



## TECHNICAL SAFETY BULLETIN

**TSB No. 2102**

**STATUS: INITIAL RELEASE**

**SUBJECT: WELD PROCEDURE – CLUSTER DRILLS**

**PRIORITY: 3-GENERAL**

**RELEASE DATE: 12/20/21**

### KEYSTONE TECHNICAL BULLETIN INFORMATION

The bulletin was established to provide customers welding procedures for tie-down lugs for safety restraints on cluster drills. The procedures may also be used during repairs to the cluster drill.

NOTE: If repairs are needed to the cluster drill, consult Keystone Drill prior to welding.

### BULLETIN DETAILS

If welding/pre-heat will occur within 4 inches of a module, the hammer will need to be removed to prevent damage to O-rings.

#### **Welding specifications - shop environment (preferred)**

- Pre-heat area of weld 300°F soak – not to exceed 500°F
- Filler material: Lincoln Electric Ultracore 81Ni2A75-H (or equal)  
AWS E81T1-Ni2M-JH4-1/16" diameter
- Shielding gas: 75%-85% Argon/balance CO<sub>2</sub>
- Multi-pass per AWS D1.1 Standard
- Post cool: cover and allow to slow cool

#### **Welding specifications - field environment**

- Pre-heat area of weld 300°F soak – not to exceed 500°F
- Stick electrode: Lincoln Electric Excalibur 8018-C1 MR (or equal)  
AWS E8018-C1 H4R
- Multi-pass per AWS D1.1 Standard
- Post cool: cover and allow to slow cool

### RELATED EQUIPMENT

Keystone Cluster Drills, Keystone Hole Openers, Keystone Core Barrels

# UltraCore® 81Ni2A75-H

Low Alloy, All Position • AWS E81T1-Ni2M-JH4

## Key Features

- ▶ Capable of producing weld deposits with impact toughness exceeding 41 - 89 J (30 - 66 ft•lbf) at -51°C (-60°F)
- ▶ Designed for welding with 75-85% Argon/ balance CO<sub>2</sub> shielding gas
- ▶ Premium arc performance and bead appearance
- ▶ H4 diffusible hydrogen levels
- ▶ ProTech® foil bag packaging

## Typical Applications

- ▶ Mining
- ▶ Offshore
- ▶ Bridge fabrication
- ▶ High strength fabrication

## Conformances

|                        |                                     |
|------------------------|-------------------------------------|
| AWS A5.29/A5.29M: 2005 | E81T1-Ni2M-JH4                      |
| ASME SFA-A5.29:        | E81T1-Ni2M-JH4                      |
| ABS:                   | 3YSA H5                             |
| Lloyd's Register:      | 3YS H5                              |
| DNV Grade:             | III Y40MS H5                        |
| CWB/CSA W48-06:        | E551T1-Ni2M-JH4<br>(E81T1-Ni2M-JH4) |
| EN ISO 17632-B:        | T556T1-1MA-N5-H5                    |

## Welding Positions

All

## Shielding Gas

75% - 85% Argon / Balance CO<sub>2</sub>  
Flow Rate: 40-55 CFH

## DIAMETERS / PACKAGING

| Diameter<br>in (mm) | 33 lb (15 kg)<br>Spool* |
|---------------------|-------------------------|
| 0.045 (1.1)         | ED032217                |
| 0.052 (1.3)         | ED032277                |
| 1/16 (1.6)          | ED032216                |

\*Spool may be plastic or fiber.

