



ESAB Welding and Cutting Products  
1500 Karen Lane, Hanover PA 17331

## **State Highway**

### **Certificates of Conformance**

#### **ESAB Welding and Cutting Products**

We certify that the results given on the following sections for the electrode-flux combinations and gas metal arc electrodes listed in the index are the results recorded on file at ESAB Welding and Cutting where the tests were performed.

The submerged arc and gas metal arc welding shown in the sections of this report meet the appropriate classifications as outlined in the various American Welding Society specifications listed. The testing conforms to the AWS A5.01:2013 (ISO 14344:2010 MOD) Schedule 2 and were produced under the Quality System Program approved by ASME and ABS.

These Certificates serve to document that ESAB Welding and Cutting Product's welding consumables conform to the referenced specifications. These Certificates can be used to demonstrate compliance with the AWS D1.1 "Structural Welding Code-Steel" requirements, which reads "When requested by the Engineer, the Contractor or fabricator shall furnish certification that the electrode or electrode-flux combination conforms to the requirement of the classification "[See Paragraph 5.3.1.1]. Also, these Certificates can be used to demonstrate compliance with ANSI/AASHTO/AWS D1.5 document.

These tests are updated annually to meet Federal Highway Administration requirements. This data is available on line.

A handwritten signature in black ink, reading "Karl Furr", is positioned above a horizontal line.

Karl Furr, Product Compliance, QA  
ESAB Welding and Cutting Products

8/29/2019

## CERTIFICATE OF CONFORMANCE INDEX

| ESAB Electrode | ESAB Flux or Shielding Gas | AWS Classification                    | AWS Specification | Section |
|----------------|----------------------------|---------------------------------------|-------------------|---------|
| Spoolarc 81    | OK Flux 231                | F7A2-EM12K-H8                         | A5.17:1997        | 1       |
|                | OK Flux 350                | F7A2-EM12K-H8                         | A5.17:1997        | 2       |
|                | OK Flux 429                | F7A2-EM12K-H8                         | A5.17:1997        | 3       |
|                | OK Flux 10.71              | F7A5-EM12K-H8                         | A5.17:1997        | 4       |
|                | OK Flux 10.62              | F7A8-EM12K-H8                         | A5.17:1997        | 5       |
|                | OK Flux 10.72              | F7A8-EM12K-H8                         | A5.17:1997        | 6       |
| Spoolarc 29S   | OK Flux 350                | F7A2-EM13K-H8                         | A5.17:1997        | 7       |
|                | OK Flux 429                | F7A2-EM13K-H8                         | A5.17:1997        | 8       |
|                | OK Flux 10.71              | F7A4-EM13K-H8                         | A5.17:1997        | 9       |
| Spoolarc 53    | OK Flux 429                | F7A4-EH12K-H8                         | A5.17:1997        | 10      |
|                | OK Flux 10.71              | F7A5-EH12K-H8                         | A5.17:1997        | 11      |
|                | OK Flux 10.62              | F7A8-EH12K-H8                         | A5.17:1997        | 12      |
| Spoolarc 75    | OK Flux 429                | F8A4-ENi1K-Ni1-H8                     | A5.23::2011       | 13      |
|                | OK Flux 10.71              | F8A4-ENi1K-Ni1-H8                     | A5.23::2011       | 14      |
|                | OK Flux 10.72              | F8A4-ENi1K-Ni1-H8 & F9A4-ENi1K-Ni1-H8 | A5.23::2011       | 15      |
| Spoolarc ENi4  | OK Flux 429                | F9A4-ENi4-Ni4-H8                      | A5.23::2011       | 16      |
|                | OK Flux 10.62              | F8A8-ENi4-Ni4-H8                      | A5.23: 2011       | 17      |
| Spoolarc 95    | OK Flux 10.62              | F10A6-EM2-M2-H8                       | A5.23::2011       | 18      |
| Spoolarc 29S   | 100% CO2                   | ER70S-3-H4                            | A5.18:2005        | 19      |
| Spoolarc 65    | 100% CO2                   | ER70S-2-H4                            | A5.18:2005        | 20      |
| Spoolarc 82    | 100% CO2                   | ER70S-3 H4                            | A5.18:2005        | 21      |
| Spoolarc 86    | 100% CO2                   | ER70S-6-H4                            | A5.18:2005        | 22      |
| Spoolarc 83    | 100% CO2                   | ER80S-D2 H4                           | A5.28:2005        | 23      |
| Spoolarc 83    | 95Ar/5O2                   | ER90S-D2 H4                           | A5.28:2005        | 24      |
| Spoolarc 95    | 98Ar/2O2                   | ER100S-1 H4                           | A5.28:2005        | 25      |



ESAB Welding and Cutting Products  
1500 Karen Lane, Hanover, Pennsylvania 17331

Certificate of Conformance  
EN 10204 Type 2.2 Certificate  
To: Specification Requirements  
For: Welding Electrodes and Fluxes.

This is to certify that this welding electrode and the flux material are of the same classification as listed below and were tested on the test date shown. The electrode and flux were manufactured and supplied according to Quality System Programs of ESAB Welding and Cutting Products, located in Hanover, Pennsylvania or Monterrey, NL, Mexico.  
All tests required by the AWS Specification were performed, and met all the requirements listed for the AWS Classification.  
The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|                 |               |
|-----------------|---------------|
| Product:        | Spoolarc 81   |
| Diameter:       | 5/32          |
| Heat:           | 081DL16106990 |
| Flux Material : | OK 231        |
| Flux Lot:       | ME 703052     |

|                      |                     |
|----------------------|---------------------|
| AWS Specification:   | AWS A5.17-97(R2007) |
| AWS Classification : | F7A2-EM12K-H8       |
| Issue Date           | 3/9/2017            |
|                      |                     |
|                      |                     |

#### Chemistry (wt%)

|                                     | C         | Mn        | Si        | P     | S     | Cr   | Ni   | Mo   | Cu   |
|-------------------------------------|-----------|-----------|-----------|-------|-------|------|------|------|------|
| AWS Rqmts (single values are max)   | 0.05-0.15 | 0.80-1.25 | 0.10-0.35 | 0.030 | 0.030 | N/R  | N/R  | N/R  | 0.35 |
| Chemical Composition of Electrode   | 0.10      | 1.00      | 0.21      | 0.006 | 0.018 |      |      | 0.01 | 0.10 |
| AWS Requirements                    | N/R       |           |           |       |       |      |      |      |      |
| Chemical Com. of Weld Metal Deposit | 0.05      | 1.62      | 0.92      | 0.034 | 0.020 | 0.07 | 0.07 | 0.02 | 0.16 |

#### Radiography Test:

|                    |
|--------------------|
| Satisfactory       |
| Weld Test Number : |
| F2-11757-17-10500  |

#### Weld Metal Diffusible Hydrogen:

|                         | #1          | #2  | #3  | #4  | Avg         | Req'ts |
|-------------------------|-------------|-----|-----|-----|-------------|--------|
| (ml/100g)               | 4.6         | 4.4 | 4.4 | 4.5 | 4.5         | 8 max. |
| Test: F2-11757-17-10500 | Habs = 32.2 |     |     |     | 72°F; 27%RH |        |

#### As Welded Mechanical Results:

|   | AWS Rqmts      | Results   |
|---|----------------|-----------|
| Ultimate Tensile Strength: ksi (MPa)    | 70-95(480-660) | 92.4(637) |
| Yield Strength (0.2% Offset): ksi (MPa) | 58 (400) min.  | 78.8(543) |
| Elongation: (%)                         | 22 min.        | 24        |
| Reduction in Area: (%)                  | N/R            | 48        |

#### Welding Parameters:

|                        | AWS Rqmts  | Actual     |
|------------------------|------------|------------|
| Current: (Amps)        | 475-575    | 550        |
| Voltage: (Volts)       | 27-30      | 28.5       |
| Travel Speed: (in/min) | 15-17      | 16.3       |
| Diameter: in (mm)      | 5/32 (4.0) | 5/32 (4.0) |

#### As Welded Charpy V-Notch Impact Results

| Temperature | Results |        |         | Rqmts  |        |            |
|-------------|---------|--------|---------|--------|--------|------------|
| °F (°C)     | ft-lbs  | Joules | Avg.* * | ft-lbs | Joules | ft-lbs (J) |
| -20 (-30)   | 27      | 37     |         | 29     | 39     | 20 (27)    |
|             | 26      | 35     |         |        |        |            |
|             | 31      | 42     |         |        |        |            |
|             | 30      | 41     |         |        |        |            |
|             | 31      | 42     |         |        |        |            |

#### Plate & Joint

|                               | AWS Rqmts   | Results    |
|-------------------------------|-------------|------------|
| Base Plate :                  | A515 Gr 70  | A515 Gr 70 |
| Set-up:                       | 30° 1/2" RO | 30° - 1/2" |
| Pass/Layer:                   |             | 8S / 1T    |
| Preheat /Interpass: (°F)/(°F) | 60 / 300±25 | 70 / 275   |

\*\*Discard High and Low Value and Avg. Remaining Values

Signature:

*Karl Furr*

Karl Furr  
QA, Product Compliance



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This is to certify that this welding electrode and the flux material are of the same classification as listed below and were tested on the test date shown. The electrode and flux were manufactured and supplied according to Quality System Programs of ESAB Welding and Cutting Products, located in Hanover, Pennsylvania or Monterrey, NL, Mexico.  
All tests required by the AWS Specification were performed, and met all the requirements listed for the AWS Classification.  
The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|                 |               |
|-----------------|---------------|
| Product:        | Spoolarc 81   |
| Diameter:       | 5/32          |
| Heat:           | 081DL16106990 |
| Flux Material : | OK 350        |
| Flux Lot:       | ME 702062     |

|                      |                     |
|----------------------|---------------------|
| AWS Specification:   | AWS A5.17-97(R2007) |
| AWS Classification : | F7A2-EM12K-H8       |
| Issue Date           | 3/9/2017            |
|                      |                     |
|                      |                     |

#### Chemistry (wt%)

|                                     | C         | Mn        | Si        | P     | S     | Cr   | Ni   | Mo   | Cu   |
|-------------------------------------|-----------|-----------|-----------|-------|-------|------|------|------|------|
| AWS Rqmts (single values are max)   | 0.05-0.15 | 0.80-1.25 | 0.10-0.35 | 0.030 | 0.030 | N/R  | N/R  | N/R  | 0.35 |
| Chemical Composition of Electrode   | 0.10      | 1.00      | 0.21      | 0.006 | 0.018 |      |      | 0.01 | 0.10 |
| AWS Requirements                    | N/R       |           |           |       |       |      |      |      |      |
| Chemical Com. of Weld Metal Deposit | 0.06      | 1.72      | 1.02      | 0.021 | 0.019 | 0.06 | 0.07 | 0.02 | 0.16 |

#### Radiography Test:

|                    |
|--------------------|
| Satisfactory       |
| Weld Test Number : |
| F2-11758-17-10500  |

#### Weld Metal Diffusible Hydrogen:

|                         | #1          | #2  | #3  | #4  | Avg         | Req'ts |
|-------------------------|-------------|-----|-----|-----|-------------|--------|
| (ml/100g)               | 6.2         | 6.2 | 6.5 | 6.5 | 6.4         | 8 max. |
| Test: F2-11758-17-10500 | Habs = 32.2 |     |     |     | 72°F; 27%RH |        |

#### As Welded Mechanical Results:

|   | AWS Rqmts      | Results   |
|---|----------------|-----------|
| Ultimate Tensile Strength: ksi (MPa)    | 70-95(480-660) | 88.5(610) |
| Yield Strength (0.2% Offset): ksi (MPa) | 58 (400) min.  | 71.6(494) |
| Elongation: (%)                         | 22 min.        | 28        |
| Reduction in Area: (%)                  | N/R            | 63        |

#### Welding Parameters:

|                        | AWS Rqmts  | Actual     |
|------------------------|------------|------------|
| Current: (Amps)        | 475-575    | 540        |
| Voltage: (Volts)       | 27-30      | 29         |
| Travel Speed: (in/min) | 15-17      | 15.9       |
| Diameter: in (mm)      | 5/32 (4.0) | 5/32 (4.0) |

#### As Welded Charpy V-Notch Impact Results

| Temperature | Results |        |         | Rqmts  |        |            |
|-------------|---------|--------|---------|--------|--------|------------|
| °F (°C)     | ft-lbs  | Joules | Avg.* * | ft-lbs | Joules | ft-lbs (J) |
| -20 (-30)   | 23      | 31     |         | 27     | 37     | 20 (27)    |
|             | 26      | 35     |         |        |        |            |
|             | 28      | 38     |         |        |        |            |
|             | 28      | 38     |         |        |        |            |
|             | 31      | 42     |         |        |        |            |

#### Plate & Joint

|                               | AWS Rqmts   | Results    |
|-------------------------------|-------------|------------|
| Base Plate :                  | A515 Gr 70  | A515 Gr 70 |
| Set-up:                       | 30° 1/2" RO | 30° - 1/2" |
| Pass/Layer:                   |             | 7S / 1T    |
| Preheat /Interpass: (°F)/(°C) | 60 / 300±25 | 70 / 300   |

\*\*Discard High and Low Value and Avg. Remaining Values

Signature:

*Karl Furr*

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QA, Product Compliance



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All tests required by the AWS Specification were performed, and met all the requirements listed for the AWS Classification.  
The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|                 |             |
|-----------------|-------------|
| Product:        | Spoolarc 81 |
| Diameter:       | 5/32        |
| Heat:           | DL18103139  |
| Flux Material : | OK 429      |
| Flux Lot:       | ME832042    |

|                      |                     |
|----------------------|---------------------|
| AWS Specification:   | AWS A5.17-97(R2007) |
| AWS Classification : | F7A2-EM12K-H8       |
| Issue Date           | 10/9/2018           |
|                      |                     |
|                      |                     |

