Welding Technology Corporation

World Leader in Resistance Welding Controls

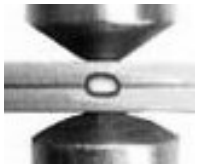
Medar
Nadesco
Robotron
Technitron
Weltronic

Automotive Welding

Serving Automotive Leaders …

… around the world

Global Products & Services



Welding Controls Group

Developing and supplying the most dependable and advance welding controls for the world

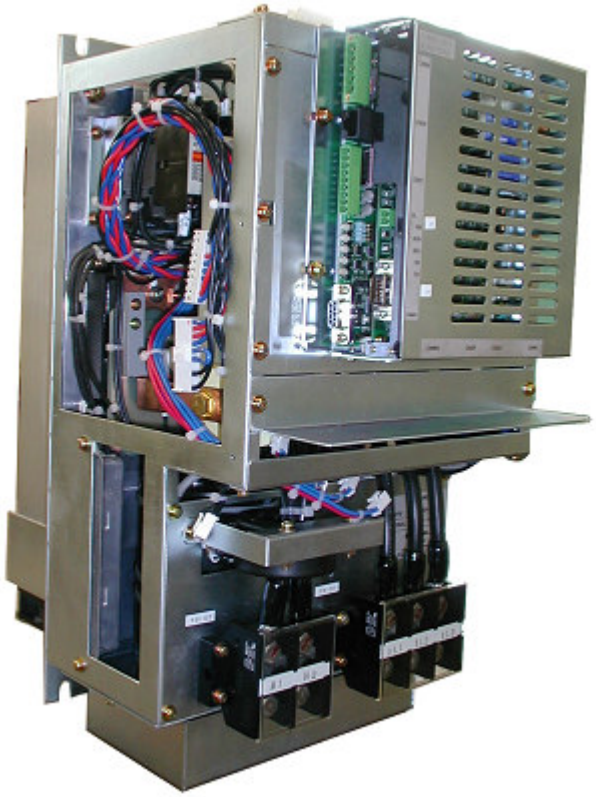
Advance Products Group

Sourcing advanced products to enhance welding processes

Industrial Technical Services

Supporting, training, and servicing welding processes in automotive manufacturing plants

MFDC Inverters



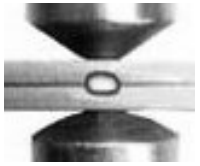
Kits or Control Assemblies

Various sizes available

Air or Water Cooled Versions

Advanced benefits for today's environment

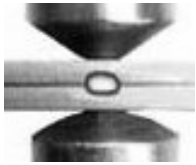
There are applications and situations where the MFDC resistance welding is the best choice available. The overall cost of using MFDC are significantly lower as compared to the cost single-phase SCR control may actually be.



Significant Energy Savings

MFDC Inverter will do more welding with less energy

	MFDC	AC Transgun	AC Cable Gun
Electricity Cost per KW Hour	$0.08000	$0.08000	$0.08000
Secondary Current	15000	15000	15000
Turns Ratio	74	50	15
Welding Cycles	12	12	12
Power Factor	99%	85%	95%
Primary Voltage	480	480	480
Cost per weld	$0.000428	$0.000544	$0.002027
Welds per part by control	25	25	25
Parts per hour	62	62	62
Hours per day	16	16	16
Days per week	6	6	6
Weeks per year	50	50	50
Parts per year	297,600	297,600	297,600
Welds per year by control	7,440,000	7,440,000	7,440,000
Electricity cost for weld per year	$3,185	$4,047	$15,078



The calculating tool shown here is available from WTC

Improved & Consistent Power Factor

MFDC load appears to have unity power factor, which would then reduce penalties assessed by the power company.

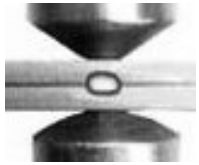
Inductive impedance is eliminated since the diodes on the secondary of the welding transformer provides Direct Current to the weld instead of Alternating Current.

Power mains are not distorted since there is no induction.

There is no need to purchase expensive Power Factor correction systems for the plant if all welding is done with MFDC inverters.

Capacitors in the inverters improves the mains.

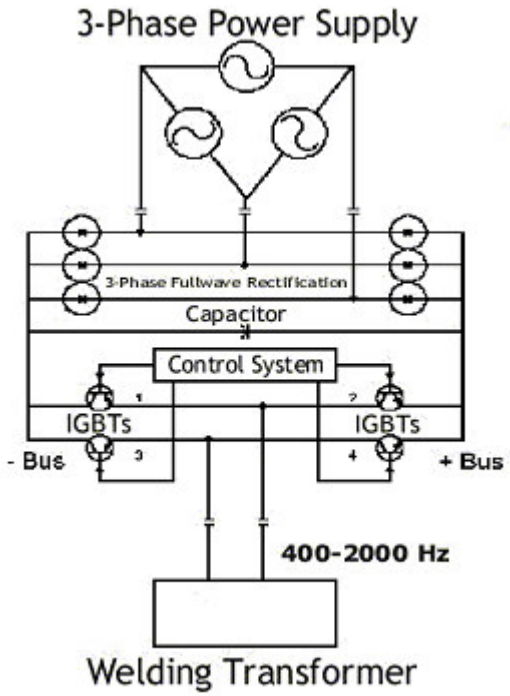
What kind of penalties does your electricity supplier charge for Power Factor distortions caused by your plants?



