TC 43

International Standard 3822/1

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Acoustics — Laboratory tests on noise emission from appliances and equipment used in water supply installations — Part 1: Method of measurement

Acoustique — Mesurage en laboratoire du bruit émis par les robinetteries et les équipements hydrauliques utilisés dans les installations de distribution d'eau — Partie 1: Méthode de mesurage

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been authorized has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

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 3822/1 was developed by Technical Committee ISO/TC 43, *Acoustics*, and was circulated to the member bodies in April 1982.

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

Australia	Germany, F.R.	Norway
Austria	Greece	Poland
Belgium	Hungary	Romania
Canada	India	South Africa, Rep. of
China	Israel	Spain
Czechoslovakia	Italy	Sweden
Denmark	Japan	Switzerland
Egypt, Arab Rep. of	Netherlands	United Kingdom
Finland	New Zealand	USSR
France		

No member body expressed disapproval of the document.

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Acoustics — Laboratory tests on noise emission from appliances and equipment used in water supply installations — Part 1: 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 part of ISO 3822 describes a method of measurement allowing comparable results to be obtained in laboratory measurements.

It is not possible to describe in detail how a given tap would give the same result in different laboratories unless the principle of comparing results to a standardized hydraulic noise generator (referred to as an installation noise standard, INS) is utilized. This procedure can be regarded as a kind of calibration of the test arrangement. The installation noise standard is described in detail and the basic arrangements for a laboratory water supply installation are given in this part of ISO 3822.

The test conditions described herein constitute the standard reference conditions essential for comparisons between laboratories.

The installation noise standard may also be useful for prediction of plumbing noise levels in the field. The sound pressure level produced by an appliance may be too low to be measured accurately. In this case, it can be determined 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 testing different types of appliances are given in other parts of this International Standard; see ISO 3822/2 for draw-off taps, ISO 3822/3 for in-line valves and ISO 3822/4 for special appliances.

In national standards, the method given in this part of ISO 3822 may be supplemented by a method of calculation to enable an estimate to be made of the appliance sound pressure level expected in buildings.

1 Scope and field of application

This part of ISO 3822 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 draw-off taps, in-line valves and special appliances, for example pressure reducers and water-heating appliances, all of which are hereafter referred to as "appliances".

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

2 References

ISO 7/1, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Designation, dimensions and tolerances.*

ISO 49, *Malleable cast iron fittings threaded to ISO 7/1.*

ISO 65, *Carbon steel tubes suitable for screwing in accordance with ISO 7/1.*

ISO 3822/2, *Acoustics — Laboratory tests on noise emission from appliances and equipment used in water supply installations — Part 2: Mounting and operating conditions for draw-off taps.*[1)]

ISO 3822/3, *Acoustics — Laboratory tests on noise emission from appliances and equipment used in water supply installations — Part 3: Mounting and operating conditions for in-line valves and appliances.*[1)]

ISO 3822/4, *Acoustics — Laboratory tests on noise emission from appliances and equipment used in water supply installations — Part 4: Mounting and operating conditions for special appliances.*[1)]

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

IEC Publication 651, *Sound level meters.*

1) At present at the stage of draft.

3 Definitions

For the purpose of this part of ISO 3822, the following definitions apply.

3.1 octave band sound pressure level, in decibels: The unweighted sound pressure level in the frequency band of one octave. In this part of ISO 3822, octave band sound pressure levels and sound pressure level differences are denoted by the subscript n.

3.2 A-weighted sound pressure level, in decibels: The sound pressure level weighted with the A-weighting specified in IEC Publication 651.

3.3 standardized sound pressure level difference, D_{sn}, for octave bands: A quantity defined by

$$D_{sn} = L_{sn} - L_n \quad \ldots \quad (1)$$

where

L_{sn} is the average octave band sound pressure level in octave n, in the test room, due to the noise produced by the installation noise standard (abbreviation INS) at a flow pressure of 0,3 MPa* (see clause 7);

L_n is the corresponding octave band sound pressure level in the test room due to the noise produced by the appliance under the specified test conditions.

3.4 appliance sound pressure level, L_{apn}, for octave bands: A quantity defined by

$$L_{apn} = L_{srn} - D_{sn} \quad \ldots \quad (2)$$

or

$$L_{apn} = L_n - (L_{sn} - L_{srn}) \quad \ldots \quad (3)$$

where L_{srn} is the reference value of the octave band sound pressure level in the octave n for the INS at a flow pressure of 0,3 MPa (see clause 7).

