
नेमी विश्लेषण सिगरेट-धूम्रपान मशीन —
मशीन के सत्यापन हेतु अतिरिक्त परीक्षण
पद्धतियाँ

(पहला पुनरीक्षण)

**Routine Analytical Cigarette -
Smoking Machine — Additional Test
Methods for Machine Verification**
(*First Revision*)

ICS 65.160

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FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Tobacco and Tobacco Products Sectional Committee had been approved by the Food and Agriculture Division Council.

The standard was first published in 2019 under dual numbering as identical adoption of ISO 7210 : 2013 'Routine analytical cigarette-smoking machine — Additional test methods for machine verification' issued by International Organization for Standardization (ISO).

Subsequently, ISO 7210 : 2013 was revised as ISO 7210 : 2018, wherein the requirements given by the intense smoking regime described in ISO 20778 was included and a description for a soap film bubble flowmeter for the determination of the puff volume has been added. Alignment of Indian standard with Intense Smoking Regime of ISO was not found suitable in Indian conditions. This Indian Standard has accordingly been revised to update the standard and to publish it as an indigenous standard excluding the requirements given by the intense smoking regime described in ISO 20778.

While formulating this standard, necessary consideration has also been given to the relevant rules and regulations prescribed by the Government of India under the *Cigarettes and Other Tobacco Products Act (COTPA)*, 2003 and the *Legal Metrology (Packaged Commodities) Rules*, 2011.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'.

Indian Standard

ROUTINE ANALYTICAL CIGARETTE-SMOKING MACHINE — ADDITIONAL TEST METHODS FOR MACHINE VERIFICATION

*(First Revision)***1 SCOPE**

1.1 This standard specifies additional test methods for routine analytical cigarette-smoking machines intended to check the conformity of these machines with IS 16022. The test methods prescribed in this standard are for testing pressure drop, puff profile, restricted smoking and puff volume.

1.2 This standard does not deal with actual smoking, which is described in other Indian Standards.

2 REFERENCES

The standards listed below contain provisions, which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below:

<i>IS No.</i>	<i>Title</i>
IS 16022 : 2015	Routine analytical cigarette-smoking machine — Definitions and standard conditions (<i>first revision</i>)
IS 16023 : 2021	Cigarettes — Determination of total and nicotine-free dry particulate matter using a routine analytical smoking machine (<i>first revision</i>)
IS 16121 : 2013	Tobacco and tobacco products — Atmosphere for conditioning and testing

3 DEFINITIONS

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

3.1 Bubble — Liquid film of surface-active agent/wetting agent solution extending over the cross section of a pipe.

3.2 Channel — Element of a smoking machine

consisting of one or more cigarette holders, one trap and a means of drawing a puff through the trap.

3.3 Port — Aperture of the suction mechanism through which a puff is drawn and to which is attached a smoke trap.

3.4 Pressure Drop — Static pressure difference between the two ends of a pneumatic circuit (of a smoking machine) when it is traversed by an air flow under steady conditions in which the measured volumetric flow, under standard conditions, at the output end is 17.5 ml/s.

3.5 Puff Duration — Interval of time during which the port of a smoking machine is connected to the suction mechanism.

3.6 Puff Profile — Flow rate measured directly behind the butt end of the cigarette, and depicted graphically as a function of time.

3.7 Puff Volume — Volume of smoke leaving the butt end of a cigarette and passing through the smoke trap of a smoking machine.

3.8 Restricted Smoking — Condition that exists when the butt end of a cigarette is closed to the atmosphere between successive puffs.

3.9 Smoulder Stream Smoke — All smoke which leaves the butt end of the cigarette during the interval of time between successive puffs.

4 DETERMINATION OF PRESSURE DROP**4.1 Principle**

Measurement, under well-specified air flow conditions, of the pressure drop of a smoking machine by means of an appropriate manometer.

4.2 Apparatus

The test apparatus shall be capable of:

- a) Sucking a constant flow of air which is unaffected by the pressure drop of the system under test; and

- b) Measuring the pressure drop with sufficient accuracy.

4.3 Test Atmosphere

All measurements shall be carried out under standard ambient conditions of temperature and relative humidity as specified in IS 16121.

4.4 Procedure

4.4.1 General

The flow of air through the smoking machine shall always be in the same direction as during the puffing cycle, that is from the cigarette to the suction source. The air used for measurement shall be from the test atmosphere.

