

Welding — Basic welded joint details in steel

Part 1: Pressurized components

ICS 25.160.40

National foreword

This British Standard is the UK implementation of EN 1708-1:2010. It supersedes BS EN 1708-1:1999 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee WEE/-/1, Briefing committee for welding.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Foreword

This document (EN 1708-1:2010) has been prepared by Technical Committee CEN/TC 121 “Welding”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2010, and conflicting national standards shall be withdrawn at the latest by July 2010.

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

This document supersedes EN 1708-1:1999.

EN 1708, *Welding — Basic weld joint details in steel*, consists of the following parts:

- *Part 1: Pressurized components*
- *Part 2: Non internal pressurized components*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

The purpose of this European Standard is to exemplify commonly accepted welded connections in pressure systems. It does not promote the standardization of connections that may be regarded as mandatory or restrict development in any way. Stress analysis rules should be considered if necessary.

This standard contains examples of connections welded by:

- Manual metal-arc welding with covered electrode (111);
- Submerged arc welding (12);
- Gas shielded metal arc welding (13);
- Tungsten inert gas arc welding; TIG-welding (14);
- Plasma arc welding (15)

processes (process numbers according to EN ISO 4063) in steel pressure systems. Other processes by agreement.

This standard covers welded joint details in steel, but can be applied to other metallic materials. In such cases the shape and dimensions of the weld should be checked.

The estimation of the suitability of welded connections for special service conditions, for example corrosion and fatigue are not specially considered.

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.

EN ISO 4063, *Welding and allied processes — Nomenclature of processes and reference numbers (ISO 4063:2009)*

EN ISO 5817, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections (ISO 5817:2003, corrected version:2005, including Technical Corrigendum 1:2006)*

EN ISO 9692-1:2003, *Welding and allied processes — Recommendations for joint preparation — Part 1: Manual metal-arc welding, gas-shielded metal-arc welding, gas welding, TIG welding and beam welding of steels (ISO 9692-1:2003)*

EN ISO 9692-2:1998, *Welding and allied processes — Joint preparation — Part 2: Submerged arc welding of steels (ISO 9692-2:1998)*

3 Requirements

3.1 Selection of detail

Connections are not considered to be equally suitable for all service conditions, nor is the order in which they are shown indicative of their relative characteristics. In selecting the appropriate detail to use from the several

alternatives shown for each type of connection, consideration shall be given to existing fabrication and service conditions that pertain.

3.2 Joint preparation (geometry and size)

3.2.1 General

The limitations quoted in weld profiles and sizes are based on commonly accepted practice, but they may be subjected to modifications if required by special welding techniques or design conditions, which should be included in the design documents and in the welding procedure specifications (WPS).

3.2.2 Joint preparation geometry

Examples of recommended joint preparation geometry (e.g. bevel angles, root radius, presence of backing strips, root faces) are referred to EN ISO 9692-1 when applicable and to EN ISO 9692-2 relative to submerged arc welding process. Missing dimensions of preparations are in accordance with EN ISO 9692-1.

In case where full penetration butt joints are indicated, it is intended that they shall be back chipped or gouged and back welded, or alternatively that the welding procedure shall be such as to ensure sound, effective root penetration.

For relevant difference of thickness (generally a difference of about 3 mm (see Table 1, no. 1.1.1 to 1.1.6) could be considered relevant; in any case the thickness of material shall be taken into account, as well as the shape of the joint) of parts to be butt welded, the thickest element shall be shaped with a slope of 1:5 up to 1:2. Smoother transition of wall thickness is applicable in severe service conditions.

3.2.3 Weld sizes

The thickness of welds (in particular of fillet welds), which are not determined by their profile, are based on the assumption that the connection need not be stronger than the connected parts.