#### Chemistry (wt%)

|                                     | C         | Mn        | Si        | P     | S     | Cr   | Ni   | Mo   | Cu   |
|-------------------------------------|-----------|-----------|-----------|-------|-------|------|------|------|------|
| AWS Rqmts (single values are max)   | 0.05-0.15 | 0.80-1.25 | 0.10-0.35 | 0.030 | 0.030 | N/R  | N/R  | N/R  | 0.35 |
| Chemical Composition of Electrode   | 0.13      | 1.05      | 0.21      | 0.007 | 0.011 |      |      |      | 0.08 |
| AWS Requirements                    | N/R       |           |           |       |       |      |      |      |      |
| Chemical Com. of Weld Metal Deposit | 0.06      | 1.55      | 0.52      | 0.019 | 0.017 | 0.06 | 0.07 | 0.02 | 0.17 |

#### Radiography Test:

|                    |
|--------------------|
| Satisfactory       |
| Weld Test Number : |
| F2-13093-18-10500  |

#### Weld Metal Diffusible Hydrogen:

|                         | #1          | #2  | #3  | #4  | Avg         | Req'ts |
|-------------------------|-------------|-----|-----|-----|-------------|--------|
| (ml/100g)               | 6.8         | 6.2 | 6.8 | 6.9 | 6.7         | 8 max. |
| Test: F2-13093-18-10500 | Habs = 33.6 |     |     |     | 71°F; 29%RH |        |

#### As Welded Mechanical Results:

|   | AWS Rqmts      | Results   |
|---|----------------|-----------|
| Ultimate Tensile Strength: ksi (MPa)    | 70-95(480-660) | 83.0(572) |
| Yield Strength (0.2% Offset): ksi (MPa) | 58 (400) min.  | 68.0(469) |
| Elongation: (%)                         | 22 min.        | 28        |
| Reduction in Area: (%)                  | N/R            | 65        |

#### Welding Parameters:

|                        | AWS Rqmts  | Actual     |
|------------------------|------------|------------|
| Current: (Amps)        | 475-575    | 548        |
| Voltage: (Volts)       | 27-30      | 29         |
| Travel Speed: (in/min) | 15-17      | 15.9       |
| Diameter: in (mm)      | 5/32 (4.0) | 5/32 (4.0) |

#### As Welded Charpy V-Notch Impact Results

| Temperature | Results |        |         | Rqmts  |        |            |
|-------------|---------|--------|---------|--------|--------|------------|
| °F (°C)     | ft-lbs  | Joules | Avg.* * | ft-lbs | Joules | ft-lbs (J) |
| -20 (-30)   | 37      | 50     |         | 44     | 60     | 20 (27)    |
|             | 47      | 64     |         |        |        |            |
|             | 54      | 73     |         |        |        |            |
|             | 49      | 66     |         |        |        |            |
|             | 37      | 50     |         |        |        |            |

#### Plate & Joint

|                               | AWS Rqmts   | Results    |
|-------------------------------|-------------|------------|
| Base Plate :                  | A515 Gr 70  | A515 Gr 70 |
| Set-up:                       | 30° 1/2" RO | 30° - 1/2" |
| Pass/Layer:                   |             | 7S / 1T    |
| Preheat /Interpass: (°F)/(°F) | 60 / 300±25 | 70 / 300   |

\*\*Discard High and Low Value and Avg. Remaining Values

Signature:

*Karl Furr*

Karl Furr  
QA, Product Compliance



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Certificate of Conformance  
EN 10204 Type 2.2 Certificate  
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For: Welding Electrodes and Fluxes.

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All tests required by the AWS Specification were performed, and met all the requirements listed for the AWS Classification.  
The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|                 |               |
|-----------------|---------------|
| Product:        | Spoolarc 81   |
| Diameter:       | 5/32          |
| Heat:           | 081DL17101513 |
| Flux Material : | OK 10.71      |
| Flux Lot:       | ME 719021     |

|                      |                     |
|----------------------|---------------------|
| AWS Specification:   | AWS A5.17-97(R2007) |
| AWS Classification : | F7A5-EM12K-H8       |
| Issue Date           | 6/21/2017           |
|                      |                     |
|                      |                     |

#### Chemistry (wt%)

|                                     | C         | Mn        | Si        | P     | S     | Cr   | Ni   | Mo   | Cu   |
|-------------------------------------|-----------|-----------|-----------|-------|-------|------|------|------|------|
| AWS Rqmts (single values are max)   | 0.05-0.15 | 0.80-1.25 | 0.10-0.35 | 0.030 | 0.030 | N/R  | N/R  | N/R  | 0.35 |
| Chemical Composition of Electrode   | 0.12      | 1.10      | 0.24      | 0.005 | 0.012 |      |      |      | 0.15 |
| AWS Requirements                    | N/R       |           |           |       |       |      |      |      |      |
| Chemical Com. of Weld Metal Deposit | 0.08      | 1.52      | 0.57      | 0.018 | 0.013 | 0.07 | 0.05 | 0.02 | 0.16 |

#### Radiography Test:

|                    |
|--------------------|
| Satisfactory       |
| Weld Test Number : |
| F2-12079-17-10500  |

#### Weld Metal Diffusible Hydrogen:

|                         | #1          | #2  | #3  | #4 | Avg         | Req'ts |
|-------------------------|-------------|-----|-----|----|-------------|--------|
| (ml/100g)               | 5.2         | 5.6 | 5.7 | 7  | 5.9         | 8 max. |
| Test: F2-12079-17-10500 | Habs = 34.0 |     |     |    | 70°F; 31%RH |        |

#### As Welded Mechanical Results:

|   | AWS Rqmts      | Results   |
|---|----------------|-----------|
| Ultimate Tensile Strength: ksi (MPa)    | 70-95(480-660) | 89.9(620) |
| Yield Strength (0.2% Offset): ksi (MPa) | 58 (400) min.  | 74.4(513) |
| Elongation: (%)                         | 22 min.        | 29        |
| Reduction in Area: (%)                  | N/R            | 63        |

#### Welding Parameters:

|                        | AWS Rqmts  | Actual     |
|------------------------|------------|------------|
| Current: (Amps)        | 475-575    | 550        |
| Voltage: (Volts)       | 27-30      | 28         |
| Travel Speed: (in/min) | 15-17      | 16.5       |
| Diameter: in (mm)      | 5/32 (4.0) | 5/32 (4.0) |

#### As Welded Charpy V-Notch Impact Results

| Temperature | Results |        |         | Rqmts  |        |            |
|-------------|---------|--------|---------|--------|--------|------------|
| °F (°C)     | ft-lbs  | Joules | Avg.* * | ft-lbs | Joules | ft-lbs (J) |
| -50 (-46)   | 24      | 33     |         | 32     | 43     | 20 (27)    |
|             | 36      | 49     |         |        |        |            |
|             | 21      | 28     |         |        |        |            |
|             | 51      | 69     |         |        |        |            |
|             | 37      | 50     |         |        |        |            |

#### Plate & Joint

|                               | AWS Rqmts   | Results    |
|-------------------------------|-------------|------------|
| Base Plate :                  | A515 Gr 70  | A515 Gr 70 |
| Set-up:                       | 30° 1/2" RO | 30° - 1/2" |
| Pass/Layer:                   |             | 7S / 1T    |
| Preheat /Interpass: (°F)/(°F) | 60 / 300±25 | 70 / 275   |

\*\*Discard High and Low Value and Avg. Remaining Values

Signature:

*Karl Furr*

Karl Furr  
QA, Product Compliance



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All tests required by the AWS Specification were performed, and met all the requirements listed for the AWS Classification.

The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|                 |               |
|-----------------|---------------|
| Product:        | Spoolarc 81   |
| Diameter:       | 5/32          |
| Heat:           | 081DL17104349 |
| Flux Material : | OK 10.62      |
| Flux Lot:       | ME 708032     |

|                      |               |
|----------------------|---------------|
| AWS Specification:   | AWS A5.17     |
| AWS Classification : | F7A8-EM12K-H8 |
| Test Date :          | 11/2/2017     |
|                      |               |
|                      |               |

**Chemistry (wt%)**

|                                      | C         | Mn        | Si        | P     | S     | Cr   | Ni   | Mo    | Cu   |
|--------------------------------------|-----------|-----------|-----------|-------|-------|------|------|-------|------|
| AWS Requirements                     | 0.05-0.15 | 0.80-1.25 | 0.10-0.35 | 0.030 | 0.030 | N/R  | N/R  | N/R   | 0.35 |
| Chemical Composition of Electrode    | 0.12      | 0.95      | 0.21      | 0.006 | 0.021 | 0.04 | 0.03 | 0.005 | 0.12 |
| AWS Requirements                     | N/R       |           |           |       |       |      |      |       |      |
| Chem. Composition of Weld Metal Dep. |           |           |           |       |       |      |      |       |      |

**Radiography Test:**

|                    |
|--------------------|
| Satisfactory       |
| Weld Test Number : |
| F2-12160-17-10500  |

**Weld Metal Diffusible Hydrogen:**

|                         | #1                      | #2  | #3  | #4  | Avg         | Req'ts |
|-------------------------|-------------------------|-----|-----|-----|-------------|--------|
| (ml/100g)               | 7.6                     | 7.3 | 7.5 | 6.5 | 7.2         | 8 max. |
| Test: F2-12160-17-10500 | H <sub>abs</sub> = 39.1 |     |     |     | 73°F; 32%RH |        |

**As Welded Mechanical Results:**

|   | AWS Req'ts     | Results   |                        |  | AWS Req'ts | Actual     |
|---|----------------|-----------|------------------------|--|------------|------------|
| Ultimate Tensile Strength: ksi (MPa)    | 70-95(480-660) | 76.4(527) | Current: (Amps)        |  | 475-575    | 551        |
| Yield Strength (0.2% Offset): ksi (MPa) | 58 (400) min.  | 64.1(442) | Voltage: (Volts)       |  | 27-30      | 29.3       |
| Elongation: (%)                         | 22 min.        | 31        | Travel Speed: (in/min) |  | 15-17      | 16.4       |
| Reduction in Area: (%)                  | N/R            | 70        | Diameter: in (mm)      |  | 5/32 (4.0) | 5/32 (4.0) |

**As Welded Charpy V-Notch Impact Results**

| Temperatur | Results |        |        |        | Req'ts |            | AWS Req'ts                    | Results     |
|------------|---------|--------|--------|--------|--------|------------|-------------------------------|-------------|
| °F (°C)    | ft-lbs  | Joules | Avg.** | ft-lbs | Joules | ft-lbs (J) |                               |             |
| -80(-62)   | 88      | 119    |        | 59     | 80     | 20 (27)    | Base Plate :                  | A515 Gr 70  |
|            | 101     | 137    |        |        |        |            | Set-up:                       | 30° 1/2" RO |
|            | 17      | 23     |        |        |        |            | Pass/Layer:                   | 7S/1T       |
|            | 20      | 27     |        |        |        |            | Preheat /Interpass: (°F)/(°F) | 60 / 300±25 |
|            | 69      | 94     |        |        |        |            |                               | 70/300      |

\*\* Discard High and Low Value and Avg. Remaining Values

Signature:

Karl Furr  
QA, Product Compliance



ESAB Welding and Cutting Products  
1500 Karen Lane, Hanover, Pennsylvania 17331

Certificate of Conformance  
To Specification Requirements  
For Welding Electrodes

This is to certify that this welding electrode and the flux material are of the same classification as listed below and were tested on the test date shown. The electrode was manufactured and supplied according to Quality System Program of ESAB Welding and Cutting Products, Hanover, Pennsylvania or Monterrey, NL, Mexico. All tests required by the AWS Specification were performed, and met all the requirements for the AWS classification listed. The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|               |               |
|---------------|---------------|
| Product:      | Spoolarc 81   |
| Flux Material | OK Flux 10.72 |
| Diameter:     | 5/32          |
| Heat:         | 081DL17107421 |
| Flux Lot:     | ME 752011     |

|                                 |                              |
|---------------------------------|------------------------------|
| AWS Specification:              | AWS A5.17 1997(R2007)        |
| AWS Classification :            | F7A8-EM12K-H8, F6P8-EM12K-H8 |
| Test Date :                     | 2/2/2018                     |
| Weld Test Number :              | F2-12594-18-10500            |
| Stress Relief Hours / Temp. °F: | 1 hour / 1150° F             |

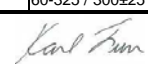
| Chemistry (wt%)                            | C         | Mn        | Si        | P     | S     | Cr  | Ni  | Mo  | Cu   |
|--|-----------|-----------|-----------|-------|-------|-----|-----|-----|------|
| AWS Requirements                           | 0.05-0.15 | 0.80-1.25 | 0.10-0.35 | 0.030 | 0.030 | N/R | N/R | N/R | 0.35 |
| Chemical Composition of Electrode          | 0.10      | 0.92      | 0.20      | 0.006 | 0.018 |     |     |     | 0.13 |
| AWS Requirements                           | N/R       | N/R       | N/R       | N/R   | N/R   | N/R | N/R | N/R | N/R  |
| Chemical Composition of Weld Metal Deposit | 0.08      | 1.43      | 0.24      | 0.013 | 0.013 |     |     |     | 0.12 |

Radiography Test:

|                    |
|--------------------|
| Satisfactory       |
| Weld Test Number : |
| F2-12594-18-10500  |

