International Standard 2016

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Capillary solder fittings for copper tubes — Assembly dimensions and tests

Raccords à braser par capillarité pour tubes en cuivre — Dimensions d'assemblage et essais

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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 2016 was developed by Technical Committee ISO/TC 5, *Ferrous metal pipes and metallic fittings*, and was circulated to the member bodies in April 1980.

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

Austria	Germany, F.R.	South Africa, Rep. of
Belgium	India	Spain
Brazil	Israel	Sweden
Czechoslovakia	Korea, Rep. of	Switzerland
Denmark	Netherlands	USSR
Egypt, Arab Rep. of	Poland	
Finland	Romania	

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Australia	Japan
Canada	United Kingdom
France	USA

This International Standard cancels and replaces ISO Recommendation R 2016-1971, of which it constitutes a technical revision.

Capillary solder fittings for copper tubes — Assembly dimensions and tests

1 Scope and field of application

This International Standard specifies the field of application, the assembly dimensions and their tolerances, the materials and tests for capillary solder fittings for copper tubes.

Capillary soldered joints having socket and male end dimensions and tolerances as given in this International Standard are suitable for the service conditions shown in table 1.

2 References

ISO 7, *Pipe threads where pressure-tight joints are made on the threads —*

Part 1 : Designation, dimensions and tolerances.[1)]

Part 2 : Verification by means of limit gauges.[2)]

ISO 228, *Pipe threads where pressure-tight joints are not made on the threads —*

Part 1 : Designation, dimensions and tolerances.[3)]

Part 2 : Verification by means of limit gauges.

Table 1 — Service conditions

Soldering/ brazing	Typical examples of soldering/ brazing alloys[1)2)]	Service temperature[2)] °C max.	Service pressure in bars for assembly diameters[2)3)]		
			6 to 28 mm	35 to 54 mm	76,1 to 108 mm
Soldering	I lead/tin 50/50 % or 60/40 %	30	16	16	10
		65	10	10	6
		110	6	6	4
	II tin/silver or tin/copper 95/5 % or 97/3 %	30	40	25	16
		65	25	16	16
		110	16	10	10
Brazing	III silver cadmium free 55 % silver	30	40	25	16
	IV silver with cadmium 30 or 40 % silver	65	25	16	16
	V copper/phosphorous 94/6 % or with 2 % silver	110	16	10	10

1) The choice depends upon the field of application and the rules in force.

2) For use in applications involving higher working pressures and higher working temperatures, solder/brazing alloys with suitable fluxes as recommended by the solder or fitting manufacturer shall be used.

3) A factor of safety of 2,5 will be achieved with 50/50 % tin/lead solder when a solder bond of 60 % of the specified assembly surface is attained.

1) At present at the stage of draft. (Revision of ISO 7/1-1978.)

2) At present at the stage of draft.

3) At present at the stage of draft. (Revision of ISO 228/1-1978.)

ISO 272, *Fasteners — Hexagon products — Widths across flats.*

ISO 274, *Copper tubes of circular section — Dimensions.*

ISO 426, *Wrought copper-zinc alloys — Chemical composition and forms of wrought products —*
Part 1 : Non-leaded and special alloys. [1)]
Part 2 : Leaded alloys. [2)]

ISO 1085, *Combinations of double-ended wrench gaps.*

ISO 1336, *Wrought coppers (having minimum copper contents of 97,5 %) — Chemical composition and forms of wrought products.*

ISO 1337, *Wrought coppers (having minimum copper contents of 99,85 %) — Chemical composition and forms of wrought products.*

ISO 1338, *Cast copper alloys — Composition and mechanical properties.*

ISO/R 1938, *ISO system of limits and fits — Part 2 : Inspection of plain workpieces.*

3 Materials, design and manufacture

3.1 Materials

3.1.1 Fittings of copper

The fittings shall be made from copper tubes or bars etc. having characteristics and properties similar to

Cu-DHP specified in ISO 1337.

Appropriate copper alloys containing tellurium or sulphur according to ISO 1336 are also allowed.

3.1.2 Fittings of gunmetal

The fittings shall be made from castings or pressings having characteristics and properties similar to

CuPb 5 Sn 5 Zn 5 specified in ISO 1338.

