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ISO 8178-7

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Reciprocating internal combustion engines — Exhaust emission measurement —

Part 7: Engine family determination

Moteurs alternatifs à combustion interne — Mesurage des émissions de gaz d'échappement —

Partie 7: Détermination des familles de moteurs

Reference number
ISO 8178-7:1996(E)

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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 8178-7 was prepared by Technical Committee ISO/TC 70, *Internal combustion engines*, Subcommittee SC 8, *Exhaust gas emission measurement*.

ISO 8178 consists of the following parts, under the general title *Reciprocating internal combustion engines — Exhaust emission measurement*:

- *Part 1: Test-bed measurement of gaseous and particulate exhaust emissions*
- *Part 2: Measurement of gaseous and particulate exhaust emissions at site*
- *Part 3: Definitions and methods of measurement of exhaust gas smoke under steady-state conditions*
- *Part 4: Test cycles for different engine applications*
- *Part 5: Test fuels*
- *Part 6: Test report*
- *Part 7: Engine family determination*
- *Part 8: Engine group determination*
- *Part 9: Test bed measurement of exhaust gas smoke emissions from engines used in non-road mobile machinery*

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Introduction

Unlike engines for on-road applications, engines for off-road use are made in a much wider range of power output and configuration and are used in a great number of different applications.

The object of ISO 8178 is to rationalize the test methods for off-road engines in order to simplify and make more cost effective the drafting of legislation, the development of engine specifications and the certification of engines to control gaseous and particulate emissions.

In order to achieve its objectives, ISO 8178 embraces four concepts:

a) grouping of engine applications in order to reduce the number of test cycles as defined in ISO 8178-4;

b) use of observed brake power as defined in ISO 8178-1 as the basis for the expression of specific emission levels;

c) incorporation of an "engine family" concept in which engines with similar emission characteristics and design may be represented by an engine within the family;

d) incorporation of an "engine group" concept in which addresses the modification and adjustment of engines (see ISO 8178-8).

In this part of ISO 8178 the engine family concept is elaborated.

The engine family concept provides the possibility of reducing the number of engines which must be submitted for type approval testing, while providing safeguards for the parties involved that all engines within the family will comply with the approval requirements.

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Reciprocating internal combustion engines — Exhaust emission measurement —

Part 7:
Engine family determination

1 Scope

This part of ISO 8178 specifies the parameters to be applied for the determination of which engine specifications may be included in an engine family and for the selection of the parent engine of the family.

This part of ISO 8178 is applicable to reciprocating internal combustion engines for land, rail traction and marine use, excluding engines for motor vehicles primarily designed for on-road operation. It may be applied to engines for power production and/or propulsion in e.g. agricultural equipment, road construction and earth moving machines, industrial trucks, generating sets, etc..

2 Definitions

For the purposes of this part of ISO 8178, the following definitions apply.

2.1 engine family: Manufacturer's grouping of engines which, through their design, are expected to have similar exhaust emission characteristics where members of the family must comply with the applicable emission limit values.

2.2 parent engine: Engine selected from an engine family in such a way that it will incorporate those features which will adversely affect the levels of the relevant exhaust components.

NOTE — Such an engine would be expected to be a comparatively high emitting engine.

3 General

A manufacturer should provide a list of engines, and their specifications, which he considers to be within a family and on the basis of tests and technical considerations agree with the parties involved which engine(s) should be selected for testing and which will give high emissions.

The selection procedure for the parent engine is such that the selected engine will incorporate those features which will adversely affect the emission level of the relevant exhaust components.

The parties involved should have the possibility of selecting a different engine, either for approval or production conformity testing, in order to have confidence that the complete family of engines complies with the requirements.

4 Parameters defining the engine family

The engine family may be defined by basic characteristics which must be common to engines within the family. In some cases there may be interaction of parameters. These effects must also be taken into consideration to ensure that only engines with similar exhaust emission characteristics are included within an engine family; e.g. the number of cylinders may become a relevant parameter on some engines due to the aspiration or fuel system used, but with other designs exhaust emission characteristics will be independent of the number of cylinders or configuration.