Weld Metal Diffusible Hydrogen:

|           | #1                | #2  | #3          | #4  | Avg         | Req'ts |
|-----------|-------------------|-----|-------------|-----|-------------|--------|
| (ml/100g) | 6.4               | 5.6 | 5.9         | 6.4 | 6.1         | 8 max. |
| Test:     | F2-12594-18-10500 |     | Habs = 21.3 |     | 69°F; 20%RH |        |

| As Welded and Stress Relieved Mechanical Results       |                |                |                 |            | Welding Parameters   |                 |                                |                 |
|--|----------------|----------------|-----------------|------------|--|-----------------|--------------------------------|-----------------|
|  | AW req't's     | SR req't's     | AW              | SR         |  | AWS Req't's     |                                | Actual          |
| Ultimate Tensile Strength; ksi (MPa)                   | 70-95(480-660) | 60-80(430-560) | 81.9(565)       | 73.6(507)  | Current: (Amps)  | 475-575         |                                | 551             |
| Yield Strength (0.2% Offset); ksi (MPa)                | 58(400)        | 48(330)        | 70.3(485)       | 60.7(418)  | Voltage: (Volts)   | 27-30           |                                | 28              |
| Elongation (%)   | 22             | 22             | 29              | 33         | Travel Speed: (in/min)   | 16±1            |                                | 15.6            |
| Reduction in Area (%)                                  | N/R            | N/R            | 74              | 76         | Diameter: in (mm)  | 5/32            |                                | 5/32            |
| As Welded Charpy V-Notch Impact Results                |                |                |                 |            | Plate  |                 |                                |                 |
| Temperature  | AW Results     |                | AW              | SR results |  |                 |                                | Results         |
| °F (°C)  | ft-lbs         | Joules         | Avg. ft-lbs (J) | ft-lbs     | Joules   | Avg. ft-lbs (J) |                                |                 |
| -80(-60) AW  | 64             | 87             | 75 (102)        | 99         | 134  | 102 (138)       | Base Plate:                    | A515            |
| -80(-60) SR  | 86             | 117            |                 | 93         | 126  |                 | Set-up:                        | 30° X 1/2"      |
|  | 76             | 103            |                 | 111        | 150  |                 | Pass/Layer:                    | 7S / 1T         |
|  | 68             | 92             |                 | 179        | 243  |                 | Preheat (°F) /Interpass (°F) : | 60-325 / 300±25 |
|  | 80             | 108            |                 | 95         | 129  |                 |                                | 70 / 300        |
| * Discard High and Low Value and Avg. Remaining Values |                |                |                 |            | Signature  |                 |                                |                 |
|  |                |                |                 |            | <br>Karl Furr<br>QA, Product Compliance |                 |                                |                 |



## ESAB Welding and Cutting Products

1500 Karen Lane, Hanover, PA 17331

**Certificate of Conformance**  
**To Specification Requirements**  
**For Welding Electrodes and Fluxes.**

This is to certify that this welding electrode and the flux material are of the same classification as listed below and were tested on the test date shown. The electrode and flux were manufactured and supplied according to Quality System Programs of ESAB Welding and Cutting Products, located in Hanover, Pennsylvania or Monterrey, NL, Mexico.  
 All tests required by the AWS Specification were performed, and met all the requirements listed for the AWS Classification.  
 The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|                 |              |
|-----------------|--------------|
| Product:        | Spoolarc 29S |
| Diameter:       | 5/32         |
| Heat:           | 082T123133   |
| Flux Material : | OK 350       |
| Flux Lot:       | ME 330061    |

|                      |               |
|----------------------|---------------|
| AWS Specification:   | AWS A5.17     |
| AWS Classification : | F7A2-EM13K-H8 |
| Test Date :          | 4/7/2014      |
|                      |               |

**Chemistry (wt%)**

|  | C         | Mn        | Si        | P     | S     | Cr   | Ni   | Mo   | Cu   |
|--|-----------|-----------|-----------|-------|-------|------|------|------|------|
| AWS Requirements                           | 0.06-0.15 | 0.90-1.40 | 0.35-0.75 | 0.030 | 0.030 |      |      |      | 0.35 |
| Chemical Composition of Electrode          | 0.09      | 1.18      | 0.54      | 0.015 | 0.007 | 0.04 | 0.04 | 0.01 | 0.21 |
| AWS Requirements                           |           |           |           |       |       |      |      |      |      |
| Chemical Composition of Weld Metal Deposit | 0.039     | 2.04      | 1.05      | 0.029 | 0.009 | 0.04 | 0.05 | 0.01 | 0.19 |

|                    |                   |
|--------------------|-------------------|
| Radiography Test:  | Satisfactory      |
|                    |                   |
| Weld Test Number : | B1-10081-14-10500 |

**Weld Metal Diffusible Hydrogen**

|           | #1  | #2  | #3  | #4  | Avg | Req'ts |
|-----------|-----|-----|-----|-----|-----|--------|
| (ml/100g) | 3.7 | 3.2 | 3.3 | 3.3 | 3.4 | 8      |

Test Number : B1-10081-14-10500

| As Welded Mechanical Results            |                |  |           | Welding Parameters     |            |  |        |
|---|----------------|--|-----------|------------------------|------------|--|--------|
|   | AWS Req'ts     |  | Results   |                        | AWS Req'ts |  | Actual |
| Ultimate Tensile Strength ; ksi (MPa)   | 70-95(483-656) |  | 94.1(649) | Current: (Amps)        | 475-575    |  | 550    |
| Yield Strength (0.2% Offset); ksi (MPa) | 58 (400)       |  | 78.6(542) | Voltage: (Volts)       | 27-30      |  | 28     |
| Elongation (%)                          | 22             |  | 27        | Travel Speed: (in/min) | 15-17      |  | 15.9   |
| Reduction in Area (%)                   | N/R            |  | 64.7      | Diameter; in (mm)      | 5/32       |  | 5/32   |

| As Welded Charpy V-Notch Impact Results |         |        |       |        |            | Plate      |                                |             |
|---|---------|--------|-------|--------|------------|------------|--------------------------------|-------------|
| Temperature                             | Results |        |       |        | AWS Req'ts |            | AWS Req'ts                     | Results     |
| °F (°C)                                 | ft-lbs  | Joules | Avg.* | ft-lbs | Joules     | ft-lbs (J) |                                |             |
| -20(-29)                                | 29      | 39     |       | 27     | 37         | 20 (27)    | Base Plate :                   | A515 Gr 70  |
|   | 21      | 28     |       |        |            |            | Set-up                         | 30° 1/2" RO |
|   | 26      | 35     |       |        |            |            | Pass/Layer:                    | 7S/1T       |
|   | 26      | 35     |       |        |            |            | Preheat (°F) /Interpass (°F) : | RT / 300±25 |
|   | 28      | 38     |       |        |            |            |                                | 70/275      |

\* Discard High and Low Value and Avg. Remaining Values

Signature

*Roger A. Buskey*



ESAB Welding and Cutting Products  
1500 Karen Lane, Hanover, PA 17331

Certificate of Conformance  
To Specification Requirements  
For Welding Electrodes


This is to certify that this welding electrode and the flux material are of the same classification as listed below and were tested on the test date shown. The electrode and flux were manufactured and supplied according to Quality System Programs of ESAB Welding and Cutting Products, located in Hanover, Pennsylvania or Monterrey, NL, Mexico.  
All tests required by the AWS Specification were performed, and met all the requirements listed for the AWS Classification.  
The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|               |              |
|---------------|--------------|
| Product:      | Spoolarc 29S |
| Flux Material | OK Flux 429  |
| Diameter:     | 5/32         |
| Heat:         | T125279      |
| Flux Lot:     | ME737042     |

|                      |                  |
|----------------------|------------------|
| AWS Specification:   | AWS A5.17 1997   |
| AWS Classification : | F7A2-EM13K-H8    |
| Test Date :          | 10/24/2017       |
| Weld Test Number :   | R1-12429-17-2952 |
| Radiography Test :   | Satisfactory     |

| Chemistry (wt%)                            | C         | Mn        | Si        | P     | S     | Cr   | Ni   | Mo   | Cu   |
|--|-----------|-----------|-----------|-------|-------|------|------|------|------|
| AWS Requirements                           | 0.06-0.16 | 0.90-1.40 | 0.35-0.75 | 0.030 | 0.030 | N/R  | N/R  | N/R  | 0.35 |
| Chemical Composition of Electrode          | 0.08      | 1.01      | 0.47      | 0.009 | 0.006 | 0.06 | 0.06 | 0.01 | 0.15 |
| AWS Requirements                           | N/R       | N/R       | N/R       | N/R   | N/R   | N/R  | N/R  | N/R  | N/R  |
| Chemical Composition of Weld Metal Deposit | 0.04      | 1.74      | 0.71      | 0.02  | 0.01  | 0.06 | 0.07 | 0.01 | 0.17 |

| Typical Weld Metal Diffusible Hydrogen |     |     |     |     |     |        |                    |    |      |
|--|-----|-----|-----|-----|-----|--------|--------------------|----|------|
|  | #1  | #2  | #3  | #4  | Avg | Req'ts | H <sub>ABS</sub> * | °F | % RH |
| (ml/100g)                              | 7.2 | 7.5 | 7.4 | 7.2 | 7.3 | 8      | 26.7               | 71 | 23   |

| As Welded Mechanical Results                           |         |                 |              |            |        |            | Welding Parameters   |                 |         |             |
|--|---------|-----------------|--------------|------------|--------|------------|--|-----------------|---------|-------------|
|  |         | AWS Req'ts      |              | Results    |        |            | AWS Req'ts   |                 | Actual  |             |
| Ultimate Tensile Strength; ksi (MPa)                   |         | 70-95 (483-656) |              | 84.5 (585) |        |            | Current: (Amps)  | 475-575         |         | 550         |
| Yield Strength (0.2% Offset); ksi (MPa)                |         |                 | 58(400) min. | 70.7 (490) |        |            | Voltage: (Volts)   | 27-30           |         | 29          |
| Elongation (%)   |         |                 | 22 min.      | 29         |        |            | Travel Speed: (in/min)   | 16±1            |         | 16          |
| Reduction in Area (%)                                  |         |                 | N/R          | 66         |        |            | Diameter; in (mm)  | 5/32            |         | 5/32        |
| As Welded Charpy V-Notch Impact Results                |         |                 |              |            |        |            | Shielding Gas  |                 | N/A     | N/A         |
| Temperature  | Results |                 |              |            |        | AWS Req'ts | Plate  |                 |         |             |
| °F (°C)  | ft-lbs  | Joules          | Avg.*        | ft-lbs     | Joules | ft-lbs (J) | AWS Req'ts   |                 | Results |             |
| -20(-29)   | 51      | 69              |              | 41         | 56     | 20 (27)    | Base Plate:  | A-36            |         | A-36        |
|  | 36      | 49              |              |            |        |            | Set-up:  | 30° 1/2" RO     |         | 30° 1/2" RO |
|  | 36      | 49              |              |            |        |            | Pass/Layer:  |                 |         | 8S / 2T     |
|  | 42      | 57              |              |            |        |            | Preheat (°F) /Interpass (°F) :   | 60-325 / 300±25 |         | 70/300      |
|  | 44      | 60              |              |            |        |            | <div>Signature</div> <div><br/>Karl Furr<br/>QA, Product Compliance</div> |                 |         |             |
| * Discard High and Low Value and Avg. Remaining Values |         |                 |              |            |        |            |  |                 |         |             |
| N/R= Not Required<br>N/A = Not Applicable              |         |                 |              |            |        |            |  |                 |         |             |



## ESAB Welding and Cutting Products

1500 Karen Lane, Hanover, PA 17331

### Certificate of Conformance To Specification Requirements For Welding Electrodes and Fluxes.

This is to certify that this welding electrode and the flux material are of the same classification as listed below and were tested on the test date shown. The electrode and flux were manufactured and supplied according to Quality System Programs of ESAB Welding and Cutting Products, Hanover, Pennsylvania or Monterrey, NL, Mexico.  
All tests required by the AWS Specification were performed, and met all the requirements listed for the AWS Classification.  
The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|                 |              |
|-----------------|--------------|
| Product:        | Spoolarc 29S |
| Diameter:       | 5/32         |
| Heat:           | 029T125279   |
| Flux Material : | OK 10.71     |
| Flux Lot:       | ME 516022    |

|                      |               |
|----------------------|---------------|
| AWS Specification:   | AWS A5.17     |
| AWS Classification : | F7A4-EM13K-H8 |
| Test Date :          | 5/18/2015     |
|                      |               |

#### Chemistry (wt%)

|  | C         | Mn        | Si        | P     | S     | Cr   | Ni   | Mo   | Cu   |
|--|-----------|-----------|-----------|-------|-------|------|------|------|------|
| AWS Requirements                           | 0.06-0.15 | 0.90-1.40 | 0.35-0.75 | 0.030 | 0.030 |      |      |      | 0.35 |
| Chemical Composition of Electrode          | 0.078     | 1.1       | 0.53      | 0.012 | 0.015 | 0.04 | 0.06 | 0.01 | 0.1  |
| AWS Requirements                           |           |           |           |       |       |      |      |      |      |
| Chemical Composition of Weld Metal Deposit | 0.073     | 1.58      | 0.85      | 0.023 | 0.011 | 0.05 | 0.06 | 0.01 | 0.13 |

Radiography Test: Satisfactory

Weld Test Number : B1-10705-15-10500

#### Weld Metal Diffusible Hydrogen

|           | #1  | #2  | #3 | #4  | Avg | Req'ts |
|-----------|-----|-----|----|-----|-----|--------|
| (ml/100g) | 7.8 | 7.8 | 8  | 7.7 | 7.8 | 8      |

Test Number : B1-10590-15-10500 H abs=9.6

#### As Welded Mechanical Results

|   | AWS Req'ts     | Results   |                        | AWS Req'ts | Actual |
|---|----------------|-----------|------------------------|------------|--------|
| Ultimate Tensile Strength ; ksi (MPa)   | 70-95(483-656) | 92.5(638) | Current: (Amps)        | 475-575    | 550    |
| Yield Strength (0.2% Offset); ksi (MPa) | 58 (400)       | 78.7(542) | Voltage: (Volts)       | 27-30      | 29     |
| Elongation (%)                          | 22             | 29        | Travel Speed: (in/min) | 15-17      | 16.1   |
| Reduction in Area (%)                   | N/R            | 73.8      | Diameter; in (mm)      | 5/32       | 5/32   |

#### As Welded Charpy V-Notch Impact Results

| Temperature | Results |        |       |        | AWS Req'ts |            | AWS Req'ts                     | Results     |
|-------------|---------|--------|-------|--------|------------|------------|--------------------------------|-------------|
| °F (°C)     | ft-lbs  | Joules | Avg.* | ft-lbs | Joules     | ft-lbs (J) |                                |             |
| -40(-40)    | 38      | 52     |       | 31     | 42         | 20 (27)    | Base Plate :                   | A515 Gr 70  |
|             | 36      | 49     |       |        |            |            | Set-up                         | 30° 1/2" RO |
|             | 22      | 30     |       |        |            |            | Pass/Layer:                    | 7S / 1Qd    |
|             | 35      | 47     |       |        |            |            | Preheat (°F) /Interpass (°F) : | RT / 300±25 |
|             | 21      | 28     |       |        |            |            |                                | 69/300      |

\* Discard High and Low Value and Avg. Remaining Values

Signature

*Roger A. Buskey*



ESAB Welding and Cutting Products  
1500 Karen Lane, Hanover, PA 17331

# Certificate of Conformance

To: Specification Requirements  
For: Welding Electrodes and Fluxes.

