DEUTSCHE NORM February 2003

	Welding of railway vehicles and parts **Part 3: Design rules**	**DIN** **6700 – 3**

ICS 25.160.01; 45.060.01

Welding of railway vehicles and parts – Part 3: Design rules

Soudage des véhicules ferroviaires et des pièces – Partie 3: Règles de construction

contents **page**

Introduction

Welding is an essential process for the manufacture of railway vehicles and vehicle parts. In this standard series the required instructions for the special process „welding“ are being met. Basis of these rules are the welding technological basic standards in consideration of the special requirements of railway vehicle manufacture.

Part 1 deals with basic terms and basic rules.
Part 2 contains the requirements for the qualification of welding plants.
Part 4 deals with the rules for carrying out the work.
Part 5 contains the quality requirements for welding joints.
Part 6 contains the specifications for materials, welding fillers, welding procedures and the welding technological documents.

1 Area of application

This standard deals with the construction references of metallic materials for the manufacture and maintenance of rail vehicles and their components except for pressure tanks.

2 Normative instructions

This standard contains dated and undated specifications from other publications. These normative references are cited in various places in the text and the publication are quoted. With fixed references later modifications belong only to this standard if they have been added by way of alteration. With undated references the latest published edition is valid.

DIN 6700-1 Welding of railway vehicles and parts – part 1: basic terms, basic rules
DIN 6700-2 Welding of railway vehicles and parts – part 2: classes of parts, recognition of welding plants, conformity evaluation
DIN 6700-4 Welding of railway vehicles and parts – partl 4: rules of execution
DIN 6700-5 Welding of railway vehicles and parts – part 5: quality requirements
DIN 6700-6 Welding of railway vehicles and parts – part 6: materials, filler metals, welding processes, welding technological documents
DIN EN 1011-1 Welding- recommendations for welding of metallic materials – Part 1: General guidance for arc welding; German version EN 1011-1:1998
DIN EN 22553 Welding and soldering seams- symbol representation in drawings (ISO 2553:1992), German version of EN 22553:1994
DIN EN ISO 13920 Welding – General tolerances for welding construction – length and angle measurements, form, position (ISO 13920: 1996); German version EN ISO 13920: 1996

Normenausschuß Schienenfahrzeuge (FSF) im DIN Deutsches Institut für Normung e. V.
Normenausschuß Schweißtechnik (NAS) im DIN Deutsches Institut für Normung e.V.

3 Terms
For the application of this standard the terms stated in DIN 6700-1 are valid.

4 General design rules
In the arrangements of welding joints the following general design rules have to be observed:

4.1 The choice of weld seam quality classes (SGK) follows the basic principle, that the welding joints have to be arranged as far as quality and dimensioning is concerned that they can stand up to the loading under operating conditions. For that the weld seam quality classes have to be chosen depending on the safety requirements and load capacity to table 1.

The possibility of the execution of the weld seam quality class and the weldability of the part (welding suitability of material, the welding safety of the construction, welding possibility in production) are to be taken into account.

The weld seam quality classes fall into three groups depending on the permissible irregularities (see section 4 in DIN 6700-5):

- welding seams with special requirements SGK 1
- welding seams with high to medium requirements SGK 2.1, 2.2, 2.3
- welding seams with medium to low requirements SGK 3

The SGK 2.1 to 2.3 differentiate only in test extent, see section 6 of DIN 6700-5.

The permissible stresses are contained in the valid regulations. The exploitation of load capacity must be agreed between customer and manufacturer. The guidelines of the appropriate supervisory authority must be observed.

If nothing else has agreed, then DV 952 (appendix II) and instruction leaflets DVS 1608 and DVS 1612 are valid.

Table 1: Weld seam quality classes in dependency on safety requirement and exploitation of load capacity

		Safety requirement			
		high	medium	low	
exploitation of load capacity [1]	high (+)	1 [2]	2.1	2.2 [3]	Weld seam quality class SGK
	high	2.1	2.2 [3]	2.3 [4]	
	medium	2.2 [3]	2.3 [4]	3	
	low	2.3 [4]	3	3	

1) approximate values:
high (+): high static and high dynamic load and reaching permissible stresses ($\sigma = \sigma_{zul}$).
high: high static load and danger of exceeding the yielding point, but with adequate safety margin against failure ($\sigma > R_{p0,2}$) or load with high dynamic proportion under exploitation of the permissible stress up to max. 100% ($\sigma \leq \sigma_{zul}$).
medium: dynamic and static load under exploitation of the permissible stresses up to about 90% ($\sigma \leq 0{,}9\ \sigma_{zul}$) or pure static load up to 100% ($\sigma \leq \sigma_{zul}$).
low: load under exploitation of the permissible stress up to max. 75% ($\sigma \leq 0{,}75 \times \sigma_{zul}$).

2) Welding seams with special requirements (special quality with machined surface) only permissible in exceptional cases.
3) SGK 2.1 is valid for poor manufacturing accessibility, for materials with limited welding suitability or for high proportion of residual stress.
4) SGK 2.2 is valid for poor manufacturing accessibility, for materials with limited welding suitability or for high proportion of residual stress.

4.2 In order to carry out the welding joints the following conditions have to be met :

- the welding seam must be visible and accessible
- the execution must be possible in accordance with DIN 6700-4,
- the materials and welding fillers must be chosen in accordance with DIN 6700-6,
- the execution of the welding technological documents must be carried out in accordance with DIN 6700-6.

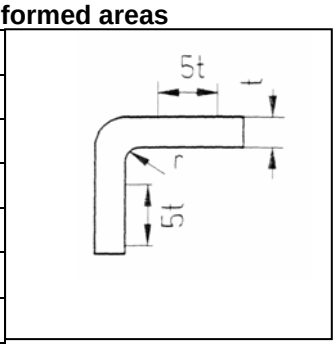
4.3 Welding joints with sharp corners and abrupt changes in the cross section are to be avoided. The flux of lines of force should be undisturbed if possible. Accumulations of welding seams are to be avoided.If this is not possible, special measures must be planned (welding sequence, heat treatment, increased quality requirements; in exceptional cases fillers with higher elasticity than the basic material should be used).
The mass axes of the parts to be welded should meet at one point if possible.
The arrangement of seams at high loaded areas is to be avoided. If this is not possible, increased test requirements are to be planned (see table 1).

