# INTERNATIONAL STANDARD ISO 3822/I

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# Acoustics — Laboratory tests on noise emission by appliances and equipment used in water supply installations — Part I : Method of measurement

*Acoustique — Mesure en laboratoire du bruit émis par les appareils et l'équipement utilisés dans les installations de distribution d'eau —*
*Partie I : Méthode de mesure*

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## FOREWORD

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 3822/I was developed by Technical Committee ISO/TC 43, *Acoustics,* and was circulated to the member bodies in september 1975.

It has been approved by the member bodies of the following countries :

| | | |
|---|---|---|
| Australia | Germany | Portugal |
| Austria | Hungary | Romania |
| Belgium | India | South Africa, Rep. of |
| Brazil | Korea, Dem. P. Rep. of | Spain |
| Canada | Mexico | Sweden |
| Czechoslovakia | Netherlands | Switzerland |
| Denmark | New Zealand | Turkey |
| Egypt, Arab Rep. of | Norway | |
| France | Poland | |

No member body expressed disapproval of the document.





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# Acoustics — Laboratory tests on noise emission by appliances and equipment used in water supply installations — Part I : Method of measurement

## 0 INTRODUCTION

Noise caused by water supply installations may lead to annoyance in adjacent rooms, for example in dwellings, hospitals and hotels, especially at night. This noise has its origin mainly in appliances. Standardized measurements of such noise are needed to permit comparison of the noise of commercial products made in different countries.

This International Standard describes a measuring method to achieve such comparable results in laboratory measurements.

The basic arrangements are given. However, it does not seem practicable to describe them in such detail that sound pressure levels due to, for example, a given tap would give the same results in different laboratories. This difficulty is overcome by the principle that the measuring results are always compared with those for an installation noise standard which is carefully described. This procedure can also be regarded as a kind of calibration of the measuring arrangement.

The test conditions described here constitute the standard reference conditions essential for comparisons between laboratories. This has been checked in an international "round robin" test using an appliance of which the noise spectrum was comparable in shape with that of the installation noise standard.

Other test conditions, including variation in such elements as the test pipe, pipe brackets or test wall, may be investigated by this method but should be related to the standard reference conditions described herein by appropriate calibration tests.

The installation noise standard may also be useful for prediction of plumbing noise levels in the field. In the field the sound pressure level produced by an appliance may be too low to be measured with sufficient accuracy. In that case, it can be calculated by measuring the sound pressure level produced by an installation noise standard, mounted in place of the appliance, and subtracting from this level the difference, as measured in the laboratory, between the sound pressure levels caused by the installation noise standard and the appliance under consideration.

Descriptions of the mounting and operating conditions for different types of appliances are given in subsequent parts of this International Standard.

In national standards the method given in this International Standard could be supplemented by a calculation method to enable an estimate to be made of the appliance sound level expected in buildings.

## 1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies a method of measurement, in the laboratory, of the noise emission resulting from the flow of water through appliances and equipment used in water supply installations.

The items covered include, for example, drain valves, globe valves, pressure reducers and water-heating appliances, all of which are hereafter referred to in brief as "appliances".

The method specified makes it possible to obtain comparable results of measurements in different laboratories.

## 2 REFERENCES

ISO/R 49, *Malleable cast iron pipe fittings screwed in accordance with ISO Recommendation R 7.*

ISO 65, *Steel tubes for screwing in accordance with International Standard ISO 7.*

ISO/R 468, *Surface roughness.*

IEC Publication 179, *Precision sound level meters.*

IEC Publication 225, *Octave, half-octave and third-octave band filters intended for the analysis of sounds and vibrations.*

## 3 DEFINITIONS

**3.1 sound level (A) :** The weighted sound pressure level measured with the A-weighting specified in IEC Publication 179. It is expressed in decibels, symbol dB. In tables and diagrams the abbreviation dB(A) is used.

