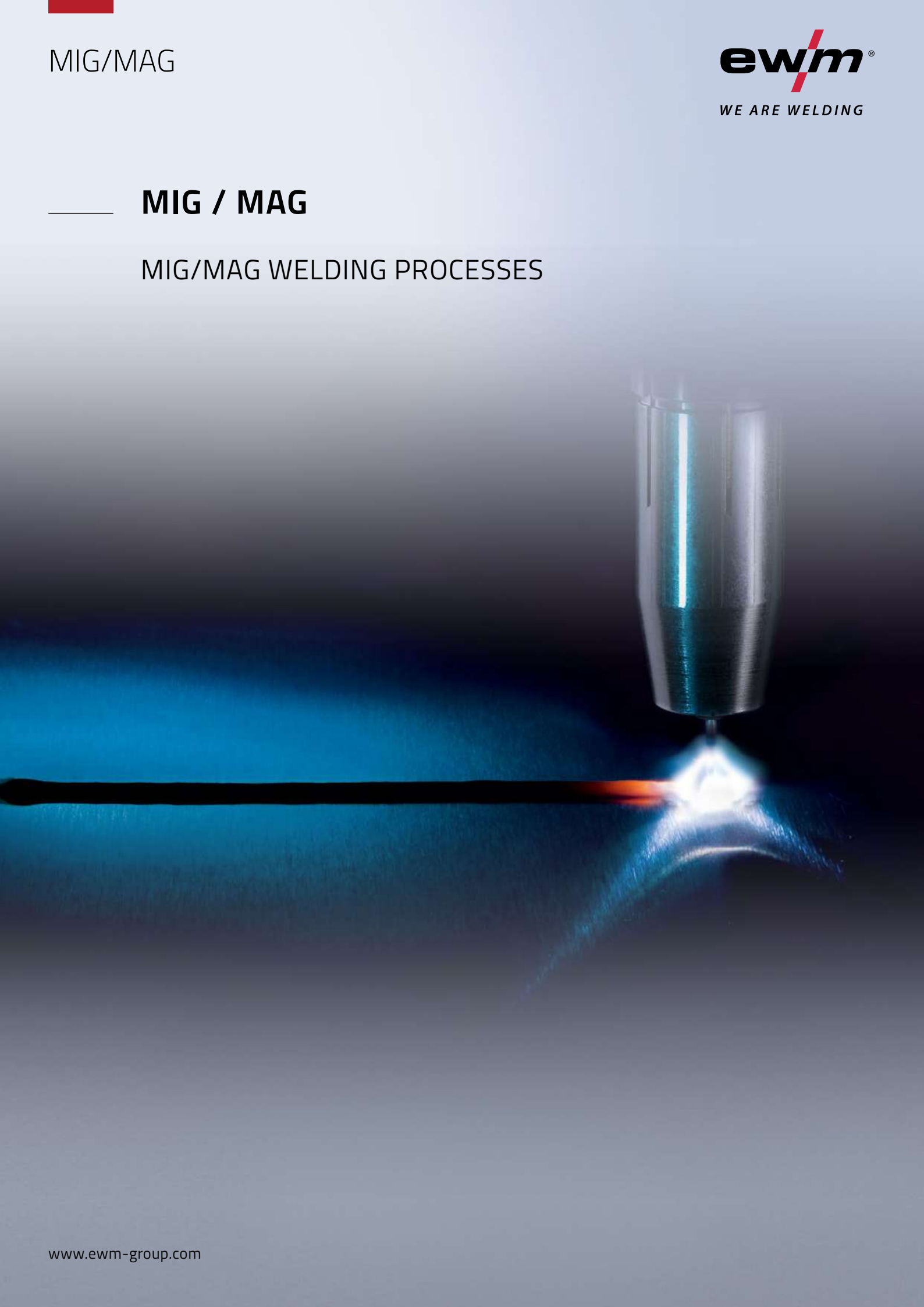
WE ARE WELDING

MIG / MAG

MIG/MAG WELDING PROCESSES



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- Welding aluminium and aluminium alloys — pulsed arc XQ
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f) Surfacing

- Cladding, hardfacing

2. Root welding of unalloyed and low-alloy steel

Welding process: rootArc® XQ

Advantages:

- Perfect gap bridging
- Excellent root formation and sidewall fusion
- High arc force for root welding in all positions
- High welding speed and deposition rate compared to TIG or MMA welding
- Low-spatter process
- Rapid digital control of the process, easy to guide and control
- Uses standard welding torches without additional wire movement
- Welding even with long hose packages without additional voltage measuring leads thanks to RCC power module (Rapid Current Control)
- For manual and mechanised applications
- Flat, smooth weld surface and virtually spatter-free process for reduced finishing work

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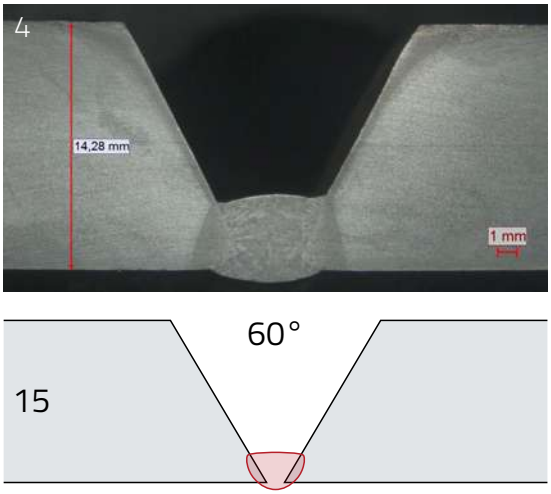
Root welding in PC position with air gap, without backing

Weld preparation of root welds on pipes, 60° included angle with 3 mm air gap

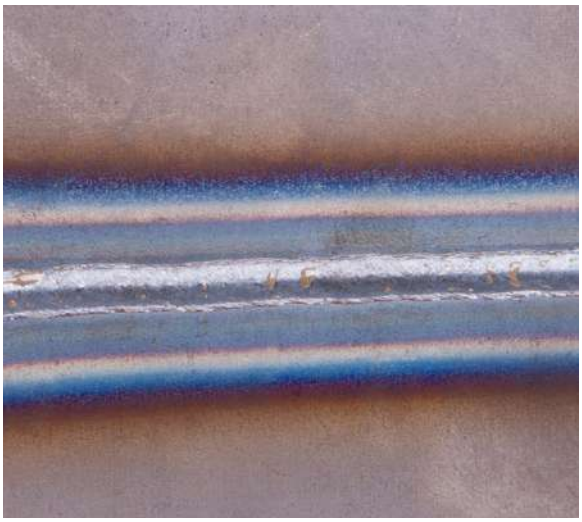
Root

Front view

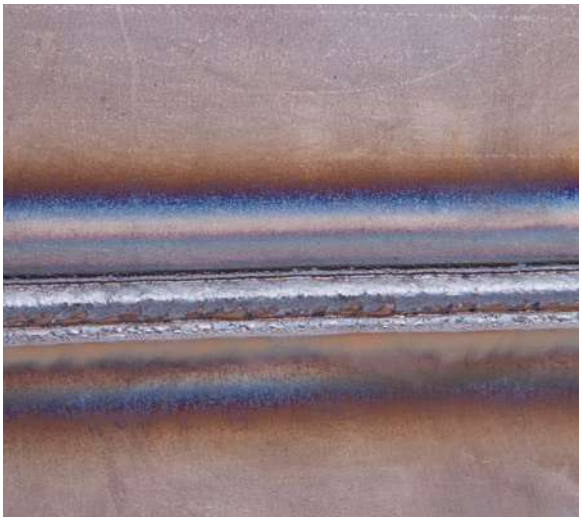


Pipe welding, wall thickness :15 mm, included angle: 60°

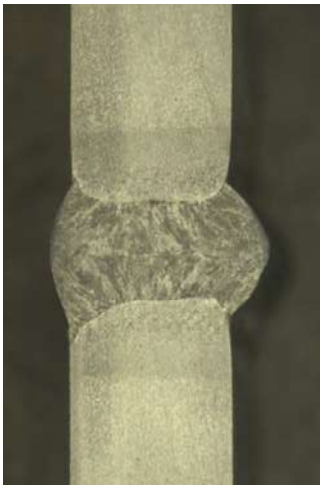
Root welding in PC position with air gap, without backing (t = 5 mm)

