International Standard 1161

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

Series 1 freight containers — Corner fittings — Specification

Conteneurs de la série 1 — Pièces de coin — Spécifications

Fourth edition — 1984-12-15

UDC 621.896.88 **Ref. No. ISO 1161-1984 (E)**

Descriptors : containers, freight containers, corner fittings, specifications, dimensions.

ISO 1161-1984 (E)

Price based on 21 pages

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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 1161 was prepared by Technical Committee ISO/TC 104, *Freight containers*.

The third edition of ISO 1161 was published in 1980. This fourth edition cancels and replaces the third edition, following incorporation of draft Amendment 1 (new annex C, guide on the choice of sizes for, and the positioning of, twistlock devices for securing freight containers) and an update of the references (ISO 8323 replaces ISO 1496/7).

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Printed in Switzerland

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Series 1 freight containers — Corner fittings — Specification

0 Introduction

This International Standard on corner fittings is the result of the efforts of technical and operational personnel drawn from all phases of the transportation industry. The figures show the fittings for the top and bottom corners of series 1 freight containers which will provide compatibility in interchange between transportation modes. Care has been taken to limit consideration only to those details vital to this function.

The size and configuration of corner fitting apertures are specified. The faces of the corner fittings having apertures for the engagement of handling and securing devices have specified thickness and tolerances as shown in figures 1, 2, 3 and 4. The thickness of the blank walls is not specified since they are not involved in the engagement of the handling and securing devices, provided that their inner surfaces do not protrude into the corner fitting cavity reserved for the engaging devices; however, typical overall dimensions of box-shaped top and bottom corner fittings are given in annex A by way of example. These overall dimensions are not mandatory.

The purpose of this International Standard is to define some details of design vital to container interchange in automatic, semi-automatic and conventional systems.

The strength and testing requirements specified in this International Standard do not take any account of the stresses which may result from the practice of end-to-end coupling of containers.

Typical examples of twistlock lifting devices which may be fitted on handling devices are given in annex B.

A guide on the choice of sizes of twistlock tie-down devices and their positioning for securing series 1 freight containers to carrying vehicles is given in annex C.

NOTE — The requirements of this International Standard do not preclude the provision of additional facilities for lifting either from the top or at the base of the freight container.

1 Scope and field of application

This International Standard establishes the basic dimensions and the functional and strength requirements of corner fittings for series 1 freight containers, i.e. containers which conform to ISO 668 and ISO 1496 with the exception of air mode containers (see ISO 8323).

2 References

ISO 668, *Series 1 freight containers — Classification, external dimensions and ratings.*

ISO 1496/1, *Series 1 freight containers — Specification and testing — Part 1 : General cargo containers for general purposes.*

ISO 8323, *Freight containers — Air/surface (intermodal) general purpose containers — Specification and tests.*[1]

1) At present at the stage of draft.

3 Dimensional requirements

3.1 General

3.1.1 The dimensions and tolerances of the corner fittings shall conform to figures 1, 2, 3 and 4.

Each series 1 container shall have two right-hand top corner fittings (on the right as the observer faces either end of the container) and two left-hand top corner fittings which are the mirror image of the right-hand fittings.

The bottom corner fittings shall have a similar configuration except in respect of the end aperture.

The corner fittings shown in figures 1 to 4 illustrate right-hand top and bottom fittings only; for the left-hand corner fittings, the dimensions are simply transposed.

3.1.2 Typical overall dimensions which may be used to develop a box-shaped fitting are given as an example in annex A.

3.2 Detailed dimensional and manufacturing requirements

3.2.1 Sharp corners shall be removed as far as practicable.

3.2.2 Where dimensions are not specified for inner and outer edges of apertures, these edges shall be given a radius of $3\ ^{0}_{-1,5}$ mm $(1/8\ ^{0}_{-1/16}$ in).

3.2.3 At the junction of the two 6 mm (1/4 in) outside edge radii with the 14,5 mm (9/16 in) edge radius, the corner should be rounded by blending the radiused edges, removing minimum amounts of material from the flat outer faces and walls.

3.2.4 Where a corner fitting has an optional inner side wall and is made to the minimum dimension of 149 mm (5 7/8 in), the junction of the mandatory horizontal face to the optional inner side wall may be provided with a radius not exceeding 5,5 mm (7/32 in).

If a greater radius is required, the 149 mm (5 7/8 in) dimensions shall be increased accordingly.

4 Strength requirements

The corner fittings shall be designed and constructed in such a manner and of such materials as to enable them to pass the operating and testing requirements laid down in ISO 1496/1.

5 Design requirements

5.1 Loads

The following container design loads and criteria were used in establishing the dimensional design of corner fittings specified in this International Standard.

Corner fittings for series 1 freight containers shall be capable of withstanding the loads calculated in accordance with the requirements of ISO 1496/1 for 1AA, 1A and 1AX containers. The calculated design loads are listed in the following sub-clauses.

5.1.1 Stacking	Design loads
Top corner fitting [superimposed load offset 25,4 mm (1 in) laterally and 38 mm (1 1/2 in) longitudinally]	680 kN
Bottom corner fitting (resting on flat support)	810 kN
Bottom corner fitting [of No. 5 container offset 25,4 mm (1 in) laterally and 38 mm (1 1/2 in) longitudinally with respect to No. 6 container]	680 kN

5.1.2 Lifting	Design loads
Top corner fitting [twistlock (see also clause 6), hook or shackle]	150 kN
Bottom corner fitting : sling at 30° to horizontal	300 kN

NOTES

Lifting from the bottom corner fitting

1 The line of action of the sling is assumed to be parallel to and not more than 38 mm (1 1/2 in) from the outer face of the corner fitting.

2 The load values quoted are for slings at the angles stated, but it is recognized that slings may be used at any angle between the angle stated and the vertical.

5.1.3 Longitudinal restraint	Design loads
Bottom corner fittings	300 kN each
(two fittings carrying load)	($2\ g \times 1\ R$)

5.1.4 Lashing and securing

The force, or resultant of any combination of forces, imparted on the aperture in the end or the side of a corner fitting as a result of the use of a lashing or a securing device, or a combination of such devices, is assumed not to exceed the value indicated by the point on the "envelope" shown in figure 5 which is appropriate to the angle at which the force, or resultant force, is applied. It is further assumed that the force or resultant force lies in a plane parallel to and no more than 38 mm (1 1/2 in) from the face of the corner fitting.

5.1.5 Misgather (localized loading of bottom corner fittings caused by lowering of the container onto locating fittings which are not gathered into the hole)

Bottom corner fittings shall be capable of withstanding a load of 150 kN applied normally to the contact area of 25 mm (1 in) × 6 mm (1/4 in) on the bottom face (see figure 7).

5.2 Compulsory features

Compulsory walls or faces in the corner fittings are :

Top corner fittings :

- the top face;
- the external side wall;
- the external end wall.

Bottom corner fittings :

- the bottom face;
- the external side wall;
- the external end wall.

