

Welding Guidelines for Sandvik 2RE10

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1. Introduction

Sandvik 2RE10 is a fully austenitic stainless steel characterised by excellent resistance to corrosion in nitric acid. Due to high chromium content and low carbon content this alloy exhibits excellent resistance to intergranular corrosion.

2RE10 has good weldability. Suitable welding methods are manual metal arc welding (MMA/SMAW), tungsten inert gas welding (TIG/GTAW), metal inert gas welding (MIG/GMAW) and submerged-arc welding (SAW) with wire. In joint welding matching filler metals are recommended in order to obtain a weld metal with optimum corrosion resistance and mechanical properties. The welding consumables are designated Sandvik 25.20.L.

Sandvik 25.20.L and 2RE10 have fully austenitic weld metal and HAZ. 2RE10 as well as 25.20.L filler material have an austenitic solidification mode, which imply that the material is more prone to solidification cracking than standard austenitic grades such as 304L and 316L. Therefore excessive heat input should be avoided.

In common with most austenitic stainless steels 2RE10 has high thermal expansion and low thermal conductivity. Welding must therefore be carried out with thoroughly prepared welding plans in order to minimise weld distortion.

The structural stability of 2RE10 is good. However, the thermal cycle during welding must be kept under close control for optimum properties in the weld.

2. Welding consumables

Sandvik welding consumables for 2RE10 have a matching composition to the base material and are designed to give optimum properties of the weld metal.

Table 1. Welding consumables for 2RE10

Welding process	Filler metal	Product	Dimension range Ø (mm)
TIG/GTAW	Sandvik 25.20.L	Welding rod	1,6 – 3,2
MIG/GMAW	Sandvik 25.20.L	Wire electrode	0,8 – 1,6
MMA/SMAW	Sandvik 25.20.LR	Covered electrode	2,0 – 4,0
SAW	Sandvik 25.20.L	Wire electrode	2,0 – 4,0

For SAW Sandvik flux 15W is recommended

3. Overlay welding

Overlay welding is not very common with this grade. If overlay welding is needed for 2RE10 applications Sandvik 25.22.2.LMn filler is recommended with the following welding processes:

- Electro-slag welding with strip electrodes (ESW) using Sandvik 25.22.2.LMn and flux 37S or 47S.
- Submerged-arc welding with strip electrodes (SAW) using Sandvik 25.22.2.LMn
- Shielded metal arc welding with covered electrodes (MMA/SMAW) using Sandvik 25.22.2.LMnB.
- TIG/GTAW welding using 25.22.2.LMn.

Sandvik 25.22.2.LMn gives a weld deposit with corrosion resistance at least at the same level as that of 2RE10. Overlay welding of Sandvik 25.22.2.LMn can be performed directly on carbon steel. In order to counteract the effects of dilution from the base metal and thus achieve good weld metal properties, it is important to ensure that sufficient number of layers of 25.22.2.L are applied.

Sandvik 25.22.2.LMn can also be used for joint welding of 2RE10.

4. Joint welding

A proper joint design is important to obtain a good weld quality of the welded joint. TIG/GTAW is generally the preferred method and it is strongly recommended for root passes. Out of position welding is preferably performed with TIG/GTAW or MMA/SMAW. The risk of hot cracking should be considered especially when welding with SAW and MIG/GMAW.

Excessive heat input, weaving and large weld pools should be avoided to minimise the risk of hot cracking. For covered electrodes a maximum diameter of 2.5mm is recommended when welding tube and pipe wall thickness up to 6mm. For larger wall thickness, maximum 3.25mm diameter electrodes are recommended. A stringer bead technique should be used. For plate welding in gauges above 6mm also 4.0mm diameter can be used.

