



400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE STANDARD

SAE AS4059**REV.
B**

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Superseding AS4059A

Submitted for recognition as an American National Standard

AEROSPACE-CLEANLINESS CLASSIFICATION FOR HYDRAULIC FLUIDS

1. SCOPE:

- 1.1 This SAE Aerospace Standard (AS) defines cleanliness levels for particulate contamination of hydraulic fluids and includes methods of reporting data relating to the contamination levels. The contamination levels selected are an extension and simplification of the widely accepted NAS 1638.

1.2 Purpose:

The intent of this document is to establish the minimum information required to allow valid comparison and interpretation of contamination levels in hydraulic systems that require contamination control of particulate to insure system performance and reliability.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification 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 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

ARP598	The Determination of Particulate Contamination in Liquids by the Particle Count Method
AIR877	Particle Count Data Conversion and Extrapolation
ARP1192	Procedure for Calibration and Verification of Liquid-Borne Particle Counter: An Absolute Standard

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2.2 NAS Standards:

Available from Aerospace Industries Association, 1250 Eye Stree NW,
Washington, DC 20005.

NAS 1638 Cleanliness Requirements of Parts Used in Hydraulic Systems

3. CLEANLINESS CLASSIFICATION:

NAS 1638 has been widely used in the aerospace industry for specifying system fluid cleanliness in hydraulic systems. Because of its long use and familiarity, its classes have been retained as a basis for AS4059. This AS extends NAS 1638 to include cumulative measurement of particulate contamination in the fluid down to 2 μm and Class 000. In addition, AS4059 simplifies the reporting and interpretation of contamination data.

3.1 Cleanliness Level:

Table 1 lists the cleanliness classes established to provide a set of criteria for specifying fluid cleanliness levels. The classes are based on contaminant size, count, and distribution.

TABLE 1 - AS4059 Cleanliness Classes

Size/ Micrometers	000	00	0	1	2	3	4	5	6	7	8	9	10	11	12
>2	164	328	656	1310	2620	5250	10 500	21 000	42 000	83 900	168 000	336 000	671 000	1 340 000	2 690 000
>5	76	152	304	609	1220	2430	4 860	9 730	19 500	38 900	77 900	156 000	311 000	623 000	1 250 000
>15	14	27	54	109	217	432	864	1 730	3 460	6 920	13 900	27 700	55 400	111 000	222 000
>25	3	5	10	20	39	76	152	306	612	1 220	2 450	4 900	9 800	19 600	39 200
>50	1	1	2	4	7	13	26	53	106	212	424	848	1 700	3 390	6 780

3.2 Application of Cleanliness Levels:

The cleanliness levels of Table 1 apply to particle sizes and counts per 100 mL sample of fluid.

4. PROCEDURE:

4.1 Measurement of Cleanliness Level:

- 4.1.1 Measurement: Cleanliness shall be measured in accordance with microscopic counts per ARP598 or counts with an automatic particle counter calibrated per ARP1192.

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4.1.1 (Continued):

Different means of measurement (microscopic or automatic particle counters) can provide different counts. Automatic particle counters calibrated per ARP1192 will count significantly different in the larger sizes than particle counters calibrated with fine test dust. Accordingly, the type counting procedure and the method of calibration for automatic particle counters must be recorded on the fluid cleanliness data sheet.

4.1.2 Sampling: Sampling bottles and sampling systems for Class 2 and above shall be precleaned to a level not exceeding Class 0. Sampling equipment used for measuring levels cleaner than Class 2 shall be at least two classes lower or 25% of the sample cleanliness level.

4.1.3 High Contamination Concentration: High levels of contamination may saturate automatic particle counters, therefore, counts greater than 75% of the saturation level of the counter may be suspect. If it is necessary to count particles at a level approaching saturation or greater, it will be necessary to dilute the sample accordingly. Dilution, however, must be approached with caution. The dilution fluid must be very clean, Class 0 or better, and must be compatible with the hydraulic fluid and the optical qualities of the fluid used in APC calibration. (See 7.3 and Section 9.)

5. REPORTING DATA:

The fluid cleanliness classification is determined from Table 1 by the number of particles greater than 5 μm .

At the discretion of the procuring agency, 2 mm or 15 mm may be specified in lieu of the standard 5 μm . Plot all particle counts greater than 2, 5, 15, 25, and 50 mm per 100 mL, and list other data on Fluid Cleanliness Data Sheet in AS4059 (Figure 1). It should be noted that if cumulative particle counts greater than 25 and 50 mm are used to determine the cleanliness class, these points will not lie on the extrapolated straight lines of Figure 1.

