SAE INTERNATIONAL

AEROSPACE STANDARD

AS4059™ REV. G

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Superseding AS4059F

Contamination Classification for Hydraulic Fluids

RATIONALE

This document contains a reference to ISO 11500 which requires a statistical check that is not applicable for new clean fluid. This revision introduces a note regarding the non-applicability of ISO 11500 to clarify the verification requirements for new fluids.

1. SCOPE

This SAE Aerospace Standard (AS) defines contamination classes and levels for particulate contamination of hydraulic fluids and includes methods of reporting related data (Appendix A).

2. REFERENCES

2.1 APPLICABLE DOCUMENTS

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

ARP5376 Methods, Locations, and Criteria for System Sampling and Measuring the Solid Particle Contamination of Hydraulic Fluids

AS598 Aerospace Microscopic Sizing and Counting of Particulate Contamination for Fluid Power Systems

2.1.2 AIA Publications

Available from Aerospace Industries Association, 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209-3928, Tel: 703-358-1000, www.aia-aerospace.org.

NAS1638 Cleanliness Requirements of Parts Used in Hydraulic Systems (inactive for new design and not for use with automatic particle counters)

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
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SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/AS4059G/

2.1.3 ISO Publications

Available from International Organization for Standardization, ISO Central Secretariat, 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, Tel: +41 22 749 01 11, www.iso.org.

ISO 4402 (1991) Hydraulic Fluid Power - Calibration of Automatic-Count Instruments for Particles Suspended in Liquids - Method Using Classified AC Fine Test Dust (standard withdrawn and replaced by ISO 11171)

ISO 4407 Hydraulic Fluid Power - Fluid Contamination - Determination of Particulate Contamination by the Counting Method Using an Optical Microscope

ISO 11171 Hydraulic Fluid Power - Calibration of Automatic Particle Counters for Liquids

ISO 11500 Hydraulic Fluid Power - Determination of the Particulate Contamination Level of a Liquid Sample by Automatic Particle Counting Using the Light-Extinction Principle

2.2 Definitions

CONTAMINATION LEVEL: This is the maximum number of counts for a given particle size range.

CONTAMINATION CODE: This is a series of five or six numbers separated by a forward slash used to describe the fluid sample contamination levels at standardized particle size ranges as defined in Tables 1 and 2.

CONTAMINATION CLASS: This is the highest contamination level number within the contamination code.

PARTICLE SIZE: This is the longest dimension of the particle in the case of microscopic counting or the diameter of a circle with an area equal to that of the projected image in the case of automatic particle counting.

3. AS4059 CONTAMINATION LEVELS

3.1 Contamination Levels

Table 1 provides AS4059 contamination levels for differential particle counts, and Table 2 provides AS4059 contamination levels for cumulative particle counts.

These tables list the maximum contamination limits established to provide a set of criteria for specifying the fluid contamination levels, code, and class. The contamination level is based on the particle size range and particle count. Note that the symbol µm(c) is used in Tables 1 and 2 and throughout this document to designate that the particle size was determined using a liquid automatic particle counter calibrated per ISO 11171 or a microscope using image analysis software to calculate the diameter of a circle with the equivalent projected area.

Table 1 - Maximum contamination limits for differential particle counts (particles/100 mL)[3]

Contamination Levels	[1] 5, incl to 15, incl µm	15, excl to 25, incl µm	25, excl to 50, incl µm	50, excl to 100, incl µm	>100 µm
	[2] 6, incl to 14, incl µm(c)	14, excl to 21, incl µm(c)	21,excl to 38, incl µm(c)	38, excl to 70, incl µm(c)	>70 µm(c)
00	125	22	4	1	0
0	250	44	8	2	0
1	500	89	16	3	1
2	1000	178	32	6	1
3	2000	356	63	11	2
4	4000	712	126	22	4
5	8000	1425	253	45	8
6	16000	2850	506	90	16
7	32000	5700	1012	180	32
8	64000	11400	2025	360	64
9	128000	22800	4050	720	128
10	256000	45600	8100	1440	256
11	512000	91200	16200	2880	512
12	1024000	182400	32400	5760	1024

[1] Size range, microscope particle counts, based on the longest dimension as measured per AS598 or ISO 4407.

[2] Size range, automatic particle counters calibrated per ISO 11171 or an optical or electron microscope with image analysis software, based on projected area equivalent diameter.

[3] Contamination classes and particle count limits are identical to NAS1638.

Table 2 - Maximum contamination limits for cumulative particle counts (particles/100 mL)

Contamination Levels	[1] >1 µm	>5 µm	>15 µm	>25 µm	>50 µm	>100 µm
	[2] >4 µm(c)	>6 µm(c)	>14 µm(c)	>21 µm(c)	>38 µm(c)	>70 µm(c)
000	195	76	14	3	1	0
00	390	152	27	5	1	0
0	780	304	54	10	2	0
1	1560	609	109	20	4	1
2	3120	1217	217	39	7	1
3	6250	2432	432	76	13	2
4	12500	4864	864	152	26	4
5	25000	9731	1731	306	53	8
6	50000	19462	3462	612	106	16
7	100000	38924	6924	1224	212	32
8	200000	77849	13849	2449	424	64
9	400000	155698	27698	4898	848	128
10	800000	311396	55396	9796	1696	256
11	1600000	622792	110792	19592	3392	512
12	3200000	1245584	221584	39184	6784	1024

[1] Size range, optical microscope, based on the longest dimension as measured per AS598 or ISO 4407.

[2] Size range, automatic particle counters calibrated per ISO 11171 or an optical or electron microscope with image analysis software, based on projected area equivalent diameter.

3.2 Specifying and Determining the AS4059 Contamination Class

3.2.1 Converting NAS1638 Class Specifications to AS4059 Classes

NAS1638 classes used in current specifications can be converted directly to AS4059 contamination classes. In the simplest form, where NAS1638 Class 6 is currently specified, AS4059 Class 6 applies. Similarly, to designate a fluid contamination class equivalent to NAS1638 Class 6, one would specify: Fluid contamination class shall meet AS4059 Class 6.