

# NIDEC MOTOR CORPORATION

8050 WEST FLORISSANT AVE.  
ST. LOUIS, MO 63136



**DATE:** 10/31/2022

**P.O. NO.:** GF45  
**Order/Line NO.:** 25214 MN 100

**TO:**

**Model Number:** GF45  
**Catalog Number:** 8D5P2C  
841 Plus Configuration  
CONF,MOTOR,841 PLUS

**REVISIONS:**  
(NONE)

**ALL DOCUMENTS HEREIN ARE CONSIDERED CERTIFIED BY NIDEC MOTOR CORPORATION.  
THANK YOU FOR YOUR ORDER AND THE OPPORTUNITY TO SERVE YOU.**

## Features:

Horsepower ..... 00005.00 ~ KW: 3.73  
Enclosure ..... TEFC  
Poles ..... 04 ~ RPM: 1800  
Frame Size ..... 184~T  
Phase/Frequency/Voltage.. 3~060~460  
Winding Type ..... Random Wound  
Service Factor ..... 1.15  
Insulation Class ..... Class "F" ~ Insulife 2000  
Altitude In Feet (Max) .. 3300 Ft.(1000 M)  
Ambient In Degree C (Max) +40 C  
Assembly Position ..... "F-1" Assembly Position  
Efficiency Class ..... Premium Efficiency  
Application ..... **Air Cooler Fan**  
~  
Customer Part Number ....  
"AK" Dimension (Inches).. NA  
Temperature Rise (Sine Wave): 80 C Rise @ 1.0SF (Resist)  
Design Letter ..... B  
Starting Method ..... Direct-On-Line Start or VFD  
Duty Cycle ..... Continuous Duty  
Efficiency Value ..... 89.5 % ~ Typical  
Load Inertia: NEMA ~ Standard Inertia: 27 LB-FT2  
Number Of Starts Per Hour: NEMA  
Motor Type Code ..... CE  
Rotor Inertia (LB-FT<sup>2</sup>) ..... .405 LB-FT<sup>2</sup>  
Qty. of Bearings PE (Shaft) ..... 1  
Qty. of Bearings SE (OPP) ..... 1  
Bearing Number PE (Shaft) ..... 6206-J/C3  
Bearing Number SE (OPP) ..... 6206-J/C3

Nidec trademarks followed by the ® symbol are registered with the U.S. Patent and Trademark Office.

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## Accessories:

THIS MOTOR WILL BE LABELED AS: IEEE STD 841-2021 Inpro Seals - Both Ends  
Stainless Steel T-Drains-Both  
Corro-Duty  
Special Foot Flatness  
Grease Fittings/Press. Drains  
Ground Lug In Conduit Box  
Grounding Terminal on Frame (Two 1/4" dia UNC coarse threaded holes located in  
motor frame on each side of the junction box)

Precision Balance  
Standard Leadtime: NA  
F.O.B.:  
PRIMARY GROUND  
LOCATED IN MAIN  
CONDUIT BOX  
-----

THIS MOTOR WILL BE~ LABELED AS:  
IEEE STD 841-2021~  
-----

**USE THE DATA PROVIDED BELOW TO SELECT THE APPROPRIATE DIMENSION PRINT**

|                  |       |
|------------------|-------|
| Horsepower       | 5     |
| Pole(s)          | 04    |
| Voltage(s)       | 460   |
| Frame Size       | 184T  |
| Shaft U Diameter | 1.125 |
| Outlet Box AF    | 2.31  |
| Outlet Box AA    | 0.75  |

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- Additional Modifications -

(3) to make a total of (4) Grounding  
Lugs in the Junction Box and Shaft  
Slinger for Shaft Down.