3.5 appliance sound pressure level, L_{ap}, in decibels: The A-weighted sound pressure level, which is a characteristic value for the noise emission by an appliance. It is defined, in decibels, by

$$L_{ap} = 10 \lg \sum_{n=1}^{6} 10^{[L_n - (L_{sn} - L_{srn}) + k(A)_n]/(10\,dB)}\,dB \quad \ldots \quad (4)$$

where

$n = 1, 2, 3, \ldots, 6$ are the octaves with mid-frequencies from 125 to 4 000 Hz;

$k(A)_n$ are the A-weighting values, in decibels, given in IEC Publication 651 for the six octave mid-frequencies from 125 to 4 000 Hz.

When the sound pressure level difference $(L_{sn} - L_{srn})$ at the octave band mid-frequencies from 125 to 4 000 Hz is constant to within ± 2 dB (see clause 8), the appliance sound pressure level L_{ap} may be obtained directly from the A-weighted sound pressure levels as follows:

$$L_{ap} = L - (L_s - L_{sr}) \quad \ldots \quad (5)$$

where

L is the average A-weighted sound pressure level in the test room due to the noise produced by the appliance under the specified test conditions;

L_s is the average A-weighted sound pressure level in the test room due to the noise produced by the INS at a flow pressure of 0,3 MPa;

L_{sr} is the reference A-weighted sound pressure level of the INS at a flow pressure of 0,3 MPa (see clause 7).

3.6 standardized level difference, D_s: The difference between the average A-weighted sound pressure levels given by

$$D_s = L_s - L \quad \ldots \quad (6)$$

D_s may only be determined in this manner when the sound pressure level difference $(L_{sn} - L_{srn})$ is constant to within ± 2 dB over the frequency range from 125 to 4 000 Hz (see clause 8).

If the condition is not satisfied, the standardized level difference D_s shall be determined from the appliance sound pressure level:

$$D_s = L_{sr} - L_{ap} \quad \ldots \quad (7)$$

where L_{ap} is determined in accordance with equation (4).

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 m³. For new laboratories, a volume of approximately 50 m³ is recommended.

* 1 MPa = 10 bar

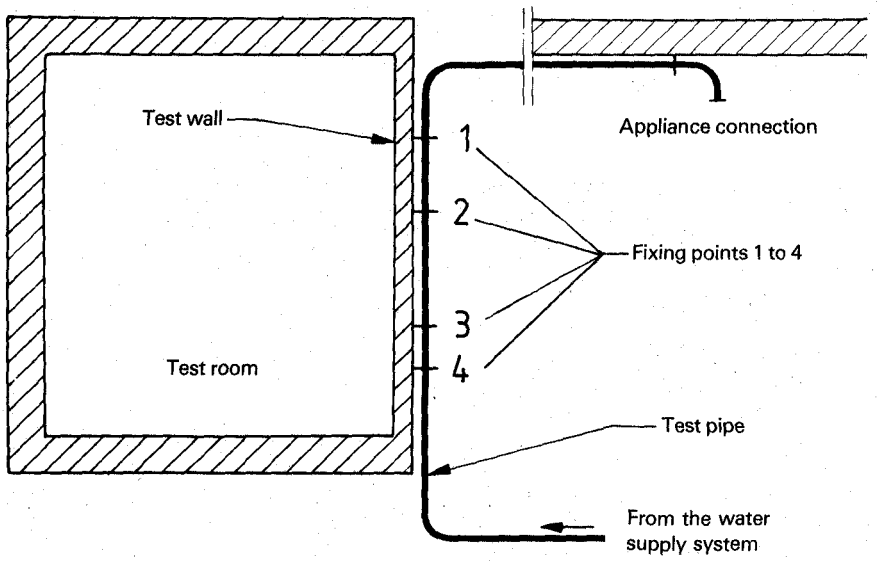


Figure 1 — Example of test arrangement

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

In the test room, the reverberation time should be between 1 s and 5 s for the octave bands with mid-frequencies from 125 to 2 000 Hz.

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

5.2 Background noise

The level of the background noise should be at least 10 dB below the level produced by the appliance under test.

NOTE — This in general requires a level of background noise 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 shall also be considered when determining the level of the background noise. The same applies to structure-borne sound not originating from the appliance under test.

When the difference is less than 10 dB, a correction as given in table 1 shall be applied.

