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Remote handling devices for radioactive materials —

Part 5: Remote handling tongs

Dispositifs de manipulation à distance pour matériaux radioactifs —

Partie 5: Pinces de manipulation à distance

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 17874-5 was prepared by Technical Committee ISO/TC 85, *Nuclear energy*, Subcommittee SC 2, *Radiation protection*.

ISO 17874 consists of the following parts, under the general title *Remote handling devices for radioactive materials*:

— *Part 1: General requirements*

— *Part 2: Mechanical master-slave manipulators*

— *Part 4: Power manipulators*

— *Part 5: Remote handling tongs*

The following part is under preparation:

— *Part 3: Electrical master-slave manipulators*

Introduction

This part of ISO 17874 concerns multi-purpose remote handling tongs for nuclear applications.

These remote handling tongs replace some functions of human hands and arms in inaccessible areas (generally, behind shielding or containment walls). In general, remote handling tongs provide limited functionality compared to master-slave manipulators, such as those described in ISO 17874-2.

Remote handling tongs are typically used in hot cells for the following applications: fuel element examination, radio-isotope manipulation, reprocessing and waste treatment, radio-chemical analysis.

Vertically mounted remote handling tongs are typically applied in pools for work on radioactive sources and irradiated fuel elements.

End-effectors other than tongs, e.g. special-purpose tools, can be mounted on similar actuators, but these are not included within the normative part of this part of ISO 17874.

This part of ISO 17874 addresses only manually-actuated remote handling tongs and does not address any powered versions.

Remote handling devices for radioactive materials —

Part 5:
Remote handling tongs

1 Scope

The purpose of this part of ISO 17874 is to provide guidance for the selection, installation and use of manually-operated remote handling tongs within nuclear installations.

This part of ISO 17874 covers only the specific engineering aspects of manually-operated remote handling tongs and their interfaces with the nuclear facilities in which these devices are to be installed.

Specifically, it does not address design options concerning aspects such as the process and general maintenance arrangements that lead to the selection of any particular type of remote handling device.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7212 *Enclosures for protection against ionizing radiation (Lead shielding units for 50 mm and 100 mm thick walls)*

ISO 9404-1, *Enclosures for protection against ionizing radiation (Lead shielding units for 150 mm, 200 mm and 250 mm thick walls) — Part 1: Chevron units of 150 mm and 200 mm thickness*

ISO 11933-1, *Components for containment enclosures — Part 1: Glove/bag ports, bungs for glove/bag ports, enclosure rings and interchangeable units*

ISO 11933-2, *Components for containment enclosures — Part 2: Gloves, welded bags, gaiters for remote handling tongs and for manipulators*

ISO 10648-2, *Containment enclosures — Part 2: Classification according to leak tightness and associated checking methods*

ISO 17874-1, *Remote handling devices for radioactive materials — Part 1: General requirements*

ISO 17874-2, *Remote handling devices for radioactive materials — Part 2: Mechanical master-slave manipulators*

3 Terms and definitions

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

3.1
axis
direction of a Cartesian coordinate system defined from the operator standing point, considered as the origin of this system

NOTE The following axes are considered:

— X axis, from right to left along the shielding wall;

— Y axis, forward into the shielded cell;

— Z axis, up towards the ceiling of the shielded cell.

3.2
containment enclosure
enclosure designed to prevent leakage of products contained in the internal environment under consideration into the external environment, or the penetration of substances of the external environment into the internal environment, or both simultaneously

NOTE This is a generic term to designate all kinds of enclosures, including glove boxes, or cells of different geometries used for handling or to store radioactive materials, with handling devices.

3.3
shielded containment enclosure
hot cell
containment enclosed by a shielding wall intended to provide complementary shielding against penetrating radiation

NOTE This shielding wall can be integral with, mounted on or independent of the containment enclosure wall. The choice and thickness of the protection material are determined according to the type of radiation (beta, gamma or neutron) and the type of handling required.

3.4
disconnection
mechanical operation allowing the separation of two assembled elements, such as the disconnection of the tongs from the leak-tight coupling

3.5
disconnection device
mechanical device located inside a hot cell and used to connect or disconnect the end-effectors of a remote handling device, e.g. tongs, jaws, special tool, etc.

NOTE Such a device can also be used to store these elements.

3.6
enclosure ring
plastic or metallic ring mounted on containment enclosure or glove box walls, using threaded components or by welding or bonding

NOTE The ring is used to allow fitting of interchangeable leak-tight units mounted on a support ring (e.g. gloves, rigid plugs, gaiters for remote handling tongs, etc.).

3.7
ejection device
device used to release an interchangeable element, e.g. a gaiter or a seal, and to replace it with another element without compromising the integrity of the containment

3.8
handle
component gripped by the operator, fixed to the end of the rod and enabling control of the movement of the remote-handling device

3.9
jaws (of tongs)
components fixed to the actuator assembly of the tongs which enable the handling of an object

NOTE The jaws can be disconnectable.

3.10
joint
assembly of several moveable components allowing at least one rotational motion about one axis

3.11
operating volume
space in which the operation of tongs is possible, considering all the positions reached by any end-effector

3.12
tongs
gripping device fixed at the active end of the rod and consisting of an actuator assembly and jaws

NOTE The actuator assembly is also referred to as the tongs unit.

3.13
sphere unit
component inserted in the shielding or containment wall used to support a spherical or cylindrical moving part and forming the pivot for the remote handling tongs

NOTE Swivel joints, or systems using pins but having the same properties of two parts swivelling at right angles to one another (as in universal joints or gimbals), can also be referred to as sphere units.

3.14
gaiter
booting US
specially profiled flexible sleeve designed to protect the mechanical parts of the remote handling tongs from contamination or to provide the continuity of the leak-tightness of the hot cell

3.15
gaiter assembly
gaiter equipped at one side with a leak-tight coupling and at the other side with a support ring or an expandable ring

3.16
rod
rigid tube which connects the handle and the tongs and contains the transmission elements for the gripping motions

NOTE The length of the rod defines the working range of the tongs.

3.17
leak-tight coupling
intermediate device mounted between the tongs unit and the rod, ensuring the continuity of the leak-tightness of the gaiter and the transmission of the gripping motion in a leak-tight way

3.18
motion
term defining the possibility to execute a movement, which may be linear or rotation about a defined axis

3.19
orientation motion
rotational motions around certain axes of the tongs.

NOTE According to the axes considered, three following motions are distinguished: tilt (α), twist (β) and swivel or azimuth motion (γ).

3.20
positioning motion
motion effecting a linear displacement of the tongs (or end-effector)

NOTE According to the axes considered, three different motions are distinguished: x, y and z.

4 General features and classification

4.1 General

Remote handling tongs consist of an end-effector and a handle connected together by means of a tubular rod containing elements providing the mechanical linkage between the handle and the end-effector. They are either installed in a shielding or containment wall, or mounted on a carrying system or held by an operator.

Remote handling tongs permit the direct transfer of the operator's movements from the handle to the end-effector (in accordance with ISO 17874-1). Through this direct mechanical linkage, the operator is able to feel the forces applied to the end-effector and any reaction forces transferred back. This is termed "bilateral force reflection".

When installed on a shielding or containment wall, remote handling tongs may be fitted with a gaiter assembly which ensures leak tightness and protection against contamination.

Depending on the intended use, the tongs unit mounted at the end of the rod may have to be interchangeable in order to allow the use of different end-effectors or to replace the gaiter assembly.

4.2 Classification and mode of use

4.2.1 Horizontal remote handling tongs

These are remote handling tongs where the central axis of the rod is essentially horizontal. The load capacity is modest (see 5.2).

Horizontal remote handling tongs are used in cases where medium or low dexterity and a small operating volume are required. They are generally used in containment enclosures with shielding walls, mounted in pairs by means of sphere units (in accordance with ISO 7212 and ISO 9404-1).

The design of the overall assembly must ensure that the shielding effect of the wall is not significantly compromised by this installation.

A similar class of remote handling tongs may also be held by the operator, without any support. When using such devices (sometimes referred to as "reachers"), a sufficient distance between the operator and the radioactive source must be provided to ensure the required protection.

4.2.2 Vertical remote handling tongs

These are remote handling tongs where the central axis of the rod is essentially vertical. The absence of significant bending moments allows the load capacity to be considerably larger than with the horizontal type (see 5.2).

They are used where medium or low dexterity is required, generally in pools. They can be held by the operator or mounted on a carrying system that takes the vertical load, throughout the X and Y positioning axes. The z motion is realized via a separate hoist or crane.

The design of the overall assembly must ensure that the shielding effect provided by the water it displaces is not compromised by this installation (e.g. a gas-filled hollow structure would not generally be advisable).

4.3 Kinematics

4.3.1 General

Remote handling tongs ensure four to six motions and a gripping motion, as described below. Accordingly three different designs of remote handling tongs are distinguished:

— with a rigid rod: four motions;

— with an articulated rod (allowing variation of the inclination of the gripper): five motions;

— with a wrist joint (providing articulation and rotation motion of the gripper): six motions.

4.3.2 Horizontal remote handling tongs

4.3.2.1 Remote handling tongs with a rigid rod

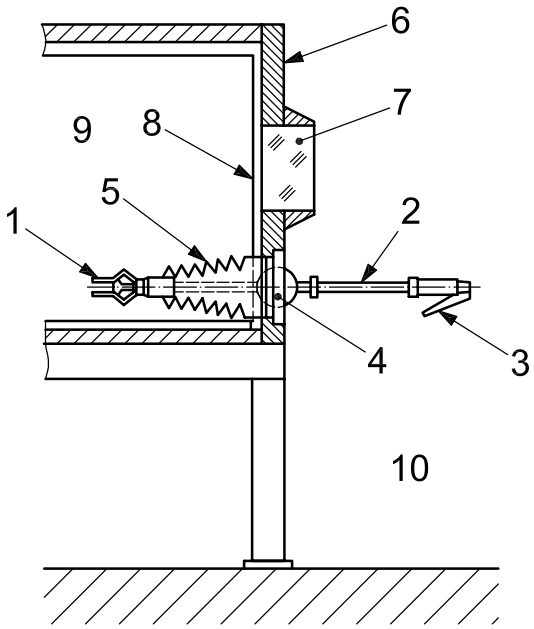
The kinematics of such tongs includes four motions [see Figures 1 a) and 1 b)] and provides (when placed in the basic position):

— the rotation of a sphere unit inserted in a shielding wall: the two motions of rotation around the X and Z axes permit the displacements of the end-effector primarily in the Z and X directions respectively;

— the sliding of the tubular rod within the sphere, along the Y axis;

— the rotation of the tubular rod around the Y axis (β motion).

