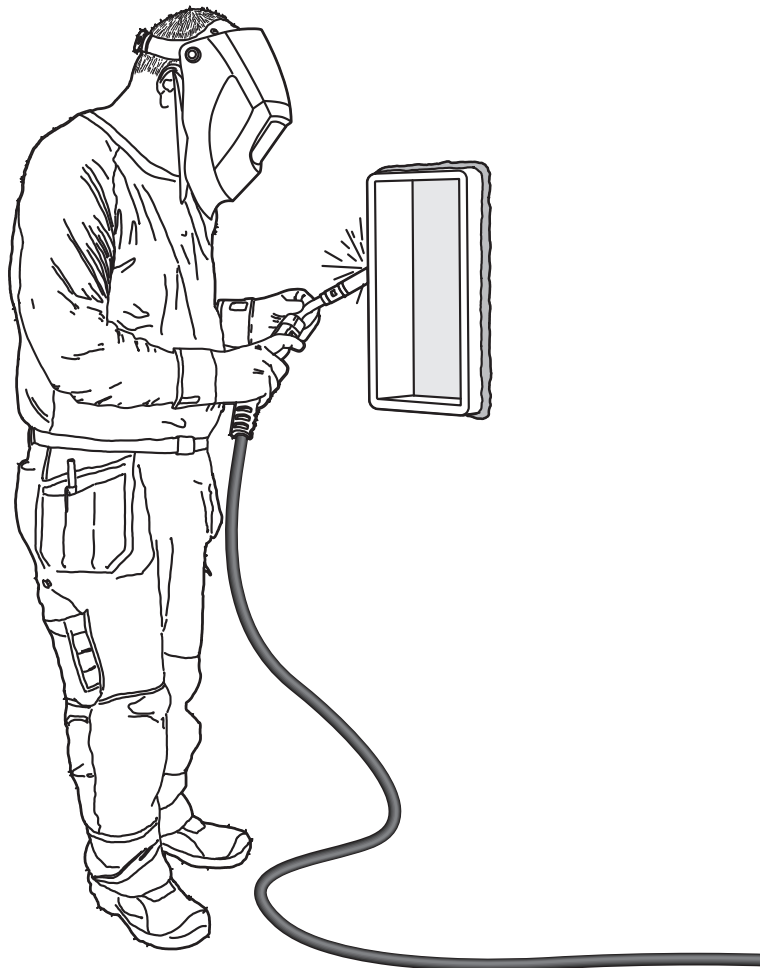


Description and application guidelines

Roxtec welding guidelines



Prepared for: Roxtec International AB

Date: 2023-04-20

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Abstract

This guideline is a help for the welding responsible to produce a welding procedure specification (WPS). This can be unique for every site due to local requirements and regulations.

Personnel competence recommendations

For reliable and high quality results, welders are recommended to be qualified according to the latest editions of AWS D1.1, ISO 9606-1 2013, ISO 9606-2 2004 or other authorized system.

Welding methods described in the guideline

- Shielded metal arc welding (SMAW)
- Flux core arc welding (FCAW)
- Gas tungsten arc welding (GTAW)

Welding consumables

Welding consumables are to be chosen depending on the materials that shall be welded together. Shall be handled and treated according to instructions from manufacturer of consumables.

Welding quality levels for imperfections of the frame

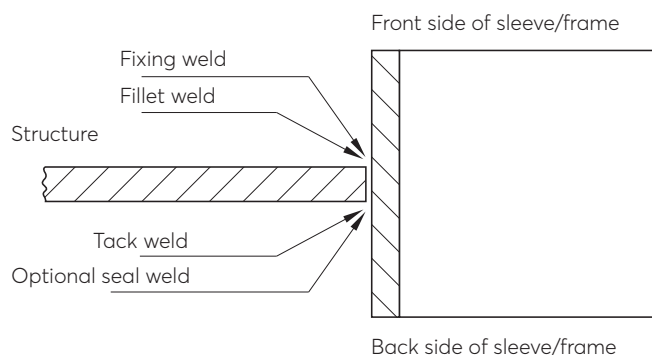
Roxtec frames manufactured in mild steel and stainless steel are welded according to EN-ISO 5817 Min Class C. Aluminum frames are welded according to EN-ISO 10042 Min Class C.