4.4 Welding in cold formed areas including the adjoining areas of 5x plate thickness is only allowed with the material groups 1.1, 1.2 and 2 (according to DIN 6700-6), if

- the parts get a heat treatment (e.g. normalizing) before welding or
- the requirements according to table 2 are kept depending on the ratio of the bending radius (r) of the curve to the plate thickness (t).

table 2: Requirements of welding in cold formed areas

min r/t	max. t in mm
10	50
3	24
2	12
1,5	8
1	$\Leftrightarrow 4^{1)}$
[1]) with S235J2G3 up to 6 mm permissible	



4.5 Constructions, in which the parts depend on a load in direction of thickness, suitable constructive measures must be planned (e.g. according to DIN EN 1011-1) and materials must be selected with the required fracture reduction.

4.6 Supplements (permanent welding backups) are to be taken into consideration if designing the welding construction.Welding backups on aluminium constructions must be preferably fitted with a nut. It can be necessary to bevel the welding backup on T-joints of aluminium and steel constructions, for instance HV-welds.

4.7 Interrupted or one sided not through welding seams are permissible only, if a sufficient protection against corrosion has been guaranteed by suitable measures (for instance use of coating which can be overwelded, use of sealing compounds, notches).

4.8 The welding of screw heads and nuts to secure them against loosening is not permissible on parts with high safety relevance (classes of parts C1 and C2 according to DIN 6700-2).

4.9 The position for marking with a stamping punch is to be specified in the drawing.

4.10 The loss of strength in the heat affected zone must be taken into account in the design of the welded construction when cold hardened steels or aluminium alloys are used.

4.11 The precision grades for length and angle measurements and for shape and position tolerances must be selected to DIN EN ISO 13920. Additional requirements must be agreed between customer and manufacturer.

4.12 If necessary for decision making in the development and construction phase the proof of attaining the calculated seam thickness (a_R) must be carried out by work specimen.

5 Welded seam- or procedure-related design rules

5.1 The seam thickness „a“ planned in the drawing is to be specified according to appendix A ($a=a_R$). Seam lengths must be stated. The geometrical reachable „resultant“ seam thickness a_R and the seam length given in appendix A are valid for the calculation.

The seam types listed in appendix A must be used in the execution and design of the seam preparation. If this is not possible the proof is to be carried out to 4.12.

5.2 The following rules are to be observed in the design of butt joints:

5.2.1 For welding joints with high safety requirement and high exploitation of the load capacity (see also table 1) table 2 of DIN 6700-5 is to be observed.

5.2.2 A design without full connection according to table A.1(for instance line 4a) is only permissible for parts with high safety relevance (classes of parts C1 and C2 according to DIN 6700-2) under the following conditions:

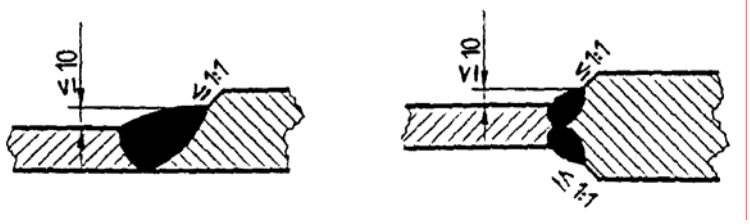
- It is a welding joint with low safety requirement and low exploitation of load capacity (see table 1) or a corresponding proof of the strength with secured assessment of the notch effect exists according to valid regulations of calculation.
- Proof that the calculated seam thickness is attained by work specimen before the beginning of production, see 7.1.1 of DIN 6700-4)
- sufficient protection against corrosion has been guaranteed by suitable measures (see 4.7).

5.2.3 If the plate thickness or width changes in a butt weld, transitions which ensure favourable flux of lines of force are to be created according to the load:

a) Under static or low dynamic loads, a difference in thickness of more than 10 mm or $t_2 \leq 3 \cdot t_1$ is to be executed with a transition with an inclination not sharper than 1:1 (see figure 1).

b) For high dynamic loads and a difference in thickness Δt of more than 3 mm or $t_2 \leq 1{,}5 \cdot t_1$ in a single-sided flush joint and 6 mm in a central joint, the transition is to be executed with an inclination not sharper than 1:4 and without notches in direction of load (see figure 2).

The transitions for the plate widths are to be executed equivalently.



dimensions in millimeter

figure 1: single-sided flush joint and central joint (inclination 1:1)

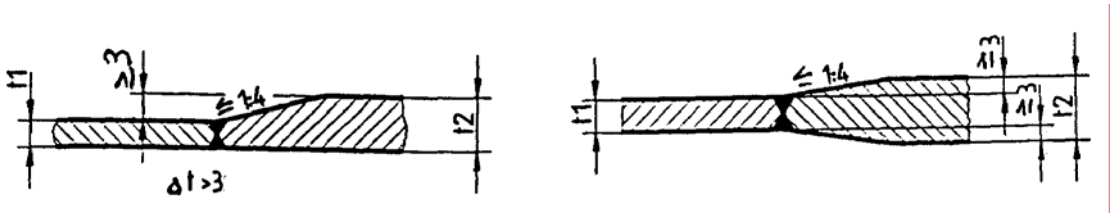


figure 2: single-sided flush joint and central joint (inclination 1:4)

5.2.4 Are planned notches for parts with high dynamic load, so they can be done according to figure 3 and 4. Alternative versions are possible. The front ends are to be welded all around.

