Rapid Z® Galvanized Welding

**Overview**

**Rapid Z®** – High Speed, Low Porosity.
- Less Spatter*
- Better Bead Appearance*
- Less Internal & External Porosity*
- Higher Productivity & Less Rework*

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*As compared to DCEN with E70C-GS on galvanized steel.
Process Description

When it comes to making automotive parts, productivity and quality are the highest priorities. But those targets can be hard to hit when welding galvanized material with conventional processes. Welding on galvanized can be difficult for many reasons. The zinc coating thickness varies, part fit up varies, and porosity is likely, forcing a difficult balance between proper weld size, faster weld speed, or good x-ray quality.

Process Z™ provides all three, without compromising. Metalshield® Z gas-shielded wire, combined with Rapid Z waveform technology operating on AC polarity, minimizes the internal porosity of welds and assures virtually no external porosity while maintaining faster travel speeds.

With the Rapid Z waveform the electrode droplet transfer is focused and predictable. Less of the surrounding zinc coating is introduced into the weld — meaning less internal porosity. Smooth droplet transfer also delivers more stability and less spatter when welding at increased travel speeds.

Waveform

1. Negative Ramp
   Ramps current slowly to avoid spatter from a superheated molten droplet.

2. Negative Peak
   Provides energy to create a molten droplet without transferring.

3. Positive Peak
   Provides a pinch force to the droplet.

4. Tailout
   Reduced current relaxes the plasma force as the droplet approaches the puddle.

5. Wet-in
   Proprietary hardware quickly reduces the current at the instant the droplet contacts the puddle, reducing spatter as the droplet detaches.
Synergic Welding

1. Adjust WFS to the desired setting. Refer to the Applications section for the recommended settings.

Voltage and UltimArc®

2. Based on WFS, a pre-programmed nominal voltage is selected.

3. Adjusting voltage increases or decreases the arc length, allowing the user to fine tune arc characteristics.

4. Synergic Weld modes improve the ease of set-up by pre-selecting an ideal voltage based on the selected WFS. The user can then fine tune their Voltage setting based on their personal preference and can easily see whether they are above or below the nominal setting.

   **Voltage Display**
   - Above Ideal Voltage (Upper bar displayed)
   - At Ideal Voltage (No bar displayed)
   - Below Ideal Voltage (Lower bar displayed)

5. The UltimArc® control fine-tunes the heat input into the plate.
ASTM Designations for Hot-Dipped Galvanized Plate

ENGLISH:
60G60G designates the minimum coating weight per ASTM specification.

METRIC:
Z120 designates the minimum coating weight per ASTM specification.

Typical Zinc Coating Thickness for these ASTM specifications average 9.1 microns.

Synergic Procedures – 2F Lap Joint

- Use a 0-5° drag angle.
- Use a 40-50° work angle.
- For 2F-Horizontal, position the electrode approximately one electrode diameter outside the joint favoring the bottom leg.
- For 2F-Vertical, position the electrode approximately one electrode diameter outside the joint favoring the top leg.

Synergic Procedures – 2F Lap Joint continued on page 4

## APPLICATIONS

### Synergic Procedures – 2F Lap Joint (continued)

#### ENGLISH

**90Ar / 10CO₂ @40-45 CFH**

- 5/8 in - 3/4 in
- 0°-5° drag angle

<table>
<thead>
<tr>
<th>Metalshield Z 0.035 in</th>
<th>in/min</th>
<th>in/min</th>
<th>cm/min</th>
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<tr>
<td>20 ga (0.95 mm)</td>
<td>370</td>
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<td>20 ga (0.95 mm)</td>
<td>420</td>
<td>50</td>
<td>21.5</td>
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<tr>
<td>18 ga (1.27 mm)</td>
<td>400</td>
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<td>14 ga (1.98 mm)</td>
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<td>14 ga (1.98 mm)</td>
<td>660</td>
<td>50</td>
<td>24.5</td>
</tr>
</tbody>
</table>

*60G60G* designates the minimum weight per ASTM specification

#### METRIC

**80Ar / 20CO₂ @40-45 l/min**

- 16 mm - 19 mm
- 0°-5° drag angle

<table>
<thead>
<tr>
<th>Metalshield Z 0.9 mm</th>
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<th>m/min</th>
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<td>1.0</td>
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<td>2.0</td>
<td>16.8</td>
<td>125</td>
<td>24.5</td>
</tr>
</tbody>
</table>

**Z120** designates the minimum weight per ASTM specification

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#### ENGLISH

**90Ar / 10CO₂ @40-45 CFH**

- 5/8 in - 3/4 in
- 0°-5° drag angle

<table>
<thead>
<tr>
<th>Metalshield Z 0.040 in</th>
<th>in/min</th>
<th>in/min</th>
<th>cm/min</th>
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<td>14 ga (1.98 mm)</td>
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<td>14 ga (1.98 mm)</td>
<td>520</td>
<td>50</td>
<td>23.5</td>
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*60G60G* designates the minimum weight per ASTM specification

#### METRIC

**80Ar / 20CO₂ @40-45 l/min**

- 16 mm - 19 mm
- 0°-5° drag angle

<table>
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<td>2.0</td>
<td>13.2</td>
<td>125</td>
<td>23.5</td>
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</table>

**Z120** designates the minimum weight per ASTM specification

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*See Customer Assistance Policy and Disclaimer Notice on page 10.*
**Sense Leads**

An electrode sense lead is required. This is a standard connection in an ArcLink® cable.

