

JIS

JAPANESE INDUSTRIAL STANDARD

Automotive parts — Test methods of lubricating oil filters

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Automotive parts — Test methods
of lubricating oil filters

D 1611-1995

1. Scope This Japanese Industrial Standard specifies the testing methods of the oil filters of full-flow type, bypass type and combination type used for automobile engines (hereafter referred to as "filters").

Remarks 1. The standard cited in this Standard are shown in Attached Table 1.

2. The International Standards corresponding to this Standard are shown in Attached Table 2.

2. Definitions For the purpose of this Standard, the following definitions of principal terms apply:

- (1) rated flow Maximum oil flow rate of the specified filter denoted in terms of liter per minute (L/min).
- (2) pressure drop Difference in static pressures at the inlet and outlet of the filter denoted in terms of kilopascal (kPa).
- (3) opening pressure of relief valve The pressure to open the relief valve at the time when increasing the oil flow rate of the relief valve and coming to the specified flow rate, being denoted in terms of kilopascal (kPa).
- (4) closing pressure of relief valve The pressure to close the relief valve at the time when decreasing the oil flow rate of the relief valve and coming to the specified flow rate, being denoted in terms of kilopascal (kPa).
- (5) slurry Mixture of an oil to be used for the test and contaminant.
- (6) filtering efficiency Mass ratio of petroleum ether-insoluble contents in the contaminant caught by the filter to solid contents in the added contaminant, being denoted in %.
- (7) quantity of drain back oil Quantity of oil in the filter dropping from the anti-drain valve and its vicinity, being denoted in terms of milliliter (mL).
- (8) bubble ratio Ratio of the air pressure when the air pressure is applied to the filter element (hereafter referred to as "element") in oil and the first bubble is produced from the surface of the element to the air pressure when the air flow is 3 L/min, being denoted in terms of %.

Remarks: The term of "specified" in this Standard means to be determined in accordance with the agreement between the parties concerned.

3. Test items The tests shall be conducted with respect to the following items:

- (1) Pressure drop test
- (2) Relief valve performance test
- (3) Differential pressure strength test of element

- (4) Filtering efficiency test
- (5) Impulse resistance test
- (6) Pressure-proof test
- (7) Vibration test
- (8) Drain back oil quantity test
- (9) Bubble test

4. General condition for test The condition of laboratory for each test shall be the ordinary temperature (5°C to 35°C) and the ordinary humidity (45 % to 85 %) specified in JIS Z 8703 unless specified otherwise.

5. Pressure drop test

5.1 Test condition The test condition shall be as follows:

- (1) Test oil The test oil shall be clean ⁽¹⁾, and unless specified otherwise, be as follows:

Note ⁽¹⁾ The test oil and the test apparatus are considered to be clean when circulating the test oil of test temperature in the filter for test at the rated flow rate for five min using the test apparatus and then recognizing no increase of pressure drop of the filter for the test.

- (a) The test oil for simulating in general operating conditions (hereafter referred to as "general use") shall be the oil of ISO VG 100 specified in JIS K 2001 and used at $75 \pm 3^\circ\text{C}$.
- (b) The test oil for simulating in cold conditions of operation (hereafter referred to as "cold district use") ⁽²⁾ shall be the oil of ISO VG 680 specified in JIS K 2001 and used at $45 \pm 3^\circ\text{C}$.

Note ⁽²⁾ Applying only to the full-flow type filter and the full-flow type part of the combination type filter.

- (2) Measurement of pressure difference The pressure difference shall be measured with the precision of $\pm 5\%$ and denoted with the unit of kilopascal (kPa).

5.2 Testing apparatus The testing apparatus shall be as follows:

- (1) The testing apparatus shall be clean ⁽¹⁾ and be of the device shown in Attached Fig. 1 and Attached Fig. 2
- (2) The oil tank shall be of the bottom surface of conical shape, be capable of storing sufficient oil necessary for test and be equipped with oil gauge and temperature control device.

In addition, the by-pass circuit and filter outlet pipe returning to the oil tank shall open its mouth under the oil surface within oil tank when the oil is circulating.