4.4.2 Testing

4.4.2.1 Connect the manometer, M , as indicated in Fig. 1A and set it to zero.

4.4.2.2 Connect the flowmeter, F , as indicated in Fig. 1B and establish an air flow of (17.5 ± 0.5) ml/s.

4.4.2.3 Disconnect the flowmeter, F , and if needed in regard to **4.4.2.4** attach a suitable length of wide-bore tubing, W , to the test head point, H , as indicated in Fig. 1C. Read the pressure, if any, on the manometer, M . Record the value as PD_1 .

4.4.2.4 Attach the free end of the wide-bore tubing, W , to the point in the smoking machine from which the puffing source was disconnected as indicated Fig. 1D. Read the pressure on manometer, M . Record the value as PD_2 .

4.4.2.5 Calculate the pressure drop $(PD_2 - PD_1)$.

4.4.2.6 Repeat the operation for each channel of the smoking machine.

4.5 Expression of Results

The following values shall be recorded:

- a) Pressure drop for each channel, in Pascals; and
- b) Test atmosphere used.

5 DETERMINATION OF SIGNIFICANT PUFF PROFILE PARAMETERS

5.1 Principle

Continuous measurement of the flow rate of air of a puff through a pressure drop device of $(1\ 000 \pm 50)$ Pa (see IS 16022).

5.2 Apparatus

5.2.1 The apparatus shall comprise the elements shown in the principle diagram (Fig. 2) that is the diagram of elements required for the two alternative measuring systems, A and B, with two different levels of sophistication.

5.2.2 System A

The signal delivered by the pressure transducer is linearized by appropriate circuits and transmitted to an integrator and a recording apparatus. The system can record a picture of the puff profile and measure its volume.

5.2.3 System B

This system uses digital conversion and a computer to produce the same information as it is given by system A.

5.2.4 Requirements for Both Systems

The device shall not increase the pressure drop of the system above the limit of 300 Pa and the overall gain and response of the system shall be sufficient to visualize the puff profile and determine its significant parameters. A sufficient result will be achieved by the use of elements that fulfil the following conditions:

- a) Laminar flow element having a nominal pressure drop of $100\text{ Pa} \pm 10\text{ Pa}$, at a flow of 17.5 ml/s; and
- b) Pressure transducer with a suitable range, an accuracy of $\pm 5\text{ Pa}$ or better with a minimal response frequency of 1 kHz.

The above apparatus provides the means to obtain flow rate and time profiles for puffing as shown in IS 16022.

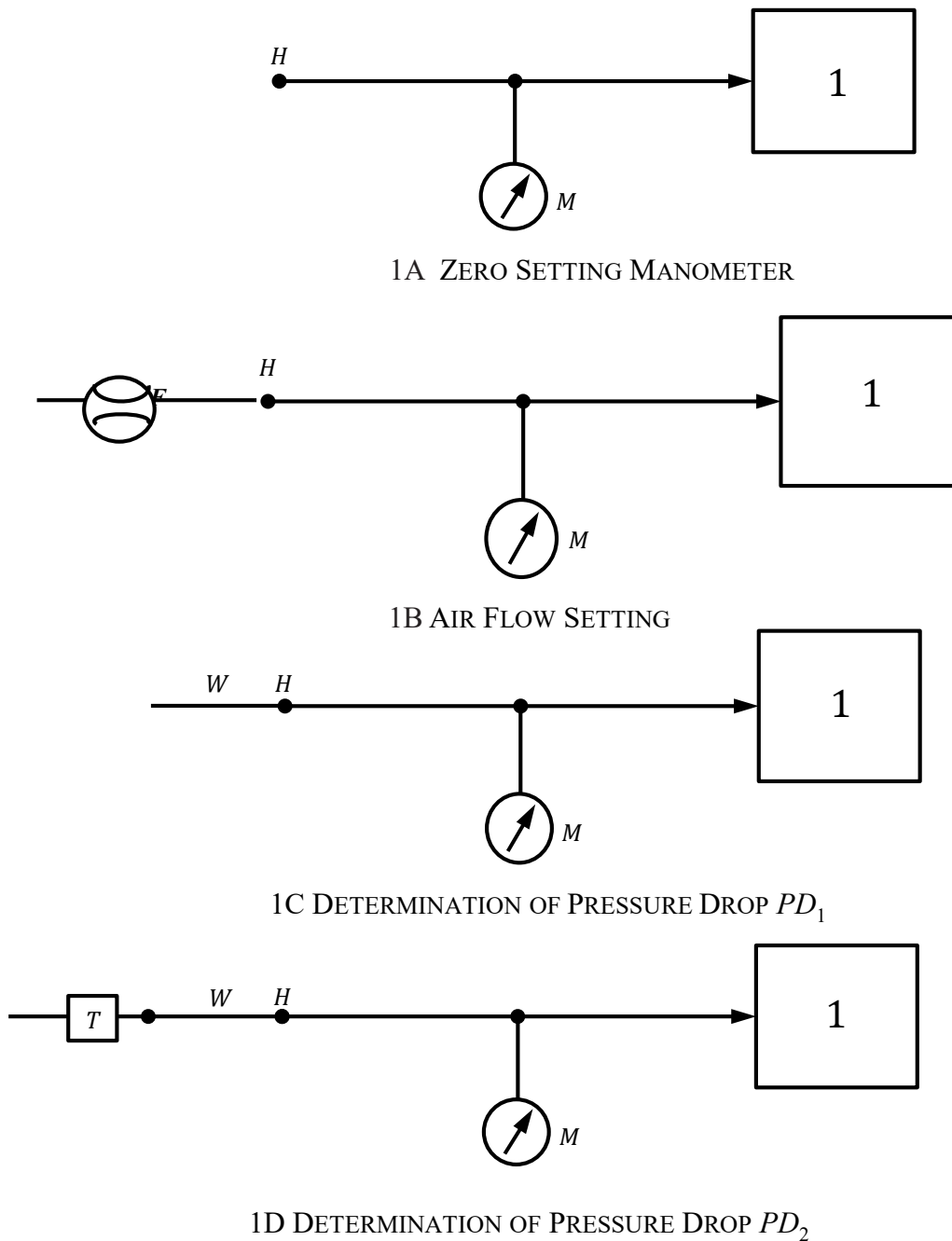
NOTE — Measurement of puff volume, by either system A or system B, can only be a secondary measurement following calibration by reference to a primary device such as a soap film burette as described in 7.