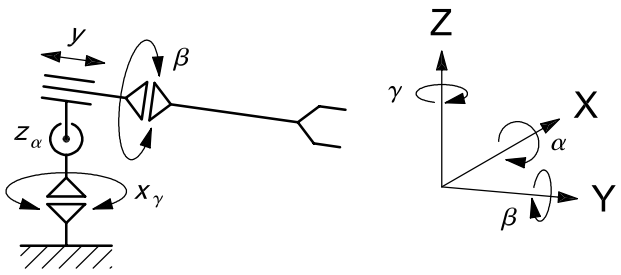
This type of handling device is referred to as “rigid tongs”.



Key

1 tongs
2 rod (rigid)
3 handle
4 sphere unit
5 leak-tight gaiter
6 shielding wall
7 shielding window
8 enclosure wall
9 hot cell
10 operating room

a) General view



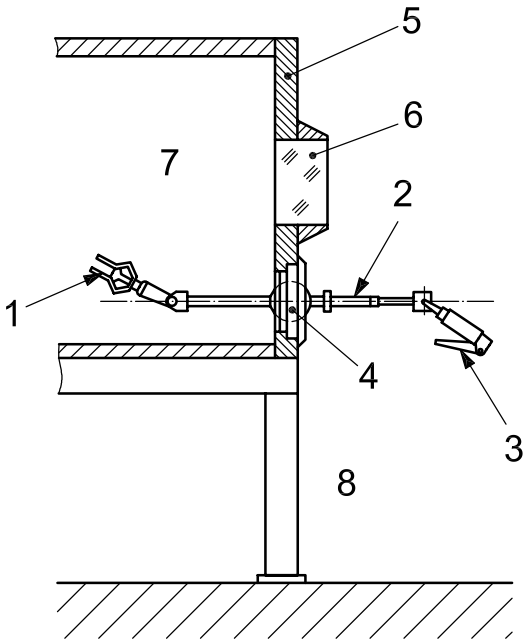
b) Kinematics

Figure 1 — Horizontal remote handling tongs (rigid rod), with a gaiter

4.3.2.2 Remote handling tongs with an articulated rod

Such tongs are equipped with an articulation enabling the tongs to reproduce inclination of the handle as moved by the operator (α rotation). Their kinematics thus provides five motions [see Figures 2 a) and 2 b)].

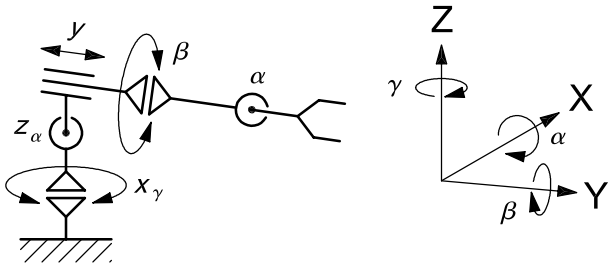
This type of handling device is referred to as “articulated tongs”.



Key

1 tongs
2 articulated rod
3 handle
4 sphere unit
5 shielding wall
6 shielding window
7 hot cell
8 operating room

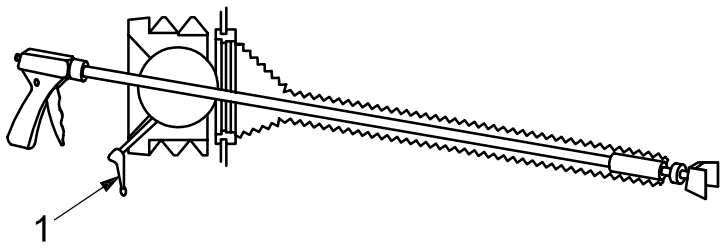
a) General view, with gaiter



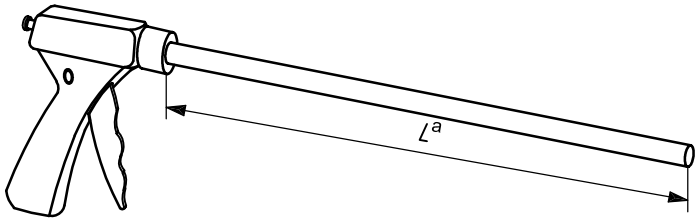
b) Kinematics, without gaiter

Figure 2 — Horizontal remote handling tongs (articulated rod)

Figure 3 gives an example of rigid tongs equipped with a gaiter, mounted on a shielding wall [Figure 3 a)] and rigid tongs without gaiter [Figure 3 b)].



a) Rigid remote handling tongs with gaiter



b) Rigid remote handling tongs without gaiter

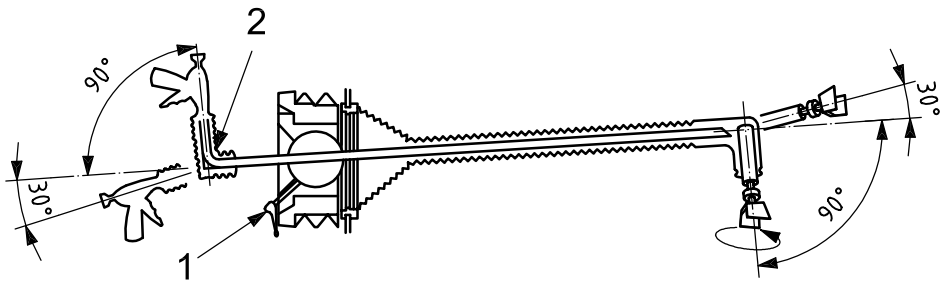
Key

1 optional sphere rotation lock

a The dimensions of the length L are given in 5.2.1.2.

Figure 3 — Rigid remote handling tongs

Figure 4 gives an example of articulated tongs equipped with a gaiter, mounted on a shielding wall.



Key

1 optional sphere rotation lock

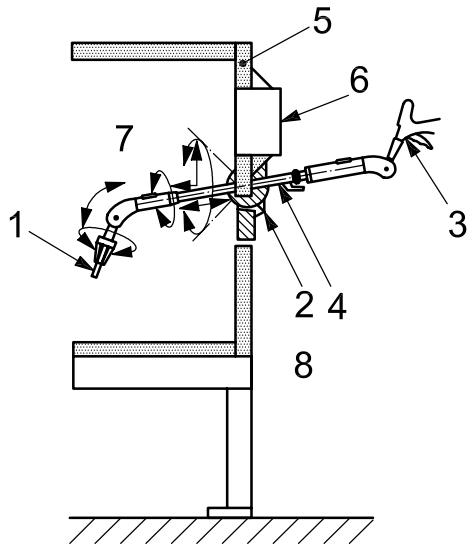
2 gaiter designed to protect the pivot from dust and the operator's fingers from harm

Figure 4 — Articulated remote handling tongs with gaiter

4.3.2.3 Remote handling tongs with a wrist joint

These tongs include a wrist joint which enables the inclination of the tong (α rotation) and the rotation of the tong around the Y axis (β rotation). This inclination is actuated by an identical motion of the handle made by the operator. Accordingly, the tongs provide six motions [see Figures 5 a) and 5 b)].

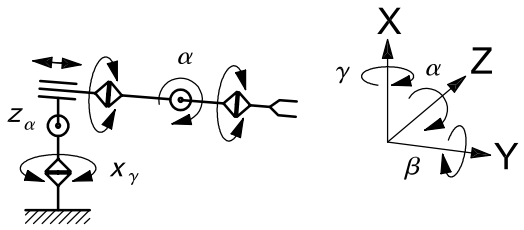
This type of handling device is referred to as “tongs with a wrist joint”.



Key

1	tongs	5	shielding wall
2	sphere unit	6	shielding window
3	handle	7	hot cell
4	articulated rod	8	operating room

a) General view



b) Kinematics

Figure 5 — Articulated remote handling tongs with wrist joint

4.3.3 Vertical remote handling tongs

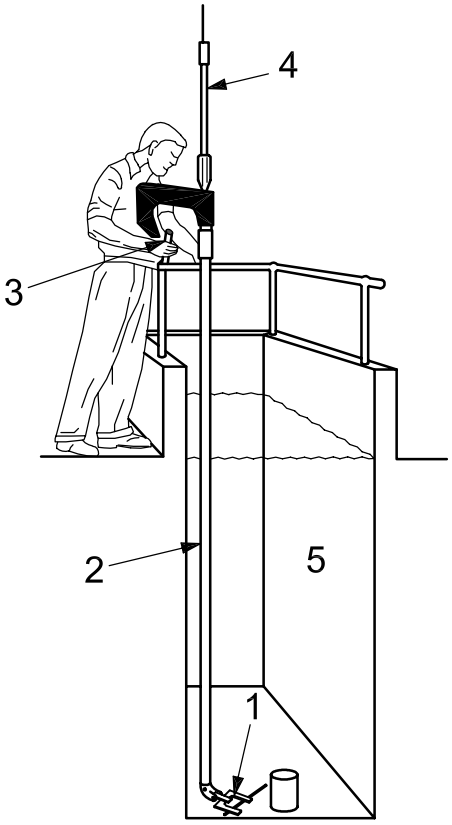
In this configuration, the remote handling tongs are equipped with a long vertical rod between the gripper and the handle to facilitate their use in pools. These types of remote handling tongs are available in the same three concepts (rigid tongs, articulated tongs, tongs with wrist joint similar to that of a mechanical master-slave manipulator).

The movements of vertical remote handling tongs are similar to those provided by horizontal tongs, the orientation of the gripper being adjusted by identical movement of the handle. Figure 6 gives an example of vertical remote handling tongs providing the functions corresponding to the third design above. The differences between the horizontal and vertical remote handling tongs are primarily represented by the detailed design of the rods, which are much longer and larger in diameter for the vertical class.

Any movements associated with a carrying system may be added to the range of movements inherent in the handling device itself [Figure 7 a)]. The number of motions, excluding the gripping motion, therefore varies between four and six [see Figures 7 a and 7 b)].

Remote handling tongs for pools usually have a carrying system to take the weight and to enable precise positioning (see Figure 7a). Such a device typically provides additional x and y motions. z and γ motions are typically achieved respectively via a separate hoist or crane and manual rotation of the rod.