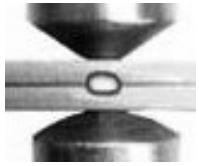
Automatic Load Distribution

MFDC Loads are evenly distributed over the three phase.

The bank of capacitors that are found on the MFDC system allows for current to draw from the bank as well as from the line thus reducing peak line currents.



During installation, you do not need to map out phase distribution since MFDC inverters loads all phases evenly

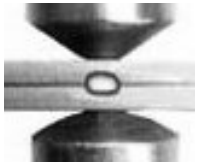


Eliminates Need and Maintenance of Expensive Kickless Cables

Due to higher operating frequencies (400 to 2000Hz), the welding transformer can be as much as 74% smaller than the traditional AC weld transformer (50 / 60 Hz).

This allows the user to locate the transformer much closer to the welding gun thus eliminating the use of expensive Kickless cables that need to be maintained and monitored.

Kickless cables are likely to break at the most inconvenient time such as during production cycle time.



Precise Welding Current

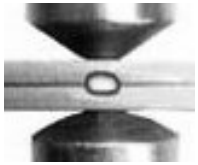
MFDC utilizes IGBTs for switching. These are turned on and off at the rate of 400 to 2000 times per second.

By controlling both the turn on and turn off, the MFDC can use a deterministic approach to controlling weld current.

Conventional AC controls utilize SCRs for switching. These are turned on by the weld control but then remain conducting until the line voltage crosses the zero point during the base frequency line cycle.

Because of this, conventional AC controls must use a predictive algorithm rather than a deterministic approach. Also, if an under or over compensation occurs on one of the cycles, the AC control will have to wait until the next period of the base frequency whereas the MFDC need only wait a fraction (1/20th nominal) of that time.

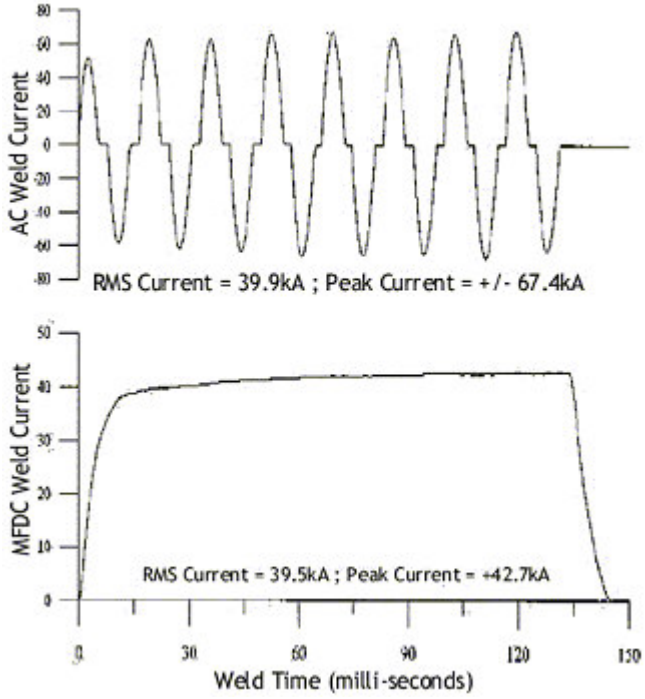
Most precise current control is achieved with MFDC inverters.

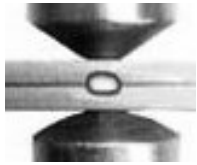


Welding Process Friendly

MFDC eliminates undesired inter-cycle cooling periods that exist in AC resistance welding processes. Welding therefore can occur faster which would then reduce heat waste and the problems associated to eliminating that waste.