This is to certify that this welding electrode and the flux material are of the same classification as listed below and were tested on the test date shown. The electrode and flux were manufactured and supplied according to Quality System Programs of ESAB Welding and Cutting Products, located in Hanover, Pennsylvania.

All tests required by the AWS Specification were performed, and met all the requirements listed for the AWS Classification. The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|                 |             |
|-----------------|-------------|
| Product:        | Spoolarc 53 |
| Diameter:       | 5/32        |
| Heat:           | 053C96320   |
| Flux Material : | OK 429      |
| Flux Lot:       | ME804042    |

|                      |               |
|----------------------|---------------|
| AWS Specification:   | AWS A5.17     |
| AWS Classification : | F7A4-EH12K-H8 |
| Test Date :          | 2/19/2018     |
|                      |               |
|                      |               |

## Chemistry (wt%)

|                                      | C         | Mn        | Si        | P     | S     | Cr   | Ni   | Mo    | Cu   |
|--------------------------------------|-----------|-----------|-----------|-------|-------|------|------|-------|------|
| AWS Requirements                     | 0.06-0.15 | 1.50-2.00 | 0.20-0.65 | 0.025 | 0.025 | N/R  | N/R  | N/R   | 0.35 |
| Chemical Composition of Electrode    | 0.10      | 1.65      | 0.26      | 0.008 | 0.008 |      |      |       | 0.02 |
| AWS Requirements                     | N/R       |           |           |       |       |      |      |       |      |
| Chem. Composition of Weld Metal Dep. | 0.06      | 1.93      | 0.62      | 0.018 | 0.011 | 0.03 | 0.02 | 0.005 | 0.08 |

## Radiography Test:

|                    |
|--------------------|
| Satisfactory       |
| Weld Test Number : |
| F2-12607-18-10500  |

## Weld Metal Diffusible Hydrogen:

|               | #1                | #2  | #3  | #4  | Avg                     | Req'ts |
|---------------|-------------------|-----|-----|-----|-------------------------|--------|
| (ml/100g)     | 5.0               | 4.9 | 5.2 | 5.5 | 5.1                     | 8 max. |
| Test Number : | F2-12607-18-10500 |     |     |     | Habs = 16.0 69°F; 15%RH |        |

## As Welded Mechanical Results:

|   | AWS Req'ts     | Results   |                        |  | AWS Req'ts | Actual     |
|---|----------------|-----------|------------------------|--|------------|------------|
| Ultimate Tensile Strength: ksi (MPa)    | 70-95(480-660) | 84.5(583) | Current: (Amps)        |  | 475-575    | 549        |
| Yield Strength (0.2% Offset): ksi (MPa) | 58 (400) min.  | 70.1(483) | Voltage: (Volts)       |  | 27-30      | 28         |
| Elongation: (%)                         | 22 min.        | 28        | Travel Speed: (in/min) |  | 15-17      | 15.8       |
| Reduction in Area: (%)                  | N/R            | 68        | Diameter: in (mm)      |  | 5/32 (4.0) | 5/32 (4.0) |

## Welding Parameters:

## As Welded Charpy V-Notch Impact Results

| Temperatur | Results |        |       |        | Req'ts |            |                               | AWS Req'ts  | Results     |
|------------|---------|--------|-------|--------|--------|------------|-------------------------------|-------------|-------------|
| °F (°C)    | ft-lbs  | Joules | Avg.* | ft-lbs | Joules | ft-lbs (J) |                               |             |             |
| -40(-40)   | 53      | 72     |       | 63     | 85     | 20 (27)    | Base Plate :                  | A516 Gr 70  | A516 Gr 70  |
|            | 59      | 80     |       |        |        |            | Set-up:                       | 30° 1/2" RO | 30° 1/2" RO |
|            | 65      | 88     |       |        |        |            | Pass/Layer:                   |             | 7S/1T       |
|            | 72      | 98     |       |        |        |            | Preheat /Interpass: (°F)/(°F) | 60 / 300±25 | 70 / 300    |
|            | 64      | 87     |       |        |        |            |                               |             |             |

\* Discard High and Low Value and Avg. Remaining Values

Signature:

Karl Furr  
QA, Product Compliance



**ESAB Welding and Cutting Products**  
**1500 Karen Lane, Hanover, PA 17331**

**Certificate of Conformance**  
**To: Specification Requirements**  
**For: Welding Electrodes and Fluxes.**

This is to certify that this welding electrode and the flux material are of the same classification as listed below and were tested on the test date shown. The electrode was manufactured and supplied according to Quality System Program of ESAB Welding and Cutting Products, Hanover, Pennsylvania. All tests required by the AWS Specification were performed, and met all the requirements for the AWS classification listed. The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|                        |             |
|------------------------|-------------|
| <b>Product:</b>        | Spoolarc 53 |
| <b>Diameter:</b>       | 5/32        |
| <b>Heat:</b>           | 053C96320   |
| <b>Flux Material :</b> | OK 10.71    |
| <b>Flux Lot:</b>       | ME737021    |

|                             |               |
|-----------------------------|---------------|
| <b>AWS Specification:</b>   | AWS A5.17     |
| <b>AWS Classification :</b> | F7A5-EH12K-H8 |
| <b>Test Date :</b>          | 2/19/2018     |
|                             |               |

#### Chemistry (wt%)

|   | C        | Mn        | Si        | P     | S     | Cr    | Ni   | Mo    | Cu   |
|---|----------|-----------|-----------|-------|-------|-------|------|-------|------|
| <b>AWS Requirements</b>                     | .06-0.15 | 1.50-2.00 | 0.20-0.65 | 0.025 | 0.025 | N/R   | N/R  | N/R   | 0.35 |
| <b>Chemical Composition of Electrode</b>    | 0.10     | 1.65      | 0.26      | 0.008 | 0.008 |       |      |       | 0.02 |
| <b>AWS Requirements</b> N/R                 |          |           |           |       |       |       |      |       |      |
| <b>Chem. Composition of Weld Metal Dep.</b> | 0.06     | 1.83      | 0.57      | 0.015 | 0.009 | 0.037 | 0.02 | 0.005 | 0.08 |

#### Radiography Test:

|                           |
|---------------------------|
| Satisfactory              |
| <b>Weld Test Number :</b> |
| F2-12609-18-10500         |

#### Weld Metal Diffusible Hydrogen:

|                      | #1                | #2  | #3  | #4  | Avg         | Req'ts      |
|----------------------|-------------------|-----|-----|-----|-------------|-------------|
| <b>(ml/100g)</b>     | 6.4               | 5.9 | 5.3 | 5.4 | 5.8         | 8 max.      |
| <b>Test Number :</b> | F2-12609-18-10500 |     |     |     | Habs = 16.0 | 69°F; 15%RH |

#### As Welded Mechanical Results:

| AWS Req'ts                                     |                |  | Results   | Welding Parameters:           |  |  | AWS Req'ts | Actual     |
|--|----------------|--|-----------|-------------------------------|--|--|------------|------------|
| <b>Ultimate Tensile Strength: ksi (MPa)</b>    | 70-95(480-660) |  | 84.6(583) | <b>Current: (Amps)</b>        |  |  | 475-575    | 550        |
| <b>Yield Strength (0.2% Offset): ksi (MPa)</b> | 58 (400) min.  |  | 72.8(502) | <b>Voltage: (Volts)</b>       |  |  | 27-30      | 28         |
| <b>Elongation: (%)</b>                         | 22 min.        |  | 31        | <b>Travel Speed: (in/min)</b> |  |  | 15-17      | 16.1       |
| <b>Reduction in Area: (%)</b>                  | N/R            |  | 71        | <b>Diameter: in (mm)</b>      |  |  | 5/32 (4.0) | 5/32 (4.0) |

#### As Welded Charpy V-Notch Impact Results

| Temperatur | Results |        |       | Req'ts |        |            | Plate & Joint                        |                 |             | Results     |
|------------|---------|--------|-------|--------|--------|------------|--------------------------------------|-----------------|-------------|-------------|
| °F (°C)    | ft-lbs  | Joules | Avg.* | ft-lbs | Joules | ft-lbs (J) | AWS Req'ts                           |                 |             |             |
| -50(-45)   | 62      | 84     |       | 71     | 96     | 20 (27)    | <b>Base Plate :</b>                  |                 | A516 Gr 70  | A516 Gr 70  |
|            | 72      | 98     |       |        |        |            | <b>Set-up:</b>                       |                 | 30° 1/2" RO | 30° 1/2" RO |
|            | 76      | 103    |       |        |        |            | <b>Pass/Layer:</b>                   |                 |             | 7S/1T       |
|            | 64      | 87     |       |        |        |            | <b>Preheat /Interpass: (°F)/(°F)</b> | 60 min / 300±25 |             | 70 / 300    |
|            | 82      | 111    |       |        |        |            |                                      |                 |             |             |

\* Discard High and Low Value and Avg. Remaining Values

Signature:

*Karl Furr*  
 Karl Furr  
 QA, Prodcut Compliance



# ESAB Welding and Cutting Products

1500 Karen Lane, Hanover, PA 17331

## Certificate of Conformance To Specification Requirements For Welding Electrodes and Fluxes.

This is to certify that this welding electrode and the flux material are of the same classification as listed below and were tested on the test date shown. The electrode and flux were manufactured and supplied according to Quality System Programs of ESAB Welding and Cutting Products, located in Hanover, Pennsylvania.  
All tests required by the AWS Specification were performed, and met all the requirements listed for the AWS Classification.  
The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|                 |             |
|-----------------|-------------|
| Product:        | Spoolarc 53 |
| Diameter:       | 5/32        |
| Heat:           | 053C96320   |
| Flux Material : | OK 10.62    |
| Flux Lot:       | ME 708032   |

|                      |               |
|----------------------|---------------|
| AWS Specification:   | AWS A5.17     |
| AWS Classification : | F7A8-EH12K-H8 |
| Test Date :          | 11/9/2017     |

### Chemistry (wt%)

|  | C         | Mn        | Si        | P     | S     | Cr   | Ni   | Mo    | Cu   |
|--|-----------|-----------|-----------|-------|-------|------|------|-------|------|
| AWS Requirements                           | 0.06-0.15 | 1.50-2.00 | 0.20-0.65 | 0.025 | 0.025 |      |      |       | 0.35 |
| Chemical Composition of Electrode          | 0.10      | 1.65      | 0.26      | 0.008 | 0.008 | 0.02 | 0.01 | 0.008 | 0.02 |
| AWS Requirements                           | N/R       |           |           |       |       |      |      |       |      |
| Chemical Composition of Weld Metal Deposit |           |           |           |       |       |      |      |       |      |

|                    |                   |
|--------------------|-------------------|
| Radiography Test:  | Satisfactory      |
| Weld Test Number : | F2-12218-17-10500 |

### Weld Metal Diffusible Hydrogen

|   | #1  | #2  | #3  | #4  | Avg | Req'ts |
|---|-----|-----|-----|-----|-----|--------|
| (ml/100g)   | 6.2 | 5.9 | 6.2 | 6.3 | 6.1 | 8      |
| Test Number : F2-12218-17-10500 H abs= 41.6 73°F; 34%RH |     |     |     |     |     |        |

### As Welded Mechanical Results

|   | AWS Req'ts     | Results   |
|---|----------------|-----------|
| Ultimate Tensile Strength ; ksi (MPa)   | 70-95(483-656) | 80.2(553) |
| Yield Strength (0.2% Offset); ksi (MPa) | 58 (400)       | 67.5(465) |
| Elongation (%)                          | 22             | 32        |
| Reduction in Area (%)                   | N/R            | 76        |

### Welding Parameters

|                        | AWS Req'ts | Actual |
|------------------------|------------|--------|
| Current: (Amps)        | 475-575    | 552    |
| Voltage: (Volts)       | 27-30      | 28     |
| Travel Speed: (in/min) | 15-17      | 15.6   |
| Diameter; in (mm)      | 5/32       | 5/32   |

### As Welded Charpy V-Notch Impact Results

| Temperature | Results |        |       |        |        | AWS Req'ts |
|-------------|---------|--------|-------|--------|--------|------------|
| °F (°C)     | ft-lbs  | Joules | Avg.* | ft-lbs | Joules | ft-lbs (J) |
| -80(-62)    | 135     | 183    |       | 131    | 178    | 20 (27)    |
|             | 129     | 175    |       |        |        |            |
|             | 110     | 149    |       |        |        |            |
|             | 130     | 176    |       |        |        |            |
|             | 134     | 182    |       |        |        |            |

### Plate

|                                | AWS Req'ts  | Results     |
|--------------------------------|-------------|-------------|
| Base Plate :                   | A515        | A515        |
| Set-up                         | 30° 1/2" RO | 30° 1/2" RO |
| Pass/Layer:                    |             | 7S/1T       |
| Preheat (°F) /Interpass (°F) : | RT / 300±25 | 70/300      |

\* Discard High and Low Value and Avg. Remaining Values

Signature:

*Karl Furr*  
Karl Furr  
QA, Product Compliance



ESAB Welding and Cutting Products  
1500 Karen Lane, Hanover, PA 17331

Certificate of Conformance  
To Specification Requirements  
For Welding Electrodes

