



400 Commonwealth Drive, Warrendale, PA 15096-0001

# SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J968/1

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Submitted for recognition as an American National Standard

## DIESEL INJECTION PUMP TESTING—PART 1: CALIBRATING NOZZLE AND HOLDER ASSEMBLIES

**Foreword**—This Reaffirmed Document has been changed only to reflect the new SAE Technical Standards Board format.

This SAE Recommended Practice is similar to ISO 7440/1.

The calibrating nozzle and holder assemblies are intended to simulate closely the function of the nozzle and holder assemblies in the fuel injection system of a diesel engine. They are flow gauges and require careful handling and maintenance.

The manufacturer of the injection equipment and/or the manufacturer of the engine shall specify the type of calibrating nozzle and holder assembly, the appropriate single hole orifice plate size or pintle nozzle (as applicable), high pressure pipes, exact limits, etc., to be used.

1. **Scope**—This part of SAE J968 specifies two types of calibrating nozzle and holder assemblies intended for the testing and setting of diesel injection pumps on test benches.

It applies to:

- a. A calibrating nozzle and holder assembly with a single hole orifice plate;
- b. A calibrating nozzle and holder assembly with a delay pintle type nozzle.

The approximate range of the calibrating nozzle and holder assembly is up to:

- a. 300 mm<sup>3</sup>/stroke with the single hole orifice plate;
- b. 150 mm<sup>3</sup>/stroke with the delay pintle type nozzle.

Setting and maintenance requirements are specified in ISO 4008/3.

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## 2. References

**2.1 Applicable Publications**—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J967—Calibration Fluid for Diesel Injection Equipment  
SAE J968/2—Orifice Plate Flow Measurement

2.1.2 ISO PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO 2697—Road vehicles—Fuel injection nozzles—Size “S”  
ISO 2699—Road vehicles—Flange-mounted injection nozzle holders size “S”—Types 2, 3, 4, 5, and 6  
ISO 4008/3—Road vehicles—Fuel injection pump testing—Part 3: Application and test procedures  
ISO 4010—Road vehicles—Calibrating nozzle, delay pintle type  
ISO 4093—Road vehicles—Fuel injection pumps—High pressure pipes for testing  
ISO 4113—Road vehicles—Calibration fluid for diesel injection equipment  
ISO 7440/1—Road vehicles—Fuel injection equipment testing—Part 1: Calibrating nozzle and holder assemblies  
ISO 7440/2—Road vehicles—Fuel injection equipment testing—Part 2: Orifice plate flow-measurement

**3. Required Characteristics**—The functionally critical dimensions are shown in the following diagrams:

### 3.1 Calibrating Nozzle and Holder Assemblies

With single hole orifice plate, Figure 1.  
With delay pintle type nozzle, Figure 2.

### 3.2 Components

Holder body with and without vent, Figure 3.  
Spring, standard, and low rate, Figure 4.  
Inlet stud with edge filter, Figure 5.  
Suggested edge filter flow measuring system, Figure 6.

NOTE—The outlet of the fixture (within the dotted lines) shall be at ambient pressure.

Needle valve assembly, Figure 7.  
Single hole orifice plate and flow ranges, Figure 8.  
Delay pintle type nozzle is specified in ISO 4010.  
Distance sleeve, Figure 9.  
Retaining nuts, Figures 10 and 11.

## 4. Designation

**4.1 General Example**—There are many possible combinations of nozzle, nozzle holder, nozzle retaining nut, and nozzle opening pressure. To facilitate identification of calibrating nozzle and holder assemblies, they shall be designated in code form as given by the following example:

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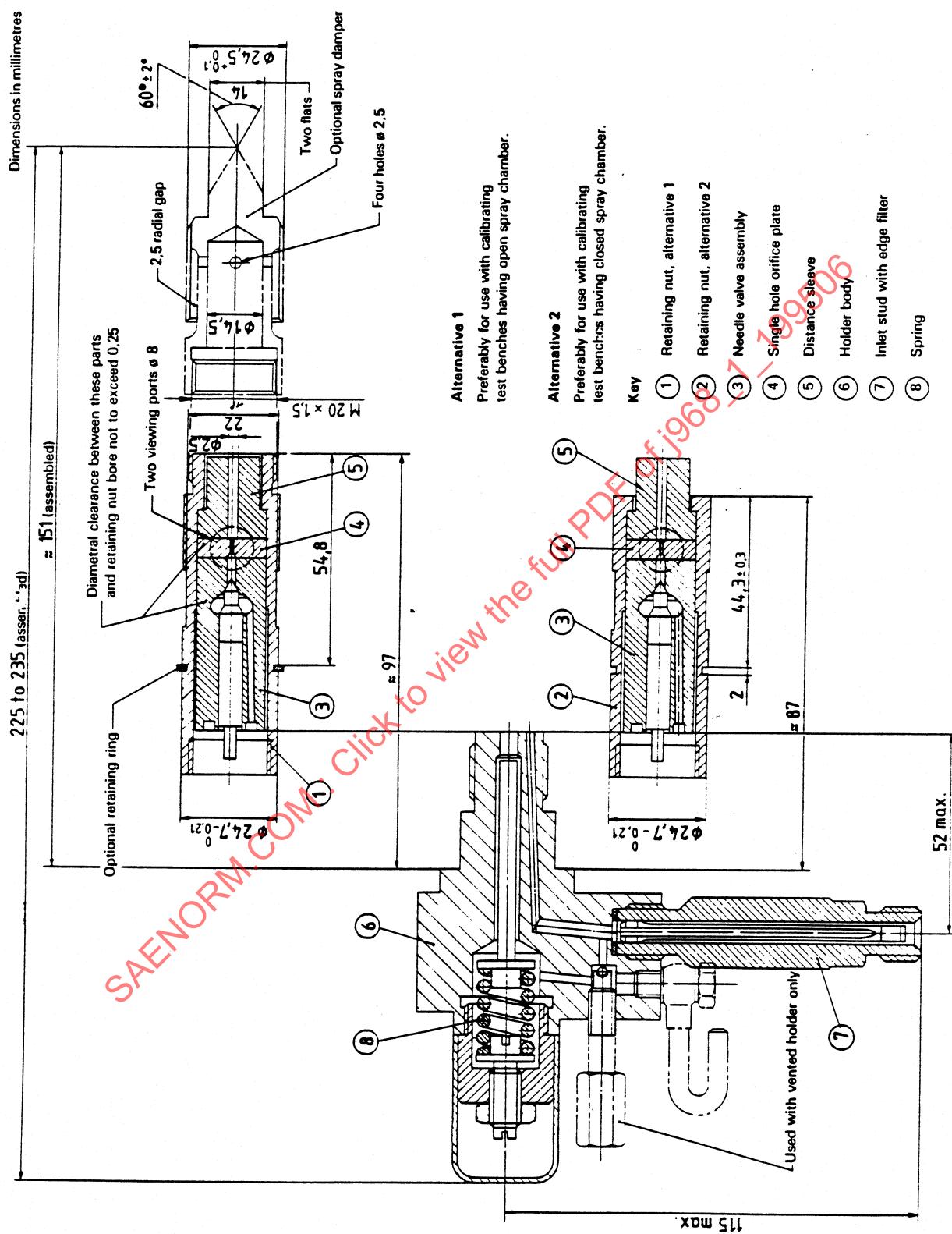