3.1.3 Fittings of brass

The fittings shall be made from castings or bars having characteristics and properties similar to

CuZn 40 specified in ISO 1338 and ISO 426.

3.1.4 Fittings of other materials

Notwithstanding these requirements in clauses 3.1.1 to 3.1.3, any other materials which give results similar to those specified above will be admitted.

1) At present at the stage of draft. (Revision of ISO 426/1-1973.)

2) At present at the satge of draft. (Revision of ISO 426/2-1973.)

3.2 Design

Illustrations used in this International Standard are diagrammatic only and have been chosen without prejudice.

3.2.1 Assembly dimensions and tolerances

3.2.1.1 Assembly diameters D

The diameters and tolerances specified permit the assembly of fittings with tubes having the following outside diameters D :

6 — 8 — 10 — 12 — 15 — 18 — 22 — 28 — 35 — 42 — 54 — 76,1 — 88,9 — 108

3.2.1.2 Tolerances on the assembly diameters

In order to ensure the distribution of solder by capillary action and to allow for the alignment of the male end of a fitting or the free end of a tube in the socket, the tolerances shown in table 2 shall be maintained.

3.2.1.3 Lengths of engagement and their tolerances

An internal soldering end according to figure 1 is the socket end of a fitting intended for capillary soldering and is the end which is passed over the tube end.

An external soldering end according to figure 2 is the end of a tube or the male end of a fitting intended for capillary soldering which is pushed into a capillary solder fitting.

The values of the lengths of engagement and their tolerances are given in table 3.

Table 2 — Tolerances on the assembly diameter

Values in millimetres

Assembly diameter D [1)]	Tolerances of the mean diameter [2)] with respect to the assembly diameter D		Resulting diametrical difference	
	Outside diameter of male end	Inside diameter of socket	max.	min.
6 to 18	± 0,045 [3)]	+ 0,155 + 0,065	0,20	0,02
22 and 28	± 0,055 [3)]	+ 0,185 + 0,075	0,24	0,02
35 to 54	± 0,07 [3)]	+ 0,230 + 0,090	0,30	0,02
76,1 to 108	± 0,07	+ 0,33 + 0,10	0,40 [4)]	0,03

1) Outside diameter of copper tube.

2) Arithmetical mean of two diameters at right angles in a cross-section taken anywhere on the length of the socket or of the male end.

3) Equal to the reduced outside diameter tolerances as specified in ISO 274, table 2.

4) The jointing process under these conditions is not entirely controlled by capillary action. Skilled soldering techniques are required.

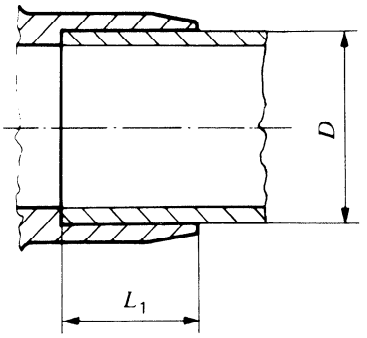


Figure 1 — Socket

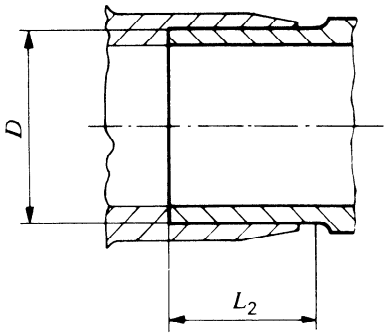


Figure 2 — Male end

Table 3 — Lengths of engagement and their tolerances

Dimensions in millimetres

Assembly diameter D[1]	Socket length L_1[2]	Male end length L_2[2]	Tolerance on length valid for L_1 and L_2
6	7	9	± 1,2
8	8	10	
10	9	11	
12	10	12	± 1,4
15	12	14	
18	14	16	
22	17	19	± 1,6
28	20	22	
35	25	27	± 2,0
42	29	31	
54	34	36	
76,1	36	39	± 2,5
88,9	40	43	
108	50	53	

1) Outside diameter of copper tube.

2) The lengths L_1 and L_2 of integral solder ring fittings shall be increased by the width of the solder groove.

