

# Weldability Chart – Micro Resistance Welding

| Materials to be Welded (Melting Point °C)             | Aluminum       | Beryllium Copper | Brass        | Cold Rolled Steel | Copper         | Dumet            | Galvanized Steel | Gold           | Inconel, Kanthal, Kovar, and Nichrome | Molybdenum and Tungsten | MP35N          | Nickel     | Niobium        | Phosphor Bronze | Platinum     | Stainless Steel | Titanium       |
|---|----------------|------------------|--------------|-------------------|----------------|------------------|------------------|----------------|---------------------------------------|-------------------------|----------------|------------|----------------|-----------------|--------------|-----------------|----------------|
| Titanium (1670°)                                      | 5 A,E<br>A,B c | 4 A<br>A,B       | 4 A<br>A,B c | 2 A,B<br>A,B a    | 4 E<br>A,B c   | 3 A,B<br>A,B d   | 3 A<br>A,B d     | 4 A,E<br>A,B a | 1 A,B<br>A e                          | 2 A,B<br>A a            | 2 A<br>A a     | 2 A<br>A,B | 2 A,B<br>A,B c | 5 A<br>A,B      | 2 A<br>A,B   | 2 A,B<br>A,B c  | 1 A,B<br>A,B a |
| Stainless Steel (1450°)                               | 4 A,E<br>A,B c | 4 A<br>A,B       | 4 A<br>A,B c | 1 A,B<br>A,B a    | 4 E<br>A,B c   | 3 A,B<br>A,B d   | 2 A<br>A,B d     | 4 A,E<br>A,B a | 1 A,B<br>A,B e                        | 3 A,B<br>A,B a          | 2 A,B<br>A,B a | 1 A<br>A,B | 2 A,B<br>A,B   | 5 A<br>A,B c    | 2 A,B<br>A,B | 1 A,B<br>A,B a  |                |
| Platinum (1770°)                                      | 4 A,E<br>A,B   | 4 A<br>A,B       | 4 A<br>A,B   | 2 B<br>A,B        | 4 E<br>A,B c   | 3 A,B<br>A,B d   | 3 A<br>A,B d     | 3 A,E<br>A,B a | 2 A,B<br>A,B a                        | 2 A<br>A b,e            | 2 A,B<br>A,B a | 1 A<br>A,B | 2 A,B<br>A,B   | 4 A<br>A,B c    | 1 A<br>A a   |                 |                |
| Phosphor Bronze (900°)                                | 4 A,E<br>A c   | 3 A<br>A c       | 3 A<br>A c   | 4 B<br>A c        | 3 E<br>A c     | 3 A,B<br>A d     | 4 A<br>A d       | 3 A,E<br>A c   | 4 A,B<br>A c                          | 5 A,B<br>A c,e          | 5 A,B<br>A c,d | 4 A<br>A c | 5 A,B<br>A c   | 2 A<br>A c      |              |                 |                |
| Niobium (2470°)                                       | 4 A,E<br>A,B c | 4 A<br>A,B c     | 4 A<br>A,B c | 3 B<br>A,B        | 4 E<br>A,B c   | 3 A,B<br>A,B d   | 3 A<br>A,B d     | 4 A,E<br>A,B a | 2 A,B<br>A,B e                        | 2 A,B<br>A,B a          | 2 A,B<br>A,B   | 3 A<br>A,B | 2 A,B<br>A,B a |                 |              |                 |                |
| Nickel (1450°)  | 4 A,E<br>A c   | 3 A<br>A c       | 3 A<br>A     | 2 B<br>A a        | 3 E<br>A c     | 2 A,B<br>A d     | 2 A<br>A d       | 3 A,E<br>A a   | 1 A,B<br>A a                          | 2 A,B<br>A a            | 2 A,B<br>A a   | 1 A<br>A a |                |                 |              |                 |                |
| MP35N (1400°)   | 4 A,E<br>A c   | 4 A<br>A c       | 4 A<br>A c   | 3 B<br>A c        | 4 E<br>A c     | 3 A,B<br>A d     | 3 A<br>A d       | 4 A,E<br>A c   | 2 A,B<br>A a                          | 2 A,B<br>A a            | 1 A,B<br>A a   |            |                |                 |              |                 |                |
| Molybdenum (2000°) & Tungsten (3400°)                 | 4 A,E<br>A,B e | 4 A<br>A,B e     | 4 A<br>A,B e | 4 B<br>A,B e      | 4 E<br>A,B c,e | 4 A,B<br>A,B d,e | 4 A<br>A,B e     | 4 A,E<br>A,B e | 3 A,B<br>A,B e                        | 2 A,B<br>A,B e          |                |            |                |                 |              |                 |                |
| Inconel, Kanthal, (1400°) Kovar, and Nichrome -1500°) | 4 A,E<br>A,B c | 4 A<br>A,B c     | 4 A<br>A,B c | 2 B<br>A,B a      | 4 E<br>A,B c   | 3 A,B<br>A,B d   | 3 A<br>A,B d     | 4 A,E<br>A,B c | 1 A,B<br>A,B a                        |                         |                |            |                |                 |              |                 |                |
| Gold (1060°)  | 4 A,E<br>A,E c | 2 A<br>A,E a     | 2 A<br>A,E   | 4 B<br>A,E c      | 2 E<br>A,E c   | 3 A,B<br>A,E d   | 4 A<br>A,E d     | 2 A,E<br>A,E   |                                       |                         |                |            |                |                 |              |                 |                |
| Galvanized Steel (1450°)                              | 4 A,E<br>A c,d | 4 A<br>A c       | 4 A<br>A c   | 2 B<br>A d        | 4 E<br>A c     | 3 A,B<br>A d     | 2 A<br>A d       |                |                                       |                         |                |            |                |                 |              |                 |                |
| Dumet (N/A)   | 4 A,E<br>A,B d | 3 A<br>A,B d     | 3 A<br>A,B d | 2 B<br>A,B d      | 3 E<br>A,B d   | 2 A,B<br>A,B d   |                  |                |                                       |                         |                |            |                |                 |              |                 |                |
| Copper (1080°)  | 4 A,E<br>E c,d | 2 A<br>E         | 2 A<br>E     | 3 B<br>E d        | 2 E<br>E       |                  |                  |                |                                       |                         |                |            |                |                 |              |                 |                |
| Cold Rolled Steel (1450°)                             | 4 A,E<br>B c,d | 4 A<br>B         | 4 A<br>B     | 1 A<br>B a        | 1 B<br>B a     |                  |                  |                |                                       |                         |                |            |                |                 |              |                 |                |
| Brass (900°)  | 4 A,E<br>A c   | 2 A<br>A         | 2 A<br>A     |                   |                |                  |                  |                |                                       |                         |                |            |                |                 |              |                 |                |
| Beryllium Copper (980°)                               | 4 A,E<br>A c,d | 2 A<br>A         |              |                   |                |                  |                  |                |                                       |                         |                |            |                |                 |              |                 |                |
| Aluminum (660°)                                       | 3 A<br>A d     |                  |              |                   |                |                  |                  |                |                                       |                         |                |            |                |                 |              |                 |                |