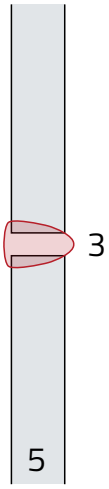


Front view



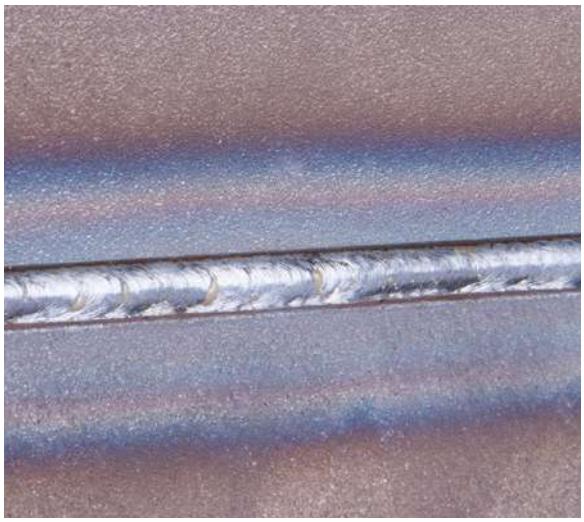
Root



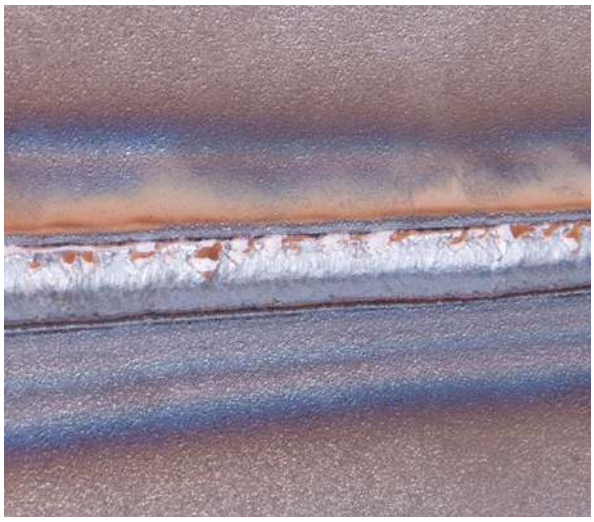


Material thickness: 5 mm
air gap: 3 mm

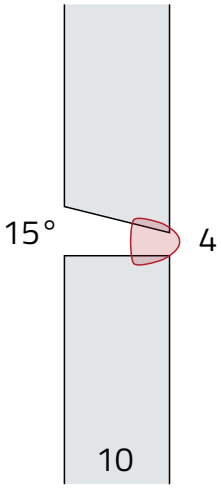
Root welding in PC position with air gap, without backing (t = 10 mm)



Front view



Root



Material thickness: 10 mm, one-sided bevel:
15 degrees, air gap: 4 mm

3. Welding filler passes and cover passes in unalloyed and low-alloy steel

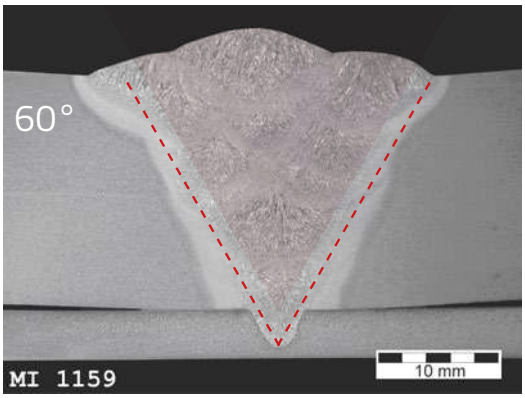
Welding process: forceArc puls® XQ

Advantages:

- Easy to learn, even for inexperienced welders, thanks to rapid digital control of the process, virtually spatter free, reduced undercuts
- Deep penetration for excellent root and sidewall fusion
- Modified, heat-reduced, directionally stable pulsed arc
- Enables weld volumes to be reduced, potential for over 50% reduction of welding times in production, manual and automated
- Perfect welding even with very long stick-outs
- Excellent gap bridging even in high power ranges
- Excellent wetting of the material surface, smooth weld surface even on heavily oxidised or soiled sheet metal
- Qualified by welding procedure test (process no. 135), compliant with EN ISO 15614-1

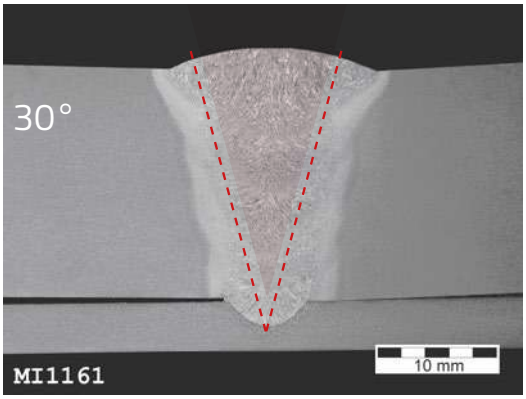
Welding with reduced seam volumes has been tested and confirmed multiple times by independent institutes. The EWM forceArc® XQ and forceArc puls® XQ welding processes allow welding times to be reduced by up to 50% compared to standard spray arc processes. The reduced included angle saves resources without changing the mechanical and technological properties.

Standard spray arc



11 runs

forceArc® XQ

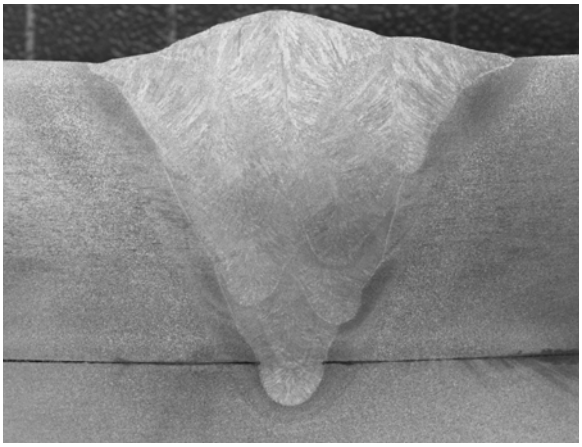


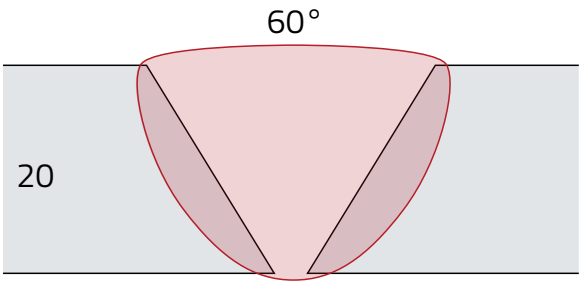
5 runs
50% shorter welding time

Unchanged mechanical/technological properties

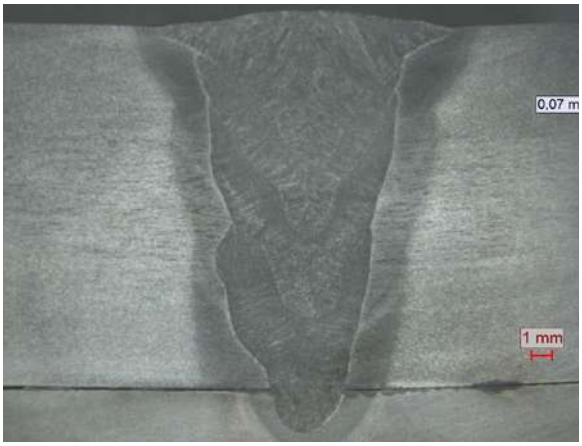
A complete technical report documenting all the advantages can be found online at the following link: www.ewm-group.com/sl/fachbericht

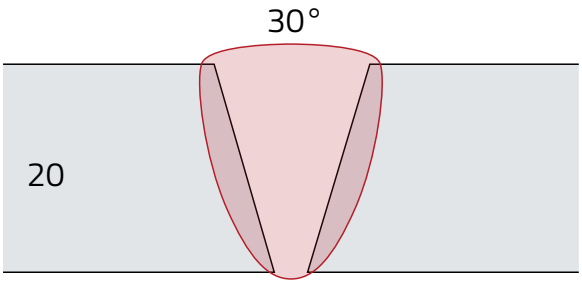
Full penetration, one-sided butt joint with reduced included angle