3.2.2 Tube stop

An effective abutment shall be incorporated to control the joint length even with a male end having the minimum outside diameter.

3.2.3 Assembling threads

Outlets of soldering fittings with assembling threads shall be made :

3.2.3.1 For jointing threads in accordance with ISO 7, external threads tapered 1 : 16; internal threads parallel.

3.2.3.2 For fastening threads on union nuts and their mating parts in accordance with ISO 228.

3.2.3.3 Chamfer of threads

Internal threads shall be chamfered to a minimum included angle of 90°.

External threads shall be chamfered too.

The chamfer shall have a height at least equal to the thread depth.

3.2.4 Tolerance for the alignment of the fitting ends

The alignment of the socket and/or male ends and/or threaded ends of the fittings shall be within a tolerance of ± 1°.

3.2.5 Flats for spanners

Flats for spanners on threaded fittings and nuts may be polygonal at the option of the manufacturer.

The widths across flats are at the option of the manufacturer but should be approximate to those values specified in ISO 272 and ISO 1085.

3.2.6 Minimum wall thickness of fittings

Table 4 — Minimum wall thickness

Dimensions in millimetres

Assembly diameter D	Copper fittings made from drawn tube $s_{min.}$ 1)	Brass fittings made from pressings $s_{min.}$	Gunmetal or brass fittings from castings $s_{min.}$
6	0,6	1,0	1,0
8	0,6	1,0	1,0
10	0,6	1,1	1,1
12	0,6	1,1	1,2
15	0,7	1,2	1,4
18	0,8	1,4	1,5
22	0,9	1,4	1,6
28	0,9	1,5	1,8
35	1,0	1,6	1,9
42	1,1	1,8	2,2
54	1,2	2,0	2,3
76,1	1,6	2,6	3,4
88,9	1,8	2,9	3,9
108	2,1	3,3	4,5

1) Minimum wall thickness of copper tube fittings which may occur at isolated places as a result of the fabrication methods used. In order to satisfy the service and application conditions, these minimum wall thicknesses shall not apply over the whole surface of the fittings.

NOTE — In the case of integral solder ring fittings where a groove is made within the soldering length, the wall thickness s' of the groove may be reduced : for copper fittings up to 10 %, for pressings up to 35 % and for castings up to 30 %.

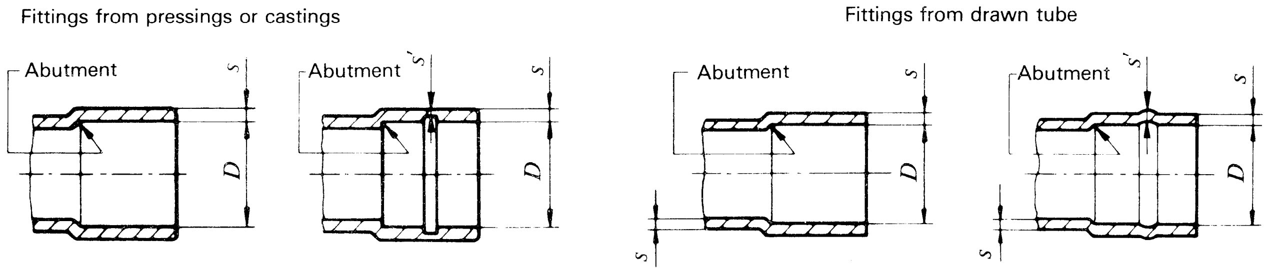


Figure 3 — Wall thickness

3.3 Manufacture

The fittings shall be free from defects such as folds, blowholes, porosity and cracks and shall be deburred and properly finished.

The bores of cast and pressed fittings shall be chamfered or radiused on the inside and sharp edges shall be removed from the outside.

4 Designation

The fittings shall be designated by quoting :

4.1 Denomination

The denomination, for example, bend, elbow, etc.

4.2 Assembly diameter

The assembly diameter of the connecting tube or the designation of thread in the case of screwed connections.

4.2.1 Equal fittings

Equal fittings on which all outlets have the same assembly diameter shall be designated by this one diameter.

4.2.2 Reducing fittings

In the case of reducing fittings, the outlets shall be indicated in the following sequence quoting the corresponding tube outside diameter or the corresponding designation of thread.