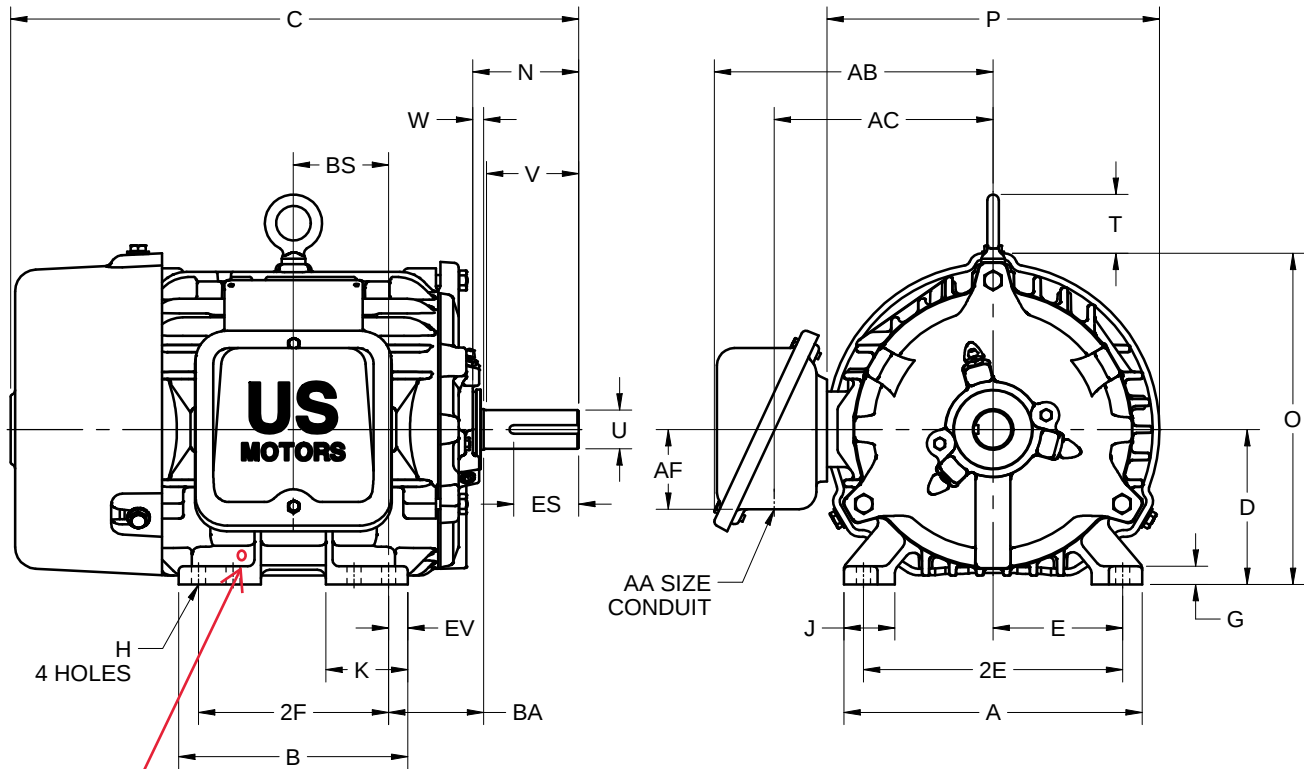
EFFECTIVE:  
**18-MAY-17**

SUPERSEDES:  
**NEW**

**DIMENSION PRINT**  
**WORLD MOTOR 841 PLUS**  
**FRAME: 182T, 184T**  
**BASIC TYPE: CE**

PRINT:  
**08-1045**

SHEET:  
**1 OF 1**



(Two 1/4" dia UNC coarse threaded holes located in motor frame on each side of junction box)

ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS

| UNITS | A    | B    | C     | D<br>-.06 | E    | 2E<br>±.03 | G   | H<br>+.05 | J    | K    | N    | O    | P <sup>2</sup> |
|-------|------|------|-------|-----------|------|------------|-----|-----------|------|------|------|------|----------------|
| IN    | 8.63 | 6.63 | 16.44 | 4.50      | 3.75 | 7.50       | .53 | .41       | 1.47 | 2.38 | 3.06 | 9.59 | 9.84           |
| MM    | 219  | 168  | 418   | 114       | 95   | 191        | 13  | 10        | 37   | 60   | 78   | 244  | 250            |

| UNITS | T    | U<br>-.001 | V<br>MIN | W   | AA      | AB   | AC   | AF   | BA   | BS   | EV  | ES<br>MIN | SQ KEY |
|-------|------|------------|----------|-----|---------|------|------|------|------|------|-----|-----------|--------|
| IN    | 1.72 | 1.1250     | 2.50     | .31 | 3/4 NPT | 8.06 | 6.34 | 2.31 | 2.75 | 2.75 | .56 | 1.78      | .250   |
| MM    | 44   | 28.575     | 64       | 8   |         | 205  | 161  | 59   | 70   | 70   | 14  | 45        | 6.35   |

| FRAME | UNITS | 2F<br>±.03 |
|-------|-------|------------|
| 182T  | IN    | 4.50       |
|       | MM    | 114        |
| 184T  | IN    | 5.50       |
|       | MM    | 140        |

1. DIMENSIONS MAY VARY .25" DUE TO CASTING AND/OR FABRICATION VARIATIONS
2. LARGEST MOTOR WIDTH
3. STANDARD ASSEMBLY POSITION F-1 IS SHOWN. F-2 IS PROVIDED WHEN SPECIFIED. CONDUIT OPENING MAY BE LOCATED IN STEPS OF 90° REGARDLESS OF THE LOCATION
4. TOLERANCES ARE SHOWN IN INCHES ONLY

08-1045/-

**Nidec Motor Corporation**  
**St. Louis, Missouri**

INFORMATION DISCLOSED ON THIS DOCUMENT  
IS CONSIDERED PROPRIETARY AND SHALL NOT BE  
REPRODUCED OR DISCLOSED WITHOUT WRITTEN  
CONSENT OF NIDEC MOTOR CORPORATION