FIGURE 1—CALIBRATING NOZZLE AND HOLDER ASSEMBLY WITH SINGLE HOLE ORIFICE PLATE

Dimensions in millimetres

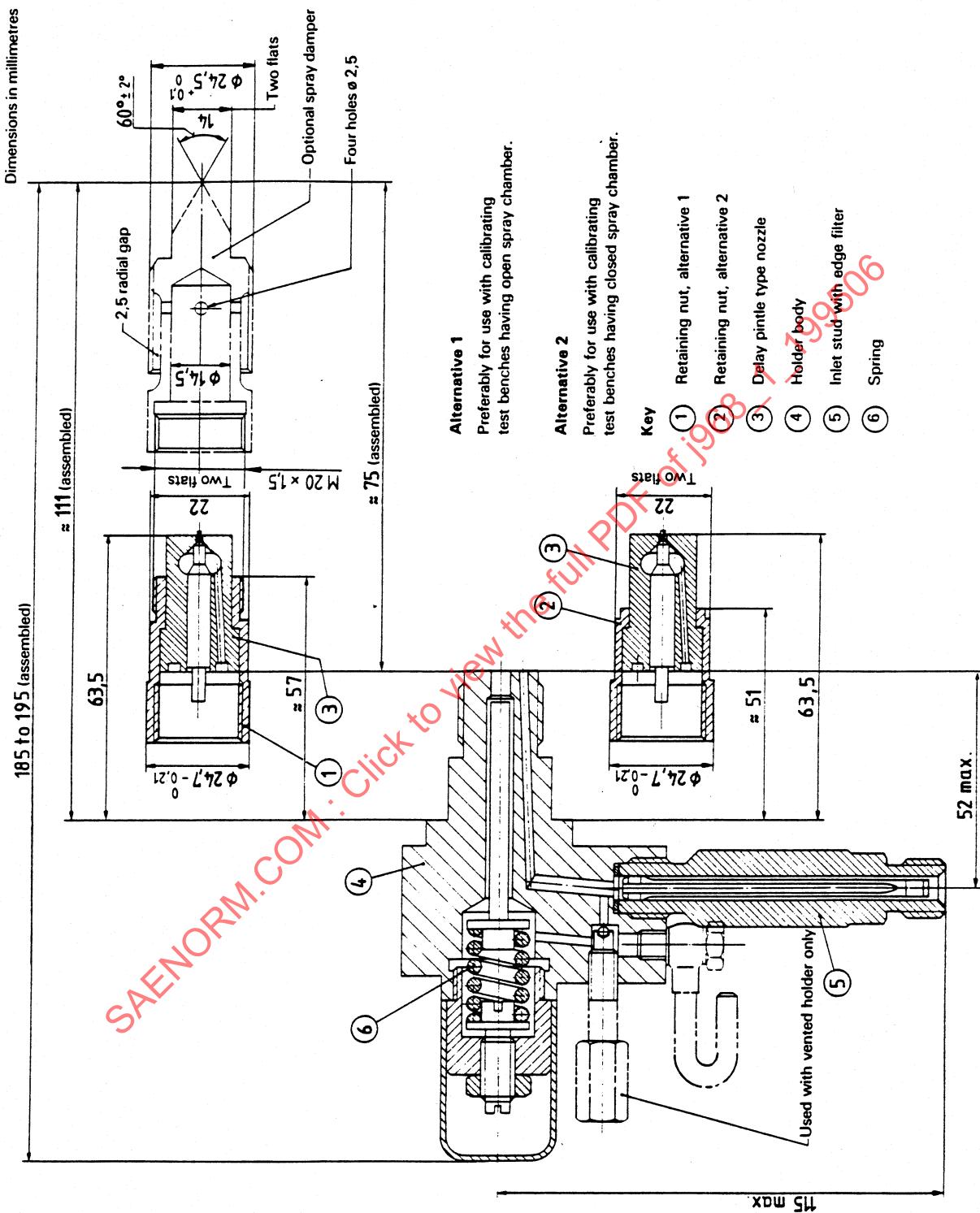


FIGURE 2—CALIBRATING NOZZLE AND HOLDER ASSEMBLY WITH DELAY PINTLE TYPE NOZZLE

