Welder Guide Book

ALL-POSITIONAL RUTILE FLUX CORED WIRES FOR NON AND LOW ALLOYED STEELS

Contents

Product	**AWS A5.20**	**Shielding Gas**	
Dual Shield 710X	E71T-1C-DH8/T-1M / T-9C-DH8/T-9M	CO_2	
Dual Shield 710 X-M	E71T-1C/T-1M-DH8 / T-9C-T-9M-DH8		75% Ar / 25% CO_2
Dual Shield II 711X	E71T-1C-JH8 / T-12C-JH8	CO_2	
Dual Shield II 712X	E71T-1M-JH8 / T-12M-JH8		75% Ar / 25% CO_2
Dual Shield 7100 Ultra	E71T-1C-DH8 / T-1M-DH8 T-9C-DH8 / T-9M-DH8	CO_2	75% Ar / 25% CO_2
Dual Shield II 70 Ultra	E71T-1M / T-9M / T-12M		75% Ar / 25% CO_2
Dual Shield II 71 Ultra	E71T-1C-J / T9CJ / T-12C-J	CO_2	
Dual Shield II 70T-12H4	E71T-1M-JH4 / T-9M-JH4 / T-12M-JH4		75% Ar / 25% CO_2
Product	**AWS A5.29**		
Dual Shield II 80-Ni1H4	E81T1-Ni1M-JH4		75% Ar / 25% CO_2
Dual Shield 810X-Ni1	E81T1-Ni1C-H8	CO_2	
Dual Shield 8000-Ni2	E81T1-Ni2C / T1-Ni2M	CO_2	75% Ar / 25% CO_2
Dual Shield 8000-B2	E81T1-B2C / T1-B2M	CO_2	75% Ar / 25% CO_2
Dual Shield II 101-TC	E91T1-K2C	CO_2	
Dual Shield II 101H4M	E91T1-GM-H4		75% Ar / 25% CO_2
Dual Shield 9000-C1	E91T1-Ni2C / T1-Ni2M	CO_2	75% Ar / 25% CO_2
Dual Shield 9000-D1	E91T1-D1C / T1-D1M	CO_2	75% Ar / 25% CO_2
Dual Shield 9000-M	E91T1-K2C / T1-K2M	CO_2	75% Ar / 25% CO_2

Introduction

This guide provides practical information on the use of the ESAB all-positional rutile flux cored wires listed below. When correctly applied, these wires provide:

- Excellent weldability with spray arc droplet transfer in all welding positions.
- Good weld appearance with smooth weld metal wetting.
- High productivity, especially in vertical-up position.
- Defect free welds with good mechanical properties.
- Low-hydrogen weld metal.

Before you start welding

In order to fully benefit from the excellent weldability of ESAB all-positional rutile flux cored wires, the welding equipment needs to be maintained in good condition. The following checklist serves as a guide.

CHECKLIST

Contact tips and gas nozzle

✓ Remove spatter and replace worn or damaged contact tip.

Correct Incorrect

✓ Grind the end of the liner conically for optimal fitting of the contact tip (ESAB M8).

Contact tip size, liner size and wire diameter

✓ Ensure that the contact tip is the correct size and fits tightly.

✓ Ensure the gas nozzle is free from spatter.

Shown with gas diffuser.

Liner

- ✓ Spiral steel liners are recommended.
- ✓ Ensure that the liner has the correct inner diameter for the wire size being used.
- ✓ Check liners regularly for kinks and excessive wear and replace when needed
- ✓ Clean liners regularly using compressed air.

Note: Remove contact tip prior to cleaning.

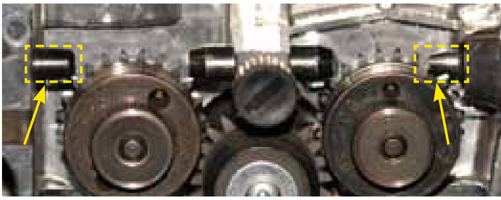
Gas and water

- ✓ Check gas and water connections for leaks.
- ✓ Check if water cooler is filled and pump operates properly.

Note: If equipped with water cooled torch.

Wire feed unit

- ✓ Position wire guide tubes as close as possible to the rollers to prevent kinking of the wire.
- ✓ A substantial amount of fine metallic shavings underneath the drive rolls indicates misalignment or excessive drive roll pressure.



Correct

Incorrect

Before you start welding

- ✓ Use v-groove drive rolls for solid wires.
- ✓ Use knurled drive rolls for flux cored and most metal cored wires. Knurled drive rolls typically increase wear on contact tip and liner assemblies and will likely need to be replaced more often.
- ✓ Check that the groove size is correct for the wire diameter.
- ✓ Apply the correct pressure on feed rolls. Too much pressure flattens the wire, resulting in feedings problems and higher liner and contact tip wear. Insufficient pressure may cause wire to slip in the feed rolls, resulting in irregular feeding and possible wire burnback.
- ✓ Check that the wire is feeding correctly from the contact tip.