5.2.5 Expression of Results

The following results need to be reported:

- a) Total drawn puff volume, in ml;
- b) Maximum flow rate, in ml/s;
- c) Time between starting and reaching the maximum flow rate, in s;
- d) Volume drawn after the time the puffing source ceases to apply suction, in ml; and
- e) Total puff duration, in s.

The target values for the above parameters are given in IS 16022.



Key

- 1 - Flow generator
- H - Test head point
- F - Flowmeter
- W - Wide-bore tubing
- T - Smoking machine under test
- M - Manometer

NOTE — Arrows indicate the direction of air flow.

FIG. 1 PNEUMATIC CIRCUIT OF A TYPICAL APPARATUS

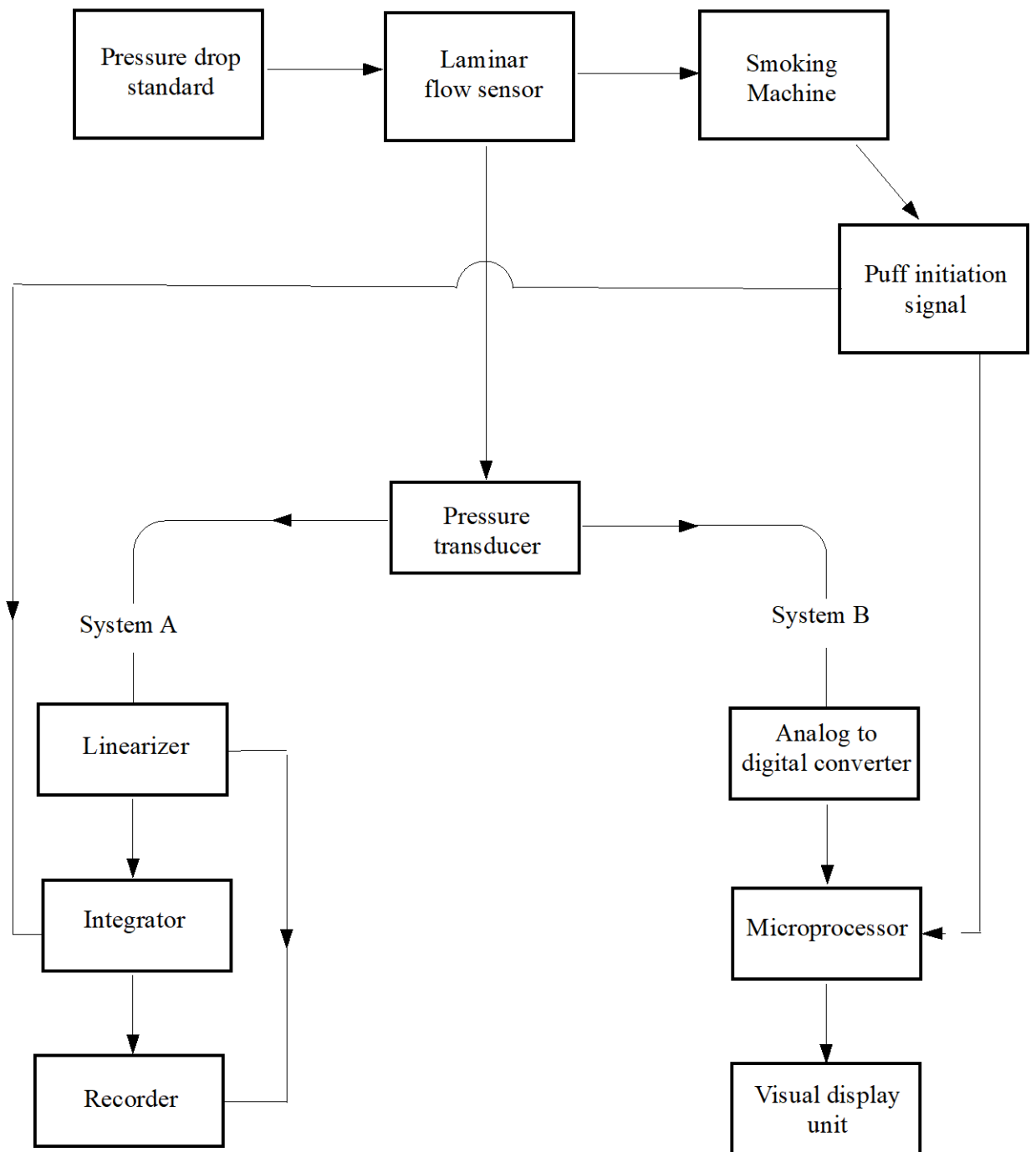


FIG. 2 PRINCIPLE DIAGRAM

6 VERIFICATION OF RESTRICTED SMOKING

6.1 Principle

Measurement of the volume of the smoulder stream smoke between two puffs for machines of discontinuous function or between two suction strokes for machines of continuous function.

NOTE — For smoking machines with permanent connection of the port to the suction device, this test is not necessary.

6.2 Apparatus

Apparatus permitting an assembly as shown in Fig. 3, so that:

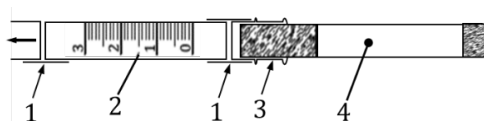
- Length of a soap film bubble flowmeter does not exceed 12 cm; and
- There is close contact between the smoke port or the cigarette holder, the soap film bubble flowmeter and the cigarette.

6.3 Procedure

Smoke the first half of a cigarette without using the test unit. Introduce and adjust a soap bubble in the soap film bubble flowmeter as described in the supplier's manual. Connect the test unit to the smoke port or cigarette holder and insert the cigarette into it. Carry out the test during smouldering of the second half of the total length of the cigarette. On linear machines the test should be performed for at least 1 min. On rotary machines it should be performed over a full rotation.