- (3) The discharge pressure of the pump shall be not less than 1 MPa and the discharge capacity shall be 1.2 to 1.5 times the rated flow rate for full-flow type filter and combination type filter and 5 to 10 times the rated flow rate for bypass type filter.
- (4) The throttle valves (③ and ⑩ in Attached Fig. 1 and Attached Fig. 2) shall be used for controlling pressure and flow rate (needle valve or diaphragm valve are recommended).
- (5) The flowmeter shall be capable of measuring the flow rate in the pipe coming to the filter to the nearest $\pm 2\%$.
- (6) This testing apparatus can be equipped with the following filters:
 - (a) Spin-on type cartridge filter not including cast head.
 - (b) Spin-on type cartridge filter with cast head including element relief part.
 - (c) Other filters. Usually detachable filters are used and cast head is included.
- (7) An example of typical mounting head in the case of mounting the filter written in (6) (a) is shown in Attached Fig. 3. The pressure drop of entire filter is measured in such a way that the outlet pressure pipe mounted on C is removed and the pressure outlets A and B are used. The pressure drop of the element is measured by using the charging pressure outlet A and the discharging outlet pipe at C.
- (8) In the case of the filters described in (6) (b) and (c), the inlet pipe and outlet pipe of the filter shall be the straight pipes of length of about six times the inner diameter of pipe (d) and its inner diameter shall be the same as the inner diameters of inlet and outlet of the filter.

The inner diameters of inlet pipe and outlet pipe may be based on the agreement between the parties concerned ⁽³⁾.

The outlet for measurement of pressure drop of entire filter shall be on the position distant about three times the pipe inner diameter in front of the filter inlet and about five times the pipe inner diameter in the rear of filter outlet.

Note ⁽³⁾ For example, adjust to the diameter of oil conduit of the engine block using the filter.

- (9) In the case of the filters described in (6) (b) and (c), the outlet for measuring the pressure drop of element shall be made within the filter for the test so as to connect with the upper stream side and lower stream sides of the element. These outlets are desirable to be at the position within the filter where the flow speed is not disordered even when being slow.

An example of typical housing for measuring the pressure drop of the element is shown in Attached Fig. 4.

5.3 Testing procedures The testing procedures shall be as follows:

- (1) Full-flow type filter The testing procedure for full-flow type filter shall be as follows:

- (a) Mount the filter for the test on the testing apparatus as shown in Attached Fig. 1. Make the ON-OFF valves ④ and ⑮ closed.
- (b) Put clean test oil in the oil tank ①, open the throttle valve ③, circulate the test oil making pass only through the bypass circuit and adjust the oil temperature to the test temperature. At this stage, the test oil does not pass the filter for the test.
- (c) Open the ON-OFF valve ④ when the test oil in the oil tank becomes stable at the test temperature and pour the test oil into the filter for the test at flow rate of about 50 % of rated flow rate. Make the temperature of oil the stable state again.
- (d) When the temperature of test oil at the inlet of the filter for the test becomes stable at the test temperature (confirm by the thermometer ⑤), measure the pressure drop of filter at the flow rates of 10, 40, 60, 80, 100 and 110 % of the rated filter flow rate.

The flow rate shall be adjusted by the throttle valves ③ and ⑩ for pressure and flow rate respectively so that the positive pressure is kept at the filter outlet. Before reading the pressure drop the flow rate is kept constant until the pressure is stabilized.

- (e) Carry out the procedures of (a) to (d) on the test oils for general use and cold district use.
 - (f) When measuring the pressure drop of element, carry out the same procedures using the head in 5.2 (7) or the housing in (9).
- (2) Bypass type filter The testing procedure for the bypass type filter shall be as follows:

- (a) Mount the filter for the test on the testing apparatus as shown in Attached Fig. 1. Make the ON-OFF valves ④ and ⑮ closed.
- (b) Put clean test oil in the oil tank ①, open the throttle valve ③, circulate the test oil making pass only through the bypass circuit and adjust the temperature of oil to the test temperature. At this stage, the test oil does not pass the filter for the test.
- (c) Open the ON-OFF valve ⑮ when the test oil in the oil tank becomes stable at the test temperature and pour the test oil into the filter for the test.
- (d) When the oil temperature at the filter inlet is stabilized, adjust the inlet pressure increasing 100 kPa at a time from 100 kPa to 500 kPa by using the throttle valve ③ unless specified otherwise to measure the flow rate and the pressure drop at each pressure.

- (3) Combination type filter The testing procedure for the combination type filter shall be as follows:

- (a) Mount the filter for the test on the testing apparatus as shown in Attached Fig. 2. Make the ON-OFF valve ④ closed.
- (b) Put clean test oil in the oil tank ①. Open the throttle valve ③, circulate the test oil making pass only through the bypass circuit, and adjust the oil temperature to the test temperature. At this stage, the test oil does not pass the filter for the test.