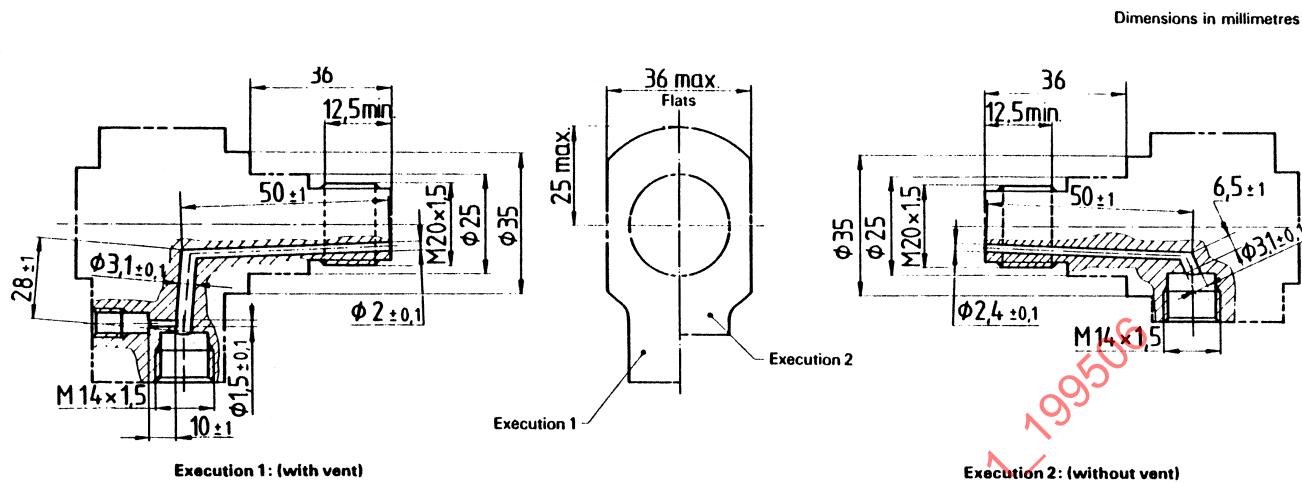


FIGURE 3—HOLDER BODY

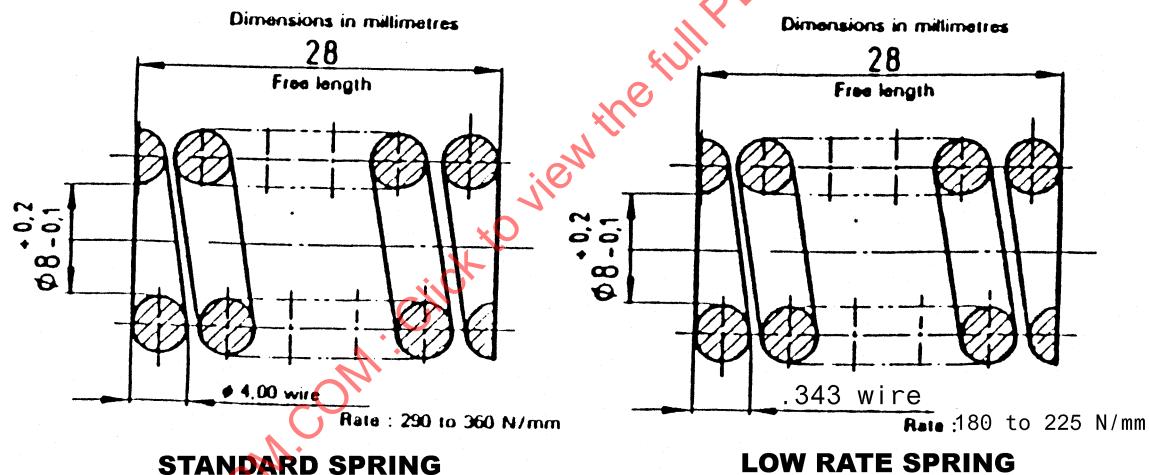
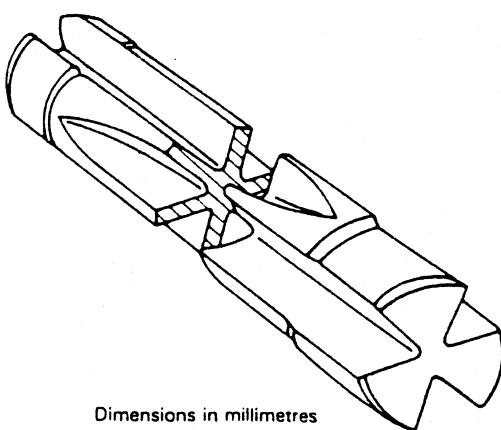
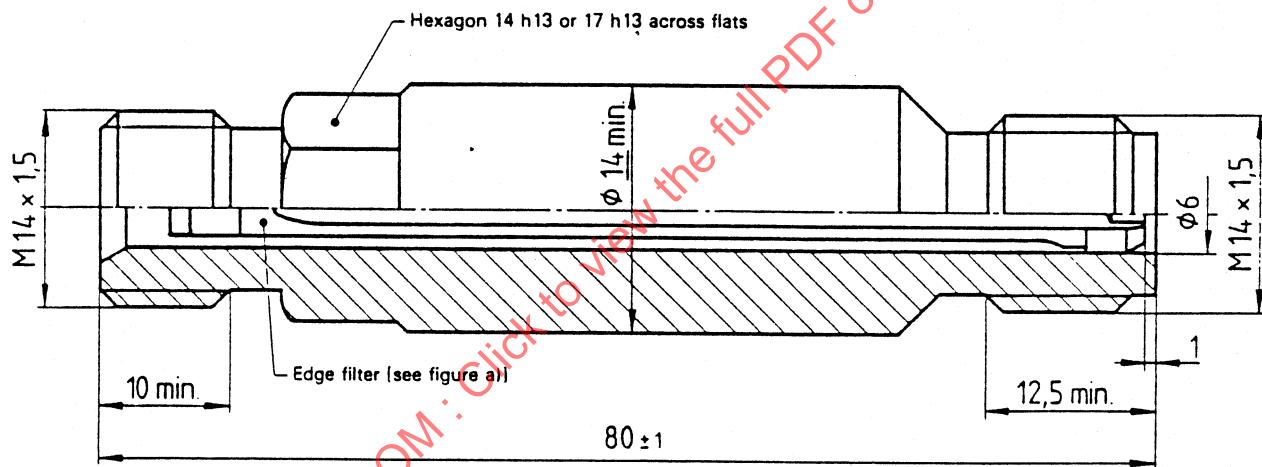