Smooth v-groove　　Knurled v-groove

Shielding gas

✓ Check that the appropriate gas is used (page 3). Adjust gas flow rate between 30 and 40 cfh (15 and 20 l/min).

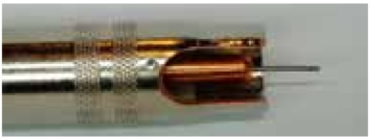
✓ Use 40 cfh (20 l/min) when welding outside.

✓ Check that the gas flow from the gas nozzle is at the recommended rate.

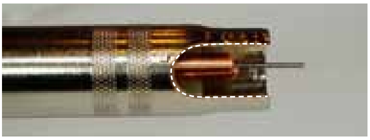
✓ Check the gas flow rate again if the gas nozzle diameter is changed.

R-33 FM580 regulator flowmeter

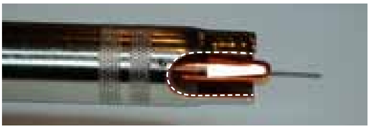
Contact tip and gas nozzle



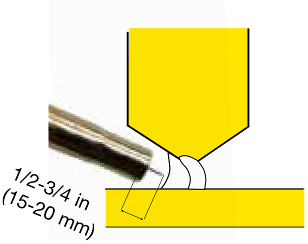
Correct positioning of contact tip.



Incorrect. Contact tip too recessed.



Incorrect. Contact tip protruding beyond gas nozzle.



Ideal stick-out for wire diameters .045 and .052 in (1.2 and 1.4mm) 3/4 - 1 in for ø 1/16 in (20-25mm for ø 1.6mm).

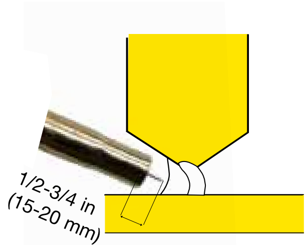
It is essential to fit the gas nozzle and contact tip at the right distance relative to each other. The ideal distance of the contact tip is 5/64 in (2mm) recessed. A longer distance will force the welder to use too long of a stick-out, resulting in poor weldability. This may lead to lack of fusion and slag entrapment, particularly in narrow joints. Contact tips protruding beyond the gas nozzle can result in insufficient gas shielding.

Correct stick-out length
The stick-out is the distance between the contact tip and workpiece and must be kept between 1/2 to 3/4 in (15 to 20mm) for .045 and .052 in diameters (ø1.2 and 1.4mm). Excessive stick-out results in too short of an arc length, larger droplets, unstable arc, and splatter which causes poor weldability.

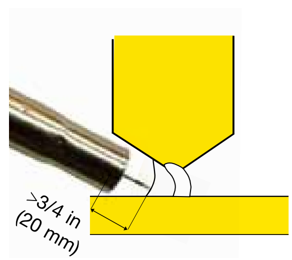
If the stick-out is too short, the current will increase and possibly cause undercut.

Gas nozzle diameter

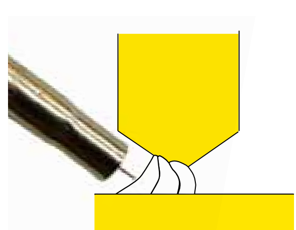
Various nozzle diameters must be available to allow satisfactory access to the joint, to maintain the above recommended stick-out, and to ensure proper shielding gas protection. Small diameter gas nozzles are used for the first layers only. Revert to the standard gas nozzle diameter when access to the weld joint allows this, so full gas protection can be assured.



Correct. Use a smaller diameter nozzle or a conical nozzle for the 1st layers in the root area.



Incorrect. Use of standard gas nozzle restricts access to narrow joints, resulting in too long a stick-out



Correct. Use of standard gas nozzle for completing the joint ensures good gas protection and correct stick-out.

Polarity and inductance

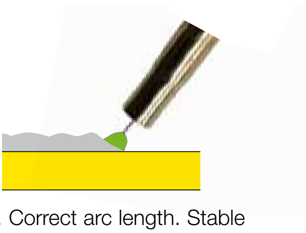
Always use DCEP (DC electrode positive) polarity for ESAB all-positional rutile flux cored wires.

DC ELECTRODE POSITIVE
ESAB all-positional rutile flux cored wires operate in the spray arc mode at all welding currents, so no inductance is needed. Switch off the inductance or select minimum setting if the inductance can not be disconnected.

Correct. Minimum inductance setting selected.

Welding parameter setting

A given welding current requires a specific arc voltage for optimum weldability. The welding current is set by adjusting the wire feed speed control. The arc voltage is regulated by the voltage setting of the power source. Pages 16 and 17 give average parameters for various wire diameters and welding positions.



Correct. Correct arc length. Stable and concentrated arc with a quiet spray droplet transfer.

Achieving the optimum setting
For the following procedure, it is vitally important to keep the stick-out constant within the correct range for each welding position

- From the range given in the table on pages 16 and 17, select a welding current (I) which suits your application.

- Start welding with the lowest voltage value from the given range. This may result in stubbing, however wire burnback will be avoided.

Incorrect. Arc length too short. Wire dips into weld pool (stubbing) caused by too low an arc voltage, too high a wire speed or too long a stick-out.