This is to certify that this welding electrode and the flux material are of the same classification as listed below and were tested on the test date shown. The electrode and flux were manufactured and supplied according to Quality System Programs of ESAB Welding and Cutting Products, located in Hanover, Pennsylvania.  
All tests required by the AWS Specification were performed, and met all the requirements listed for the AWS Classification.  
The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|               |             |
|---------------|-------------|
| Product:      | Spoolarc 75 |
| Flux Material | OK Flux 429 |
| Diameter:     | 5/32        |
| Heat:         | 7520522520  |
| Flux Lot:     | ME652041    |

|                      |                   |
|----------------------|-------------------|
| AWS Specification:   | AWS A5.23 2011    |
| AWS Classification : | F8A4-ENi1K-Ni1-H8 |
| Test Date :          | 12/6/2017         |
| Weld Test Number :   | 2-59419-00-0-CWB  |
| Radiography Test :   | Satisfactory      |

| Chemistry (wt%)                            | C        | Mn        | Si        | P     | S     | Cr   | Ni        | Mo   | Cu   | Ti+V+Zr |
|--|----------|-----------|-----------|-------|-------|------|-----------|------|------|---------|
| AWS Requirements                           | 0.12     | 0.80-1.40 | 0.40-0.80 | 0.020 | 0.020 | N/R  | 0.75-1.25 | N/R  | 0.35 |         |
| Chemical Composition of Electrode          | 0.10     | 0.90      | 0.52      | 0.007 | 0.005 | 0.03 | 0.94      | 0.01 | 0.08 |         |
| AWS Requirements                           | 0.10 (a) | 1.8 (a)   | 0.80      | 0.025 | 0.030 | 0.15 | 0.75-1.10 | 0.35 | 0.35 | 0.05    |
| Chemical Composition of Weld Metal Deposit | 0.06     | 1.74      | 0.80      | 0.020 | 0.009 | 0.03 | 0.88      | 0.01 | 0.10 | 0.011   |

| Typical Weld Metal Diffusible Hydrogen |     |     |     |      |     |        |                  |    |      |
|--|-----|-----|-----|------|-----|--------|------------------|----|------|
|  | #1  | #2  | #3  | #4   | Avg | Req'ts | H <sub>ABS</sub> | °F | % RH |
| (ml/100g)                              | 7.2 | 7.0 | 7.7 | 7.00 | 7.2 | 8      | 21.3             | 69 | 20   |

| As Welded Mechanical Results                           |         |        |                   |        |            |            | Welding Parameters                  |  |         |           |
|--|---------|--------|-------------------|--------|------------|------------|-------------------------------------|--|---------|-----------|
|  |         |        | AWS Req'ts        |        | Results    |            | ABS Req'ts                          |  |         | Actual    |
| Ultimate Tensile Strength; ksi (MPa)                   |         |        | 80-100 (552--690) |        | 89.9 (620) |            | Current: (Amps)                     |  | 475-575 | 546       |
| Yield Strength (0.2% Offset); ksi (MPa)                |         |        | 68(469)           |        | 73.8 (509) |            | Voltage: (Volts)                    |  | 27-30   | 29        |
| Elongation (%)   |         |        | 20                |        | 28         |            | Travel Speed: (in/min)              |  | 16±1    | 15.6      |
| Reduction in Area (%)                                  |         |        | N/R               |        | 63         |            | Diameter: in (mm)                   |  | 5/32    | 5/32      |
| As Welded Charpy V-Notch Impact Results                |         |        |                   |        |            |            | Shielding Gas                       |  |         |           |
| Temperature  | Results |        |                   |        |            | AWS Req'ts | Plate                               |  |         |           |
| °F (°C)  | ft-lbs  | Joules |                   | ft-lbs | Joules     | ft-lbs (J) | ABS Req'ts                          |  |         | Results   |
| -40(-40)   | 39      | 53     | Avg.*             | 33     | 45         | 20 (27)    | Base Plate:                         |  | N/R     | A537      |
|  | 34      | 46     |                   |        |            |            | Set-up:                             |  | N/R     | 1/2 X 30° |
|  | 31      | 42     |                   |        |            |            | Pass/Layer:                         |  |         | 7S / 1T   |
|  | 29      | 39     |                   |        |            |            | Preheat (°F) /Interpass (°F) :      |  | 300±25  | 325/325   |
|  | 35      | 47     |                   |        |            |            |                                     |  |         |           |
| * Discard High and Low Value and Avg. Remaining Values |         |        |                   |        |            |            | Signature                           |  |         |           |
| a) 1.8% Max. when carbon is restricted to 0.10 max.    |         |        |                   |        |            |            | Karl Furr<br>QA, Product Compliance |  |         |           |



ESAB Welding and Cutting Products  
801 Wilson Ave. Hanover, PA 17331

**Certificate of Compliance**  
**EN 10204 Type 2.2 Certificate**

This is to certify that the properties shown are typical for this welding electrode and flux, and meet the requirements of the AWS classifications listed. The electrode and flux were manufactured and supplied according to Quality System Program of ESAB Welding and Cutting Products. The chemical composition of the electrode deposit and the typical mechanical properties of the deposited weld metal are as follows:

|                 |               |
|-----------------|---------------|
| Product:        | Spoolarc 75   |
| Diameter:       | 5/32          |
| Lot Number:     | 20522560      |
| Flux:           | OK Flux 10.71 |
| Flux Lot Number | ME912021      |

|                      |                   |
|----------------------|-------------------|
| AWS Specification:   | AWS A5.23         |
| AWS Classification : | F8A4-ENi1K-Ni1-H8 |
| Date :               | 12/9/2019         |
|                      |                   |
|                      |                   |

**Chemistry (wt%)**

|  | C    | Mn        | Si          | P     | S     | Cr   | Ni          | Mo    | Cu   |
|--|------|-----------|-------------|-------|-------|------|-------------|-------|------|
| AWS Requirements of Electrode              | 0.12 | 0.80-1.40 | 0.40 - 0.80 | 0.020 | 0.020 | NS   | 0.75 - 1.25 | NS    | 0.35 |
| Chemical Composition of Electrode          | 0.09 | 0.93      | 0.49        | 0.008 | 0.008 | 0.04 | 0.94        | 0.01  | 0.12 |
| AWS Requirements (single values are max)   | 0.12 | 1.60      | 0.80        | 0.030 | 0.025 | 0.15 | 0.75 - 1.10 | 0.35  | 0.35 |
| Chemical Composition of Weld Metal Deposit | 0.06 | 1.51      | 0.69        | 0.016 | 0.006 | 0.04 | 0.8         | 0.009 | 0.1  |

**Weld Metal Diffusible Hydrogen**

|                   |                  |
|-------------------|------------------|
| Radiography Test: | Satisfactory     |
|                   |                  |
| Weld Test Number: | L2-14007-19-0429 |

|              | #1  | #2  | #3  | #4  | Avg | Req'ts          |
|--------------|-----|-----|-----|-----|-----|-----------------|
| (ml/100g)    | 7.3 | 7.4 | 7.6 | 7.6 | 7.5 | 8               |
| 72°F/ 22% RH |     |     |     |     |     | Habs=26.2 gr/lb |

**As-Welded Mechanical Results**

|   | AWS Req'ts       | Result     |
|---|------------------|------------|
| Ultimate Tensile Strength ; ksi (MPa)   | 80-100 (550-700) | 91.2 (629) |
| Yield Strength (0.2% Offset); ksi (MPa) | 68 (470) min.    | 79.3 (547) |
| Elongation (%)                          | 20               | 26         |
| Reduction in Area (%)                   | N/R              | 69         |

**Typical Welding Parameters**

|                        | AWS Req'ts | Actual     |
|------------------------|------------|------------|
| Current: (Amps)        | 475-575    | 550        |
| Voltage: (Volts)       | 27-30      | 28         |
| Travel Speed: (in/min) | 16 ± 1     | 15.5       |
| Diameter; in (mm)      | 5/32 (4.0) | 5/32 (4.0) |

**Typical Charpy V-Notch Impact Results**

| Temperature                      | SR Results |        |
|----------------------------------|------------|--------|
| °F (°C)                          | ft-lbs     | Joules |
| -40(-40)                         | 33         | 45     |
|                                  | 23         | 31     |
|                                  | 23         | 31     |
|                                  | 44         | 60     |
|                                  | 33         | 45     |
| AWS Avg * Req'ts 20 ft-lbs (27J) | 30         | 40     |

| Plate                          | AWS Req'ts    | Results     |
|--------------------------------|---------------|-------------|
| Base Plate :                   | ASTM A537     | ASTM A5537  |
| Set-up :                       | 30° 1/2" RO   | 30° 1/2" RO |
| Pass/Layer :                   |               | 7S / 1T     |
| Preheat (°F) /Interpass (°F) : | 300±25/300±25 | 275 / 325   |

Signature

Karl Furr - QA, Product Compliance

\* Discard High and Low Values and Average Remaining Three Values

N/R = Not Required by AWS A5.23 Specification  
N/A = Not Applicable NS = Not Specified



ESAB Welding and Cutting Products  
1500 Karen Lane, Hanover, PA 17331

To Specification Requirements  
For Welding Electrodes

This is to certify that this welding electrode and the flux material are of the same classification as listed below and were tested on the test date shown. The electrode and flux were manufactured and supplied according to Quality System Programs of ESAB Welding and Cutting Products, located in Hanover, Pennsylvania.

All tests required by the AWS Specification were performed, and met all the requirements listed for the AWS Classification.

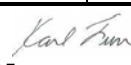
The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|               |               |
|---------------|---------------|
| Product:      | Spoolarc 75   |
| Flux Material | OK Flux 10.72 |
| Diameter:     | 5/32          |
| Heat:         | 07520522520   |
| Flux Lot:     | ME803011      |

|                      |                   |
|----------------------|-------------------|
| AWS Specification:   | AWS A5.23 2011    |
| AWS Classification : | F8A4-ENi1K-Ni1-H8 |
| AWS Classification : | F8A6-ENi1K-Ni1-H8 |
| Test Date :          | 2/21/2018         |
| Weld Test Number :   | F2-12610-18-2952  |
| Radiography Test :   | Satisfactory      |

| Chemistry (wt%)                            | C        | Mn        | Si        | P     | S      | Cr   | Ni        | Mo   | Cu   | Ti+V+Zr |
|--|----------|-----------|-----------|-------|--------|------|-----------|------|------|---------|
| AWS Requirements                           | 0.12     | 0.80-1.40 | 0.40-0.80 | 0.020 | 0.020  | N/R  | 0.75-1.25 | N/R  | 0.35 |         |
| Chemical Composition of Electrode          | 0.10     | 0.98      | 0.56      | 0.009 | 0.006  |      | 0.89      |      | 0.04 |         |
| AWS Requirements                           | 0.10 (a) | 1.8 (a)   | 0.80      | 0.025 | 0.030  | 0.15 | 0.75-1.10 | 0.35 | 0.35 | 0.05    |
| Chemical Composition of Weld Metal Deposit | 0.063    | 1.76      | 0.65      | 0.015 | <0.001 | 0.05 | 0.93      | 0.01 | 0.11 | 0.015   |

| Typical Weld Metal Diffusible Hydrogen |     |     |     |     |     |        |                    |     |      |
|--|-----|-----|-----|-----|-----|--------|--------------------|-----|------|
|  | #1  | #2  | #3  | #4  | Avg | Req'ts | H <sub>ABS</sub> : | °F  | % RH |
| (ml/100g)                              | 4.6 | 4.2 | 4.7 | 4.3 | 4.4 | 8      | 15.5               | 68° | 15   |

| As Welded Mechanical Results                           |  |                  |        |            | Welding Parameters  |             |         |             |
|--|--|------------------|--------|------------|---|-------------|---------|-------------|
|  |  | AWS Req'ts       |        | Results    | AWS Req'ts  |             | Actual  |             |
| Ultimate Tensile Strength; ksi (MPa)                   |  | 80-100 (550-700) |        | 93.7 (646) | Current: (Amps)   | 475-575     |         | 550         |
| Yield Strength (0.2% Offset); ksi (MPa)                |  | 68 (470)         |        | 80.6 (556) | Voltage: (Volts)  | 27-30       |         | 28          |
| Elongation (%)   |  | 20               |        | 28         | Travel Speed: (in/min)  | 16±1        |         | 15.9        |
| Reduction in Area (%)                                  |  | N/R              |        | 72         | Diameter: in (mm)   | 5/32        |         | 5/32        |
| As Welded Charpy V-Notch Impact Results                |  |                  |        |            | Shielding Gas   |             |         |             |
| Temperature  |  | -40°             | -40°   | -60°       | Plate   |             |         |             |
| °F (°C)  |  | ft-lbs           | Joules | ft-lbs     | AWS Req'ts  |             | Results |             |
| -40(-40)   |  | 66               | 89     | 55         | Base Plate:   | A537        |         | A537        |
| -60(50)  |  | 94               | 127    | 72         | Set-up:   | 30°/1/2" RO |         | 30°/1/2" RO |
|  |  | 74               | 100    | 56         | Pass/Layer:   |             |         | 7S / 1T     |
|  |  | 99               | 134    | 69         | Preheat (°F) /Interpass (°F) :  | 300±25      |         | 275/300     |
|  |  | 70               | 95     | 55         | Signature<br><br>Karl Furr<br>QA, Product Compliance |             |         |             |
| Avg. **  |  | 79               | 107    | 60         |   |             |         |             |
| * AWS Requirements: 20 ft-lbs (27 J)                   |  |                  |        |            |   |             |         |             |
| * Discard High and Low Value and Avg. Remaining Values |  |                  |        |            |   |             |         |             |

a) Mn level is 1.80 max when C is restricted to 0.10 max.



## ESAB Welding and Cutting Products

1500 Karen Lane, Hanover, PA 17331

### Certificate of Conformance To Specification Requirements For Welding Electrodes and Fluxes.

This is to certify that this welding electrode and the flux material are of the same classification as listed below and were tested on the test date shown. The electrode and flux were manufactured and supplied according to Quality System Programs of ESAB Welding and Cutting Products, located in Hanover, Pennsylvania.

