New Technologies

Robotic GMAW

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New GMAW Technology

Low Spatter Control LSC
Pulse Multi Control PMC
TPSi Cold Metal Transfer CMT
NEW PROCESS: LSC – LOW SPATTER CONTROL
EQUIPPED WITH THE NEW PENETRATION STABILIZER ASSISTANCE SYSTEM

Focus: less spatter & more stability

The result: A modified dip transfer arc process based on the standard process, with an extremely high arc stability for high-quality weld seams with minimal spattering and increased deposition rate.

Less rework
- Optimal weld seam appearance – perfect for visible weld seams
- Minimum of welding spatter

Characteristic packages tailored to individual needs
- LSC Root characteristics: High arc pressure for better root formation in forced weld layers
- LSC Universal characteristics: For controlling the breaking of the short circuit with gentler re-ignition and fast adjustment response

Constant penetration
- Thanks to intelligent stabilizers
NEW PROCESS: LSC ADVANCED
EQUIPPED WITH THE NEW PENETRATION STABILIZER ASSISTANCE SYSTEM

Focus: optimum weld properties and process stability even with long hosepacks

/ The challenge: The longer the welding circuit (hosepack length), the higher the inductivity generated, which affects the stability of the welding process.
/ The result: The built-in LSC Advanced module inside the power source guarantees that the inductivity generated in the hosepack is diverted. This ensures a more constant droplet detachment \(\rightarrow\) less welding spatter.

Maximum arc stability = reproducible welding results

/ … thanks to intelligent stabilizers and additional LSC Advanced module
/ Own variant TPS 400i LSC Advanced

No additional sensor line needed

/ Several welding operations can be performed simultaneously on one component

Even more stable
PMC Pulse Multi Control

COMPARISON PMC WITHOUT/WITH PENETRATION-STABILIZER

VERGLEICH PMC OHNE/MIT EINBRANDSTABILISATOR
Lower risk of burn-through
NEW PROCESS: PMC – PULSE MULTI CONTROL
EQUIPPED WITH THE NEW PENETRATION & ARC LENGTH STABILIZER ASSISTANCE SYSTEMS

Focus: Penetration, heat input & speed

The result: A development based on the pulse process. The high-speed data processing and precision detection of the process status hugely improve droplet detachment. Perfect for everyone who wants to weld even faster, yet stably and with a constant penetration and less heat input.

Defined weave pattern

- Synchropulse – perfect for visible weld seams
- Welding combinations of thin/thick sheets

Increased welding speed

- Reduced cycle time
- Increased productivity

COMPARISON HEATINPUT PULSE VS. PMC

VERGLEICH WÄRMEEINTRAG PULS VS. PMC
The distance control during welding maintains a constant penetration ... no matter what

- The assistance system automatically compensates for any imprecision
- ... Component tolerances: changing sheet thicknesses or gaps
  ... Torch stick-out changes
  ... Heat-induced material distortion during welding
- How? Wire feed speed can be dynamically controlled and is automatically increased or reduced depending on the external influence
- What’s it for? Constant penetration = the decisive quality criterion for the weld seam
HIGHEST WELDING SPEED IN SHORT CIRCUIT
ASSISTANCE SYSTEM: ARC LENGTH STABILIZER
THE CRUISE CONTROL ASSISTANT ... KEEPING A CONSTANT SPEED BOTH UPHILL AND DOWN

The cruise control during welding maintains a constant arc length,
... no matter what

WITH
Arc length \( A = \) Arc length \( B \)

WITHOUT
Arc length \( A > \) Arc length \( B \)

// The assistance system automatically compensates for any imprecision
// ... Dynamic, changing torch positions
  ... Component tolerances: changing sheet thicknesses or gaps
  ... Uneven heat extraction
// How? The system keeps the arc at constant length
// What's it for? No need for the welding operation to be interrupted or for manual readjustment of the arc length when the torch position changes.
Quick parameter-finding \( \rightarrow \) focussed arc, faster welding speed possible
HIGHLIGHTS

Exceptional weld properties and maximum precision

- TPS/i stands for perfect process stability and the best welding performance, even under changing external conditions.
- Highly dynamic real-time control for excellent welding results

Unimagined possibilities joining complex materials

- The system can be updated at any time with the latest Fronius developments

No more compromises: maximum welding speeds can be combined with a constant penetration, good weld seam appearance and excellent weld seam quality

Achieving reproducible quality has never been easier

- Faster control reduces spatter and evens out component tolerances to reduce rework, reject rates and production downtimes to a minimum

Rework can be reduced to a minimum

- Increased productivity and lower costs
Arc length changes can appear during welding due to surface variations, increased travel speed
Principle PMC Arc + Arc length stabilizer

- PMC adds dedicated short circuits to increase travel speed, penetration and arc stability.
Pulse vs Pmc using arc length stabilizer
Arc Length Stabilizer

Regardless of the welding position, the weld geometry or interference, the properties of the controlled, faulted arc remain the same.
Arc length stabilizer settings

Arc length stabilizer set to 0.0

- No dedicated short circuits
- Good arc stability
- Low travel speed
- Applications:
  - Cap passes
  - 1F / PA position
  - ........

Arc length stabilizer set to 0.5

- Low amount of dedicated short circuits
- Increased arc stability
- Increased travel speed
- Applications:
  - High deposition
  - Fillet welds
  - Out of position welds
  - ........