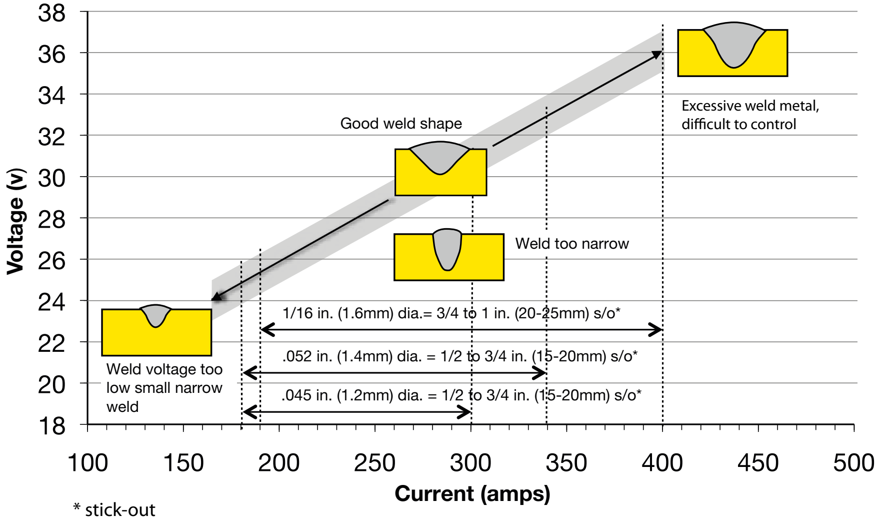
Incorrect. Arc length too long. Arc becomes too wide, giving insufficient penetration and a risk of slag traps. Also a risk of burnback to the contact tip. This may be caused by the arc voltage being too high, the wire feed speed too low or the stick-out being too short.

- Increase the arc voltage in steps of 1 or 2V, until the arc becomes stable, smooth and spatter free, with a slightly crackling sound. Ensure the correct stick-out length is maintained.

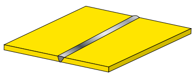
- If a different current is required, i.e change of welding position, the procedure described on the previous page needs to be repeated.

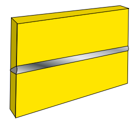
- The table on pages 16 and 17 gives settings for 75% Ar/25% CO_2 mixed gas. The arc voltage needs to be increased by 1-2V when CO_2 shielding gas is being used. Note that the CO_2 arc is not as smooth, with a more globular droplet transfer and more spatter.

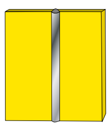
NOTE: As mentioned, stick-out control is very important. If the recommended stick-out length is not maintained constant, weldability will fluctuate. Shortening the stick-out will result in an increasing current and a longer arc. Lengthening the stick-out will result in a lower current and the arc being too short.

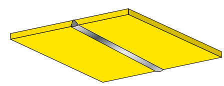


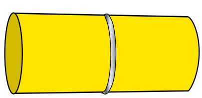
ASME and EN ISO positions

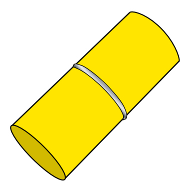

1G/PA

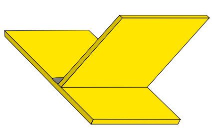

2G/PC

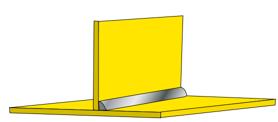

3G/PF&PG

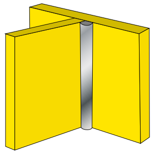

4G/PE

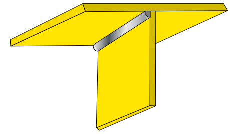

5G/PF&PG


6G/HL045


1F/PA


2F/PB


3F/PF&PG


4F/PD

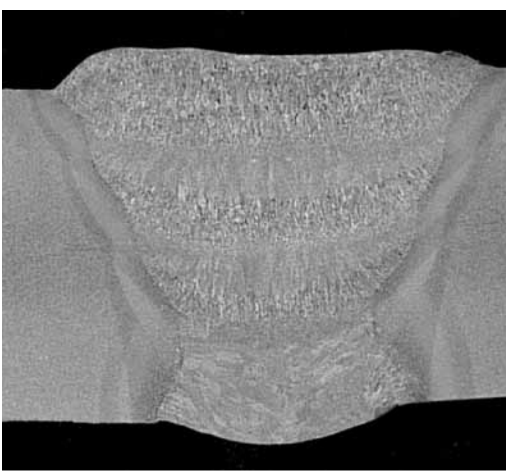
Choice of wire size

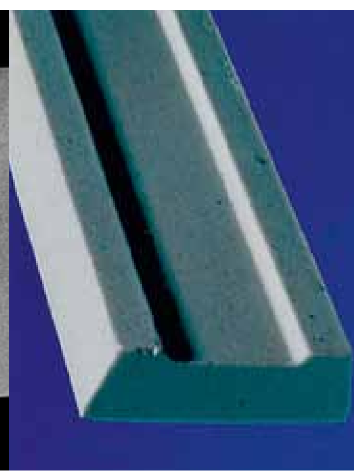
The diameter range of ESAB all-positional rutile flux cored wires is .045-1/16 in (1.2-1.6mm), allowing optimal productivity for various combinations of plate thicknesses and welding positions. Diameter .052 in (1.4mm) provides a useful compromise between productivity and the use of a single diameter wire for all welding positions. The table on page 15 shows suitable recommendations for each diameter.