Requirements after welding

The Roxtec system is certified for pressure up to 6 bar. Therefore we recommend undestructive testing of the welds such as liquid penetrant, ultrasonic testing and magnetic particle testing. The dimensions should be according to the table on page 9 to obtain optimal performance of the transit.

Legend

Location of various welds between structure and sleeve/frame.



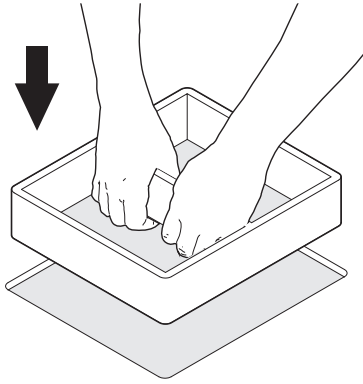
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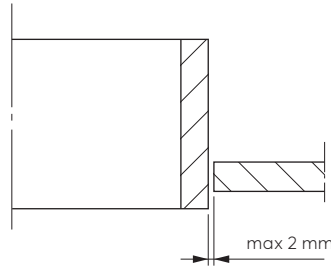
1 Aperture and weld buildup

1.1 For frames without flange

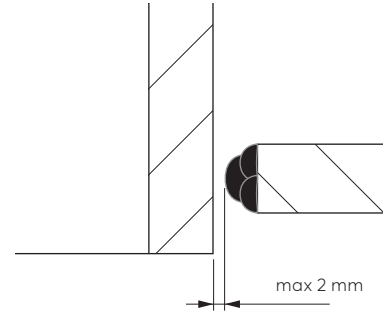
Make the aperture as close to the frame outer dimension as possible to avoid large root gaps. Max allowed total root gap before welding is 2 mm. Larger gaps must be minimized using weld buildup to avoid deformation of the frame. The weld buildup shall not be made on the frame.



Measure the aperture using the frame.



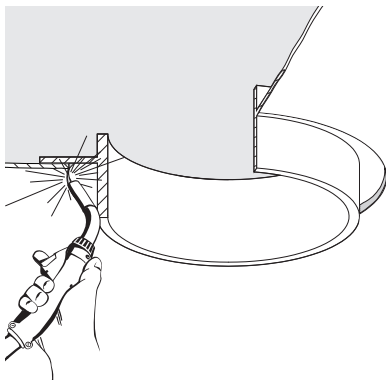
Maximum total root gap for fillet weld.



Weld buildup of aperture shall be performed on the structure.

1.2 For frames with flange

Make the aperture considering the minimum clearance of 15 mm. The edge of the aperture should be placed at the center of the flange of the frame to make room for welding on the inside.



Position of frame with flange in an aperture.

2 Positioning and fixing

The frame or sleeve can be centered or fixed in a corner of the aperture at any depth or angle. It is important not to exceed the maximum allowed root gap also when welding the frame in an angle. Frames and sleeves with flange must cover the aperture in full.

Check fire certification with regard to allowed positioning.

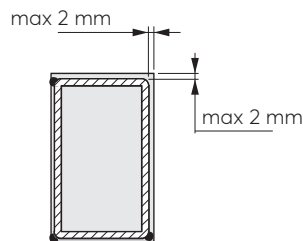
2.1 Positioning

When positioning the frame in weather exposed areas it is recommended to have the frame or sleeve protruding and/or tilted from the structure to prevent standing water and icing on the transit. Frames and sleeves welded to moving structures should be tilted away from the direction of travel if possible.

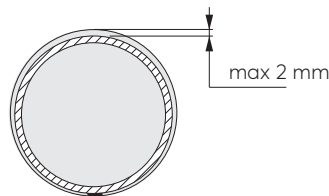


2.2 Fixing

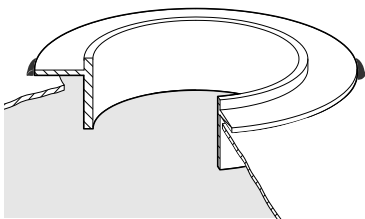
The frame can be centered or fixed in a corner of the aperture at any depth. The maximum allowed root gap is 2 mm to prevent heat deflection.