FIGURE 4—SPRINGS



a) Edge filter with flutes (schematic)



b) Inlet stud with edge filter

Characteristic	Value
Filter clearance (radial)	0,02 mm to 0,033 mm
Filter clearance area	7,3 mm <sup>2</sup> min.
Flow area for three flutes (see figure a)]	7,5 mm <sup>2</sup> min.
Internal volume	1 450 mm <sup>3</sup> ± 40 mm <sup>3</sup>
Filter flow at 0,3 MPa (3 bar) pressure <sup>1)</sup>	4 750 cm <sup>3</sup> /min to 6 500 cm <sup>3</sup> /min
Minimum flow of assembled holder body with inlet stud and edge filter at 0,3 MPa (3 bar) pressure <sup>1)</sup>	2 000 cm <sup>3</sup> /min

1) These tests shall be made using calibration fluid as specified in ISO 4113 at 40 °C ± 1 °C and the tolerance of the supply pressure shall be ± 0,03 MPa (0,3 bar).

FIGURE 5—CHARACTERISTIC DIMENSIONS AND VALUES OF INLET STUD WITH EDGE FILTER

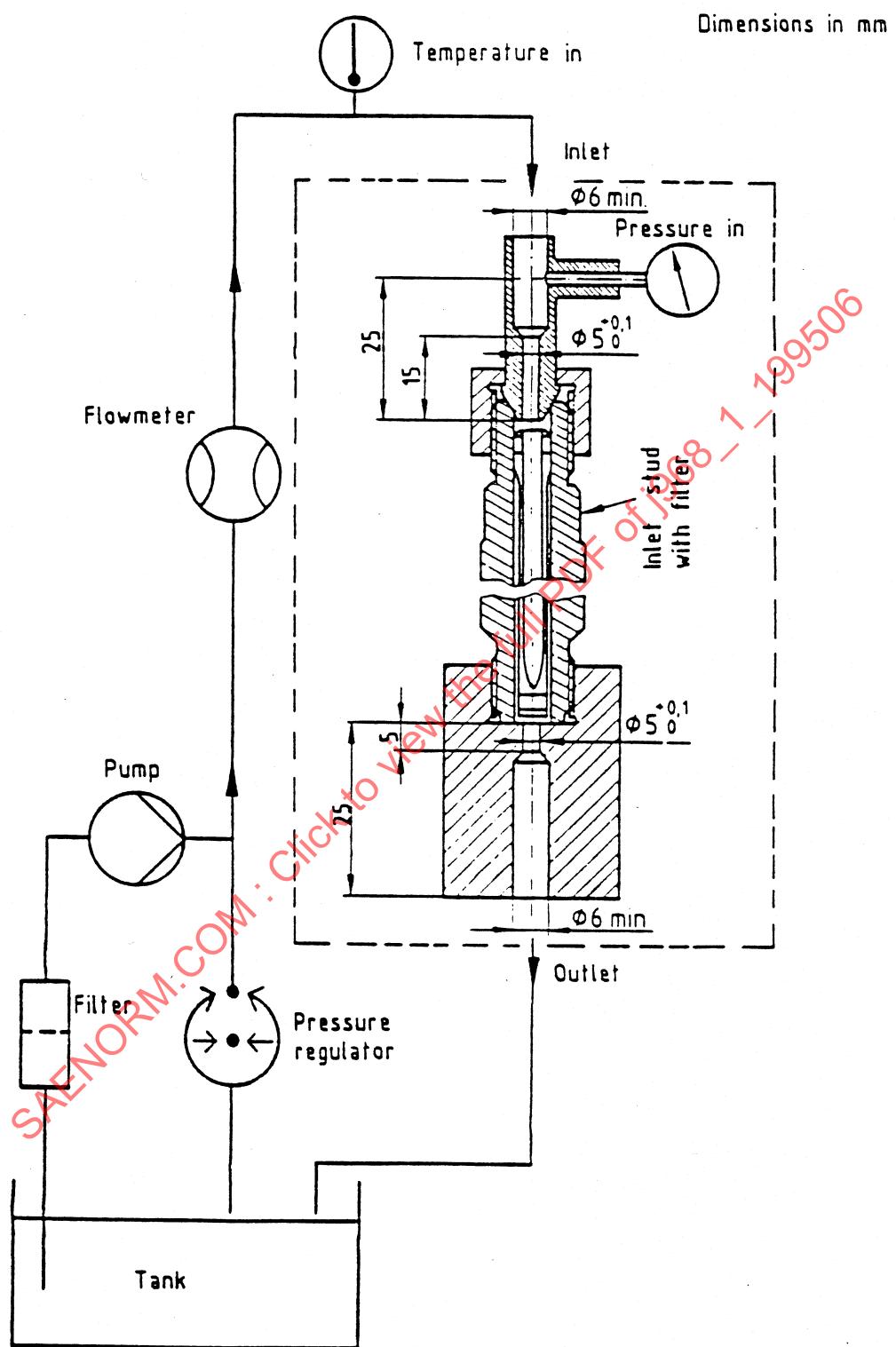


FIGURE 6—INLET STUD FLOW MEASURING SYSTEM

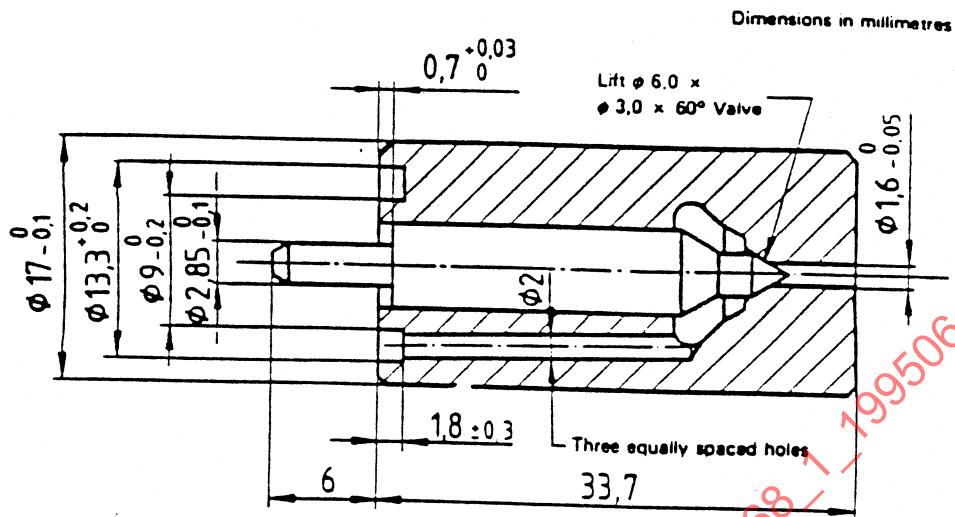
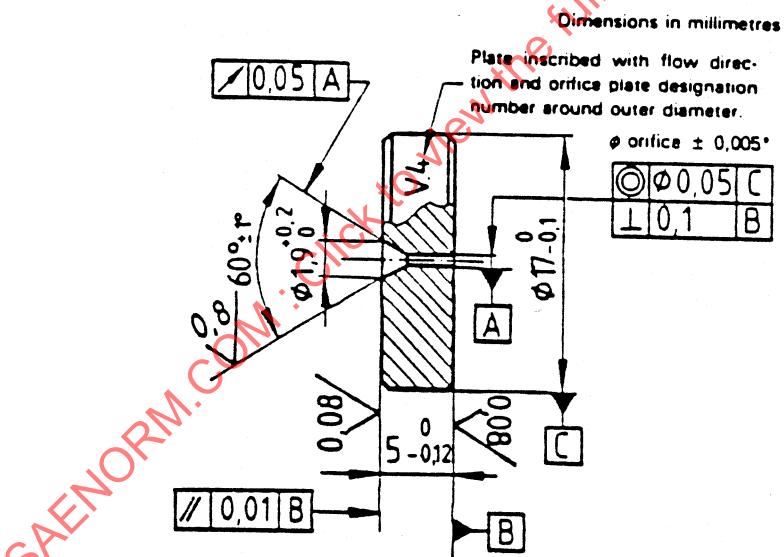


FIGURE 7—NEEDLE VALVE ASSEMBLY



• Tolerance of orifice hole is only a guide for manufacturing. Its purpose is to assist in meeting the final static flow limits specified in the table when flow-tested under the test conditions described in part 2 of ISO 7440.