Vertical down welding is not recommended, particularly on thicker plate material > 3/16 in (5mm), because of the risk of lack of fusion.

Single-sided root pass welding

All-positional rutile flux cored wires are not suited for welding single-sided open root passes. In many applications, however, high quality single-sided root passes in V-joints can be produced very economically on ceramic backing materials. Always use ceramic backing with a rectangular groove.





PF/3G butt weld in 3/4 in (18mm) plate.

Root pass on ceramic backing.

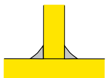
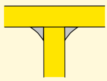
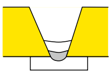
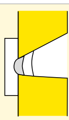
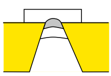
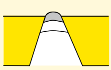
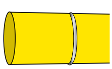
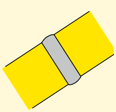
	Position	Ø .045 in (1.2mm)	Ø .052 in (1.4mm)	Ø 0.62 in (1.6mm)
		Suitability for a typical application		
–	1F/PA	yes[2]	yes	yes
–	2F/PB	yes[2]	yes	yes
–	3F↑/PF	yes	yes	yes
–	4F/PD	yes	yes	yes
Root	1G/PA	on backing[1]	on backing[1]	not recommended
Fill	1G/PA	yes[2]	yes	yes
Root	2G/PC	on backing	on backing	not recommended
Fill	2G/PC	yes	yes	yes
Root	3G/PF	on backing	on backing[3]	not recommended
Fill	3G/PF	yes	yes	possible[3]
Root	4G/PE	no	no	no
Fill	4G/PE	yes	yes[3]	not recommended
Root	5G/PF	no	no	no
Fill	5G/PF	yes	yes[3]	not recommended
Root	6G/PF	no	no	no
Fill	6G/PF	yes	yes	not recommended

1 *One-sided root pass on ceramic backing, V-joint. Centerline cracking may occur at welding currents over 200A, see page 31.*

2 *.052 and .062 in (1.4 and 1.6mm) sizes will improve productivity.*

3 *.045 in (1.2mm) size is preferred.*

Recommended parameter settings

Position		.045 in (1.2mm) wire diameter ½ - ¾ in (15 - 20 mm) stick-out			
		Current (A)	WFS (ipm)	WFS (m/min)	Volts*
1F/2F 		180-300	240-550	6.0-14.0	24-31
3F/4F 		180-250	240-400	6.0-10.0	23-28
1G 	Root** Fill	180-200 180-280	240-320 240-470	6.0-8.0 6.0-12.0	23-26 25-31
2G 	Root** Fill	180-210 180-260	240-330 240-400	6.0-8.5 6.0-10.0	23-26 25-29
3G 	Root** Fill	180-220 180-240	240-330 240-350	6.0-8.5 6.0-9.0	23-27 24-28
4G 	Root Fill	no 180-260	 240-400	 6.0-10.0	 24-28
5G 	Root Fill	no 180-240	 240-350	 6.0-9.0	 24-28
6G 	Root Fill	no 180-240	 240-350	 6.0-9.0	 24-28

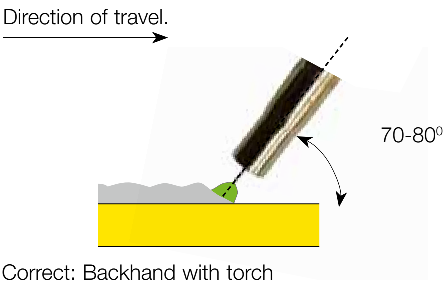
* Arc voltage valid for 75% Ar/25%CO_2 mixed gas. Increase arc voltage 1-2V for CO_2.
** On ceramic backing.
***Not recommended.

.052 in (1.4 mm) wire diameter ½ - ¾ in (15 - 20 mm) stick-out				1/16 in (1.6 mm) wire diameter ¾ - 1 in (20 - 25 mm) stick-out			
Current (A)	WFS (ipm)	WFS (m/min)	Volts*	Current (A)	WFS (ipm)	WFS (m/min)	Volts*
190-340	180-420	4.5-10.5	24-32	200-400	155-420	4.0-10.5	25-35
190-240	180-240	4.5-6.0	24-28	3F: 220-250 4F: 200-250	200-230 155-230	5.0-5.8 4.0-5.8	24-28 25-29
*** 190-340	175-420	4.4-10.5	24-32	*** 210-400	180-420	4.5-10.5	25-35
180-210 190-300	155-200 175-340	4.0-5.0 4.4-8.5	23-27 24-32	190-220 210-320	145-200 180-320	3.7-5.0 4.5-8.0	25-28 25-33
180-210 190-240	155-220 175-245	4.0-5.5 4.4-6.2	23-27 24-29	*** 220-250	200-240	5.0-6.0	24-28
*** 190-240	180-240	4.5-6.0	24-28	***			
*** 190-240	180-240	4.5-6.0	24-28	***			
*** 190-240	180-240	4.5-6.0	24-28	***			