The engine manufacturer is responsible for defining those engines from his range which are to be included

in a family. In order that engines be considered to belong to the same engine family, the following list of basic characteristics (but not specifications) must be common.

If there are engines which incorporate other features which could be considered to affect exhaust emissions, these features must be identified and taken into account in the selection of engines to be included in the family.

a) Combustion cycle:
   - two-stroke;
   - four-stroke.

b) Cooling medium:
   - air;
   - water;
   - oil.

c) Individual cylinder displacement: engines to be within a total spread of 15 % (a deviation of more than 15 % may be used if agreed between the parties involved).

d) Number of cylinders and cylinder configuration (applicable to spark ignition engines only).

e) Method of air aspiration:
   - naturally aspirated;
   - pressure charged.

f) Fuel type:
   - diesel;
   - petrol;
   - gas;
   - alcohol;
   - other fuels.

g) Combustion chamber type:
   - open;
   - divided.

h) Valve and porting (configuration, size and number):
   - cylinder head;
   - cylinder wall;
   - crankcase.

i) Fuel system type:
   1) fuel only:
      - combination pump-line-injector,
      - in-line,
      - distributor,
      - single element pump,
      - unit injector,
      - gas valve,
      - throttle body injection;
   2) fuel and air;
   3) carburettor.

j) Miscellaneous features:
   1) exhaust gas recirculation;
   2) water emulsion or injection;
   3) air injection;
   4) charge cooling system;
   5) exhaust after-treatment:
      - oxidation catalyst,
      - reduction catalyst,
      - thermal reactor,
      - particulate trap;
   6) dual fuel;
   7) ignition type:
      - compression,
      - spark,
      - glow plug.

5 Guidelines for the choice of parent engine

Two methods are described for the selection of the parent engine. The method selected should be agreed between the parties concerned.

Method 1 is based upon selecting an engine which incorporates engine features and characteristics which, from experience, are known to make the achievement of low emissions more difficult. This method requires detailed knowledge of the engine within the family, but is typically accurate in selecting a high emitting engine (see 5.1).

Method 2 is more arbitrary since it only considers the fuel delivery rate of the engine at intermediate and rated speeds. This method is more simple to administer, but may not result in the selection of an engine with emissions as high as the other method of selection (see 5.2).

If necessary, with the agreement of the parties involved, alternative criteria for the selection of the parent engine may be established.

5.1 Method 1

The selection of the parent engine of the family in terms of exhaust emission control may be made on the basis that the engine incorporating those features which are most disadvantageous in terms of specific exhaust emissions (expressed in grams per kilowatt hour) should be chosen. The possibility of choosing more than one engine to represent the family is not excluded. The following features may be regarded as being disadvantageous, but the choice must take into account the combination of basic characteristics in the engine specification.

a) an engine whose injection control or ignition timing control is not dependent on speed;

b) an engine whose injection control or ignition timing control is not dependent on load;

c) an engine with the lowest maximum injection pressure;

d) an engine with the highest charge air temperature at the inlet to the cylinder;

e) an engine with the lowest charge air pressure at the inlet to the cylinder;

f) an engine with the least number of cylinders;

g) an engine with the lowest rated power at rated speed;

h) an engine with the lowest rated speed;

i) an engine with the lowest low idle speed;

j) an engine with the least number of fuel injection points.

If engines within the family incorporate other variable features which could be considered to affect exhaust emissions, these features must also be identified and taken into account in the selection of the parent engine.

5.2 Method 2

The parent engine of the family may be selected using the primary criterion of the highest fuel delivery per stroke at the declared maximum torque speed. In the event that two or more engines share this primary criterion, the parent engine shall be selected using the secondary criterion of highest fuel delivery per stroke at rated speed.

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