6.4 Expression of Results

Note the flow rate of the smoulder stream smoke, in ml/min, for each channel of the smoking machine. The result shall not exceed 1 ml/min.



Key

- 1 - Rubber connection;
- 2 - Soap film bubble flowmeter;
- 3 - Cigarette holder or glass tube; and
- 4 - Cigarette.

FIG. 3 DIAGRAM OF TEST APPARATUS FOR RESTRICTED SMOKING

7 SOAP FILM BUBBLE FLOWMETER FOR THE DETERMINATION OF THE PUFF VOLUME

7.1 General

This clause describes the apparatus of a soap bubble flowmeter used for the determination of the puff volume as specified in IS 16023.

7.2 Principle

The burette is moistened with wetting agent solution and connected to the smoking position of the smoking machine. A bubble is generated and adjusted to the zero-mark of the burette. Upon release of a puff, the bubble is displaced by the puff volume of the smoking machine and thus indicates the actual puff volume amount. Fig. 4 shows the principal design of a soap film bubble flowmeter.

7.3 Apparatus

7.3.1 Glass Burette

The glass burette for 35 ml has a zero-point mark at the lower part and a scale from 34 ml to 36 ml at the upper part, with an accuracy of ± 0.2 ml and 0.1 ml graduation. The glass burette for 55 ml has a zero-point mark at the lower part and a scale from 54 ml to 56 ml at the upper part, with an accuracy of ± 0.5 ml and 0.2 ml graduation.

7.3.2 Bubble Generation

The apparatus shall have a device for generating the bubble.

7.3.3 Bubble Positioning

The apparatus shall have a device for positioning the bubble at the zero-point mark.