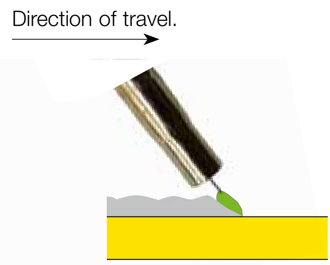
Direction of travel

To ensure good penetration and to prevent slag running ahead of the weld pool:

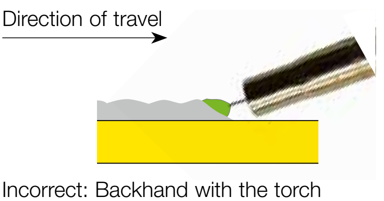
Always weld with a backhand angle.
A forehand weld can deliver a reasonable appearance, but penetration is often poor. There is also a chance of slag running ahead of the weld pool, causing slag traps and lack of fusion. The same is valid for backhand when the torch angle is too small.



Correct: Backhand with torch angle at 70-80°.



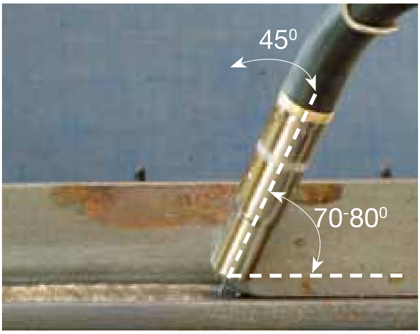
Incorrect: Forehand welding.



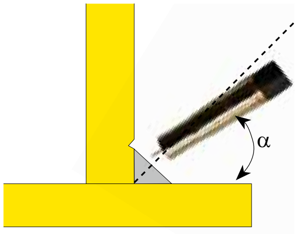
Incorrect: Backhand with the torch angle too small.

Welding positions

The following are typical situations where the correct torch position plays an important role in avoiding weld defects.

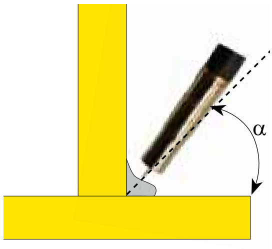


2F/PB - horizontal-vertical fillet
The photo shows the ideal torch position, using the recommended backhand technique. Still, undercut and sagging faults can occur in this position. The possible causes of these faults are listed below.



Undercut:

- Welding current too high.
- Arc voltage too high.
- Travel speed too fast.
- Arc positioned too close to the vertical plate.
- Torch angle (α) too small.
- Stickout too long.



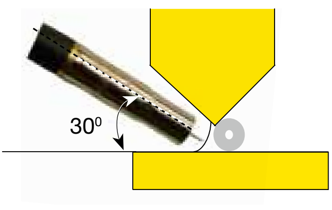
Sagging:

- Welding current too high.
- Arc voltage too high.
- Torch angle (α) too large.
- Layer too thick.
- Travel speed too slow.
- Stickout too short.

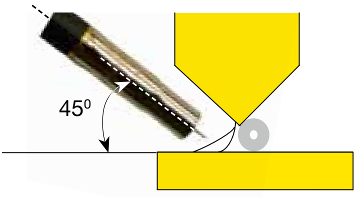
2G/PC - horizontal-vertical

The correct torch position will depend on plate thickness and joint angle. If the torch positions shown cannot be used, it is recommended that the joint angle or root gap is increased.

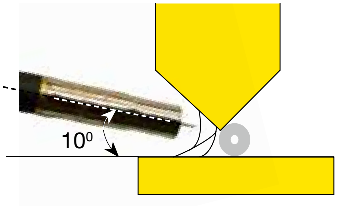
Always maintain the torch angle of 70-80° relative to the weld bead and direction of travel as advised on page 18. Maintain a steady travel speed to achieve a regular bead thickness without sagging.



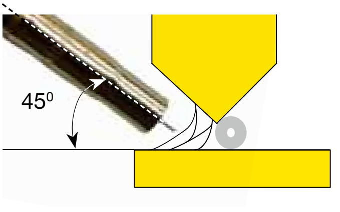
A. Root pass welded on round ceramic. Avoid beads that are too thick.



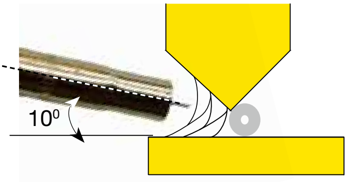
B. 2nd pass positioned towards horizontal plate.



C. 3rd pass completes 2nd layer.



D. 4th pass creates a favorable platform for the following passes.



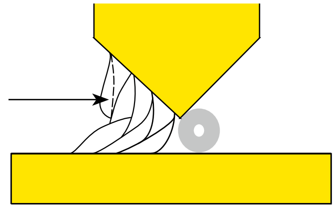
E. 5th pass. Note how layers are always built-up from the bottom side as weld thickness increases.