- (c) The test on the full-flow type filter part is carried out in the same procedures as in 5.3 (1) (b) to (f) by closing the ON-OFF valve ⑮ and opening the ON-OFF valve ④.
- (d) The test on the by-pass type filter part is carried out in the same procedures as in 5.3 (2) (c) to (d) by closing the throttle valve ⑩ and opening the ON-OFF valves ④ and ⑮.

5.4 Record The record shall be as follows:

- (1) Relation between pressure drop and flow rate The relation between the following pressure drop and the flow rate shall be shown graphically as in Fig. 1.
 - (a) As for the full-flow type filter and the full-flow type filter part of combination type filter, the relation between the pressure drop of entire filter and pressure drop of element, and the flow rate shall be shown for every test oil (general use and cold district use).
 - (b) As for the bypass type filter, the relation between the pressure drop of entire filter and the flow rate shall be shown for the test oil of general use.
- (2) Items to be reported The items to be reported shall be as follows:
 - (a) Testing establishment
 - (b) Filter type (manufacturer's name, type No. and lot No.)
 - (c) Date of tests
 - (d) Test oil (brand and oil temperature)
 - (e) Graph of variations

Fig. 1. Graph of relation between pressure drop and low rate (example)

- (a) Full-flow type filter and full-flow type filter part of combination type filter