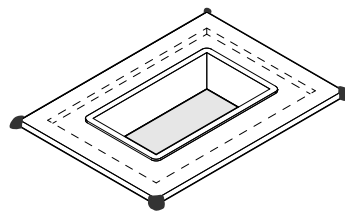
Fixing of rectangular frame without flange.



Fixing of sleeve without flange.



Fixing of sleeve with flange.



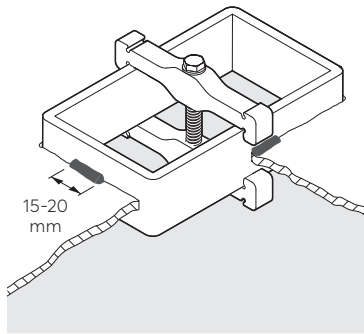
Fixing of rectangular frame with flange.

3 Tack weld

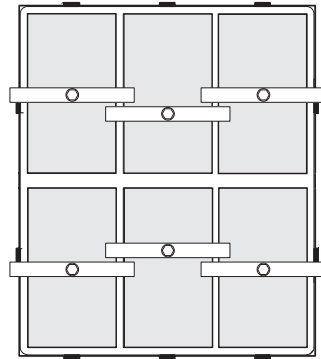
Apply tack welds with a length of 15–20 mm on the back side at the corners and in the center of every opening of the flange. Use an appropriate tool to clamp the frame in tolerance during the whole welding process to avoid heat deflection. Do not remove the tool until the frame has a temperature below 50°C.

Fixing tools are required in all openings on combination frames of size x1, x2 and x3. On combination frames >x4, it is only required to use fixing tools at the side openings.

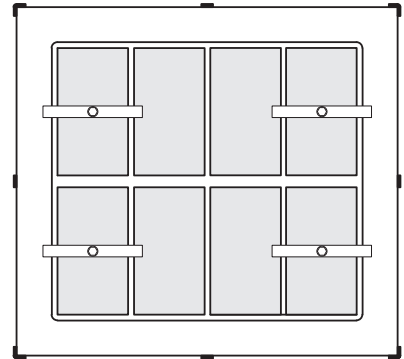
Note: If the fillet weld is applied on only one side, the tacking must be made on the opposite side.



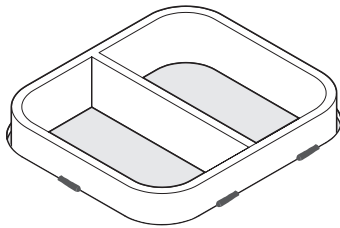
Clamp tool applied on a rectangular frame without flange.



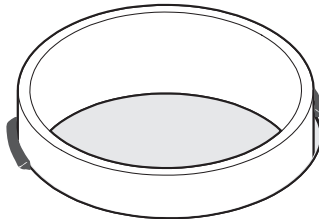
Tack weld of a rectangular combination frame without flange.



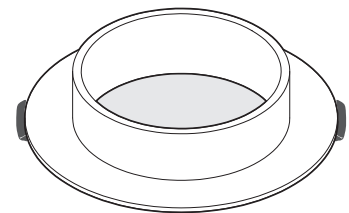
Tack weld of a rectangular combination frame with flange.



Tack welded rectangular frame without flange.

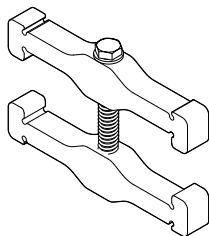


Tack weld of a sleeve without flange.



Tack weld of a sleeve with flange.

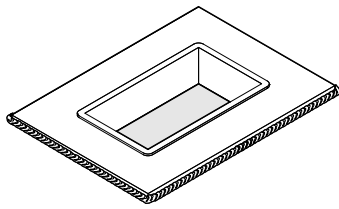
Roxtec welding fixtures are used on S series frames and are designed to prevent frames from expanding out of tolerance during welding. By clamping the frame partition walls early in the welding process, the heat input from the weld is managed.



