≥ 100 µm

The absolute number of particles is counted for each class.

Extrapolation and Normalization

This absolute number of particles can be scaled if the scanned area of the filter differs from the flow-through area on the filter. The final counting result must be normalized to 100 ml of hydraulic fluid.

Contamination Levels

The contamination level is defined by the maximum particle number for each class as:

Contamination level	Particles in 100 ml fluid				
	Class B	Class C	Class D	Class E	Class F
00	125	22	4	1	0
0	250	44	8	2	
1	500	88	16	3	1
2	1,000	178	32	6	
3	2,000	356	63	11	2
4	4,000	712	126	22	4
5	8,000	1,425	253	45	8
6	16,000	2v850	506	90	16
7	32,000	5,700	1,012	180	32
8	64,000	11,400	2,025	360	64
9	128,000	22,800	4,050	720	128
10	256,000	45,600	8,100	1,440	256
11	512,000	91,200	16,200	2,880	512
12	1,024,000	182,400	32,400	5,720	1,024
13	2,048,000	364,800	64,800	11,520	2,048
14	4,096,000	729,000	129,600	23,040	4,096

Cleanliness Code

The result is the largest contamination level of all particle classes. The particle class itself is not displayed.

Example: 11

Standard: NF E 48-651:1986

This French standard is for determination of particulate contamination in hydraulic fluids.

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are classified into the following differential bins:

Particle class name	Maximum Feret diameter of particle
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	x ≥ 100 µm

The absolute number of particles is counted for each class.

Extrapolation and Normalization

This absolute number of particles can be scaled if the scanned area of the filter differs from the flow-through area on the filter. The final counting result must be normalized to 100 ml of hydraulic fluid.

Contamination Levels

The number of particles is the final result. A contamination level is not defined.

Cleanliness Code

There is no definition of a resulting cleanliness code.

Standard: NF E 48-655:1989

This French standard is inspired by NAS 1638 but has a different expression of results.

Specifics

- The results can be based on differential or on cumulative counts.
- The contamination levels are defined for differential and cumulative classification.

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are either classified into the following differential bins:

Particle class name	Maximum Feret diameter of particle
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	x ≥ 100 µm

Or all particles are classified into the following cumulative bins:

Particle class name	Maximum Feret diameter of particle
B	x ≥ 5 µm
C	x ≥ 15 µm
D	x ≥ 25 µm
E	x ≥ 50 µm
F	x ≥ 100 µm

The absolute number of particles is counted for each class.

Extrapolation and Normalization

This number of particles can be extrapolated if the examined filter area differs from the flow-through area on the filter. The final counting result must be normalized on an amount of hydraulic fluid of 100 ml.

Contamination Levels

The contamination level is defined by the maximum particle number for each class as:

Contamination level	Particles in 100 ml fluid				
	Class B	Class C	Class D	Class E	Class F
00	125	22	4	1	0
0	250	44	8	2	
1	500	88	16	3	1
2	1,000	178	32	6	
3	2,000	356	63	11	2
4	4,000	712	126	22	4
5	8,000	1,425	253	45	8
6	16,000	2,850	506	90	16
7	32,000	5,700	1,012	180	32
8	64,000	11,400	2,025	360	64
9	128,000	22,800	4,050	720	128
10	256,000	45,600	8,100	1,440	256
11	512,000	91,200	16,200	2,880	512
12	1,024,000	182,400	32,400	5,720	1,024
13	2,048,000	364,800	64,800	11,520	2,048
14	4,096,000	729,000	129,600	23,040	4,096

The contamination level for cumulative classes is defined by the maximum particle number for each class as:

Contamination level	Particles in 100 ml fluid				
	Class B	Class C	Class D	Class E	Class F
00	152	27	5	1	0
0	304	54	10	2	
1	609	109	20	4	1
2	1,217	217	39	7	
3	2,432	432	76	13	2
4	4,864	864	152	26	4
5	9,731	1,731	306	53	8
6	19,462	3,462	612	106	16
7	38,924	6,924	1,224	212	32
8	77,849	13,849	2,448	424	64
9	155,558	27,698	4,898	848	128
10	311,396	55,396	9,796	1,896	256
11	622,792	110,792	19,592	3,392	512
12	1,245,584	221,584	39,184	6,784	1,024
13	2,491,188	443,168	78,368	13,668	2,048
14	4,981,736	885,736	156,736	27,136	4,096

Cleanliness Code

The result is the contamination level for each particle class.