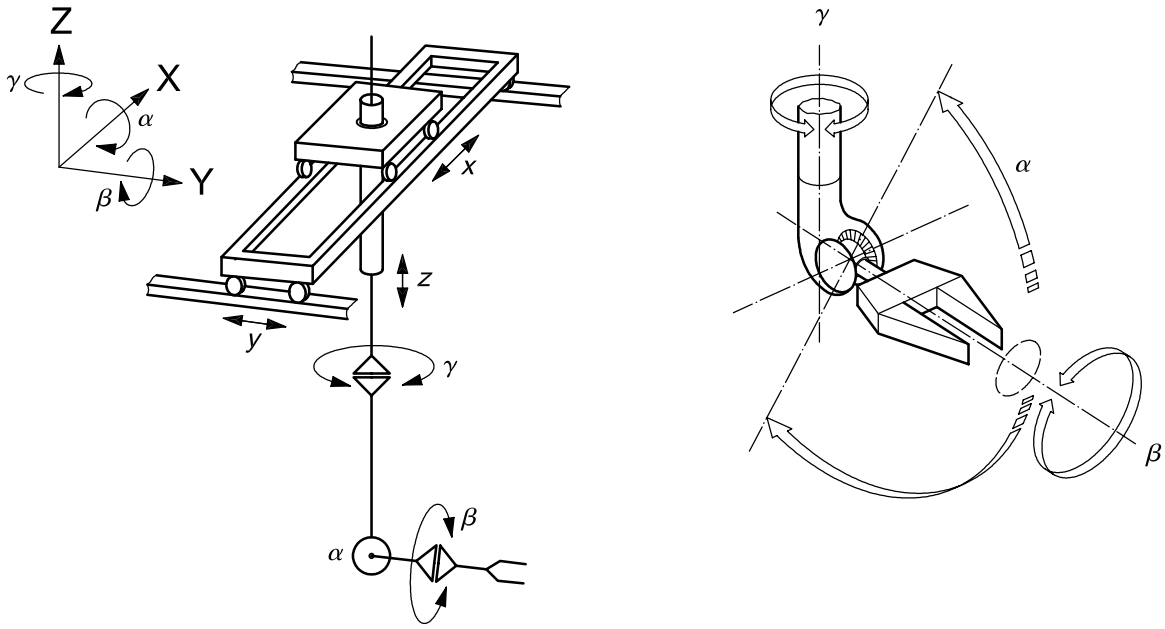
Variations are possible, e.g. remote handling tongs with a rigid rod (without α and β motions) or with an articulated rod (without β motion).



Key

1 tongs
2 rod
3 handle
4 carrying system
5 pool

Figure 6 — Vertical remote handling tongs: General view



a) Motions associated with vertical remote handling tongs on a carrier

b) Wrist motions

Figure 7 — Vertical remote handling tongs on a carrying system: Kinematics

5 Basic selection criteria

5.1 General criteria

The work to be done within the containment enclosure or the pool determines the choice of the type of remote handling tongs:

— rigid tongs;

— articulated tongs;

— tongs with a wrist joint.

In general, the less complex types are easier to use and maintain, are of lower weight and of higher reliability.

To facilitate the operation, the design of the containment enclosure and the positioning of the remote handling tongs in the containment wall shall be made so as to allow the handling of the objects in the simplest possible way. Objects to be handled should be positioned and orientated to allow them to be moved with the simplest possible handling device, respecting the operating volume. The design of the containment enclosure should allow objects that do not need to be handled by the tongs to be excluded from the operating volume of the tongs.

Where these objectives are fulfilled, rigid handling tongs will generally be sufficient. Articulated tongs or tongs with a wrist are necessary given any of the following requirements:

a) extended dexterity for complicated tasks;

b) extended operating volume;

c) particular orientations of the tongs or of the objects;

d) easier use of special tools;

e) special operating conditions.

NOTE Articulated handling tongs and tongs with a wrist can be considered as intermediate devices between rigid handling tongs and mechanical master-slave manipulators with articulated arms (see ISO 17874-2).

5.2 Particular criteria

5.2.1 General

This section describes the technical characteristics which need to be specified to enable the choice of the type of remote handling tongs.

5.2.2 Main characteristics of remote handling tongs

5.2.2.1 General

5.2.2.1.1 Load capacity

In order to select the appropriate type of remote handling tongs, it is necessary to define the task to be performed. For this purpose, the following parameters shall be considered:

— the maximum as well the likely weight of the loads to be handled or lifted (objects, tools);

— the forces (static and dynamic) to be exerted on objects to be handled;

— the reaction forces of tools;

— the geometry/shape of the object(s) to be handled.

5.2.2.1.2 Horizontal remote handling tongs

The useful load capacity depends upon the intended application.

— Laboratory work requiring some dexterity should be restricted to loads[1)] of up to about 2 kg. Such loads also ensure a good reliability of the tongs.

— Work involving very simple tasks (i.e. just moving an object) is readily possible with loads of up to 5 kg, although 10 kg may be possible depending on the rod dimensions and the lever lengths around the sphere unit.

5.2.2.1.3 Vertical remote handling tongs

Vertical remote handling tongs are typically used in pools, often for tasks involving heavy equipment and high forces. The maximum handling capacity is usually 10 kg and the maximum load to be lifted (using a carrying system) is generally 45 kg.

To increase reliability, extended use near the limit of the maximum load capacity should be avoided.

5.2.2.2 Size and shape

5.2.2.2.1 Horizontal remote handling tongs

The characteristics are the following:

1) The term load here means the mass of the object(s) to be handled.

— length of the tubular rod[2]: the usual length varies from 500 mm to 1500 mm [see Figure 3 b)];

— diameter of the rigid tubular rod: the traditional diameter for rigid tongs is 14 mm;

— diameter of the articulated tubular rod: the traditional diameters are 33 mm and 45 mm;

— the diameter of the sphere unit, which is determined by the thickness of the shielding wall.

5.2.2.2.2 Vertical remote handling tongs

The characteristics are the following:

— they are usually designed for the task intended;

— they are typically made of aluminium or stainless steel;

— they have lengths of several metres, sometimes consisting of modular elements (e.g. of 1 m).

The traditional rod diameters are 33 mm, 45 mm and 60 mm.

5.2.2.3 Connection methods for tongs

The three conventional techniques for connecting the tongs onto the rod are: screw, ball[3] and bayonet connections.

5.2.3 Installation of horizontal remote handling tongs

5.2.3.1 General

The following factors shall be considered when choosing horizontal remote handling tongs.

The design of the sphere unit should be consistent with the primary functions of the wall in which it is fitted, i.e. radiation shielding or radiological contamination control. Lead sphere units are recommended for shielding and plastic ones for contamination control where no significant γ or neutron radiation is present.

5.2.3.2 Interaction between the sphere unit diameter, the rod diameter and the thickness of the shielding wall

The following features have to be taken into consideration regarding the achievable operating volume (see Figure 8):

— for a given shielding wall thickness, a standard sphere unit diameter is defined (in accordance with ISO 7212 and ISO 9404-1);

— where the situation requires only a thin containment wall, the achievable angular motion increases;

— where the total wall thickness is increased (e.g. when shielding and containment walls are combined), further restriction on the angular motion arises.

In addition, the achievable angular motion within the hot cell (or containment enclosure) will reduce slightly as the rod diameter is increased.

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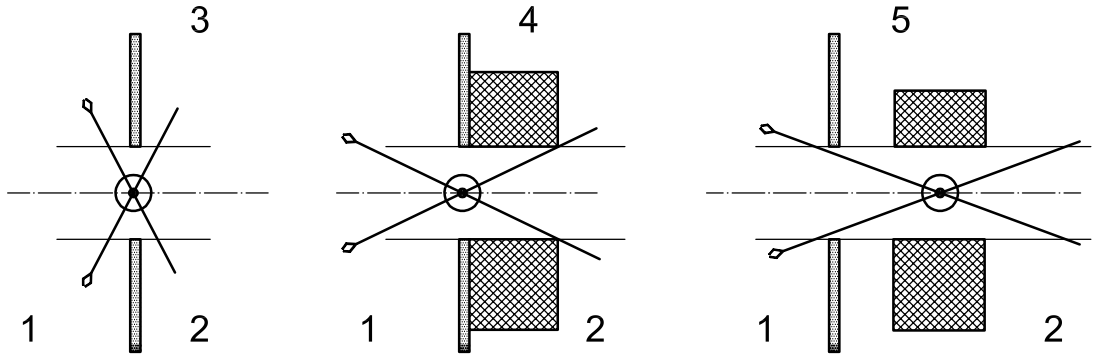
2) The length of the rod corresponds to the distance between the handle and the tongs. When articulated tongs (or tongs with a wrist) are considered, it corresponds to the length of the rigid part of the rod.

3) Ball connection comprises spring loaded balls engaging in an azimuthal groove.



Key

1 hot side
2 cold side
3 alpha wall
4 alpha and beta contiguous walls
5 alpha and beta separated walls

NOTE The apex of the cone determines the operating volume of the tongs.

Figure 8 — Installation scheme using rigid remote handling tongs

5.2.3.3 Position of the sphere unit with respect to the height at which the operator stands

The position of the sphere unit is largely governed by ergonomic considerations (e.g. location and accessibility of the objects to be handled), but the height of the working level of the operator must also be considered. The recommended distance between the centre of the sphere unit and the floor level on which the operator stands is 1 000 mm minimum and 1 250 mm maximum (see Figure 9).

5.2.3.4 Inter-axis distance

A workstation is generally fitted with two identical handling devices. The recommended inter-axis distance between remote handling tongs is 500 mm to 700 mm.

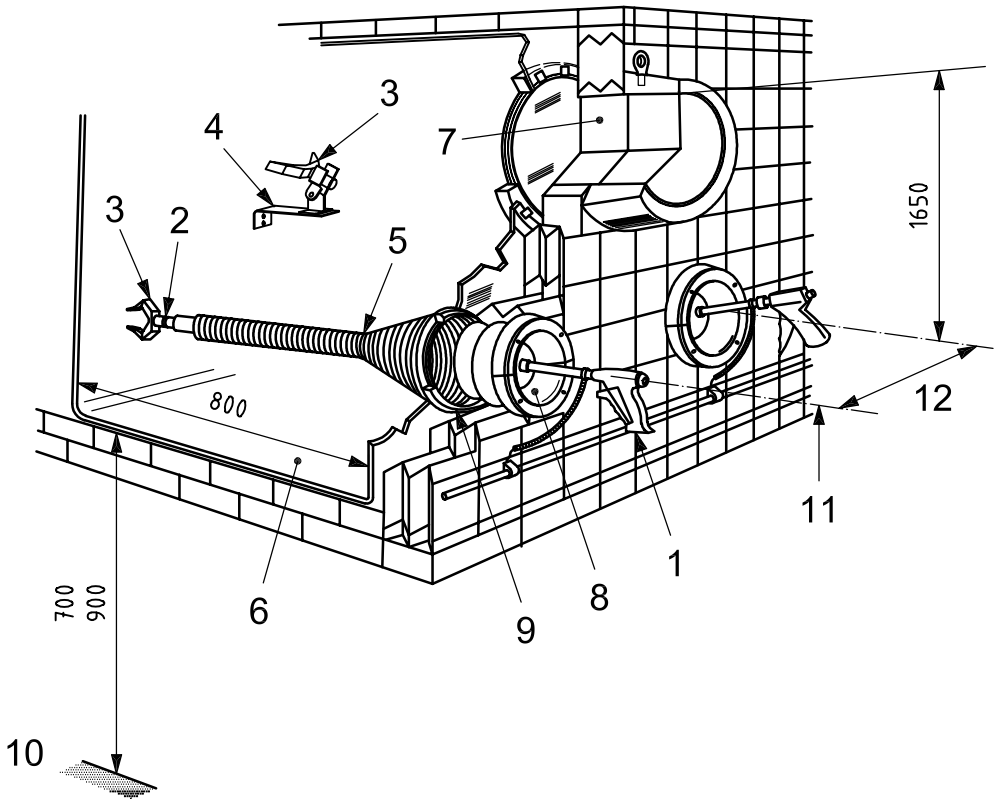
The actual value specified by manufacturers depends on the design of the remote handling tongs and must not be reduced when the overall hot cell design is implemented, otherwise conflicts can arise.