ISSUED BY  
**R. TIMMERMANN**  
APPROVED BY  
**M. CULLEN**

IHP\_DP\_NMCA (MAR-2011) SOLIDEDGE

# NAMEPLATE DATA

|                          |      |                   |      |                   |      |                   |           |
|--------------------------|------|-------------------|------|-------------------|------|-------------------|-----------|
| CATALOG NUMBER:          |      | 8D5P2C            |      | NAMEPLATE PART #: |      | 2104620-007       |           |
| MODEL                    | GF45 | FR                | 184T | TYPE              | CE   | ENCL              | TEFC-IP55 |
| SHAFT<br>END BRG         |      | 6206-J/C3 - QTY 1 |      | OPP<br>END BRG    |      | 6206-J/C3 - QTY 1 |           |
| PH                       | 3    | MAX<br>AMB        | 40 C | ID#               |      |                   |           |
| INSUL<br>CLASS           | F    | Asm.<br>Pos.      | F1   | DUTY              | CONT |                   |           |
| HP                       | 5    | RPM               | 1760 | HP                |      | RPM               |           |
| VOLTS                    | 460  |                   |      | VOLTS             |      |                   |           |
| FL<br>AMPS               | 6.3  |                   |      | FL<br>AMPS        |      |                   |           |
| SF<br>AMPS               | 7.2  |                   |      | SF<br>AMPS        |      |                   |           |
| SF                       | 1.15 | DESIGN            | B    | CODE              | J    |                   |           |
| NEMA NOM<br>EFFICIENCY   | 89.5 | NOM<br>PF         | 82.7 | KiloWatt          | 3.73 |                   |           |
| GUARANTEED<br>EFFICIENCY | 87.5 | MAX<br>KVAR       | 1.7  | HZ                | 60   |                   |           |

## HAZARDOUS LOCATION DATA (IF APPLICABLE):

|           |  |          |  |          |  |
|-----------|--|----------|--|----------|--|
| DIVISION  |  | CLASS I  |  | GROUP I  |  |
| TEMP CODE |  | CLASS II |  | GROUP II |  |

△ Class 1 Div 2, Gas Group A,B,C,D, Temp Code T3C



## VFD DATA (IF APPLICABLE):

|                   |            |                   |     |
|-------------------|------------|-------------------|-----|
| VOLTS             | 460        | AMPS              | 6.6 |
| TORQUE 1          | 14.90LB-FT | TORQUE 2          |     |
| VFD LOAD TYPE 1   | VT/PWM     | VFD LOAD TYPE 2   |     |
| VFD HERTZ RANGE 1 | 3-60       | VFD HERTZ RANGE 2 |     |
| VFD SPEED RANGE 1 | 90-1800    | VFD SPEED RANGE 2 |     |
| SERVICE FACTOR    | 1.00       | FL SLIP           |     |
| NO. POLES         |            | MAGNETIZING AMPS  |     |
| VECTOR MAX RPM    |            | Encoder PPR       |     |
| Radians / Seconds |            | Encoder Volts     |     |

## TEAO DATA (IF APPLICABLE):

|                     |  |                         |  |                         |  |                       |  |
|---------------------|--|-------------------------|--|-------------------------|--|-----------------------|--|
| HP (AIR OVER)       |  | HP (AIR OVER<br>M/S)    |  | RPM (AIR<br>OVER)       |  | RPM (AIR OVER<br>M/S) |  |
| FPM AIR<br>VELOCITY |  | FPM AIR<br>VELOCITY M/S |  | FPM AIR<br>VELOCITY SEC |  |                       |  |