Example: [8-8-10-10-11]

Standard: SAE A S4059:2020

This international standard defines cleanliness classes for particulate contamination of hydraulic fluids. The classes selected are based on NAS 1638 cleanliness classes.

Specifics

- The results can be based on differential or cumulative counts.
- The contamination levels are defined for differential and cumulative classification.

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are either classified into the following differential bins:

Particle class name	Maximum Feret diameter of particle
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	x ≥ 100 µm

Or the following cumulative bins:

Particle class name	Maximum Feret diameter of particle
B	x ≥ 5 µm
C	x ≥ 15 µm
D	x ≥ 25 µm
E	x ≥ 50 µm
F	x ≥ 100 µm

The absolute number of particles is counted for each class.

Extrapolation and Normalization

This number of particles can be scaled if the scanned area of the filter differs from the flow-through area on the filter. The final counting result must be normalized to 100 ml of hydraulic fluid.

Contamination Levels

The contamination level is defined by the maximum particle number for each class as:

Contamination level	Particles in 100 ml fluid				
	Class B	Class C	Class D	Class E	Class F
00	125	22	4	1	0
0	250	44	8	2	
1	500	88	16	3	1
2	1,000	178	32	6	
3	2,000	356	63	11	2
4	4,000	712	126	22	4
5	8,000	1,425	253	45	8
6	16,000	2,850	506	90	16
7	32,000	5,700	1,012	180	32
8	64,000	11,400	2,025	360	64
9	128,000	22,800	4,050	720	128
10	256,000	45,600	8,100	1,440	256
11	512,000	91,200	16,200	2,880	512
12	1,024,000	182,400	32,400	5,720	1,024

The contamination level for cumulative classes is defined by the maximum particle number for each class as:

Contamination level	Particles in 100 ml fluid				
	Class B	Class C	Class D	Class E	Class F
000	76	14	3	1	0
00	152	27	5		
0	304	54	10	2	
1	609	109	20	4	1
2	1,217	217	39	7	
3	2,432	432	76	13	2
4	4,864	864	152	26	4
5	9,731	1,731	306	53	8
6	19,462	3,462	612	106	16
7	38,924	6,924	1,224	212	32
8	77,849	13,849	2,449	424	64
9	155,698	27,698	4,898	848	128
10	311,396	55,396	9,796	1,696	256
11	622,792	110,792	19,592	3,392	512
12	1,245,584	211,584	39,184	6,784	1,024

Cleanliness Code

The result is the largest contamination level of all particle classes. It is written with the name “AS4059” of the cleanliness standard and the maximum contamination class and level.

Example: AS4059 Class 11F

Standard: USP 788:2011*

This international standard defines the contamination of extraneous mobile undissolved particulate matter in injections and parental infusions. This standard refers to 1 ml of the filtered fluid.

Specifics

The particle size is defined by the equivalent circle diameter (ECD).

Particle Size Classification

The equivalent circle diameter (x) is measured for each particle. All particles are classified into the following cumulative bins:

Particle class name	Equivalent circle diameter of particle
B	x ≥ 10 µm
C	x ≥ 25 µm

The absolute number of particles is counted for each class

Extrapolation and Normalization

This number of particles can be extrapolated if the examined filter area differs from the flow-through area on the filter. The final counting result must be normalized on an amount of filtered fluid of 1 ml.