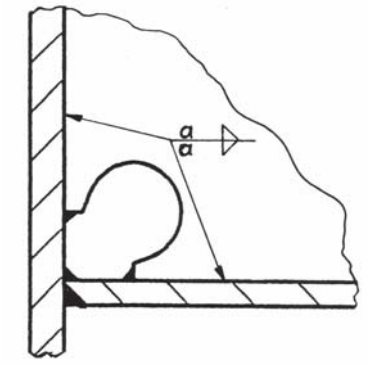
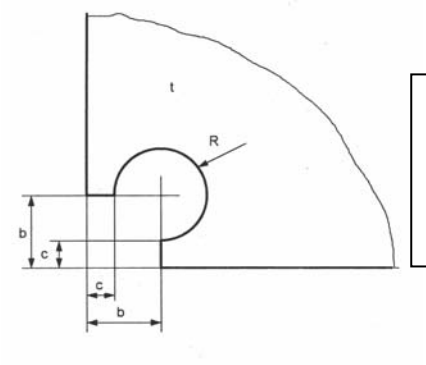


figure 3: connection of the bracket



b=3 x t, min. 30 mm
c= web height
R= 3 x t
t = plate thickness

figure 4: notch at strengthening rib

5.3 The following rules are to be observed in the design of fillet welds:

5.3.1 Fillet welds are usually to be executed with equal leg length. If fillet welds of unequal leg lengths are required for reasons of the design or to improve the course of force lines, the leg length z is to be included in addition to the seam thickness in the drawing, see DIN EN 22553, 6.2.

5.3.2 Fillet welds must not be specified thicker than required by the design, and the seam thicknesses of table A.1, lines 10 b,c and 13 a,b are to be held for technological and welding technique reasons.

5.3.3 The distance to the edge must be $e \geq 2{,}5 \times a$, see figure 5.

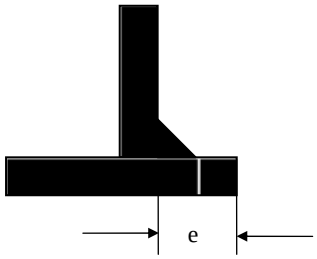


figure 5: distance to edge

5.3.4 For fillet welds at bores and slots, the hole diameter is to be specified as $d \geq (3....4) \times t_2$ (figure 6) and the slot width as $c \geq 3 \times t_2$ (figure 7).

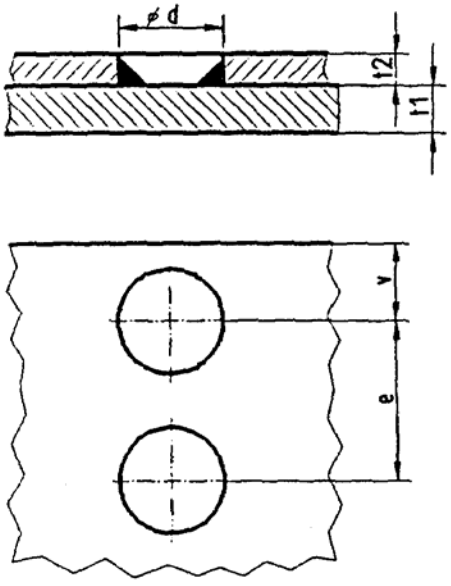


figure 6: fillet weld at bores

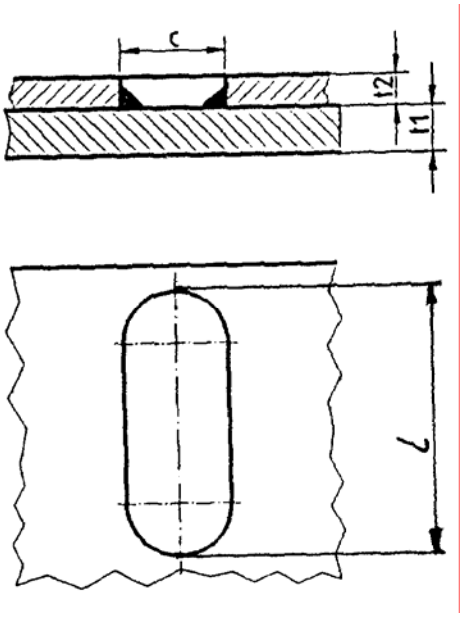


figure 7: fillet weld at slots

$d_{min} \geq 12$ mm
$c_{min} \geq 12$ mm
$v \geq d$
$e = 3...4 \times d$
$l = 2 \times c$

5.4 The following rules are to be observed in the design of T-joints:

5.4.1 HV- (single-bevel butt groove) and DHV- (double-bevel butt groove) welded joints at T-joints as shown in table A.1, lines 10a to 10e are only permissible when the root fusion is secured in production by

- design measures (weld preparation, root opening, cap pass, backing)
- production engineering measures (welding procedure, welding filler, backing) .

The fulfilment of the above specified measures is to be ensured by work specimen and must be verified by test measures if necessary.

5.4.2 HV welded joints at T-joints which are only accessible from one side as shown in table A.1, line 10a, are to be avoided for bogies, chassis and loading gantries.

If a cap pass is impossible in bogies, chassis and loading gantries for reasons of the design (e.g. in box section supports), the root fusion must be secured by measures of the welding technique and verified by work specimen and test measures.

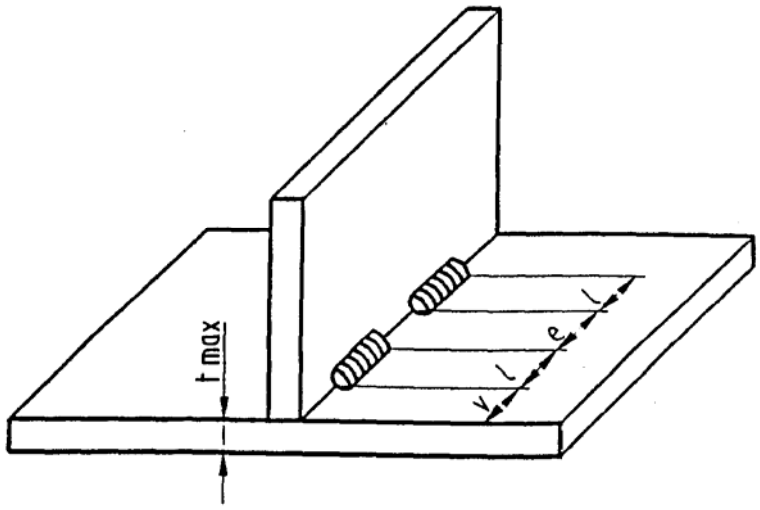
In other cases the welded joint can be designed as HY-weld (single-bevel tee butt weld) corresponding to the calculated conditions.