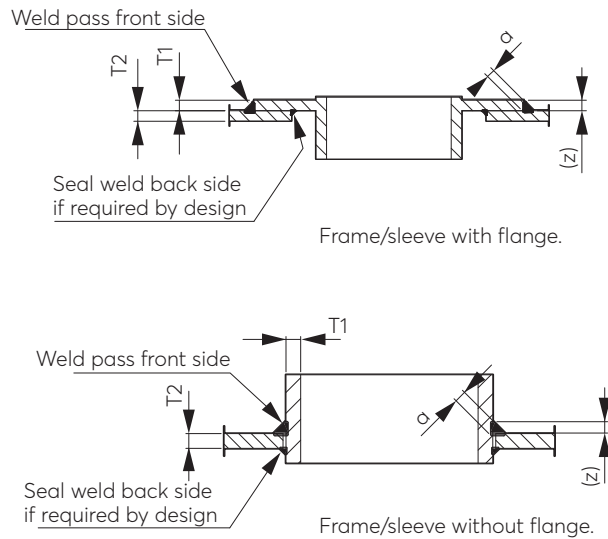
Roxtec Welding fixture tool

4 Fillet and seal weld

- Apply the fillet weld in several weld seams on the front side with an interpass temperature below 150 °C for stainless steel or aluminum and below 250 °C for mild steel. The weld runs shall not exceed 150 mm/weld pass.
- Grind off the tack welds on the back side before applying the optional seal weld.



Note: The optional seal weld is for corrosion protection only and not mandatory unless specified by the design.



Weld sizes				Max heat input (kJ/mm)		
Frame thickness T1	Structure thickness T2	Fillet weld size (max)	Seal weld size (max)	Mild steel	Stainless steel	Aluminum
5–6	3<T2<12	α3 (z4)	α3 (z4)	1.1	1.0	0.8
10–12	≤6	α4 (z5)	α3 (z4)	1.1	1.0	0.8
10–12	>6	α5 (z7)	α3 (z4)	1.1	1.0	0.8

$$Q = \frac{k \times U \times I \times 60}{v \times 1000}$$

Q = Heat input [KJ/mm]
 U = Voltage [V]
 I = Current [A]
 v = Welding speed [mm/min]
 k = Thermal efficiency [dimensionless]

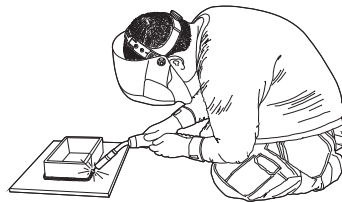
Welding method	Thermal efficiency
MMA (manual metal arc, SMAW)	0.8
MIG/MAG (metal inert gas/metal active gas, GMAW)	0.8
TIG (tungsten inert gas, GTAW)	0.6

4.1 Weld passes – frames/sleeves without flange (horizontal weld)

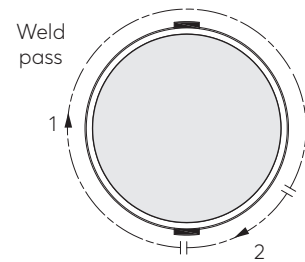
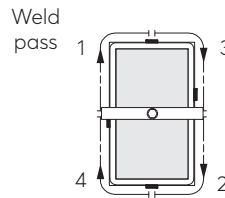
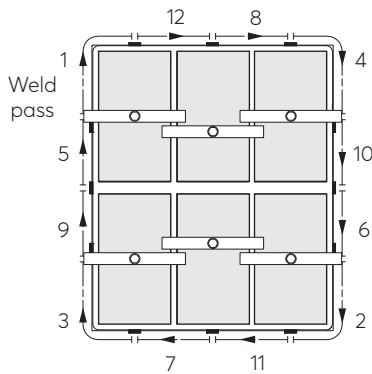
The weld passes are evenly distributed to reduce heat buildup. Take weld length and interpass temperatures into consideration when welding large frame sizes.



