
**Road vehicles — Calibration fluids for
diesel injection equipment**

*Véhicules routiers — Fluides d'essai pour équipements d'injection à
gazole*

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Foreword

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Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 4113 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 7, *Injection equipment and filters for use on road vehicles*.

This third edition cancels and replaces the second edition (ISO 4113:1988), which has been technically revised.

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Road vehicles — Calibration fluids for diesel injection equipment

1 Scope

This International Standard specifies the requirements for calibration fluids, i.e. a basic fluid and a closer value (CV) fluid, intended for testing and calibrating diesel fuel injection equipment in production, in service, and in laboratories. The CV calibration fluid requires a closer tolerance range for kinematic viscosity and density, and can be specified to enhance the accuracy of the calibration setting.

This International Standard also allows the specification of an anti-wear (AW) requirement in order to aid the running-in of diesel fuel injection equipment.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2049, *Petroleum products — Determination of colour (ASTM scale)*

ISO 2160, *Petroleum products — Corrosiveness to copper — Copper strip test*

ISO 2719, *Determination of flash point — Pensky-Martens closed cup method*

ISO 3015, *Petroleum products — Determination of cloud point*

ISO 3104, *Petroleum products — Transparent and opaque liquids — Determination of kinematic viscosity and calculation of dynamic viscosity*

ISO 3405, *Petroleum products — Determination of distillation characteristics at atmospheric pressure*

ISO 3675, *Crude petroleum and liquid petroleum products — Laboratory determination of density — Hydrometer method*

ISO 12937, *Petroleum products — Determination of water — Coulometric Karl Fischer titration method*

ASTM D665-06, *Standard test method for rust-preventing characteristics of inhibited mineral oil in the presence of water*

ASTM D892-06, *Standard test method for foaming characteristics of lubricating oils*

ASTM D1748-02(2008), *Standard test method for rust protection by metal preservatives in the humidity cabinet*

ASTM D2140-08, *Standard practice for calculating carbon-type composition of insulating oils of petroleum origin*

ASTM D2783-03(2009), *Standard test method for measurement of extreme-pressure properties of lubricating fluids (four-ball method)*

IP 306-82, *Oxidation stability of straight mineral oil*

3 Requirements

3.1 General

The calibration fluids shall be refined and deodorized mineral oils and may contain additives to inhibit undesirable characteristics such as foaming, ageing, corrosion and wear.

The calibration fluids shall not contain components in such a concentration that adversely affects human health, e.g. causing skin irritation, etc.

The calibration fluids shall be such that, without cleaning of the fuel injection equipment after calibration, proper functioning of the equipment is ensured after storage of the equipment for a period of one year minimum, in normal conditions.

The calibration fluids shall have the properties specified in Table 1.

3.2 Anti-wear

The anti-wear property of calibration fluid defined in this International Standard refers to the ability of the fluid to form a thin chemical layer between the sliding surfaces of moving parts under the initial high loading of the residual surface peaks, formed during the machining processes, in order to prevent these asperities from welding during the running-in procedure. This property is tested by means of the modified four-ball-test device. The ASTM D2783-03(2009) test procedure shall be modified as follows:

- number of test runs: 3;
- duration of each test run: 10 s;
- rotational speed: $(1\,450 \pm 40) \text{ min}^{-1}$;
- load: 500 N.

None of the lower-ball wear-scar diameters from each of the three test runs shall exceed the maximum value given in Table 1.

NOTE The lubricity requirement of diesel fuel refers to the ability of the fluid to form a film between the moving parts in order to prevent them from wear and abrasion during normal loading conditions and lifetime operation of the fuel injection equipment. This property is tested by means of the high-frequency reciprocating rig (HFRR) defined in ISO 12156-1.

4 Designation

A calibration fluid that meets the requirements of this International Standard shall be designated by the following, in the order given:

- a) the term "Calibration Fluid";
- b) reference to this International Standard, "ISO 4113";
- c) the designation "CV" if the closer tolerances for kinematic viscosity and for density are required;
- d) the designation "AW" if the specification for wear protection is required.

NOTE Designations c) and d) can be applied together.

EXAMPLE 1 Designation of a calibration fluid meeting the ISO 4113 basic requirements:

Calibration Fluid ISO 4113

EXAMPLE 2 Designation of a calibration fluid meeting the ISO 4113 basic requirements and the closer value of kinematic viscosity and density:

Calibration Fluid ISO 4113-CV

EXAMPLE 3 Designation of a calibration fluid meeting the ISO 4113 basic requirements and the wear protection requirement:

Calibration Fluid ISO 4113-AW

EXAMPLE 4 Designation of a calibration fluid meeting the ISO 4113 basic requirements and the closer value of kinematic viscosity and density and the wear protection requirement:

Calibration Fluid ISO 4113-CV-AW

Table 1 — Properties of calibration fluids

Characteristics	Requirements		Method of determination
	ISO 4113 (basic requirements)	ISO 4113-CV (closer value)	
Density at 15 °C	0,820 g/ml to 0,830 g/ml	0,823 5 g/ml to 0,826 5 g/ml	ISO 3675
Flash point	$\geq +75$ °C		ISO 2719
Kinematic viscosity at 40 °C ^a	2,45 mm ² /s to 2,75 mm ² /s	2,50 mm ² /s to 2,55 mm ² /s	ISO 3104
Volume distilled	at 210 °C	≤ 5 % volume fraction	ISO 3405
	at 360 °C	≥ 95 % volume fraction	
Ageing test (catalysed)	Sludge	$\leq 0,05$ % mass fraction	IP 306-82 (time: 48 h)
	Total acidity after oxidation ^b	$\leq 0,7$ mg KOH/g	
Cloud point	≤ -10 °C		ISO 3015
Rust protection	Five out of six faces on three panels shall pass the test.		ASTM D1748-02(2008) (test time: 50 h with polished panels)
Corrosion test	Ferrous metals	Pass the test	ASTM D665-06 (procedure A)
	Copper	Class 1	ISO 2160 (3 h at 100 °C)
Water content	≤ 500 mg/kg		ISO 12937
Aromatic components, C_A	≤ 12 %		ASTM D2140-08
Foaming	Tendency	≤ 50 ml	ASTM D892-06 (sequence I only)
	Stability	0 ml	
Colour	$\leq 2,0$		ISO 2049
Wear protection (ISO 4113-AW) ^c Scar diameter	$\leq 0,8$ mm		ASTM D2783-03(2009) modified ^d

^a ISO 4008-3 specifies that the viscosity discard limit is 3 mm²/s (1 mm²/s = 1 cSt) at 40 °C.

^b Sum of volatile and soluble acidity.

^c Additional characteristic that may be specified for inclusion of anti-wear additive or additives.

^d For the test, a four-ball extreme-pressure test machine shall be used as described in ASTM D2783-03(2009); however, the test machine shall be modified by using a variable speed motor to achieve the required rotational speed of the top ball (see 3.2).

Bibliography

- [1] ISO 4008-3, *Road vehicles — Fuel injection pump testing — Part 3: Application and test procedures*
- [2] ISO 12156-1, *Diesel fuel — Assessment of lubricity using the high-frequency reciprocating rig (HFRR) — Part 1: Test method*
- [3] ASTM D2709-96(2006), *Standard test method for water and sediment in middle distillate fuels by centrifuge*

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