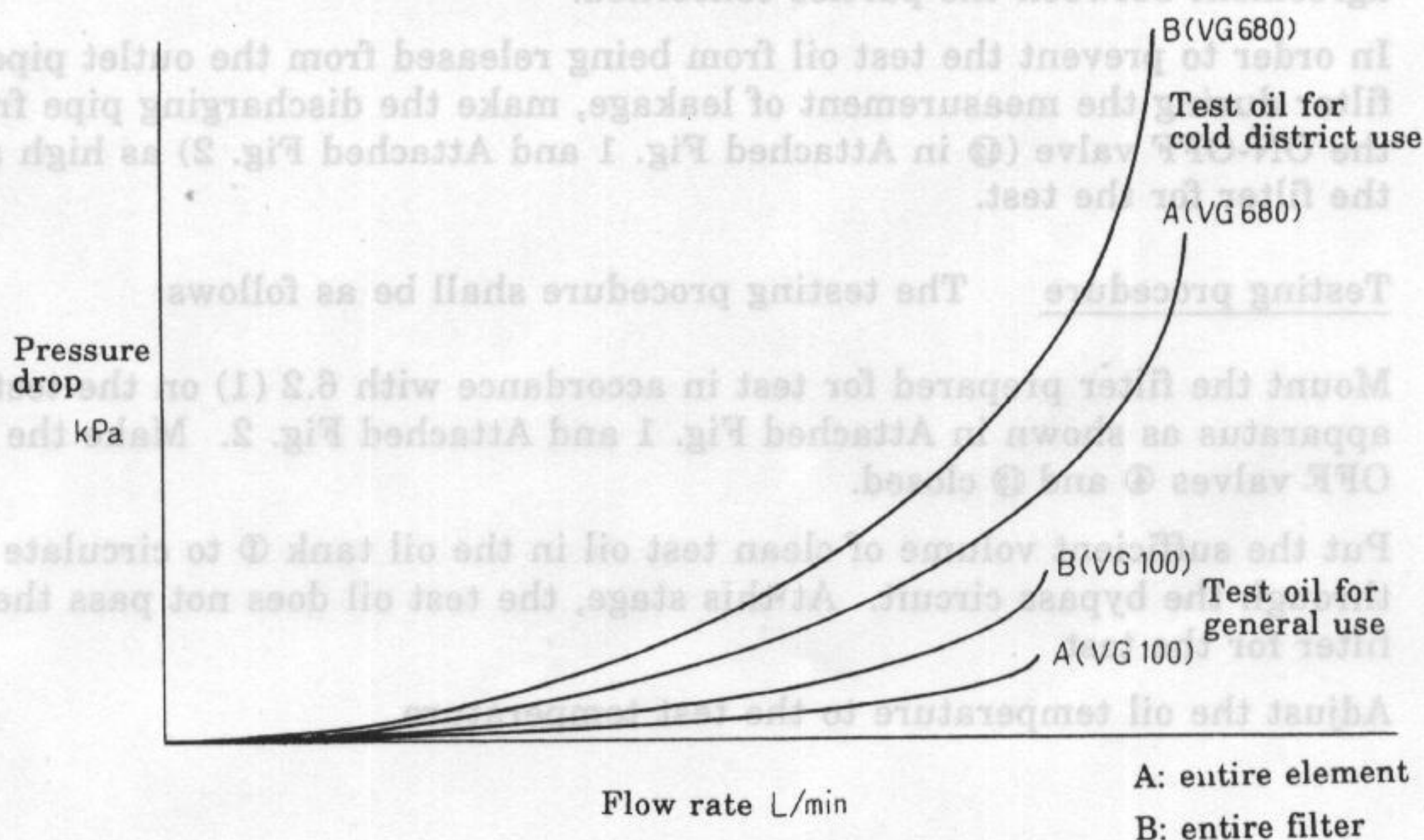
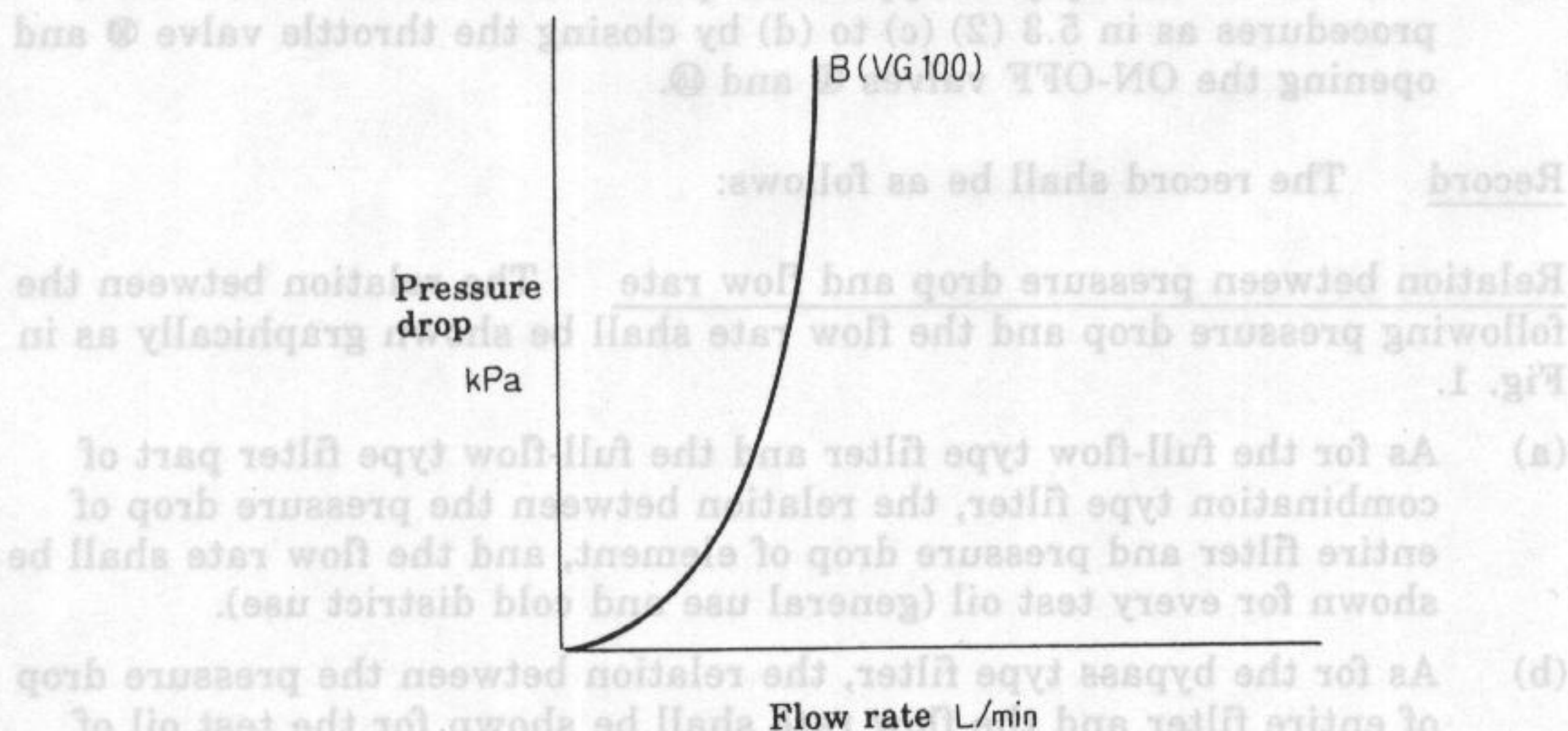