3.3 Presentation

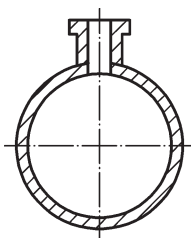


Figure 1 — Transversal section

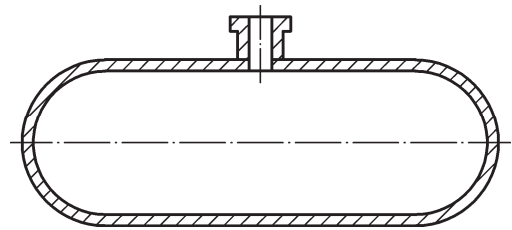


Figure 2 — Longitudinal section

The drawings of the nozzle and branch connections (see Tables 2 and 3) show a transversal section of the connection (see Figure 1) and a longitudinal section of the connection (see Figure 2).

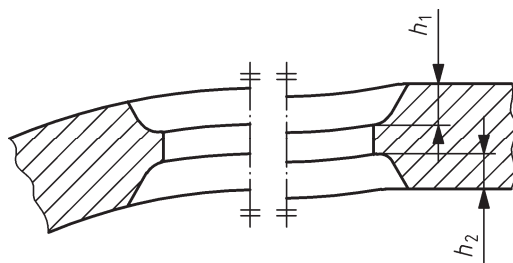
3.4 Removal of internal sharp edges in branch bores

It will be noted that the internal edges on the bores of branches are shown partially radiused (for example see Table 2, no. 2.1.6) because a stress concentration occurs at this point. The rounding of the edges is recommended when the branch connection is subjected to severe service conditions like fatigue, creep and stress corrosion.

3.5 Preparation of holes in shell for set-through branches

In case of set-in and set-through branches (according to Table 2, no. 2.2 and no. 2.3) holes in the shell may be cut and profiled in two ways as follows:

- The depth of the grooves h_1 and h_2 may be constant around the hole as shown in Figure 3.



Key
 h_1, h_2 depth of the grooves

Figure 3 — Preparation of holes in the shell

- The roots of the joint preparations may be in one plane, as for example when they are machine drilled, in which case the depths of the grooves will vary around the hole as shown in Figure 4.

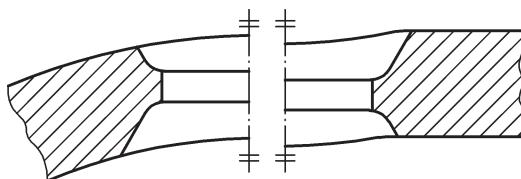


Figure 4 — Preparation of holes in the shell

3.6 Welds for smooth transition

In some cases it is convenient to foresee a fillet weld providing smooth geometric transition from the surface of one welded part to the surface of the other one, e.g. from branch to shell. Its purpose is to soften the notch effect in the branch-shell edge and therefore the throat thickness is not presented on the figure concerned.

3.7 Oblique and tangential branches

The welded connections are contained in Tables 1 to 13. Regarding branches, the oblique and tangential ones are not specially considered as their preparation is similar to that reported on Tables 2 and 3 for radial branches. Only some significant cases are therefore considered (see Table 2, no. 2.2).

NOTE 1 The welds are only blackened in the following tables when the figures do not give information about the dimension of the values for the preparation.

NOTE 2 It is not intended that the values of the dimension given in the tables should be measured precisely but rather the general philosophy should be applied.