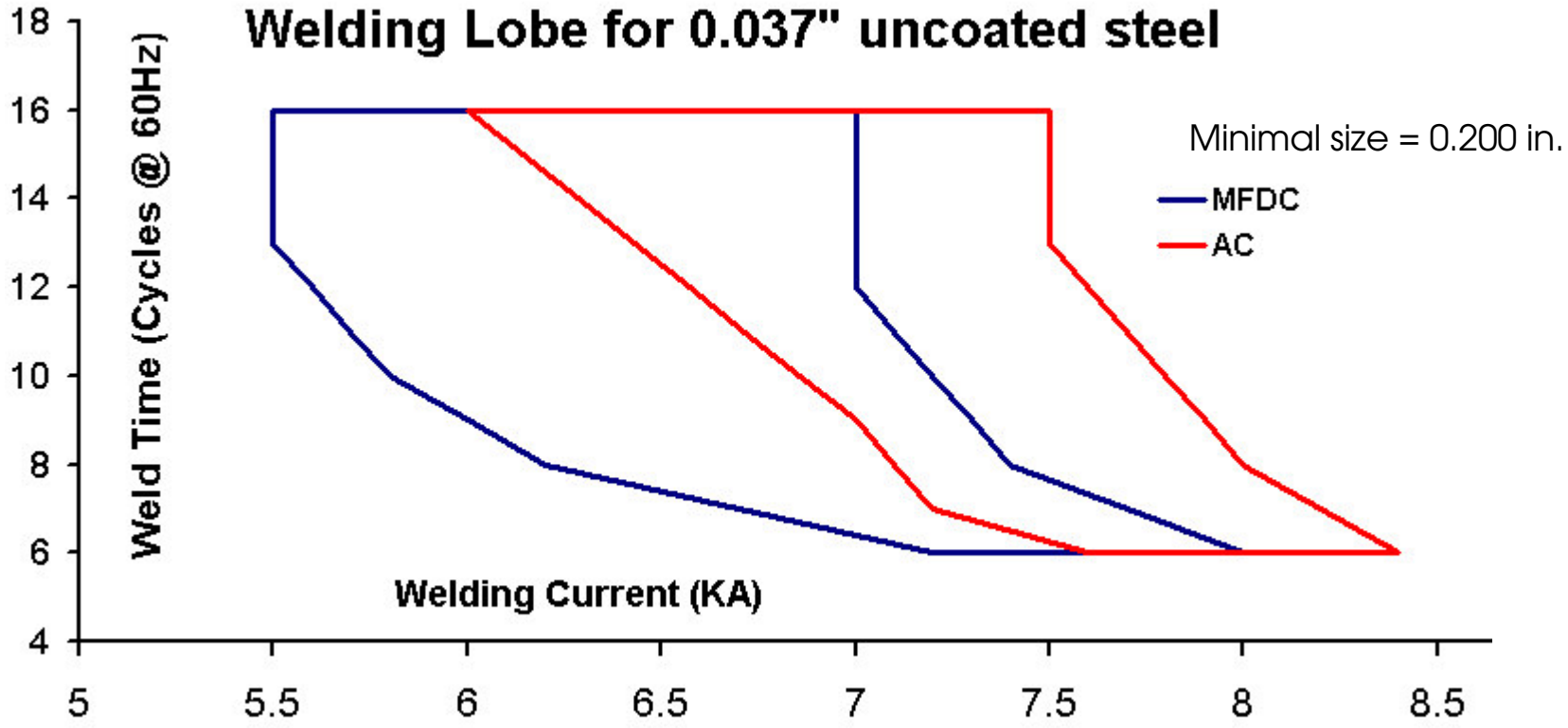
Welding current time can also be decreased since there is no inter-cycle cooling periods. This additional benefit would contribute to more energy savings, better production cycle times, reduced wear on welding apparatus, and more…





Wider Welding Lobes

MFDC systems has wider welding lobes at lower weld current levels as compared to AC systems