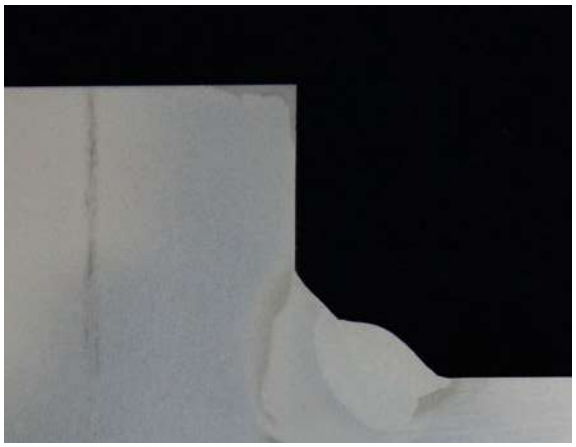
S355, 20 mm, included angle: 60°
9 weld beads, standard spray arc

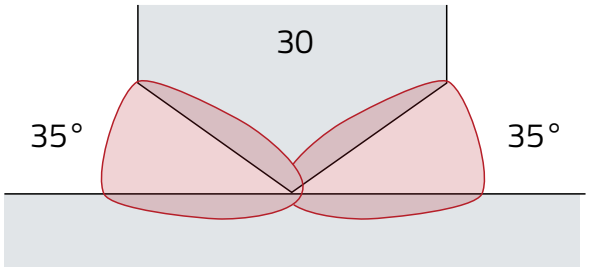




S355, 20 mm, included angle: 30°
4 weld beads, forceArc puls® XQ

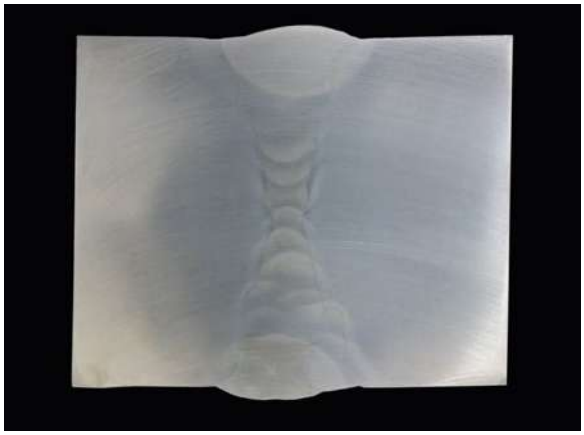
Full penetration,
T-joint welded on both sides

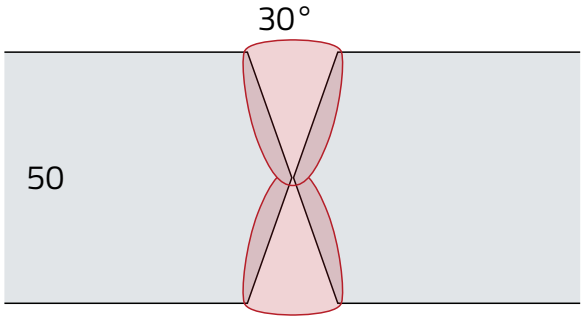




S235, 30 mm, included angle: 35°
8 weld beads

Full penetration,
butt joint welded on both sides





S355, 50 mm, included angle: 30°
15 weld beads

4. Welding fillet welds with deep penetration on unalloyed and low-alloy steel

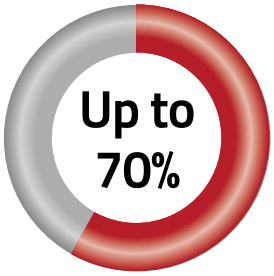
Welding process: forceArc puls® XQ

Advantages:

- Reduced number of welding passes for fillet welds
- Deep penetration for excellent root and sidewall fusion
- Modified, heat-reduced, directionally stable spray arc
- Perfect welding in narrow grooves, even with very long stick-outs
- Rapid correction of alterations to stick-out lengths, reliable processing of stick-out lengths up to 40 mm
- Forces transferred to the interior of the component by deep penetration, seam volume reduced by large effective seam thickness compliant with EN ISO 17659:2005-09, reduced heat input into the component
- Qualified by welding procedure test (process no. 135), compliant with EN ISO 15614-1
- Rapid digital control of the process, easy to learn and directly applicable regardless of torch angle

Additional information
www.ewm-group.com/sl/forcearctitan

Energy savings

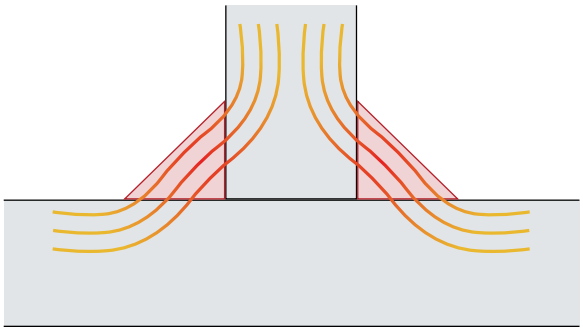


Reduced production time
(welding, finishing work)

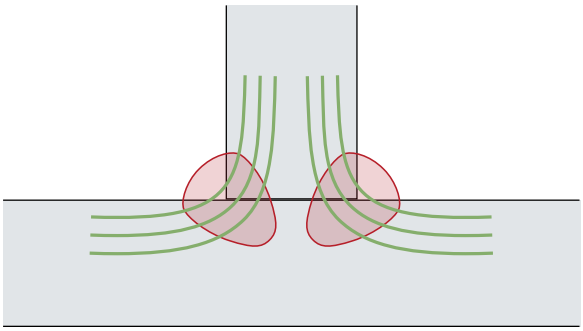
Reduced material costs

Reduced welding fume emissions

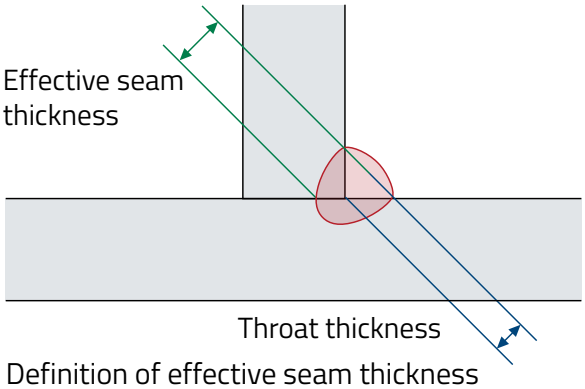
Welding with deep penetration compliant with EN 1090
By taking the effective seam thickness of fillet welds into account, the forceArc puls® XQ process enables single-pass welds up to throat = 8 mm to be created as opposed to throat = 5 mm in processes without deep penetration.



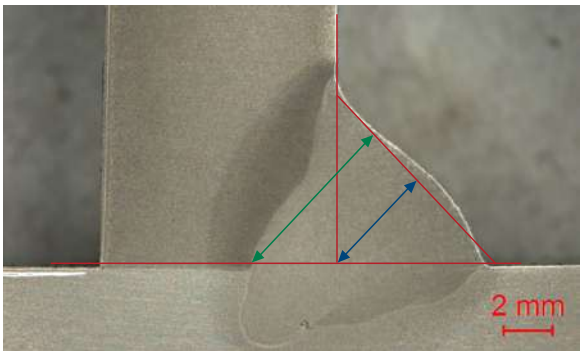
Flow of force in standard fillet welds



Improved flow of force thanks to deep penetration

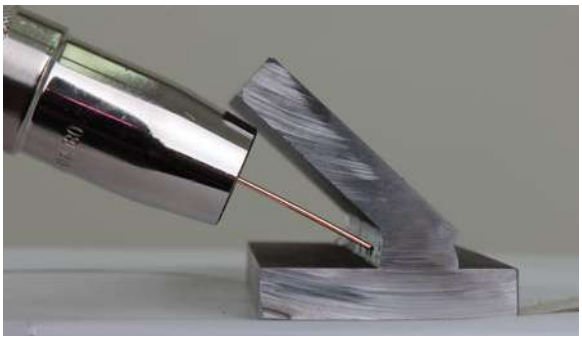


Definition of effective seam thickness compliant with EN ISO 17659:2005-09

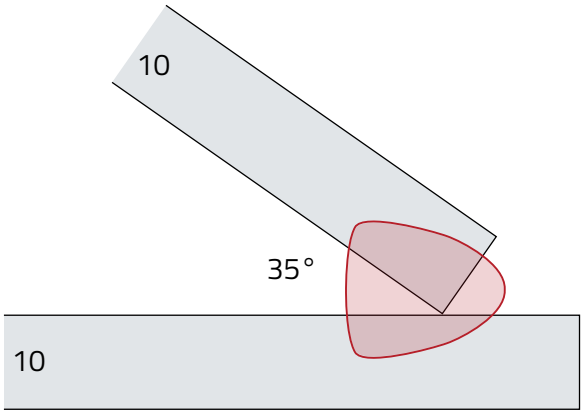


S355, 10 mm, effective seam thickness of 8 mm compliant with EN ISO 17659:2005-09