Avoid sagging

Sagging (rollover) is typically caused by:

- Travel speed too slow.
- Incorrect torch angle.
- Welding current too high.
- Wrong weld bead sequence.

Sagging requires grinding to avoid defects when welding subsequent passes.

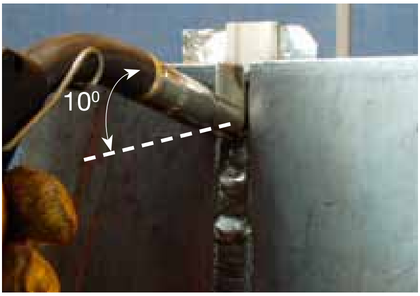


Avoid sagging but if it occurs then grind back to dotted line as shown above.

3G↑/3F↑/PF - vertical up

ESAB all-positional rutile flux cored wires can weld a 3/16 in (4mm) throat fillet weld at welding speeds up to 7 ipm (18cm/min) without weaving.

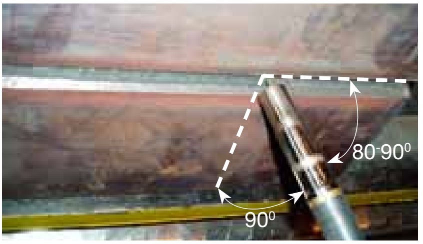
For butt welding in the vertical up position, root passes are deposited onto ceramic backing materials with a rectangular groove. The joint angle must allow good access to the root area. If access is restricted then use a narrower gas nozzle.



Root pass

Fill pass(es)

4G/PE 4F/PD - overhead
Use a stick electrode for the root pass and fill with ESAB all-positional rutile flux cored wires. Photo right gives the ideal torch positioning.



Vertical up welding techniques

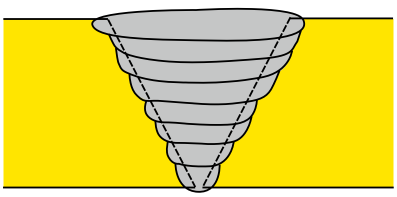
Full width weaving

Full width weaving is commonly practiced with ESAB all-positional rutile flux cored wires. However, care must be taken to ensure that the heat input is not excessive, otherwise weld metal impact properties may deteriorate.

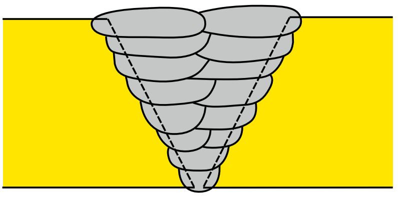
The weaving technique involves crossing the joint from edge to edge in a straight line, while gradually moving upwards in the direction of travel.

Split weave and stringer beads.

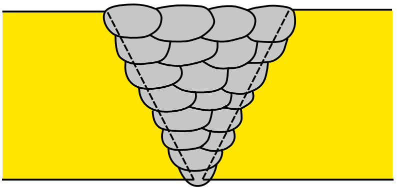
The split weave and stringer bead techniques should be used where optimal subzero weld metal toughness properties are required. (e.g. offshore fabrication)



Full width weaving: high heat input



Split weave: medium heat input
better toughness



Stringer beads: low heat input
best toughness

	Heat input
Full width weaving:	2.5-3.5 kJ/mm
Split weave:	1.5-2.5 kJ/mm
Stringer bead:	1.0-1.5 kJ/mm

Mechanized welding

Mechanized welding is a great way to fully benefit from the productivity of ESAB all positional rutile flux cored wires. It allows higher welding currents and travel speeds which are not manageable in manual welding, while monotonous work is avoided. The ESAB range of light mechanization equipment for MIG/MAG and FCAW consists of:

- ESAB Miggytrac for horizontal welds.
- ESAB Railtrac for horizontal and horizontal vertical welds.
- ESAB Railtrac orbital for circumferential joints

ESAB Miggytrac

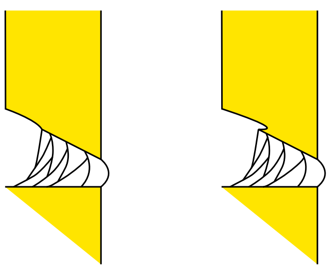
ESAB Railtrac

ESAB Railtrac Orbital for circumferential joints.

Grinding

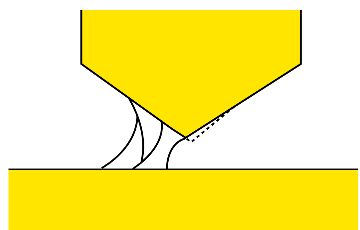
Grinding may be necessary to correct weld metal sagging or beads which are too convex. Remove only the most obvious irregularities and avoid making deep grooves. They can lead to slag traps and lack of fusion when welding subsequent passes.

Root pass treatment
When welding double-sided joints, ensure that grinding is done to remove the root pass from the first side to sound metals before welding the first pass on the second side.