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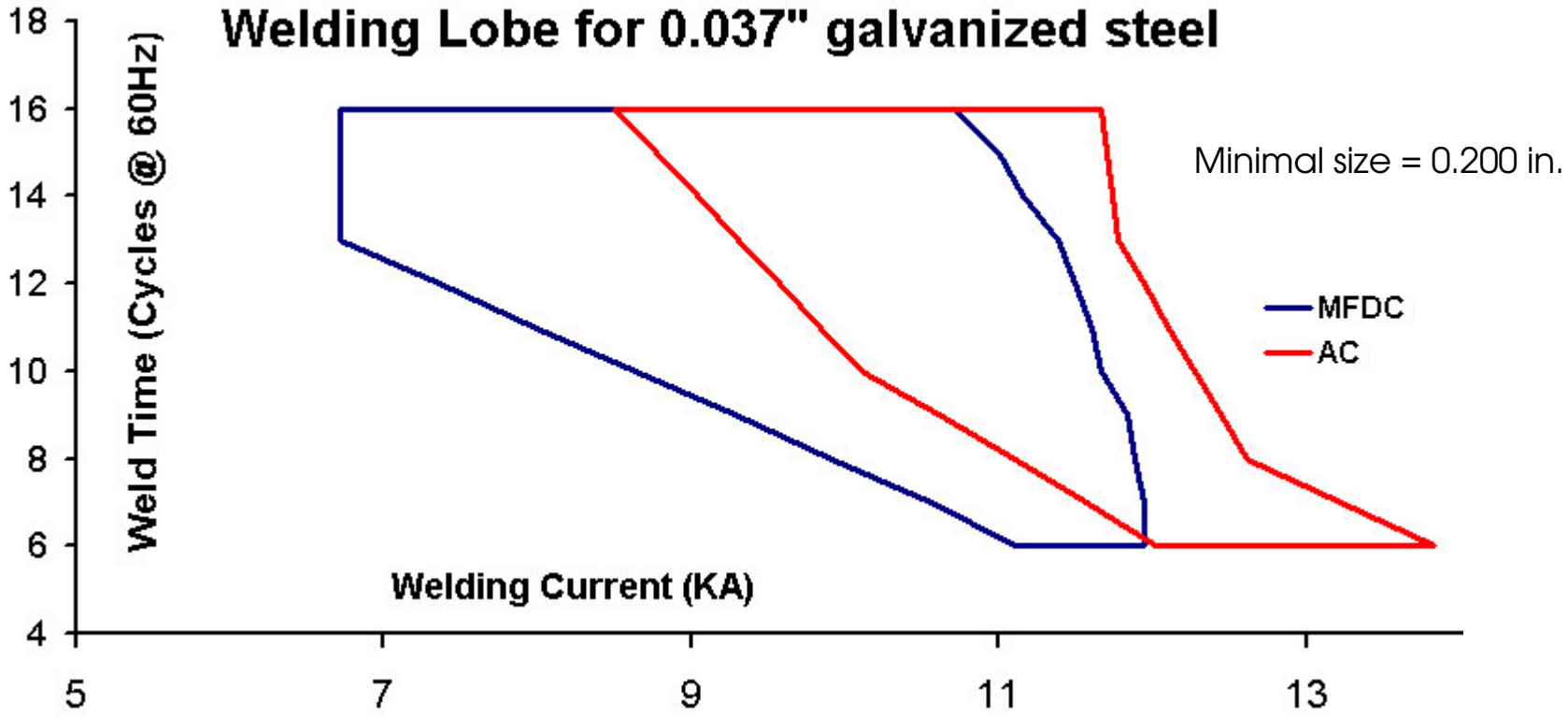
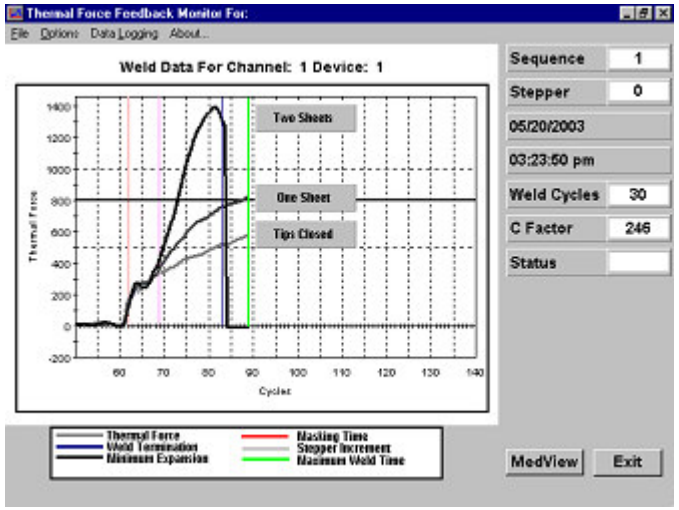
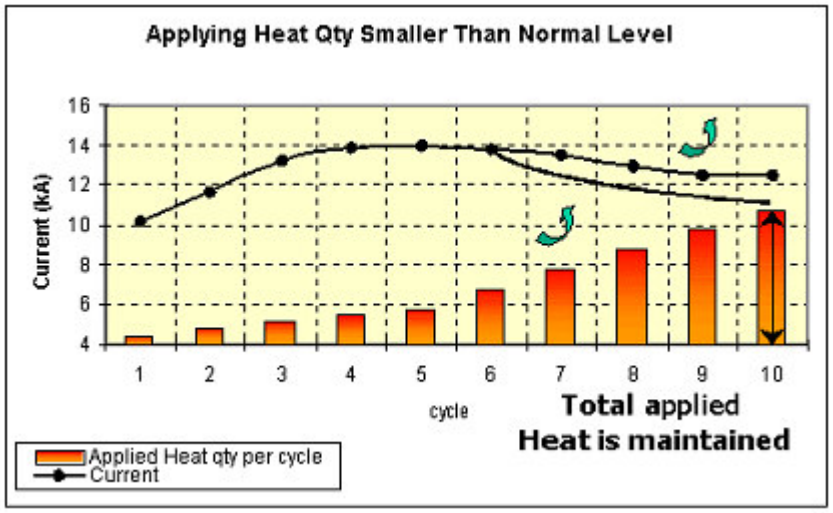


Adaptive Welding

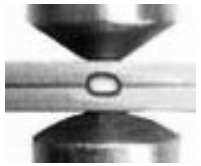
Fast Response

The inverter control is most appropriate type of control for deploying WTC adaptive welding algorithms due to its quick response for current control





Thermal Force Feedback (TFF) and Constant Heat Control (CHC) are resistance welding algorithms developed by WTC.



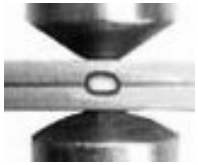
Flexible Welding Systems

AC systems need to be sized correctly so that control of welding current is achieved in the area of 70 to 90 percent of maximum current.

This means for example that a 20K amp welder is suited for welding applications ranging from 14K amps to 18K amps. Although it is possible to use this welder for applications requiring much less than 14K amps, it does mean working in areas of instability.