Welding with deep penetration and long stick-out



Material thickness: 10 mm, included angle: 35°



5. Welding with constant penetration and constant power on unalloyed, low-alloy and high-alloy steel

Welding processes: wiredArc® XQ/ wiredArc® puls XQ

Advantages:

- Welding process with consistently high penetration depth regardless of alterations to the stick-out
- Virtually spatter-free welding results thanks to rapid digital control of the welding process
- Digital process control supplies a consistent welding current
- The energy per unit length and heat input remain virtually consistent despite changes to the stick-out
- Ability to reduce the seam's included angle and therefore the weld seam volume
- Flat, even weld surface and virtually spatter-free process for reduced finishing work
- Easy to learn and to control

Standard

Alteration of the stick-out causes the penetration depth to change in standard welding processes (Figure 43). In particular, welding with an increasing stick-out length can cause the weld root to be insufficiently fused (lack of fusion).

wiredArc XQ

With EWM wiredArc XQ (Figure 44), the penetration remains consistent when the stick-out is altered. The innovative control keeps the welding current and the heat input virtually consistent.

Figure 43: Standard welding process

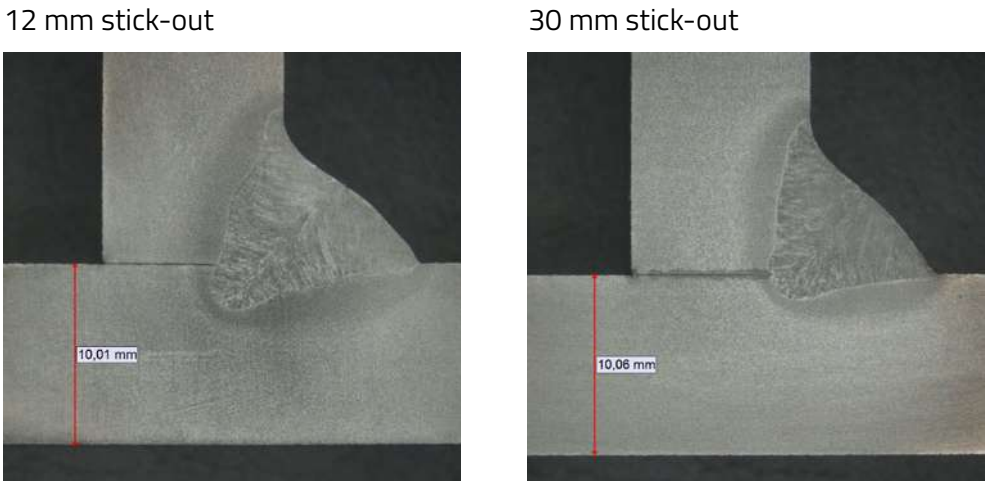
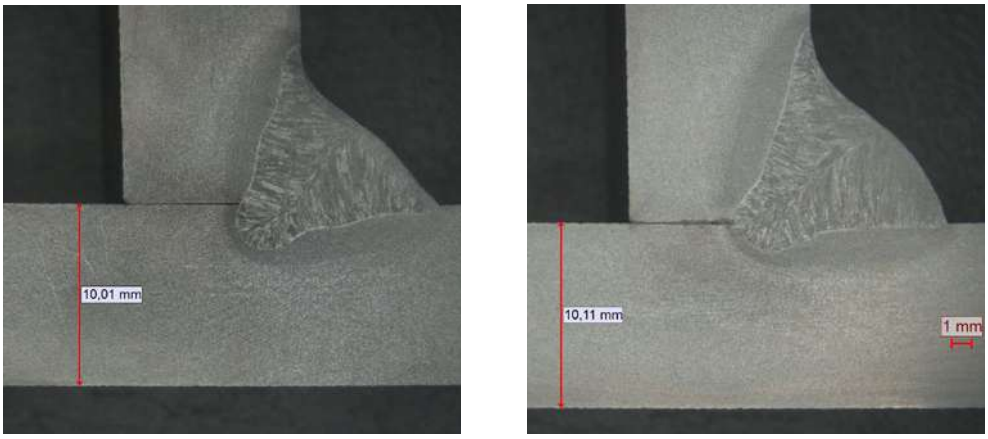


Figure 44: wiredArc XQ



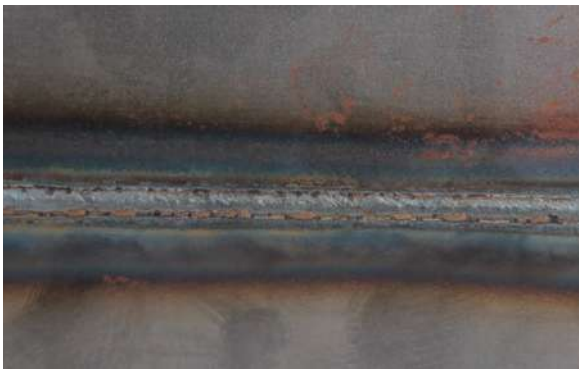
6. Welding using 100% CO_2 on unalloyed and low-alloy steel

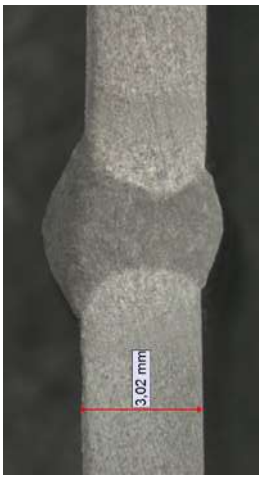
Welding processes: coldArc® XQ/ rootArc® XQ/Standard

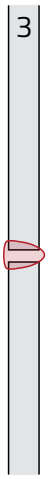
Advantages:

- Digital process control for low-spatter droplet transfer thanks to the RCC power module (Rapid Current Control)
- Rapid process control thanks to the use of the latest microelectronics
- Minimised weld spatter similar to mixed gas
- Welding even with long hose packages without additional voltage measuring leads thanks to RCC power module (Rapid Current Control)
- Easy to guide and control

Root welding in PC position with an air gap and without weld pool backing

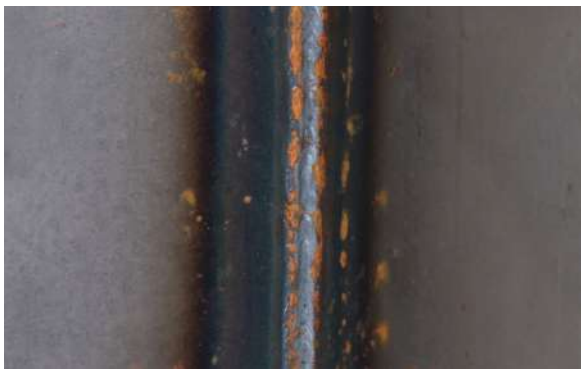


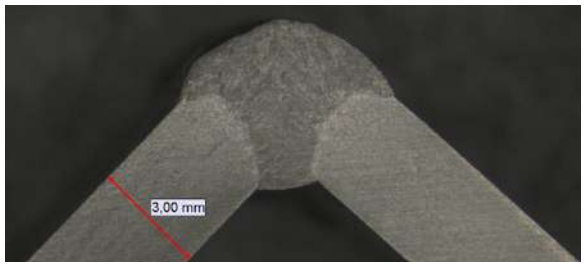


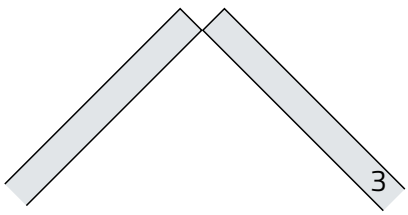


S355, material thickness: 3 mm, using G3Si1 1.2 mm diameter at 100% CO^2

Root welding in PA position with an air gap and without weld pool backing







S355, material thickness: 3 mm, using G3Si1 1.2 mm diameter at 100% CO_2

7. Welding full-penetration fillet welds on unalloyed, low-alloy and high- alloy steel

Welding process: forceArc puls® XQ

Advantages:

- Good gap bridging even in high power ranges, easy to learn and directly applicable
- Considerably reduced welding fume emissions compared to pulsed arc welding
- Reliable full penetration even without air gap, therefore good for fitting work
- Enables included angles to be reduced thereby reducing weld seam volumes, lowering the number of runs and significantly lowering costs
- Double-sided full-penetration welds on butt joints or T-joints without grinding or gouging the transverse root side
- Deep penetration for excellent root and sidewall fusion
- Good process stability when welding on the weld pool even at small included angles
- Perfect welding even with very long stick-outs
- Even in tight and narrow grooves with very long stick-outs
- Rapid correction of alterations to stick-out lengths, reliable processing of stick-out lengths up to 40 mm

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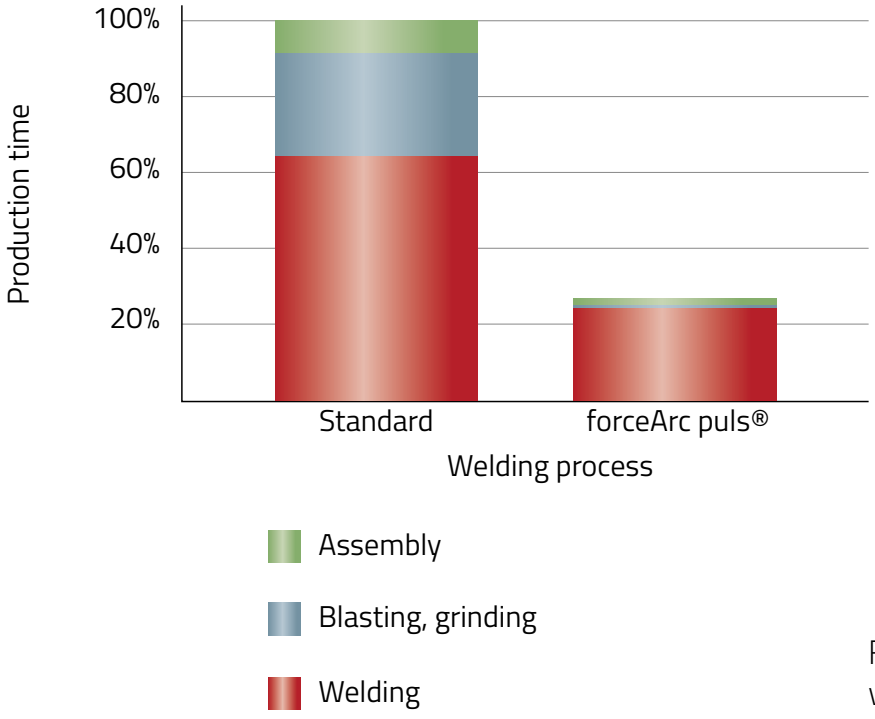
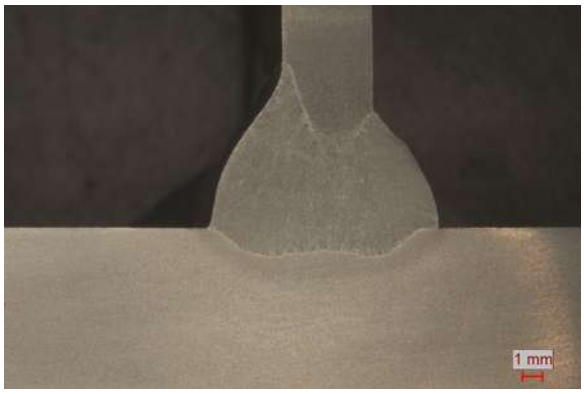
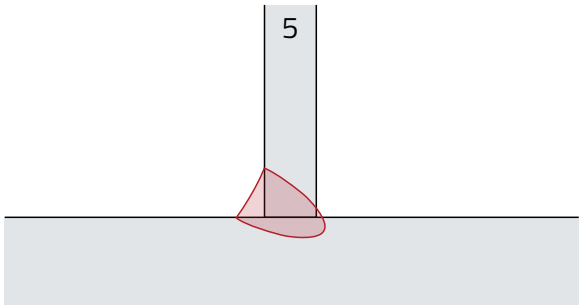
Time saved by using forceArc puls® XQ in production



Further information
www.ewm-group.com/sl/savings

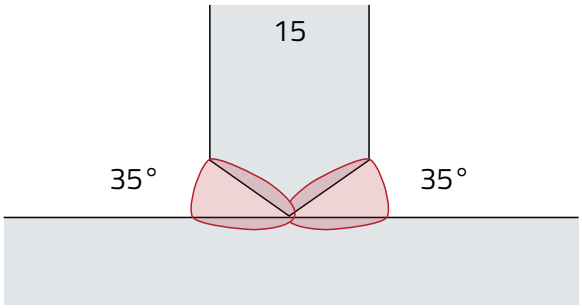
One-sided fillet weld





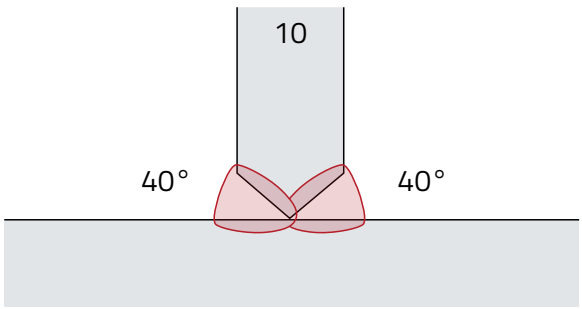
S355, 5 mm on 10 mm

Full penetration, welded on both sides



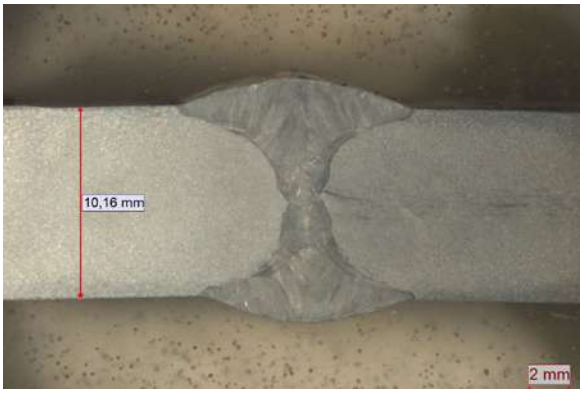
S355, 15 mm, included angle: 35°

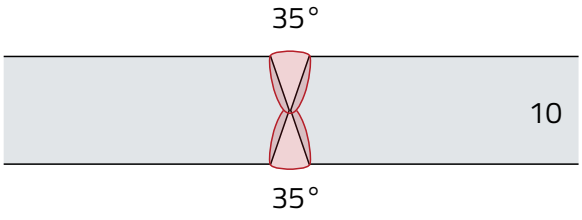
Full penetration, welded on both sides



1.4301, 10 mm, included angle: 40°

Full penetration, welded on both sides





1.4301, 10 mm, double-sided full penetration on a butt joint with an included angle of 35°

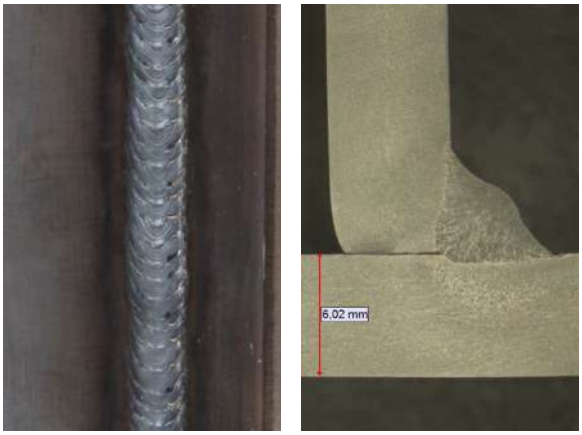
8. Positional welding without using the “Christmas tree” technique on unalloyed, low- alloy and high-alloy steel