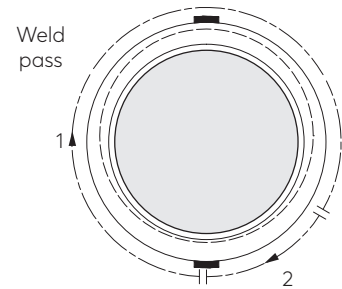
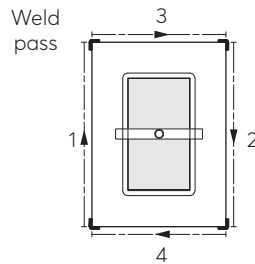
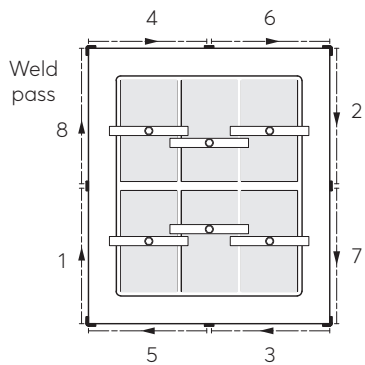
Horizontal MMA welding



Horizontal MAG welding

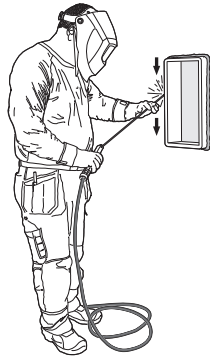


4.2 Weld passes – frames/sleeves with flange (horizontal weld)

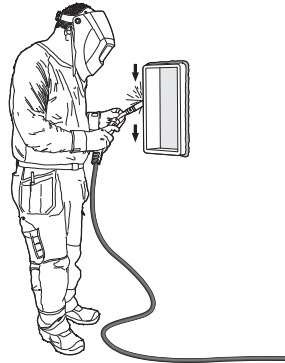


4.3 Weld passes – frames/sleeves without flange (vertical weld)

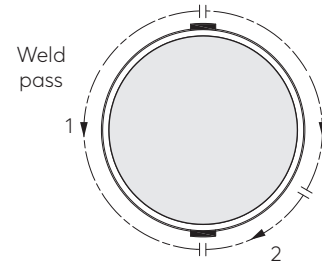
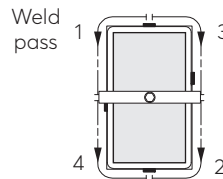
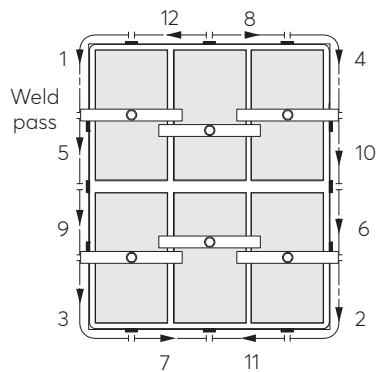
Make sure to fix the frame or sleeve with a gap all around the circumference and to use filler metal approved for welding position vertical welding (ISO 6947 position PG). A 45° upward angle of the welding gun is recommended for the weld passes.



Vertical MMA welding

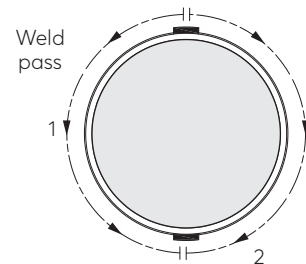
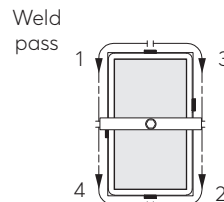
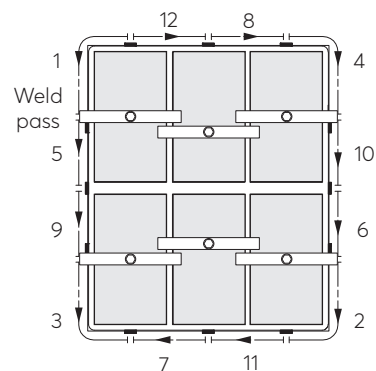


Vertical MAG welding



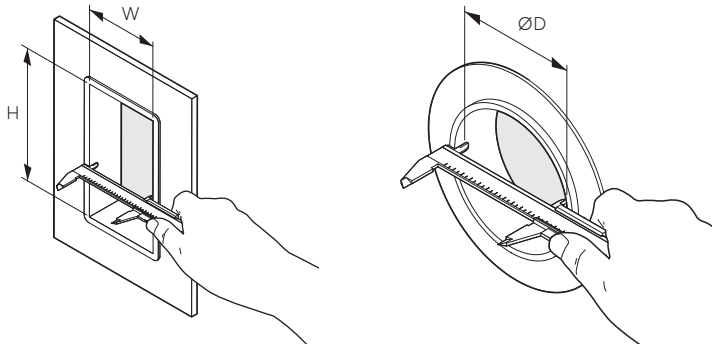
4.4 Weld passes – frames/sleeves with flange (vertical weld)

Make sure to fix the frame or sleeve with a gap all around the circumference and to use filler metal approved for welding position vertical welding (ISO 6947 position PG). A 45° upward angle of the welding gun is recommended for the weld passes.