Contamination Levels

The number of particles is the final result. A contamination level is not defined.

Cleanliness Code

There is no definition of a resulting cleanliness code.

Maximum Approval Levels

The maximum number of particles in 1 ml of filtered fluid is defined with the following limits:

Particle class name	Maximum particles in 1 ml fluid
B	12 particles/ml
C	2 particles/ml

*not preinstalled in the CIX100 system but can be defined

Standard: USP 789:2018*

This international standard defines the contamination of extraneous mobile undissolved particulate matter in ophthalmic solutions. This standard refers to 1 ml of the filtered fluid.

Specifics

• The particle size is defined by the equivalent circle diameter (ECD)
• The maximum approval is defined in the standard

Particle Size Classification

The equivalent circle diameter (x) is measured for each particle. All particles are classified into the following cumulative bins:

Particle class name	Equivalent circle diameter of particle
B	x ≥ 10 µm
C	x ≥ 25 µm
D	x ≥ 50 µm

The absolute number of particles is counted for each class.

Extrapolation and Normalization

This number of particles can be extrapolated if the examined filter area differs from the flow-through area on the filter. The final counting result must be normalized on an amount of filtered fluid of 1 ml.

Contamination Levels

The number of particles is the final result. A contamination level is not defined.

Cleanliness Code

There is no definition of a resulting cleanliness code.

Maximum Approval Levels

The maximum number of particles in 1 ml of filtered fluid is defined with the following limits:

Particle class name	Maximum particles in 1 ml fluid
B	50 particles/ml
C	5 particles/ml
D	2 particles/ml

*not preinstalled in the CIX100 system but can be defined

Standard: VDA 19.1:2015 (A)

This standard is based on the international standard ISO 16232 and modified by the German association of car manufacturers (VDA = Verband der Automobilindustrie). The standard defines the cleanliness of components for the fluid circuits of motor vehicles. It also defines the levels of contamination of these components. This standard refers to 100 cm^3 of wetted volume of the component.

Specifics

- Adjust the camera exposure time or the microscope illumination to get an image intensity of 55% of the possible image dynamics (histogram) for the white filter membrane.
- Intensity threshold for particle detection set to 70% of the value for the filter membrane, which results in an upper threshold of 38.5% (~40%) of the image dynamics.

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are classified into the following differential bins:

Particle class name	Maximum Feret diameter of particle
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	100 µm ≤ x < 150 µm
G	150 µm ≤ x < 200 µm
H	200 µm ≤ x < 400 µm
I	400 µm ≤ x < 600 µm
J	600 µm ≤ x < 1,000 µm
K	1,000 µm ≤ x < 1,500 µm
L	1,500 µm ≤ x < 2,000 µm
M	2,000 µm ≤ x < 3,000 µm
N	x ≥ 3,000 µm

The size classes B, C, and D are optional.
The absolute number of particles is counted for each class.

Extrapolation and Normalization

This absolute number of particles can be extrapolated if the examined filter area differs from the flow-through area on the filter. The final counting result must be normalized on a wetted surface area of 1000 cm^2.

Contamination Levels

The contamination level of each class is defined as:

Contamination level	Particles per 1000 cm² wetted surface area
00	0
0	0 < n ≤ 1
1	1 < n ≤ 2
2	2 < n ≤ 4
3	4 < n ≤ 8
4	8 < n ≤ 16
5	16 < n ≤ 32
6	32 < n ≤ 64
7	64 < n ≤ 130
8	130 < n ≤ 250
9	250 < n ≤ 500
10	500 < n ≤ 1,000
11	1,000 < n ≤ 2,000

Contamination level	Particles per 1000 cm² wetted surface area
12	2,000 < n ≤ 4,000
13	4,000 < n ≤ 8,000
14	8,000 < n ≤ 16,000
15	16,000 < n ≤ 32,000
16	32,000 < n ≤ 64,000
17	64,000 < n ≤ 130,000
18	130,000 < n ≤ 250,000
19	250,000 < n ≤ 500,000
20	500,000 < n ≤ 1,000,000
21	1,000,000 < n ≤ 2,000,000
22	2,000,000 < n ≤ 4,000,000
23	4,000,000 < n ≤ 8,000,000
24	8,000,000 < n ≤ 16,000,000

Cleanliness Code

The combination of particle class and contamination level results in a cleanliness code. The prefix “A” indicates the normalization on wetted surface.