**ADDITIONAL NAMEPLATE DATA:**

|                           |                     |                           |             |
|---------------------------|---------------------|---------------------------|-------------|
| Decal / Plate             | WD=499495           | Customer PN               |             |
| Notes                     |                     | Non Rev Ratchet           |             |
| Max Temp Rise             |                     | OPP/Upper Oil Cap         | GREASE      |
| Thermal (WDG)             |                     | SHAFT/Lower Oil Cap       | GREASE      |
| Altitude                  |                     | Usable At                 |             |
| Regulatory Notes          |                     | Regulatory Compliance     | CC 030A     |
| COS                       |                     | Marine Duty               |             |
| Balance                   | 0.05 IN/SEC         | Arctic Duty               |             |
| 3/4 Load Eff.             | 91.2                | Inrush Limit              |             |
| Motor Weight (LBS)        | 100                 | Direction of Rotation     |             |
| Sound Level               |                     | Special Note 1            |             |
| Vertical Thrust (LBS)     |                     | Special Note 2            |             |
| Thrust Percentage         |                     | Special Note 3            |             |
| Bearing Life              |                     | Special Note 4            |             |
| Starting Method           |                     | Special Note 5            |             |
| Number of Starts          |                     | Special Note 6            |             |
| 200/208V 60Hz Max Amps    |                     | SH Max. Temp.             |             |
| 190V 50 hz Max Amps       |                     | SH Voltage                |             |
| 380V 50 Hz Max Amps       |                     | SH Watts                  |             |
| NEMA Inertia              |                     | Load Inertia              |             |
| Sumpheater Voltage        |                     | Sumpheater Wattage        |             |
| Special Accessory Note 1  |                     | Special Accessory Note 16 |             |
| Special Accessory Note 2  |                     | Special Accessory Note 17 |             |
| Special Accessory Note 3  |                     | Special Accessory Note 18 |             |
| Special Accessory Note 4  |                     | Special Accessory Note 19 |             |
| Special Accessory Note 5  |                     | Special Accessory Note 20 |             |
| Special Accessory Note 6  |                     | Special Accessory Note 21 |             |
| Special Accessory Note 7  |                     | Special Accessory Note 22 |             |
| Special Accessory Note 8  |                     | Special Accessory Note 23 |             |
| Special Accessory Note 9  |                     | Special Accessory Note 24 |             |
| Special Accessory Note 10 |                     | Special Accessory Note 25 |             |
| Special Accessory Note 11 |                     | Special Accessory Note 26 |             |
| Special Accessory Note 12 |                     | Special Accessory Note 27 |             |
| Special Accessory Note 13 |                     | Special Accessory Note 28 |             |
| Special Accessory Note 14 |                     | Special Accessory Note 29 |             |
| Special Accessory Note 15 |                     | Special Accessory Note 30 |             |
| Heater in C/B Voltage     |                     | Heater in C/B Watts       |             |
| Zone 2 Group              |                     | Division 2 Service Factor |             |
| Note 1                    | CL.I GR.A B C D     | Note 2                    | CL.II GR.F  |
| Note 3                    | T3C TEMP CODE DIV 2 | Note 4                    | AT 1.0 S.F. |
| Note 5                    |                     | Note 6                    |             |
| Note 7                    |                     | Note 8                    |             |
| Note 9                    |                     | Note 10                   |             |
| Note 11                   |                     | Note 12                   |             |
| Note 13                   |                     | Note 14                   |             |
| Note 15                   |                     | Note 16                   |             |
| Note 17                   |                     | Note 18                   |             |
| Note 19                   |                     | Note 20                   |             |
| Note 21                   |                     | Note 22                   |             |

**NIDEC MOTOR CORPORATION**  
ST. LOUIS, MO

TYPICAL NAMEPLATE DATA  
ACTUAL MOTOR NAMEPLATE LAYOUT MAY VARY  
SOME FIELDS MAY BE OMITTED

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# MOTOR PERFORMANCE

| MODEL NO.                     | CATALOG NO. | PHASE | TYPE     | FRAME  |
|-------------------------------|-------------|-------|----------|--------|
| GF45                          | 8D5P2C      | 3     | CE       | 184T   |
| ORDER NO.                     |             | 25214 | LINE NO. |        |
| MPI:                          |             |       |          | 231629 |
| HP:                           |             |       |          | 5      |
| POLES:                        |             |       |          | 4      |
| VOLTS:                        |             |       |          | 460    |
| HZ:                           |             |       |          | 60     |
| SERVICE FACTOR:               |             |       |          | 1.15   |
| EFFICIENCY (%):               |             |       |          |        |
| S.F.                          |             |       |          | 88.7   |
| FULL                          |             |       |          | 89.5   |
| 3/4                           |             |       |          | 91.2   |
| 1/2                           |             |       |          | 91.2   |
| 1/4                           |             |       |          | 87.6   |
| POWER FACTOR (%):             |             |       |          |        |
| S.F.                          |             |       |          | 84.2   |
| FULL                          |             |       |          | 82.7   |
| 3/4                           |             |       |          | 78.3   |
| 1/2                           |             |       |          | 68.8   |
| 1/4                           |             |       |          | 47.5   |
| NO LOAD                       |             |       |          | 5.6    |
| LOCKED ROTOR                  |             |       |          | 47.3   |
| AMPS:                         |             |       |          |        |
| S.F.                          |             |       |          | 7.2    |
| FULL                          |             |       |          | 6.3    |
| 3/4                           |             |       |          | 4.9    |
| 1/2                           |             |       |          | 3.7    |
| 1/4                           |             |       |          | 2.8    |
| NO LOAD                       |             |       |          | 2.5    |
| LOCKED ROTOR                  |             |       |          | 47     |
| NEMA CODE LETTER              |             |       |          | J      |
| NEMA DESIGN LETTER            |             |       |          | B      |
| FULL LOAD RPM                 |             |       |          | 1760   |
| NEMA NOMINAL / EFFICIENCY (%) |             |       |          | 89.5   |
| GUARANTEED EFFICIENCY (%)     |             |       |          | 87.5   |
| MAX KVAR                      |             |       |          | 1.7    |
| AMBIENT (°C)                  |             |       |          | 40     |
| ALTITUDE (FASL)               |             |       |          | 3300   |
| SAFE STALL TIME-HOT (SEC)     |             |       |          | 10     |
| SOUND PRESSURE (DBA @ 1M)     |             |       |          | 56     |
| TORQUES:                      |             |       |          |        |
| BREAKDOWN{% F.L.}             |             |       |          | 319    |
| LOCKED ROTOR{% F.L.}          |             |       |          | 185    |
| FULL LOAD{LB-FT}              |             |       |          | 14.9   |

