



# HARMS WENDE

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# The classic Aluminum Mode

CAM





1xxx

2xxx

3xxx

4xxx

5xxx

6xxx

7xxx



#### Aluminum types

> 99 % aluminum	7
Copper	1
Mangan	1
Silicium	1
Magnesium	1
Magnesium und Silicium	1
Zinc	2

'0...190 <sup>N</sup>/<sub>mm<sup>2</sup></sub> 90...570 <sup>N</sup>/<sub>mm<sup>2</sup></sub> 00...350 <sup>N</sup>/<sub>mm<sup>2</sup></sub> 70...380<sup>N</sup>/<sub>mm<sup>2</sup></sub> 00...450<sup>N</sup>/<sub>mm<sup>2</sup></sub> 00...450<sup>N</sup>/<sub>mm<sup>2</sup></sub>  $220...700^{N}/_{mm^{2}}$ 

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### The welding modes – by schedule

• **CAM – <u>Classic Alu M</u>ode** Software package to weld aluminum material.



#### • IQR

Adaptive welding package for steel materials running from mild steel to UHSS (Ultra High Strength Steel)

CCR – Secondary <u>Constant Current Regulation</u>
 Up to 7 seconds regulated current possible.





## The Tool: MFDC inverter GeniusHWI

- Flexible configuration through software from factory.
- Later update possible at customers site.
- Suitable to run CAM and adaptive IQR welding for steel one unit.
- All major field bus systems available as EthernetIP or Devicenet.
- Available in wide power range from 80 to 600 KVA.







### The CAM - overview



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#### CAM in XPegasus (HMI)

🛃 Aluminium-Parame	ter											- • •
Program	1										Module group:	HWH
Program name ALU											Module name:	2012_10_17_Date
Aluminium-Parameter HWH												
Pre hold time	1000	ms	Force bef	ore	500.0	daN	Regulation more	de	ALU	•		
Pre heat curr	0.00	kA	Force cur	rrent phase	300.0	daN	Program state		Frei	•		
Pre heat time	0	ms	Force after	er	500.0	daN	Continue after elapsed	time	nein	•		
Heat eqv. time	0	ms	Force equ	ualization time	30	ms						
Condition. current	15.00	kA	Shift set	value to earlier			Real values:					
Condition.Time (max)	100	ms					Conditioning time:					
Condition. level	85	muOhm					Al	uminum weld c	ycle			
Pause time	0	ms	35									- 500
Upslope time	0	ms	30 -									-400
Main current	35.00	kA	25						1			
Main current time	140	ms	20 - ¥									-300 N
Re-cooling time	0	ms	-15						]			-200
Post heat current	0.00	kA	10									- 100
Post heat time	0	ms	5-									
Post heat downsl. time	0	ms	0-0	1 200	40	0	600	800	1000	1200	1400	
Post hold time	300	ms						Zeit/m	s			
Show main times only												
											Close	Help
ОК						_						

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- Small concave shape prevents electrodes to penetrate sheets.
- Penetration is related to the soft material and high current.
- Electrode material: Cu Cr- Zr and electrodes with aluminum alloy.



Small concave shape

High concave shape

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#### Electrode forces related to its shape



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### The force

## During welding resistance spot welding of aluminum high electrode forces are required.

- The material expands very much with fast raising temperatures.
- A fast cooling of the expanded material leads to bad recrystallizations of the aluminum.
- The high force compresses the weld lens.
- Under this pressure recrystallizations is improved.
- Low electrode concave shape keeps remaining wall thickness high.
- Due to the high forces electrodes shall have larger diameter.





## The Alloys

Overview

For resistance welding aluminum of the group 5000 to 6000 is suitable.

#### 5xxx

- Difficult on high environmental temperatures.
- Simple to weld.
- Strength: 100 to 450  $^{N}/_{mm^{2}}$ .

6xxx

- No problems at high environmental temperatures.
- Heat related cracks may occur.
- Strength: 100 to 450  $^{N}/_{mm^{2}}$ .





### Requirements

ltem	Reaction
Clamping of the material before welding	High force
Resistance raise while welding	Small force
Non-optimal recrystallization due to expanded lens	High force
Extreme expulsion due to oxide layers	Current profile to avoid expulsion





### **Comparison in welding**

Parameter	Steel	Aluminum
Joining type	Melting process	Melting process
Typ. Weld current	12 kA	36 kA
Typ. gun force	3000 N	6000 N
Electrode type	Concave	flat
Typ. Inverter pwr	80 KVA	1600 KVA
Welding mode	Adaptive IQR or constant current	CAM
Mass production	yes	yes
Tip dress cycle	high	Typ. 30-50 spots







**References** (examples)

- **CAM**: Audi, Mercedes (Voestalpine in USA, China, South Africa and China), VW
- IQR: VW global, Hyundai global, Kia, Audi, Skoda, Gestamp, Magna Europe, Ford Motor Europe, Camaco NE

- Industrial: Stihl USA, Magneti Marelli USA, Miele, Continental, TRW, Autoliv, Takata, ZF (shock absorbers)
- Tiers: Magna Europe, Kirchhoff, Gestamp, ISE Alabama, Ajin USA, Sungwoo Hitech, PWO Canada





# Support structure USA

- Alliance Engineered Solutions, Troy MI
  Sales contact automotive USA
- Stegner Controls, Auburn Hills MI Test resistance welding lab, panel building according UL, installation, training facilities, import handling.
- Huys Industries, Toronto (Canada)
  Industrial sales and service, equipment repair.
- Coldwater Machine, Coldwater OH Friction Welding full service supplier USA





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#### Thank you very much.

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