All tests required by the AWS Specification were performed, and met all the requirements listed for the AWS Classification. The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|                 |               |
|-----------------|---------------|
| Product:        | Spoolarc ENi4 |
| Diameter:       | 5/32          |
| Heat:           | 093AK2600     |
| Flux Material : | OK 429        |
| Flux Lot:       | ME 804042     |

|                      |                  |
|----------------------|------------------|
| AWS Specification:   | AWS A5.23        |
| AWS Classification : | F9A4-ENi4-Ni4-H8 |
| Test Date :          | 2/20/2018        |
|                      |                  |
|                      |                  |

#### Chemistry (wt%)

|  | C         | Mn        | Si        | P     | S     | Cr   | Ni        | Mo        | Cu   |
|--|-----------|-----------|-----------|-------|-------|------|-----------|-----------|------|
| AWS Requirements                           | 0.12-0.19 | 0.60-1.00 | 0.10-0.30 | 0.015 | 0.020 | N/R  | 1.60-2.10 | 0.10-0.30 | 0.35 |
| Chemical Composition of Electrode          | 0.16      | 0.86      | 0.2       | 0.008 | 0.004 |      | 1.76      | 0.15      | 0.07 |
| AWS Requirements                           | 0.14      | 1.6       | 0.8       | 0.03  | 0.025 |      | 1.40-2.10 | 0.10-0.35 | 0.35 |
| Chemical Composition of Weld Metal Deposit | 0.07      | 1.49      | 0.52      | 0.016 | 0.007 | 0.07 | 1.57      | 0.16      | 0.16 |

#### Weld Metal Diffusible Hydrogen

|                    |                   |
|--------------------|-------------------|
| Radiography Test:  | Satisfactory      |
| Weld Test Number : | F2-12608-18-10500 |

|              | #1                | #2  | #3  | #4           | Avg | Req'ts    |
|--------------|-------------------|-----|-----|--------------|-----|-----------|
| (ml/100g)    | 4.8               | 4.4 | 4.5 | 4.7          | 4.6 | 8         |
| Test Number: | F2-12608-18-10500 |     |     | 69°F/ 16% RH |     | Habs=17.1 |

#### As Welded Mechanical Results

|   | AWS Req'ts       | Results    |                        | AWS Req'ts | Actual |
|---|------------------|------------|------------------------|------------|--------|
| Ultimate Tensile Strength ; ksi (MPa)   | 90-110 (620-760) | 99.2 (684) | Current: (Amps)        | 475-575    | 551    |
| Yield Strength (0.2% Offset); ksi (MPa) | 78 (540)         | 84.0 (579) | Voltage: (Volts)       | 27-30      | 28     |
| Elongation (%)                          | 17               | 25         | Travel Speed: (in/min) | 15-17      | 15.9   |
| Reduction in Area (%)                   | N/R              | 62         | Diameter; in (mm)      | 5/32       | 5/32   |

#### As Welded Charpy V-Notch Impact Results

| Temperature | Results |        |       |        | AWS Req'ts |            |  |
|-------------|---------|--------|-------|--------|------------|------------|--|
| °F (°C)     | ft-lbs  | Joules | Avg.* | ft-lbs | Joules     | ft-lbs (J) |  |
| -40(-40)    | 41      | 56     |       | 47     | 64         | 20 (27)    |  |
|             | 48      | 65     |       |        |            |            |  |
|             | 51      | 69     |       |        |            |            |  |
|             | 48      | 65     |       |        |            |            |  |
|             | 44      | 60     |       |        |            |            |  |

\* Discard High and Low Value and Avg. Remaining Values

#### Plate

|                                | AWS Req'ts  | Results     |
|--------------------------------|-------------|-------------|
| Base Plate :                   | A537        | A537        |
| Set-up                         | 30° 1/2" RO | 30° 1/2" RO |
| Pass/Layer:                    |             | 7S/ 1T      |
| Preheat (°F) /Interpass (°F) : | 300±25      | 275/325     |

Signature

*Karl Furr*  
Karl Furr  
QA, Prodcut Compliance



**ESAB Welding and Cutting Products**  
1500 Karen Lane, Hanover, PA 17331

**Certificate of Conformance**  
**To Specification Requirements**  
**For Welding Electrodes and Fluxes.**

This is to certify that this weldng electrode and the flux material are of the same classification as listed below and were tested on the test date shown. The electrode and flux were manufactured and supplied according to Quality System Programs of ESAB Welding and Cutting Products, located in Hanover, Pennsylvania.

All tests required by the AWS Specification were performed, and met all the requirements listed for the AWS Classification. The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|                 |               |
|-----------------|---------------|
| Product:        | Spoolarc ENi4 |
| Diameter:       | 5/32          |
| Heat:           | 093AK2600     |
| Flux Material : | OK 10.62      |
| Flux Lot:       | ME 708032     |

|                      |                  |
|----------------------|------------------|
| AWS Specification:   | AWS A5.23:2011   |
| AWS Classification : | F8A8-ENi4-Ni4-H8 |
| Test Date :          | 2/20/2018        |

| Chemistry (wt%)                            | C         | Mn        | Si        | P     | S     | Cr   | Ni        | Mo        | Cu   |
|--|-----------|-----------|-----------|-------|-------|------|-----------|-----------|------|
|  | 0.12-0.19 | 0.60-1.00 | 0.10-0.30 | 0.015 | 0.020 | N/R  | 1.60-2.10 | 0.10-0.30 | 0.35 |
| AWS Requirements                           | 0.16      | 0.86      | 0.2       | 0.008 | 0.004 |      | 1.76      | 0.15      | 0.07 |
| Chemical Composition of Electrode          |           |           |           |       |       |      |           |           |      |
| AWS Requirements                           | 0.15      | 1.6       | 0.8       | 0.03  | 0.025 |      | 1.40-2.10 | 0.10-0.35 | 0.35 |
| Chemical Composition of Weld Metal Deposit | 0.087     | 0.86      | 0.23      | 0.01  | 0.003 | 0.04 | 1.63      | 0.17      | 0.08 |

**Weld Metal Diffusible Hydrogen**

|                    |                   |
|--------------------|-------------------|
| Radiography Test:  | Satisfactory      |
| Weld Test Number : | F2-12624-18-10500 |

|              | #1                | #2  | #3  | #4         | Avg | Req'ts                  |
|--------------|-------------------|-----|-----|------------|-----|-------------------------|
| (ml/100g)    | 5.7               | 5.8 | 5.9 | 6.0        | 5.9 | 8                       |
| Test Number: | F2-12624-18-10500 |     |     | 69°F 12%RH |     | H <sub>abs</sub> = 12.8 |

| As Welded Mechanical Results            |                 | Results    | Welding Parameters     |         |
|---|-----------------|------------|------------------------|---------|
| AWS Req'ts                              |                 |            | AWS Req'ts             |         |
| Ultimate Tensile Strength ; ksi (MPa)   | 80-100(550-700) | 89.6 (618) |                        | Actual  |
| Yield Strength (0.2% Offset); ksi (MPa) | 68(470)         | 77.1 (532) | Current: (Amps)        | 475-575 |
| Elongation (%)                          | 20              | 27         | Voltage: (Volts)       | 27-30   |
| Reduction in Area (%)                   | N/R             | 72         | Travel Speed: (in/min) | 15-17   |
|   |                 |            | Diameter; in (mm)      | 5/32    |

| As Welded Charpy V-Notch Impact Results                |         | Plate  |             |
|--|---------|--|-------------|
| As Welded Charpy V-Notch Impact Results                |         | AWS Req'ts                                     |             |
| Temperature  | Results | AWS Req'ts                                     |             |
| °F (°C)  | ft-lbs  | ft-lbs (J)                                     | Results     |
| -80(-62)   | 104     | 141  | A537        |
|  | 100     | 136  | 30° 1/2" RO |
|  | 113     | 153  | 7S,1T       |
|  | 109     | 148  |             |
|  | 107     | 145  |             |
| * Discard High and Low Value and Avg. Remaining Values |         | Signature: Karl Furr<br>QA, Prodcut Compliance |             |



**ESAB Welding and Cutting Products**  
**1500 Karen Lane, Hanover, PA 16331**

**Certificate of Conformance**  
**To Specification Requirements**  
**For Welding Electrodes and Fluxes.**

This is to certify that this welding electrode and the flux material are of the same classification as listed below and were tested on the test date shown. The electrode and flux were manufactured and supplied according to Quality System Programs of ESAB Welding and Cutting Products, located in Hanover, Pennsylvania.

All tests required by the AWS Specification were performed, and met all the requirements listed for the AWS Classification.

The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|                        |             |
|------------------------|-------------|
| <b>Product:</b>        | Spoolarc 95 |
| <b>Diameter:</b>       | 5/32        |
| <b>Heat:</b>           | 095154266   |
| <b>Flux Material :</b> | OK 10.62    |
| <b>Flux Lot:</b>       | ME 708032   |

|                             |                 |
|-----------------------------|-----------------|
| <b>AWS Specification:</b>   | AWS A5.23       |
| <b>AWS Classification :</b> | F10A6-EM2-M2-H8 |
| <b>Test Date :</b>          | 9/12/2017       |
|                             |                 |

**Chemistry (wt%)**

|   | C    | Mn        | Si        | P     | S     | Cr   | Ni        | Mo        | Cu / Al / V       |
|---|------|-----------|-----------|-------|-------|------|-----------|-----------|-------------------|
| <b>AWS Requirements</b>                           | 0.10 | 1.25-1.80 | 0.20-0.60 | 0.010 | 0.015 | 0.30 | 1.40-2.10 | 0.25-0.55 | 0.25/0.10/0.05    |
| <b>Chemical Composition of Electrode</b>          | 0.04 | 1.59      | 0.36      | 0.003 | 0.005 | 0.10 | 1.90      | 0.38      | 0.08/0.004/0.007  |
| <b>AWS Requirements</b>                           | 0.10 | 0.90-1.80 | 0.80      | 0.02  | 0.02  | 0.35 | 1.40-2.10 | 0.25-0.65 | 0.30/Ti+V+Zr;0.03 |
| <b>Chemical Composition of Weld Metal Deposit</b> | 0.06 | 1.55      | 0.32      | 0.008 | 0.003 | 0.15 | 1.74      | 0.38      | 0.01/0.01/<0.001  |

|                           |                   |
|---------------------------|-------------------|
| <b>Radiography Test:</b>  | Satisfactory      |
|                           |                   |
| <b>Weld Test Number :</b> | F2-12164-17-10500 |

**Weld Metal Diffusible Hydrogen**

|           | #1  | #2  | #3  | #4  | Avg | Req'ts |
|-----------|-----|-----|-----|-----|-----|--------|
| (ml/100g) | 6.0 | 6.0 | 5.2 | 5.5 | 5.7 | 8      |

F2-12164-17-10500 H abs= 38.3

| As Welded Mechanical Results                   |                  |  |            | Welding Parameters            |            |  |        |
|--|------------------|--|------------|-------------------------------|------------|--|--------|
|  | AWS Req'ts       |  | Results    |                               | AWS Req'ts |  | Actual |
| <b>Ultimate Tensile Strength ; ksi (MPa)</b>   | 100-120(690-828) |  | 110.0(758) | <b>Current: (Amps)</b>        | 475-575    |  | 521    |
| <b>Yield Strength (0.2% Offset); ksi (MPa)</b> | 88(607)          |  | 99.5(686)  | <b>Voltage: (Volts)</b>       | 27-30      |  | 27.4   |
| <b>Elongation (%)</b>                          | 16               |  | 25         | <b>Travel Speed: (in/min)</b> | 15-17      |  | 16.6   |
| <b>Reduction in Area (%)</b>                   | N/R              |  | 69         | <b>Diameter; in (mm)</b>      | 5/32       |  | 5/32   |

| As Welded Charpy V-Notch Impact Results |         |        |       |        |        | Plate      |                                       |             |
|---|---------|--------|-------|--------|--------|------------|---------------------------------------|-------------|
| Temperature                             | Results |        |       |        |        | AWS Req'ts |                                       | Results     |
| °F (°C)                                 | ft-lbs  | Joules | Avg.* | ft-lbs | Joules | ft-lbs (J) |                                       |             |
| -60(-51)                                | 70      | 95     |       | 75     | 102    | 20 (27)    | <b>Base Plate :</b>                   | ASTM A514   |
|   | 70      | 95     |       |        |        |            | <b>Set-up</b>                         | 30° 1/2" RO |
|   | 79      | 107    |       |        |        |            | <b>Pass/Layer:</b>                    | 7S, 1T      |
|   | 79      | 107    |       |        |        |            | <b>Preheat (°F) /Interpass (°F) :</b> | 300±25      |
|   | 76      | 103    |       |        |        |            |                                       | 300/300     |

\* Discard High and Low Value and Avg. Remaining Values

Signature

*Karl Furr*  
 Karl Furr  
 QA, Product Compliance



**ESAB Welding and Cutting Products**  
**1500 Karen Lane, Hanover, PA 17331**

Certificate of Conformance  
 To Specification Requirements  
 For Welding Electrodes

This is to certify that this welding electrode is of the same classification as listed below and was tested on the test date shown. The electrode was manufactured and supplied according to Quality System Programs of ESAB Welding and Cutting Products, located in Hanover, Pennsylvania or Monterrey, NL, Mexico. All tests required by the AWS Specification were performed, and met all the requirements listed for the AWS Classification. The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|                     |              |
|---------------------|--------------|
| Product:            | Spoolarc 29S |
| Diameter: in. (mm): | 1/16 (1.6)   |
| Heat:               | 8253149071   |
|                     |              |
|                     |              |

|                      |                 |
|----------------------|-----------------|
| AWS Specification:   | AWS A5.18: 2005 |
| AWS Classification : | ER70S-3 H4      |
| Date Issued          | 1/18/2018       |
|                      |                 |
|                      |                 |

## Chemistry (wt%)

|  | C         | Mn        | Si        | P     | S     | Cr   | Ni   | Mo   | Cu   |
|--|-----------|-----------|-----------|-------|-------|------|------|------|------|
| AWS Requirements                           | 0.06-0.15 | 0.90-1.40 | 0.45-0.75 | 0.025 | 0.035 | 0.15 | 0.15 | 0.15 | 0.5  |
| Chemical Composition of Electrode          | 0.08      | 1.18      | 0.54      | 0.010 | 0.016 | 0.06 | 0.07 | 0.01 | 0.21 |
| AWS Requirements                           | N/R       |           |           |       |       |      |      |      |      |
| Chemical Composition of Weld Metal Deposit |           |           |           |       |       |      |      |      |      |

## Weld Metal Diffusible Hydrogen

|                    |                |
|--------------------|----------------|
| Radiography Test:  | Satisfactory   |
|                    |                |
| Weld Test Number : | 2-59515-00-0-A |

|                                  | #1  | #2  | #3 | #4  | Avg | Req'ts   |
|----------------------------------|-----|-----|----|-----|-----|----------|
| (ml/100g)                        | 1.8 | 1.1 | 1  | 1.2 | 1.3 | 4.0 max. |
| Test No.2-59515-00-0-A Habs=10.7 |     |     |    |     |     |          |