## MECHANICAL PROPERTIES<sup>(1)</sup> – As Required per AWS A5.29/A5.29M: 2005

|   | Yield Strength <sup>(2)</sup><br>MPa (ksi) | Tensile Strength<br>MPa (ksi) | Elongation<br>% | Charpy V-Notch<br>J (ft•lbf) |                 |
|---|--|-------------------------------|-----------------|------------------------------|-----------------|
|   |  |                               |                 | @ -40°C (-40°F)              | @ -51°C (-60°F) |
| <b>Requirements<sup>(4)</sup></b> - AWS E81T1-Ni2M-JH4                            | 470 (68) min.                              | 550-670 (80-100)              | 19 min.         | 27 (20) min.                 | 27 (20) min.    |
| <b>Typical Results<sup>(3)</sup></b><br>As-Welded with 75% Ar/25% CO <sub>2</sub> | 555-580 (80-84)                            | 615-635 (89-92)               | 25-28           | 69-115 (51-85)               | 41-89 (30-66)   |

# UltraCore® 81Ni2A75-H

(AWS E81T1-Ni2M-JH4)

## DEPOSIT COMPOSITION<sup>(1)</sup> – As Required per AWS A5.29/A5.29M: 2005

|   | %C          | %Mn       | %Si   | %S          |
|---|-------------|-----------|---|-------------|
| <b>Requirements<sup>(4)</sup> - AWS E81T1-Ni2M-JH4</b>                            | 0.12 max.   | 1.50 max. | 0.80 max.                                     | 0.030 max.  |
| <b>Typical Results<sup>(3)</sup></b><br>As-Welded with 75% Ar/25% CO <sub>2</sub> | 0.04-0.05   | 0.93-1.05 | 0.25-0.28                                     | 0.005-0.006 |
|   | %P          | %Ni       | Diffusible Hydrogen<br>(mL/100g weld deposit) |             |
| <b>Requirements<sup>(4)</sup> - AWS E81T1-Ni2M-JH4</b>                            | 0.030 max.  | 1.75-2.75 | 4.0 max.                                      |             |
| <b>Typical Results<sup>(3)</sup></b><br>As-Welded with 75% Ar/25% CO <sub>2</sub> | 0.006-0.008 | 2.01-2.13 | 3-4   |             |