6. DERIVATION OF CLEANLINESS CLASSES:

The cleanliness classes have been developed from NAS 1638 particle counts, which are defined by particle size ranges. Herein, NAS 1638 particle counts by range are presented as cumulative values. A 2 mm cumulative count is also included for procuring agencies who wish to acquire particle control to this finer level. The greater than 2 mm counts in Table 1 have been derived by the extrapolation of the straight lines through the greater than 5 and greater than 15 mm counts. The AS, however, does not recommend the imposition of the 2 mm option for the higher numbered classes. In addition, the cleanliness levels have been expanded to include a 000 Class. NAS 1638 counts, for particles greater than 100 mm, have been incorporated in counts for particles above 50 mm herein.

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FLUID CLEANLINESS DATA SHEET PER AS4059

STANDARD FLUID CLEANLINESS CLASS Per AS4059 Based on $>5 \mu\text{m}$. REQUIRED CLASS Class Based on Particles $>2 \mu\text{m}$ or $>15 \mu\text{m}$ Other: $>$ μm Sample Identification: Date/By Sample From: Analysis Procedure: In-line Bottle Fluid Analyzed: Volume of Sample Analyzed: mLMicroscopic Particle Count Data

Microscopic Analysis per ARP598

Microscope Powers: Membrane: Type: Manuf: Pore size: Automatic Particle Counter DataAPC Model No.: Sensor Model: Date of Calibration: Method of Calibration: Sensor Flow Rate: mL/minVolume Counted Per Run: mLDilution Fluid: Dilution Ratio: FLUID SAMPLE PARTICLE
COUNTS PER 100 mL

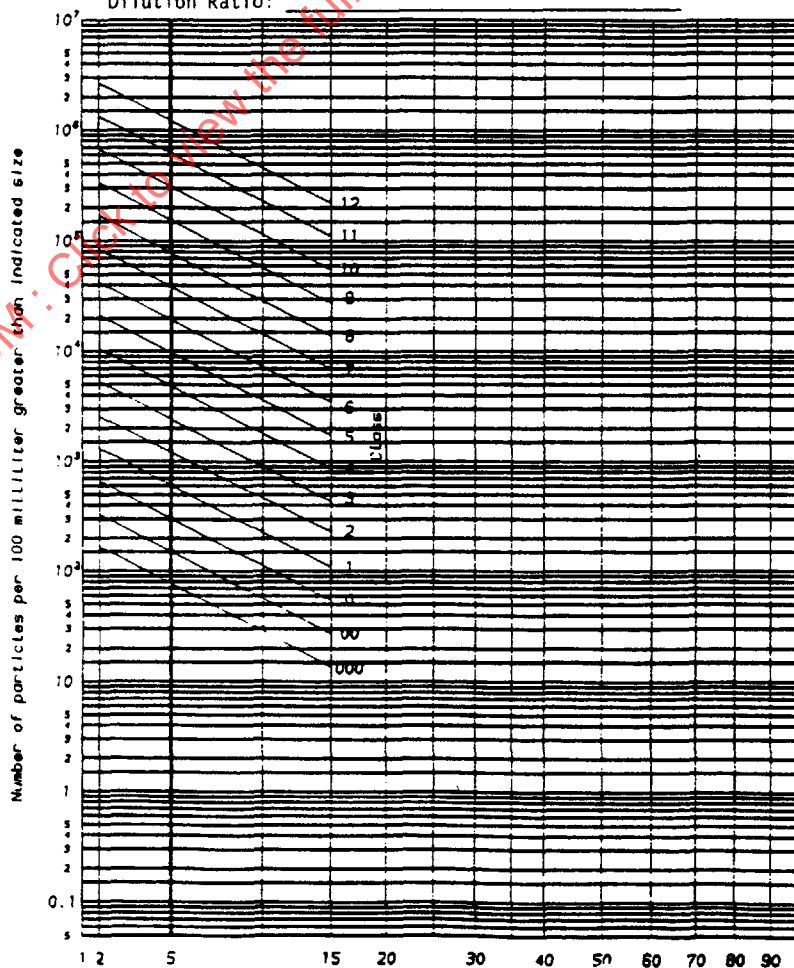
@2 mm

@5 mm

@15 mm

@25 mm

@50 mm

FIGURE 1 - Particle Size, Micrometers μm Log/Log² Graph Paper