**DO NOT** connect either sense lead to a welding stud on the power source as this may result in erratic arc behavior.

A work sense lead (optional) is highly recommended for total welding cable lengths >50 ft. and should be connected directly to the workpiece.

For best performance, connect the work sense lead close to the welding arc.

The work sense lead should be separated away from welding cables to minimize interference.

**DO NOT** route sense lead cable close to high current welding cables as this may distort the sense lead signal.

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**Work Leads**

Connect the work lead to the negative stud on the power source and directly to the workpiece. Maintain the shortest connection length possible.

The total length of the welding current loop (A+B+C) should be minimized to reduce inductance. Route cables (A,B) close together to further reduce cable inductance.

**Test cable inductance levels using the Power Wave® Manager software exclusively from Lincoln Electric® Software. Available at [www.powerwavesoftware.com](http://www.powerwavesoftware.com).**

For configurations with excessive inductance, use Lincoln Electric® patented coaxial welding cables.

Lincoln Electric® coaxial cables combine the positive and negative welding leads into one cable to minimize cable inductance.
Connection Diagram – Advanced Module
### Troubleshooting

<table>
<thead>
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<th>Problem</th>
<th>Check</th>
<th>Action</th>
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<tr>
<td>Gas Coverage</td>
<td>Volts</td>
<td>Travel Speed</td>
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<td><strong>ERRATIC ARC</strong></td>
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<td>![Action Icon]</td>
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<tr>
<td>Proper Feeding</td>
<td>Volts</td>
<td>Travel Speed</td>
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<td><strong>POROSITY</strong></td>
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<td>Wire Feed Speed</td>
<td>Volts</td>
<td>Travel Speed</td>
</tr>
<tr>
<td><strong>CONCAVE BEAD</strong></td>
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<td>![Action Icon]</td>
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<tr>
<td>Volts</td>
<td>Wire Feed Speed</td>
<td>Contact Tip to Work Surface</td>
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<td><strong>UNDER CUT</strong></td>
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<tr>
<td>Volts</td>
<td>Travel Speed</td>
<td>Wire Feed Speed</td>
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</tbody>
</table>

- **Increase**
- **Decrease**
- **Inspect & Replace**
- **Important**
## Troubleshooting

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<tr>
<th>Issue</th>
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<tr>
<td><strong>CONVEX BEAD</strong></td>
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<tr>
<td><strong>POOR PENETRATION</strong></td>
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<td>![Increase Symbol] ![Decrease Symbol] ![Increase Symbol] ![Decrease Symbol] ![Decrease Symbol]</td>
</tr>
</tbody>
</table>

*Increase*, *Decrease*, *Inspect & Replace*, *Important*
GLOSSARY

Icons

Wire Type | Gas | Material Thickness | Wire Feed Speed | Travel Speed | Volts | Amps | Contact Tip to Work Surface | Drag Angle | Arc Length
---|---|---|---|---|---|---|---|---|---
Control Knob | Weld Stud | Torch | Work Sense Lead | Work Clamp | Torch Nozzle | Spatter | Erratic Arc | Proper Feeding | Stop / Avoid
Knurled Drive Rolls | Gas Coverage | Zinc Coating Thickness | Porosity | Concave Bead | Burn Through | Under Cut | Convex Bead | Poor Penetration | UltrArc®

Technical Terms

Cable Inductance | Resistance to change in current.
GMAW | Gas metal arc welding including metal inert gas (MIG) and metal active gas (MAG) welding.
Porosity | Gas entrapped in solidifying metal forms spherical or elongated pores in the weld.
Drag Angle | The angle at which the electrode trails the weld pool relative to the direction of travel.
Synergic | A mode of control which automatically selects a pre-programmed nominal voltage based on the wire feed speed (WFS) set by the operator.
Work Angle | The angle of the electrode, off perpendicular, relative to the work piece surface.
Zinc Coating Thickness | Thickness of Zinc Coating; typically designated by weight per ASTM specification.

Procedure Notes

All listed procedures are starting points and may require some adjustment depending on the specific application. Torch angle, electrode placement, contamination, mill scale, joint fit up, and joint consistency are factors that may require special consideration depending on the specific application.

At higher travel speeds, joint fit up, wire placement, and contamination all become factors that are more significant. The result of welding at higher travel speeds is a tendency to produce more spatter, less penetration, more undercut, and a less desirable bead shape. Depending on the limitations / requirements of the actual application, slower travel speeds and higher arc voltages may be required. As the travel speed increases in fast follow applications (1/4” to 14 Gauge), a tighter arc length must be maintained so that the puddle properly follows the arc. Operators typically reduce the arc length control (Voltage) to achieve this. At faster travel speeds, the bead-shape can become very convex (or ropy), and the weld will not “wet” well. There is a point at which the arc is set so short that the arc will become unstable and stubbing will occur. This forms a limitation of just how fast the travel speed can be raised.

It is ultimately the responsibility of the end user to ensure the proper weld deposition rate, bead profile, and structural integrity of a given weld application.
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