Table 1 — Corrections of octave band sound pressure levels due to background noise

Increase in level produced by the appliance	Correction to be subtracted from measured value
dB	dB
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 shall 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 complying with the requirements of 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, 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 the test pipe and the 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 test pipe may have several outlets for testing purposes. The length of test pipe between the appliance connection and the first fixing point on the test wall (see figure 1) shall be between 2 and 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 union or fitting for mounting the appliances to be tested. It shall be possible to vent this branch. Details of the connections for testing different types of appliances are given in other 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.

For the mounting of appliances with two inlets, a test pipe with a twin outlet is needed. The straight portions of the branches constituting the twin outlet shall not be less than 700 mm long. Both ends shall be rigidly fixed with brackets to a wall other than the test wall, or to some other independent, rigid support.

The A-weighted sound pressure levels of the INS measured at the twin outlet (see clause 7) shall not differ by more than 1 dB and the octave band sound pressure levels shall not differ by more than 2 dB. The average of the INS values for the two outlets shall be used for all tests on appliances with two inlets.

NOTE — The twin outlet may also be obtained by branching a second test pipe upstream of the first bracket (fixing point 4, see figure 1) on the test wall, provided both branches meet the requirements of 5.4 and the tolerances for the INS values.

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 draw-off taps as used in dwellings, the following ranges are sufficient:

— flow pressure: up to 0,5 MPa
— flow rate: up to 2 l/s

For testing pressure regulators, a flow pressure range up to 1 MPa is recommended.

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

5.7 Equipment for stabilization and checking of the test arrangement

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 complying with the requirements of clause 7 for constant supervision of the test arrangement.

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

5.8 Measurement 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 pressure level 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 and filters

Sound level meters complying at least with the requirements for type 1 of IEC Publication 651 shall be used, the time weighting characteristic "S" being recommended.

Alternative measuring equipment, including for example a level recorder, may be used provided its overall electro-acoustic performance complies at least with the relevant clauses of the type 1 requirements of IEC Publication 651.

Octave band filters, when used, shall comply with the requirements of IEC Publication 225.

6.2 Hydraulic measuring instruments

The flow pressure shall be determined with an accuracy of ± 5 % or better.