**3.2 octave band sound pressure level :** The unweighted sound pressure level in the frequency band of one octave. It is expressed in decibels, symbol dB. For the requirements of octave-band filters, see IEC Publication 225.

**3.3 standardized level difference $D_s$** : Defined by :

$$D_s = L_s - L$$

where

$L_s$ is the average sound level (A) or the average octave-band sound pressure level with mid-frequencies of 125 Hz through 4 000 Hz in the test room, due to the noise produced by the installation noise standard at a water pressure of 3 bar[1] (see clause 9);

$L$ is the corresponding level of the noise produced by the appliance under test under specified conditions.

**3.4 appliance sound level $L_{ap}$** : A characteristic value of noise emission for appliances. The appliance sound level $L_{ap}$ is defined by :

$$L_{ap} = L_{sr} - D_s$$
$$= L + (L_{sr} - L_s)$$

where $L_{sr}$ is a reference level (in sound level A or in octave-bands).

In that case $L_{ap}$ is higher the noisier the appliance is (see also clause 9).

## 4 PRINCIPLE

The appliance to be tested is mounted at the end of a water pipe, the test pipe, which is fixed to the wall of a room. The wall is called the test wall, the room the test room (see figure 1).

The sound generated by the appliance is transmitted from the test pipe to the test wall. The airborne sound which is radiated from the test wall into the test room is measured.

In order to obtain comparable measurements in different laboratories, the noise produced by the appliance is compared with the noise produced by an installation noise standard.

## 5 TEST ARRANGEMENT (see figure 1)

### 5.1 Test room

The test room shall have a volume of at least 30 $m^3$. For new laboratories a volume of approximately 50 $m^3$ is recommended.

Two opposite surfaces of the test room shall not be less than 2,3 m apart.

In the test room a reverberation time between 1 and 2 s is recommended. It should not vary with frequency by more than plus or minus 10 % in the octave-bands with frequencies of 125 Hz through 2 000 Hz.

The sound field in the test room shall be sufficiently diffuse.



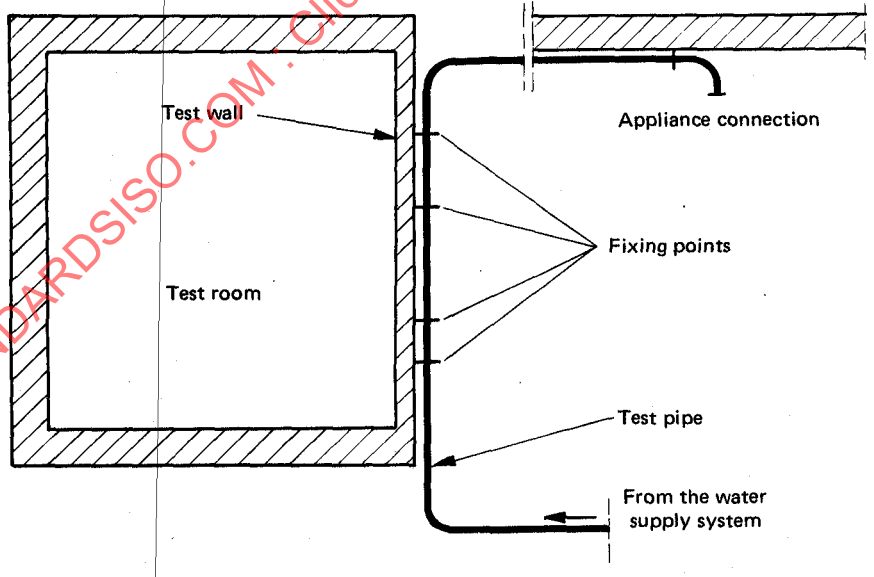



FIGURE 1 — **Example of test arrangement**

1) 1 bar = $10^5$ Pa

### 5.2 Background noise

For measurement of sound level (A) or octave-band sound pressure level, the background sound level shall be at least 10 dB below the level produced by the appliance under test.