Example: A (B15/C13/D12/E10/F7/GH5/IJ0/KLMN00)

Standard: VDA 19.1:2015 (N)

This standard is based on the international standard ISO 16232 and modified by the German association of car manufacturers (VDA = Verband der Automobilindustrie). The standard defines the cleanliness of components for the fluid circuits of motor vehicles. This standard refers to the number of particles per component.

Specifics

- Adjust the camera exposure time or the microscope illumination to get an image intensity of 55% of the possible image dynamics (histogram) for the white filter membrane.
- Intensity threshold for particle detection set to 70% of the value for the filter membrane, which results in an upper threshold of 38.5% (~40%) of the image dynamics.

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are classified into the following differential bins:

Particle class name	Maximum Feret diameter of particle
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	100 µm ≤ x < 150 µm
G	150 µm ≤ x < 200 µm
H	200 µm ≤ x < 400 µm
I	400 µm ≤ x < 600 µm
J	600 µm ≤ x < 1,000 µm
K	1,000 µm ≤ x < 1,500 µm
L	1,500 µm ≤ x < 2,000 µm
M	2,000 µm ≤ x < 3,000 µm
N	x ≥ 3,000 µm

The absolute number of particles is counted for each class.
The small classes B, C, and D are optional.

Extrapolation and Normalization

This absolute number of particles can be extrapolated if the examined filter area differs from the flow-through area on the filter. The final counting result must be normalized on the number of washed parts.

Contamination Levels

The number of particles is the final result. A contamination level is not defined.

Cleanliness Code

The combination of particle class and number of particles results in a cleanliness code. The prefix “N” indicates the normalization on washed parts.

Example: N (B52171/C11072/D5412/E1199/F181/G50/H47/I12/J2/KLMN0)

Fast, Reliable Technical Cleanliness Process Control in Manufacturing Industries

Compliant

One-click reporting meets the requirements and methodologies set forth in international standards. Report customization makes it easy to meet company standards.

Standard: VDA 19.1:2015 (V)

This standard is based on the international standard ISO 16232 and modified by the German association of car manufacturers (VDA = Verband der Automobilindustrie). The standard defines the cleanliness of components for the fluid circuits of motor vehicles. It also defines the levels of contamination of these components. This standard refers to 100 cm^3 of wetted volume of the component.

Specifics

- Adjust the camera exposure time or the microscope illumination to get an image intensity of 55% of the possible image dynamics (histogram) for the white filter membrane.
- Intensity threshold for particle detection set to 70% of the value for the filter membrane, which results in an upper threshold of 38.5% (~40%) of the image dynamics.

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are classified into the following differential bins:

Particle class name	Maximum Feret diameter of particle
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	100 µm ≤ x < 150 µm
G	150 µm ≤ x < 200 µm
H	200 µm ≤ x < 400 µm
I	400 µm ≤ x < 600 µm
J	600 µm ≤ x < 1,000 µm
K	1,000 µm ≤ x < 1,500 µm
L	1,500 µm ≤ x < 2,000 µm
M	2,000 µm ≤ x < 3,000 µm
N	x ≥ 3,000 µm

The size classes B, C, and D are optional.
The absolute number of particles is counted for each class.

Extrapolation and Normalization

This absolute number of particles can be extrapolated if the examined filter area differs from the flow-through area on the filter. The final counting result must be normalized on a wetted volume of 100 cm^3.