NEMA Nominal and Guaranteed Efficiencies are up to 3,300 feet above sea level and 25 ° C ambient

The Above Data Is Typical, Sinewave Power Unless Noted Otherwise

**NIDEC MOTOR CORPORATION**  
ST. LOUIS, MO

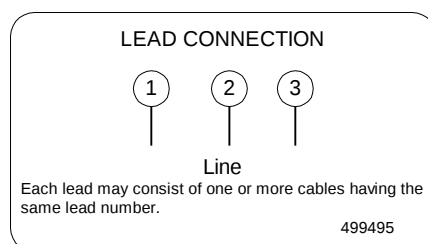
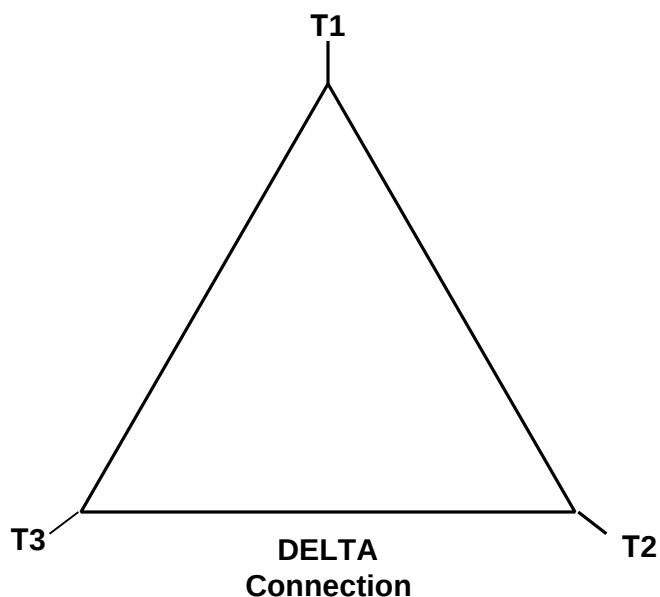


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499495

## Motor Wiring Diagram



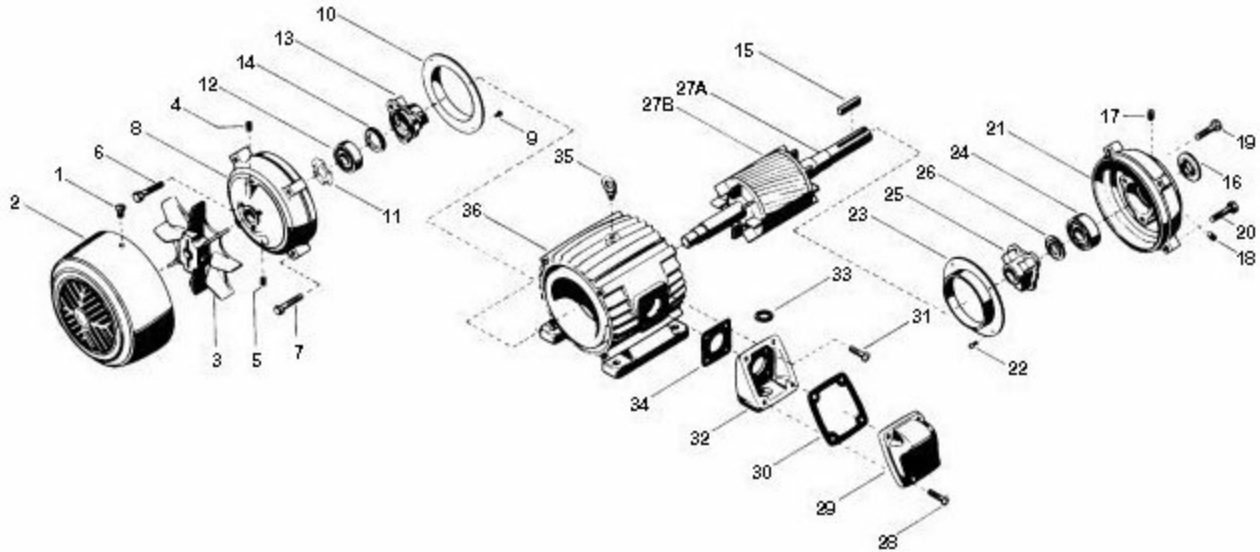
Lead size  
18 AWG

To reverse direction of rotation interchange connections L1 and L2.  
Each lead may be comprised of one or more cables.  
Each cable will be marked with the appropriate lead number.