HY-welds are not permissible for welded joints with dynamic load and high safety requirement and high exploitation of the load capacity (see also table 1).

5.5 The following rules are to be observed in the design of interrupted weld seams:

5.5.1 The minimum weld length of interrupted seams is:

- at t_{max} < 10 mm : $l_{min} > 5 \times t_{max}$, at least 20 mm for steel and 30 mm for aluminium materials.
- at t_{max} > 10 mm : $l_{min} > 3 \times t_{max}$, at least 50 mm, see figure 8.



$e \leq 3 \times l$
$v \leq 0{,}5 \times l$

figure 8: interrupted fillet weld

5.6 The following rules must be observed in the design of brackets and strap plates:

5.6.1 In the design of welded on parts, the transitions must be rounded to reduce the notch effect.

5.6.2 For parts with high dynamic load the additional strap plates are to be connected at their front ends by fillet welds of unequal leg length as shown in figure 9. The corners must be rounded or must have a bevel cut. The transitions must be machined free of notches in the direction of the load.

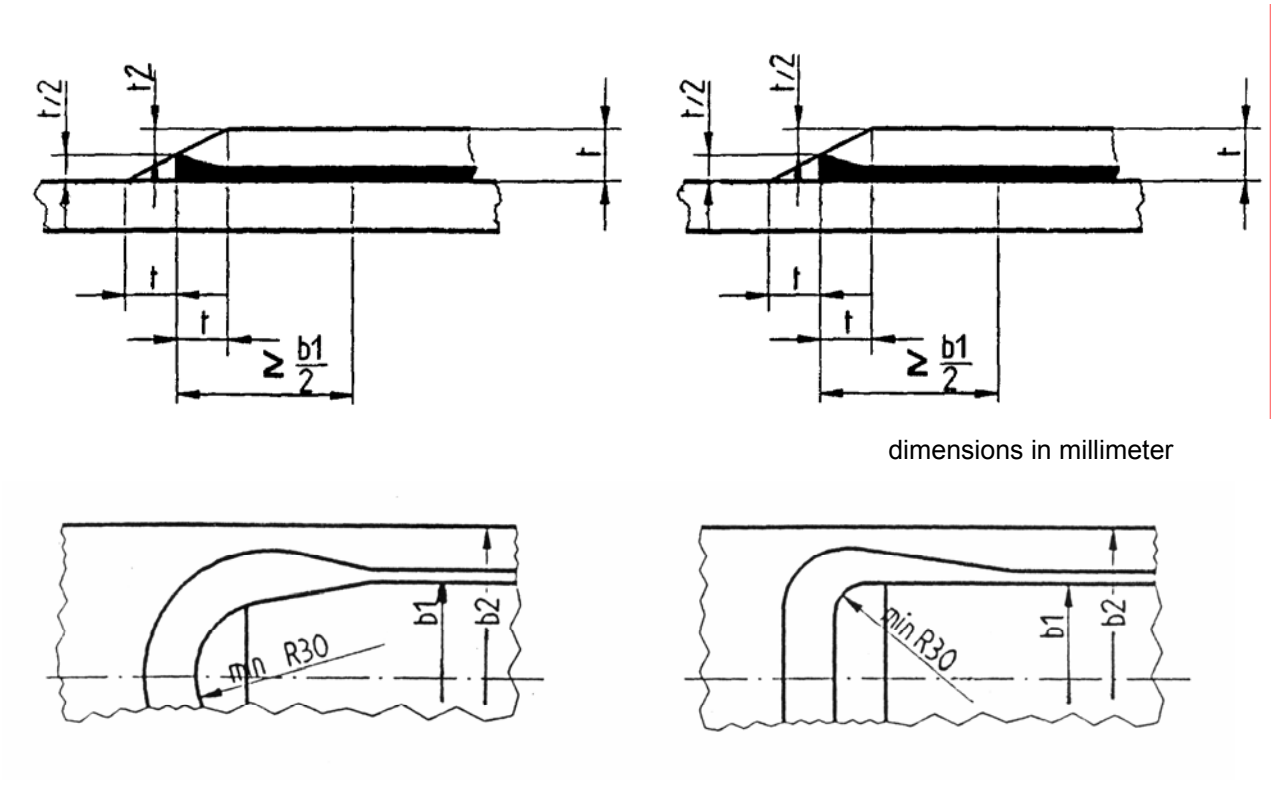


figure 9: Design and connection of strap plates

5.7 For overlapped welded joints, resistance spot welding or roll seam welding processes are permissible apart from fusion weld joint.The plate thicknesses to be welded can be seen from appendix B and the specific, material-related conditions must be observed.

5.7.1 The design of resistance spot-welded joints is described in appendix B. For roll seam welded joints, an equivalent procedure is to be used. For the specification of the weld seam quality class, 6.2.1 of DIN 6700-5 must be observed.

5.7.2 Resistance weldable coatings, sealing pastes, sealing tapes or adhesives may be used for protection against corrosion in the overlapping areas.

5.7.3 Roll seam welding is to be used for sealing welds. A distance to the edge of max. 2 mm is permissible for the plate cladding of railway vehicles with external sealing welds. 6.2.1 of DIN 6700-5 must be observed.

5.8 In the design of flash-welded joints the joint faces must be equally large if possible, so that the same current density exists over the entire cross-section and the same amount of heat is generated. If the thicknesses change, the procedures specified in 6.2.3 of DIN 6700-5 are to be used.