Fig. 1. (continued)

(b) Bypass type filter and bypass type filter part of combination type filter



6. Relief valve performance test

6.1 Test condition The test oil and the oil temperature shall be in accordance with 5.1 (1) unless specified otherwise.

6.2 Testing apparatus The following apparatus shall be used in addition to those in 5.2.

- (1) Remove the element from the filter and mount in place of it a dummy element of the same dimension that does not let oil pass through. In the case where the element cannot be replaced readily as in the case of spin-on cartridge filter, take the relief valve away and carry out the test in other housing. The shape of the housing shall be in accordance with the agreement between the parties concerned.
- (2) In order to prevent the test oil from being released from the outlet pipe of filter during the measurement of leakage, make the discharging pipe from the ON-OFF valve (⑫ in Attached Fig. 1 and Attached Fig. 2) as high as the filter for the test.

6.3 Testing procedure The testing procedure shall be as follows:

- (1) Mount the filter prepared for test in accordance with 6.2 (1) on the testing apparatus as shown in Attached Fig. 1 and Attached Fig. 2. Make the ON-OFF valves ④ and ⑮ closed.
- (2) Put the sufficient volume of clean test oil in the oil tank ① to circulate only through the bypass circuit. At this stage, the test oil does not pass the filter for the test.
- (3) Adjust the oil temperature to the test temperature.

- (4) When the oil temperature in the oil tank becomes stable, pour the test oil in the relief valve at a rate of about 50 % of the rated flow rate of filter and stabilize the oil temperature again.
- (5) When the temperature of test oil at the filter inlet is stabilized at the test temperature (confirm by the thermometer ②), send the oil into the discharging pipe ⑬ from the ON-OFF valve and return the collected oil to the oil collecting tank. Make the flow rate of relief valve zero several times.
- (6) Increase gradually the inlet pressure of the relief valve by 10 kPa at a time from 60 % of the specified valve opening pressure until coming up to the specified flow rate.

At each stage of pressure, collect the oil flowing out of the ON-OFF valve ⑪ in a measuring cylinder to measure the amount that leaked at each pressure. The time taken for collection of sample shall be measured by a stopwatch.

Prior to collecting the sample, confirm the leakage to become stable. At this time, pay attention to the valve opening pressure of the relief valve.

- (7) Change the ON-OFF valve ⑪ to increase the flow rate up to 110 % of the rated flow rate of filter by 10 % of it at a time and measure the pressure drop of the relief valve at each flow rate.

Adjust the flow rate to the test flow rate by means of the throttle valves ③ and ⑩ for adjusting the pressure and the flow rate. Make effort to keep the positive pressure at the filter outlet. Accession to each flow rate shall be made in the order from lower flow rate. Before reading the pressure drop, keep the flow rate constant until the indication of pressure becomes stable for 10 s or more.