6 Minimum bearing area — Top corner fitting

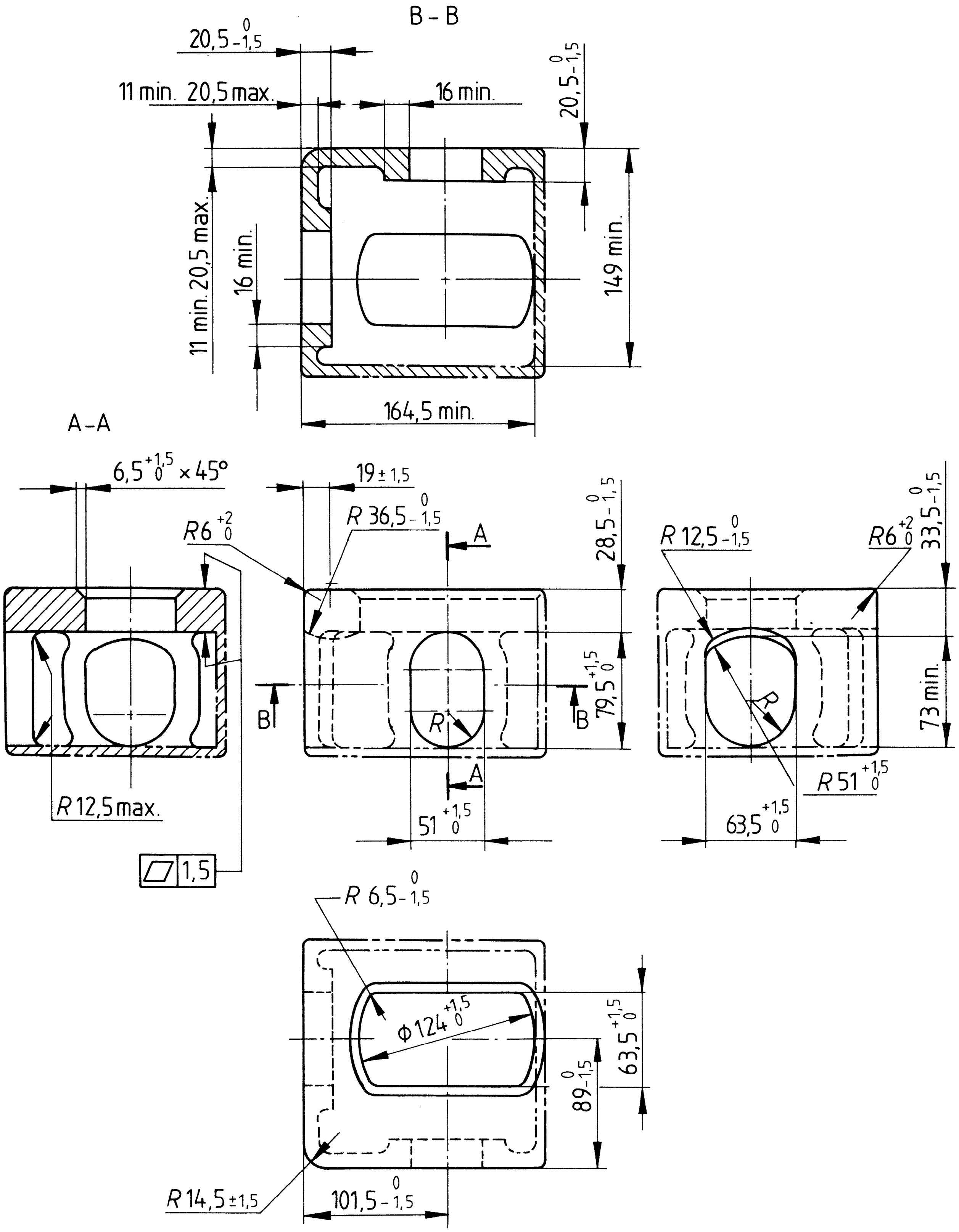
It is assumed that lifting devices which only use the top apertures of the four top corner fittings will have a minimum total bearing area on the horizontal part of the inner top surfaces of the top corner fittings of 800 mm^2 (1.24 in^2), for each of the top corner fittings.

Examples of twistlock lifting devices are given in annex B.

7 Corner fitting marking (where provided)

Markings on top and bottom corner fittings shall be located at positions where they are clearly visible after assembly of the fittings to freight containers and where they will not interfere with the satisfactory functioning of handling, locating and securing devices used in conjunction with the corner fittings.

[Dimensions in millimetres]



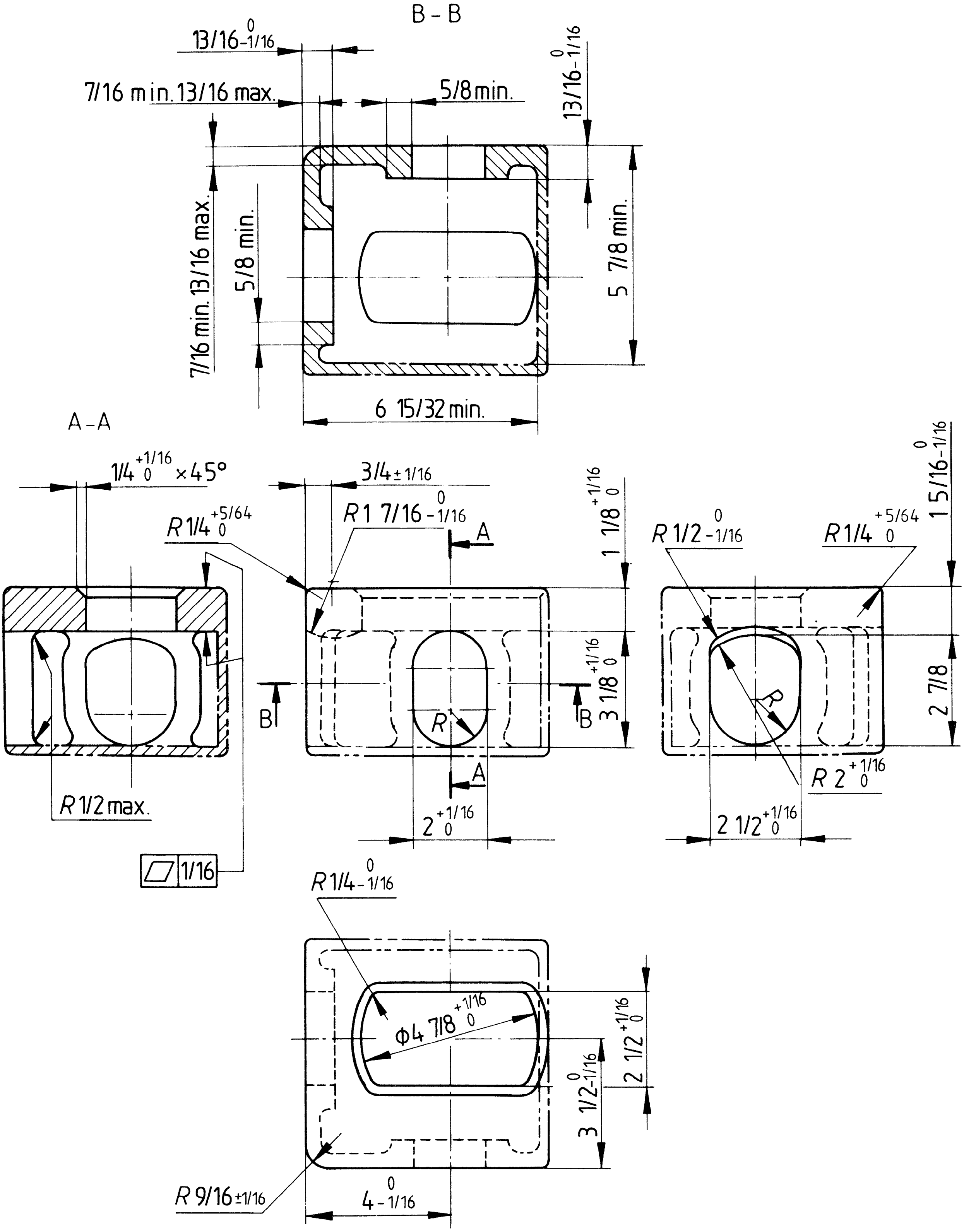
NOTES

1 Solid and broken lines (— and ---) show surfaces and contours which shall be physically duplicated in the fitting.

2 Phantom lines (—··—··—) show optional walls, which may be used to develop a box-shaped fitting.

Figure 1 — Top corner fitting — Dimensions in millimetres
(see clause 3)

[Dimensions in inches]