5.2.3.5 Vertical movements

The same restrictions in the angular motion arise in the vertical direction, as described above for the horizontal movement, due to the thickness of the wall. In addition, the vertical movement is constrained by the height of any working platform inside the hot cell.

Shielding walls can be realized using either standardized components, such as those described in ISO 7212 and ISO 9404-1, or special components fabricated as required. Figure 9 gives an example of such a construction.

Dimensions in millimetres



Key

1 handle
2 leak-tight connection
3 tongs
4 disconnection station
5 gaiter
6 containment enclosure
7 shielding window
8 sphere unit
9 enclosure ring
10 ground level
11 distance above ground level
12 distance between two tongs

Figure 9 — Layout of a horizontal remote handling tongs system

5.3 Leak-tightness and protection against contamination

5.3.1 General

Processes undertaken in hot cells often require a high degree of integrity of the containment in order to minimize any risk of contamination or chemical reagents migrating into the operator area.

When using horizontal remote handling tongs, this integrity may be provided by a gaiter connected at one end to the handling device by means of a leak-tight coupling and at the other end to the containment wall by means of an enclosure ring.

Such gaiters (see ISO 11933-2) ensure both leak-tightness and protection against contamination.

Requirements for leak-tightness of the containment enclosure and the associated leak-tight coupling of the handling device are given in ISO 10648-2.

5.3.2 Gaiter material

Gaiters are generally made of PVC, rubber or polyurethane.

5.3.3 Gaiters mounted on interchangeable support rings

5.3.3.1 Description

Gaiters are fixed on their support rings and fitted to enclosure rings mounted on the containment wall, which is generally located behind the shielding wall (see Figure 10).

Their replacement requires the use of an ejection device (see description in Annex E).

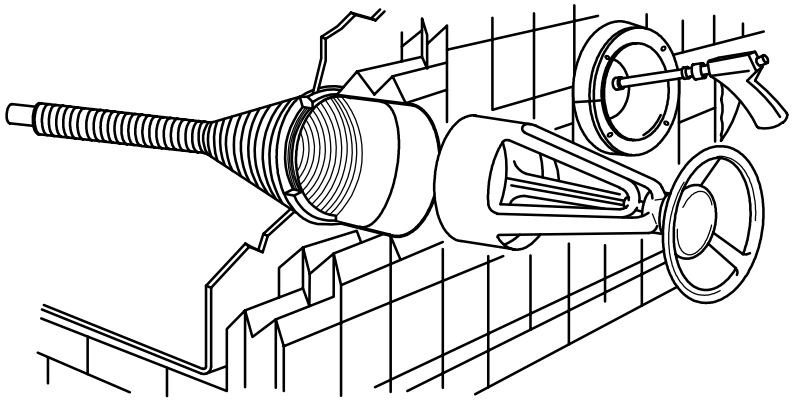


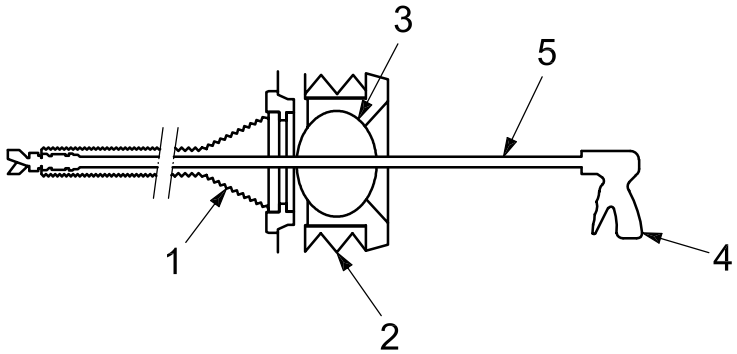
Figure 10 — Remote handling tongs gaiter fixed on an ejectable support ring

5.3.3.2 Mounting on the containment wall

Two situations may arise, as described below.

a) **Containment enclosures placed behind a shielding wall**

In this configuration, the remote handling tongs are generally mounted on a shielded sphere unit, itself directly mounted to the shielding wall (see Figure 11).



Key

1 gaiter
2 shielding wall
3 sphere unit
4 handle
5 rod

Figure 11 — Mounting of remote handling tongs gaiter on the shielding wall

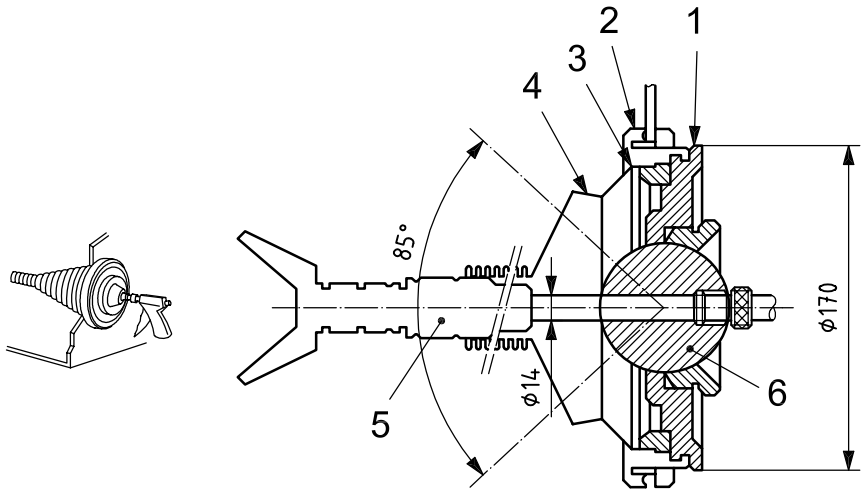
b) **Non shielded containment enclosures**

In this configuration, the remote handling tongs are fixed on a special plastic sphere unit, itself mounted directly on the enclosure ring and retained by a locking-ring. According to the type of support ring used (see ISO 11993-1), two mounting systems are available:

1) mounting on a Type 1 support ring [see Figure 12 a)];

2) mounting on a Type 3 support ring [see Figure 12 b)].

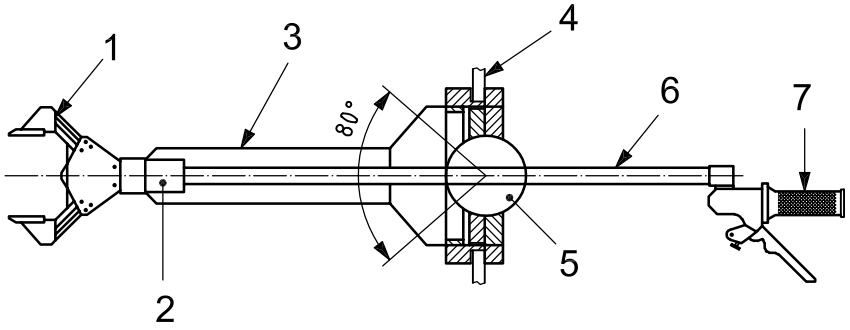
Dimensions in millimetres



Key

1 housing
2 enclosure ring
3 support ring
4 gaiter
5 tongs
6 sphere unit

a) Remote handling tongs gaiter, mounted on a Type 1 support ring



Key

1 tongs
2 leak-tight coupling
3 gaiter
4 containment enclosure wall
5 sphere unit
6 rod
7 handle

b) Remote handling tongs gaiter, mounted on a Type 3 support ring

Figure 12 — Mounting of remote handling tongs gaiter on the containment enclosure wall

5.3.4 Leak-tight couplings

Leak-tight couplings are fixed at the end of the rods by means of a bayonet or a screw-type system. The diameter of the leak-tight coupling varies according to the diameter of the rod.

EXAMPLE The diameter of the leak-tight coupling is 25 mm or 30 mm for a 14 mm diameter rod (see Figure 13), or 33 mm for a 33 mm diameter rod (see Figure 14).

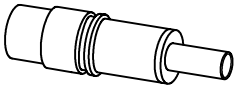


Figure 13 — Leak-tight coupling for a 14 mm diameter rod

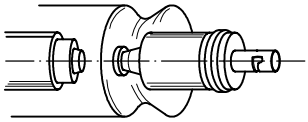


Figure 14 — Leak-tight coupling for a 33 mm diameter rod

5.4 Maintenance

5.4.1 Removal of remote handling tongs

The remote handling tongs are removed from the operating side of the containment enclosure by means of the following procedure:

a) remove the end-effector and clamp the leak-tight coupling using a disconnection device provided for this purpose;

b) unlock the leak-tight coupling from the rod;

c) extract the rod by pulling it straight out of the containment enclosure wall.

5.4.2 Replacement of gaiters

In order to ensure a permanent high standard of leak-tightness, the leak-tight gaiter should be replaced regularly. This maintenance is realized without any risk for the operator, by means of the procedure described in Annex E.

5.5 Shielding

The rod shall provide a similar shielding effect to that of the corresponding sphere unit. The sphere units are chosen according to the material construction of the shielding wall and the thickness (in accordance with ISO 7212 and ISO 9404-1). The rods of remote handling tongs do not generally provide adequate protection against neutrons.

The desired specification should be indicated to the manufacturer.

NOTE The remote handling tongs exchange procedure transiently interrupts the radiation protection shielding. To avoid this risk, the radiation sources are removed from the shielded enclosure before commencing the operation.

5.6 Tongs units

Tongs units are considered as standard end-effectors.