## TYPICAL OPERATING PROCEDURES

| Diameter, Polarity<br>Shielding Gas                                     | CTWD <sup>(5)</sup><br>mm (in) | Wire Feed Speed<br>m/min (in/min) | Voltage<br>(volts) | Approx. Current<br>(amps) | Melt-Off Rate<br>kg/hr (lb/hr) | Deposition Rate<br>kg/hr (lb/hr) | Efficiency<br>(%) |       |
|---|--------------------------------|-----------------------------------|--------------------|---------------------------|--------------------------------|----------------------------------|-------------------|-------|
| <b>0.045 in (1.1 mm), DC+</b><br>75%-85% Ar/<br>balance CO <sub>2</sub> | 25 (1)                         | <b>All Position</b>               |                    |                           |                                |                                  |                   | 86-88 |
|   |                                | 4.4 (175)                         | 21-26              | 140                       | 1.8 (4.0)                      | 1.6 (3.5)                        |                   |       |
|   |                                | 5.1 (200)                         | 22-27              | 150                       | 2.1 (4.6)                      | 1.8 (4.0)                        |                   |       |
|   |                                | 6.4 (250)                         | 22-27              | 165                       | 2.6 (5.7)                      | 2.3 (5.0)                        |                   |       |
|   |                                | 7.6 (300)                         | 23-28              | 190                       | 3.1 (6.8)                      | 2.7 (6.0)                        |                   |       |
|   |                                | 8.9 (350)                         | 24-29              | 205                       | 3.6 (8.0)                      | 3.2 (7.0)                        |                   |       |
|   |                                | 9.5 (375)                         | 24-29              | 225                       | 3.9 (8.6)                      | 3.4 (7.5)                        |                   |       |
|   |                                | <b>Flat &amp; Horizontal</b>      |                    |                           |                                |                                  |                   |       |
|   |                                | 10.8 (425)                        | 25-30              | 245                       | 4.4 (9.7)                      | 3.8 (8.5)                        |                   |       |
|   |                                | 12.1 (475)                        | 26-31              | 265                       | 4.9 (10.8)                     | 4.3 (9.5)                        |                   |       |
| 12.7 (500)  | 27-32                          | 275                               | 5.2 (11.4)         | 4.5 (10.0)                |                                |                                  |                   |       |
| <b>0.052 in (1.3 mm), DC+</b><br>75%-85% Ar/<br>balance CO <sub>2</sub> | 25 (1)                         | <b>All Position</b>               |                    |                           |                                |                                  |                   | 86-88 |
|   |                                | 3.8 (150)                         | 21-26              | 150                       | 2.0 (4.5)                      | 1.8 (3.9)                        |                   |       |
|   |                                | 4.7 (185)                         | 22-27              | 165                       | 2.5 (5.5)                      | 2.2 (4.8)                        |                   |       |
|   |                                | 5.7 (225)                         | 22-27              | 190                       | 3.1 (6.7)                      | 2.7 (5.9)                        |                   |       |
|   |                                | 6.4 (250)                         | 23-28              | 215                       | 3.4 (7.5)                      | 2.9 (6.5)                        |                   |       |
|   |                                | 7.0 (275)                         | 23-28              | 235                       | 3.7 (8.2)                      | 3.2 (7.2)                        |                   |       |
|   |                                | 7.6 (300)                         | 24-29              | 255                       | 4.1 (9.0)                      | 3.5 (7.8)                        |                   |       |
|   |                                | <b>Flat &amp; Horizontal</b>      |                    |                           |                                |                                  |                   |       |
|   |                                | 8.5 (335)                         | 24-30              | 275                       | 4.5 (10.0)                     | 4.0 (8.7)                        |                   |       |
|   |                                | 9.5 (375)                         | 25-31              | 295                       | 5.1 (11.2)                     | 4.4 (9.8)                        |                   |       |
| 10.2 (400)  | 25-32                          | 310                               | 5.4 (12.0)         | 4.7 (10.4)                |                                |                                  |                   |       |
| <b>1/16 in (1.6 mm), DC+</b><br>75%-85% Ar/<br>balance CO <sub>2</sub>  | 25 (1)                         | <b>All Position</b>               |                    |                           |                                |                                  |                   | 86-88 |
|   |                                | 3.8 (150)                         | 21-27              | 200                       | 2.9 (6.3)                      | 2.5 (5.5)                        |                   |       |
|   |                                | 4.4 (175)                         | 21-28              | 210                       | 3.3 (7.4)                      | 2.9 (6.4)                        |                   |       |
|   |                                | 5.1 (200)                         | 22-29              | 235                       | 3.8 (8.4)                      | 3.3 (7.3)                        |                   |       |
|   |                                | 5.7 (225)                         | 23-30              | 265                       | 4.3 (9.5)                      | 3.7 (8.2)                        |                   |       |
|   |                                | 6.4 (250)                         | 24-31              | 285                       | 4.8 (10.5)                     | 4.2 (9.2)                        |                   |       |
|   |                                | 7.0 (275)                         | 24-32              | 315                       | 5.3 (11.6)                     | 4.6 (10.1)                       |                   |       |
|   |                                | <b>Flat &amp; Horizontal</b>      |                    |                           |                                |                                  |                   |       |
|   |                                | 8.3 (325)                         | 24-32              | 335                       | 6.2 (13.7)                     | 5.4 (11.9)                       |                   |       |
|   |                                | 8.9 (350)                         | 25-33              | 365                       | 6.7 (14.7)                     | 5.8 (12.8)                       |                   |       |

<sup>(1)</sup>Typical all weld metal. <sup>(2)</sup>Measured with 0.2% offset. <sup>(3)</sup>See test results disclaimer below. <sup>(4)</sup>As-Welded with 75% Argon / 25% CO<sub>2</sub>. <sup>(5)</sup>To estimate ESO, subtract 1/4 in (6.0 mm) from CTWD.