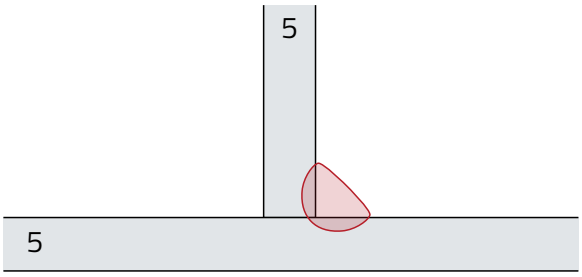
Welding process: Positionweld

Advantages:

- High welding speeds compared to the traditional “Christmas tree” technique
- Concentrated, digitally modified pulsed arc
- Virtually spatter-free welding results thanks to rapid digital control of the welding process
- Optimum, ex-works configured switching between low and high welding power
- Heat-reduced process with low arc power and energy per unit length
- Flat weld surface with even ripples and virtually spatter-free process for reduced finishing work
- Easy to set and easy to guide

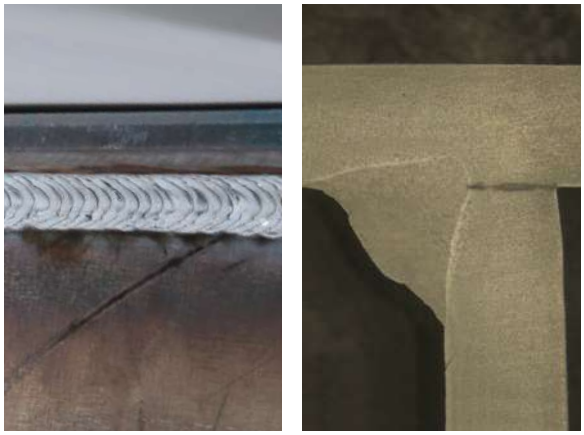
Vertical-up weld, straight torch guidance without using the “Christmas tree” technique

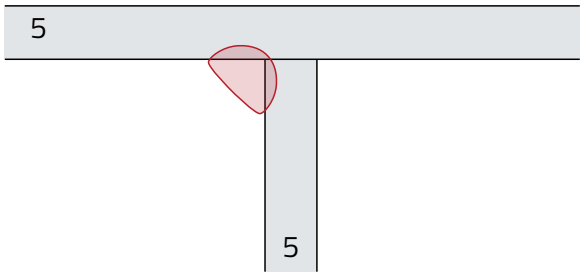




S355, material thickness: 5 mm

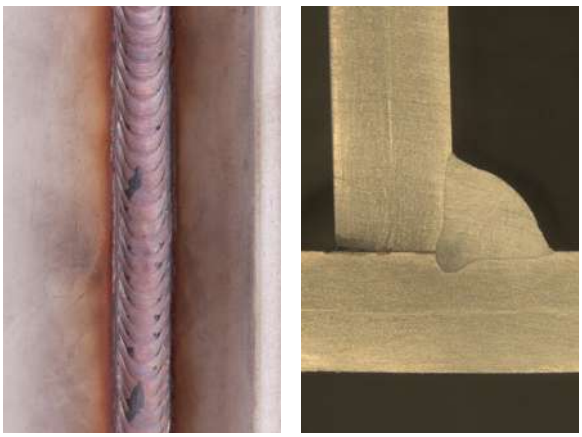
Overhead welding, easy handling

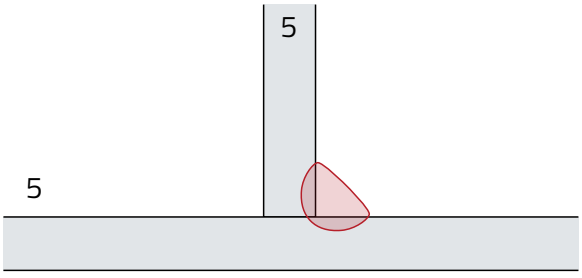




S355, material thickness: 5 mm

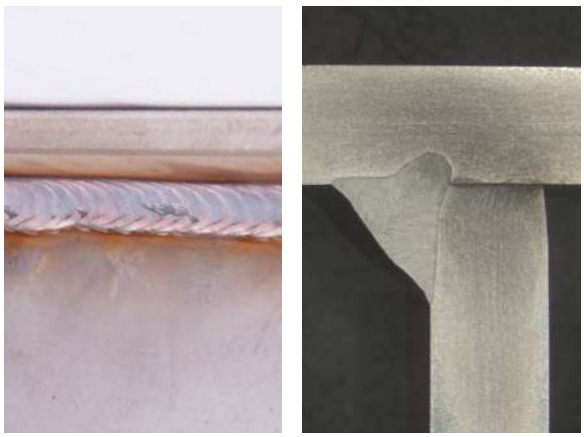
Vertical-up weld, straight torch guidance without using the “Christmas tree” technique

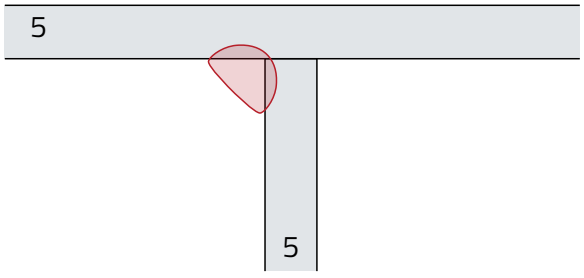




1.4301 material thickness: 5 mm

Overhead welding, easy handling





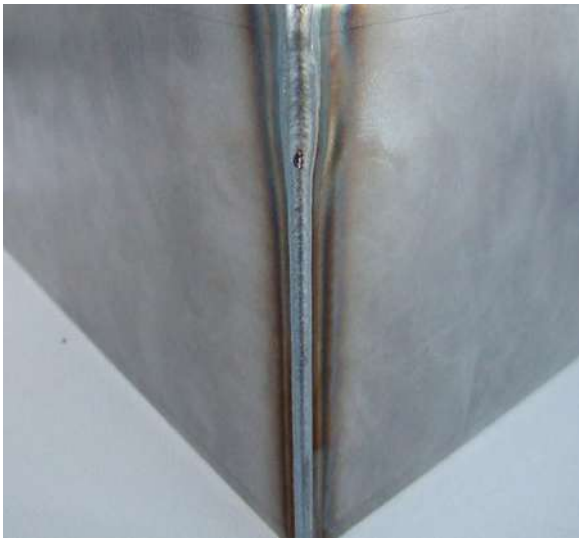
1.4301 material thickness: 5 mm

9. Welding and brazing of unalloyed, low-alloy and high-alloy steel thin sheet metal and galvanised sheet metal

Welding processes: coldArc® XQ/ coldArc® puls XQ

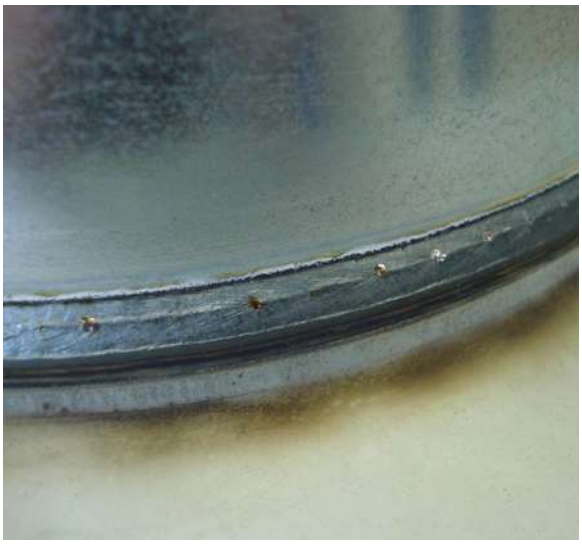
Advantages:

- Lower heat input due to digital control of droplet transfer in short-circuit welding thanks to RCC power module (Rapid Current Control)
- Flat, smooth weld surface and virtually spatter-free process, less discolouration and distortion reduces finishing work, excellent wetting of surfaces when brazing
- No sagging of the molten metal, reliable sidewall fusion even with misaligned edges
- Optimum process performance configuration, steady and stable welding process
- Rapid digital control of the process, easy to guide and control
- Welding even with long hose packages without additional voltage measuring leads thanks to RCC power module
- Minimal spatter formation, minimal impact on corrosion resistance