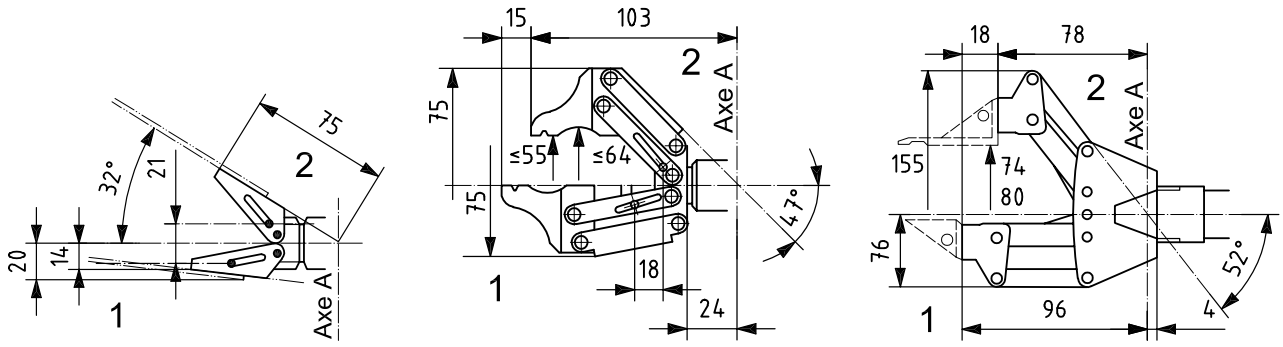
Figure 15 shows examples of tongs units for horizontal remote handling tongs. Indicated gripping forces at the jaws may be obtained for an average gripping force on the handgrip of 250 N.

Two different types of tongs units are available:

— tongs units providing an action like scissors [see Figure 15 a)];

— tongs units providing parallel gripping action [see Figures 15 b) to 15 e)].

Dimensions in millimetres



a) Tongs unit providing an action like scissors

Ø of object to be picked up mm	Gripping force N
20	25
50	20
100	10

b) Tongs unit providing a parallel action

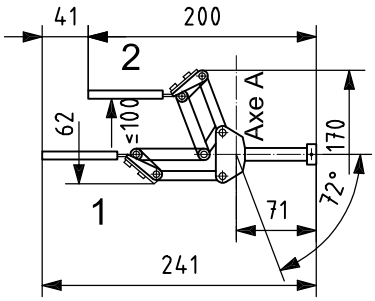
Ø of object to be picked up mm	Gripping force N
40	30
50	25
60	20

c) Tongs unit providing a parallel action

Ø of object to be picked up mm	Gripping force N
40	30
60	25
75	20

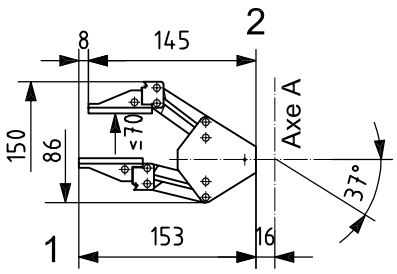
Figure 15 — Tongs units

Dimensions in millimetres



d) Tongs unit providing a parallel action

Ø of object to be picked up mm	Gripping force N
20	100
40	80
60	70
80	60



e) Tongs unit providing a parallel action

Ø of object to be picked up mm	Gripping force N
20	80
40	70
60	60

Key

1 closed position

2 open position

NOTE In each of the figures, the upper half of the drawing shows the tongs unit with the jaws open and the lower half shows it with the jaws closed.

Figure 15 (*continued*)

To address a specific task, tongs units and/or jaws can be replaced by special accessories (see Annex C).

6 Examples of special handling tongs

Specific remote handling tongs have been developed mainly for the following applications. Because of the special shape of the end part of the gaiter, they generally provide reduced leakage rate.

6.1 Remote handling tongs for repetitive movements

Figure 16 shows an example of remote handling tongs for repetitive movements, permitting the unscrewing of tubes or flasks.

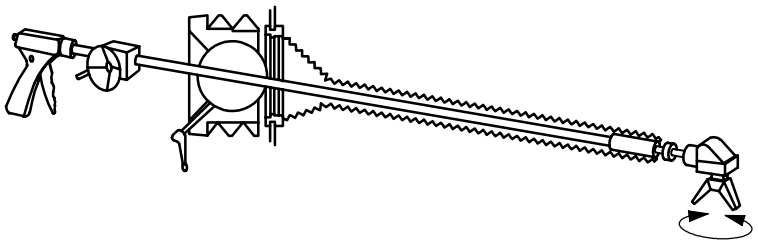
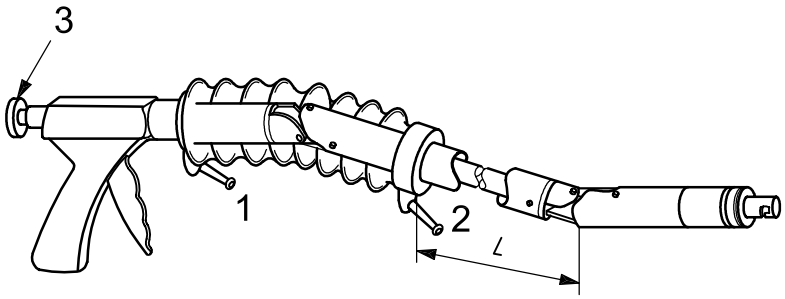


Figure 16 — Remote handling tongs for repetitive movements

6.2 Articulated remote handling tongs used for delicate work

Figure 17 shows an example of articulated remote handling tongs, of 14 mm diameter, designed for delicate work.



Key

1 rotation lock
2 coupling lock
3 rotation knob
L length of rod

Figure 17 — Remote handling tongs for delicate work

7 Accessories

Some typical accessories required when using remote handling tongs are described in Annexes B and C.

Annex A
(normative)

Sphere units

A.1 Lead sphere unit

Figures A.1, A.2, A.3, A.4 and A.5 give examples of standard lead sphere units. For more information, see ISO 7212 and ISO 9404-1.

Dimensions in millimetres

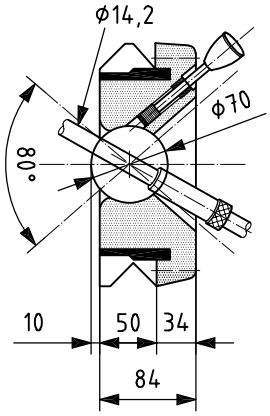


Figure A.1 — Sphere unit ∅ 14

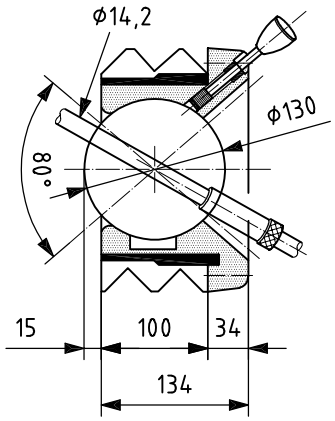


Figure A.2 — Sphere unit ∅ 14

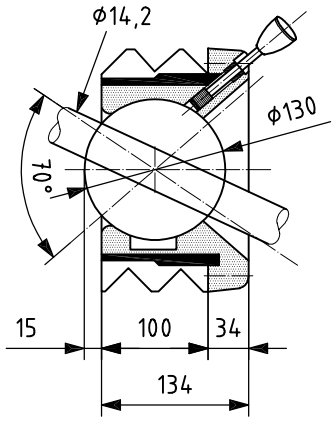


Figure A.3 — Sphere unit ∅ 33

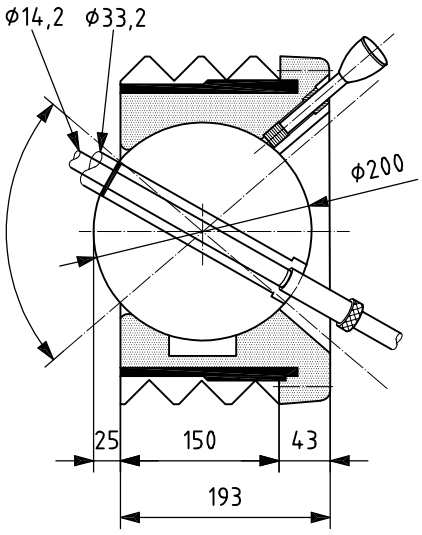


Figure A.4 — Sphere unit ∅ 33

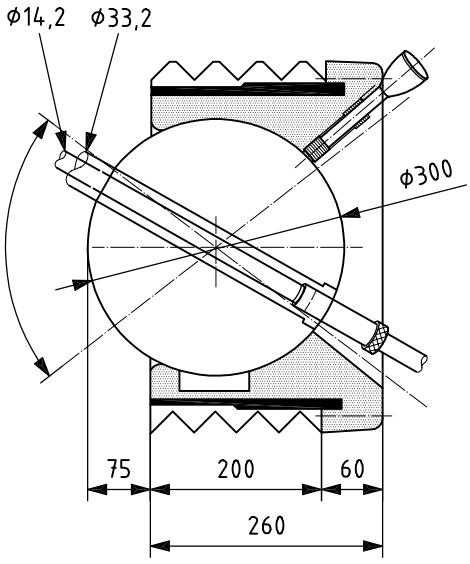


Figure A.5 — Sphere unit ∅ 33

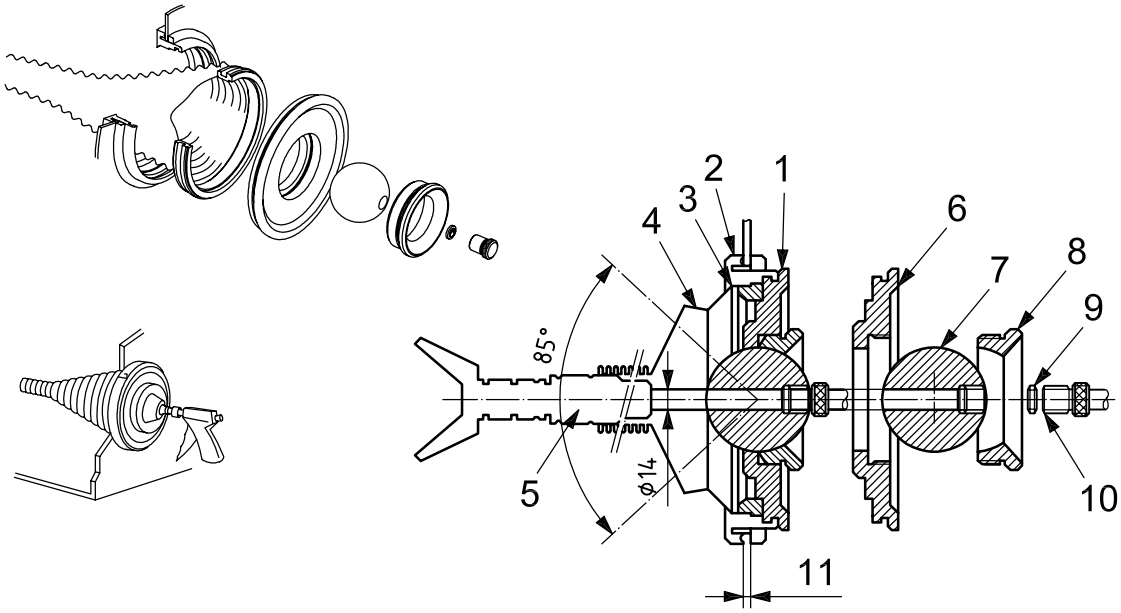
A.2 Plastic sphere units

These kinds of sphere units are used on containment enclosures when protection against γ or neutron radiation is not required.