MFDC systems can work from 20 to 90 percent of maximum hence in a similar 20K amp MFDC welder can be used reliably from 4K amps to 18K amps.

Robots can be used to weld more varied parts of the auto structure using MFDC inverters



Case Study:
Gill Manufacturing

Comparison of AC and DC Welders

Consumers Energy
Count on Us

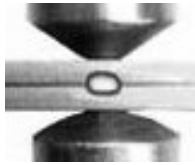
Per our conversation during the on-site testing of 04/23/99, please find attached the results of the RPM tests as you requested. The tests were conducted 04/23/99 at approximately 9:45 to 11:15 AM to record the differences in two different types of welding operation to accomplish the same end product.

Max voltage variations @ 480 volts was approximately 10V or less.
The first welder was a new DC style that spreads the total load across all three phases for a single weld. It was rated @ 85KVA 3 phase 3 wire 480V and controlled by an 80 Amp circuit breaker. The max inrush was approximately 164 Amps (3 cycle) per phase.

Actual max inrush was: A=164.1; B=150.8; C=140.3 AMPS.

The other welder was a more standard single phase AC welder. It was rated @ 150KVA 1 phase 2 wire 480V and controlled by a 400 amp circuit breaker.

The max inrush was approximately 684 Amps (12 cycles), also shown on the attachment.



This testimonial was written by a distributor and planner of energy.

DC Welding has tighter range

Consumers Energy
Count on Us

AC RESULTS	
PC No.	Brake Torque (Newton Meters)
1	225
2	235
3	200
4	215
5	225
6	248
7	200
8	175
9	228
10	220
11	170
12	240
13	215
14	235
15	235
AVERAGE	218
RANGE	78

DC RESULTS	
PC No.	Brake Torque (Newton Meters)
1	175
2	175
3	170
4	175
5	170
6	170
7	170
8	175
9	170
10	175
11	173
12	170
13	170
14	170
15	175
AVERAGE	172
RANGE	5

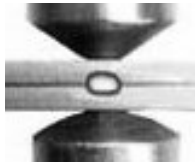
The minimal acceptable torque level is set at 75 Newton Meters.

It was possible to reduce the welding cycle time on the DC welder and still maintain well above the acceptance range.

The AC welder had a wider range of results hence the cycle time was programmed longer.

AC Welder
Primary Current=687Amps
Upslope = 0 Cycles
Weld Time = 12 Cycles

DC Welder
Primary Current=164 Amps
Upslope = 0 Cycles
Weld Time = 3 Cycles



Welding Steel

Resistance Welding Process
Steel with coatings

Metal	Thermal Conductivity *(27° C)*	Melting Point *(° C)*	Electrical Resistivity (Ohms/CMF) *(20° C)*
Iron	0.803	1300	400
Aluminum	2.37	680	17.6
Zinc	-	435	22.3
Copper	3.98	1115	10.4

Steel

Resistance welding of steel is relatively easier than welding of aluminum. The characteristics that makes steel easier to resistance weld than aluminum is its higher electrical resistivity and its lower thermal conductivity as compared to the copper electrodes. The cooling of the electrodes is very important since steel requires a build up of temperature in excess of 1300°C to melt which is well above the melting temperature of copper of 1115°C. The flow of water in the electrodes is necessary to take away heat that builds up at the electrode / work piece contact area. This will also help in maintaining the surface contact area of the copper electrodes at a proper dimension which will result in maintaining the current density to melt the steel.

Coatings on Steel

Characteristics of zinc are shown above to illustrate the approaches necessary to weld coated materials. As compared to bare steel, the coated steels would require a pulse of current prior to the weld to melt the coating. It only requires 435°C to melt the coating. The resistance to the pulse of current by the steel would create the heat that would boil off the zinc coating. Once melted however, the zinc would puddle around the weld zone and would provide lower resistivity as compared to bare steel onto bare steel. Because of this lowered resistivity, significant higher levels of current would be required to weld coated steel as compared to bare steel.

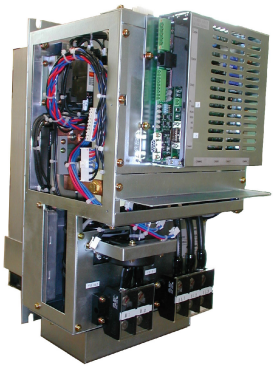
Welding Aluminum

Resistance Welding Process Aluminum

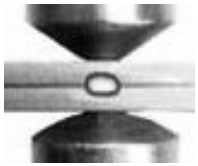
Metal	Thermal Conductivity *(27° C)*	Melting Point *(° C)*	Electrical Resistivity (Ohms/CMF) *(20° C)*
Iron	0.803	1300	400
Aluminum	2.37	680	17.6
Zinc	-	435	22.3
Copper	3.98	1115	10.4

