

Reporting Cleanliness Levels of Hydraulic Fluids — SAE J1165 JUL79

SAE Recommended Practice
Approved July 1979

S. A. E.
LIBRARY

THIS IS A PREPRINT WHICH IS
SUBJECT TO REVISIONS AND
CORRECTIONS. THE FINAL
VERSION WILL APPEAR IN THE
1981 EDITION OF THE SAE
HANDBOOK.

Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096



PREPRINT

SAENORM.COM : Click to view the full PDF of J1165 JUL79

SAENORM.COM : Click to view the full PDF of j1165_197907

REPORTING CLEANLINESS LEVELS OF HYDRAULIC FLUIDS—SAE J1165 JUL79

SAE Recommended Practice

Report of the Off-Road Machinery Technical Committee, approved July 1979.

Scope—This SAE Recommended Practice has been formulated to advance and endorse the use of the ISO (International Organization for Standardization) Solid Contaminant Code as the universal means for expressing the level of particulate contaminant in hydraulic fluid and for specifying acceptable limits of cleanliness. Worldwide approval was gained for this coding system because it provides a simple, unmistakable, meaningful, and consistent means of communication between suppliers and users. The code applies to all types of hydraulic (liquid) fluids used in fluid power and control systems.

Purpose—The purpose of this recommended practice is to provide a practical and uniform method for graphically representing the contamination level of a fluid and assigning its proper ISO Cleanliness Code. Although the approval code is explicit and offers no opportunity for misinterpretation, flexibility in application is provided to satisfy the customs of the cooperating nations. This recommended practice is intended to facilitate the use of the ISO code and encourage its promulgation throughout the industry.

Background—Many attempts have been made to devise an ideal means for ranking the contamination level of hydraulic fluids with respect to the particle size population. The most notable of these are the disavowed SAE, ASTM, and AIA Levels, NAS 1638, and Mil-Std-1246A. Since these methods were predicated on the existence of fixed contaminant distributions, they are no better than using the two fundamental characteristics of the contaminant — the gravimetric level and the particle concentration of a specified distribution per unit volume of fluid. The cleanliness level spectrum covered by the various methods is reflected in Table 1. Basically all of the methods assume a fixed particle size distribution (roughly corresponding to that of ACFTD) except the ISO Solid Contaminant Code.

The approved coding system is based on the fact that a step ratio of two for particle concentration is adequate both to differentiate between two significantly different systems and also to allow for reasonable differences in measurement. Range numbers are used to identify each step in particle population throughout the spectrum of levels. To allow measurements to be taken from differing fluid volumes, the numbers of particles counted above 5 and 15 μm respectively are normalized on either a one milliliter or

100 milliliter basis and reported in terms of pairs of range numbers. Thus, a theoretically infinite number of range pairs is available to describe the contamination level of a fluid.

The ISO Solid Contaminant Code is assigned on the basis of the number of particles per unit volume greater than 5 and 15 μm in size. These two sizes were selected because it was felt that the concentration at the smaller size would give an accurate assessment of the *silting* condition of the fluid, while the population of the particles greater than 15 μm would reflect the prevalence of *wear* catalysts. Thus, the particle size distribution by the ISO coding system is described by a 5 μm range number and a 15 μm range number (with the two numbers separated by a solidus).

Data Acquisition—In order to assign an ISO cleanliness code to represent the contamination level of a fluid, the number of particles greater than 5 and 15 μm per unit volume must be available. Furthermore, the particle population must be obtained from a particle counting system which has been calibrated per ISO/DIS 4404 or an ISO approved equivalent method in order to assign a valid cleanliness code. The actual counting system is immaterial as long as the acceptable calibration certification is available.

Code Designation—There are two ways that the ISO code can be assigned. The first is by adhering rigidly to a tabular method of identifying the correct pair of Range Numbers needed by the code, and the second is by plotting the results of the actual particle count measurements on a specially prepared graphical background displaying the Range Number spectrum.

The tabular method utilizes Table 2, in which each Range Number corresponds to a concentration limit for the specific cumulative particle counts. The appropriate Range Numbers for both the 5 and 15 μm particle counts can be obtained from Table 2.

The graphical method utilizes the particle size distribution graph shown in Fig. 1. The ISO Range Number scale is overlaid to facilitate the visual assignment of the ISO code. The mechanics of the coding technique are illustrated by appropriate examples in Fig. 1. The graphical method offers additional insight regarding the slope and displacement of the distribution curve which is not afforded by the tabular method.

TABLE 1—CLEANLINESS LEVEL CORRELATION TABLE

ISO Code	Particles per milliliter > 10 μm	ACFTD ^a Gravimetric Level — mg/L	Mil Std 1246A (1967)	NAS 1638 (1964)	Disavowed "SAE" Level (1963)
26/23	140 000	1000			
25/23	85 000		1000		
23/20	14 000	100	700		
21/18	4500			12	
20/18	2400		500		
20/17	2300			11	
20/16	1400	10			
19/16	1200			10	
18/15	580			9	6
17/14	280		300	8	5
16/13	140	1		7	4
15/12	70			6	3
14/12	40		200		
14/11	35			5	2
13/10	14	0.1		4	1
12/9	9			3	0
11/8	5			2	
10/8	3		100		
10/7	2.3			1	
10/6	1.4	0.01			
9/6	1.2			0	
8/5	0.6			00	
7/5	0.3		50		
6/3	0.14	0.001			
5/2	0.04		25		
2/8	0.01		10		

^aACFTD (Air Cleaner Fine Test Dust)—ISO approved test and calibration contaminant.