International Standard 3938

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Hydraulic fluid power — Contamination analysis — Method for reporting analysis data

Transmissions hydrauliques — Analyse de la pollution — Méthode de présentation des résultats d'analyse

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Descriptors : hydraulic fluid power, hydraulic fluids, contamination, particle density (concentration), experimental data, data processing.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 3938 was prepared by Technical Committee ISO/TC 131, *Fluid power systems*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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INTERNATIONAL STANDARD ISO 3938-1986 (E)

Hydraulic fluid power — Contamination analysis — Method for reporting analysis data

0 Introduction

In hydraulic fluid power systems, power is transmitted and controlled through a liquid under pressure within an enclosed circuit. Hydraulic fluids all contain a certain amount of solid particle contaminants.

Reliable system performance requires control of the contaminant level. One element of this control is an accurate and uniform method for reporting contamination analysis data.

1 Scope and field of application

This International Standard specifies methods for reporting data relative to contamination levels of hydraulic fluids used in industrial, mobile and marine applications for the following types of contamination analysis techniques:

a) microscopic particle counting;

b) automatic particle counter;

c) gravimetric.

This International Standard is intended to establish the minimum information required to allow valid comparison and interpretation of contamination level data.

2 References

ISO 3722, *Hydraulic fluid power — Fluid sample containers — Qualifying and controlling cleaning methods.*

ISO 4021, *Hydraulic fluid power — Particulate contamination analysis — Extraction of fluid samples from lines of an operating system.*

ISO 4402, *Hydraulic fluid power — Calibration of liquid automatic particle-count instruments — Method using Air Cleaner Fine Test Dust contaminant.*

ISO 4405, *Hydraulic fluid power — Fluid contamination — Determination of particulate contaminants by the gravimetric method.*[1)]

ISO 4406, *Hydraulic fluid power — Fluids — Solid contaminant code.*[1)]

ISO 4407, *Hydraulic fluid power — Fluids — Determination of solid particle contamination — Counting method using a microscope under transmitted light.*[1)]

ISO 4408, *Hydraulic fluid power — Fluids — Determination of solid particle contamination — Counting method using a microscope under incident light.*[1)]

ISO 5598, *Hydraulic and pneumatic fluid power — Vocabulary.*

3 Definitions

For the purposes of this International Standard, the definitions of terms given in ISO 5598 apply.

4 Representative fluid samples

4.1 It shall be confirmed that fluid samples for particulate contamination analysis were extracted in accordance with ISO 4021.

4.2 It shall be confirmed that sample containers have a required cleanliness level (RCL) at least two decades lower than the expected samples as qualified in accordance with ISO 3722.

5 Information to be reported

When reporting hydraulic fluid particulate contamination data, the information described in 5.1 to 5.3 shall be included.

5.1 Microscopic particle count

The microscopic particle count data shall be in accordance with ISO 4407 or ISO 4408.

Data shall be recorded in accordance with figure 1.

The particle count data shall be plotted graphically using figure 3.

The contaminant level shall be reported in accordance with the ISO solid contaminant code (see figure 4).

1) At present at the stage of draft.

5.2 Automatic particle count

It shall be confirmed that the automatic particle counter was calibrated in accordance with ISO 4402.

Data shall be recorded in accordance with figure 2.

The particle count data shall be plotted graphically using figure 3.

The contaminant level shall be reported in accordance with the ISO solid contaminant code (see figure 4).

5.3 Gravimetric analysis

Gravimetric analysis data shall be in accordance with ISO 4405.

Data shall be recorded in accordance with figure 5.

NOTE — No attempt should be made to report a particle size distribution from a gravimetric level.

6 Limitations of data

6.1 One particle size range shall only be converted to another by interpolation.

NOTE — The assumption is made that particle count distribution curves approximate straight line segments when plotted on $\log/\log^2$ graph paper. The assumption of straight-line distribution (when plotting particle count data on $\log/\log^2$ coordinates) may not always be valid.

6.2 Extreme care shall be exercised when multiplying count data to place them on a scale larger than the actual sample size.

NOTE — The inaccuracies of expanding (for example, the particle count of a 10 ml sample) can be realized when one considers each particle count as the sum of the actual count of the fluid and the background count. The background count is not usually proportional to the sample volume. Expansion should only be used where it has been verified that the actual count is at least two orders of magnitude higher than the background contamination.

7 Identification statement (Reference to this International Standard)

Use the following statement in test reports, catalogues and sales literature when electing to comply with this International Standard.

"Method for reporting contamination analysis data in accordance with ISO 3938, *Hydraulic fluid power — Contamination analysis — Method for reporting analysis data.*"

Microscopic particle count data sheet

Sample identification: .....

Date of analysis: ..... Counted by: .....

.....

.....

Analysis procedure: .....

Volume of sample analysed: ..... Fluid: .....