Table 1 — Butt joints of different thickness

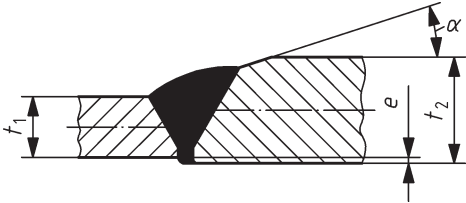
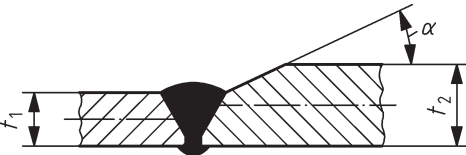
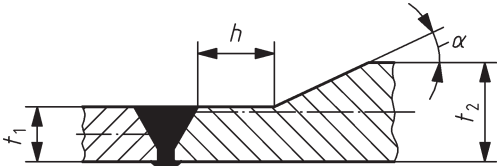
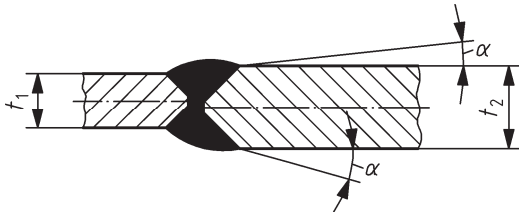
no.	Figure	Application/ condition	Note	Reference to EN ISO 9692-1:2003 and EN ISO 9692- 2:1998
1.1 Butt joints in plates of different thickness				
1.1.1		$\alpha \leq 30^\circ$ $t_1 < t_2$	In case of severe service conditions, the design shall be in accordance with Figures 1.1.2 and 1.1.3. $e \leq 0,1 t_1$ max. 2 mm (for one side welding)	1.5 and 2.3
1.1.2		$\alpha \leq 30^\circ$ $t_1 < t_2$		1.5, 2.3 and 2.5.2
1.1.3		$\alpha \leq 30^\circ$ $t_1 < t_2$	for ultrasonic test $h > 3 t_1$, but min. 20 mm for radiographic test $h \geq t_1$	1.5, 2.3 and 2.5.2
1.1.4		$\alpha \leq 30^\circ$	see 1.1.1	2.5.1

Table 1 (continued)

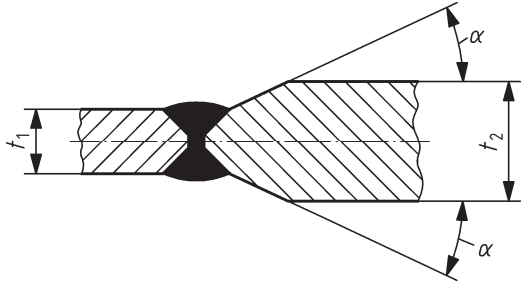
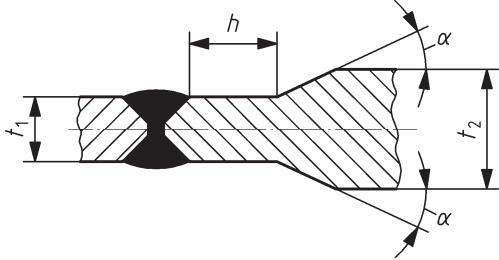
no.	Figure	Application/ condition	Note	Reference to EN ISO 9692-1:2003 and EN ISO 9692- 2:1998
1.1.5		$\alpha \leq 30^\circ$		2.5.1
1.1.6		$\alpha \leq 30^\circ$	for ultrasonic test $h > 3 t_1$, but min. 20 mm for radiographic test $h \geq t_1$	2.5.1

Table 1 (continued)

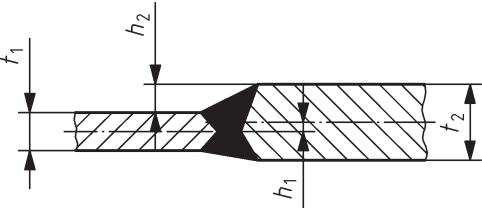
no.	Figure	Application/ condition	Note	Reference to EN ISO 9692-1:2003 and EN ISO 9692- 2:1998
1.1.7		longitudinal weld: $h_1 \leq 0,15 t_1$; maximum 3 mm $h_2 \leq 0,3 t_1$; maximum 6 mm $t_2 - t_1 \leq 0,3 t_1$; maximum 6 mm circumferential weld: $h_1 \leq 0,2 t_1$; maximum 5 mm $h_2 \leq 0,4 t_1$; maximum 10 mm $t_2 - t_1 \leq 0,4 t_1$; maximum 10 mm		

Table 1 (continued)