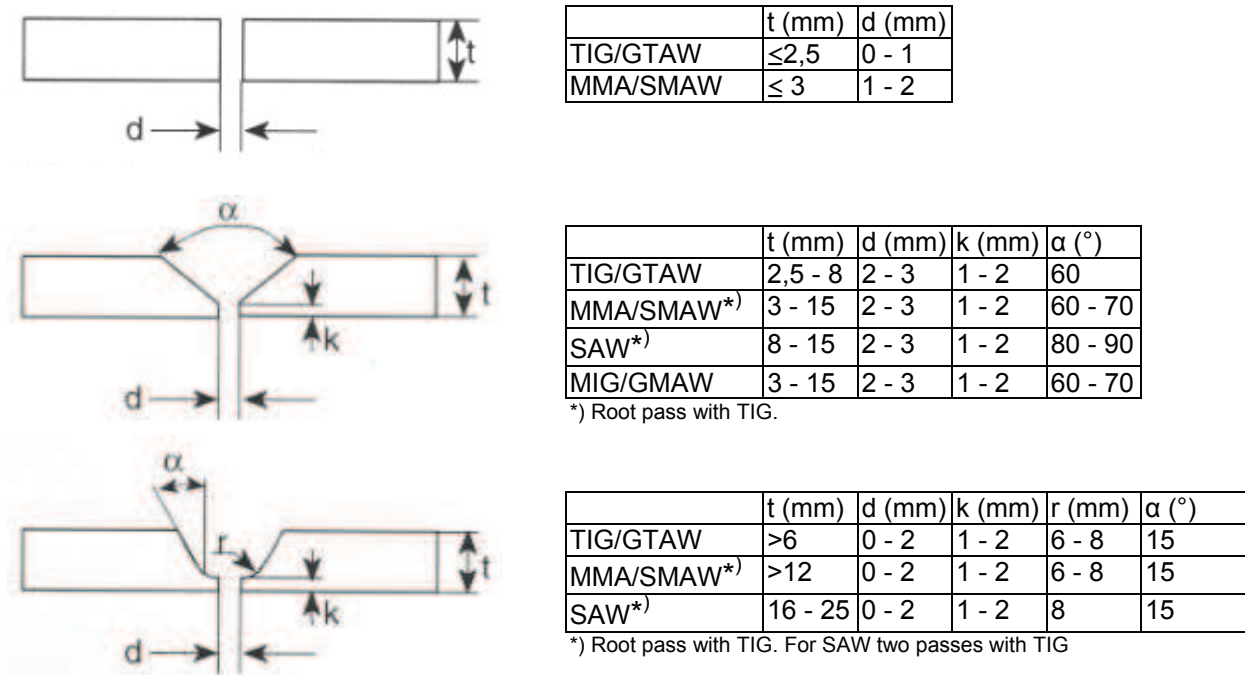


Figure 1. Joint preparation single sided welding.

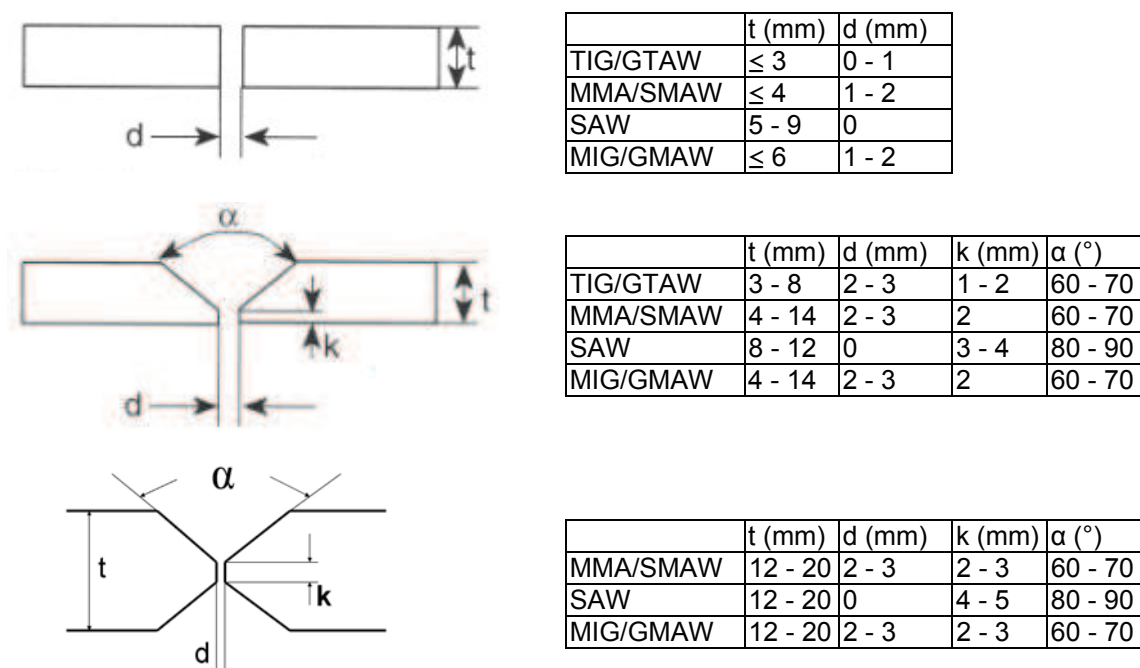


Figure 2. Joint preparation, welding from both sides. Root grinding before welding of backside.