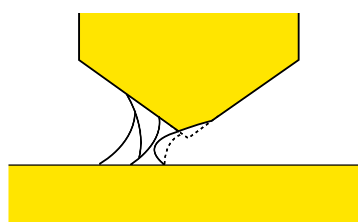


Correct Incorrect

Always grind stop-start areas.



Correct



Incorrect.
Grinding wheel pushed into root, resulting in a deep groove. The narrow joint is almost inaccessible to the torch.

Troubleshooting

Process faults

Although good equipment maintenance and good welder training will help prevent process faults, they can never be avoided completely. In such cases, understanding the most common causes will help the welder to solve any problems quickly. Listed below are the most common process faults and their likely causes.

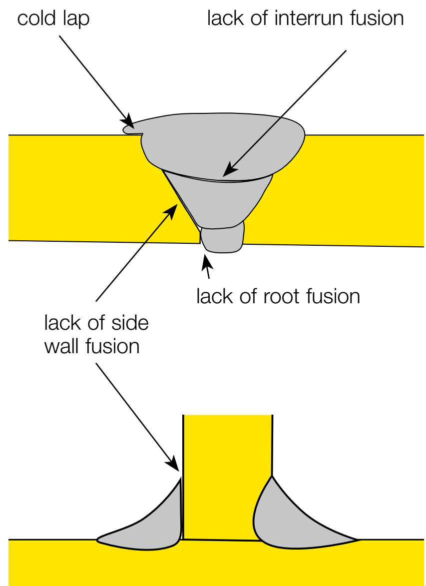
Process faults	Likely causes
1. wire stubbing	- incorrect parameters - Volts too low for wire feed speed or wire feed speed too high for volts
2. wire burn-back	- spool brake too tight - incorrect parameter settings - damaged/worn contact tip - incorrect machine burn back setting - slipping in feed rolls
3. excess spatter	- incorrect parameter settings - wrong shielding gas - incorrect gas flow - erratic wire feed - damaged or worn contact tip
4. erratic wire feed	- roll pressure too low, causing wire slippage - roll pressure too high, deforming the wire - worn drive rolls - misalignment of rolls or guide tubes - damaged or worn liner - incorrect liner type/diameter - incorrect contact tip size - damaged or worn contact tip - spool brake too tight - spool brake too loose (tangled wire)
5. unstable arc	- incorrect parameters - erratic wire feeding - incorrect gas flow - magnetic arc blow, due to poor work cable

Troubleshooting

Weld defects

Lack of fusion defects

There are several types of lack of fusion defects, but all share the same feature in that deposited weld metal has not fused with the parent metal or previously deposited weld metal. Typical forms of lack of fusion are shown in a V-butt weld. They can also occur in other types of butt joints. Also shown is a typical side wall defect in a fillet weld.



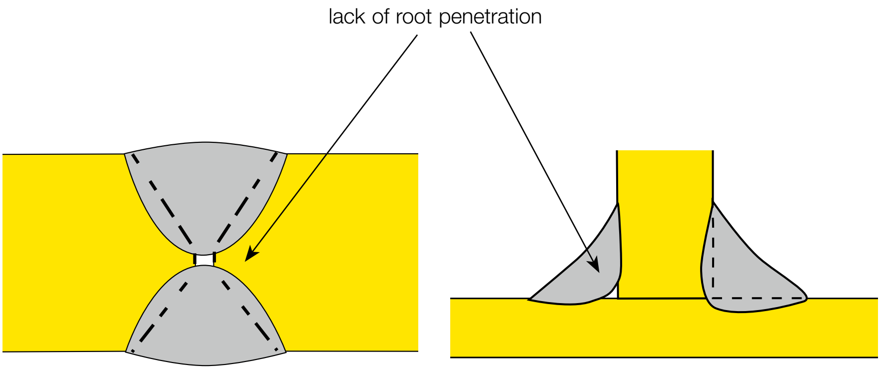
Lack of fusion defects

Possible causes	Remedies
General	
- travel speed too high	- reduce travel speed/allow more dwell time at edges
- wrong parameter setting	- adjust parameters
- forehand technique	- backhand technique, 70-80° torch angle.
Lack of root fusion*	- enlarge root gap
Fillet: lack of fusion at standing leg	
- Torch directed too much towards horizontal leg	- change torch orientation

**use of ceramic backing is recommended for single-sided root pass welding, see page 14.*

Lack of penetration

This occurs when the weld metal fails to extend into the complete root area of a joint. Shown below are two typical cases.