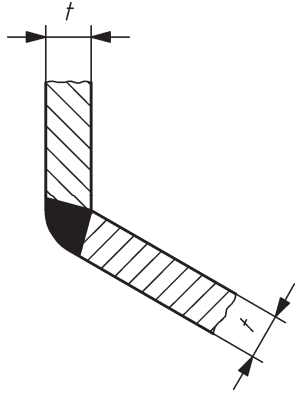
no.	Figure	Application/ condition	Note	Reference to EN ISO 9692-1:2003 and EN ISO 9692- 2:1998
1.1.8			Fully penetrated or sealing run	

Table 2 — Branches without compensation rings

no.	Figure	Application/ condition	Note	Reference to EN ISO 9692-1:2003 and EN ISO 9692- 2:1998
These connections include the provision of compensation by thickening of the branch and/or shell.				
2.1 Set-on branches (for special branch connections see 13.2) If the shell is stressed in direction of the thickness, it should be examined for laminations before setting on the branch.				
2.1.1		$t_1 < 0,5 t_2$ $45^\circ \leq \alpha \leq 60^\circ$		1.9.1 or 1.11 one side welding
2.1.2		$45^\circ \leq \alpha_1 \leq 60^\circ$ $30^\circ \leq \alpha_2 \leq 45^\circ$	These details are recommended only where the bore of the branch is readily accessible for welding. The joint should be back-gouged from the side most accessible and suitable for this purpose generally from the outside.	2.9.1, 2.9.2 or 2.11

Table 2 (continued)

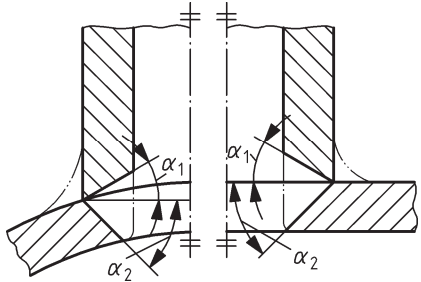
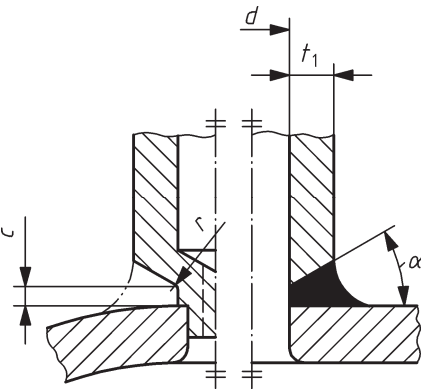
no.	Figure	Application/ condition	Note	Reference to EN ISO 9692-1:2003 and EN ISO 9692- 2:1998
2.1.3		$\alpha_1 = 30^\circ$ $\alpha_2 = 45^\circ$	See 2.1.2	
2.1.4		no gap $c \geq 1,5 \text{ mm}$ $r \geq 5 \text{ mm}$ $\alpha = 30^\circ$	— Joints generally used for small branch to shell diameter ratios. — Diameter d to be bored out after welding to remove the weld root, in order to ensure sound weld.	1.9.1 or 1.11 one side welding

Table 2 (continued)

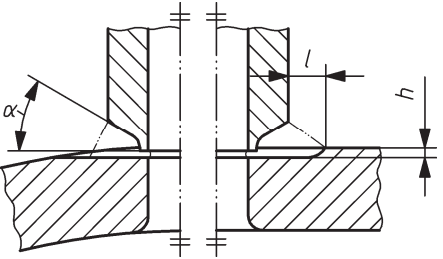
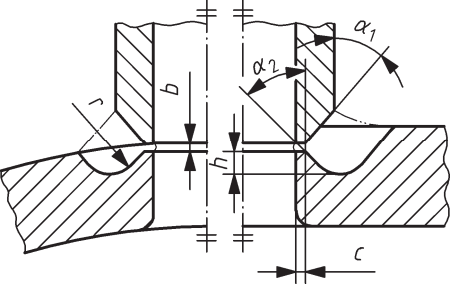
no.	Figure	Application/ condition	Note	Reference to EN ISO 9692-1:2003 and EN ISO 9692- 2:1998
2.1.5		$10 \text{ mm} \leq l \leq 15 \text{ mm}$ $h \geq 3 \text{ mm}$ $30^\circ \leq \alpha \leq 45^\circ$	Joints generally used for small branch to shell diameter ratios.	1.11 one side welding
2.1.6		For branches up to approximately 100 mm bore. $1 \text{ mm} \leq b \leq 3 \text{ mm}$ $h \leq 5 \text{ mm}$ $c = 1 \text{ mm}$ $r = 7 \text{ mm}$ $\alpha_1 \leq 45^\circ$ $\alpha_2 \leq 45^\circ$	Generally used for the attachment of branches to thick-walled shells.	