Membrane type, manufacturer and pore size: .....

.....

Colour of membrane: ..... Container RCL .....

.....

.....

Magnification X	Area per field A	Particle size range µm	Record below particles counted in each randomly selected field										Fields counted B	Total particles counted C	$D = \frac{\text{Total area}}{\text{Area counted}}$ $\left(D = \frac{\text{area}}{A \times B}\right)$	Particles in sample $C \times D$	Particles per millilitre

Figure 1 — Typical microscopic particle count data sheet

Automatic particle counter data sheet

Sample identification : .....

Date of analysis : .....

Particle counter model : ..... Sensor model : .....

Date of calibration : ..... Sensor flow rate : ..... ml/min

Method of calibration : ..... Volume counted per run : ..... ml

Sample fluid : ..... Dilution fluid : .....

Sample	Run number	Particle size				
		> µm	> µm	> µm	> µm	> µm
Dilution fluid	1					
	2					
	3					
	Average					
Sample number	1					
	2					
	3					
	Average					
Dilution ratio :	Total					
	Actual*					
Sample number	1					
	2					
	3					
	Average					
Dilution ratio :	Total					
	Actual*					

*Number of particles per millilitre greater than stated size.

Figure 2 — Typical automatic particle counter data sheet

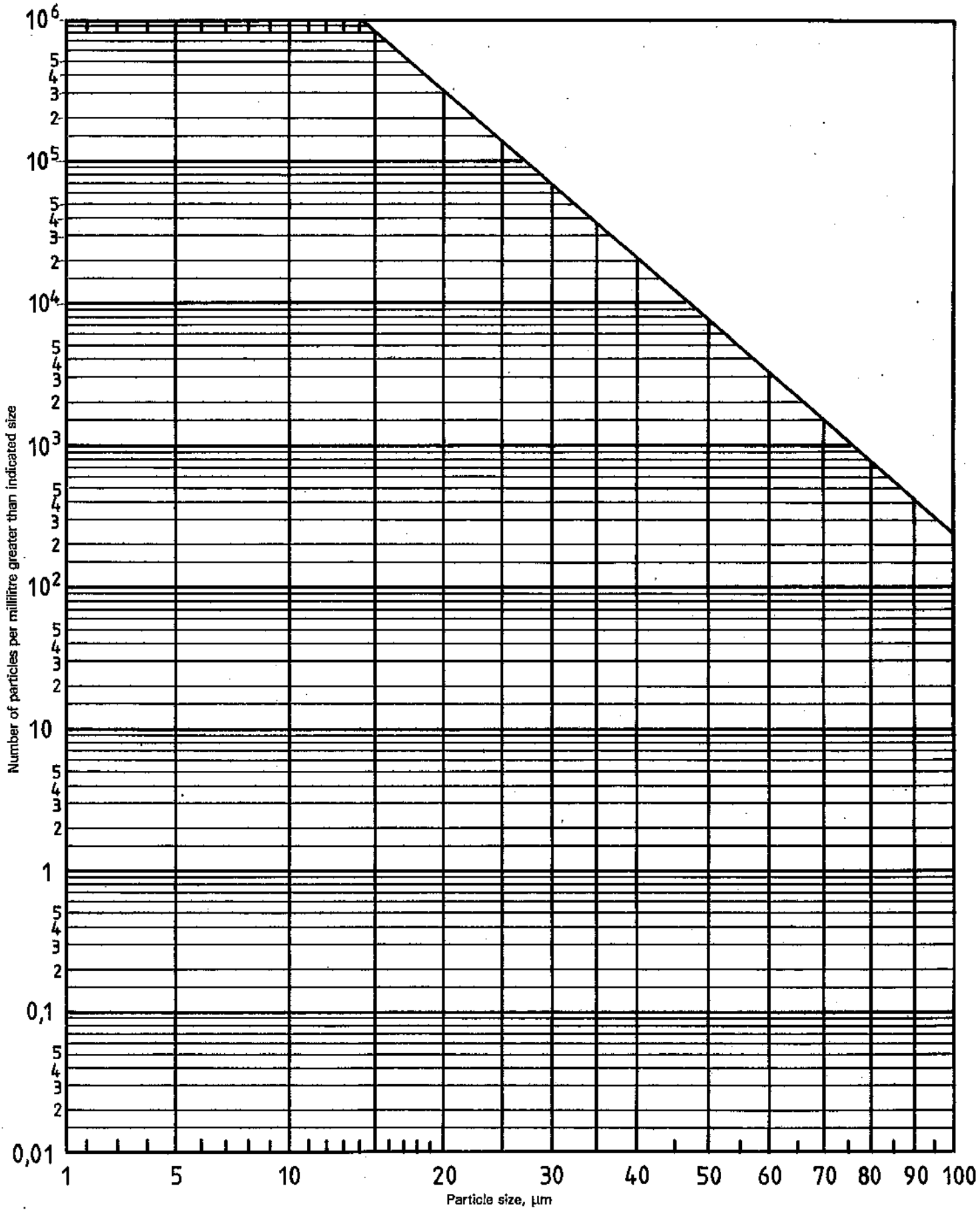

Figure 3 — Log/log^2 graph paper for results

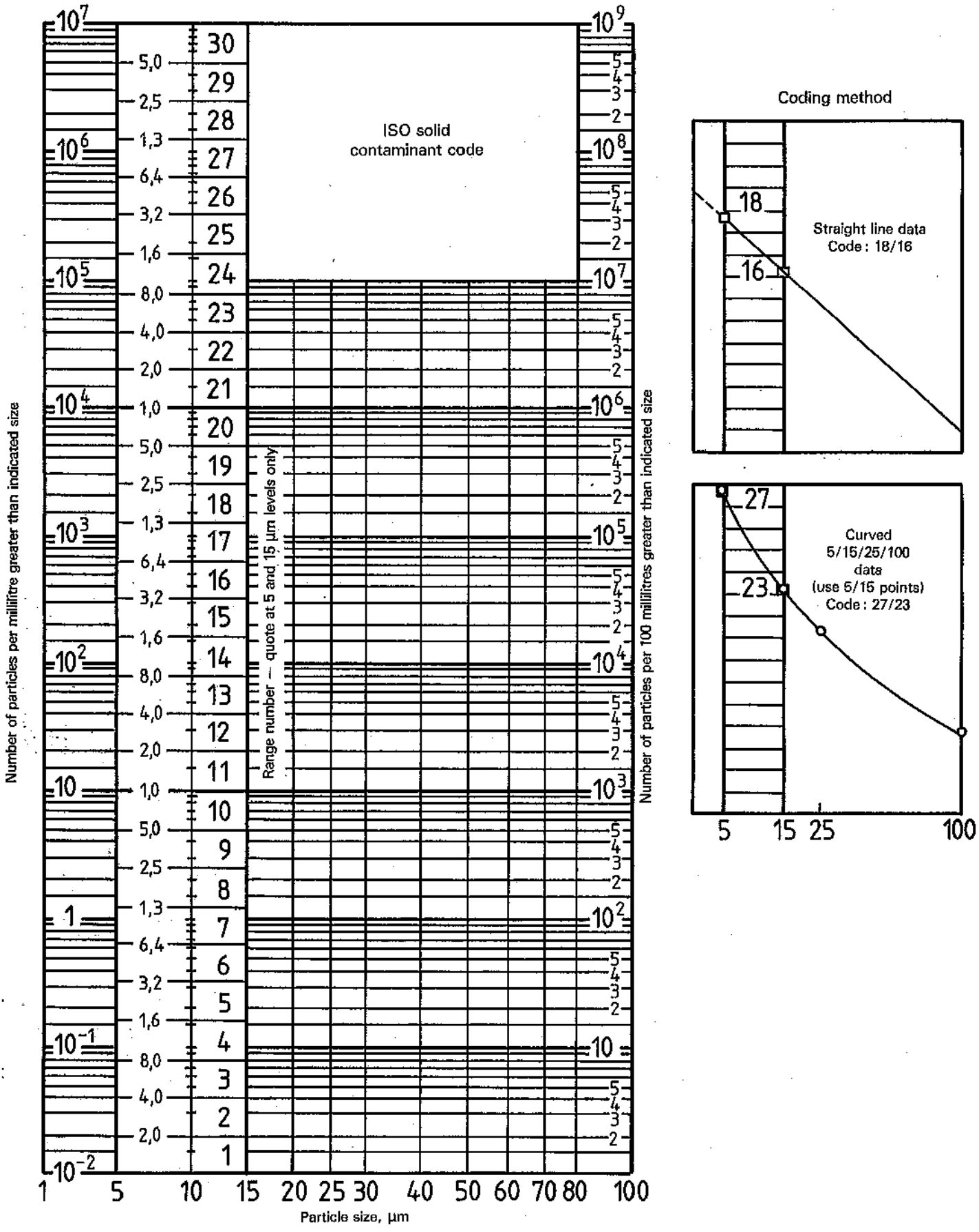

Figure 4 — Solid contaminant chart in accordance with ISO 4406

Gravimetric analysis data sheet

Sample identification : .....

Date of analysis : .....

Analysis procedure : ..... Fluid : .....

Membrane type, manufacture, and pore size : .....

Sample identification number					**Control**
Final weight, mg					
Initial weight, mg					
Differential weight, mg					
Control weight, mg					
Weight per sample, mg					
Sample volume, ml					
Gravimetric level, mg/l					

Figure 5 — Typical gravimetric analysis data sheet