Welding unalloyed sheet metal

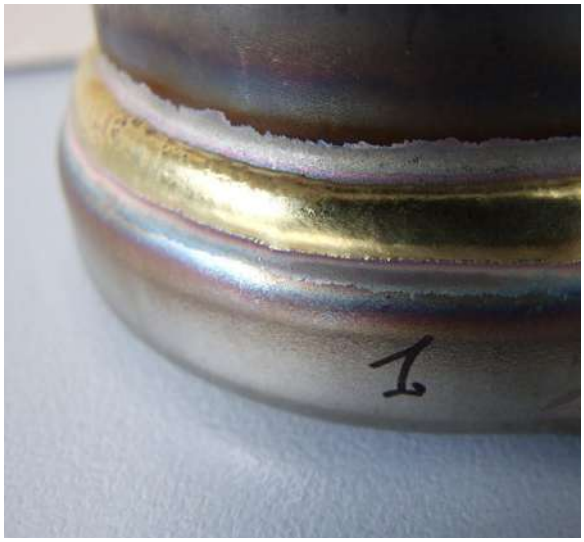
Welding high-alloy sheet metal



Welding galvanised sheet metal

Brazing galvanised sheet metal

Brazing high-tensile sheet metal, e.g. Usibor®



Brazing high-alloy (CrNi) sheet metal

10. Welding filler passes and cover passes of high-alloy steel

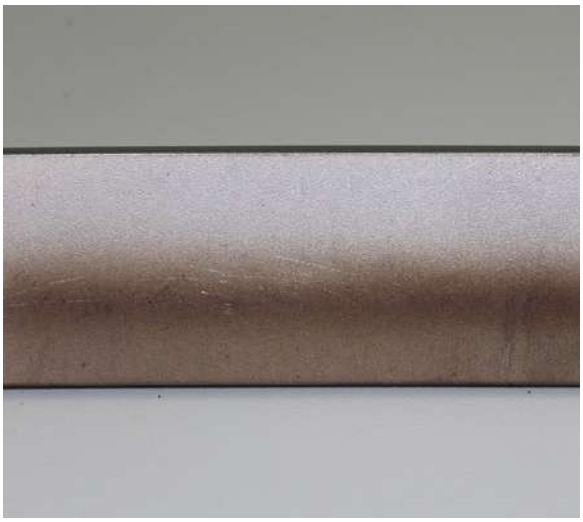
Welding process: forceArc puls® XQ

Advantages:

- Concentrated, digitally modified pulsed arc
- Virtually spatter-free welding results thanks to rapid digital control of the welding process
- Lower welding fume emissions compared to pulse arc welding
- Heat-reduced process with low arc power and energy per unit length reduced by up to 20% compared to pulsed arc
- Ability to reduce the seam volume thanks to the smaller included angle in multipass welding
- Symmetrical fillet welds with maximum attainable seam thickness (throat thickness)
- Low interpass temperature/reduced non-productive time
- Flat, smooth weld surface and virtually spatter-free process for reduced finishing work, minimal discolouration
- Rapid digital control of the process, easy to guide and control
- Consistent weld surface from various welding torch positions
- Up to 30% total cost savings
  - Reduced costs for wages, welding consumables, shielding gas and power Reduced production time
- Up to 15% lower heat input
  - Less finishing work (straightening, sanding, cleaning) thanks to reduced distortion, discolouration and stress
  - Minimisation of non-productive times thanks to shorter waiting times for multipass welding
- Up to 20% greater throat thickness
  - Deep, concentrated penetration with reliable root fusion for symmetrical seam formation
- Virtually spatter-free
  - Minimised finishing work, even on sheets with scaling or highly soiled surfaces

Front view:
Lower heat input using forceArc puls® XQ, less surface oxidation resulting in a better finish

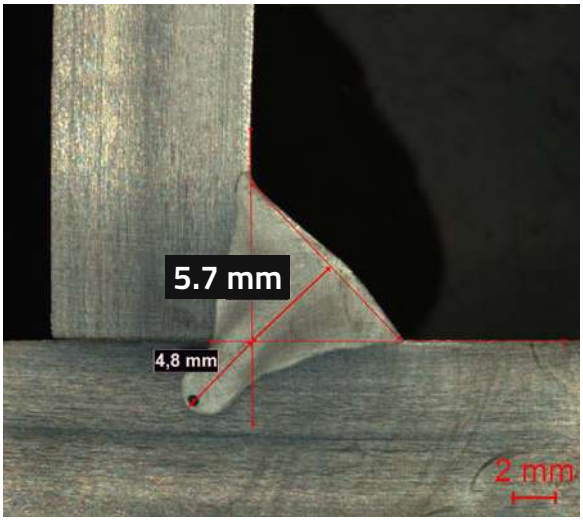
Rear view:
Low heat input using forceArc puls® XQ, less surface oxidation

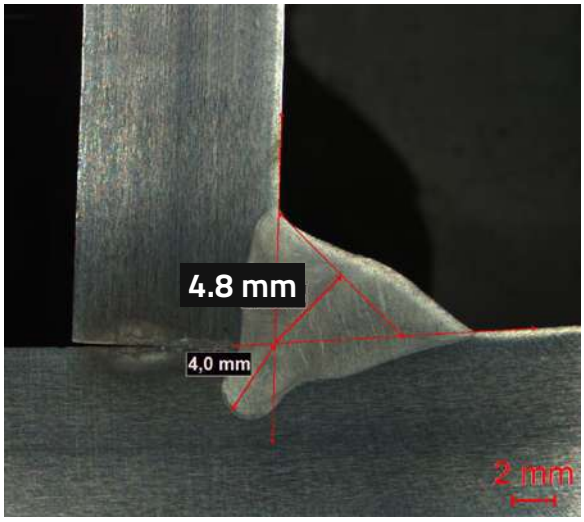


Compared to pulsed arc welding, forceArc puls® XQ inputs up to 15% less heat in the upper power ranges. This results in less discolouration and less distortion in the component.

Advantages:

- Lower heat input
- Minimised energy per unit length
- Reduces distortion, discolouration and stresses
- Less finishing work (straightening, sanding, cleaning)
- Less burn-off of alloying elements, thus producing greater corrosion resistance





Process	Wire feed in m/min	Energy per unit length in kJ/mm	Weld speed in m/min	Throat thickness
forceArc puls® XQ	13	1.21 (-15%)	0.45	5.7 (+15%)
Pulse welding	13	1.44	0.45	4.8

11. Welding of aluminium and aluminium alloys

Welding process: pulsed arc XQ

Advantages:

- Rapid and stable process control thanks to the use of the latest microprocessor technology
- Steady, stable droplet transfer, less burn marks on surface
- Individual weld appearance thanks to freely adjustable superPuls function
- Wire feeder reverse for spatter-free ignition
- Reliable process starting from 1 mm
- Rapid digital control of the process, easy to guide and control

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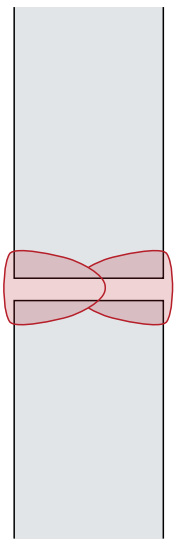
Two-sided welding of aluminium in shipbuilding



12. Positional welding of aluminium and aluminium alloys without use of the “Christmas tree” technique Welding process: Positionweld

Advantages:

- Concentrated, digitally controlled pulsed arc
- Optimum, ex-works configured switching between low and high welding power
- High welding speeds compared to traditional weaving techniques
- Flat weld surface with even ripples and virtually spatter-free process for reduced finishing work
- Rapid digital control of the process, easy to guide and control