Aluminum

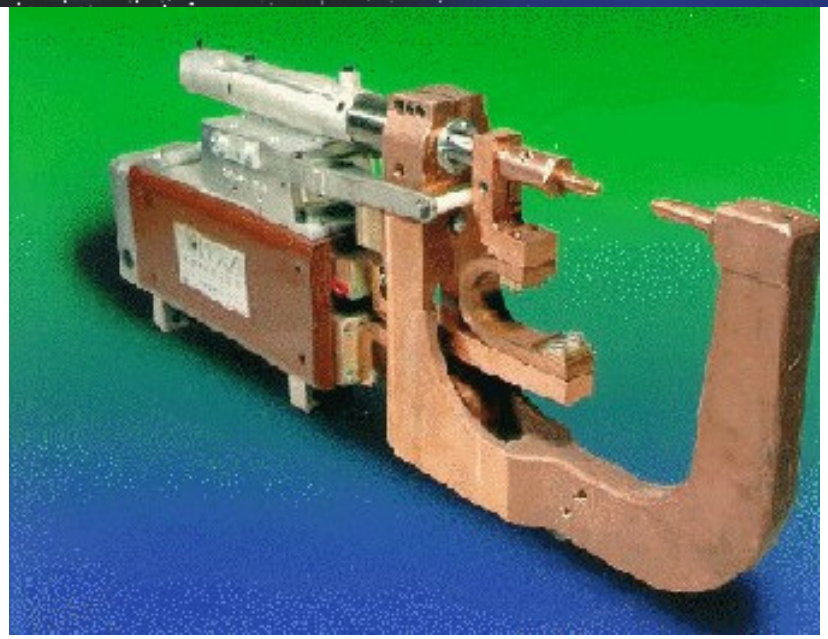
Aluminum has an electrical resistivity and thermal conductivity that is closer to that of copper. What makes it possible for resistance welding is that its melting temperature is much lower than that of copper. Due to aluminum's lower resistivity and higher thermal conductivity as compared to steel, resistance welding aluminum would require much higher levels of current but the weld must be accomplished in much less time.



Inverter DC welding is the best choice for aluminum welding applications due to short welding times.



Tooling Design



When designing a tool for resistance welding, it is best to start at the weld nugget area first then work back to the power supply.

Determine what needs to happen through the work piece first then decide how this will be accomplished. It is too late if you get the tools first then determine how you are going to use them. Determine the amount of current and time needed to do the weld and the force required across the electrode. Next determine the current carrying circuit required. Do you simply need to weld nuggets along a flange or do you need to produce a weld in the middle of wall of a train?

There are very important mechanical concerns in resistance welding. Proper electrode alignment, proper electrode force with follow-up, good part and electrode geometry, with sufficient cooling capabilities are some of the considerations that have to be accounted. The welding gun will transfer the power to the weld zone thus its capabilities are of great importance for producing quality welding results.

Transformer Sizing Secondary Voltages

The work piece electrical resistance that is presented across the electrodes is measured in micro-ohms. Since the welding current required may be in the range of a few thousand amperes up to 250,000 amperes, the range of voltage across the work piece would only be around 0.5 to 1.5 volts. When all considered, the resistance of the tools that carry the welding current will exceed the work piece resistance. The integral transformer-gun design above is very efficiently designed yet its resistance is still higher than that of the work piece.

The welding transformer that is coupled to the gun apparatus may need to be in the order of 4 to 12 volts in order to overcome the tool resistance. There are situations where an integral transformer-gun design can not be used. In such cases, the transformer is remote from the weld gun by means of large current carrying conductors. This increases the tool resistance and as a result, the output voltage across such transformers may need to be as high as 30 volts just to get the 0.5 to 1.5 volts across the work piece.