NOTE – This in general requires a background sound level of less than 30 dB or, for testing very quiet appliances, even less than 20 dB.

The airborne sound transmitted through the test wall into the test room and which is produced during the testing of the appliance must also be considered when determining the background sound level. The same applies to structure-borne sound not originating from the appliance under test.

For measurements in octave-bands the readings need no correction if they exceed those due to the background noise alone by at least 10 dB. When the difference is less than 10 dB, a correction as given in table 1 shall be applied.

TABLE 1 – **Corrections due to background noise for measurements in octave-bands**

| Decibel increase in level produced by the appliance | Decibels to be subtracted from measured value |
|---|---|
| 3 | 3 |
| 4 to 5 | 2 |
| 6 to 9 | 1 |

When corrections of 3 dB are applied, the corrected levels shall be reported in brackets. When the increase is less than 3 dB, measurements in general cease to have any significance.

### 5.3 Test wall

The test wall shall have an area of 8 to 12 $m^2$.

It shall be a single wall of masonry or poured concrete and have a mass per unit area between 100 and 250 $kg/m^2$.

### 5.4 Test pipe

The test pipe shall be a galvanized steel tube of medium series according to ISO 65 with a nominal bore of 25 mm (1 in).

The test pipe shall be fixed to the test wall outside the test room. It shall be mounted rigidly and durably approximately in the middle of the wall in a straight line by means of four brackets, which are spaced unequally over approximately the whole length of the wall. The pipe shall be clamped rigidly in the brackets (without insulation). Non-metallic pegs shall not be used. There shall be no other connections between test pipe and test wall. The test pipe shall be accessible for periodic inspection of the mounting.

It shall be possible to vent the test pipe, for example by using drain valves. It is recommended that the test pipe be mounted sloping slightly upwards in the direction of flow.

The test pipe ends at the connection for the appliance.

The length of test pipe between the appliance connection and the first fixing point on the test wall (see figure 1) shall be not less than 2 m and not more than 10 m.

### 5.5 Connection of appliances

The end of the test pipe shall be fixed rigidly with brackets (without insulation). It shall be fixed not to the test wall but, for example, to another wall.

At the end of the test pipe there shall be a branch for connecting a pressure gauge and a coupling or fitting for mounting the appliances to be tested. It shall be possible to vent this branch. Details of the connections for testing of different types of appliances are given in subsequent parts of this International Standard.

NOTE – A flow meter shall not be placed between the appliance to be tested and the part of the test pipe mounted on the test wall, nor shall the flow meter be mounted on the test wall or any other wall of the test room.

### 5.6 Water supply system

The water supply system shall be so designed that tests can be carried out over the usable range of flow pressure and flow rate of the appliances to be tested.

NOTE – As a rule, for appliances as used in dwellings, the following ranges are sufficient :

- flow pressure : up to 5 bar
- flow rate : up to 2 l/s

For testing pressure regulators a flow pressure range up to 10 bar is recommended.

The intrinsic noise of the water supply system shall be insulated from the test pipe and the test room, if necessary with the aid of silencing devices. The water used during the test shall be discharged quietly. The water temperature shall be not more than 25 °C.

### 5.7 Equipment for stabilization and checking of the test arangement

The following equipment is recommended :

a) A low-noise shut-off valve adjacent to the appliance connection in order to keep the test pipe under pressure at all times, including, for example, when changing the appliance, or when connecting the installation noise standard.

b) A free outlet near the connection of the appliance, for flushing the pipe.

c) A control installation noise standard according to clause 7 for constant supervision of the measuring arrangement.

Figure 2 shows an example of an arrangement of this equipment.

### 5.8 Testing of intrinsic noise of installation arrangement

The intrinsic noise of the installation arrangement (water supply system, test pipe, connection of appliances) shall be measured. For this purpose the appliance connection shall be fitted with a low-noise water outlet. The test shall be carried out at various flow rates. The sound level (A) of the intrinsic noise shall be considerably lower than that of the appliance to be tested (at least 10 dB).