## RENEWAL PARTS

### FRAMES 182 THRU 215 - TOTALLY ENCLOSED AND EXPLOSION PROOF MOTORS

TYPES: CE, CEF, CEF4, CT, CT2, CT4, CTC, CTE, CTE4, CTEF, CTF, CTF1, CTF4, CTFI, CTI, CTI4, CTN, CTNI, FCT, FCT4, FCTF, FCTN, FL, FLC, FLCA, FLCF, FLF, FN, FNC, FTC, FTCF, JAD, JDE, L, L1, L4, LC, LC4, LCA, LCAE, LCE, LCE4, LCEF, LCF, LCF1, LCFI, LCI, LE, LE1, LEF, LF, LF1, LF4, LFI, LFN, LI, LI4, LN, N, NC, NCE, NCEF, NCF, NI, T, TC, TC1, TC2, TC3, TC4, TCAE, TCE, TCE1, TCE2, TCE3, TCE4, TCEF, TCEFN, TCEN, TCEP, TCF, TCF1, TCF4, TCFI, TCFN, TCI, TCI3, TCN, TCNI, TF, TFN



| ITEM NO. | QTY | NAME OF PART                                                   |
|----------|-----|----------------------------------------------------------------|
| 1        | 4   | Screw (Omit for Type TFN)                                      |
| 2        | 1   | Fan Cover Guard (Omit for Type TFN)                            |
| 3        | 1   | Vent Fan (Omit for Type TFN)                                   |
| 4        | 1   | Slotted Headless Pipe Plug                                     |
| 5        | 1   | Slotted Headless Pipe Plug                                     |
| 6        | 3   | Screw (Types L & LF only)                                      |
| 7        | 4   | Screw                                                          |
| 8        | 1   | Bracket                                                        |
| 9        | 4   | Screw (Used only on Frame 184T)                                |
| 10       | 1   | Air Deflector (Used Only on Frame 184T)                        |
| 11       | 1   | Loading Spring (Types T, TF, TC, TCE, & TFN only)              |
| 12       | 1   | Ball Bearing (Short End) (Refer to section 775)                |
| 13       | 1   | Bearing Cap (Types L & LF only)                                |
| 14       | 1   | Slinger (Frames 213T & 215T, Types T, TF, TC, TCE, & TFN only) |
| 15       | 1   | Key                                                            |
| 16       | 1   | Water Deflector                                                |
| 17       | 1   | Slotted Headless Pipe Plug                                     |
| 18       | 1   | Slotted Headless Pipe Plug                                     |
| 19       | 3   | Screw (Types L & LF only)                                      |
| 20       | 4   | Screw                                                          |
| 21       | 1   | Bracket (Not used on Types TF, LF, & TFN)                      |

| ITEM NO. | QTY | NAME OF PART                                                                |
|----------|-----|-----------------------------------------------------------------------------|
| 22       | 4   | Screw (Used only on frame 184T)                                             |
| 23       | 1   | Air Deflector (Used only on frame 184T)                                     |
| 24       | 1   | Ball Bearing (Refer to section 775)                                         |
| 25       | 1   | Bearing Cap (Type L only)                                                   |
| 26       | 1   | Slinger                                                                     |
| 27       | 1   | Rotor Assembly (Includes Items 27A & 27B)                                   |
| 27A      | 1   | Motor Shaft                                                                 |
| 27B      | 1   | Rotor Core                                                                  |
| 28       | 4   | Screw                                                                       |
| 29       | 1   | Outlet Box Cover                                                            |
| 30       | 1   | Gasket (Types T, TC, TCE, TF, & TFN only)                                   |
| 31       | 2   | Screw                                                                       |
| 32       | 1   | Outlet Box Base                                                             |
| 33       | 1   | Washer                                                                      |
| 34       | 1   | Gasket (Types T, TC, TCE, TF, & TFN only)                                   |
| 35       | 1   | Eyebolt                                                                     |
| 36       | 1   | Wound Stator Assembly                                                       |
| 37       | 1   | Thermal Protectors<br>(Used on Wheel Drive units only)<br>(Not Illustrated) |
| 38       | 2   | Round Head Machine Screw (Thermal Protectors)                               |
| 39       | 2   | Hex Nut (Thermal Protectors)                                                |

#### WARNING:

Any disassembly or repair work on explosionproof motors will void the Underwriters Laboratories, Inc. label unless done by the manufacturer, or a facility approved by the Underwriters Laboratories, Inc. Refer to your nearest sales office for assistance.

#### BEARINGS:

Refer to motor nameplate for the bearing numbers.

#### PRICES:

Parts stocking distributors: refer to renewal parts numerical index. All Others: refer to your nearest parts distributor.