The sphere unit locks into an enclosure ring using a three-piece assembly.

The leak-tight gaiter is mounted on a removable support ring.

Dimensions in millimetres



Key

1 sphere unit (assembly)
2 enclosure ring
3 removable support ring
4 gaiter
5 remote handling tongs
6 housing
7 sphere unit
8 shell ring
9 split ring
10 nut
11 containment wall

NOTE 1 This assembly can only be fitted to ISO enclosure rings 1100, 1101, 1103 and 1106 where the remote handling tongs have a 14 mm diameter rod (in accordance with ISO 11933-1 and ISO 11933-2).

NOTE 2 The gaiter mounted on the support ring is exchangeable by means of an ejection device.

Figure A.6 — Mounting assembly of a plastic sphere unit

Annex B
(informative)

Tongs jaws

Tongs jaws are fingers mounted on the tongs unit. They are typically made of stainless steel or aluminium. They can be screwed or remotely demountable. They may be covered with elastomer material.

Figures B.1 to B.11, below, show examples of typical tongs jaws.

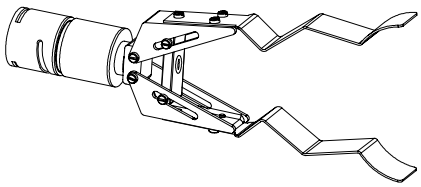


Figure B.1 — For general use

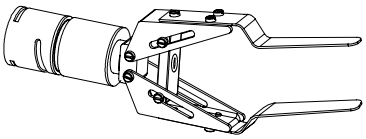


Figure B.2 — For gripping small items

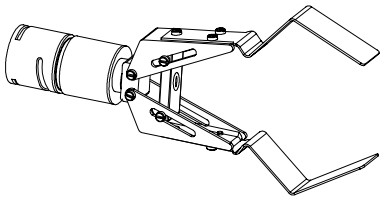


Figure B.3 — For general use

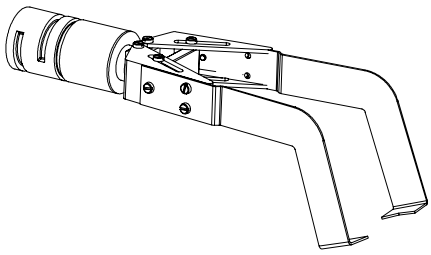


Figure B.4 — For gripping irradiation tubes or "penicillin"-type flasks

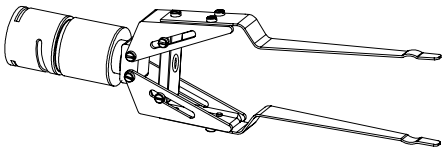


Figure B.5 — For gripping small objects

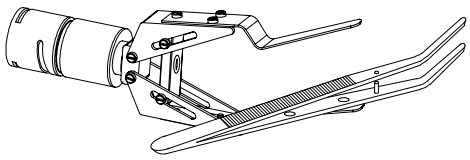


Figure B.6 — For gripping small objects

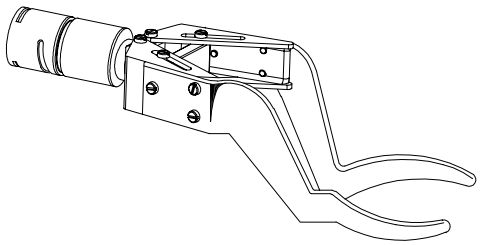


Figure B.7 — For gripping flasks

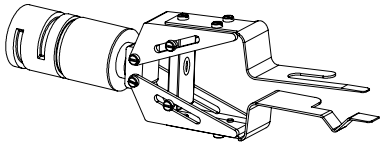


Figure B.8 — For plugging and unplugging "penicillin"-type flasks

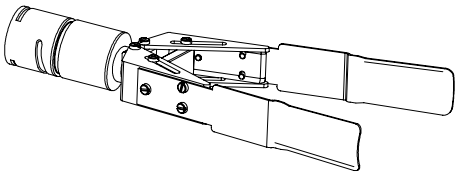


Figure B.9 — For gripping the inside of a lead cask

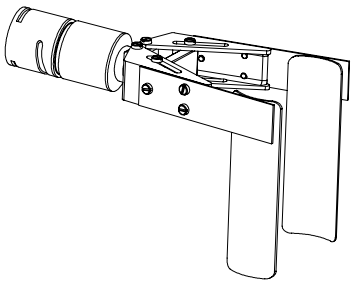


Figure B.10 — For gripping "penicillin"-type flasks in the upright position

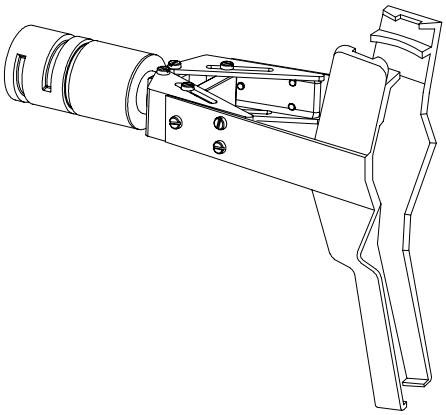


Figure B.11 — For opening containers and gripping the insides of flasks

Annex C
(informative)

Accessories

C.1 Disconnection device

Figure C.1 shows an example of a disconnection device consisting of a mechanical assembly placed inside a containment enclosure. This device is used for remotely connecting and disconnecting the various parts of the remote handling tongs, e.g. the end-effector and the leak-tight coupling.

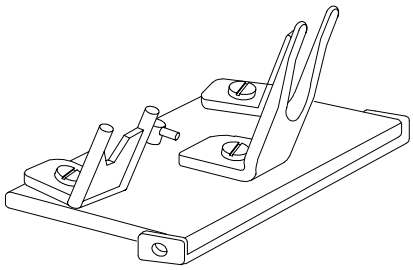


Figure C.1 — Disconnection device

C.2 Specific end-effectors

These accessories can be used instead of tongs units to allow specific tasks to be achieved. They are fitted onto the end of the rod, or onto a leak-tight coupling. They are provided with a variety of different locking systems.

Devices such as the one shown in Figure C.2 are used for cutting the ends of tubing and flexible plastic rods (e.g. support ring), wires or electric cables.

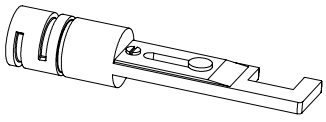
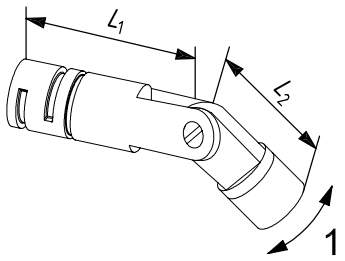


Figure C.2 — Guillotine end-effector

Devices such as the one shown in Figure C.3 are used for handling lightweight ferritic objects (maximum mass 10 g).



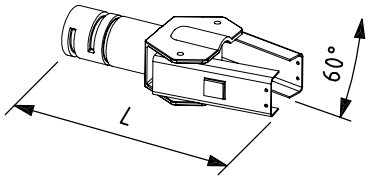
Key

1 90° shifting, both directions

NOTE L_1 = 85 mm and L_2 = 50 mm

Figure C.3 — Magnetic end-effector

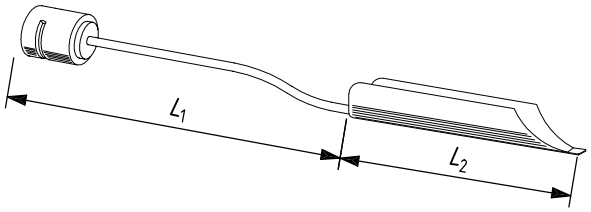
Devices such as the one shown in Figure C.4 are used where, unlike most other tongs, an internal grip is required, e.g. for gripping hollow objects on the inside.



NOTE L = 118 mm

Figure C.4 — Expanding tong for internal gripping

Devices such as the one shown in Figure C.5 are used to transfer a source into the channel of a shielding flask in the horizontal position.



NOTE L_1 = 155 mm and L_2 = 100 mm

Figure C.5 — Scoop accessory

C.3 Ejection devices

An ejection device is used for ejecting a leak-tight gaiter and replacing it with a new gaiter without compromising the integrity of the containment (in accordance with ISO 11933-1 and ISO 11933-2).

Ejection devices may be mechanical (see Figure C.6) or pneumatic. Annex E gives examples of gaiter replacement methodology using ejection devices.

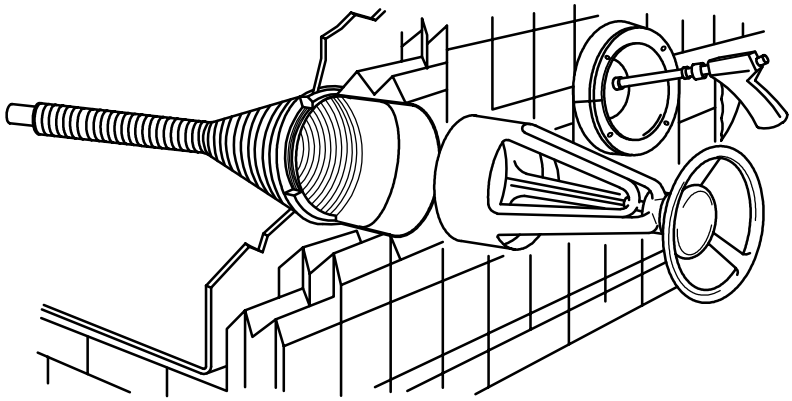


Figure C.6 — Example of a mechanical ejection device

C.4 Special accessories

Figures C.7 to C.9 give examples of special accessories.

