PROCESS CONTROL VARIANTS FOR GMAW

Gas-shielded metal arc welding (GMAW) is the most frequently used arc welding method. The welding equipment currently on the market is predominantly digitally controlled and programmable. It permits new process variants with specifically adjusted technological characteristics. New terms and names are being coined, and used in a company-specific way. The purpose of this poster is to help users to orient themselves when it comes to the various process control variants for GMAW.

classification acc. to the technical bulletin DVS 0973

Designation	Manufacturer	1) Controlled short arc	2) Low-spatter short arc	3) Energy-reduced short arc	4) High-performance short arc	5) Modified spray arc	6) Pulsed arc	7) Modified pulsed arc	8) Alternating current process	9) Combined process variant	10) Cyclic wire movement
ColdWeld	Cloos	x		x					x		
ControlWeld	Cloos	x	x								
RapidWeld	Cloos					x					
coldArc	EWM	x	x	x							
forceArc	EWM					x					
rootArc	EWM	x	x	x							
CMT Advanced	Fronius	x	x	x	x				x	x	x
CMT (Cold Metal Transfer)	Fronius	x	x	x	x						x
CMT Pulse	Fronius							x		x	x
LSC (Low Spatter Control) & LSC Advanced	Fronius	x	x	x							
PCS (Puls Controlled Spray Arc)	Fronius					x					
PMC (Pulse Multi Control)	Fronius							x			
WiseRoot	Kemppi	x	x								
WiseThin	Kemppi	x		x							
newArc	Kjellberg	x	x		x	x					
SpeedArc	Lorch	x				x					
SpeedCold	Lorch	x	x	x							
SpeedPulse	Lorch						x	x			
SpeedRoot	Lorch	x	x								
SpeedUp	Lorch	x					x	x		x	x
ColdMIG	Merkle	x	x	x							
DeepARC	Merkle					x					
HighUP	Merkle	x					x			x	
ProSWITCH	Merkle									x	
SSA (SpeedShortArc)	Oerlikon	x	x	x	x						
FOCUS.ARC	Rehm	x		x		x					
FOCUS.PULS	Rehm							x			
POWER.ARC	Rehm	x		x							

classification by the manufacturer

CMA (Cold MIG/MAG Arc)	DINSE / ESS	x	x	x							
HC MAG (Heat Controlled MIG/MAG)	DINSE / ESS	x	x	x					x		
PowerPulse	DINSE / ESS						x				x
RMT (Rapid MIG/MAG Technology)	DINSE / ESS					x					
coldArc puls	EWM						x				
forceArc puls	EWM							x			
rootArc puls	EWM						x				
pipeSolution	EWM	x	x		x						
Superpuls	EWM									x	
Advanced SeQuencer (ASQ)	Oerlikon									x	
Cold Double Puls (CDP)	Oerlikon							x		x	
HPS (High Penetration Speed)	Oerlikon					x					
SeQuencer	Oerlikon									x	
Soft Silence Puls (SSP)	Oerlikon						x	x			
Spray Modal	Oerlikon							x			

Technological allocation

The GMAW process control variants essentially belong to gas-shielded metal arc welding (13) – inert-gas metal arc welding (MIG, 131) / active-gas metal arc welding (MAG, 135). Electronically controlled GMAW process variants can also be categorized into the familiar arc types of short arc, mixed arc, spray arc and pulsed arc. Unlike classic GMAW, GMAW process control variants specifically alter the characteristics in order to deliver specific benefits.

Process window

The process variants extend the possible process window for GMAW (red areas).

1. Controlled/modified short arc

With controlled short-arc processes, the equipment electronics detect both the short circuit and the arc phase and balance them separately. This can even be split into several temporal sectors (intervals) (sector-based control).

2. Low-spatter short arc

With these types of controlled short-arc processes, control measures ensure that the current is below a specific critical value at the time of re-ignition of the arc (conclusion of the short-circuit phase).

3. Energy-reduced short arc

This type of controlled short-arc process is specially parameterised for low energy input. Low-energy short-arc processes aim to either have a low energy consumption during welding or to keep the heat input into the workpiece low.

4. High-performance short arc

The deposition rate of the short-arc process can be increased through process control by shifting the transition to the mixed arc to higher wire feed rates. Compared with the mixed arc, the short arc introduces less energy into the workpiece and requires less dressing (spatter). The desired behaviour is achieved through special current shaping during the short-circuit and arc phases.

5. Modified spray arc

The focused arc and the shortened metal transfer of the modified spray arc results in a higher energy density and a higher arc pressure deep into the melt pool. This is an advantage when welding adjusted joint geometries (e. g. narrow gaps and small weld preparation angels).

6. Pulsed arc

The welding power source periodically switches to a higher impulse current that allows for a selective and well controllable metal transfer, while the background current exclusively takes care of ionizing the arc zone and heating the end of the electrode as well as the surface of the base material. Through the current impulses a metal transfer in sync with the pulse frequency is achieved. Based on the controlled droplet transfer with a defined droplet volume, the filler material can be supplied specifically.

7. Modified pulsed arc

Controlled pulsed arc processes have more parameters, which generally require control on the basis of synergy characteristics. The variety of pulsed arc parameters in possible combination with other effects, control strategies and arc types produces a wide range of options for modifying the pulsed arc with a view to optimizing specific process characteristics.

8. Alternating current processes

Controlled changing of the polarity using additional power electronics during certain phases of the welding process adds another degree of freedom to the process control. Benefits primarily result from good bridging characteristics and in applications with low energy introduction and dilution.

9. Combined process variants

Modifications to process control in the timing of each individual metal transfer are no longer visible to the naked eye, the arc shape appears "averaged" to the human eye as a special shape with specific characteristics. The same applies to the heat conduction, the energy input, the penetration profile, the weld surface (e.g. weld ripples). Combined process variants break through this perception and effect, by enabling the timing of these effects to be resolved. By doing so they in turn achieve special new characteristics.

10. Cyclic wire movement

Cyclic modification of the wire feed rate can already be a feature of combined process variants if the individual process variants have different wire feed rates. This increases the demands placed on the wire feed system. Process variants that cyclically change the direction of the wire feed place even higher demands on the wire feed system.