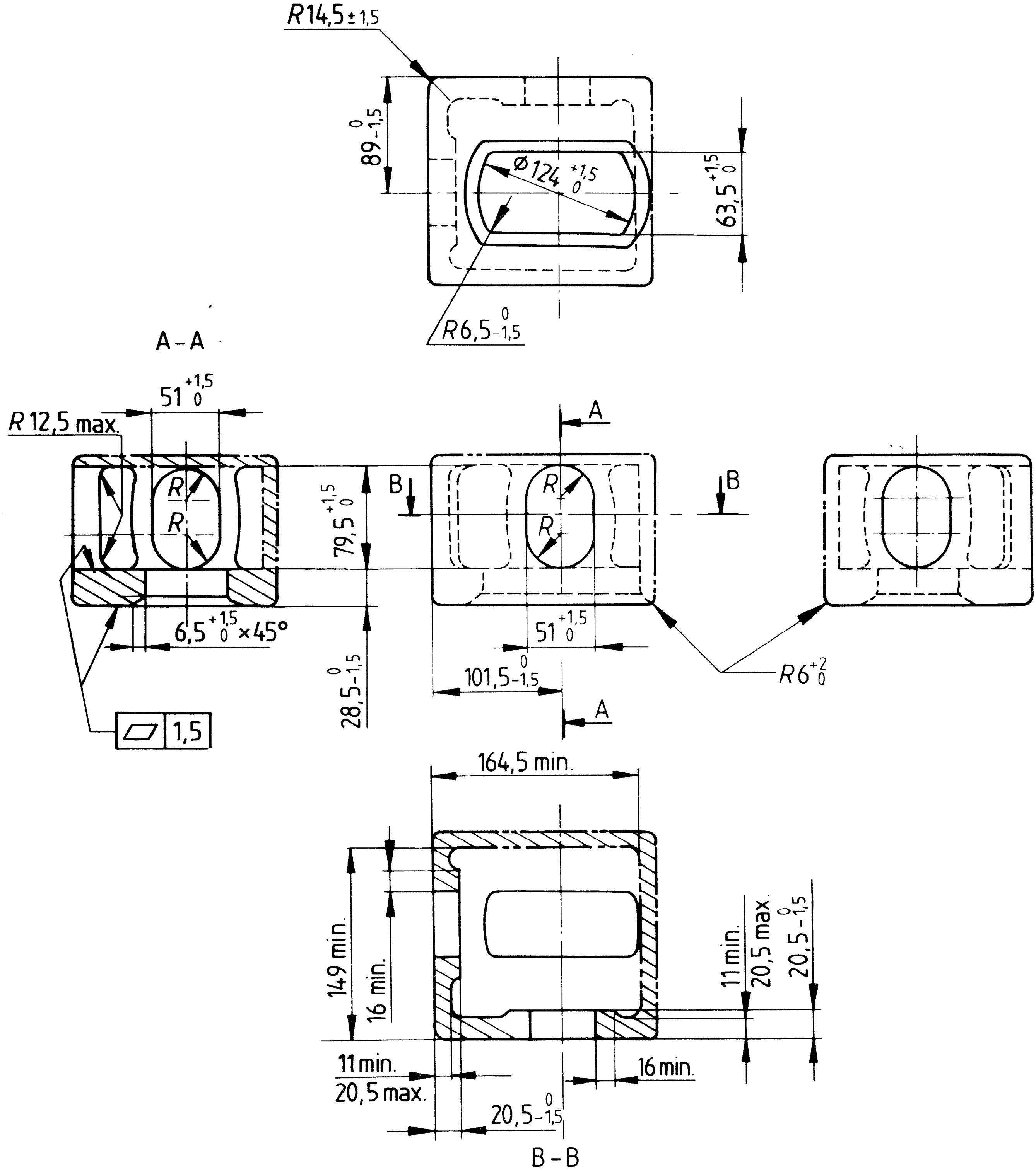
NOTES

1 Solid and broken lines (— and ---) show surfaces and contours which shall be physically duplicated in the fitting.

2 Phantom lines (—··—··—) show optional walls, which may be used to develop a box-shaped fitting.

Figure 2 — Top corner fitting — Dimensions in inches
(see clause 3)

[Dimensions in millimetres]



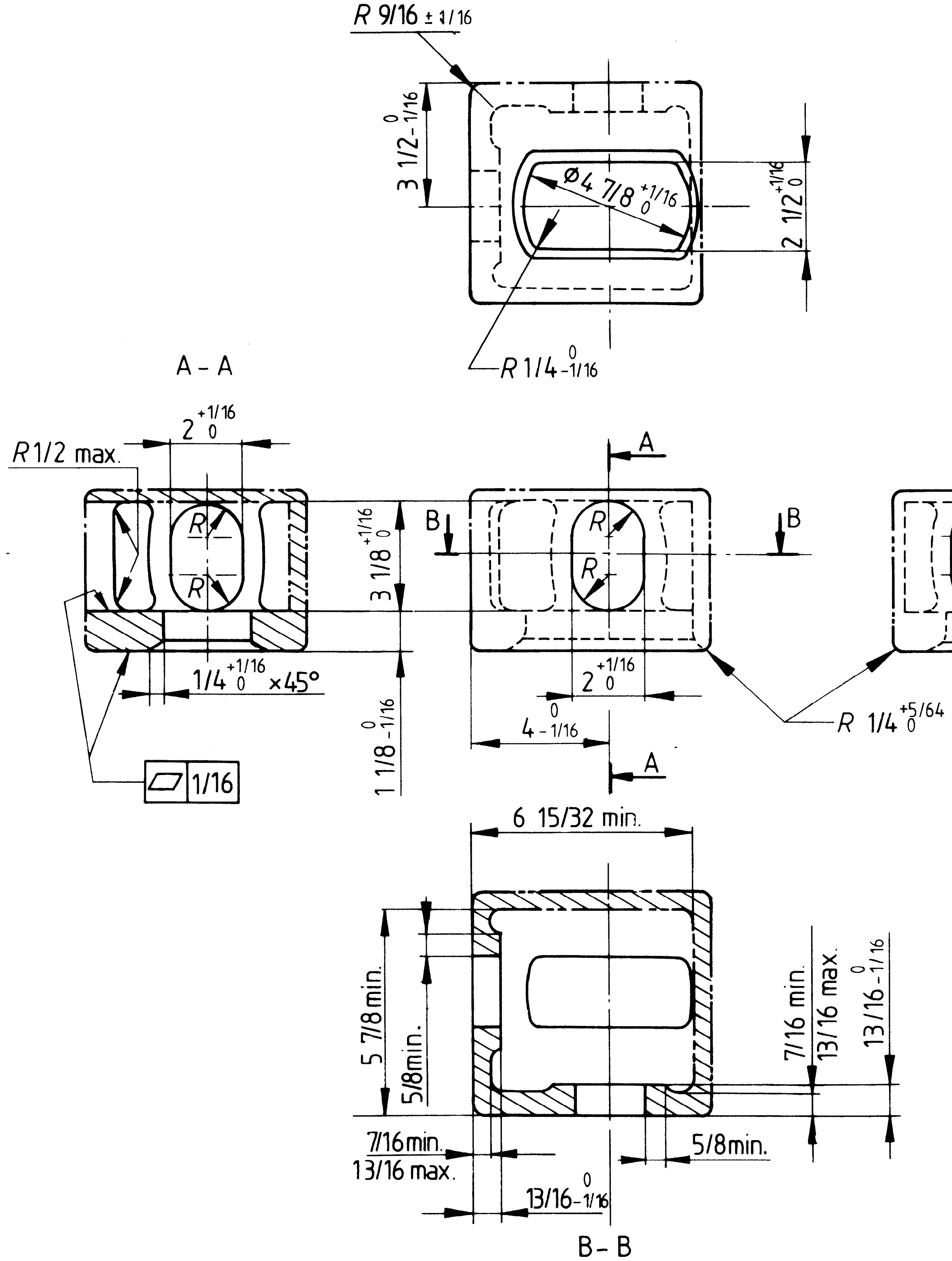
NOTES

1 Solid and broken lines (— and ---) show surfaces and contours which shall be physically duplicated in the fitting.

2 Phantom lines (—··—··—) show optional walls, which may be used to develop a box-shaped fitting.

Figure 3 — Bottom corner fitting — Dimensions in millimetres
(see clause 3)

[Dimensions in inches]



NOTES

1 Solid and broken lines (— and ---) show surfaces and contours which shall be physically duplicated in the fitting.

2 Phantom lines (—··—··—) show optional walls, which may be used to develop a box-shaped fitting.

Figure 4 — Bottom corner fitting — Dimensions in inches
(see clause 3)