# EXCALIBUR® 8018-C1 MR®

Low Alloy, Low Hydrogen ■ AWS E8018-C1 H4R

## KEY FEATURES

- Designed to produce a nominal 2.25% nickel deposit
- Premium arc performance
- Square coating burn-off
- Easy strike, re-strike and slag removal

## WELDING POSITIONS

All, except vertical down

## CONFORMANCES

|                        |              |
|------------------------|--------------|
| <b>AWS A5.5/A5.5M:</b> | E8018-C1 H4R |
| <b>ASME SFA-A5.5:</b>  | E8018-C1 H4R |
| <b>CWB/CSA W48-06:</b> | E5518-C1     |

## TYPICAL APPLICATIONS

- Low temperature applications
- Refrigerated ammonia tanks
- Liquefied gas storage, piping and transportation
- Weathering steels
- Applications requiring stress-relieved conditions

## DIAMETERS / PACKAGING

| Diameter<br>in (mm) | Length<br>in (mm) | 10 lb (4.5 kg) Easy Open Can<br>30 lb (13.6 kg) Master Carton | 50 lb (22.7 kg)<br>Easy Open Can |
|---------------------|-------------------|---|----------------------------------|
| 3/32 (2.4)          | 14 (350)          | ED032596  | ED030876                         |
| 1/8 (3.2)           | 14 (350)          | ED032597  | ED030877                         |
| 5/32 (4.0)          | 14 (350)          |   | ED030878                         |
| 3/16 (4.8)          | 14 (350)          |   | ED030879                         |
| 1/4 (6.4)           | 18 (450)          |   | ED030880                         |

## MECHANICAL PROPERTIES<sup>(1)</sup> – As Required per AWS A5.5/A5.5M

|   | Yield Strength <sup>(2)</sup><br>MPa (ksi) | Tensile Strength<br>MPa (ksi) | Elongation<br>% | Charpy V-Notch<br>J (ft·lbf)<br>@ -59°C (-75°F) |
|---|--|-------------------------------|-----------------|---|
| <b>Requirements</b> – AWS E8018-C1 H4R  | 460 (67) min                               | 550 (80) min                  | 19 min          | 20 (27) min                                     |
| <b>Typical Results<sup>(3)</sup></b><br>Stress-Relieved 1 hr @ 610°C (1125°F) | 460-525 (67-76)                            | 565-615 (82-89)               | 24-32           | 79-129 (58-95)                                  |

## DEPOSIT COMPOSITION<sup>(1)</sup> – As Required per AWS A5.5/A5.5M

|  | %C        | %Mn       | %Si  | %P       |
|--|-----------|-----------|--|----------|
| <b>Requirements</b> – AWS E8018-C1 H4R           | 0.12 max  | 1.25 max  | 0.80 max                                   | 0.03 max |
| <b>Typical Results<sup>(3)</sup></b> – As-Welded | 0.05-0.09 | 0.89-1.25 | 0.17-0.53                                  | ≤ 0.02   |
|  | %S        | %Ni       | Diffusible Hydrogen (mL/100g weld deposit) |          |
| <b>Requirements</b> – AWS E8018-C1 H4R           | 0.03 max  | 2.00-2.75 | 4.0 max                                    |          |
| <b>Typical Results<sup>(3)</sup></b> – As-Welded | ≤ 0.01    | 2.00-2.58 | 1-3  |          |

## TYPICAL OPERATING PROCEDURES

| Polarity <sup>(5)</sup> | Current (Amps)   |                 |                  |                  |                  |                 |
|-------------------------|------------------|-----------------|------------------|------------------|------------------|-----------------|
|                         | 3/32 in (2.4 mm) | 1/8 in (3.2 mm) | 5/32 in (4.0 mm) | 3/16 in (4.8 mm) | 7/32 in (5.6 mm) | 1/4 in (6.4 mm) |
| DC+                     | 70-110           | 90-160          | 130-210          | 180-300          | 250-330          | 300-400         |
| AC                      | 80-120           | 100-160         | 140-210          | 200-300          | 270-370          | 325-430         |

<sup>(1)</sup>Typical all weld metal. <sup>(2)</sup>Measured with 0.2% offset. <sup>(3)</sup>See test results disclaimer <sup>(4)</sup>Preferred polarity is listed first.