Lack of penetration

Possible causes	Remedies
General	
- welding current too low	- increase wire feed speed and arc voltage
- arc voltage too high	- reduce arc voltage
- travel speed too high	- reduce travel speed
- travel speed too low	- Increase travel speed; avoid slag running ahead of weld pool; stay on front edge of puddle
- forehand technique	- use backhand technique
- torch angle too small	- use correct angle α relative to joint, see page 21; aim the arc at the leading edge of the pool
Butt welds - incorrect joint preparation	
- root gap too small	- increase gap - reduce face
- included joint angle too small	- increase angle

Troubleshooting

Porosity

Possible causes	Remedies
- draft/wind	- close doors or windows and check fans. Use shielding tents if outside
- paint, grease or dirt	- clean and dry plates in the weld area
- gas nozzle / diffuser clogged	- clean/replace
- gas nozzle / diffuser distorted	- replace
- gas nozzle / diffuser too small	- use larger gas nozzle
- gas flow too high	- adjust flow rate
- gas leaks in system	- check by blocking gas cup; aspirate air continued gas flow indicates leaks
- water leaks in cooled guns	- check connections
- gas cup to workpiece	- check positioning of contact tip distance too long relative to gas cup; readjust parameters
- gas flow too low	- adjust flow rate

Slag inclusions

Slag inclusions occur when molten slag is allowed to run ahead of the welding arc and gets trapped below the solidifying weld pool. All-positional rutile flux cored wires are prone to this, because of their fast freezing slag and their easy weldability.

The most likely welding positions for slag inclusions to occur are the 1G/PA and 2G/PC positions, particularly in joint preparations with a small included angle. It is important is to control the penetration.

To obtain sufficient penetration, welders must use the correct stick-out and arc length. If the arc voltage is too high and/or the stick-out length too short then penetration will be reduced. Also, travel speed has an important influence on penetration and must be fast enough to secure good penetration and to avoid slag running ahead of the weld pool (1G & 2G) and weld metal sagging (2G).

Slag inclusions

Possible causes	Remedies
- welding current too low	- increase welding current
- arc voltage too high	- reduce arc voltage
- travel speed too low	- increase travel speed; avoid slag running ahead of weld pool
- forehand technique	- use dragging technique
- torch angle too small	- use 70-90° torch angle; keep slag behind arc
- convex beads	- increase arc voltage or apply some weaving

Centerline cracking on ceramic backing

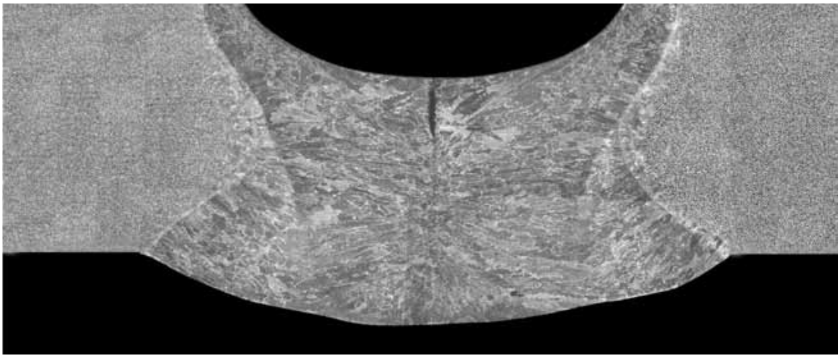
When welding root passes on ceramic backing strips, centerline cracking (hot cracks) may occur in 1G/PA position. If the current and voltage are too high, a concave bead shape may be formed which, combined with high shrinkage forces, can result in centerline cracking. To avoid centreline cracking, the following guidelines must be observed:

- Apply a joint angle of 50-60° and 1/16 to 3/16 in (4-5mm) root opening.

- Use ceramic backing with a rectangular groove. The groove width must be around 5/8 in (15mm).

- Use welding currents below 200A for .045 in (1.2mm) and a low enough arc voltage in order to obtain a flat or slightly convex bead profile.

- A bead depth to width ratio of 1/1 will help avoid centerline cracking.



Centerline crack. See page 14 for a correct root pass welded on ceramic backing.

Unrivaled service and support.

Every ESAB product is backed by our commitment to superior customer service and support. Our skilled customer service department is prepared to quickly answer any questions, address problems, and help with maintenance and upgrading of your machines. Our products are backed with the most comprehensive warranty in the business.

With ESAB, you can be sure that you purchased a machine that will meet your needs today and in the future. Product and process training is also available. Ask your ESAB sales representative or distributor for a complete ESAB solution.

NOTICE:
Test results described above were obtained under controlled laboratory conditions, and are not guarantees for use in the field. Actual use of the product may produce varying results due to conditions and welding techniques over which ESAB has no control, including but not limited to plate chemistry, weldment design, fabrication methods, wire size, welding procedure, service requirements ad the environment. The user should confirm by qualification testing, or other appropriate means, the suitability of any welding consumable and procedure before use in the intended application.

CAUTION:
Users should be thoroughly familiar with the safety precautions referenced in the product label for the relevant product and the Safety Data sheet for the product. Safety Data Sheets are available at esabna.com or by calling 800-ESAB-123.

STRENGTH THROUGH **COOPERATION**

GEN-26802 2/11

ESAB Welding & Cutting Products / **esabna.com** / **1.800.ESAB.123**

USA: P.O. Box 100545, 411 South Ebenezer Road, Florence, SC 29501-0545
Canada: 6010 Tomken Road, Mississauga, Ontario L5T-1X9
Mexico: Ave. Diego Díaz de Berlanga No. 130, Col. Nogalar
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