## As Welded Mechanical Results

|   | AWS Req'ts | Results   | Welding Parameters     | AWS Req'ts | Actual     |
|---|------------|-----------|------------------------|------------|------------|
| Ultimate Tensile Strength ; ksi (MPa)   | 70(480)    | 80.8(557) | Current: (Amps)        | 330-360    | 338        |
| Yield Strength (0.2% Offset); ksi (MPa) | 58(400)    | 66.2(456) | Voltage: (Volts)       | 26-30      | 28.5       |
| Elongation (%)                          | 22         | 27        | Travel Speed: (in/min) | 13±1       | 13.1       |
| Reduction in Area (%)                   | N/R        | 65        | Diameter; in (mm)      | 1/16 (1.6) | 1/16 (1.6) |

## As Welded Charpy V-Notch Impact Results

| Temperature | Results |        |       |        | AWS Req'ts | Shielding Gas | 100% CO <sub>2</sub>           |
|-------------|---------|--------|-------|--------|------------|---------------|--------------------------------|
| °F (°C)     | ft-lbs  | Joules | Avg.* | ft-lbs | Joules     | ft-lbs (J)    | Plate                          |
| 0 (-20)     | 61      | 83     |       | 55     | 75         | 20 (27)       | Base Plate :                   |
|             | 57      | 77     |       |        |            |               | A515 gr 70                     |
|             | 51      | 69     |       |        |            |               | Set-up                         |
|             | 51      | 69     |       |        |            |               | 45° 1/2" RO                    |
|             | 58      | 79     |       |        |            |               | Pass/Layer:                    |
|             |         |        |       |        |            |               | 3S,2T                          |
|             |         |        |       |        |            |               | Preheat (°F) /Interpass (°F) : |
|             |         |        |       |        |            |               | RT/300±25                      |
|             |         |        |       |        |            |               | 70/325                         |

\* Discard High and Low Value and Avg. Remaining Values

Signature

*Karl Furr*  
 Karl Furr  
 QA, Product Compliance



**ESAB Welding and Cutting Products**  
1500 Karen Lane, Hanover, PA 17331

Certificate of Conformance  
To Specification Requirements  
For Welding Electrodes

This is to certify that this welding electrode is of the same classification as listed below and was tested on the test date shown. The electrode was manufactured and supplied according to Quality System Programs of ESAB Welding and Cutting Products, located in Hanover, Pennsylvania.  
All tests required by the AWS Specification were performed, and met all the requirements listed for the AWS Classification.  
The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|                    |             |
|--------------------|-------------|
| Product:           | Spoolarc 65 |
| Diameter: in. (mm) | 1/16 (1.6)  |
| Heat:              | 065414049   |
|                    |             |
|                    |             |

|                      |                 |
|----------------------|-----------------|
| AWS Specification:   | AWS A5.18: 2005 |
| AWS Classification : | ER70S-2 H4      |
| Issued Date          | 11/2/2017       |
|                      |                 |
|                      |                 |

## Chemistry (wt%)

|   | C    | Mn        | Si        | P     | S     | Cr   | Ni   | Mo   | Cu   | Ti/Zr/Al                          |
|---|------|-----------|-----------|-------|-------|------|------|------|------|-----------------------------------|
| AWS Requirements                                | 0.07 | 0.90-1.40 | 0.40-0.70 | 0.025 | 0.035 | 0.15 | 0.15 | 0.15 | 0.5  | 0.05-0.15 / 0.02-0.12 / 0.05-0.15 |
| Chemical Composition of Electrode               | 0.05 | 1.11      | 0.53      | 0.003 | 0.006 | 0.04 | 0.04 | 0.01 | 0.11 | 0.10 / 0.04 / 0.07                |
| AWS Requirements                                | N/R  | N/R       | N/R       | N/R   | N/R   | N/R  | N/R  | N/R  | N/R  | N/R                               |
| Chemical Composition of Weld Metal Deposit: N/R |      |           |           |       |       |      |      |      |      |                                   |

Radiography Test: Satisfactory

Weld Test Number : 2-59314-00-0-A

## Weld Metal Diffusible Hydrogen (ml/100g)

| #1                                    | #2  | #3  | #4  | Avg | Req'ts  |
|---------------------------------------|-----|-----|-----|-----|---------|
| 1.3                                   | 1.3 | 1.5 | 1.6 | 1.4 | 4.0 max |
| Test Number 2-59314-00-0-A Habs= 22.0 |     |     |     |     |         |

## As Welded Mechanical Results

|   | AWS Req'ts | Results   |
|---|------------|-----------|
| Ultimate Tensile Strength ; ksi (MPa)   | 70(480)    | 82.0(565) |
| Yield Strength (0.2% Offset); ksi (MPa) | 58(400)    | 72.9(503) |
| Elongation (%)                          | 22         | 28        |
| Reduction in Area (%)                   | N/R        | 62        |

## Welding Parameters

|                        | AWS Req'ts | Actual |
|------------------------|------------|--------|
| Current: (Amps)        | 330-360    | 336    |
| Voltage: (Volts)       | 26-30      | 27.1   |
| Travel Speed: (in/min) | 13±1       | 12.6   |
| Diameter; in (mm)      | 1/16       | 1/16   |

## As Welded Charpy V-Notch Impact Results

| Temperature | Results       | AWS Req'ts |
|-------------|---------------|------------|
| *F (*C)     | ft-lbs Joules | ft-lbs (J) |
| -20(-30)    | 28 38         | 37 50      |
|             | 47 64         |            |
|             | 15 20         |            |
|             | 36 49         |            |
|             | 58 79         |            |

\* Discard High and Low Value and Avg. Remaining Values

## Shielding Gas

|                                |               |
|--------------------------------|---------------|
| 100% CO2                       | 100% CO2      |
| Plate                          | AWS Req'ts    |
| Base Plate :                   | A515 Gr 70    |
| Set-up                         | 45° 1/2" RO   |
| Pass/Layer:                    | 3S / 2T       |
| Preheat (*F) /Interpass (*F) : | 60-325/300±25 |
|                                | 70 / 325      |

Signature

Karl Furr  
QA, Product Compliance



**ESAB Welding and Cutting Products**  
**1500 Karen Lane, Hanover, PA 17331**

Certificate of Conformance  
 To Specification Requirements  
 For Welding Electrodes

This is to certify that this welding electrode is of the same classification as listed below and was tested on the test date shown. The electrode was manufactured and supplied according to Quality System Programs of ESAB Welding and Cutting Products, located in Hanover, Pennsylvania.  
 All tests required by the AWS Specification were performed, and met all the requirements listed for the AWS Classification.  
 The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|                     |             |
|---------------------|-------------|
| Product:            | Spoolarc 82 |
| Diameter: in. (mm): | 1/16 (1.6)  |
| Heat:               | 08253149071 |
|                     |             |
|                     |             |

|                      |                 |
|----------------------|-----------------|
| AWS Specification:   | AWS A5.18: 2005 |
| AWS Classification : | ER70S-3 H4      |
| Date Issued          | 1/18/2018       |
|                      |                 |
|                      |                 |

## Chemistry (wt%)

|  | C         | Mn        | Si        | P     | S     | Cr   | Ni   | Mo   | Cu   |
|--|-----------|-----------|-----------|-------|-------|------|------|------|------|
| AWS Requirements                           | 0.06-0.15 | 0.90-1.40 | 0.45-0.75 | 0.025 | 0.035 | 0.15 | 0.15 | 0.15 | 0.5  |
| Chemical Composition of Electrode          | 0.08      | 1.18      | 0.54      | 0.010 | 0.016 | 0.06 | 0.07 | 0.01 | 0.21 |
| AWS Requirements                           | N/R       |           |           |       |       |      |      |      |      |
| Chemical Composition of Weld Metal Deposit |           |           |           |       |       |      |      |      |      |

## Weld Metal Diffusible Hydrogen

|                    |                |
|--------------------|----------------|
| Radiography Test:  | Satisfactory   |
|                    |                |
| Weld Test Number : | 2-59515-00-0-A |

|                                  | #1  | #2  | #3 | #4  | Avg | Req'ts   |
|----------------------------------|-----|-----|----|-----|-----|----------|
| (ml/100g)                        | 1.8 | 1.1 | 1  | 1.2 | 1.3 | 4.0 max. |
| Test No.2-59515-00-0-A Habs=10.7 |     |     |    |     |     |          |

## As Welded Mechanical Results

|   | AWS Req'ts | Results   | Welding Parameters     | AWS Req'ts | Actual     |
|---|------------|-----------|------------------------|------------|------------|
| Ultimate Tensile Strength ; ksi (MPa)   | 70(480)    | 80.8(557) | Current: (Amps)        | 330-360    | 338        |
| Yield Strength (0.2% Offset); ksi (MPa) | 58(400)    | 66.2(456) | Voltage: (Volts)       | 26-30      | 28.5       |
| Elongation (%)                          | 22         | 27        | Travel Speed: (in/min) | 13±1       | 13.1       |
| Reduction in Area (%)                   | N/R        | 65        | Diameter; in (mm)      | 1/16 (1.6) | 1/16 (1.6) |

## As Welded Charpy V-Notch Impact Results

| Temperature | Results |        |       |        | AWS Req'ts | Shielding Gas | 100% CO <sub>2</sub>           |
|-------------|---------|--------|-------|--------|------------|---------------|--------------------------------|
| °F (°C)     | ft-lbs  | Joules | Avg.* | ft-lbs | Joules     | ft-lbs (J)    | Plate                          |
| 0 (-20)     | 61      | 83     |       | 55     | 75         | 20 (27)       | Base Plate :                   |
|             | 57      | 77     |       |        |            |               | A515 gr 70                     |
|             | 51      | 69     |       |        |            |               | Set-up                         |
|             | 51      | 69     |       |        |            |               | 45° 1/2" RO                    |
|             | 58      | 79     |       |        |            |               | Pass/Layer:                    |
|             |         |        |       |        |            |               | 3S,2T                          |
|             |         |        |       |        |            |               | Preheat (°F) /Interpass (°F) : |
|             |         |        |       |        |            |               | RT/300±25                      |
|             |         |        |       |        |            |               | 70/325                         |

\* Discard High and Low Value and Avg. Remaining Values

Signature

*Karl Furr*  
 Karl Furr  
 QA, Product Compliance



ESAB Welding and Cutting Products  
1500 Karen Lane, Hanover, Pennsylvania 17331

**Certificate of Conformance  
To Specification Requirements  
For Welding Electrodes**

This is to certify that this welding electrode is of the same classification as listed below and was tested on the test date shown.  
The electrode was manufactured and supplied according to Quality System Program  
of ESAB Welding and Cutting Products, Hanover, Pennsylvania or Monterrey, NL, Mexico.  
All tests required by the AWS Specification were performed, and met all the requirements for the AWS classification listed.  
The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|                     |             |
|---------------------|-------------|
| Product:            | Spoolarc 86 |
| Diameter: in. (mm): | 1/16 (1.6)  |
| Heat:               | C131617     |
|                     |             |
|                     |             |

|                      |                 |
|----------------------|-----------------|
| AWS Specification:   | AWS A5.18: 2017 |
| AWS Classification : | ER70S-6 H4      |
| Issued Date          | 11/13/2018      |
|                      |                 |
|                      |                 |


**Chemistry (wt%)**

|                                   | C         | Mn        | Si        | P     | S     | Cr   | Ni   | Mo   | Cu   |
|-----------------------------------|-----------|-----------|-----------|-------|-------|------|------|------|------|
| AWS Requirements                  | 0.06-0.15 | 1.40-1.85 | 0.80-1.15 | 0.025 | 0.035 | 0.15 | 0.15 | 0.15 | 0.50 |
| Chemical Composition of Electrode | 0.07      | 1.44      | 0.85      | 0.005 | 0.006 | 0.02 | 0.01 | 0.01 | 0.02 |

**Weld Metal Diffusible Hydrogen (Typical)**

|                    |                |
|--------------------|----------------|
| Radiography Test:  | Satisfactory   |
|                    |                |
| Weld Test Number : | 2-60202-00-0-A |

|                    | #1             | #2  | #3  | #4        | Avg          | Req'ts |
|--------------------|----------------|-----|-----|-----------|--------------|--------|
| (ml/100g)          | 0.8            | 0.8 | 0.6 | 1.3       | 0.9          | 4.0    |
| Weld Test Number : | 2-60202-00-0-A |     |     | Habs=19.7 | 71°F / 17%RH |        |

| As Welded Mechanical Results                           |         |   |       |            |        |            | Welding Parameters  |  |                      |  |                      |
|--|---------|---|-------|------------|--------|------------|---|--|----------------------|--|----------------------|
|  |         | AWS Req'ts                              |       | Results    |        |            |   |  | AWS Req'ts           |  | Actual               |
| Ultimate Tensile Strength ; ksi (MPa)                  |         | 70(483)                                 |       | 77.3 (533) |        |            | Current: (Amps)   |  | 330-360              |  | 340                  |
| Yield Strength (0.2% Offset); ksi (MPa)                |         | 58(400)                                 |       | 61.9 (427) |        |            | Voltage: (Volts)  |  | 26-30                |  | 28.2                 |
| Elongation (%)   |         | 22                                      |       | 29         |        |            | Travel Speed: (in/min)  |  | 13±1                 |  | 12.4                 |
| Reduction in Area (%)                                  |         | N/R                                     |       | 65         |        |            | Diameter; in (mm)   |  | 1/16 (1.6)           |  | 1/16 (1.6)           |
|  |         | As Welded Charpy V-Notch Impact Results |       |            |        |            | Shielding Gas   |  | 100% CO <sub>2</sub> |  | 100% CO <sub>2</sub> |
| Temperature  | Results |   |       |            |        | AWS Req'ts | Plate   |  |                      |  |                      |
| °F (°C)  | ft-lbs  | Joules                                  | Avg.* | ft-lbs     | Joules | ft-lbs (J) |   |  | AWS Req'ts           |  | Results              |
| -20(-30)   | 48      | 65                                      |       | 55         | 75     | 20 (27)    | Base Plate :  |  | A515 Gr 70           |  | A515 Gr70            |
|  | 61      | 83                                      |       |            |        |            | Set-up  |  | 45° 1/2" RO          |  | 45° 1/2" RO          |
|  | 29      | 39                                      |       |            |        |            | Pass/Layer:   |  |                      |  | 3S,2T                |
|  | 56      | 76                                      |       |            |        |            | Preheat (°F) /Interpass (°F) :  |  | RT / 300±25          |  | 70 / 300             |
|  | 64      | 87                                      |       |            |        |            | Signature  |  |                      |  |                      |
| * Discard High and Low Value and Avg. Remaining Values |         |   |       |            |        |            |   |  |                      |  |                      |