5.9 Table A.2, lines 1 and 2, must be observed in the design of plug welds.

NOTE: Table A.2 is missing (it can be used table A.1, lines 14a and b, of E DIN 6700-3: 1997)

5.10

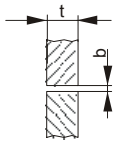
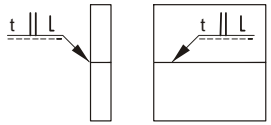
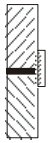
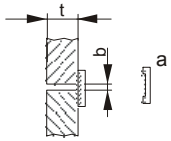
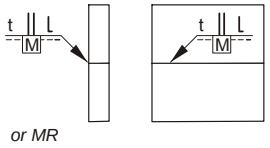
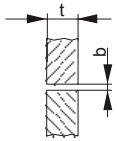
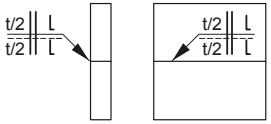
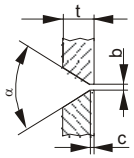
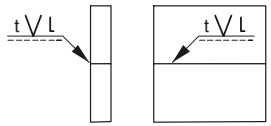
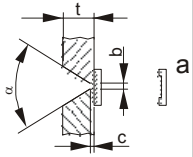
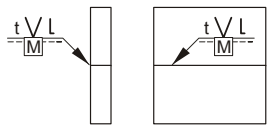
6.2.2 of DIN 6700-5 must be observed in the design of foil seam welded joints.

5.11 For stud welding, 6.1.2 of DIN 6700-5 must be observed in the design.

Appendix A (normative)

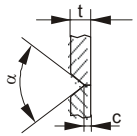
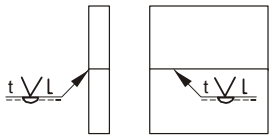
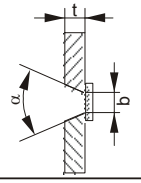
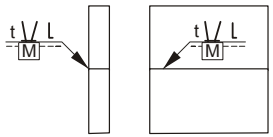
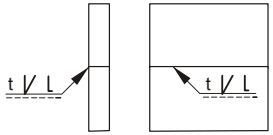
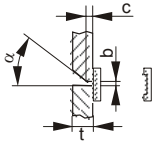
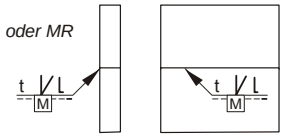
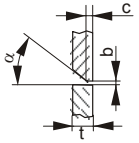
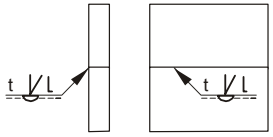
A.1: weld preparation and thickness of the welds for fusion weld joints

table A.1: groove shapes for weld joints — dimensions in millimeter

Nr.	Designation	Diagram	Symbol	Groove shape cross-section	Symbolic representation	workpiece thickness t (mm)		Preparation angle α		Root gap d b (mm)		Root face c (mm)		Bevel height h (mm)			Resultant thickness of the weld
						Al [a]	Steel	Al	Steel	Al	Steel	Al	Steel	Al	Steel		a_R (mm)
1a	I-seam single sided (square butt)					≤ 4	≤ 4	—	—	0 - 2	0 - 3	—	—	—	—		$a_R = t$
1b	I-seam with backing (square butt)					≤ 6	≤ 6	—	—	0 - 3	0 - 3	—	—	—	—		$a_R = t$
1c	I-seam Double sided					3 - 6	3 - 6	—	—	0 - 2	0 - 3	—	—	—	—		$a_R = t$
2a	V-seam (single V butt)					3 - 15	3 - 15	60 - 70	50 - 60	0 - 2	0 - 3	0 - 2	0 - 2	—	—		$a_R = t$
2b	V-seam with backing (single V butt)					3 - 15	3 - 15	60 - 70	50 - 60	0 - 4	2 - 4	0 - 2	0 - 2	—	—		$a_R = t$

[a] aluminium and aluminium alloys

Table A.1 (continued)

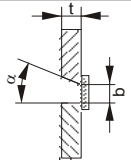
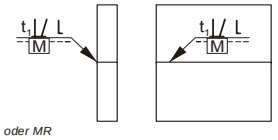
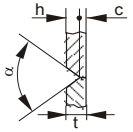
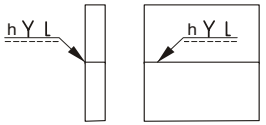
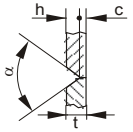
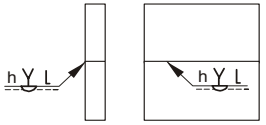
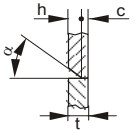
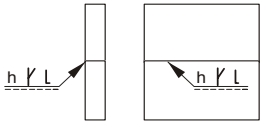
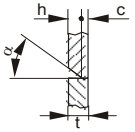
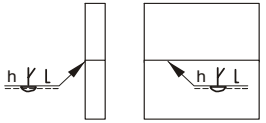
Nr.	Designation	Diagram	Symbol	Groove shape cross-section	Symbolic representation	Workpiece thickness t (mm)		Preparation angle α		Root gap b (mm)		Root face c (mm)		Bevel height h (mm)			Resultant thickness of the weld
						Al	Steel	Al	Steel	Al	Steel	Al	Steel	Al	Steel		a_R(mm)
2c	V-seam [b] With cap pass (single V butt)					3 - 15	3 -15	60 - 70	50 - 60	0-2	0-2	0 - 2	0 - 2	—	—		$a_R = t$
2d	*Square-edge weld with backing*				 *oder MR*	8 - 20	12 - 30	30-40	20-40	4 - 10	6 - 15	—	—	—	—		$a_R = t$
3a	HV-seam [c] (single bevel butt)					3 - 15	3 - 15	50 - 60	40 - 60	0 - 2	1 - 3	1 - 2	1 - 2	—	—		$a_R = t$
3b	HV-seam With backing			 a	 *oder MR*	3 - 15	3 - 15	50 - 60	40 - 60	0 - 4	2 - 4	1 - 2	1 - 2	—	—		$a_R = t$
3c	HV-seam [b] With cap pass					3 - 15	3 - 15	50 - 60	40 - 60	0 - 2	0 - 2	1 - 2	1 - 2	—	—		$a_R = t$

a aluminium and aluminium alloys

b Before welding of the cap pass, grooving out the root

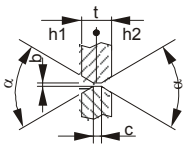
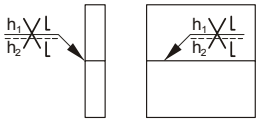
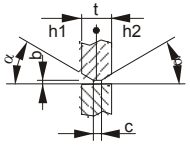
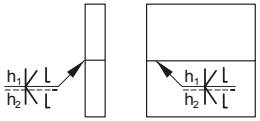
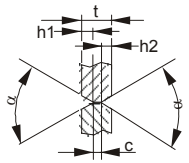
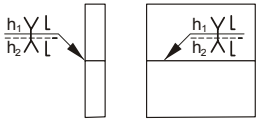
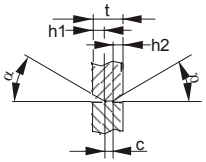
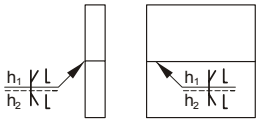
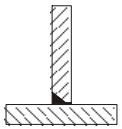
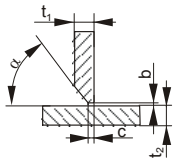
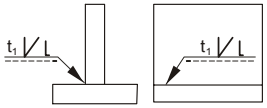
c HV-seam without cap pass with secured root fusion by design, production or testing measures (proof by work specimen)