Contamination Levels

The contamination level of each class is defined as:

Contamination level	Particles per 100 cm^3 wetted volume	Contamination level	Particles per 100 cm^3 wetted volume
00	0	12	2,000 < n ≤ 4,000
0	0 < n ≤ 1	13	4,000 < n ≤ 8,000
1	1 < n ≤ 2	14	8,000 < n ≤ 16,000
2	2 < n ≤ 4	15	16,000 < n ≤ 32,000
3	4 < n ≤ 8	16	32,000 < n ≤ 64,000
4	8 < n ≤ 16	17	64,000 < n ≤ 130,000
5	16 < n ≤ 32	18	130,000 < n ≤ 250,000
6	32 < n ≤ 64	19	250,000 < n ≤ 500,000
7	64 < n ≤ 130	20	500,000 < n ≤ 1,000,000
8	130 < n ≤ 250	21	1,000,000 < n ≤ 2,000,000
9	250 < n ≤ 500	22	2,000,000 < n ≤ 4,000,000
10	500 < n ≤ 1,000	23	4,000,000 < n ≤ 8,000,000
11	1,000 < n ≤ 2,000	24	8,000,000 < n ≤ 16,000,000

Cleanliness Code

The combination of particle class and contamination level results in a cleanliness code. The prefix “V” indicates the normalization on wetted volume.

Example: V (B12/C10/D9/E6/F4/GH2/IJ0/KLMN00)

Standard: VDA 19.2:2015 - Sedimentation Value

This standard is based on the international standard ISO 16232 and modified by the German association of car manufacturers (VDA = Verband der Automobilindustrie). It describes the conditions for applying and documenting the methods for the technical cleanliness in assembly and production. The guideline includes the method for analyzing particle traps resulting in the sedimentation value.

Specifics

- Adjust the camera exposure time or the microscope illumination to get an image intensity of 55% of the possible image dynamics (histogram) for the white filter membrane.
- Intensity threshold for particle detection set to 70% of the value for the filter membrane, which results in an upper threshold of 38.5% (~40%) of the image dynamics.

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are classified into the following differential bins:

Particle class name	Maximum Feret diameter of particle
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	100 µm ≤ x < 150 µm
G	150 µm ≤ x < 200 µm
H	200 µm ≤ x < 400 µm
I	400 µm ≤ x < 600 µm
J	600 µm ≤ x < 1,000 µm
K	1,000 µm ≤ x < 1,500 µm
L	1,500 µm ≤ x < 2,000 µm
M	2,000 µm ≤ x < 3,000 µm
N	x ≥ 3,000 µm

The size classes B, C, and D are optional.
The absolute number of particles is counted for each class.

Extrapolation and Normalization

This absolute number of particles detected in the examined filter area will be extrapolated to an area of 1000 cm^2.
The final counting result must be normalized on a sedimentation time of 1 h.

Contamination Levels

A contamination level is not defined. The result of VDA 19.2 is the sedimentation value, also known as the Illig value.

Cleanliness Code

The resulting code is the sedimentation value. The sedimentation value (Illig value) is the sum of all detected particles. The absolute particle number are extrapolated and normalized and weighted according to a weight factor. The weight factor for the size class depends on the minimum particle size of the class:

Particle class	Maximum Feret diameter of particle	Weight factor
B	5 µm ≤ x < 15 µm	0
C	15 µm ≤ x < 25 µm	0
D	25 µm ≤ x < 50 µm	0
E	50 µm ≤ x < 100 µm	1
F	100 µm ≤ x < 150 µm	4
G	150 µm ≤ x < 200 µm	9
H	200 µm ≤ x < 400 µm	16
I	400 µm ≤ x < 600 µm	64
J	600 µm ≤ x < 1,000 µm	144
K	1,000 µm ≤ x < 1,500 µm	400
L	1,500 µm ≤ x < 2,000 µm	900
M	2,000 µm ≤ x < 3,000 µm	1,600
N	x ≥ 3,000 µm	3,600

Example: Sedimentation Value: 2458 1/1,000 cm^2h

Standard: VDI 2083-21:2019*

This standard is based on the international standard ISO 16232 and modified by the German association of engineers (VDI = Verein Deutscher Ingenieure) for the cleanroom technology. The standard defines the cleanliness of medical products in the manufacturing process. This standard refers to the number of particles per component.