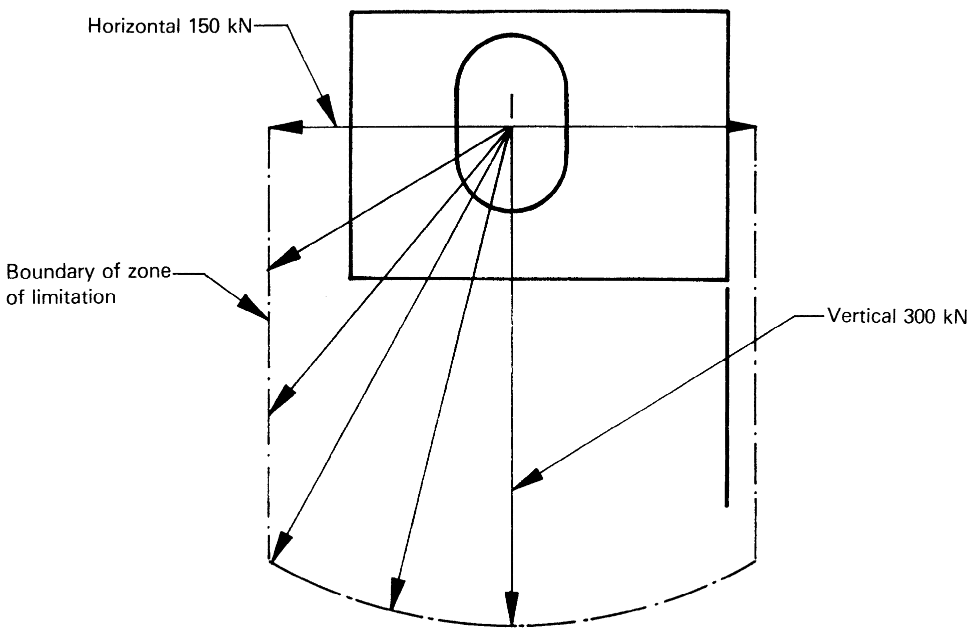


Figure 5 — Limits of loads due to lashing and securing

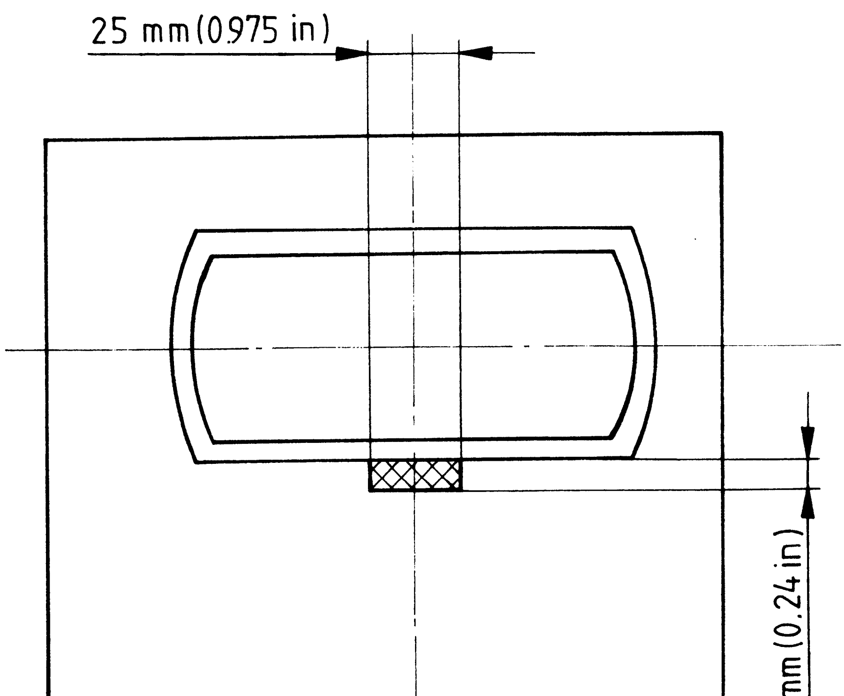


Figure 6 — Bottom view of bottom corner fitting showing contact area (shaded) for misgather (push-up) load

Annex A

Examples of overall dimensions of box-shaped corner fittings

(For information purposes only)

The following values of the actual dimensions of a particular but typical set of designs for top and bottom corner fittings are given by way of example so that if they are taken together with the obligatory dimensions given in figures 1, 2, 3 and 4 of this International Standard, fully dimensioned top and bottom corner fittings may be drawn.

Overall length = 178 mm (7 1/64 in)

Overall width = 162 mm (6 3/8 in)

Overall height = 118 mm (4 41/64 in)

NOTES

1 These typical values were selected from the ranges of overall length, width and height values available at the time of revising this International Standard.[1)]

2 The above typical values are appropriate for a commonly used grade of cast steel and where the thickness of the inner walls and faces is approximately 9 mm (23/64 in). They may not be appropriate for fittings made of other materials.

3 The typical values for overall dimensions apply to a design in which the actual distances between the outer surfaces of outside (vertical) walls and outer surfaces of inside walls are (approximately) equal to the minimum values specified for these distances in figures 1, 2, 3 and 4. Hence the inner wall thicknesses are (approximately) equal to the maximum thickness implied by the overall dimensions.

The thicknesses of inner walls and faces should be assessed in relation to the design of the structure which may be joined to the surface in question as well as to the properties of the materials and methods of joining which may be envisaged. This way leads to overall dimensions which may differ from the typical values quoted above and **which are not mandatory**.

1) The ranges were as follows :

- range of overall lengths = 178 to 180 mm (7 1/64 to 7 5/64 in);
- range of overall widths = 157 to 165 mm (6 3/16 to 6 1/2 in);
- range of overall heights = 118 to 125 mm (4 41/64 to 4 59/64 in).

Annex B

Typical examples of twistlock lifting devices

(For information purposes only)

Dimensions in millimetres
(Inch values in parentheses)

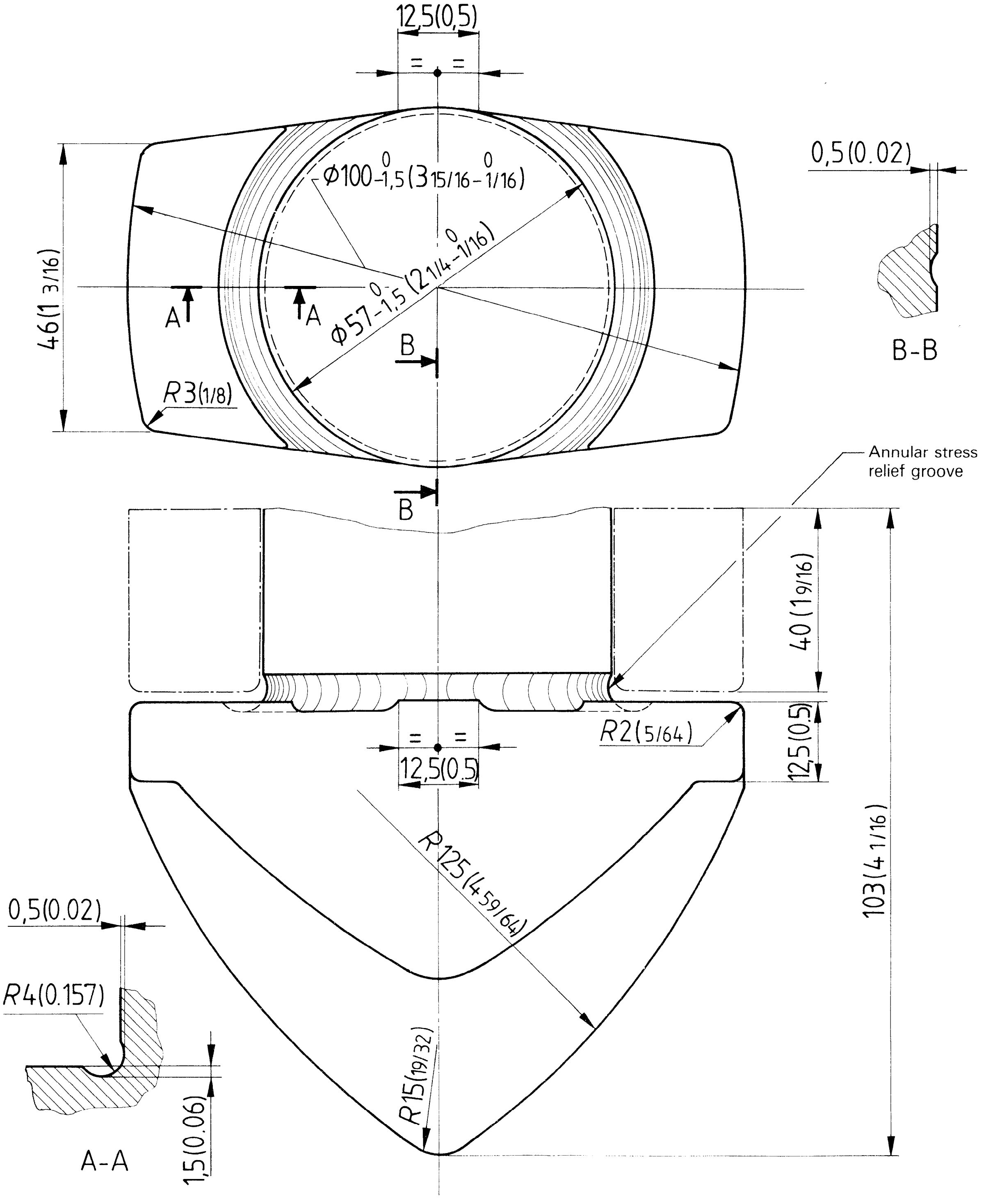


Figure 7 — Example of taper-sided twistlock

Dimensions in millimetres
(Inch values in parentheses)