# Certificate of Compliance

**Certificate:** 1175021 (LR 13009-55)

**Master Contract:** 191252

**Project:** 2608857

**Date Issued:** June 19, 2013

**Issued to:** Nidec Motor Corporation

8050 West Florissant Ave.

St. Louis, MO 63136

USA

Attention: Joel Northwall

*The products listed below are eligible to bear the CSA Mark shown*



*D. Somma*

**Issued by:** D. Somma, C.E.T.

## **PRODUCTS**

**CLASS 4228 01** - MOTORS AND GENERATORS - For Hazardous Locations

**Class I, Division 2, Groups A, B, C and D: Temperature Coded T3C, T3B, T3A, T3, T2D or T2C (where applicable)**

Three phase, squirrel cage induction motors, Class B or F insulation, 50 or 60Hz, 2, 4, 6, 8 or 10 pole.

- Types TU, TV, TV-4, CTV, CTV-4, CTV-9; Rated 600 V max, 30 HP max, Frame Sizes 143T to 286T; TEFC, Temperature Coded T3C/T3B<sup>1</sup> - Notes: b, d, e, f
- Types TV-9, CT; Rated 600 V max, 200 HP max, Frame Sizes 143T to 447T; TEFC, Temperature Coded T3C - Notes: a, b, c, d, e, f
- Types TVC, TVC-4, TVC-9, CE, TC, TUC; Rated 600 V max, 200 Hp max, Frame Sizes 143T to 447T; TEFC, Temperature Coded T3C - Notes: a, b, d, e, f
- Types JU, JV, JV4; Rated 600 V max, 350 HP max, Frame Size 449, TEFC, Temperature Coded T3/T2B<sup>aaaa</sup> - Notes: b, d, e
- Types J, JC; Rated 600 V max, 400 HP max, Frame Size 449, TEFC, Temperature Coded T3/T2D<sup>a</sup> - Notes: a, b, d, e
- Types JU, JV, JV4; Rated 6900 V max, 600 HP max, Frame Sizes 5807 - 5811, TEFC, Temperature Coded T3C/T3<sup>aa</sup> - Notes: b, d, e, f
- Types JU, JV, JV4; Rated 6900 V max, 1250 HP max, Frame Size 5812, TEFC, Temperature Coded T3B/T3<sup>aaa</sup> - Notes b, d, e
- Types R, RS; Rated 6900 V max, 1000 HP max, Frame Sizes 5006 - 5012, ODP, WPI, WPPII, Temperature Coded T3C/T<sub>2</sub> - Notes: b, d, e, f
- Types R, RS; Rated 6900 V max, 2000 HP max, Frame Sizes 5800 - 5813, ODP, WPI, WPPII, Temperature Coded T3C/T<sub>2</sub> - Notes: b, d, e, f



**Certificate:** 1175021 (LR 13009-55)

**Master Contract:** 191252

**Project:** 2608857

**Date Issued:** June 19, 2013

- 
- Types RU, RV, RV-4; Rated 6900 V max, 1750 HP max, Frame Size 5813, ODP, WPI, WPIL, Temperature Coded T3A; Notes: b, d, e
  - Types J, JC, JP ; Rated 6900 V max, 700 HP max, Frame Sizes 5008 - 5012, TEFC, Temperature Coded T3/T2D<sup>3</sup> - Notes: b, d, e, f
  - Types J, JC, JP; Rated 6900 V max, 1000 HP max, Frame Sizes 5810 - 5812, TEFC, Temperature Coded T3C/T3AΦ - Notes: b, d, e

Where:

<sup>1</sup> T3B is for Frame Size 280 when used with Inverter Duty

<sup>2</sup> (i) T3 is for Frame Size 5012, 2 pole, 800 HP and Frame Size 5813, 2 pole, 1250 HP

(ii) T2D is for Frame Size 5012, 2 pole, 800 HP and Frame Size 5813, 2 pole, 1250 HP when used with Inverter Duty

<sup>3</sup> T2D when used with Inverter Duty

Φ T3C for 1.0 S.F. @ 60 Hz; T3A for 1.15 S.F.@ 60 Hz

<sup>a</sup> (i) 350 HP max @ 600V max, when used with Inverter Duty @ 4:1 CT= T2C

(ii) 350 HP max @ 600V max when used with Inverter Duty @ 3:1 CT or VT (10:1) = T3A

(iii) 300 HP max @ 600V max when used with Inverter Duty @4:1 CT or VT (10:1) = T3A

<sup>aa</sup> Where T3C for HP rating up to 400 HP and T3 for 600 HP ratings

<sup>aaa</sup> Temperature Coded T3B for 1.0 S.F. and T3 for 1.15 S.F. ratings

<sup>aaaa</sup> T2B for VT 10:1, 200HP max [JU, JV, JV4 for 449 Frame, 600V max]

Notes:

a) May be C-Face or D-Flange mounted on frames less than 5000 or p-base mounted on all frames.

b) Cast iron stator frame, except 143T and 145T stator frame which may be optionally steel construction, 1.15 SF.

c) 1.15 SF on Frames 286T-447T, 1.0 SF max below, HP times SF = 350 max on 449T.