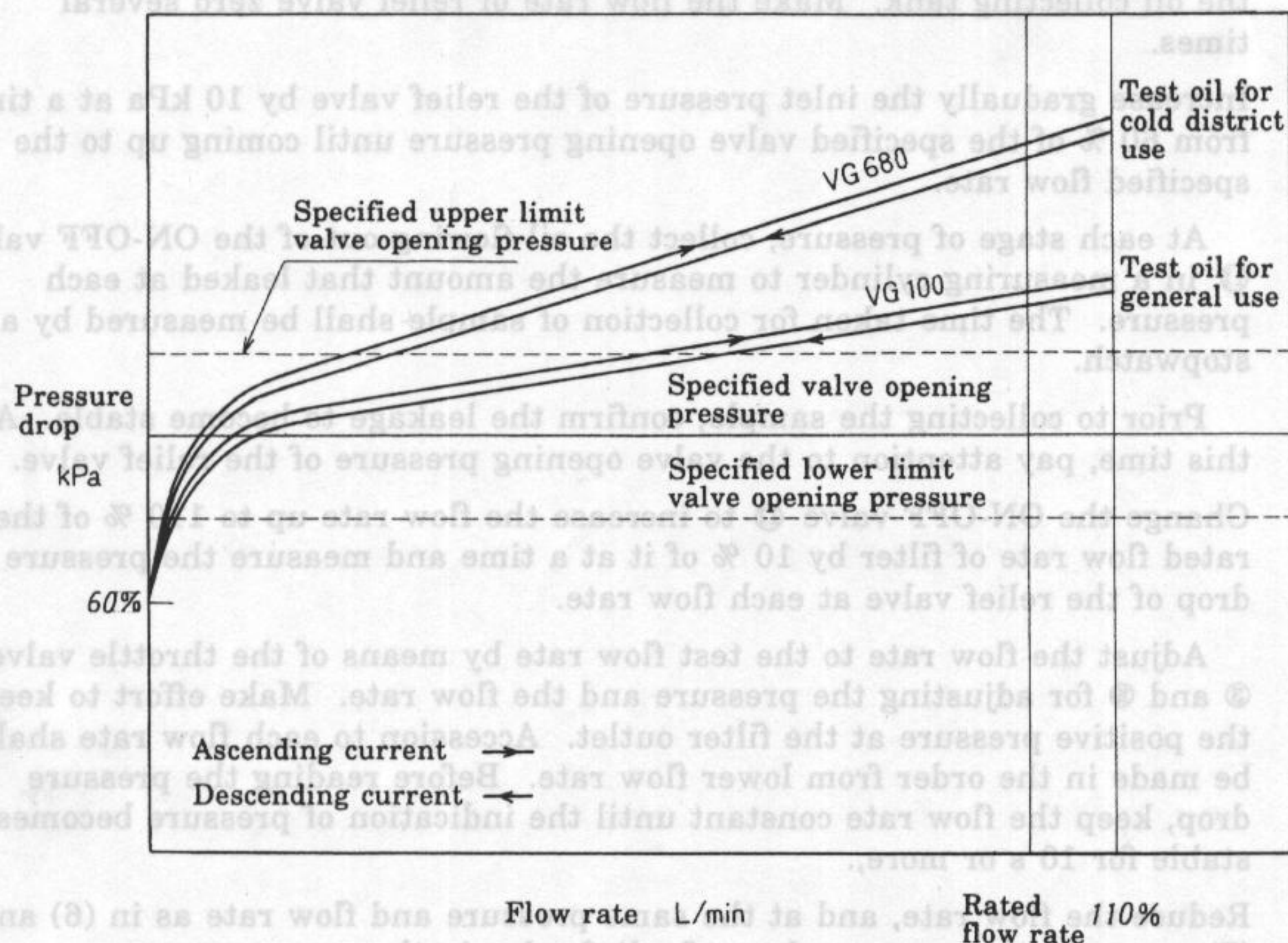
- (8) Reduce the flow rate, and at the same pressure and flow rate as in (6) and (7), measure the pressure drop of relief valve in the same manner. However, the accession to each pressure and flow rate shall be made in the order from higher stage. At this time, attention shall be paid to the valve closing pressure of the relief valve.
- (9) When the pressure drop decreases down under 60 % of the designated valve opening pressure of relief valve, measure the amount of leakage at this pressure in accordance with (6).
- (10) Carry out the procedures in (1) to (9) on the test oils for general use and cold district use.

6.4 Record The record shall be as follows:

- (1) Relation between pressure drop and flow rate The relation between the pressure drop of relief valve and the flow rate shall be shown graphically for every test oil (general use and cold district use) as shown in Fig. 2.
- (2) Items to be reported The items to be reported shall be as follows:
 - (a) Testing establishment
 - (b) Filter type (name of manufacturer, type No. and lot No.)
 - (c) Date of test
 - (d) Test oil (brand and oil temperature)

- (e) Graph of variations
(f) Amount of leakage at the pressure of 60 % of the specified valve opening pressure

Fig. 2. Graph of relation between pressure drop and flow rate of relief valve (example)



7. Differential pressure strength test of element

7.1 Test condition The test oil shall be the oil of ISO VG 680 specified in JIS K 2001 and the oil temperature during the test be 100°C or lower unless specified otherwise.

7.2 Testing apparatus The testing apparatus shall be the same as in 5.2.

7.3 Testing procedures The testing procedures shall be as follows:

- (1) Differential pressure strength test of element The testing procedure for the differential pressure strength test of element shall be as follows:
 - (a) The filter for the test shall be a new product.
 - (b) The test flow rate shall not be more than the rated flow rate of filter.
 - (c) If relief valve is equipped, the relief valve shall be restrained from operating.
 - (d) It shall be confirmed prior to the test that the element is free from defect, in accordance with 13.