**Designing Parts for Weldability:**

- In general, resistive parts are easier to weld than conductive parts.
- Consider the melting point, hardness, and electrical and thermal conductivity of the materials.
- Balance the thermal mass of the parts to be welded.
- If the thermal imbalance is too great, add projections to the part with the greater thermal mass or to the most conductive part.
- Design parts for easy electrode access. An opposed electrode configuration is always preferred.

**Weldability Codes:**

|   |                |
|---|----------------|
| 1 | Excellent      |
| 2 | Good           |
| 3 | Fair           |
| 4 | Difficult      |
| 5 | Very Difficult |

**Electrode Materials:**

**Code Description and Applications**

A - Gildcop - 0.15% Al Oxide Dispersion Strengthened Copper. Long life, high strength electrodes primarily for welding resistive parts.

B - RWMA2 - Copper Chromium Alloy. Used for welding steels, nickel alloys, and other resistive parts.

C - RWMA3 - Copper Cobalt Beryllium Alloy. Used for welding resistive parts requiring high welding forces.

D - RWMA11 - Copper Tungsten Alloy. Used for welding cuprous and precious metals.

E - RWMA13 - Tungsten. Usually inserted into RWMA2 shank. Very hard. Used to weld non-ferrous metals such as copper and brass.

F - RWMA14 - Molybdenum. Usually inserted into RWMA2 shank. Used for welding copper, silver, gold, and their alloys.

**Key:**

|                             |                             |
|-----------------------------|-----------------------------|
| Weldability                 | Electrode Material Choice ↑ |
| Electrode Material Choice ← | Comments                    |

**Comments:**

a - High joint strength is possible.

b - Use power supply with closed loop feedback.

c - Low joint strength is possible.

d - Electrode sticking may occur.

e - Short weld times may be necessary.