7.3.4 Wetting

The apparatus shall have a device for wetting the inner surface of the glass burette over the full measuring range with wetting solution.

7.3.5 Wetting Solution

Wetting solution as specified by the supplier of the soap bubble flowmeter in the corresponding manual should be used.

7.4 Procedure

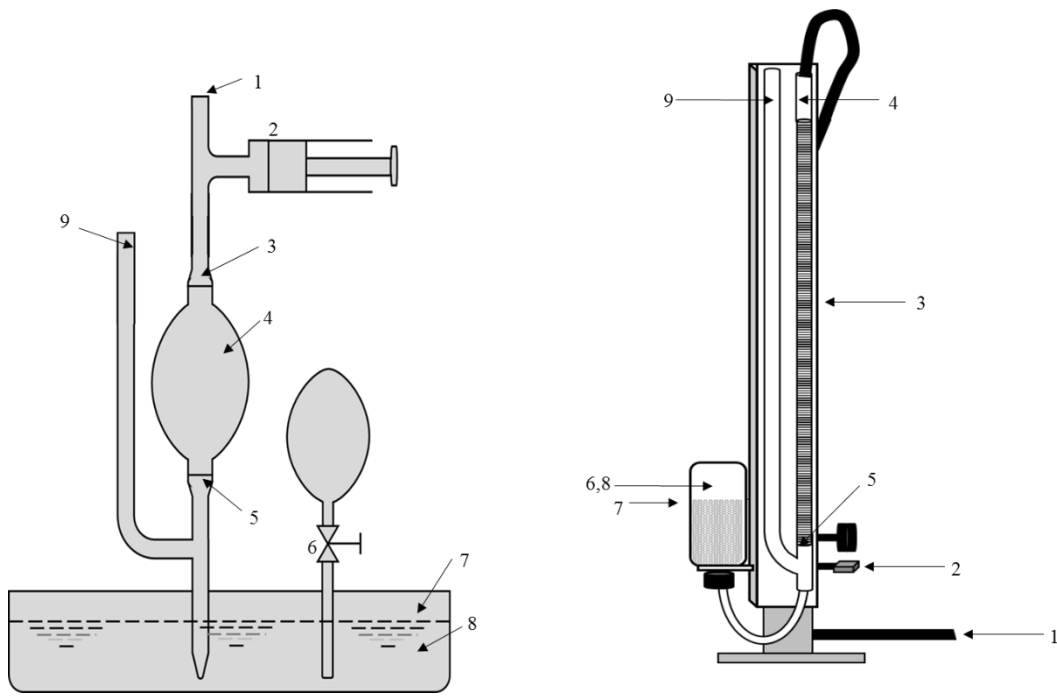
7.4.1 Preparation

For wetting the inner surface of the burette, pump the wetting liquid slowly up over the full measuring range, then slowly lower the liquid level. Since the accuracy of the measurement is influenced by the thickness of the soap film, wait at least 30 s before starting a measurement. If some bubbles remain in the burette, repeat the wetting procedure to clear the burette completely, otherwise wrong measurement results can occur. It is recommended that the wetting solution as specified by the supplier of the soap bubble flowmeter in the corresponding manual is used.

7.4.2 Performing a measurement

Determination of puff volume shall be performed according to IS 16023.

- a) Warm up the smoking machine (if necessary);
- b) Prepare the corresponding adapter required for use with the respective smoking machine and connect it to the device;
- c) Pump up the wetting solution a little above the connection of the bypass for bubble generation [Fig. 4, key reference (j)]. Upon flowing back of the solution, a bubble is generated in the burette;
- d) Adjust bubble to the zero-mark;
- e) Release from the smoking machine the puff to be measured;
- f) Read the measuring value in ml at the graduation of the burette; and
- g) Generate a new bubble and repeat the measurement procedure three times in order to ensure a high accuracy of the measurement. If the bubble bursts during a measurement procedure, rewetting of the burette is recommended. If this does not help, cleaning of the burette is required.



Key

- 1 - Suction port;
- 2 - Device for bubble positioning;
- 3 - Mark of nominal volume;
- 4 - Glass burette;
- 5 - Zero-point mark;
- 6 - Hand pump used for wetting and bubble generation;
- 7 - Level of wetting agent solution;
- 8 - Sealed container with wetting agent solution; and
- 9 - Bypass for bubble generation.

FIG. 4 SOAP FILM BUBBLE FLOWMETER: PRINCIPAL DESIGN OF TWO EXAMPLES

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This Indian Standard has been developed from Doc No.: FAD 04 (19904).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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