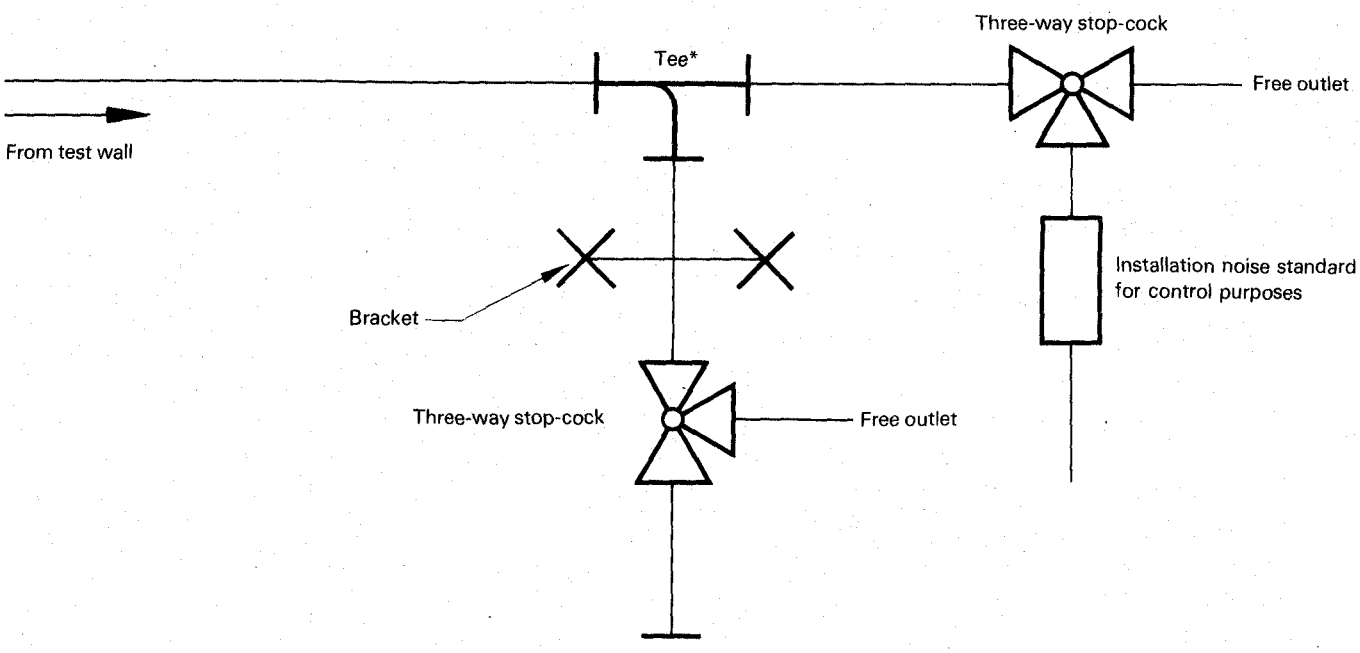
NOTES

1 To achieve this accuracy over the whole range, the use of precision instruments with an accuracy of ± 1 % and a range of not more than 0,5 MPa 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 not more than 1 m upstream of the appliances to be tested. The instrument for measuring flow pressure shall be calibrated frequently.

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

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



* Pitcher tee 1, E1 according to ISO 49

Figure 2 — Example of equipment for stabilization and checking of test arrangement

7 Installation noise standard

The noise produced by the appliance under test depends on the physical properties of the test arrangement.

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 at the end of the test pipe in place of the appliance under test (see also figures 4 and 5).

The installation noise standard shall be made of brass. The holes shall be free from burrs and not countersunk.

The installation noise standard shall be mounted by means of one of the arrangements shown in figures 4 and 5 at the same outlet used for the test for the appliance.

If a vertical connection is required, the sweep bend 5 in figure 5 may be omitted; in figure 4 such a sweep bend should be fitted between items 1 and 2.

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

The reference values of the octave band sound pressure levels L_{srn} for the INS at a flow pressure of 0,3 MPa are given in table 2.

Table 2 — Reference values for the octave band sound pressure levels, L_{srn}, for the INS at flow pressure of 0,3 MPa

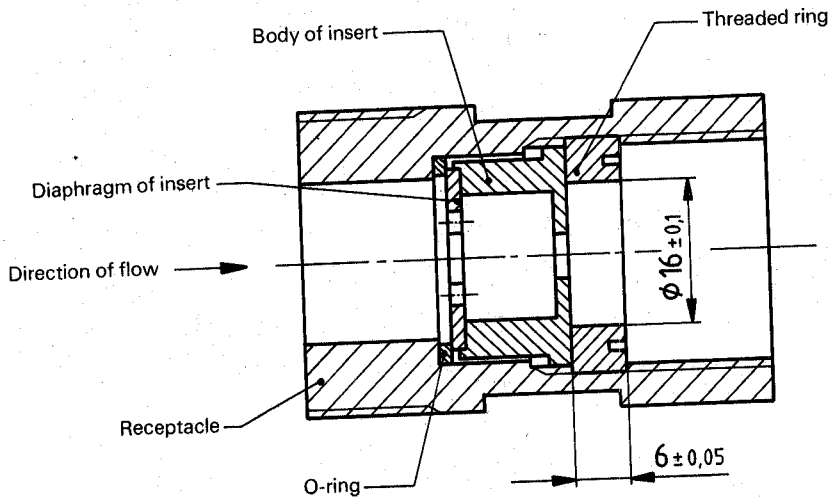
Mid-frequency of the octave band	Reference octave band sound pressure level, L_{srn}
Hz	dB
125	35
250	39
500	42
1 000	42
2 000	37
4 000	25

The reference A-weighted sound pressure level of the INS, L_{sr}, at a flow pressure of 0,3 MPa is 45 dB.