## 6 TEST EQUIPMENT

### 6.1 Sound level meter

Precision sound level meters according to IEC Publication 179 shall be used, indicating speed "slow" being recommended.

Alternative measuring equipment, including for example a level recorder, may be used provided its overall electro-acoustic performance conforms to the relevant clauses of IEC Publication 179.

### 6.2 Hydraulic measuring instruments

The water pressure shall be determined with an accuracy of plus or minus 5 % or better.

NOTES

1 To achieve this accuracy over the whole range, the use of precision instruments with an accuracy of plus or minus 1 % and a range of not more than 5 bar is recommended.

2 To be sure that only the static pressure is measured, the branch for connecting the pressure gauge shall be carefully designed. To minimize errors in flow pressure measurement at high flow rates, the branch shall be located approximately 0,15 m upstream of the appliances to be tested. The instrument for measuring water pressure shall be calibrated frequently.

The flow rate shall be determined with an accuracy of plus or minus 3 % or better.

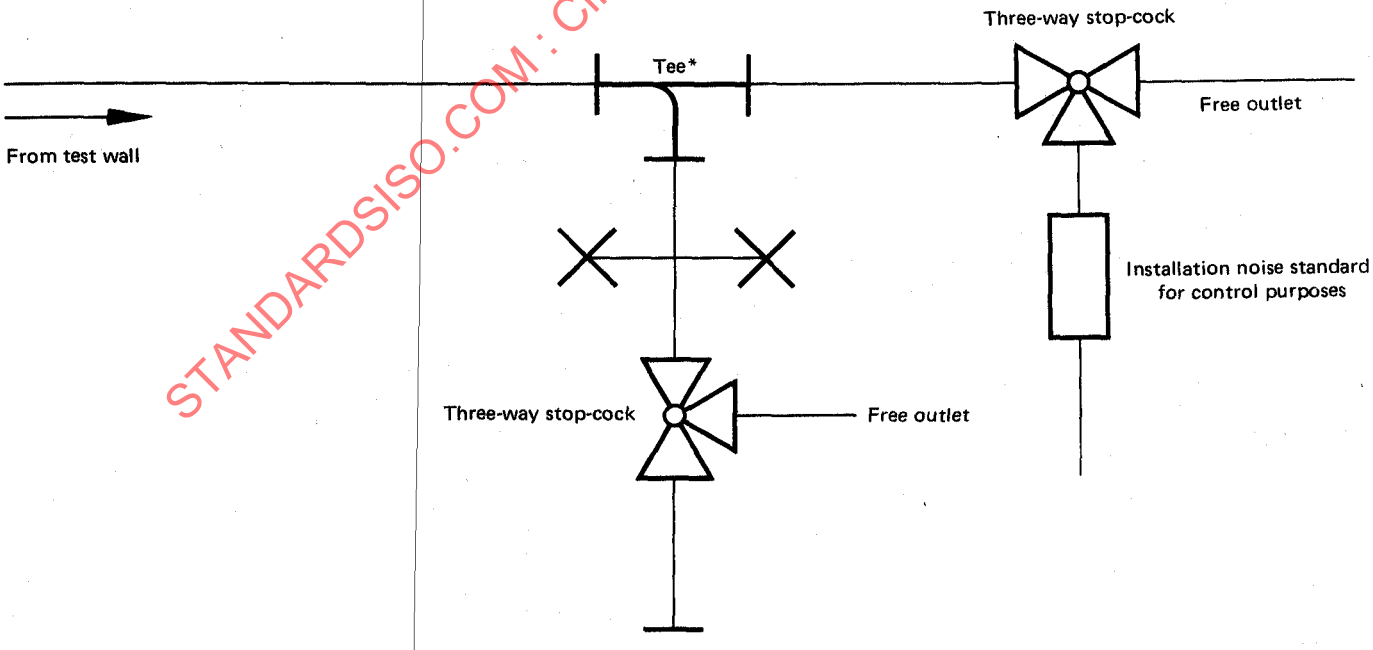
NOTE — As the accuracy of the flow meter depends significantly on the installation, its accuracy shall be checked *in situ*.

