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Road vehicles — Apparatus for measurement of the opacity of exhaust gas from diesel engines

Véhicules routiers — Dispositif pour le mesurage de l'opacité des gaz d'échappement des moteurs diesel

Technical Report 4011 was drawn up by Technical Committee ISO/TC 22, *Road vehicles*, and approved by the majority of its members. The reasons which led to the publication of this document in the form of a Technical Report are the following :

This Technical Report was prepared on the basis of present knowledge concerning the design and use of opacimeters intended in particular for measuring the opacity of exhaust gas from diesel engines running in free acceleration; this type of measurement is in fact a necessity when the legislation requires a control of the opacity of the smoke emitted by the vehicle in service; it is then essential that a device and a measurement method be available which allow reproducible and repeatable measurements to be made.

However, during the study, some difficulties arose in establishing with precision certain performance characteristics in relation to the response time of the device when the opacimeter is used in transient conditions.

Consequently, the type of device described below was not considered suitable for definition in an International Standard.

A study is in progress to fix the whole of the characteristics of the opacimeter.

CONTENTS

	Page
1 Scope	2
2 Field of application	2
3 Reference	2
4 Principle of opacimeters	2
5 Basic specifications for opacimeters	2
6 Construction specifications	3
7 Information and methods of measurement to be provided by the manufacturer	5
8 Verification of opacimeter types	6
Annex : Installation and use of opacimeters	16

1 SCOPE

This Technical Report establishes the specifications for devices for measuring the opacity of exhaust gas from diesel engines for road vehicles, and for their installation. These instruments are generally known as "opacimeters". The annex deals with the installation and use of opacimeters.

2 FIELD OF APPLICATION

This Technical Report concerns opacimeters for use in steady state and free acceleration conditions for diesel engines of road vehicles. It does not cover :

- free-piston engines;
- stationary engines;
- marine engines;
- railway engines;
- aircraft engines;
- engines for agricultural tractors and special vehicles for use in civil engineering.

3 REFERENCE

ISO 3173, *Road vehicles — Apparatus for measurement of the opacity of exhaust gas from diesel engines operating under steady state conditions*.

4 PRINCIPLE OF OPACIMETERS

The principle of measurement consists in passing a beam of light through a certain length of the medium to be measured. The proportion of the incident light reaching a receiver (for example, a photoelectric cell) is used to assess the opacity of this medium.

The opacimeter may be constructed to take the full flow of exhaust gas delivered by the engine (full flow opacimeter) or only a sample (sampling opacimeter).

Opacimeters are used under two types of test conditions :

- **Steady state conditions** : The engine is run at constant speed and under constant load; the opacimeter operates under steady state conditions (SS).
- **Transient conditions** : The engine is run under transient conditions of speed and/or load; the opacimeter operates under transient conditions (TC).

Opacimeters may also exist which are suitable for use only under steady state conditions. These are the subject of ISO 3173. Apparatus conforming to this Technical Report conforms *ipso facto* to ISO 3173.

5 BASIC SPECIFICATIONS FOR OPACIMETERS

5.1 The gas to be measured is passed through a chamber the internal surface of which is non-reflecting, or through an equivalent optical environment.

5.2 The effective path length of the light rays through the gas to be measured is determined taking into account the possible influence of devices for protecting the light source and the photoelectric cell. This effective length shall be indicated on the apparatus.

5.3 The measuring device shall have the following characteristics :

5.3.1 The indicator of the opacimeter shall have a measuring scale graduated in units of light absorption coefficient from 0 to 5 m^{-1} at least.