

MAGNESIUM

Washington Alloy offers several grades of filler metals for magnesium welding. Washington Alloy AZ61A and AZ92A are the most popular wires and produce superior joints with the maximum tensile strengths offered by these alloys. Available in 36" straightened and cut lengths for Gas or TIG welding and on 3/4 lb. and 10 lb. spools for MIG welding.

TIPS FOR WELDING WITH MAGNESIUM

Cleanliness of both the base metal and filler metal is extremely important when welding with magnesium.

Chemical or mechanical cleaning of the joint area and filler metal, to remove any surface oxidation, should precede any welding. This can be accomplished using a solution of 24 oz. chromic acid, 5-1/3 oz. ferric nitrate and 1/16 oz. potassium fluoride in enough water to make one gallon. Bring the solution to 70-90°F, then immerse the part for 3 minutes, rinse in hot water, then air dry. Mechanical cleaning can be done using an aluminum or stainless steel wire brush, steel wool or an aluminum-oxide abrasive cloth. Gloves should be worn when handling cleaned filler metal.

GAS TUNGSTEN ARC (TIG) AND GAS METAL ARC (MIG) WELDING

Flux is not required for TIG or MIG welding processes. Although this is convenient, it means the cleanliness of the base metal and filler metal is even more critical.

Argon is the recommended shielding gas, however, an argon-helium mixture can increase filler metal flow and penetration. Do not use pure helium as this will create undesirable results. TIG welding can be done with AC current, DC reverse polarity or DC straight polarity. AC current will give good penetration. DC reverse polarity (electrode positive) will give shallow penetration but wide weld deposits. DC straight polarity (electrode negative) will give deep penetration but narrow weld deposits. Pure, Thoriated or Zirconiated Tungsten may be used.

MIG welding is done with DC reverse polarity (electrode positive). MIG welding will increase weld speed by 2 to 4 times faster than TIG welding. MIG welding is the best process for heavy gage parts.

OXYACETYLENE WELDING

Oxyacetylene welding of magnesium is not commonly used. This process should only be considered for single-pass welding on thin gauges of magnesium. A fluoride or chloride flux should be used on the base metal and filler metal in order to clean and protect the weld pool. However be sure to remove any flux residue by washing in hot water, pickle for 2 minutes in a chrome pickle solution, then boil in a 6% solution of sodium dichromate for 2 hours.

References: American Welding Society ANSI/AWS A5.19-92 Penton Publishing Co. Welding & Fabrication Data Book 1994/95.

UNS M11611 WASHINGTON ALLOY AZ61A

AWS/SFA 5.19 ER AZ61A

TYPICAL CHEMICAL ANALYSIS (%)

| | |
|--------|-------------|
| Mg | Remainder |
| Al | 5.8-7.2 |
| Be | .0002-.0008 |
| Mn | 0.15-0.5 |
| Zn | 0.40-1.5 |
| Cu | 0.05 max. |
| Fe | 0.005 max. |
| Ni | 0.005 max. |
| Si | 0.05 max. |
| Others | 0.30 max. |

AVAILABLE PACKAGING AND DIAMETERS

| | |
|--------------------------|---------------|
| 3/4 lb. (0.34kg) spools: | 3/64 (1.2 mm) |
| | 1/16 (1.6 mm) |
| 10 lb. (4.54 kg) spools: | 3/64 (1.2 mm) |
| | 1/16 (1.6 mm) |
| | 3/32 (2.4 mm) |
| | 1/8 (3.2 mm) |
| 36 in. (914 mm) rods: | 1/16 (1.6 mm) |
| | 3/32 (2.4 mm) |
| | 1/8 (3.2 mm) |
| | 5/32 (4.0 mm) |
| | 3/16 (4.8 mm) |