5. Tube to tube sheet welding

TIG/GTAW is recommended for tube to tube sheet welding. Both manual and mechanised TIG welding can be used. The most common types of joint design can be used.

6. Welding settings

Table 2. Welding data for MMA.

Covered electrodes	Diameter (mm)	Current (A)	Voltage (V)
25.20.LR	2,0	40 – 60	20 – 23
	2,5	60 – 90	21 – 24
	3,25	85 – 125	21 – 24
	4,0	115 – 165	23 – 27

Table 3. Welding data for TIG.

Wire/rod	Diameter (mm)	Current (A)	Voltage (V)	Shielding gas	Gas flow (l/min)	Root gas
25.20.L	0,8	40-150	9-12	Ar	6-10	Ar or N ₂ + 10%H ₂
	1,2	100-180	9-12	Ar	8-12	Ar or N ₂ + 10%H ₂
	1,6	150-350	9-14	Ar	8-12	Ar or N ₂ + 10%H ₂
	2,0	160-370	9-15	Ar	10-12	Ar or N ₂ + 10%H ₂
	2,4	170-400	9-15	Ar	10-12	Ar or N ₂ + 10%H ₂

Table 3. Welding data for MIG – short arc

Wire	Diameter	Current (A)	Voltage (V)	Shielding gas	Gas flow
25.20.L	0,8	70-140	16-25	Ar or Ar + 30%He + 1-2%O ₂ or Ar + 1-2%O ₂	15
	1,0	80-160	13-25	Ar or Ar + 30%He + 1-2%O ₂ or Ar + 1-2%O ₂	15

Table 3. Welding data for MIG – spray arc

Wire/rod	Diameter	Current (A)	Voltage (V)	Shielding gas	Gas flow
25.20.L	1,0	150-230	24-31	Ar or Ar + 1-2%O ₂	22
	1,2	170-280	25-32	Ar or Ar + 1-2%O ₂	22
	1,6	250-370	29-33	Ar or Ar + 1-2%O ₂	22

Table 4. Welding data for ESW. Recommended welding flux: Sandvik 37S or 47S.

Strip electrode	Diameter (mm)	Current (A)	Voltage (V)	Welding speed (mm/min)
25.22.2.LMn	30 x 0,5	500-700	24-26	120-170
	60 x 0,5	1000-1250	24-26	120-200

Table 5. Welding data for SAW with wire. Recommended flux: Sandvik 15W.

Wire electrode	Diameter (mm)	Current (A)	Voltage (V)	Welding speed (mm/min)
25.20.L	2,0	200-300	28-32	300-600
	2,4	250-400	28-32	300-600
	3,2	300-450	29-34	250-600
	4,0	350-500	30-35	250-600

7. Thermal limitations

In order to minimise the risk of hot cracking in fully austenitic stainless steels it is essential to control the heat input during welding.

Table 5. Heat control

Factor	Limit	Remarks
Preheat	Not applicable	-
Interpass temperature	<100°C	-
Heat input	Q<1,0kJ/mm	Not applicable for ESW

8. Post weld cleaning

Post weld cleaning can be done mechanically by stainless steel brush, Scotch Brite grinding wheel (or similar), pickling with Sandvik pickling paste or by combining mechanical cleaning and pickling. A combination of mechanical cleaning and pickling generally gives the best result from a corrosion point of view.

9. Post weld heat treatment – PWHT

Post weld heat treatment of 2RE10 is normally not necessary. In case heat treatment is needed from construction point of view, a temperature of 1000-1100°C is recommended for 5-20min holding time. Rapid cooling in air or water is needed.

10. Dissimilar welding

Sandvik 2RE10 can readily be welded to various low alloyed steels and stainless steels. For welding to low alloyed grades Sandvik 24.13.LHF can be used as filler. For welding to other austenitic stainless steels Sandvik 25.20.L can be used. For welding to nickel base alloys the following fillers can be used: Sanicro 72HP wire, Sanicro 68HP wire, Sanicro 71 covered electrode or Sanicro 69 covered electrode.