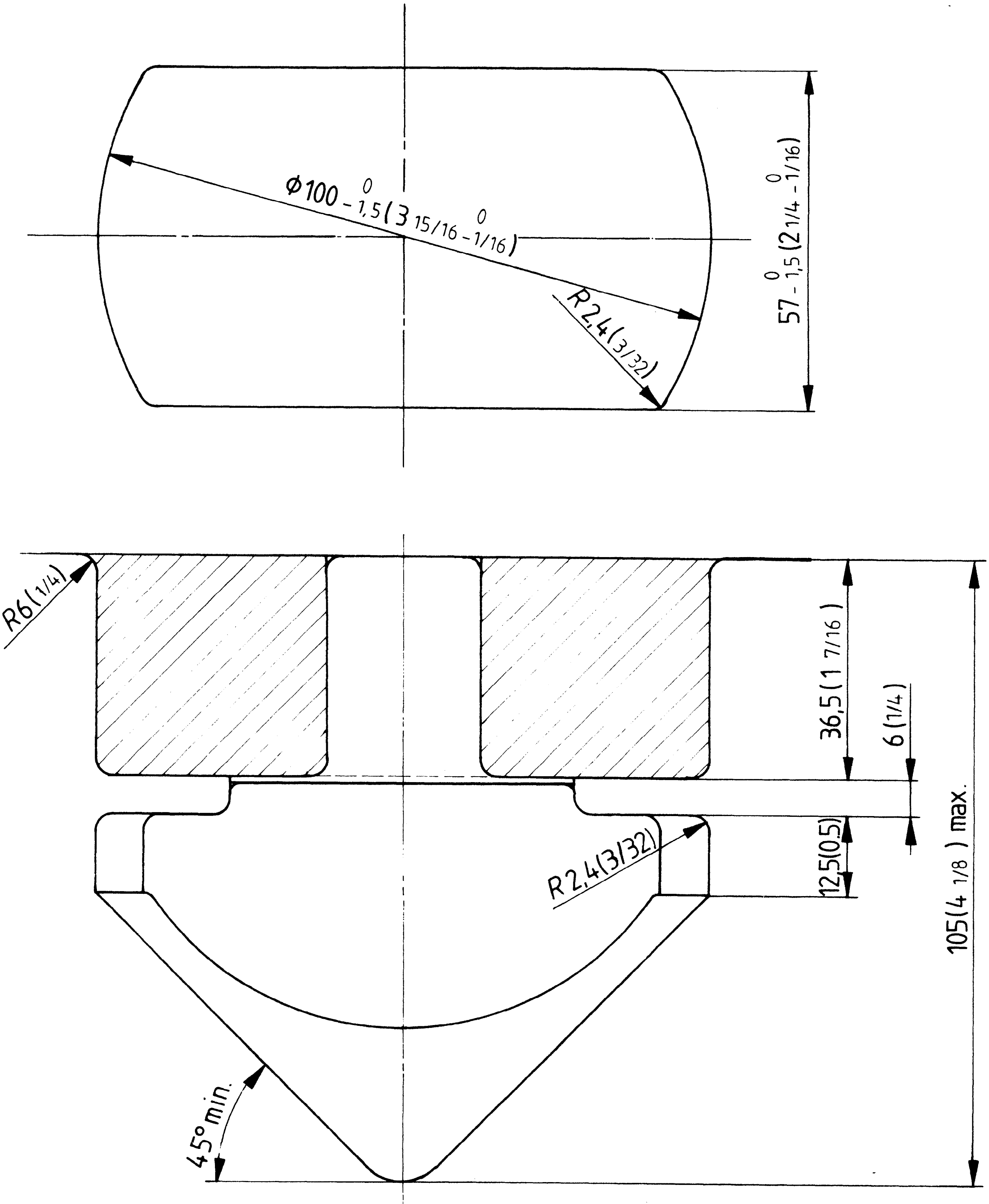


Figure 8 — Example of parallel-sided twistlock

Annex C

Guide on the choice of sizes for, and the positioning of, twistlock tie-down devices for securing series 1 freight containers to carrying vehicles

(For information purposes only)

C.1 General

C.1.1 The type of twistlock tie-down assembly and chassis envisaged is illustrated in figures 9 and 10.

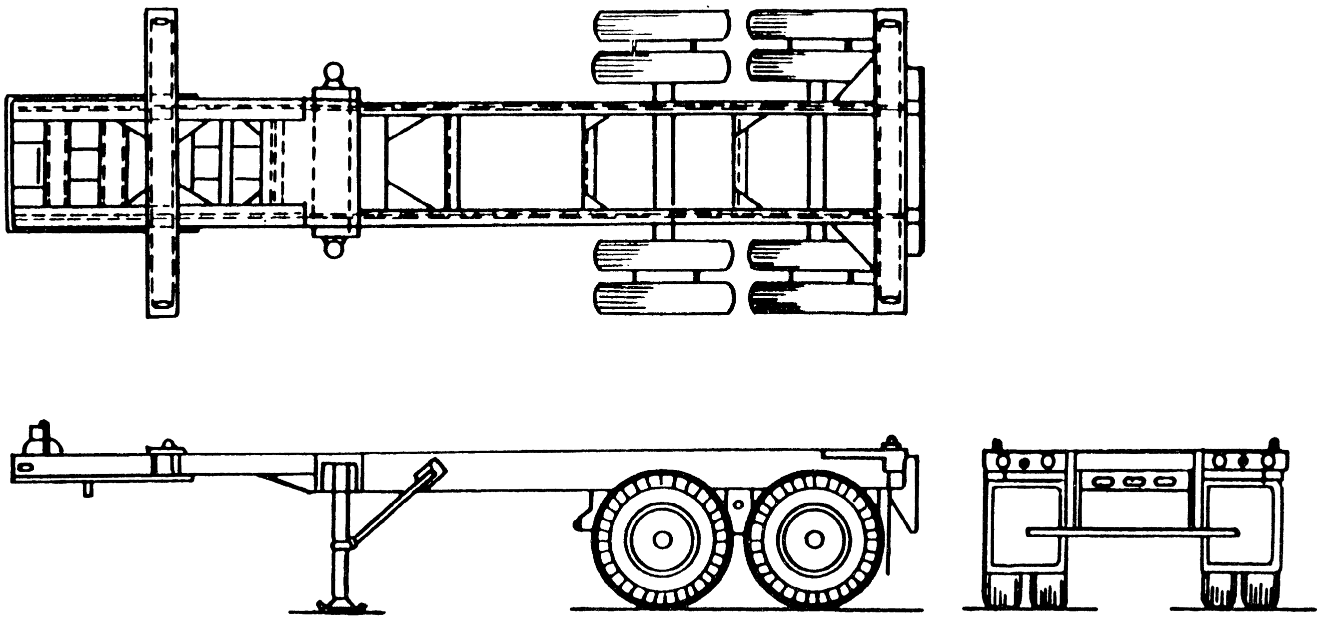


Figure 9 — Typical four twistlock chassis

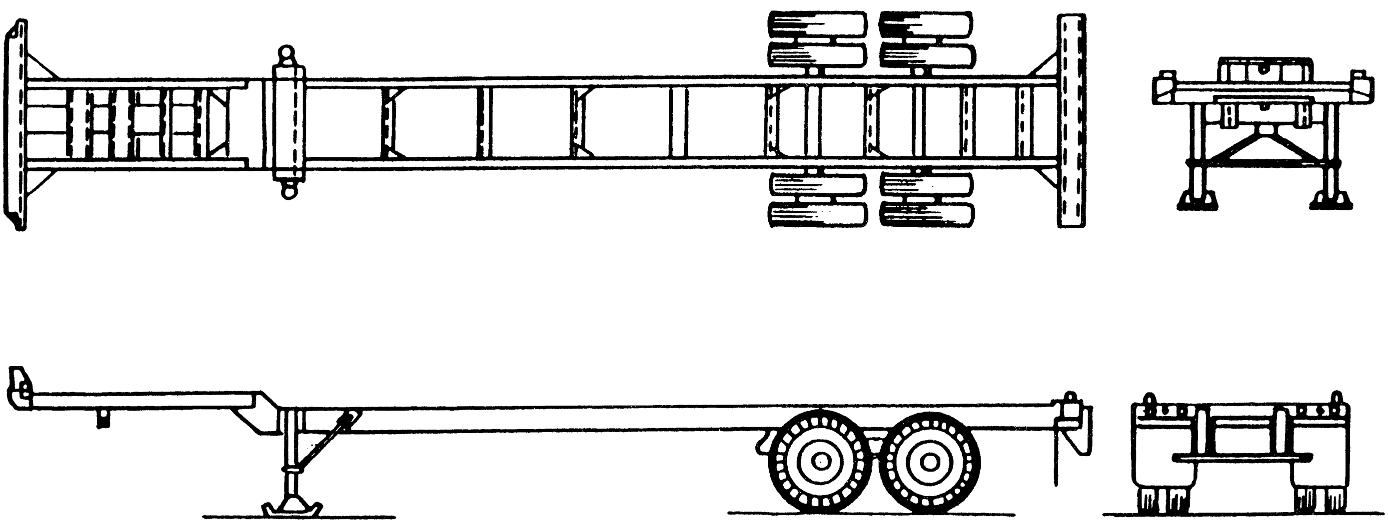


Figure 10 — Typical gooseneck container chassis

C.1.2 A typical twistlock assembly usually consists of the following components :

a) a horizontal load-bearing surface, capable of supporting the bottom corner fitting of a fully loaded container under dynamic conditions;

b) a fixed collar, designed to project upwards into the bottom hole of a bottom corner fitting to a height no lower than the level of the inner surface of fitting [having due regard to the way(s) in which different containers may be carried on the vehicle, i.e. whether the containers are supported by their four corner fittings or by their base structure];

c) a rotatable head (the twistlock proper), the head of which shall project into the corner fitting, i.e. above the load-bearing surface;

d) an arrangement for rotating the head and securing it in the desired position (and in some cases, an arrangement whereby the rotatable head may be pulled or screwed down until it exerts a clamping force on the inner surface of a corner fitting, as well as acting to restrain the corner fitting against lift off).