UNS M11922 WASHINGTON ALLOY AZ92A

AWS/SFA 5.19 ER AZ92A
MIL R6944 AMS 4395

TYPICAL CHEMICAL ANALYSIS (%)

| | |
|--------|-------------|
| Mg | Remainder |
| Al | 8.3-9.7 |
| Be | .0002-.0008 |
| Mn | 0.15-0.5 |
| Zn | 1.7-2.3 |
| Cu | 0.05 max. |
| Fe | 0.005 max. |
| Ni | 0.005 max. |
| Si | 0.05 max. |
| Others | 0.30 max. |

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OTHER MAGNESIUM ALLOYS

| | | |
|------------------|------------|-------------------|
| EZ33A (AMS 4396) | UNS M12331 | MIL-R-6944 |
| QE22A (AMS 4418) | UNS M18220 | Fed-QQ-M-56 QE22A |
| AZ101A | UNS M11101 | |

TYPICAL PHYSICAL DATA and PARAMETERS

| | AZ61A | AZ92A | EZ33A | AZ101A | QE22A |
|------------------------|--------|--------|--------|--------|--------|
| Tensile Strength (psi) | 44,000 | 25,000 | 23,000 | 22,000 | 40,000 |
| Yield Strength (psi) | 30,000 | 14,000 | 16,000 | 12,000 | 30,000 |
| Elongation (% in 2") | 16 | 2 | 3 | 2 | 4 |
| Shear Strength (psi) | 20,000 | 18,000 | 19,000 | 18,000 | 30,000 |
| Brinell Hardness | 60 | 65 | 50 | 53 | 78 |
| Melting Point (°F) | 1140 | 1110 | 1189 | 1100 | 1140 |
| Weight (ft/lb.) | | | | | |
| 3/64 | 744 | | | | |
| 1/16 | 419 | 412 | 412 | 412 | 412 |
| 3/32 | 186 | 183 | 183 | 183 | 183 |
| 1/8 | 105 | 103 | 103 | 103 | 103 |

TIG (GTAW)

POWERSOURCE

AC machines with a high frequency current or DC machines with continuous amperage control both in reverse polarity (electrode positive)

TUNGSTEN:

Pure, Zirconiated or Thoriated Tungsten.

SHIELDING GAS:

Argon or a 75% Argon, 25% Helium mixture. Helium allows for lower welding currents, but don't use Helium alone as you will get spatter and arc turbulence.

| Weld Rod Dia. | Amps | Gas Flow (CFT/HR) |
|---------------|---------|-------------------|
| 3/32 | 35-125 | 12 |
| 1/8 | 160 | 15 |
| 5/32 | 175 | 20 |
| 3/16 | 200-250 | 20 |

MIG(GMAW)

POWERSOURCE

DC machines in reverse polarity (electrode positive)

a) constant voltage DC machines for short circuit welding (3/16" or less)

b) constant current (drooping volt-ampere output) DC machines for spray-arc welding. (Use spray-arc for 3/16" and larger base plates.)

c) constant potential DC machines, designed to pulse the secondary current output need to be used for pulse-induced arc transfer welds. (Use pulse for base metals thinner than 3/16".)

SHIELDING GAS:

Argon is preferred. Argon-Helium mixtures may be used but Helium alone will cause a lot of spatter and arc turbulence

| Welding Procedure | Wire Dia.. | Amps | Volts | Gas Flow (CFT/HR) | |
|-------------------|------------|---------|-------|-------------------|----------------------|
| Short-circuiting | .040 | 25-40 | 13-14 | 40-60 | |
| Short-circuiting | 1/16 | 70-95 | 14-16 | 40-60 | |
| Short-circuiting | 3/32 | 115-175 | 14-15 | 40-60 | |
| Spray-arc | 1/16 | 240 | 27 | 50-80 | |
| Spray-arc | 3/32 | 320-420 | 24-30 | 50-80 | |
| Pulsed-arc | .040 | 50 | 21 | 40-60 | Pulse voltage: 55 |
| Pulsed-arc | 1/16 | 110-175 | 24-25 | 40-60 | Pulse voltage: 52-55 |
| Pulse-arc | 3/32 | 210 | 29 | 40-60 | Pulse voltage: 55 |

Welding speed was 24-36 inches per minute.

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