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Road vehicles — Engine EGR cooler — Heat dissipation test methods

Véhicules routiers — Refroidisseur de la vanne EGR — Méthodes d'essais de dissipation de chaleur

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Foreword

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This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 34, *Propulsion, powertrain and powertrain fluids*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Internal combustion engines used in regulated environments are fitted with cooled exhaust gas recirculation (EGR) to reduce NOx and improve fuel consumption. The EGR cooler receives gas from the exhaust system and gas is cooled by cooling liquid. This document provides manufacturers with a standardized method of measuring heat dissipation performance of the EGR cooler.

Road vehicles — Engine EGR cooler — Heat dissipation test methods

1 Scope

This document defines the methodology for the measurement of heat dissipation and pressure loss of liquid cooled engine EGR coolers in internal combustion engines for road vehicles. The principles of this document are valid for clean and fouled EGR coolers.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
EGR
technology that recirculates a portion of an engine's exhaust gas back into the intake to control the concentration of oxygen taken into the engine

3.2
EGR gas
gas that has been extracted from the exhaust gas and is passed through the *EGR cooler* (3.5) *core* (3.14)

3.3
test gas
pressurized air or exhaust gas made by burners used in place of real *EGR gas* (3.2) during the heat dissipation performance test and when measuring *EGR gas pressure loss* (3.10)

3.4
cooling liquid
water or coolant mixture during the heat dissipation performance test and when measuring *cooling liquid pressure loss* (3.11)

3.5
EGR cooler
liquid cooled heat exchanger for cooling the *EGR gas* (3.2)

3.6
EGR gas heat dissipation amount
amount of heat lost by the *test gas* (3.3) during the heat dissipation performance test

Note 1 to entry: The EGR gas heat dissipation amount is expressed in kilowatts (kW).

3.7
EGR cooler heat dissipation amount
amount of heat lost after the *EGR gas heat dissipation amount* (3.6) is corrected for the *inlet temperature difference between both fluids* (3.8) as defined upon the agreement by the parties concerned

Note 1 to entry: The EGR cooler heat dissipation amount is expressed in kilowatts (kW).

3.8
inlet temperature difference between both fluids
difference between the inlet temperature of the *test gas* (3.3) and the *cooling liquid* (3.4) that pass through the *EGR cooler* (3.5) *core* (3.14)

Note 1 to entry: The inlet temperature difference between both fluids is expressed in Kelvin (K).

3.9
EGR gas temperature effectiveness
ratio of the temperature difference of the *test gas* (3.3) between the *EGR cooler* (3.5) outlet and inlet with respect to the difference of the inlet temperature between both fluids

Note 1 to entry: The EGR gas temperature effectiveness is expressed as a percentage (%).

3.10
EGR gas pressure loss
static pressure difference of the *test gas* (3.3) between the *EGR cooler* (3.5) outlet and inlet during heat dissipation or no heat dissipation

Note 1 to entry: The EGR gas pressure loss is expressed in kilopascals (kPa).

Note 2 to entry: Total pressure difference can be used behalf of static pressure difference in case of measurement conditions are agreed by the parties concerned.

3.11
cooling liquid pressure loss
static pressure difference of the *cooling liquid* (3.4) between the *EGR cooler* (3.5) outlet and inlet

Note 1 to entry: The cooling liquid pressure loss is expressed in kilopascals (kPa).

Note 2 to entry: Total pressure difference can be used behalf of static pressure difference in case of measurement conditions are agreed by the parties concerned.

3.12
EGR gas mass flow rate
mass flow rate of the *test gas* (3.3) that passes through the *EGR cooler* (3.5) *core* (3.14)

Note 1 to entry: The EGR gas mass flow rate is expressed in kilograms per second (kg/s).

3.13
cooling liquid mass flow rate
mass flow rate of the *cooling liquid* (3.4) that passes through the *EGR cooler* (3.5) *core* (3.14)

Note 1 to entry: The cooling liquid mass flow rate is expressed in kilograms per second (kg/s).