Specifics

• Adjust the camera exposure time or the microscope illumination to get an image intensity of 55% of the possible image dynamics (histogram) for the white filter membrane.
• Intensity threshold for particle detection set to 70% of the value for the filter membrane, which results in an upper threshold of 38.5% (~40%) of the image dynamics.

Particle Size Classification

The maximum Feret diameter (x) is measured for each particle. All particles are classified into the following differential bins:

Particle class name	Maximum Feret diameter of particle
A	2 µm ≤ x < 5 µm
B	5 µm ≤ x < 15 µm
C	15 µm ≤ x < 25 µm
D	25 µm ≤ x < 50 µm
E	50 µm ≤ x < 100 µm
F	100 µm ≤ x < 150 µm
G	150 µm ≤ x < 200 µm
H	200 µm ≤ x < 400 µm
I	400 µm ≤ x < 600 µm
J	600 µm ≤ x < 1,000 µm
K	1,000 µm ≤ x < 1,500 µm
L	1,500 µm ≤ x < 2,000 µm
M	2,000 µm ≤ x < 3,000 µm
N	x ≥ 3,000 µm

The size classes A, B, C, and D are optional.
The absolute number of particles is counted for each class.

Extrapolation and Normalization

This absolute number of particles can be extrapolated if the examined filter area differs from the flow-through area on the filter. The final counting result must be normalized on the number of washed parts.

Contamination Levels

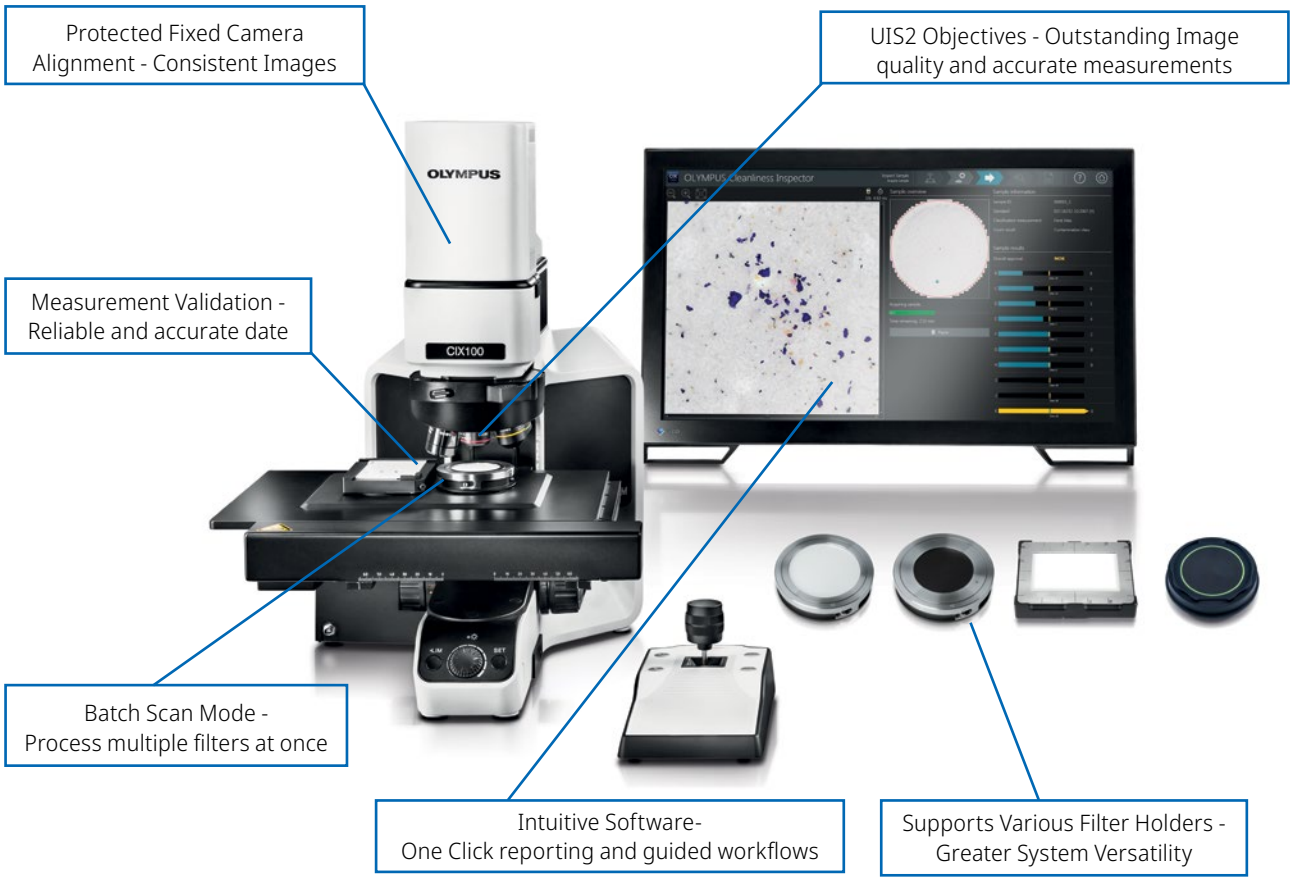
The number of particles is the final result. A contamination level is not defined.