## 7 INSTALLATION NOISE STANDARD

The noise produced by the appliance under test depends on the physical properties of the test set-up.

To make it possible to compare results from different laboratories, it is therefore necessary also to measure the noise produced by the installation noise standard (see figure 3) in each laboratory. It is mounted in place of the appliance under test (see also figures 4 and 5).

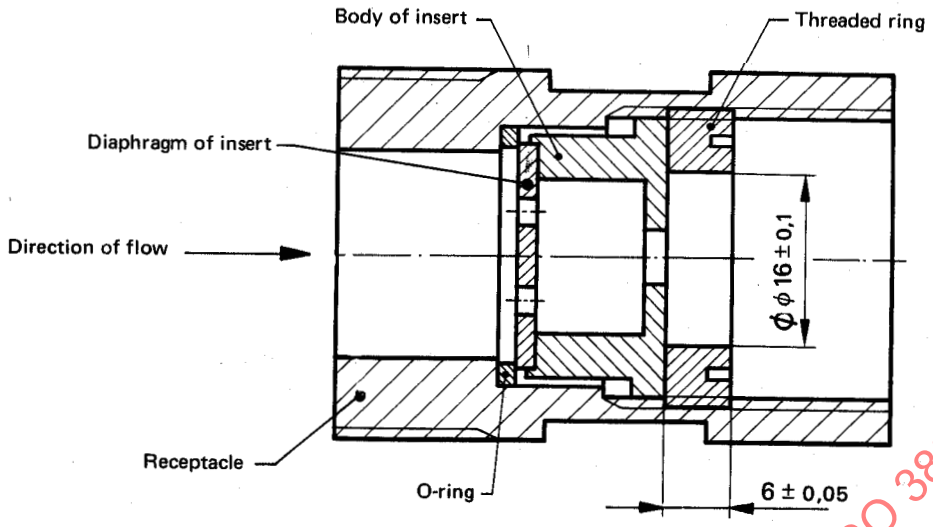




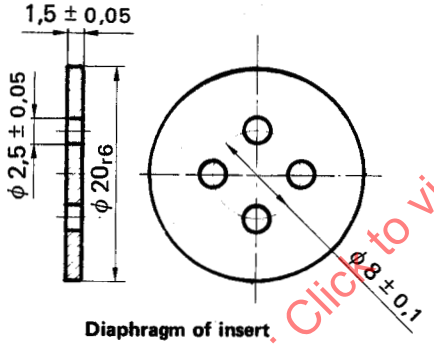

*Pitcher tee 1, EI according to ISO/R 49

FIGURE 2 — **Example of equipment for stabilization and checking of the test arrangement**