3.14
core
part at which heat is exchanged between the *EGR gas* (3.2) and the *cooling liquid* (3.4)

4 Test items

This test evaluates the following items:

a) EGR gas heat dissipation amount or EGR gas temperature effectiveness;

b) EGR gas pressure loss;

c) cooling liquid pressure loss.

5 Test setup

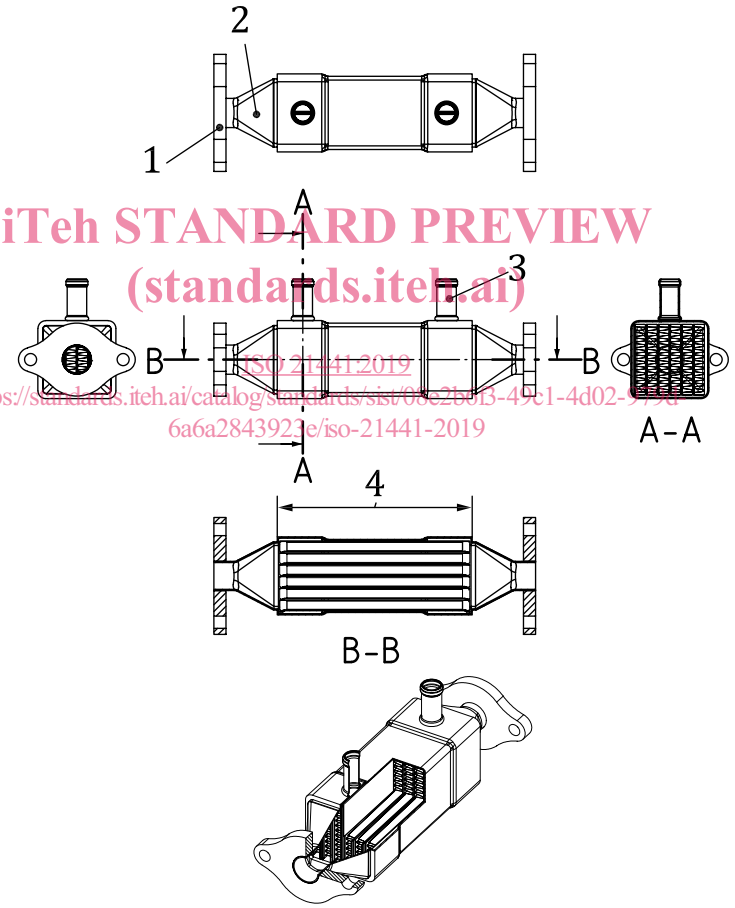
5.1 Test conditions

The EGR cooler, test gas, cooling liquid, and test location conditions are shown as follows.

In the case of measurement with the fouled EGR cooler, test conditions should be agreed by the parties concerned.

a) EGR cooler:

The EGR cooler consists of main components such as the core, tank, flanges, and pipes, as well as supplementary parts. An example is shown in Figure 1.



Key

1 flange
2 tank
3 pipe
4 core

NOTE The inlet and outlet flange can have a different flow through the cross-sectional area.

Figure 1 — EGR cooler (example)

b) Test gas:

Tests shall be run with a test gas inlet temperature, an inlet pressure and a mass flow rate that are defined upon the agreement by the parties concerned.

c) Cooling liquid:

Water used in the cooling liquid should be demineralized or treated. In the case of using a coolant mixture as the cooling liquid, the coolant type and properties of the mixture should be documented. The used fluid shall be regularly checked to confirm that the coolant mixture or properties haven't changed.