Cleanliness Code

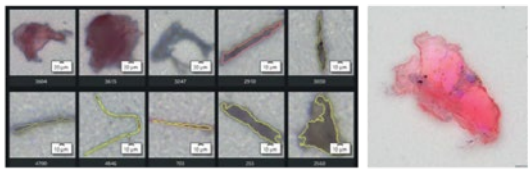
The combination of particle class and number of particles results in a cleanliness code. The prefix “N” indicates the normalization on washed parts.
Example: N (A76452/B52171/C11072/D5412/E1199/F181/G50/H47/I12/J2/KLMN0)

*not preinstalled in the CIX100 system but can be defined

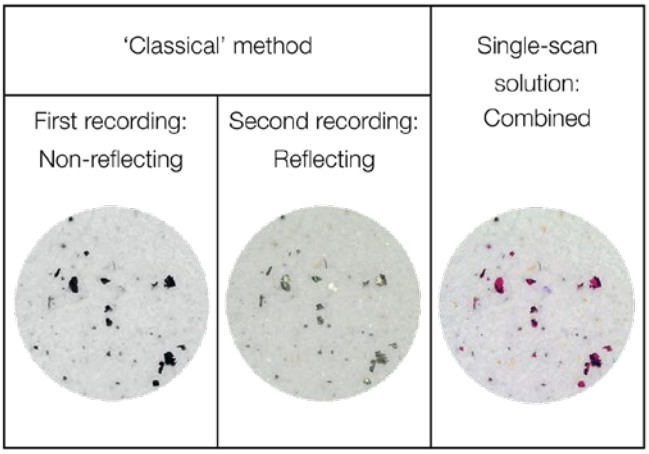
The Advantages of the CIX100 System



Quick and Powerful Sample Analysis



- Fast live analysis of particles and fibers
- Acquire height measurements and extended focus imaging for large particles
- Detect particles as small as 2.5 µm



- Distinguish reflective particles from non-reflective particles in one scan
- View the real color of particles using Real Color Slider

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