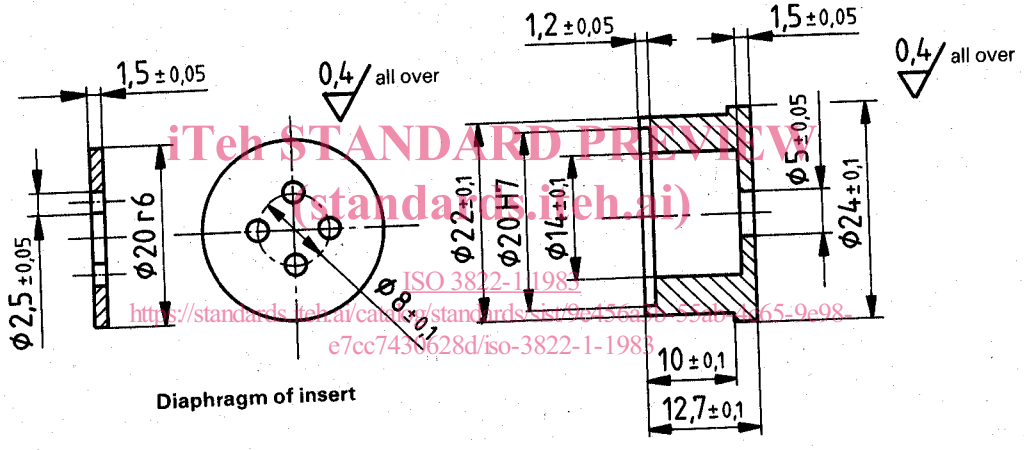
8 Test procedure

8.1 General

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

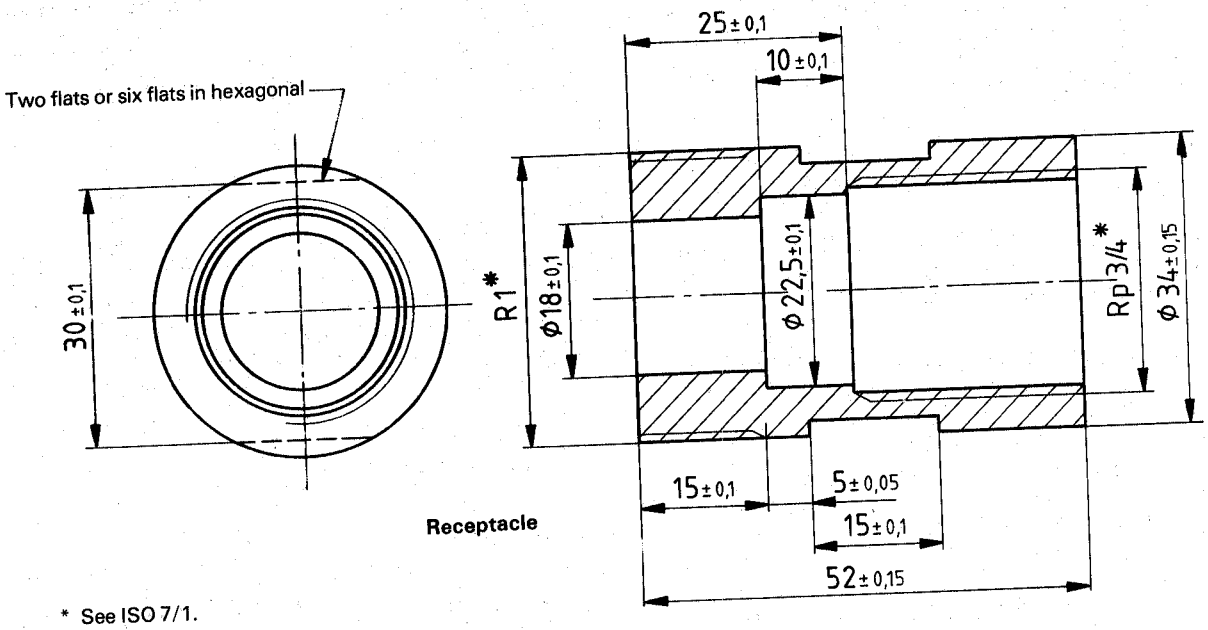


Assembly



Diaphragm of insert

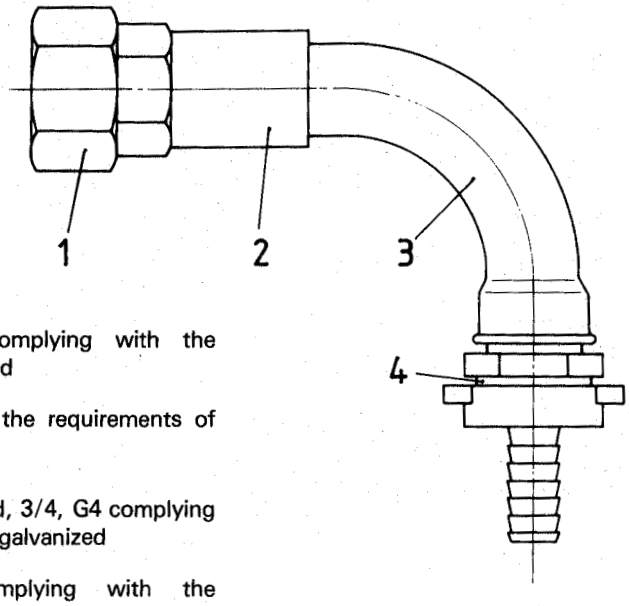
Body of insert



Receptacle

* See ISO 7/1.