Table A.1 (continued)

Nr.	Designation	Diagram	Symbol	Groove shapes cross-section	Symbolic representation	Workpiece thickness t (mm)		Preparation angle α		Root gap b (mm)		Root face c (mm)		Bevel height h (mm)			Calculated thickness of the weld
						Al	Stahl	Al	Stahl	Al	Stahl	Al	Stahl	Al	Stahl		a_R(mm)
3d	*Single square-edge weld with backing*				 oder MR	8 - 20	12 -30	30 40	20 40	4 - 10	6 - 15	—	—	—	—		$a_R = t$
4a	Y-seam (tee butt weld)					3 - 15	3 - 15	60 - 70	50 - 60	—	—	≤ 0,2 t	≤ 0,2 t	≥ 0,8 t	≥ 0,8 t		$a_R = t - c$
4b	Y-seam [d] *with cap pass*					3 - 15	3 - 15	60 - 70	50 - 60	—	—	≤ 0,2 t	≤ 0,2 t	≥ 0,8 t	≥ 0,8 t		$a_R = t - c$
5a	HY-seam (single-bevel tee butt weld)					3 - 15	3 - 15	50 - 60	40 - 50	—	—	≤ 0,2 t	≤ 0,2 t	≥ 0,8 t	≥ 0,8 t		$a_R = t - c$
5b	HY-seam [d] *With cap pass*					3 - 15	3 - 15	50 - 60	40 - 50	—	—	≤ 0,2 t	≤ 0,2 t	≥ 0,8 t	≥ 0,8 t		$a_R = t - c$

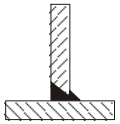
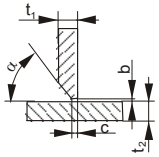
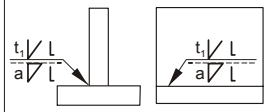
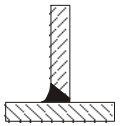
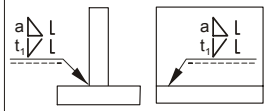
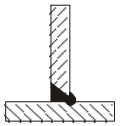
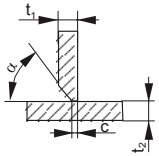
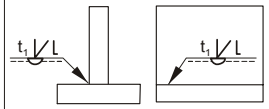
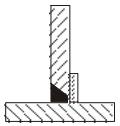
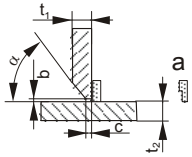
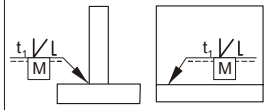
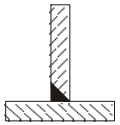
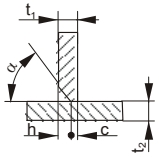
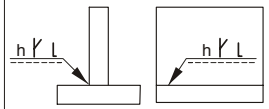
[d] Cap pass only necessary to avoid gap corrosion

Table A.1 (continued)

Nr.	Designation	Diagram	Symbol	Groove shapes cross-section	Symbolic representation	Workpiece thickness t (mm)		Preparation angle α		Root gap b (mm)		Root face c (mm)		bevel height h (mm)			Calculated thickness ot the weld
						Al	Steel	Al	Steel	Al	Steel	Al	Steel	Al	Steel		a_R(mm)
6	DV-seam [b] X-seam (double V butt)					≥ 12	≥ 12	60 - 70	50 - 60	0 - 3	0 - 3	1 - 2	1 - 2	$h_{1/2}$ 1/3 t -1/2 t			$a_R = t$
7	DHV-seam [b] (Double bevel butt)					≥ 12	≥ 12	50 - 60	40 - 50	0 - 2	1 - 3	1 - 2	1 - 2	$h_{1/2}$ 1/3 t -1/2 t			$a_R = t$
8	DY-seam (Double tee butt weld)					≥ 12	≥ 12	60 - 70	50 - 60	—	—	≤ 0,2 t	≤ 0,2 t	≥ 0,4 t	≥ 0,4 t		$a_R = t - c$
9	DHY-seam (Double single-bevel tee butt weld)					≥ 12	≥ 12	50 - 60	40 -60	—	—	≤ 0,2 t	≤ 0,2 t	≥ 0,4 t	≥ 0,4 t		$a_R = t - c$
10a	HV-seam [c] (single bevel butt)					3 - 15	3 - 15	50 - 60	50 - 60	1 - 3	1 - 3	0 - 2	0 - 2	—	—		$a_R = t_1$

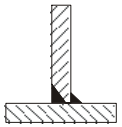
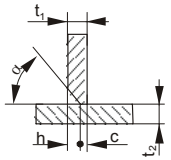
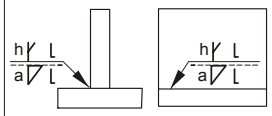
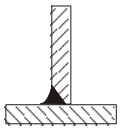
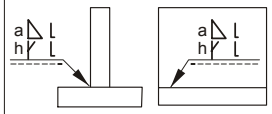
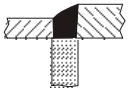
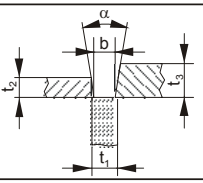
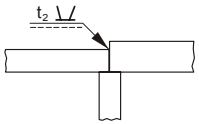
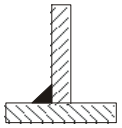
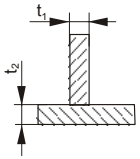
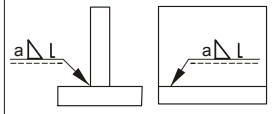
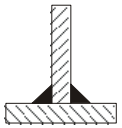
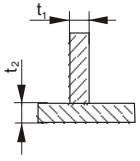
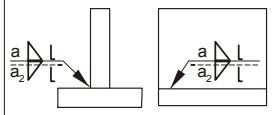
b Before welding of the cap pass, grooving out the root
c HV-seam without cap pass with secured root fusion by design, production or testing measures (proof by work specimen)