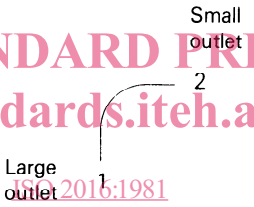


Figure 4 — Designation of fittings having two outlets

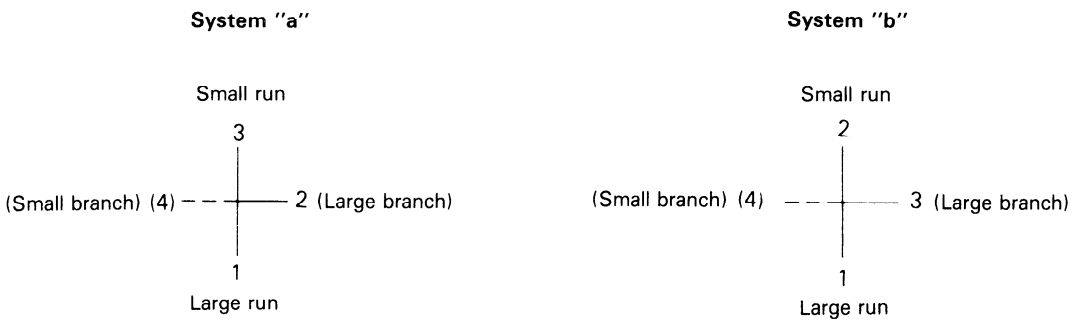


Figure 5 — Designation of tees (and crosses)

4.2.3 Abbreviated designation

However, in all cases of reducing tees where the run is equal and the branch is reduced or increased and reducing crosses where the run is equal and the branches are symmetrically reduced, the fittings are referred to by the size of the run and the size of the branch(es) in the abbreviated form as follows :

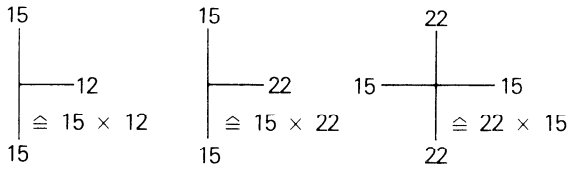


Figure 6 — Designation of tees and crosses equal on the run, reducing or increasing on the branch and symmetrically reducing on the branches

4.2.4 Adapter fittings

In the case of adapter fittings combining a capillary solder joint and a screwed joint the designation is given in the sequence

"solder size by threaded size".

5 Marking of fittings

Whenever practicable each fitting shall be marked with the trade mark or the maker's name and the assembly diameters.

6 Tests

6.1 Certification

When required by the purchaser and specified in the enquiry or order, the manufacturer shall supply a certificate stating that the materials used are in accordance with 3.1.

6.2 Check for dimensions

All required dimensions shall be checked with the aid of adequate gauging equipment, for example,

6.2.1 Assembly dimensions

GO and NOT GO plain gauges according to tables 5 and 6 which were made up similar to ISO/R 1938 but taking into account the special requirements of thin-walled pieces.

6.2.2 Threads

Gauges according to ISO 7/2 and ISO 228/2 respectively.

6.3 Leak tightness test

The body of every fitting made from a casting shall be tested by the manufacturer for porosity by a leak tightness test for an appropriate time at the manufacturer's option either :

— by the application of an internal hydraulic pressure of not less than 20 bar, or

— by application of an internal air pressure of not less than 5 bar while the fitting is completely immersed in water

— alternatively, the manufacturer may substitute other types of leak tightness tests which ensure an equivalent quality.

The test shall be carried out after machining. The fittings when so tested shall show no signs of leakage.

Fittings which do not satisfy the test shall be rejected.