5 Measuring

Measure 10 mm into the frame depth on the front and back side in accordance with the table after welding. The measurements are to be made with a frame or sleeve temperature below 50°C. Make sure not to tilt the caliper while measuring.



Frame dimensions		
Size	H (mm)	W (mm)
1	100-102	59-61
2	100-102	119-121
3	159-161	59-61
4	159-161	119-121
5	217-219	59-61
6	217-219	119-121
7	277-279	59-61
8	277-279	119-121

Sleeve dimensions	
Size	ØD (mm)
25	25-26
31	31-32
43	43-45
50	50-52
68	68-70
70	70-72
75	75-77
100	100-102
125	125-127
150	150-152
175	175-177

Sleeve dimensions	
Size	ØD (mm)
200	200-202
225	225-228
250	250-253
300	300-303
350	350-353
400	400-404
450	450-454
500	500-504
550	550-554
600	600-604
644	644-648

Note:

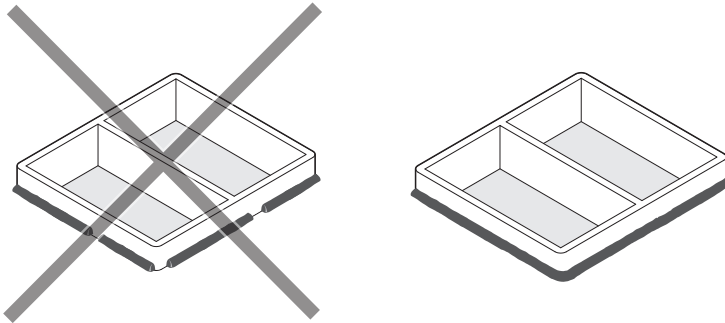
A frame exceeding tolerance might not reach the full pressure withstand performance without additional compensation modules. Contact Roxtec for consultation.

6 Caution!

Even though the guideline is an help to make safe welds, it is important to be aware of potential errors that can lead to system failure. Below sections are examples of errors that can occur during welding.

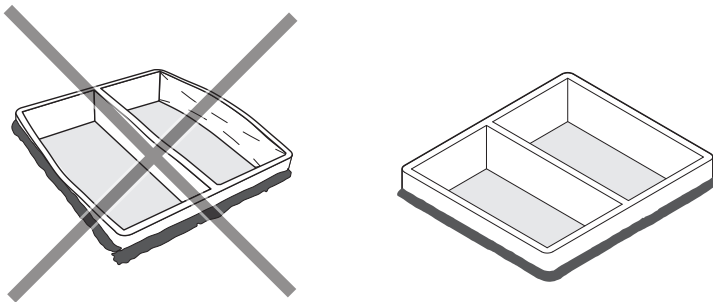
6.1 Intermittent welds

Make sure to overlap weld seams.



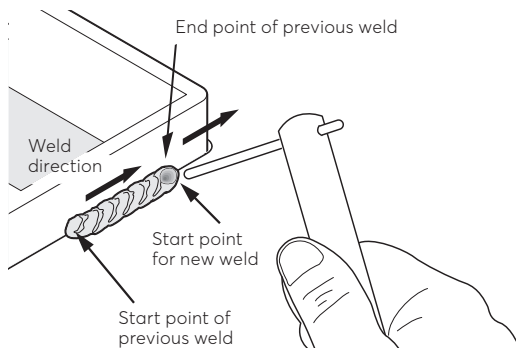
6.2 Exceeding the recommended weld size

Excessive welding or too large heat input can cause the frame to deflect and thereby increase the packing space, lowering the compression in the sealing system.



6.3 Weld pass

Start a new weld seam from an end point of a previous weld.



Disclaimer

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