Inverter Various Sizes & Configurations

Models: IPS-BW

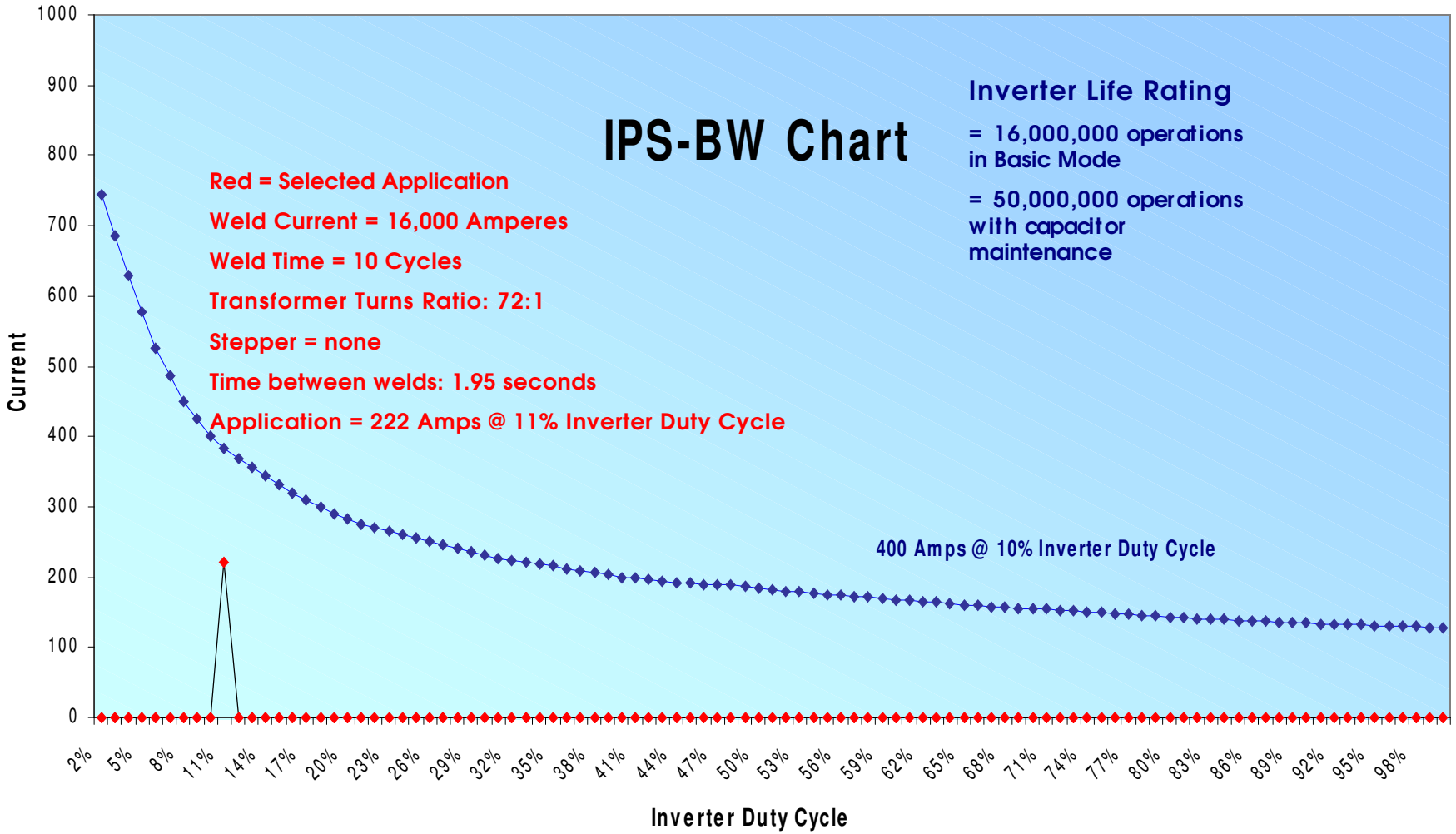
IPS = Inverter Power Switch

Size = A, B, C, D, E, & F

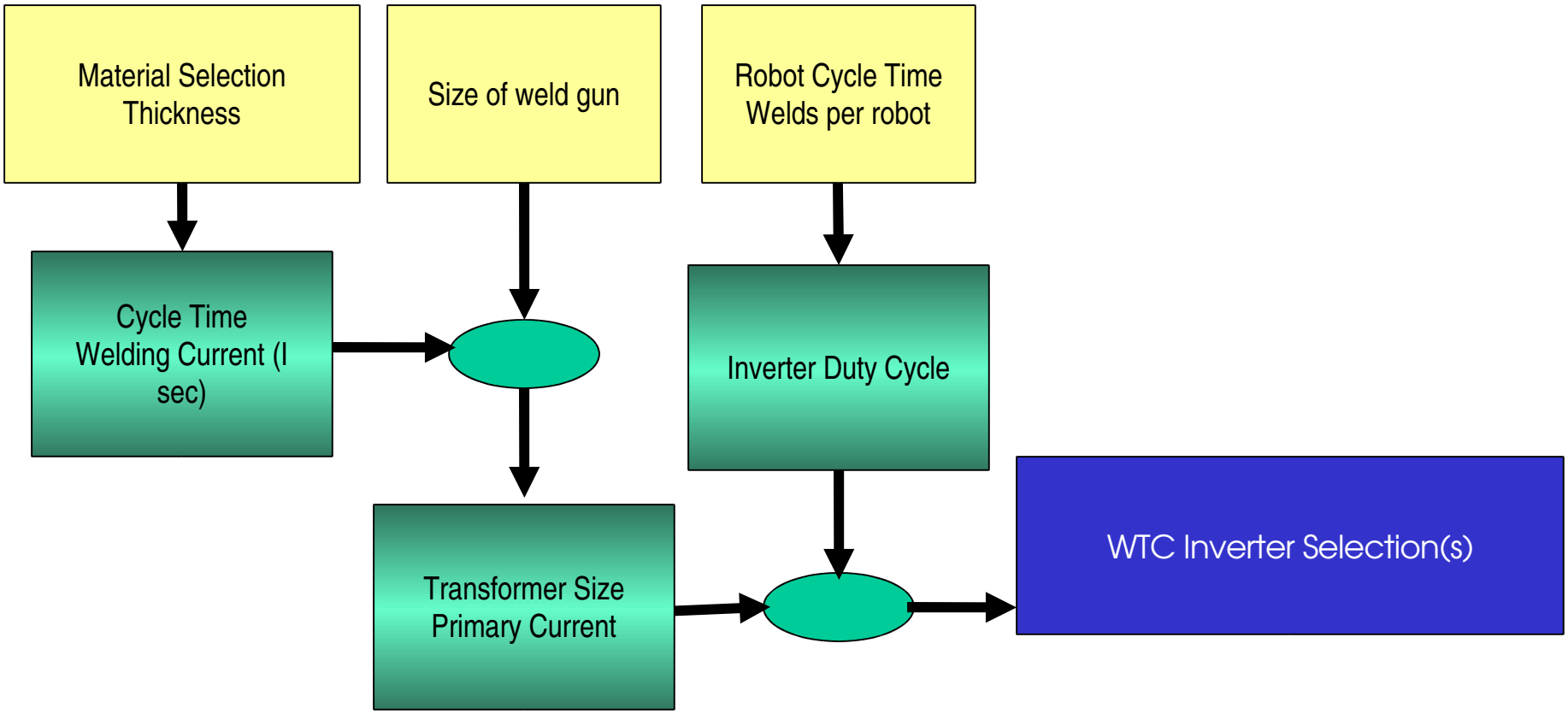
- A = 300 Amp 10%DC
- B = 400 Amp 10%DC
- C = 600 Amp 10%DC
- D = 1000 Amp 10%DC
- E = 2000 Amp 10%DC
- F = 4000 Amp 10%DC