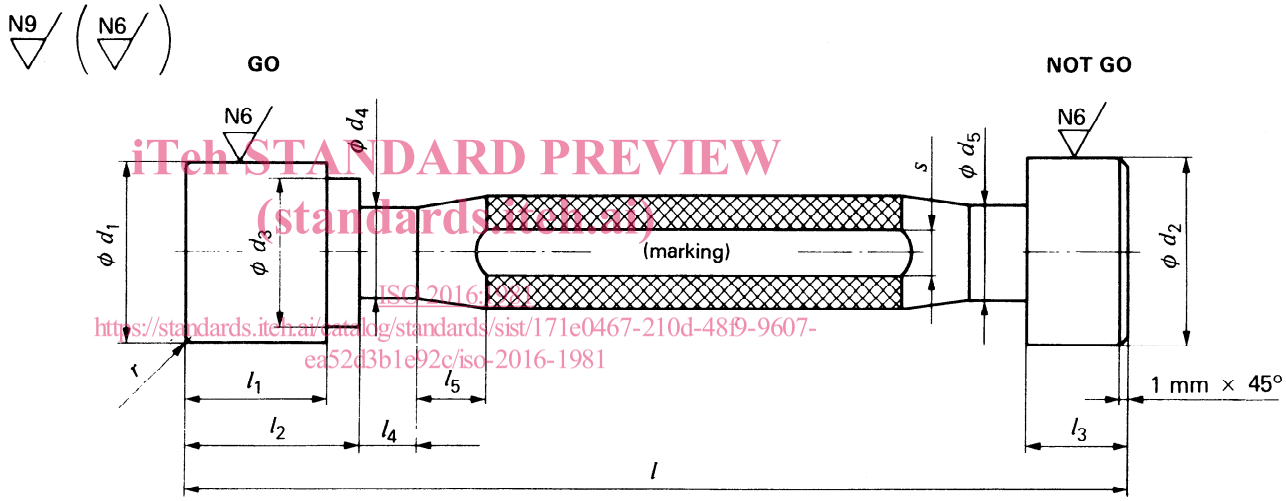
7 Type test

New types of capillary solder fittings shall be tested for their proof strength.

After having brazed at a temperature of 800 °C for 1 min for diameters up to 28 mm and for 2 min for larger diameters, a copper fitting shall withstand without any leakage a hydraulic pressure of 80 bar for diameters up to 54 mm and 40 bar for diameters above 54 mm. In this test it is recognized that permanent deformations will occur and these are not subject to limits.

Tubes used for making joints for this proof strength test shall be strong enough not to fail before the fitting.

Table 5 — GO and NOT GO plug gauges



$\phi \leqslant 18 : r = 0{,}7$ mm
$\phi \geqslant 22 : r = 1{,}0$ mm

Assembly diameter D mm	tol. mm	ϕd_1 mm	tol. µm	ϕd_1 after wear mm	ϕd_2 mm	tol. µm	ϕd_3[1] mm	ϕd_4 mm	ϕd_5 mm	l_1 mm	tol. mm	l_2 mm	tol. mm	l_3 mm	l_4 mm	l_5 mm	l mm	s mm
6	+ 0,155 + 0,065	6,068	± 1,25	6,062	6,155	± 1,25	4	2)	2)	5,8	+ 0,1 0	8,2	0 − 0,1	4	2)	2)	2)	2)
8		8,068		8,062	8,155		6			6,8		9,2		5				
10		10,068		10,062	10,155		8			7,8		10,2		5				
12		12,069	± 1,5	12,061	12,155	± 1,5	10			8,6		11,4		6				
15		15,069		15,061	15,155		13			10,6		13,4		7				
18		18,069		18,061	18,155		16			12,6		15,4		8				
22	+ 0,185 + 0,075	22,080	± 2	22,071	22,185	± 2	20			15,4	+ 0,2 0	18,6	0 − 0,2	10				
28		28,080		28,071	28,185		25			18,4		21,6		12				
35	+ 0,23 + 0,09	35,096		35,085	35,230		32			23		27		14				
42		42,096		42,085	42,230		39			27		31		16				
54		54,097	± 2,5	54,085	54,230	± 2,5	51			32		36		18				
76,1	+ 0,33 + 0,10	76,207		76,195	76,430		73			33,5	+ 0,25 0	38,5	0 − 0,25	22				
88,9		89,008	± 3	88,994	89,230	± 3	85			37,5		42,5		24				
108		108,108		108,094	108,330		104			47,5		52,5		26				

1) Two flats instead of d_3 ϕ are optional.

2) These dimensions are left to the option of the user.