Table 2 (continued)

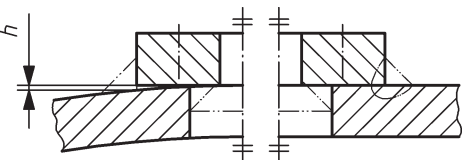
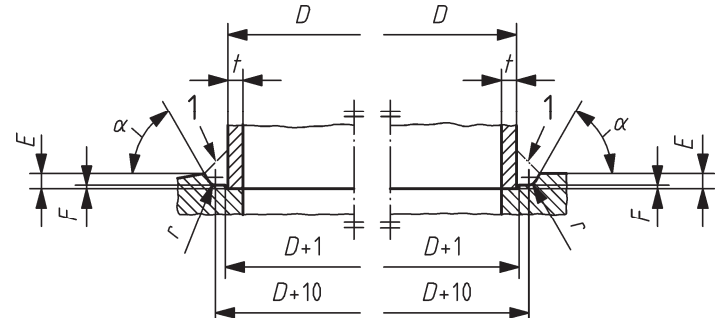
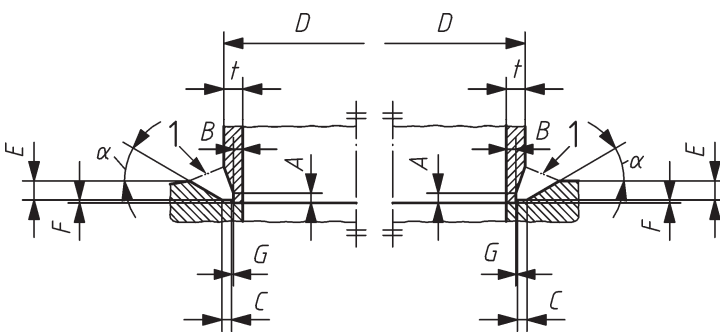
no.	Figure	Application/ condition	Note	Reference to EN ISO 9692-1:2003 and EN ISO 9692- 2:1998
2.1.7		$h \leq 3 \text{ mm}$	The sizes of the fillet welds should be based on the loads transmitted, paying due attention to other fabrication and service requirements.	
2.1.8		$r = 3 \text{ mm}$ $E = 6 \text{ mm}$ $F = 1,5 \text{ mm}$ $\alpha = 30^\circ$ 1 = Profile to meet design requirements	For tubes or nozzles up to approximately 100 mm bore and 6 mm wall thickness t .	
2.1.9		$A = 5 \text{ mm}$ $B = 5 \text{ mm}$ $C = 5 \text{ mm}$ $E = t$ $F = 1,5 \text{ mm}$ $G = 0,5 \text{ mm}$ $\alpha = 30^\circ$ 1 = Profile to meet design requirements	For tubes or nozzles up to and including 150 mm bore and wall thickness t over 6 mm and up to and including 13 mm.	

Table 2 (continued)

no.	Figure	Application/ condition	Note	Reference to EN ISO 9692-1:2003 and EN ISO 9692- 2:1998
2.1.10	Dimensions in millimetres	$A = 30 \text{ mm}$ $B = 1,5 \text{ mm}$ $H \geq 3 \text{ mm}$ $M \geq 10 \text{ mm}$ $N = 5 \text{ mm}$ $W \geq 2 \text{ mm}$ $r = 6 \text{ mm}$ $\alpha = 30^\circ$ 1 = Fin material 2 = Weld access hole (filled after welding tube to header)	Tube panel connections only applicable to tubes up to 100 mm bore and 6 mm wall thickness t .	
2.1.11		$F = 2 \text{ mm}$ $G = 1,5/2,0 \text{ mm}$ $T = 16 \text{ mm max.}$ $45^\circ \leq \alpha \leq 60^\circ$	For all tube and nozzle sizes.	