Orifice plate number	.4	.5	.6	.7	.8	
Orifice diameter, mm	0.4	0.5	0.6	0.7	0.8	
Flow cm <sup>3</sup> /min	min.	964	1 528	2 190	3 024	3 948
	max.	1 014	1 606	2 302	3 180	4 150

FIGURE 8—SINGE HOLE ORIFICE PLATE

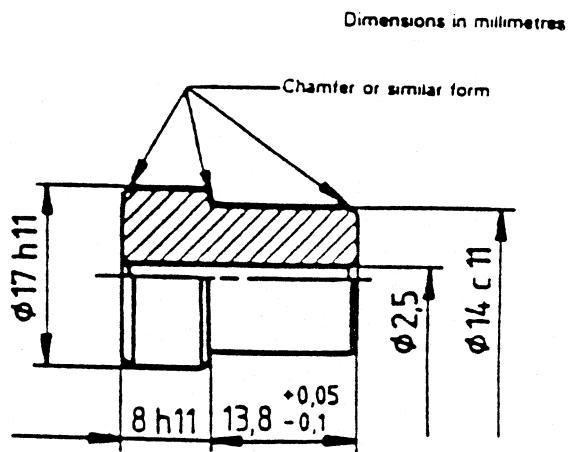


FIGURE 9—DISTANCE SLEEVE

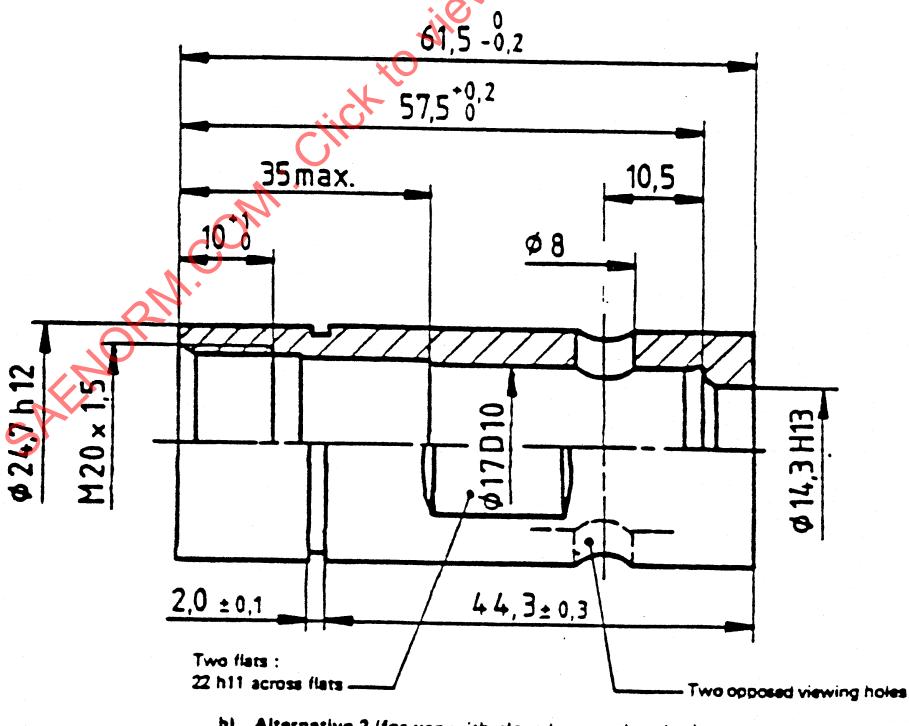
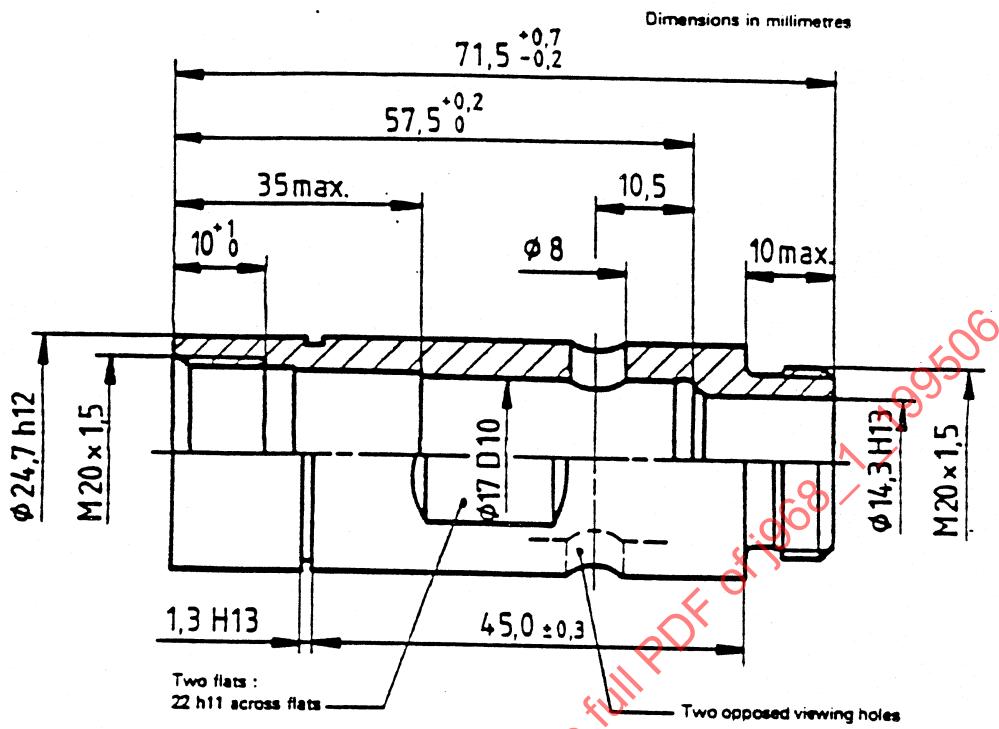
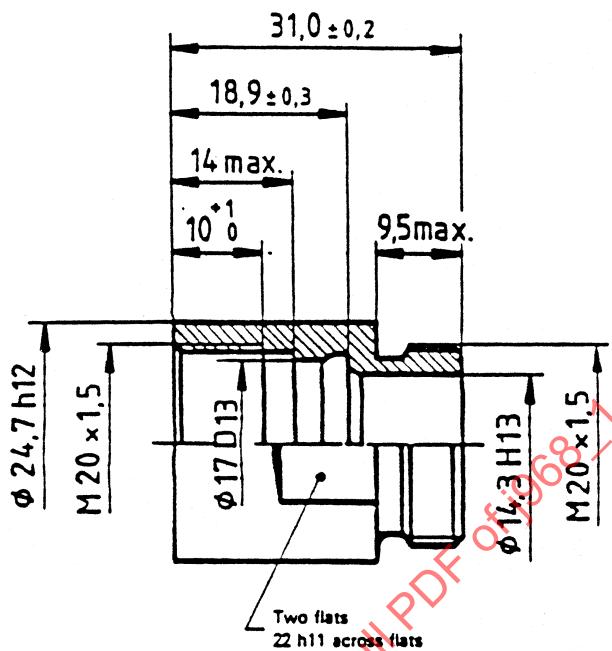
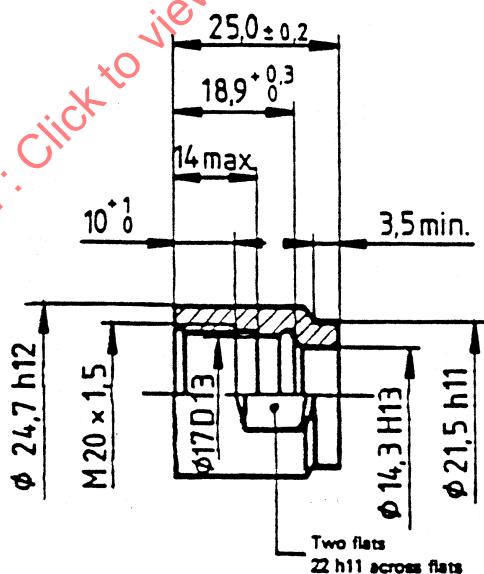


FIGURE 10—RETAINING NUTS (CAPNUTS) FOR CALIBRATING NOZZLE AND HOLDER ASSEMBLY WITH SINGLE HOLE ORIFICE PLATE

Dimensions in millimetres



a) Alternative 1 (for use with open spray chamber)

b) Alternative 2 (for use with closed spray chamber)<sup>1)</sup>

1) Retaining nut as specified in ISO 2699 (nozzle holder type 2) and in ISO 2697 (dimensions and tolerances of the nozzle capnut).

FIGURE 11—RETAINING NUTS (CAPNUTS) FOR CALIBRATING NOZZLE AND HOLDER ASSEMBLY  
WITH DELAY PINTLE TYPE NOZZLE