C.1.3 The twistlock assembly may be

a) rigidly attached to the vehicle;

b) arranged so that the fixed collar and the rotatable head can be withdrawn below the level of the load-bearing surface (e.g. on a multipurpose vehicle);

c) hinged or otherwise arranged so that the entire assembly may be withdrawn (e.g. to allow the removal of the assemblies at intermediate points along the length of a 40 ft chassis, to eliminate the possibility of interference between the bottom side rails of a 40 ft container and the surfaces provided to support the corner fittings of shorter containers).

C.2 Dimensions for arrangements involving four twistlocks for securing containers to vehicles

C.2.1 For the four twistlock system, it is assumed that the load-bearing areas of the four twistlocks of the container-carrying vehicle chassis or a container railway car are in the same horizontal plane. With the exception of the twistlock collar and rotatable head, no part of the vehicle chassis or railway car may protrude above this horizontal plane. (See also annex B of ISO 1496/1.)

C.2.2 A theoretical approach to the determination of the dimensions and tolerances required to define the centre positions of tie-down twistlocks of a particular size to ensure engagement with the bottom corner fittings of series 1 containers is given in clause C.4.

C.2.3 This theoretical approach is based on a strict interpretation of ISO 668 and this International Standard.

C.2.4 It assumes that the four twistlock collars are rigidly mounted on the vehicle (but for retractable types which inevitably involve a certain amount of "slop" or "play" — see C.2.10).

C.2.5 It assumes that metal-to-metal contact (i.e. an interference fit) between the fixed collars and the container corner fittings can only be envisaged in the most extreme case, e.g. when a container, built to maximum permitted tolerances and allowable difference between diagonals and which is parallelogrammed in one sense, is to be placed on a chassis the twistlock collars of which are positioned with the minimum permitted tolerances and allowable difference between diagonals and which are parallelogrammed in the opposite sense.

C.2.6 The probability of encountering this theoretical "worst case" is very difficult to estimate, but it is likely to be extremely small. Hence, in practice, tolerances may be used which are a little less "tight" than the theory would suggest (see C.2.11).

C.2.7 For the series 1 containers, the nominal centre-to-centre distances for the positioning of twistlock collars (defined in such a way that the positive and negative tolerances on these dimensions will have the same numerical value) will be identical to the corresponding dimensions measured between the centre points of the bottom holes in the bottom corner fittings of containers, and are given in table 1 (using the nomenclature defined in clause C.4).

Table 1 — Nominal centre-to-centre distances for positioning of twistlock collars

Values in millimetres

Container designation	Longitudinal distance $= S_t = S_c$	Lateral distance $= P_t = P_c$
1AA/1A/1AX	11 985,5	2 259,0
1BB/1B/1BX	8 918,5	2 259,0
1CC/1C/1CX	5 853,5	2 259,0
1D/1DX	2 787,0	2 259,0

C.2.8 The tolerances which may be permitted on the centre-to-centre distances between twistlock collars (S_t and P_t) in the theoretical "worst case" are dependent upon :

a) the dimensions of the collar envisaged;

b) the vehicle designers' preference for *either* tighter tolerances on centre-to-centre distances and a larger allowance for the difference between the diagonal centre-to-centre measurements *or* looser tolerances on the centre-to-centre distances and a smaller allowance for the difference between the diagonal measurements.

C.2.9 For twistlock collars of the sizes indicated, the tolerances given in table 2 would be appropriate, if the *ratio* between the tolerance on the longitudinal centre-to-centre distance and the diagonal difference applicable to the twistlock collars is approximately the same as the *ratio* between the corresponding factors for the container.

(But note that *under no circumstances* can the tolerances applicable to the container dimensions be regarded as equally applicable to the twistlock collar separations.)

Table 2 — Tolerance (t_{st}) on the longitudinal centre-to-centre distance between collars (S_t) and the tolerance (t_{pt}) on the lateral centre-to-centre distance between collars (P_t)
(making allowance for the theoretical "worst case")1)

Values in millimetres

For collars for containers of designation	t_{st}			t_{pt}			Allowable diagonal difference, k		
	Collar size			Collar size			Collar size		
	A	B	C	A	B	C	A	B	C
1AA/1A/1AX	± 2,5	± 3,5	± 4,5	± 2,0	± 3,0	± 4,0	4,5	8,5	10,5
1BB/1B/1BX	± 2,5	± 4,5	± 5,5	± 2,0	± 3,0	± 4,0	7,0	9,0	11,0
1CC/1C/1CX	± 4,0	± 5,5	± 7,0	± 2,0	± 3,0	± 4,0	10,0	13,0	14,0
1D/1DX	± 4,0	± 5,5	± 7,0	± 2,0	± 3,0	± 4,0	10,0	12,5	13,5

1) For twistlock collars of the following sizes, expressed in millimetres :

Size	Length (or diameter)	Width
A	100	57
B	97	56
C	95	55

C.2.10 Where twistlock collars do have some freedom ("float" or "slop") in the framework to which they are attached or where retractable twistlock assemblies have an inherent "slop", then for each ± 1 mm of freedom which exists for each of the four collars (longitudinally and laterally), the t_{st} and t_{pt} values quoted in table 2 could each be increased by 1 mm and the k value could be increased by 1,5 to 2 mm (alternatively, there are ways of allocating relaxations in tolerances — see note 2 under table 8 in clause C.4).

C.2.11 If the widely held view is accepted, that the probability of encountering the "extreme case" in which the worst possible accumulation of tolerances on the container and its corner fittings in one direction, coincides with the worst possible accumulation of tolerances on the chassis and its twistlock assemblies in the other direction — will be extremely rare (and hence the additional expense of maintaining the theoretical tolerances is unwarranted), then, accepting that in very rare circumstances an interference fit could occur, "relaxed" theoretical tolerances could be applied, as indicated in table 3. This is true even in cases involving rigidly mounted twistlock collars (and the ideas contained in C.2.10 could still be applied as well, in cases where collars have some freedom).

C.2.12 Table 3 also gives a set of "practical" figures proposed by the USA. The differences between the "relaxed" theoretical figures and the "practical" figures are not fully understood but it appears that :

a) the larger containers (predominantly 40 ft long) may be being built to actual length and width dimensions and actual differences between diagonals which are well within the tolerances allowed, thereby (in practice) allowing greater tolerances for twistlock collar positioning than those suggested by the theory based on the "worst possible" case;

b) a lot (but not all) of the larger containers, especially those having no diagonal bracing in the base structure, have a measure of flexibility in their base structures which will allow them to move (by a small number of millimetres) into position on twistlocks which are less than perfectly located;

c) many of the lightweight road vehicles have an even larger measure of flexibility than the average container and these chassis will tend to move to accommodate the container.

NOTE — This will *not* be the case with rail wagons which tend to be very much stiffer.

Table 3 — "Practical" dimensions proposed by the USA
[taking the case of the 100 mm × 57 mm twistlock collar (designated size A in table 2) and using the nomenclature of table 2]

Values in millimetres

For collars for container of designation	"Relaxed theoretical" tolerances			"Practical" tolerances		
	t_{st}	t_{pt}	k	t_{st}	t_{pt}	k
1AA/1A/1AX	± 4,5	± 2,0	7,0	± 6,0	$^{+0}_{-3}$	16
1BB/1B/1BX	± 4,5	± 2,0	10,0	± 6,0	$^{+0}_{-3}$	13
1CC/1C/1CX	± 6,0	± 2,0	13,0	± 6,0	$^{+0}_{-3}$	10
1D/1DX	± 6,0	± 2,0	13,0	± 6,0	$^{+0}_{-3}$	6

NOTES

1 This table should be read in conjunction with C.2.11 and C.2.12.

2 It is not considered advisable to relax the tolerance t_{pt} on the transverse distance between collars.

3 A similar set of "relaxed theoretical" tolerances can be deduced for the twistlock collar sizes designated B and C in table 2, by making relaxations of the same order of magnitude.

C.3 Dimensions for arrangements involving two pins and two twistlocks for securing containers to vehicles

C.3.1 In some arrangements for securing containers to vehicles, especially where the vehicle is a semi-trailer with a gooseneck, it is common practice to arrange for one end of the container (the gooseneck tunnel end) to be secured by means of pins engaging the end holes of the corner fittings adjacent to the tunnel and to arrange for the other end to be secured by means of twistlocks.