Table 2 (continued)

no.	Figure	Application/ condition	Note	Reference to EN ISO 9692-1:2003 and EN ISO 9692- 2:1998
2.2 Set-in branches (for special branch connection see 13.2)				
As a general recommendation all set-in branches should be welded on the inside of the shell as shown e.g. in Figures 2.2.1 and 2.2.2 if they are accessible for the purpose, otherwise preference should be given to set-on branch connections as shown e.g. in Figure 2.1.1.				
2.2.1		$a = 0,5 t_1$ $h = t_1$ $r \geq 8 \text{ mm}$ $b \leq 1 \text{ mm}$ $10^\circ \leq \alpha \leq 20^\circ$	For partial penetration welded connection. Generally used when t_1 is less than $t_2/2$. For smaller diameter branches attention is drawn to the details shown in Table 3 which may provide a preferable solution.	1.11 and 3.1.1
2.2.2		$3 \text{ mm} \leq a = 0,5 t_1$ $a_1 < 0,7 t_1$ $b \leq 1 \text{ mm}$	For partial penetration welded connection. Limited application: — Internal diameter of shell $\leq 200 \text{ mm}$; — wall thickness of branch $t_1 \leq 5 \text{ mm}$.	3.1.1 and 3.1.2

Table 2 (continued)

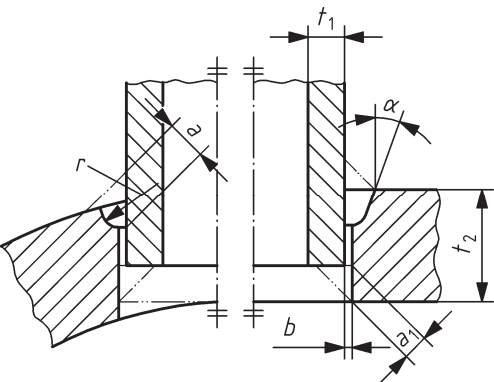
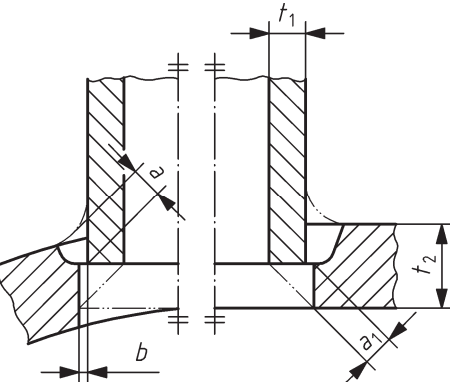
no.	Figure	Application/ condition	Note	Reference to EN ISO 9692-1:2003 and EN ISO 9692- 2:1998
2.2.3		$a \geq 5 \text{ mm}$ $a_1 \leq 0,7 t_1$ $b \leq 1 \text{ mm}$ $10^\circ \leq \alpha \leq 20^\circ$ $r \geq 8 \text{ mm}$	For partial penetration welded connection.	3.1.2 and 1.11
2.2.4		$3 \text{ mm} \leq a = 0,5 t_1$ $a_1 \leq 0,7 t_1$ $b \leq 1 \text{ mm}$	For full penetration welded connection.	3.1.2 and 1.11

Table 2 (continued)

no.	Figure	Application/ condition	Note	Reference to EN ISO 9692-1:2003 and EN ISO 9692- 2:1998
2.2.5		$h_1 = 0,6 t_1$ $h_2 = t_1$ $b \leq 1 \text{ mm}$ $r \geq 8 \text{ mm}$	For partial penetration welded connection.	2.11
2.2.6		$t_1 \geq 3 \text{ mm}$ $t_2 \leq 3 t_1$ $40^\circ \leq \alpha \leq 60^\circ$	For full penetration welded connection. For joints which are accessible from one side only.	1.9.1 and 1.11
2.2.7		$t_2 \leq 3 t_1$ $30^\circ \leq \alpha \leq 45^\circ$ $2 \text{ mm} \leq b \leq 3 \text{ mm}$ $2 \text{ mm} \leq c \leq 4 \text{ mm}$	For full penetration welded connection.	2.9.1, 2.9.2 and 2.11