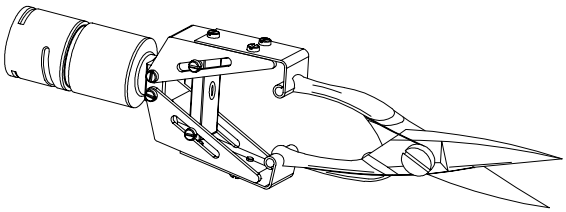


Figure C.7 — For cutting up PVC material, tin foil (maximum thickness 0,3 mm) and electric wiring (maximum thickness 0,8 mm)

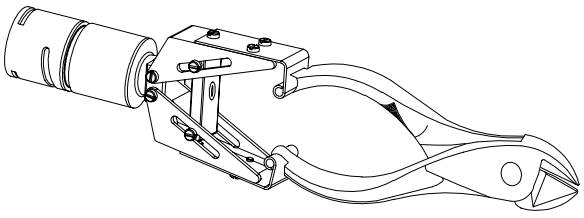


Figure C.8 — For cutting twin-core cable up to 1,2 mm

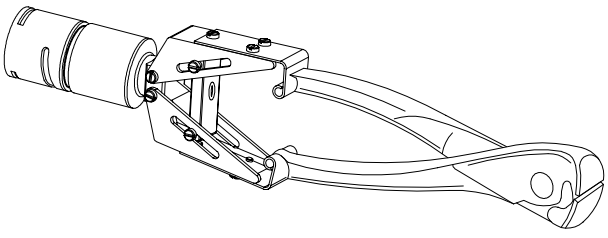


Figure C.9 — For extracting nails

Annex D
(informative)

Gaiters for remote handling tongs

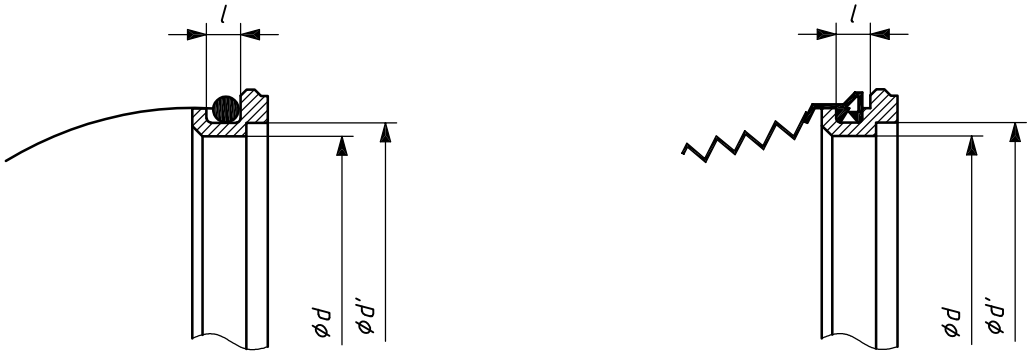
D.1 General

Gaiters are connected to the containment wall by means of disposable support rings. Examples of standardized disposable rings are given in ISO 11933-1. Depending on the size of the sphere unit (see Figures D.1 and D.2), the corresponding ISO references of the associated support rings are 1130, 1131, 1134 or 1137.

Gaiters are typically made of latex, polychloroprene (PR), polyurethane (PU) or polyvinyl chloride (PVC).

D.2 Gaiters for rigid remote handling tongs

These gaiters correspond to rigid remote handling tongs with a diameter of 14 mm.



a) Rubber (latex) gaiter mounted on its support ring **b) PVC gaiter mounted on its support ring**

Figure D.1 — Connection of the gaiters on the containment wall using an ejectable support ring

D.3 Gaiters for articulated handling tongs

These gaiters correspond to articulated remote handling tongs with a diameter of 33 mm.

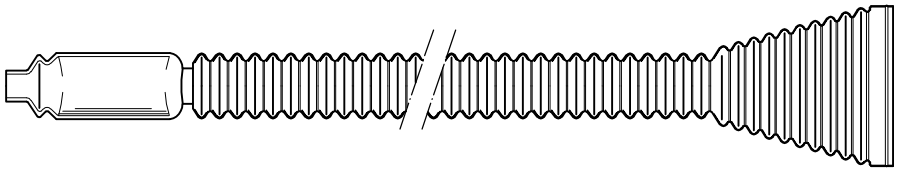


Figure D.2 — Gaiter for articulated remote handling tongs

NOTE Some special tongs are equipped with gaiters providing protection against dust and contamination only. The gaiter coupling is not leak-tight and slides along the rod, which is itself not leak-tight.

Annex E
(informative)

Replacement of gaiters for remote handling tongs

E.1 Gaiters for Type 1 support ring[4)]

The gaiter is replaced by means of the following procedure:

a) disconnect the handling tongs from the leak-tight coupling and remove the tongs [see Figure E.1, a)];

b) remove the sphere unit and the securing ring [see Figure E.1, b)];

c) lock the ejection device, equipped with the new gaiter fitted and its leak-tight coupling, to the enclosure ring [see Figure E.1, c)];

d) eject the old gaiter into the containment enclosure and replace it with the new one [see Figure E.1, d)];

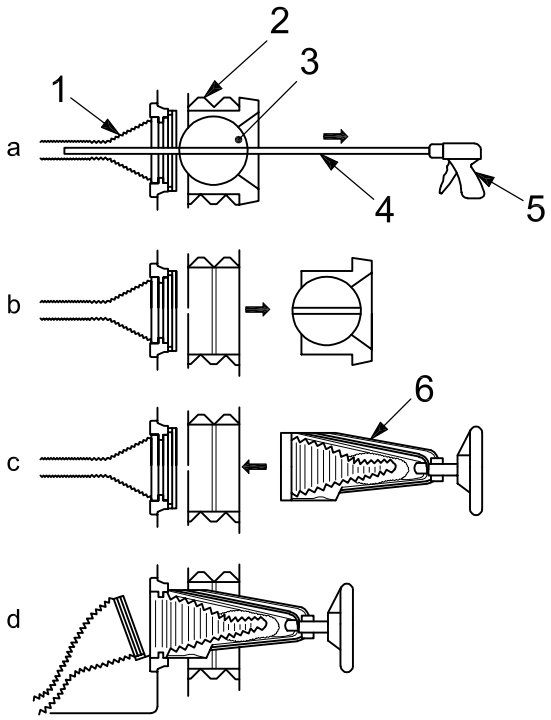
e) unlock the ejection device and fit the securing ring;

f) replace the sphere unit on the enclosure wall or on the shielding wall;

g) insert the remote handling tongs in the sphere unit;

h) position the leak-tight coupling in the disconnection device (using another pair of tongs where necessary) and lock the remote handling tongs to the leak-tight coupling.

4) See definition of Type 1 support rings in ISO 11993-1.



Key

1 leak-tight gaiter
2 containment wall
3 sphere unit
4 rod
5 handle
6 ejection device

Figure E.1 — Replacement of a remote handling tongs gaiter using a disposable support ring of Type 1

E.2 Gaiters for Type 3 support ring[5)]

The gaiter is replaced by means of the following procedure:

a) remove the remote handling tongs;

b) remove the sphere unit;

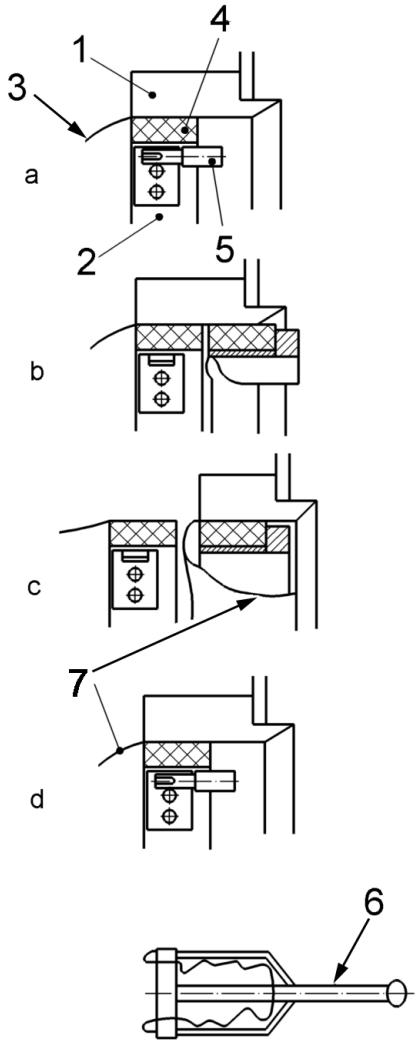
c) unlock the expandable ring by the means of the locking rod [see Figure E.2, a)];

d) insert the ejection device equipped with the new gaiter [see Figure E.2, b)];

e) eject the old gaiter inside the containment enclosure [see Figure E.2, c)];

f) lock the new gaiter equipped with the extending ring by means of a locking rod [see Figure E.2, d)].

5) See definition of Type 3 support ring in ISO 11933-1.



Key

1 enclosure ring
2 extended ring
3 gaiter to be exchanged
4 flat seal
5 locking rod
6 ejection device
7 new gaiter

Figure E.2 — Replacement of a remote handling tongs gaiter using a disposable support ring of Type 3

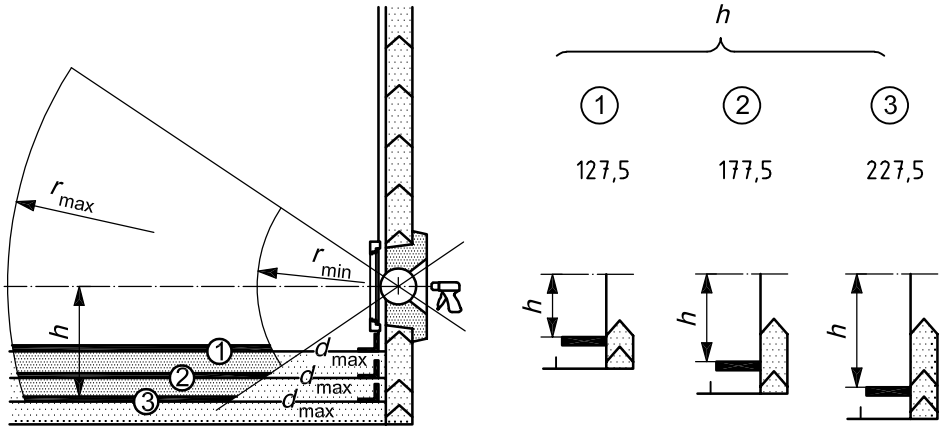
Annex F
(informative)

Relationship between the characteristics of the remote handling tongs and the operating volume

F.1 General

The present annex applies only to horizontal rigid remote handling tongs. The dimensions indicated in the following tables correspond to remote handling tongs fitted on a leak-tight coupling and jaws. For remote handling tongs without gaiter, the dimensions given on the tables below are reduced because the leak-tight coupling is not used (e.g. they can be reduced by 70 mm).