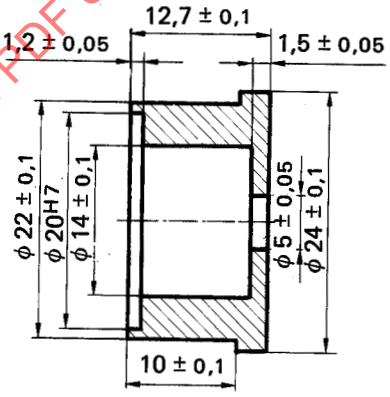
Dimensions in millimetres



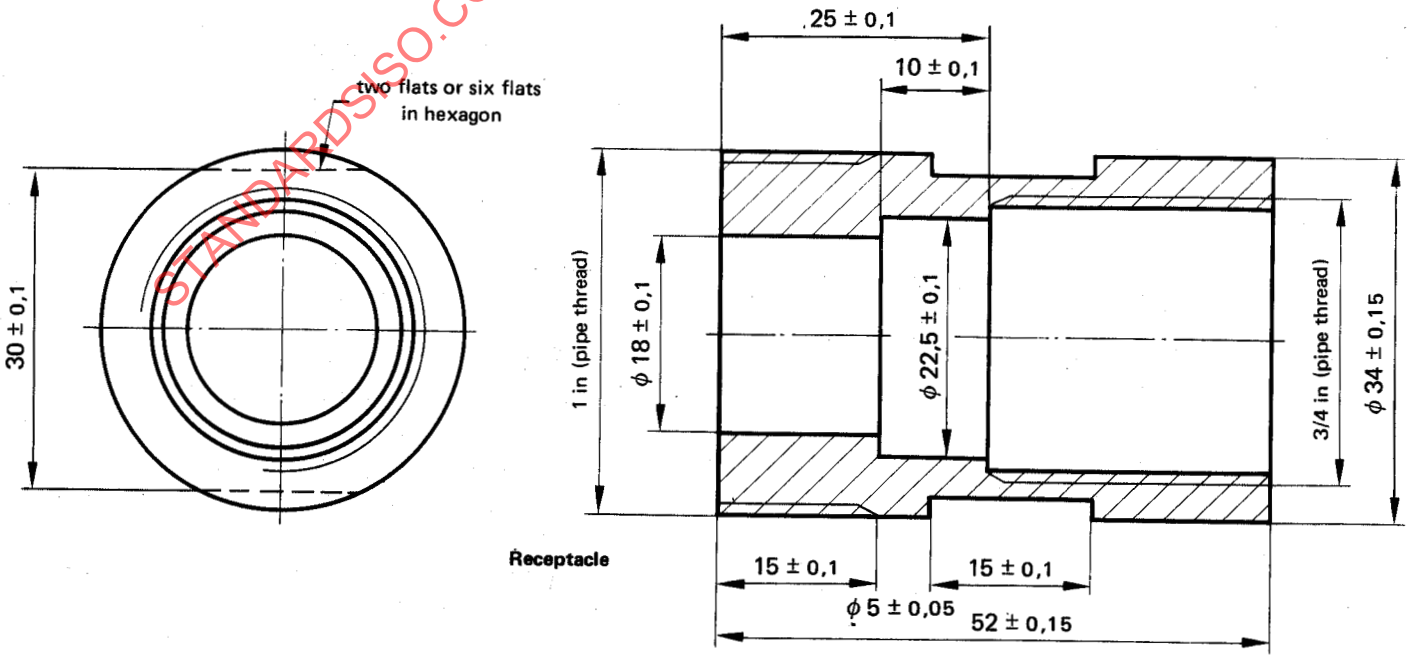

**Assembly**




**Diaphragm of insert**

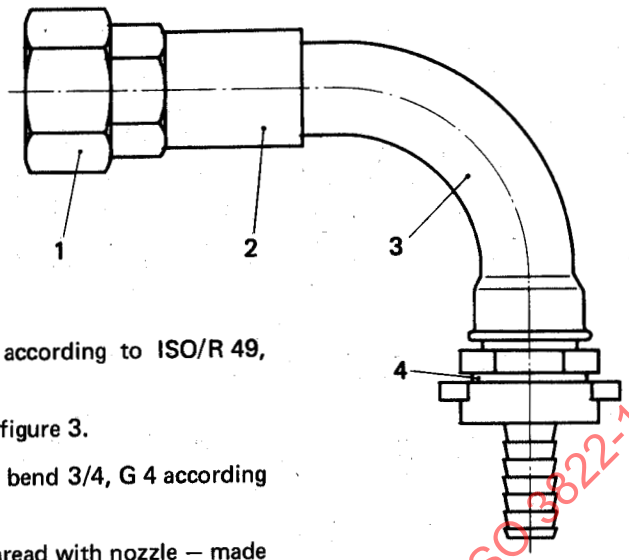



**Body of insert**




**Receptacle**

FIGURE 3 – **Installation noise standard**




1 Union, taper seat 1, U 11 according to ISO/R 49, galvanized.

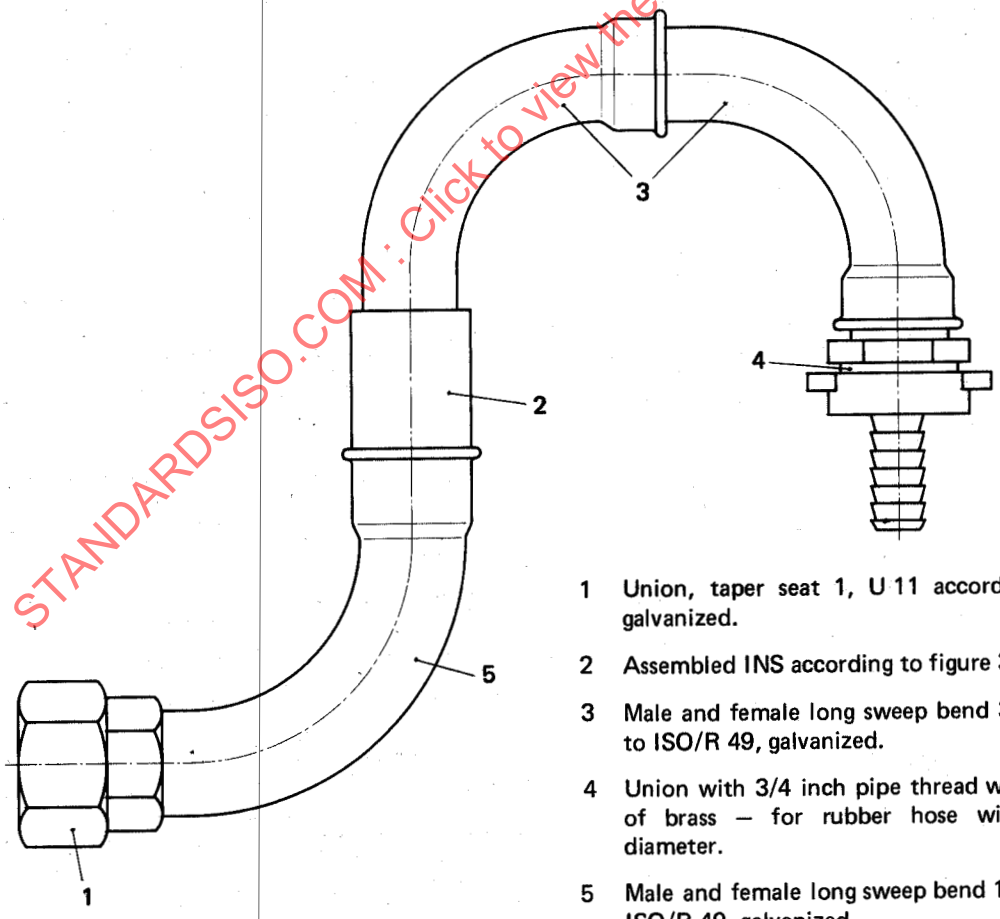
2 Assembled INS according to figure 3.

3 Male and female long sweep bend 3/4, G 4 according to ISO/R 49, galvanized.

4 Union with 3/4 inch pipe thread with nozzle – made of brass – for rubber hose with 13 mm inside diameter.

FIGURE 4 – **Arrangement for using the installation noise standard (INS) in horizontal position**






1 Union, taper seat 1, U 11 according to ISO/R 49, galvanized.

2 Assembled INS according to figure 3.

3 Male and female long sweep bend 3/4, G 4 according to ISO/R 49, galvanized.

4 Union with 3/4 inch pipe thread with nozzle – made of brass – for rubber hose with 13 mm inside diameter.

5 Male and female long sweep bend 1, G 4 according to ISO/R 49, galvanized.

FIGURE 5 – **Arrangement for using the installation noise standard (INS) in vertical position**

The sound pressure level produced by the installation noise standard is denoted by $L_s$. From this it is possible to calculate the standardized level difference $L_s$ as defined in clause 3.