Table 2 (continued)

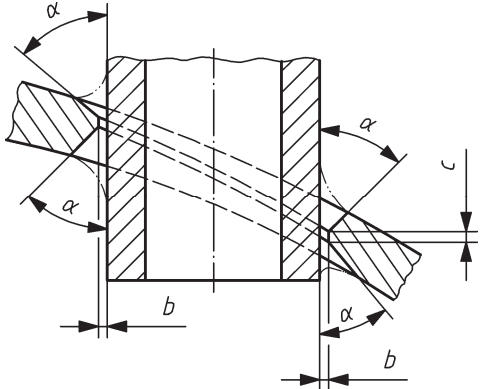
no.	Figure	Application/ condition	Note	Reference to EN ISO 9692-1:2003 and EN ISO 9692- 2:1998
2.2.8		$45^{\circ} \leq \alpha \leq 60^{\circ}$ $2 \text{ mm} \leq b \leq 3 \text{ mm}$ $2 \text{ mm} \leq c \leq 4 \text{ mm}$	For full penetration welded connection.	

Table 2 (continued)

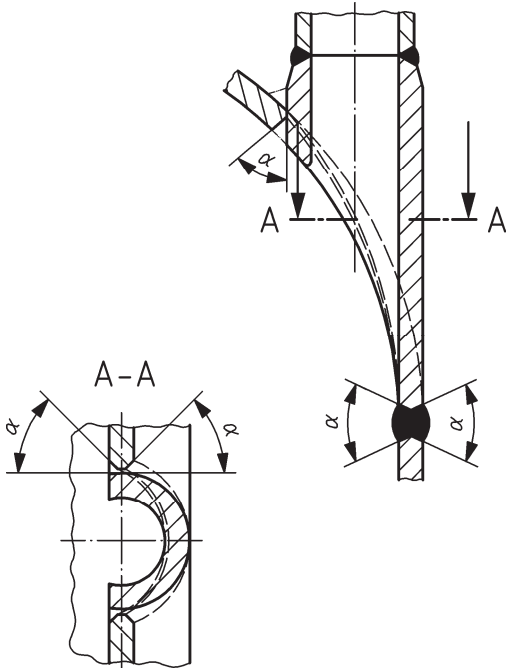
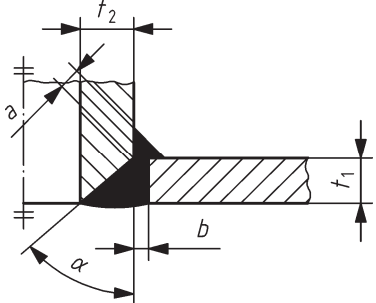
no.	Figure	Application/ condition	Note	Reference to EN ISO 9692-1:2003 and EN ISO 9692- 2:1998
2.2.9		$45^{\circ} \leq \alpha \leq 50^{\circ}$	To be welded from both sides.	
2.2.10		$3 \text{ mm} \leq a \leq 0,5 t_1$ $45^{\circ} \leq \alpha \leq 60^{\circ}$ $2 \text{ mm} \leq b \leq 4 \text{ mm}$		

Table 2 (continued)

no.	Figure	Application/ condition	Note	Reference to EN ISO 9692-1:2003 and EN ISO 9692- 2:1998
2.3 Set-through branch				
2.3.1		$a = 0,5 t_1$ $b \leq 1 \text{ mm}$	Generally used when t_1 is less than $t_2/2$.	4.1
2.3.2		$h = 0,6 t_1$ $m \geq t_1$	For partial penetration welded connection.	2.11