Arc length stabilizer set to 2.0

- Large amount of dedicated short circuits
- Increased arc stability
- High travel speeds
- Applications:
  - Lap joints
  - Vertical down welds
  - ........
COMBINATION: “AL-Stab” + “Penetration-Stabilizer”

/ Constant short arc + a constant Penetration

/ Stabilizes the welding process when disturbances occur, the welding seam position or shape or the contact tube distance changes

/ Example: Macro: G3Si1 ø1.0mm, 18% CO2 Rest Ar

P-Stab = 5m/min, AL-Stab = 0.5

Pos.2: CTWD = 20mm  Pos 1.: CTWD = 10 mm
vd = 23 m/min  vd = 18 m/min
Penetration = 4.2mm Penetration = 4.2 mm
Galvanized steel with a chemical composite of either pure Zn (Zinc) or ZnFe (Zinc Iron) can be welded up to a Zinc coating thickness of \(~15\mu m\) and a material thickness of \(2 - 3.5\, \text{mm}\).
Pulsed arc vs Pulse multi control (PMC)

• Conventional Pulsed Arc
  ◦ Travel speed: 1m/min (40ipm)
  ◦ WFS: 7m/min (275ipm)
  ◦ Gas: Ar + 10%CO₂

• PMC Universal
  ◦ Travel speed: 1m/min (40ipm)
  ◦ WFS: 7m/min (275ipm)
  ◦ Gas: Argon + 10%CO₂
  ◦ Arc Length Stabilizer: 2.0
  ◦ Penetration Stabilizer: max.
Pulsed arc vs Pulse multi control (PMC)

**Pulsed Arc**
- Good outside seam appearance
- High amount of porosity
- Spatter ejection
- High heat input

**PMC Universal**
- Very good outside seam appearance
- Minimum porosity
- Low spatter ejection
- Less heat input
Shielding gas in comparison

- **Argon + 20% CO2**
  - More silicon islands
  - Less wetting
  - Increased porosity
  - More spatter

- **Argon + 10% CO2**
  - Minimum silicon islands
  - Nice wetting
  - Low porosity
  - Less spatter
PMC on galvanized steel

- 15µm thick galvanized steel plates. Vs: 1m/min (40ipm), Process; PMC + Arc Length Stabilizer and Penetration Stabilizer.
Flat Position

- Flat position should be used to ensure proper Zinc Oxide (ZnO) outgassing.
- ZnO outgassing happens on the back side of the weld.

Horizontal Position

- Using a work angle of ~50° measured from the top plate is recommended to ensure proper ZnO outgassing and good wetting.
- ZnO outgassing happens partly thru the weld seam.

Gaps

- Maintaining a slight gap of ~¼ of the material thickness helps the ZnO vapor to escape.
- If gaps are used they need to be maintained consistent.
Minimum porosity using pmc

- Wire: 0.045” ER70S-3, Gas: Ar+ 5%CO2, Travel Speed 40ipm, Process: PMC Universal.
Seam appearance and macro using Pmc

- **Parameters**
  - Vs: 40ipm (1m/min)
  - Wire Ø: 0.045" (1,1mm)
  - Wire alloy: ER70S-3 (~ G2Si1)
  - Shielding gas: Ar + 10%CO2
  - WFS: 275ipm (7m/min)
  - Arc Length Stabilizer: 1.5 – 2.0
  - Penetration Stabilizer: max. (395ipm / 10m/min)
  - Material thickness: 2mm
CMT & CMT Mix
With the CMT process, Fronius provides users with a highly dynamic welding process with the most stable arc in the world and minimal welding spatters. CMT is also no longer just “cold” but rather allows continuous regulation of heat input from cold to hot. This results in higher welding speeds and a broader range of applications with maximum welding quality.
TPS/i CMT PROCESS BENEFITS

- Highly dynamic wire control
- Extremely stable arc
- Wider process window – up to the end of the intermediate arc
- Most stable process with minimal spattering (up to 200 cm/min)
The correction of the arc-length and the arc-dynamic at the CMT process is generated by an adjustment of the wire feed speed and the welding current profile.
CMT arc length correction

The length of the arc in the arc burning period is adjusted by the time of the backward and forward movement. This wire speed corrections in length and height are specific for synergic line.

Arc length correction

Unit
Range -10 to +10
Default 0

Application of the arc length correction

Positive correction causes a longer backward movement period and a reduced forward feeding speed for the wire electrode, what results in an extension of the arc within the CMT process period.

Negative correction gives a shorter arc length by reducing the time of the backward movement and increasing the amount of the forward feeding speed of the wire electrode.
CMT arc length correction

CMT Arclength Correction
**CMT Dynamic correction**

**Dynamic Correction**
This correction represents the dynamic or short-circuit behavior of the CMT drop transfer. The current level at the point of reigniting in a CMT period and the acceleration ramp of the wire feeder after the point when the short circuit occurs, are adjusted with this correction.

- **Unit**: 
- **Range**: -10 to +10
- **Default**: 0

**Application of the dynamic correction**

The **negative** correction rises the current level at the point of reigniting in a period and increases the acceleration ramp of the wire feed speed. As a result the drop transfer time is shortened, the process frequency is increased and CMT feels to be more intense.

The **positive** correction lowers the current level at reigniting and gives a reduced acceleration ramp for the wire feeder. This results in a longer duration of the drop transfer, the process frequency is lowered and CMT feels to be smoother.
CMT Dynamic correction

TPS/i CMT Dynamic Correction
CMT Dynamic Correction Heat Input Control
CMT Mix Correction & Parameter setting
CMT Mix
CMT Mix high power time correction
CMT Mix low power time correction

CMT Mix Low Power Time Correction