C.3.2 A typical front-penetrating pin assembly usually consists of

a) a pin that slides in the horizontal plane parallel with the longitudinal axis of the chassis;

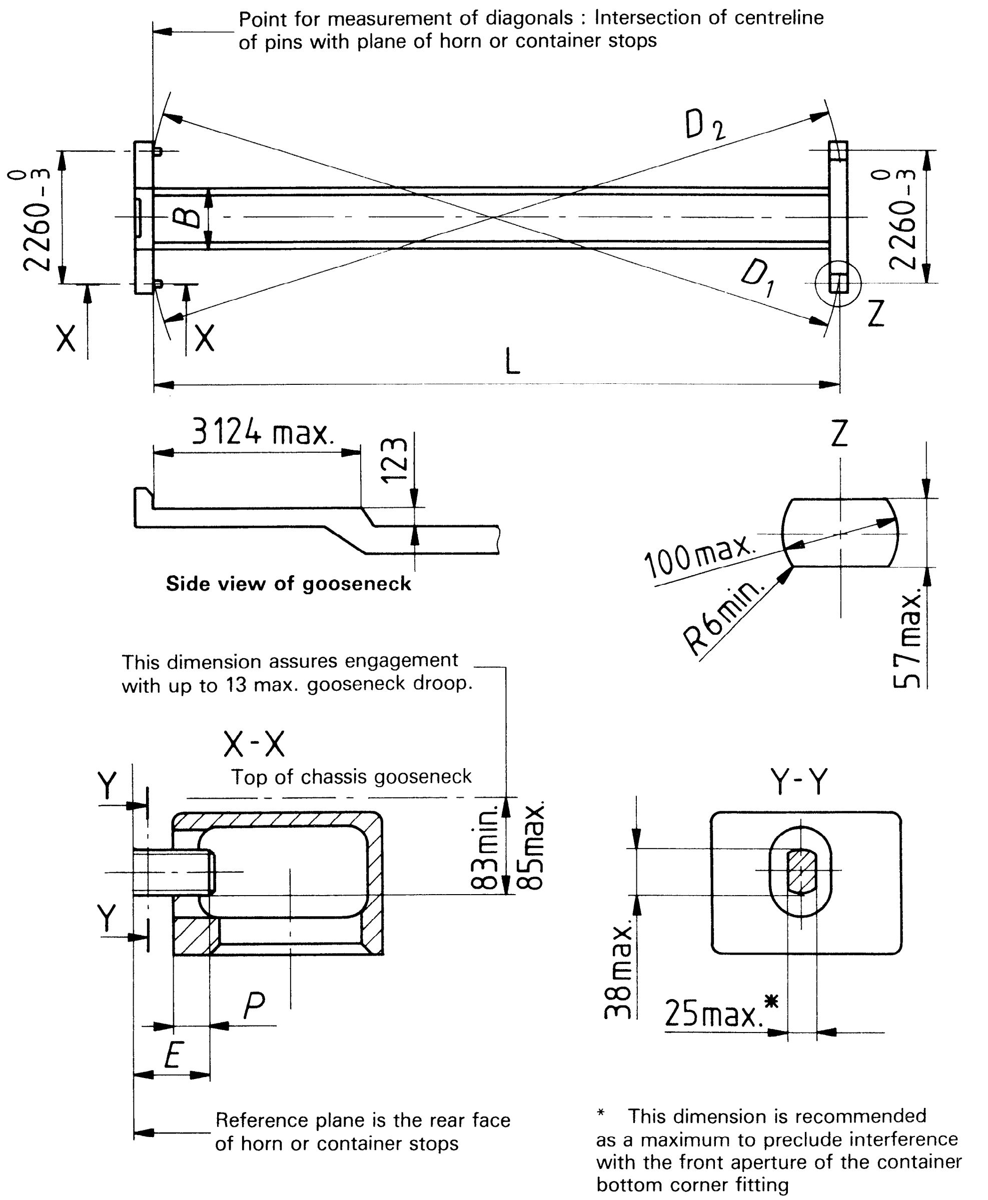
b) a handle and gear or mechanical lever assembly used to operate the pin.

C.3.3 The front-penetrating pin assembly is usually recessed into and protected by the chassis front bolster and centred so that the pin will penetrate the forward end aperture of the lower front corner fitting.

C.3.4 Arrangements involving two pins and two twistlocks are commonly used for designs to carry 1AA, 1A and 1AX containers.

C.3.5 Dimensions and tolerances of arrangements for a gooseneck chassis are given in figure 11 and table 4 .

Dimensions in millimetres 1)



P (pin penetration) = 32 min.

Dimension measured from the front face of corner fitting in rearmost position on chassis to the end of pin exclusive of chamfer.

E (pin extension) = 67 min.

Dimension measured from the rear face of horn or container stops to the end of pin exclusive of chamfer.

Figure 11 — 1AA, 1A and 1AX gooseneck chassis interface dimensions

1) The corresponding inch values are as follows :

$2\,260\ ^{0}_{-3}$ mm = $89\ ^{0}_{-1/8}$ in
3 124 mm = 121 in
123 mm = 4 3/4 in
38 mm = 1 1/2 in
25 mm = 1 in
32 mm = 1 1/4 in
67 mm = 2 5/8 in
100 mm = 3 15/16 in
57 mm = 2 1/4 in
6 mm = 1/4 in
13 mm = 1/2 in
85 mm = 3 11/32 in
83 mm = 3 9/32 in

Table 4 — Dimensions and tolerances of arrangements for a gooseneck chassis

Values in millimetres[1)]

Container designation	Container size	L	k max.
1AA/1A/1AX	12 192	12 098 ± 6	16
1BB/1B/1BX	9 125	9 030 ± 6	13
1CC/1C/1CX	6 058	5 962 ± 6	10

NOTES

1 The transversal centre-to-centre distance between collars or pins is 2 260 $_{-3}^{0}$ mm and the outer dimension of the gooseneck panel beams is 1 016 $_{-3}^{0}$ mm. The two dimensions shall be equally disposed about the longitudinal centreline of the chassis.

2 The difference between the diagonal dimensions for the chassis shall not exceed the following values :

16 mm where L = 12 192 mm
13 mm where L = 9 125 mm
10 mm where L = 6 058 mm

3 All the chassis securement devices shall be capable of being locked/unlocked to the corner fitting of either a loaded or empty freight container, without assistance, when the front of the chassis is supported either at the kingpin or its landing gear.

1) The corresponding inch values are as follows :

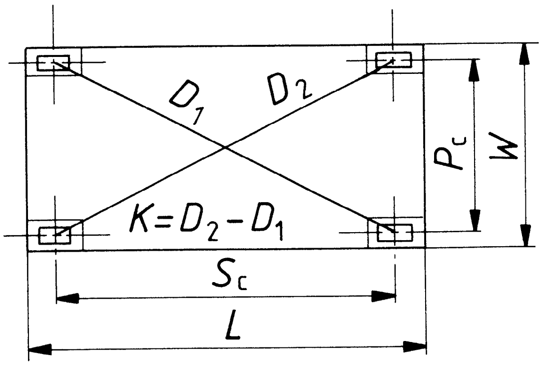
12 192 mm = 40 ft
9 125 mm = 29 ft 11 1/4 in
6 058 mm = 19 ft 10 1/2 in
12 098 ± 6 mm = 39 ft 8 1/4 ± 1/4 in
9 030 ± 6 mm = 29 ft 7 1/8 ± 1/4 in
5 962 ± 6 mm = 19 ft 6 3/4 ± 1/4 in

16 mm = 5/8 in
13 mm = 1/2 in
10 mm = 3/8 in
2 260 $_{-3}^{0}$ mm = 89 $_{-1/8}^{0}$ in
1 016 $_{-3}^{0}$ mm = 40 $_{-1/8}^{0}$ in

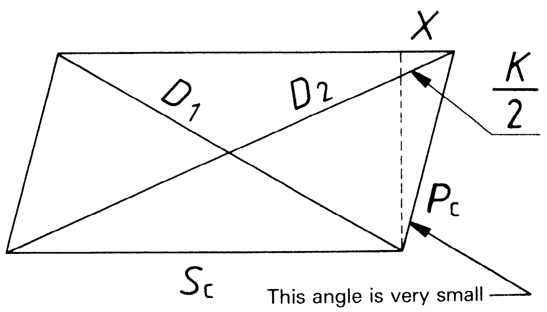
C.4 Theoretical approach to the determination of values of dimensions and tolerances for positioning of twistlocks for engagement in freight container corner fittings

Nomenclature

For the container (suffix "c")



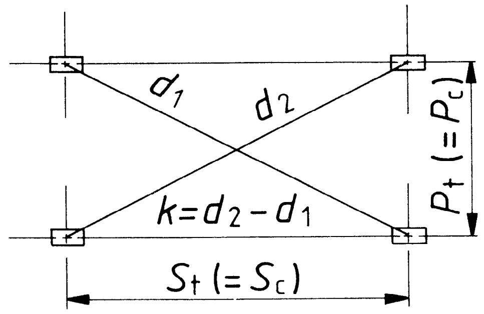
L and W are taken from ISO 668. S_c and P_c are deduced from L and W and the tolerances on L and W and the relevant corner fitting dimensions and tolerances are taken from this International Standard such that S_c and P_c are *mean* centre-to-centre distances having tolerances T_{sc} and T_{pc} (as indicated below).