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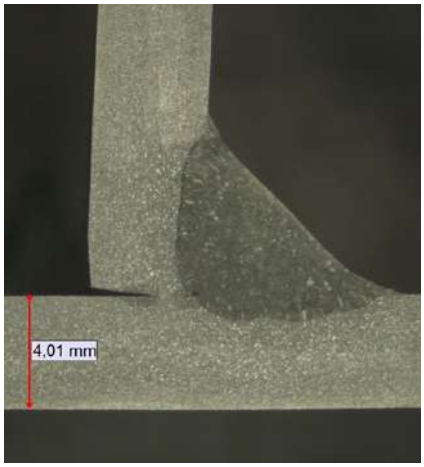
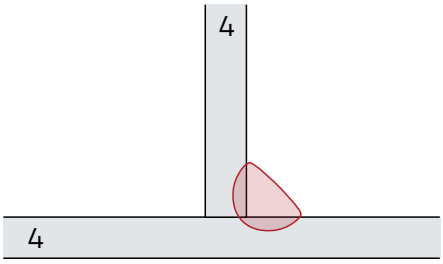
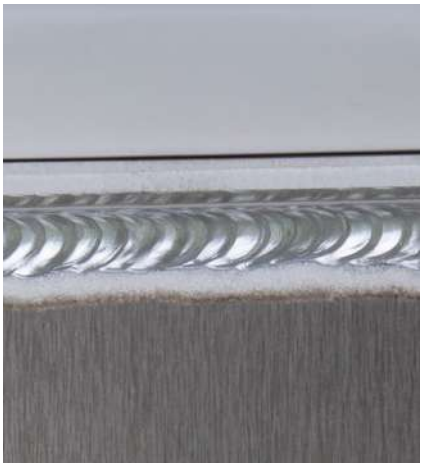
Welding in the vertical up position, easy handling

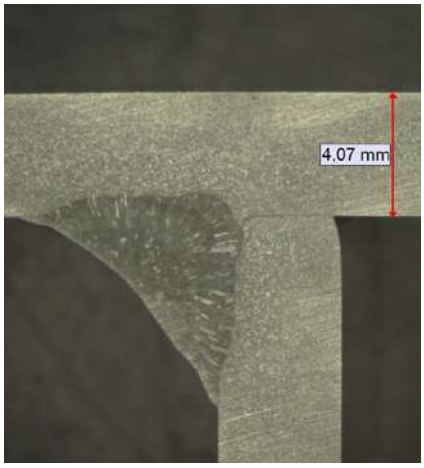


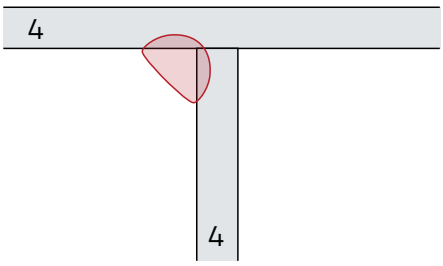


AlMg5, material thickness: 4 mm

Overhead welding, easy handling



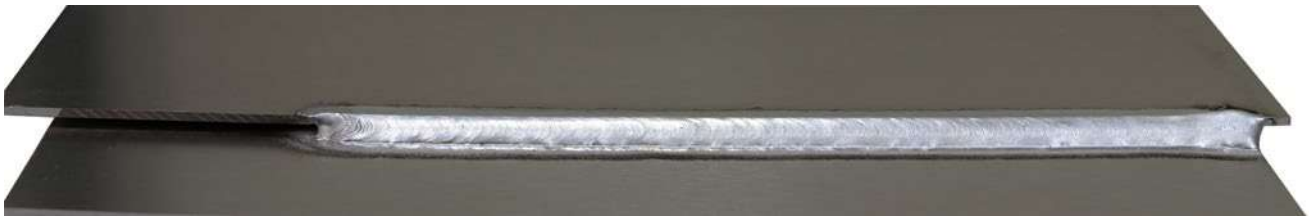




AlMg5, material thickness: 4 mm

13. Welding aluminium lap welds
Welding process: acArc puls XQ

acArc puls XQ is the optimal arc for aluminium welding on thin sheets. The easy-to-control arc is brilliantly suited to both manual and automated welding. Thanks to the reduction in welding fume emissions, the welder is less affected, and the welds remain clean.



Advantages:

- Clean weld seams as a result of greatly reduced magnesium oxide thanks to the lower droplet temperature
- Lower welding fume emissions
- Stable arc, even with large air gap
- Reduced heat input into the sheet
- Perfect aluminium welding, even on thin sheets
- Excellent gap bridging, even in automated applications
- Minimised heat input, no fall-through of the sheet

Lap weld: Material thickness: 1.5 mm | 1.2 mm AlMg 4.5 wire | Argon 100% | 69 A | 15.4 V | Welding speed: 70 cm/min. | Air gap: 1.5 mm.

14. Welding aluminium fillet welds

Welding process: acArc puls XQ + Positionweld

With acArc puls XQ, sheets of just 1.0 mm material thickness can be welded, even manually, thanks to the low heat input, without falling through.

Advantages:

- Minimised heat input
- Faster welding speed
- Simple and safe handling of the arc for both manual and automated welding
- Clean weld seams thanks to greatly reduced magnesium oxide
- Lower welding fume emissions

Fillet weld:
Material thickness: 1.0 mm | 1.2 mm
AlMg 4.5 wire | Argon 100% | 48 A | 14.1 V |
Welding speed: 60 cm/min.

With acArc puls XQ + Positionweld, MIG welds can be welded with a perfect TIG appearance. Even positional welding is very easy using this welding process.

Advantages:

- MIG welding with TIG appearance
- Simplified positional welding
- Excellent for connecting different material thicknesses

Fillet weld:
Material thickness: 2 mm | 1.2 mm
AlMg 4.5 wire | Argon 100% | 73 A | 15.4 V |
Welding speed: 45 cm/min.

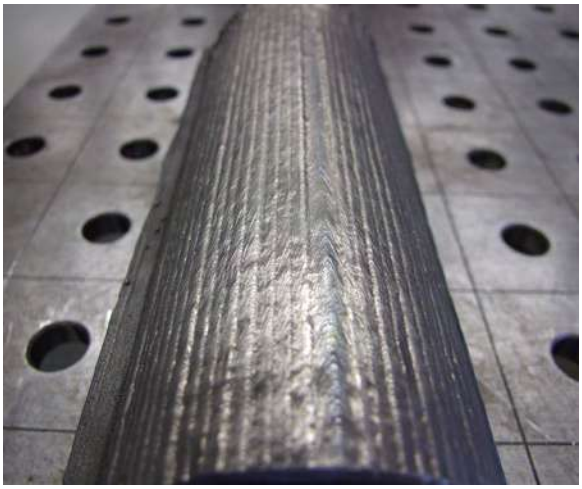
15. Surfacing

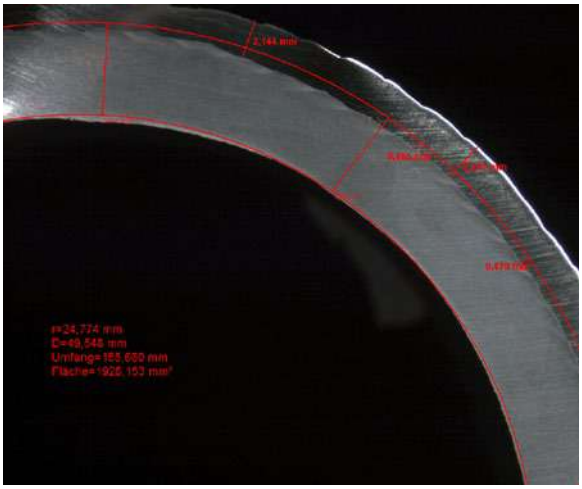
Welding processes: Cladding/ hardfacing

Advantages:

- Optimum process configuration for surfacing, hence low dilution
- Uniform deposit structure, minimal machining work
- High process stability thanks to digitally controlled arc, minimised spatter formation
- Easy to operate and adjust

Surfacing of finned tube walls





Corrosion-resistant surfacing of Alloy 625 Ni-based materials

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MAG + hot wire surfacing for increased deposition rate

New process variant combines a MAG welding process supplemented with an additional hot wire.

- Up to 13.8 kg deposition rate for significantly increased productivity
- Minimal dilution
- Further improved properties of deposited layers
- Process easy to set up and configure
- Suitable for cladding and hardfacing

Additional information
www.ewm-group.com/sl/cladding

16. Literature

[1] R. Killing: Handbuch der Schweißverfahren, Part 1: Lichtbogenschweißen, Fachbuchreihe Schweißtechnik, Volume 76/I, DVS-Verlag Düsseldorf 1999.

[2] G. Aichele: Leistungskennwerte für Schweißen und Schneiden, Fachbuchreihe Schweißtechnik, Volume 72, DVS Verlag Düsseldorf 1994.

[3] U. Reisgen, L. Stein: DVS-Fachbücher, Volume 161, Grundlagen der Fügetechnik – Schweißen, Löten, Kleben.

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