The installation noise standard shall be made of brass. The holes shall be free from burrs. They shall not be countersunk. The roughness of the surfaces of the installation noise standard, expressed by the arithmetical mean deviation $R_a$ from the line of the profile (centre-line average value CLA, arithmetical average AA) according to ISO/R 468 shall be 0,4 $\mu$m maximum. The installation noise standard shall be mounted at the end of the test pipe by means of one of the arrangements shown in figure 4 and 5.

The test pipe may have several outlets for testing purposes. For the determination of $L_s$ the installation noise standard shall be mounted at the same outlet used for the test for each appliance.

NOTE – For the correct operation of the INS there must be a laminar flow of water on the outlet side. This may be achieved, for instance, by connecting a flexible hose of approximately 500 mm length to the discharge nozzle (item 4 in figures 4 and 5).

## 8 TEST PROCEDURE

Since air contained in the test system, even in small quantities, will significantly influence the results it is essential to vent the relevant parts of the test system thoroughly before, and if necessary during, a test.

### 8.1 Determination of average sound level

To obtain adequate accuracy of the average sound level in the test room, more than one microphone position may be necessary. This can be determined by preliminary measurements in the test room. The microphone of the sound level meter shall be kept at least 1 m from the boundary surfaces of the room.

### 8.2 Measurements with flow pressure and flow rate varied

Two types of measurement may be made, as follows :

a) The sound level (A) or the octave-band sound pressure level as a function of flow pressure, for example at 1, 2, . . . 5 bar.

A check shall be made whether pressure increasing gives different results from pressure decreasing. If this is the case both measurements shall be carried out.

b) The sound level (A) or the octave-band sound pressure level as a function of flow rate by adjusting the valve setting at constant flow pressure, for example 3 bar.

Approximately 10 measurements shall be made for the total range of flow rate. A check shall be made whether flow rate increasing gives different results from flow rate decreasing. If this is the case both measurements shall be carried out.

The relevant International Standards for the testing of different types of appliances will specify the actual test procedures.

## 9 EXPRESSION OF RESULTS

Provided that the acoustic properties of the test room are not changed during the period of measurement with the installation noise standard and the appliance under test, the noise emission of the appliance can be expressed in the following ways :

a) by the standardized level difference $L_s$ as defined in clause 3;

b) by the appliance sound level $L_{ap}$ as defined in clause 3.

NOTE – The reference values of $L_{sr}$ both in terms of sound level (A) and in octave-band sound pressure level, shall be specified on, for example, a national basis (for an example see annex).

## 10 TEST REPORT

The test report shall state :

a) date of test;

b) name and address of the testing authority;

c) volume of the test room;

d) reverberation time of the test room in octave-bands with mid-frequencies 125 through 4 000 Hz;

e) size, mass per unit area and type of test wall;

f) sufficient identification of the appliance which has been tested and the type of connection to the test pipe;

g) sound level (A) or octave-band sound pressure levels with mid-frequencies from 125 through 4 000 Hz for the installation noise standard at 3 bar;

h) standardized level differences $D_s$ in terms of sound level (A) or in octave-band sound pressure levels for the appliance under test; if several similar specimens of the same appliance have been tested, all results shall be given;

i) appliance sound level $L_{ap}$ in terms of sound level (A) or in octave-band sound pressure levels for the appliance under test and the reference value $L_{sr}$; if several specimens of the same appliance have been tested, all results shall be given;

j) flow rate and flow pressure, whether increasing or decreasing;

k) reference to this International Standard.

For diagrams the following rules apply :

– 10 dB $\hat{=}$ 20 mm

– 10 : 1 $\hat{=}$ 50 mm for a logarithmic flow scale

– 1 octave $\hat{=}$ 15 mm