F.2 Operating volume of remote handling tongs – Wall thickness 50 mm



Key

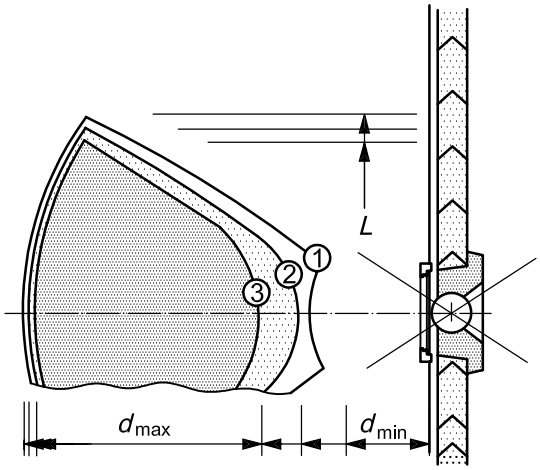
h height of sphere unit axis, in millimetres, with respect to the reference work level (varies with 1, 2, 3)

r_{max} maximum operating radius, from the centre of the sphere unit

d_{max} maximum usable distance on the work level (varies with 1, 2, 3)

r_{min} minimum radius taking into account the gaiter used (latex or PVC)

Figure F.1 — Elevation view (for a 750 mm length rod)



Key

L maximum lateral deflection on the work level (varies with 1, 2, 3)

d_{max} maximum usable distance on the work level (varies with 1, 2, 3)

d_{min} minimum distance lost on work level measured from the containment enclosure wall (varies with 1, 2, 3)

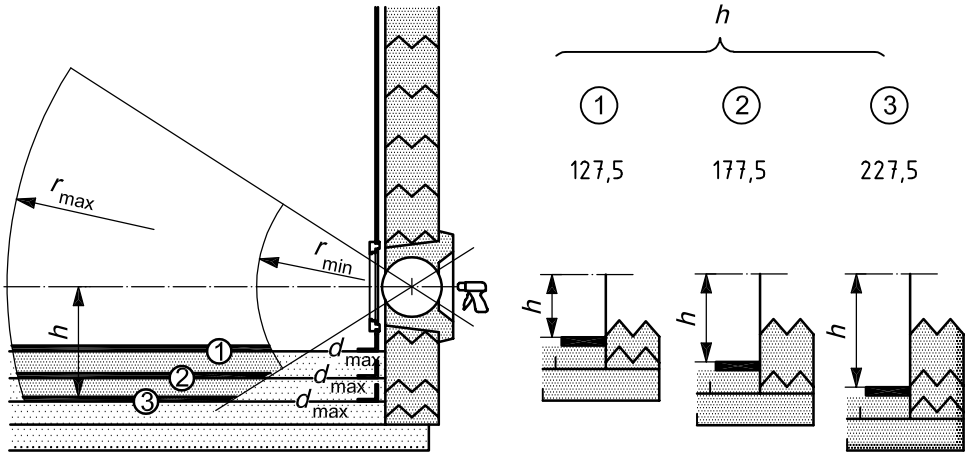
Dimensions		Length of rods mm[a]			
		500	**750**	**1 000**	**1 250**
r_{max}		565	815	1 065	1 315
r_{min}	latex	295	295	355	355
	P V C	335	335	380	380
d_{max}	1st case	485	740	990	1 240
	2nd case[b]	470	730	985	1 235
	3rd case[b]	450	720	975	1 230
d_{min}	1st case latex	190	190	245	245
	1st case PVC	225	225	265	265
	2nd case[b]	255	255	260	260
	3rd case[b]	345	345	345	345
L	1er case	480	750	1 000	1 250
	2nd case[b]	410	705	970	1 225
	3rd case[b]	300	650	925	1 190

[a] The length of the rod corresponds to the distance between the handle and the tong.

[b] For cases 2 and 3, identical dimensions for a PVC or a latex gaiter.

Figure F.2 — Cross-section view on the working level (for a 750 mm length rod)

F.3 Operating volume of remote handling tongs – Wall thickness 100 mm



Key

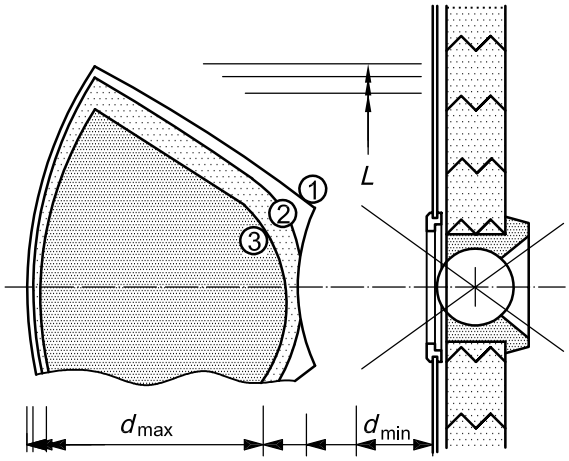
h height of sphere unit axis, in millimetres, with respect to the reference work level (varies with 1, 2, 3)

r_{max} maximum operating radius, from the centre of the sphere unit

d_{max} maximum usable distance on the work level (varies with 1, 2, 3)

r_{min} minimum radius taking into account the gaiter used (latex or PVC)

Figure F.3 — Elevation view (for a 750 mm length rod)



Key

L maximum lateral deflection on the work level (varies with 1, 2, 3)

d_{max} maximum usable distance on the work level (varies with 1, 2, 3)

d_{min} minimum distance lost on work level measured from the containment enclosure wall (varies with 1, 2, 3)

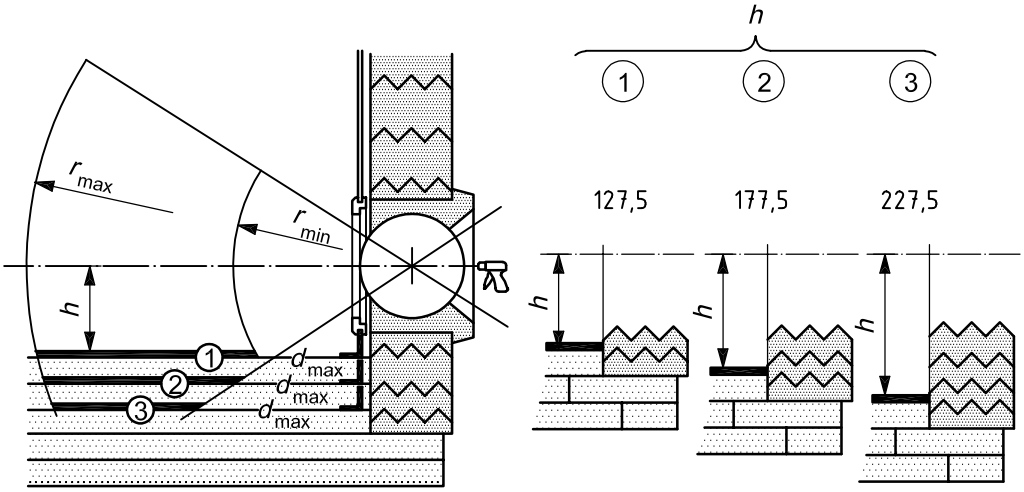
Dimensions					
		Length of rods mm[a]			
		500	**750**	**1 000**	**1 250**
r_{max}		535	785	1 035	1 285
r_{min}	latex	320	320	380	380
	P V C	360	360	405	405
d_{max}	1st case	430	690	935	1 190
	2nd case	415	680	930	1 185
	3rd case	395	665	920	1 175
d_{min}	1st case latex	190	190	240	240
	1st case PVC	225	225	265	265
	2nd case[b]	235	235	235	235
	3rd case[b]	320	320	320	320
L	1st case	445	715	970	1 220
	2nd case	365	675	935	1 195
	3rd case	240	615	890	1 160

[a] The length of the rod corresponds to the distance between the handle and the tong.

[b] For cases 2 and 3, identical dimensions for a PVC or a latex gaiter.

Figure F.4 — Cross-section view on the working level (for a 750 mm length rod)

F.4 Operating volume of remote handling tongs — Wall thickness 150 mm



Key

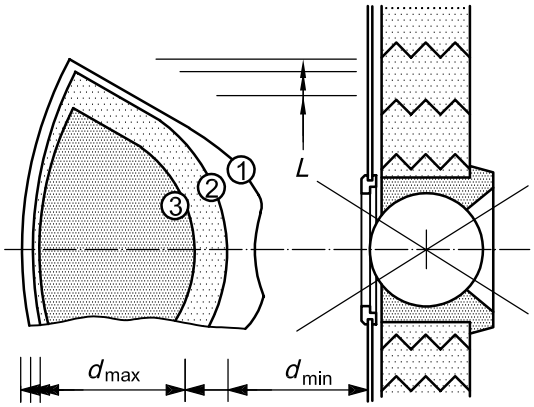
h height of sphere unit axis, in millimetres, with respect to the reference work level (varies with 1, 2, 3)

r_{max} maximum operating radius, from the centre of the sphere unit

d_{max} maximum usable distance on the work level (varies with 1, 2, 3)

r_{min} minimum radius taking into account the gaiter used (latex or PVC)

Figure F.5 — Elevation view (for a 750 mm length rod)



Key

L maximum lateral deflection on the work level (varies with 1, 2, 3)

d_{max} maximum usable distance on the work level (varies with 1, 2, 3)

d_{min} minimum distance lost on work level measured from the containment enclosure wall (varies with 1, 2, 3)

		Dimensions			
		Length of rods mm[a]			
		500	**750**	**1 000**	**1 250**
r_{max}		500	750	1 000	1 250
r_{min}	latex	345	345	405	405
	P V C	385	385	430	430
d_{max}	1st case	370	625	875	1 130
	2nd case	355	615	870	1 120
	3rd case	330[c]	605	860	1 115
d_{min}	1st case latex	185	185	240	240
	1st case PVC	225	225	265	265
	2nd case[b]	205	205	205	205
	3rd case[b]	300[c]	300	300	300
L	1st case	405	680	930	1 175
	2nd case	320	650	900	1 150
	3rd case	160	555	855	1 125

[a] The length of the rod corresponds to the distance between the handle and the tong.

[b] For cases 2 and 3, identical dimensions for a PVC or a latex gaiter.

[c] This usable field has no practical value.

Figure F.6 — Cross-section view on the working level (for a 750 mm length rod)

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