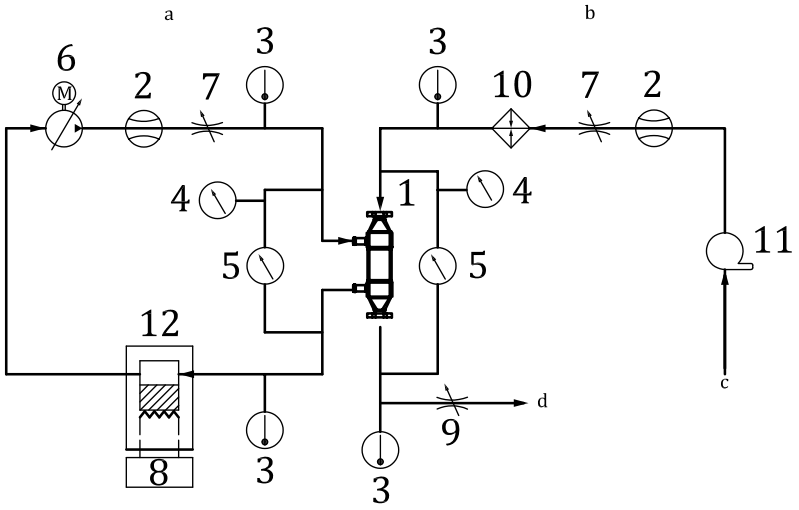
d) Test location:

Unless otherwise specified, the test location shall be kept at room temperature (5 °C to 35 °C) and normal relative humidity (20 % to 85 %).

5.2 Test equipment

5.2.1 General test equipment

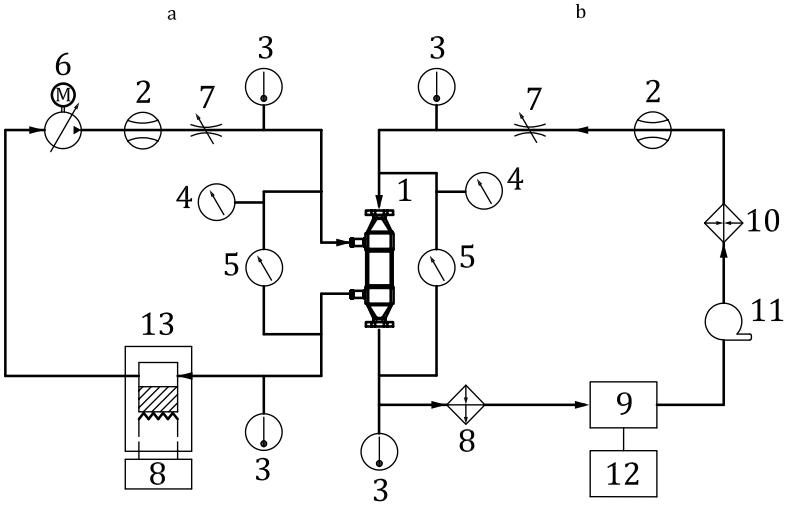
The test equipment shall be set up so that it can accurately measure the measurement items in 6.1**.** From the perspective of the test gas side structure, the test equipment can be roughly divided into two types: open type and sealed type. Both types consist of test gas and cooling liquid circuits. For sealed type test equipment, the test gas inlet pressure shall be set upon the agreement by the parties concerned.



Key

1 EGR cooler
2 flow meter
3 thermometer
4 pressure gauge
5 differential pressure gauge
6 pump
7 flow control valve
8 temperature controller
9 pressure control valve
10 heater
11 blower
12 hot water tank
a Cooling liquid side.
b Test gas side.
c Test gas.
d Open to atmospheric air.

Figure 2 — Test equipment (open type)



Key

1 EGR cooler
2 flow meter
3 thermometer
4 pressure gauge
5 differential pressure gauge
6 pump
7 flow control valve
8 temperature controller
9 pressure regulator
10 heater
11 blower
12 compressor
13 hot water tank
a Cooling liquid side.
b Test gas side.

Figure 3 — Test equipment (sealed type)

5.2.2 Test gas circuit equipment

The test gas circuit equipment shall be set up as follows.

a) The mass flow rate of the test gas that passes through the EGR cooler shall be adjustable.

b) The test gas inlet temperature shall be adjustable over the entire range of the test.

c) The measuring instrument of the test gas inlet pressure and the test gas differential pressure between the outlet and the inlet shall not be affected by the dynamic pressure and shall be connected so as not to disturb the flow of the test gas as much as possible.

5.2.3 Cooling liquid circuit equipment

The cooling liquid circuit equipment shall be set up as follows.

a) The mass flow rate of the cooling liquid that passes through the EGR cooler shall be adjustable.