Figure 3 — Installation noise standard



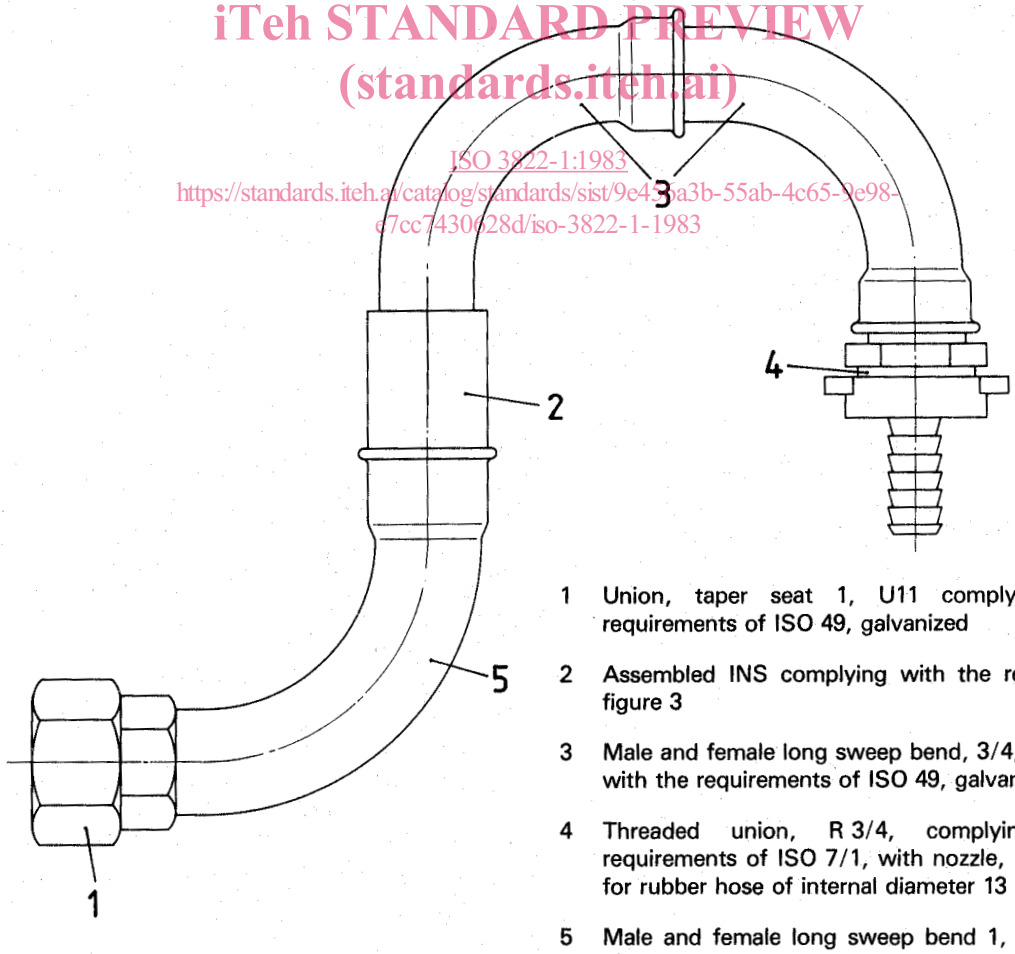
1 Union, taper seat 1, U11 complying with the requirements of ISO 49, galvanized

2 Assembled INS complying with the requirements of figure 3

3 Male and female long sweep bend, 3/4, G4 complying with the requirements of ISO 49, galvanized

4 Threaded union, R 3/4, complying with the requirements of ISO 7/1, with nozzle, made of brass, for rubber hose of internal diameter 13 mm

Figure 4 — Arrangement for using the installation noise standard (INS) in horizontal position.



1 Union, taper seat 1, U11 complying with the requirements of ISO 49, galvanized

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3 Male and female long sweep bend, 3/4, G4 complying with the requirements of ISO 49, galvanized

4 Threaded union, R 3/4, complying with the requirements of ISO 7/1, with nozzle, made of brass, for rubber hose of internal diameter 13 mm

5 Male and female long sweep bend 1, G 4 complying with the requirements of ISO 49, galvanized

Figure 5 — Arrangement for using the installation noise standard (INS) in vertical position.