Table A.1 (continued)

Nr.	Designation	Diagram	Symbol	Groove shapes cross section	Symbolic representation	Workpiece thickness t (mm)		Preparation angle α		Root gap b (mm)		Root face c (mm)		Bevel height h (mm)			Calculated thickness of the weld
						Al	Steel	Al	Steel	Al	Steel	Al	Steel	Al	Steel		a_R(mm)
10b	HV-seam [b] with fillet weld *as cap pass*					3 - 15	3 - 15	50 - 60	50 - 60	0 - 3	0 - 3	0 - 2	0 - 2	—	—		$a_R = t_1$
10c	HV-seam [c] *with built up fillet weld*					3 - 15	3 - 15	50 - 60	50 - 60	0 - 3	0 - 3	0 - 2	0 - 2	—	—		$a_R = t_1$
10d	HV-seam [b] *with cap pass*					3 - 15	3 - 15	50 - 60	50 - 60	0-3	0-3	0 - 2	0 - 2	—	—		$a_R = t_1$
10e	HV-seam [c] *with backing*					3 - 20	3 - 20	50 - 60	50 - 60	0 - 5	0 - 5	0 - 2	0 - 2	—	—		$a_R = t_1$
11a	HY-seam					3 - 15	3 - 15	50 - 60	50 - 60	—	—	≤ 0,2 t	≤ 0,2 t	—	—		$a_R = t_1 - c$

a aluminium and aluminium alloys
b Before welding of the cap pass, grooving out the root
c HV-seam without cap pass with secured root fusion by design, production or testing measures (proof by work specimen)

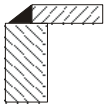
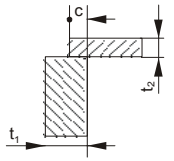
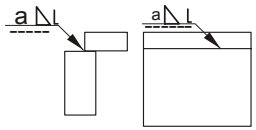
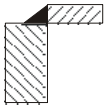
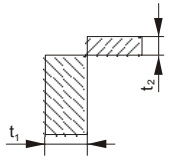
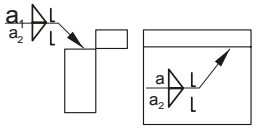
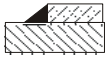
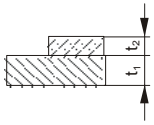
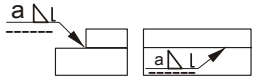
Table A.1 (continued)

Nr.	Designation	Diagram	Symbol	Groove shapes cross-section	Symbolic representation	Workpiece thickness t (mm)		Preparation angle α		Root gap b (mm)		Root face c (mm)		Bevel height h (mm)			Calculated thickness of the weld
						Al	Steel	Al	Steel	Al	Steel	Al	Steel	Al	Steel		a_R (mm)
11b	HY-seam with fillet weld as cap pass					3 - 15	3 - 15	50 - 60	50 - 60	—	—	≤ 0,2 t	≤ 0,2 t	—	—		$a_R \leq h+a \leq t_1$
11c	HY-seam with built up fillet weld					3 - 15	3 - 15	50 - 60	50 - 60	—	—	≤ 0,2 t	≤ 0,2 t	—	—		$a_R \leq h < t_1$ in special cases $a_R \leq h+a < t_1$
12	Three plate weld (square edge weld)					t_2 4 - 20	t_2 4 - 20	30-40	20-40	4 - 10	4 - 10	—	—	—	—		[e] $a_R = b$
																	[f] $a_R = t_2$
13a	Fillet weld					Alu a_{min}: 3mm ; a_{max} 12mm Steel a_{min}: 2mm ; a_{max} 12mm											$a_R = a \leq 0,7 \times t_{min}$
13b	Double fillet weld																$a_R = a_1+a_2 \leq t_{min}$ $a_{max} \leq 0,7 \times t_{min}$

[e] force transmission from t_1 to t_2 and t_3; the plate thicknesses t_1 and t_3 and the root gap b are to be taken into account in addition for the design

[f] force transmission from t_1 to t_2

table A.1 (continued)

Nr.	Designation	Diagram	Symbol	Groove shapes cross-section	Symbolic representation	Workpiece thickness t (mm)		Preparation angle α		Root gap b (mm)		Root face c (mm)		Bevel height h (mm)		Calculated thickness of the weld
						Al	Stahl	Al	Stahl	Al	Stahl	Al	Stahl	Al	Stahl	a_R(mm)
13c	Corner seam					t_1 ≥ 1	t_1 ≥ 1	—	—	—	—	—	—	—	—	$a_R = a < 0{,}7 \times t_2$ $t_2 < t_1$
13d	Corner seam					t_2 ≥ 3	t_2 ≥ 3	—	—	—	—	—	—	—	—	$a_R = a_1 + a_2 < t_2$ $a_1 < 0{,}7 \times t_2$ $t_2 < t_1$
13e	Overlapping weld					t_2 ≥ 1,5 t_1 ≥ 3	t_2 ≥ 1,5 t_1 ≥ 2	—	—	—	—	—	—	—	—	$a_R = a < 0{,}7 \times t_2$ $t_2 < t_1$

These weld preparations can be changed if special welding processes are used, e.g. mechanised processes, and the required thickness of the weld has been proved by a work specimen

Appendix B (normative)

B.1 Resistance spot welding

B.1.1
Table B.1 provides the design of the spot spacing and the edge distance in dependency on the thickness of the workpiece for resistance spot welding.