\* Discard High and Low Value and Avg. Remaining Values

Signature

Karl Furr  
QA, Product Compliance



ESAB Welding and Cutting Products  
1500 Karen Lane, Hanover, PA 17331

**Certificate of Conformance  
To Specification Requirements  
For Welding Electrodes**

This is to certify that this weldng electrode is of the same classification as listed below and was tested on the test date shown. The electrode was manufactured and supplied according to Quality System Programs of ESAB Welding and Cutting Products, located in Hanover, Pennsylvania.  
All tests required by the AWS Specification were performed, and met all the requirements listed for the AWS Classification.  
The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|           |             |
|-----------|-------------|
| Product:  | Spoolarc 83 |
| Diameter: | 1/16        |
| Heat:     | 083D114544  |
|           |             |
|           |             |

|                      |                |
|----------------------|----------------|
| AWS Specification:   | AWS A5.28:2005 |
| AWS Classification : | ER80S-D2       |
| Issue Date :         | 11/1/2017      |
|                      |                |
|                      |                |

**Chemistry (wt%)**

|  | C         | Mn        | Si        | P     | S     | Cr  | Ni   | Mo        | Cu   |
|--|-----------|-----------|-----------|-------|-------|-----|------|-----------|------|
| AWS Requirements                           | 0.07-0.12 | 1.60-2.10 | 0.50-0.80 | 0.025 | 0.025 | N/R | 0.15 | 0.40-0.60 | 0.5  |
| Chemical Composition of Electrode          | 0.09      | 1.70      | 0.56      | 0.007 | 0.007 |     | 0.01 | 0.46      | 0.12 |
| AWS Requirements                           | N/A       | N/A       | N/A       | N/A   | N/A   | N/A | N/A  | N/A       | N/A  |
| Chemical Composition of Weld Metal Deposit |           |           |           |       |       |     |      |           |      |

|                    |                |
|--------------------|----------------|
| Radiography Test:  | Satisfactory   |
|                    |                |
| Weld Test Number : | 2-59275-00-0-A |

**Weld Metal Diffusible Hydrogen**

|           | #1  | #2  | #3  | #4  | Avg | Req'ts   |
|-----------|-----|-----|-----|-----|-----|----------|
| (ml/100g) | 1.0 | 0.9 | 1.0 | 1.1 | 1.0 | 4.0 max. |

Test Number 2-59275-00-0-A H<sub>abs</sub>=23.2

| As Welded Mechanical Results            |         |   |         |           |        |            | Welding Parameters             |  |                        |  |             |      |            |      |  |
|---|---------|---|---------|-----------|--------|------------|--------------------------------|--|------------------------|--|-------------|------|------------|------|--|
|   |         | AWS Req'ts                              |         | Results   |        |            |                                |  |                        |  | AWS Req'ts  |      | Actual     |      |  |
| Ultimate Tensile Strength ; ksi (MPa)   |         | 80(550) min.                            |         | 89.5(617) |        |            | Current: (Amps)                |  |                        |  | 340-420     |      | 361        |      |  |
| Yield Strength (0.2% Offset); ksi (MPa) |         | 68(470) min.                            |         | 73.2(505) |        |            | Voltage: (Volts)               |  |                        |  | 25-30       |      | 28.2       |      |  |
| Elongation (%)                          |         |   | 17 min. |           |        |            | 22                             |  | Travel Speed: (in/min) |  |             | 13±2 |            | 13.4 |  |
| Reduction in Area (%)                   |         |   | N/R     |           |        |            | 63                             |  | Diameter; in (mm)      |  | 1/16 (1.6)  |      | 1/16 (1.6) |      |  |
|   |         | As Welded Charpy V-Notch Impact Results |         |           |        |            | Shielding Gas                  |  |                        |  | 100% CO2    |      | 100% CO2   |      |  |
| Temperature                             | Results |   |         |           |        | AWS Req'ts | Plate                          |  |                        |  |             |      |            |      |  |
| °F (°C)                                 | ft-lbs  | Joules                                  | Avg.*   | ft-lbs    | Joules | ft-lbs (J) |                                |  | AWS Req'ts             |  | Results     |      |            |      |  |
| -20(-30)                                | 36      | 49                                      |         | 38        | 52     | 20 (27)    | Base Plate :                   |  | A515 Gr 70             |  | A515 Gr70   |      |            |      |  |
|   | 38      | 52                                      |         |           |        |            | Set-up                         |  | 45° 1/2" RO            |  | 45° 1/2" RO |      |            |      |  |
|   | 44      | 60                                      |         |           |        |            | Pass/Layer:                    |  |                        |  | 5S, 1T,     |      |            |      |  |
|   | 39      | 53                                      |         |           |        |            | Preheat (°F) /Interpass (°F) : |  | 300±25                 |  | 275/325     |      |            |      |  |
|   | 35      | 47                                      |         |           |        |            |                                |  |                        |  |             |      |            |      |  |

\* Discard High and Low Value and Avg. Remaining Values

Signature

*Karl Furr*  
Karl Furr  
QA, Product Compliance



ESAB Welding and Cutting Products  
1500 Karen Lane, Hanover, PA 17331

**Certificate of Conformance  
To Specification Requirements  
For Welding Electrodes**

This is to certify that this welding electrode is of the same classification as listed below and was tested on the test date shown. The electrode was manufactured and supplied according to Quality System Programs of ESAB Welding and Cutting Products, located in Hanover, Pennsylvania.  
All tests required by the AWS Specification were performed, and met all the requirements listed for the AWS Classification.  
The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|           |             |
|-----------|-------------|
| Product:  | Spoolarc 83 |
| Diameter: | 1/16        |
| Heat:     | 083W36146   |
|           |             |
|           |             |

|                      |           |
|----------------------|-----------|
| AWS Specification:   | AWS A5.28 |
| AWS Classification : | ER90S-D2  |
| Test Date :          | 4/17/2014 |
|                      |           |
|                      |           |

**Chemistry (wt%)**

|  | C         | Mn        | Si        | P     | S     | Cr   | Ni   | Mo        | Cu   |
|--|-----------|-----------|-----------|-------|-------|------|------|-----------|------|
| AWS Requirements                           | 0.07-0.12 | 1.60-2.10 | 0.50-0.80 | 0.025 | 0.025 | N/R  | 0.15 | 0.40-0.60 | 0.5  |
| Chemical Composition of Electrode          | 0.1       | 1.7       | 0.69      | 0.013 | 0.014 | 0    | 0.06 | 0.46      | 0.1  |
| AWS Requirements                           | N/R       | N/R       | N/R       | N/R   | N/R   | N/R  | N/R  | N/R       | N/R  |
| Chemical Composition of Weld Metal Deposit | 0.085     | 1.62      | 0.64      | 0.011 | 0.016 | 0.05 | 0.07 | 0.49      | 0.07 |

|                    |                   |
|--------------------|-------------------|
| Radiography Test:  | Satisfactory      |
|                    |                   |
| Weld Test Number : | B1-10091-14-10500 |

**Weld Metal Diffusible Hydrogen**

|  | #1  | #2  | #3  | #4  | Avg | Req'ts                 |
|--|-----|-----|-----|-----|-----|------------------------|
| (ml/100g)  | 2.5 | 2.4 | 2.4 | 2.3 | 2.4 | 4.0 max.               |
| Test Number B1-9974-14-10500 (98Ar / 2O <sub>2</sub> ) |     |     |     |     |     | H <sub>abs</sub> =10.7 |

**As Welded Mechanical Results**

|   | AWS Req'ts   | Results   |
|---|--------------|-----------|
| Ultimate Tensile Strength ; ksi (MPa)   | 90(620) min. | 99.1(684) |
| Yield Strength (0.2% Offset); ksi (MPa) | 78(540) min. | 87.1(601) |
| Elongation (%)                          | 17 min.      | 24        |
| Reduction in Area (%)                   | N/R          | 51.7      |

**Welding Parameters**

|                        | AWS Req'ts              | Actual                 |
|------------------------|-------------------------|------------------------|
| Current: (Amps)        | 340-420                 | 369                    |
| Voltage: (Volts)       | 25-30                   | 27.8                   |
| Travel Speed: (in/min) | 13±2                    | 12.9                   |
| Diameter; in (mm)      | 1/16                    | 1/16                   |
| Shielding Gas          | Ar /1-5% O <sub>2</sub> | 95Ar / 5O <sub>2</sub> |

**As Welded Charpy V-Notch Impact Results**

| Temperature | Results                   | AWS Req'ts                     |
|-------------|---------------------------|--------------------------------|
| °F (°C)     | ft-lbs    Joules    Avg.* | ft-lbs    Joules    ft-lbs (J) |
| -20(-29)    | 105    142                | 115    156    20 (27)          |
|             | 114    155                |                                |
|             | 127    172                |                                |
|             | 121    164                |                                |
|             | 111    150                |                                |

| Plate                          | AWS Req'ts  | Results     |
|--------------------------------|-------------|-------------|
| Base Plate :                   | A285        | A285 Butt   |
| Set-up                         | 45° 1/2" RO | 45° 1/2" RO |
| Pass/Layer:                    |             | 2S, 3T      |
| Preheat (°F) /Interpass (°F) : | 300±25      | 325/325     |

\* Discard High and Low Value and Avg. Remaining Values

Signature

*Roger A. Buskey*

N/R = Not Required  
N/A = Not Applicable



ESAB Welding and Cutting Products  
1500 Karen Lane, Hanover, PA 17331

**Certificate of Conformance  
To Specification Requirements  
For Welding Electrodes**

This is to certify that this welding electrode is of the same classification as listed below and was tested on the test date shown. The electrode was manufactured and supplied according to Quality System Programs of ESAB Welding and Cutting Products, located in Hanover, Pennsylvania.  
All tests required by the AWS Specification were performed, and met all the requirements listed for the AWS Classification.  
The chemical composition of the electrode and mechanical properties of the deposited weld metal were as follows:

|           |             |
|-----------|-------------|
| Product:  | Spoolarc 95 |
| Diameter: | 0.045       |
| Heat:     | 095854928   |
|           |             |
|           |             |

|                      |           |
|----------------------|-----------|
| AWS Specification:   | AWS A5.28 |
| AWS Classification : | ER100S-1  |
| Test Date :          | 4/27/2015 |
|                      |           |
|                      |           |

**Chemistry (wt%)**

|  | C    | Mn        | Si        | P     | S     | Cr  | Ni        | Mo        | V     |
|--|------|-----------|-----------|-------|-------|-----|-----------|-----------|-------|
| AWS Requirements                           | 0.08 | 1.25-1.80 | 0.20-0.55 | 0.010 | 0.010 | 0.3 | 1.40-2.10 | 0.25-0.55 | 0.05  |
| Chemical Composition of Electrode          | 0.06 | 1.35      | 0.33      | 0.004 | 0.008 | 0.1 | 1.75      | 0.34      | 0.001 |
|  |      |           |           |       |       |     |           |           |       |
|  | Ti   | Zr        | Al        | Cu    |       |     |           |           |       |
| AWS Requirements                           | 0.1  | 0.1       | 0.1       | 0.25  |       |     |           |           |       |
| Chemical Composition of Electrode          | 0.02 | <0.001    | <0.001    | 0.16  |       |     |           |           |       |
|  |      |           |           |       |       |     |           |           |       |
| AWS Requirements                           | N/A  | N/A       | N/A       | N/A   | N/A   | N/A | N/A       | N/A       | N/A   |
| Chemical Composition of Weld Metal Deposit |      |           |           |       |       |     |           |           |       |

|                    |                |
|--------------------|----------------|
| Radiography Test:  | Satisfactory   |
|                    |                |
| Weld Test Number : | 2-56611-00-0-A |

**Weld Metal Diffusible Hydrogen**

|           | #1  | #2  | #3  | #4  | Avg | Req'ts   |
|-----------|-----|-----|-----|-----|-----|----------|
| (ml/100g) | 2.8 | 2.6 | 2.5 | 2.4 | 2.6 | 4.0 max. |

Test Number 2-56611-00-0-A H<sub>abs</sub>=10.0

**As Welded Mechanical Results**

|   | AWS Req'ts | Results    |
|---|------------|------------|
| Ultimate Tensile Strength ; ksi (MPa)   | 100(690)   | 105.5(728) |
| Yield Strength (0.2% Offset); ksi (MPa) | 88(607)    | 96.3(664)  |
| Elongation (%)                          | 17         | 22         |
| Reduction in Area (%)                   | N/R        | 63         |

**Welding Parameters**

|                        | AWS Req'ts           | Actual               |
|------------------------|----------------------|----------------------|
| Current: (Amps)        | 300-360              | 303                  |
| Voltage: (Volts)       | 27-32                | 27                   |
| Travel Speed: (in/min) | 13±2                 | 12.8                 |
| Diameter; in (mm)      | 0.045                | 0.045                |
| Shielding Gas          | 98Ar/2O <sub>2</sub> | 98Ar/2O <sub>2</sub> |

**As Welded Charpy V-Notch Impact Results**

| Temperature | Results |        |       |        |        | AWS Req'ts |
|-------------|---------|--------|-------|--------|--------|------------|
| °F (°C)     | ft-lbs  | Joules | Avg.* | ft-lbs | Joules | ft-lbs (J) |
| -60(-51)    | 56      | 76     |       | 64     | 87     | 20 (27)    |
|             | 62      | 84     |       |        |        |            |
|             | 73      | 99     |       |        |        |            |
|             | 84      | 114    |       |        |        |            |
|             | 55      | 75     |       |        |        |            |

| Plate                          | AWS Req'ts  | Results     |
|--------------------------------|-------------|-------------|
| Base Plate :                   | HY-80       | HY-80       |
| Set-up                         | 45° 1/2" RO | 45° 1/2" RO |
| Pass/Layer:                    |             | 2S, 3T      |
| Preheat (°F) /Interpass (°F) : | 300±25      | 275 / 275   |

\* Discard High and Low Value and Avg. Remaining Values

Signature

Roger A. Bushey

N/A: Not Applicable