By "similar triangles" and Pythagoras' theorem :

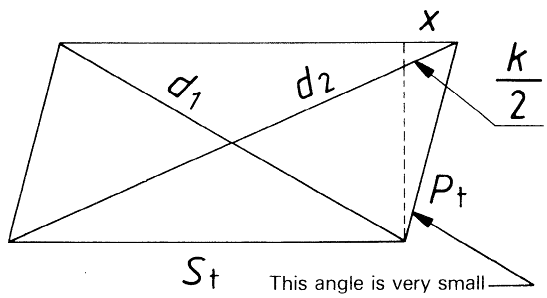
$$X = \frac{K}{2} \frac{\sqrt{P_c^2 + S_c^2}}{S_c}$$

For the twistlock arrangement (suffix "t")



S_t and P_t and their tolerances t_{st} and t_{pt} are deduced as indicated below.

Note that the tolerances T_{sc}, t_{st}, T_{pc} and t_{pt} are "half tolerances" equally disposed above and below the *mean*.



By analogy :

$$x = \frac{k}{2} \frac{\sqrt{P_t^2 + S_t^2}}{S_t}$$

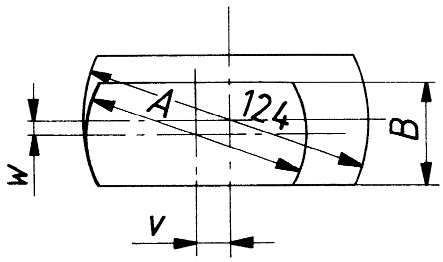
but since P_t shall equal P_c and S_t shall equal S_c :

$$\frac{x}{k} = \frac{X}{K} \text{ or } k = K \frac{x}{X}$$

Corner fitting aperture (assumed to be of minimum size)

NOTE — For a particular size of twistlock "collar" or spigot, w and v are most simply obtained by drawing.

Values in millimetres



By consideration of the two "extreme" cases, 1 and 2, ...

Case 1

Container having

a) maximum length (i.e. S_c max.),

b) maximum width (i.e. P_c max.),

c) K max. (assumed to be measured between corner fitting hole centres),

and a **twistlock arrangement** having

d) minimum length (i.e. S_t min.)

— between centres,

e) minimum width (i.e. P_t min.)

— between centres,

f) k max. (assumed to be measured between twistlock spigot centres AND with spigots parallelogrammed in opposite direction to container).

Case 2

Container having

a) minimum length (i.e. S_c min.)

b) minimum width (i.e. P_c min.)

c) K max. (as in case 1)

and a twistlock arrangement having

d) maximum length (i.e. max. S_t),

e) maximum width (i.e. max. P_t),

f) k max. (as in case 1).

... the following equations may be derived :

$$S_t \text{ max.} = S_c \text{ min.} - X + 2v - x$$

$$S_t \text{ min.} = S_c \text{ max.} + X - 2v + x$$

whence :

$$t_{st} = - T_{sc} - X + 2v - x$$ ... (A) (giving "half tolerance" on S_t, the twistlock "longitudinal" separation)

and, similarly, from consideration of P_t max. and P_t min. :

$$t_{pt} = - T_{pc} + 2w$$ ... (B) (giving "half tolerance" on P_t, the twistlock "transverse" separation).

NOTE — In equation (A), T_{sc} is known, X is known, and for any chosen size of twistlock collar "(spigot) v may be obtained as indicated above, hence t_{st} may be obtained in relation to x (or k). Thus, for any given size of twistlock collar (within a fairly narrow band determined by practical considerations), it would be theoretically possible to work with various tolerances such that the "tighter" the tolerance on longitudinal separation, the "looser" the tolerance on parallelogramming (determined by x or k).

Values of tolerances and allowable differences between diagonals for twistlock arrangements are given in tables 5 to 8 [assuming "worst" combinations of tolerances envisaged in ISO container and corner fitting standards and assuming that twistlock collars (spigots) have no freedom of movement ("float" or "slop") in the framework to which they are attached (see note 2 below table 8)].

Table 5 — Basic data
(independent of size of twistlock collar selected)

Values in millimetres

Container designation	S_t (= S_c)	T_{sc}	P_t (= P_c)	T_{pc}	K	X	K/X
1AA/1A/1AX	11 985,5	± 6,5	2 259,0	± 4,0	19	9,7	1,96
1BB/1B/1BX	8 918,5	± 6,5	2 259,0	± 4,0	16	8,3	1,93
1CC/1C/1CX	5 853,5	± 4,5	2 259,0	± 4,0	13	7,0	1,86
1D/1DX	2 787,0	± 4,0	2 259,0	± 4,0	10	6,4	1,56

Table 6 — Twistlock collars (spigots) having length (diameter) 95,0 mm, width 55,0 mm, v = 13,0 mm, w = 4,0 mm (rounded down to nearest whole number)

Values in millimetres

Container designation	By formula (A) ($t_{st} + x$)	t_{st}	x	$k\left(= x\frac{K}{X}\right)$	By formula (B) t_{pt}
		4.0	5,8	11,5	4,0
1AA/1A/1AX	9,8	**4,5**	5,3	**10,5**	4,0
		5,0	4,8	9,5	4,0
		5,0	6,2	12,0	4,0
1BB/1B/1BX	11,2	**5,5**	5,7	**11,0**	4,0
		6,0	5,2	10,0	4,0
		6,0	8,5	16,0	4,0
1CC/1C/1CX	14,5	6,5	8,0	15,0	4,0
		7,0	7,5	**14,0**	4,0
		6,0	9,6	15,0	4,0
1D	15,6	**7,0**	8,6	**13,5**	4,0
		8,0	7,6	12,0	4,0

NOTE — The values for t_{st} and k printed in bold type face are the values given in table 2 (in the C columns).

Table 7 — Twistlock collars (spigots) having length (diameter) 97,0 mm, width 56,0 mm, v = 12,0 mm, w = 3,5 mm

Values in millimetres

Container designation	By formula (A) ($t_{st} + x$)	t_{st}	x	$k\left(= x\frac{K}{X}\right)$	By formula (B) t_{pt}
		3,0	4,8	9,5	3,0
1AA/1A/1AX	7,8	**3,5**	4,3	**8,5**	3,0
		4,0	3,8	7,5	3,0
		3,5	5,7	11,0	3,0
1BB/1B/1BX	9,2	4,0	5,2	10,0	3,0
		4,5	4,7	**9,0**	3,0
		4,5	8,0	**15,0**	3,0
1CC/1C/1CX	12,5	5,0	7,5	14,0	3,0
		5,5	7,0	**13,0**	3,0
		6,0	6,5	12	3,0
1D	13,6	**5,5**	8,1	**12,5**	3,0
		6,0	7,6	12,0	3,0

NOTE — The values for t_{st} and k printed in bold type face are the values given in table 2 (in the B columns).

Table 8 — Twistlock collars (spigots) having length (diameter) 100,0 mm, width 56,0 mm, v = 10,5 mm, w = 3,5 mm

Values in millimetres

Container designation	By formula "A" ($t_{st} + x$)	t_{st}	x	$k\left(= x\frac{K}{X}\right)$	By formula "B" t_{pt}
1AA/1A/1AX	4,8	2,0	2,8	5,5	3,0
		2,5	2,3	**4,5**	3,0
		3,0	1,8	3,5	3,0
1BB/1B/1BX	6,2	**2,5**	3,7	**7,0**	3,0
		3,0	3,2	6,0	3,0
1CC/1C/1CX	9,5	3,5	6,0	11,0	3,0
		4,0	5,5	**10,0**	3,0
1D	—	**4,0**	6,6	**10,0**	—
		4,5	6,1	9,5	3,0
		5,0	5,6	9,0	3,0

NOTES

1 The values for t_{st} and k printed in bold type face are the values given in table 2 (in the A columns).

2 Where twistlock collars (spigots) do have some freedom of movement ("float" or "slop") in the framework to which they are attached, (e.g. where retractable tie-down twistlocks have an inherent "slop"), then for *each* ± 1 mm of freedom for *each* collar, both longitudinally and laterally,

a) the t_{st}, k and t_{pt} values quoted above could be retained, while the collar size is increased by 1 mm both longitudinally and laterally;

b) for the particular collar size quoted :

i) the t_{st} and t_{pt} values quoted could each be increased by 2 mm, while retaining the quoted k value,

ii) the k value quoted could be increased by 3 to 4 mm, while retaining the quoted t_{st} and t_{pt} values,

iii) the t_{st} and t_{pt} values quoted could each be increased by 1 mm and the value quoted for k could be increased by 1,5 to 2,0 mm.

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