Cooling = A (Air) & W (Water)

Various Sizes & Configurations



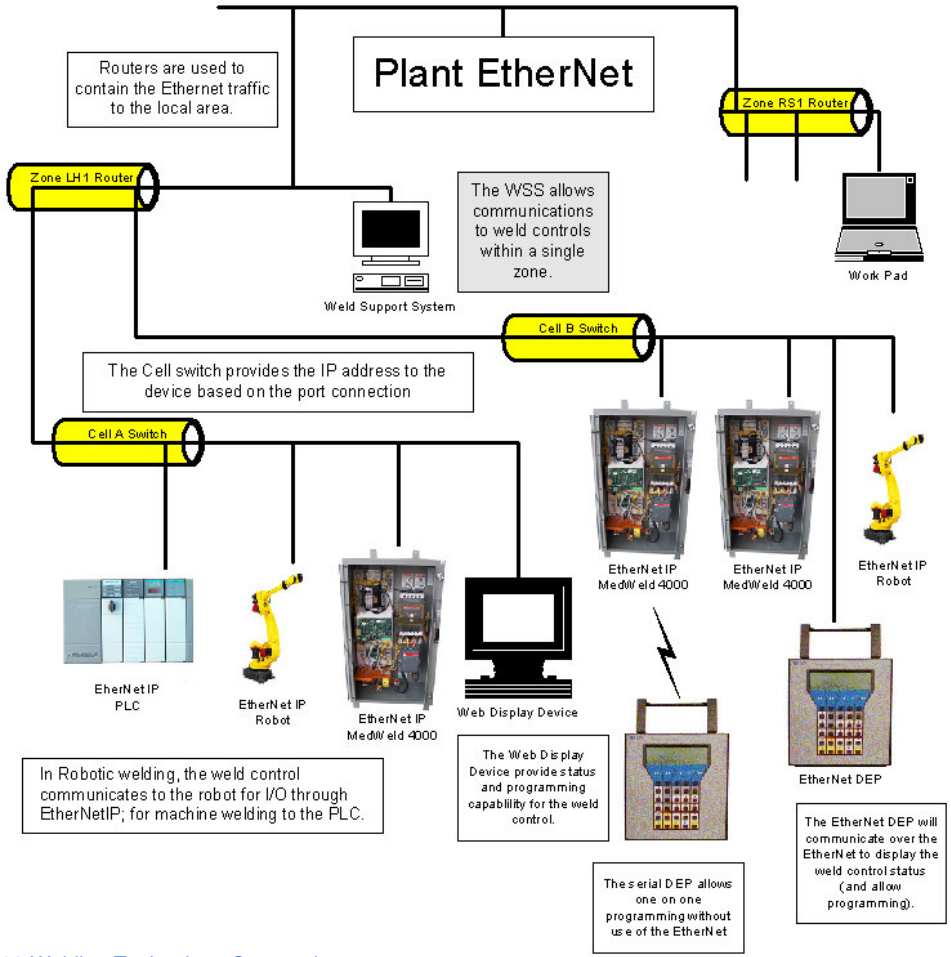
WTC Selection Charts for Inverters



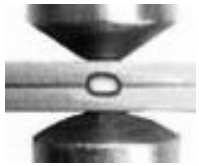
- Proper operating range is below the curve

Networking Results

WTC Networks fit in customer's plants



- All WTC Controls Series are capable to connect to network systems.



Industrial Technical Services

24/7 Toll-Free Service Hotline

1-877-982-7378

Process Application Assistance
Product Support Assistance
Training Classes: On-site or WTC Training Centers
Service Repair Technicians

State-of-the-Art Repair Centers and services

Field Engineering Services

Technical Training Services

Authorized Service Partnerships