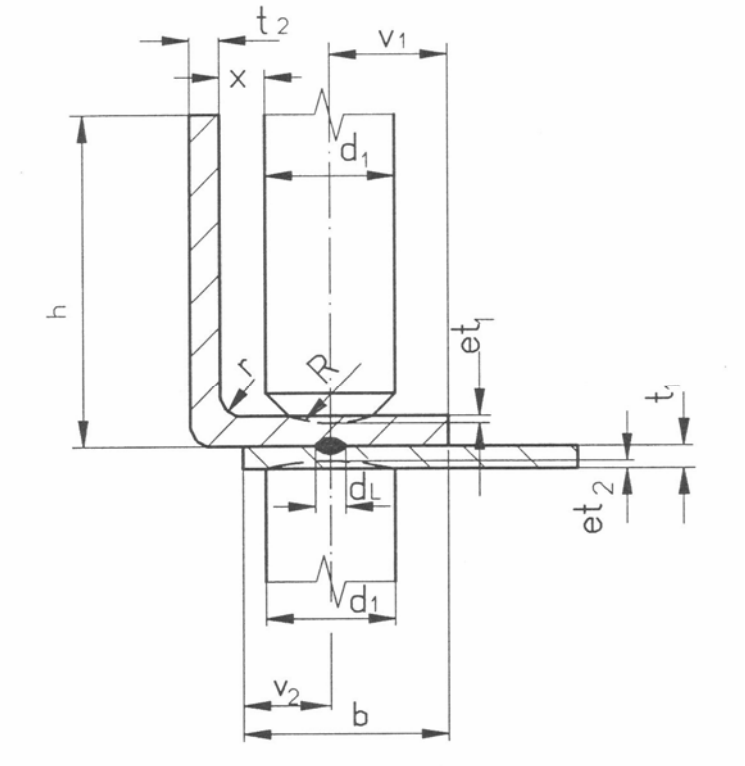
table B.1: spot spacing and edge distance

Workpiece thickness t_1	1	1,25	1,5	1,75	2	2,5	3
Spot spacing e_1	25	35	35	35	40	50	50
Edge distance v	≥10	≥10	≥10	≥10	≥15	≥15	≥15

The values of e_1 are minimum values.

The nugget diameter and the minimum tensile-shear strength and the material types are to be specified in 6.2 of DIN 6700-5 for the design.
If these values are deviated from for reasons of the design, work specimen are to be taken in compliance with section 4.12 .

Figures B.1 to B.4 represent the basic arrangement for resistance spot welding of profiles and plates.

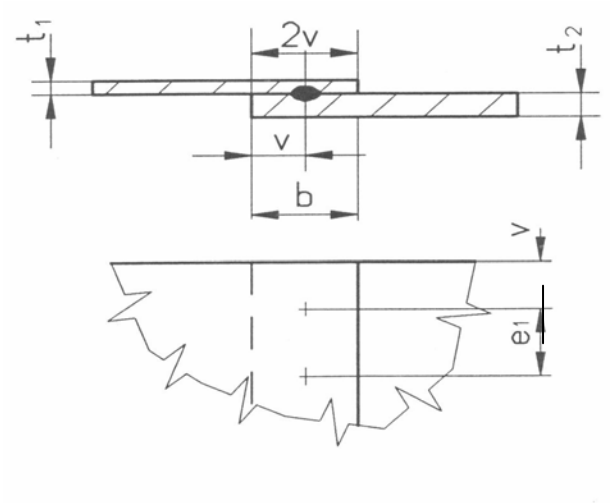


x	side distance
d_L	nugget diameter
d_1	electrode diameter
r	bending radius
t_1	smaller plate thickness
t_2	larger plate thickness
et_2	upper depth of indentation
et_1	lower depth of indentation
R	bunching radius of the electrode
b	overlap
h	leg height
v_1	edge distance 1
v_2	edge distance 2

valid for dimension x:

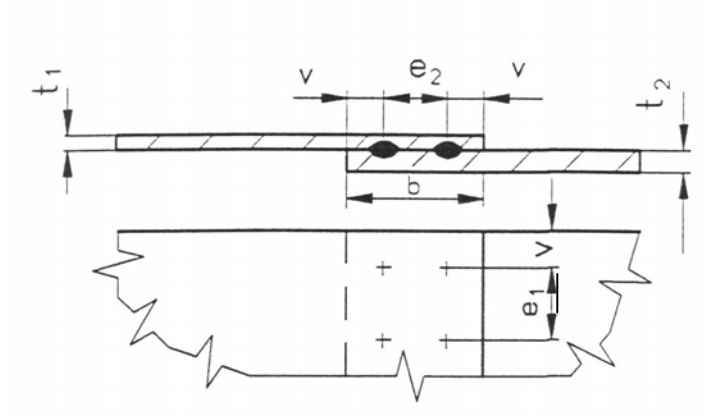
$x \geq 5mm$ und $x > r$

Figure B.1: resistance spot welding of plates



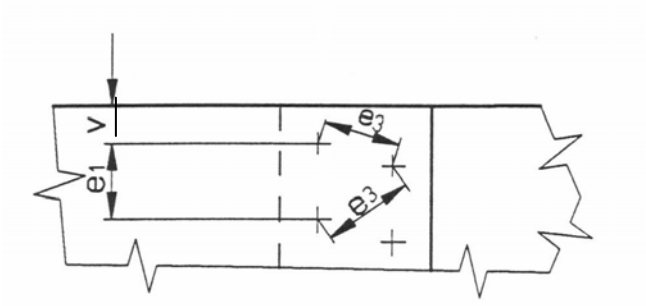
e_1	spot spacing
e_2	spot row spacing
v	edge distance
t_1	smaller plate thickness
t_2	larger plate thickness
b	overlap

figure B.2: resistance spot welding of plates, single-row



e_1	spot spacing
e_2	spot row spacing
v	edge distance
t_1	small plate thickness
t_2	large plate thickness
b	overlap

figure B.3: resistance spot welding of plates, double-row



e_1	spot spacing
e_2	spot row spacing
e_3	spot spacing (double-row offset)
v	edge distance
t_1	small plate thickness
t_2	large plate thickness
b	overlap

figure B.4: resistance spot welding of plates, double-row offset