(Frame 449 rated 350 HP @ 1.15 S.F.)

d) May include options; motor shroud, auxiliary junction box, corro duty, bearing temperature sensing device, Therma- Sentry, thermistors or RTD's embedded in winding.

# IEEE 841 Plus® World Motor

Specifically designed for Severe Duty Oil & Gas, Petro Chemical, Pulp & Paper, Automotive, Mining and Waste Treatment Industries



## Product Specifications

### Horsepower:

350 HP with World motor (Stock)

Have capability to offer through 500 HP (ETO)

**Frame Sizes:** 143 – 447

**Pole Designs:** 2, 4, 6, 8

**Design Voltages:** 460 and 575 Volts at 60 Hz

**Requirements:** Meets or exceeds 2016 DOE

NEMA Premium Efficiency rule;

Meets vibration requirements of GM7E-TA

**Warranty:** 5-year limited warranty

## Product Overview and Options

Designed to exceed the industry's most stringent IEEE 841 standards, the U.S. MOTORS® brand 841 PLUS® motors are commonly used in severe duty environments for pumps, compressors, fans, blowers, and other material processing applications. These rugged motors are ideal for constant speed or inverter duty applications typically found in the petroleum, chemical, pulp and paper, wastewater, automotive and mining industries.

U.S. MOTORS brand 841 PLUS motors are rated NEMA Premium<sup>®†</sup> efficient. Low-loss silicon steel construction and streamlined design enables the motor to operate at lower temperatures resulting in lower energy costs. This motor is designed to operate in ambient temperatures of -30°C to 40°C, in altitudes of up to 1,000 meters above sea level and with NEMA Design B torque-current characteristics. Inertia load acceleration capabilities for the 841 Plus motor meet the stringent requirements of NEMA MG 1-2009, Section 12.54.

### Product Features

- NEMA Premium<sup>®†</sup> efficient
- 1.15 Service Factor on sine wave power; 1.0 Service Factor on Inverter Duty
- Class B temperature rise at 1.0 Service Factor by resistance with sine wave power
- Class F insulation materials to increase motor life
- Exceeds NEMA MG1 Part 31 Inverter Duty
- Polyurea grease
- Stainless-steel nameplate
- Variable frequency drive or full voltage, across-the-line starting
- Ground on frame
- Division 2 suitable per NEC article 500 (NFPA 70)
- AFBMA bearing numbers on nameplate
- Protective coating on each rotor and shaft from bearing journal to bearing journal

### Inverter Duty

Nidec Motor Corporation's patented inverter grade insulation system allows the U.S. MOTORS brand 841 PLUS motor to withstand spike and transient voltages induced by insulated bipolar gate transistor drives, making it fully compliant with NEMA MG-1, Part 31. This is made possible through: NEMA Premium<sup>®†</sup> efficient

- Pulse-resistant magnetic wire that provides protection against high-voltage spikes
- Additional lacing on the end turns improve coil rigidity
- Multiple bake cycles to help prevent coil-to-coil circuits

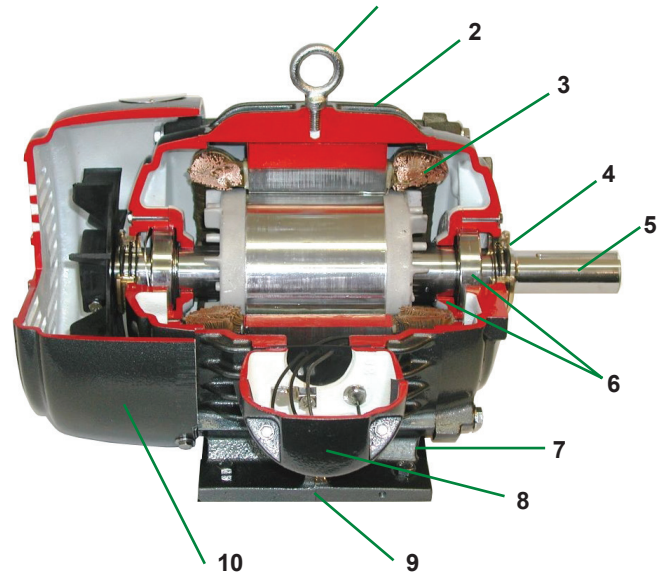
- Phase paper to help prevent phase-to-phase arcs
- Adjustable frequency of 5:1 constant torque or 20:1 variable torque for the full product line.



## Product Overview and Options

### Typical 841 PLUS® Motor Construction:

1. Corrosion resistant zinc dichromate-plated hardware
2. Heavy duty cast-iron enclosure for long life and reduced vibration
3. Inverter grade insulation
4. Inpro/Seal™ “VBXX” on both ends provides IP56 protection and prolongs motor life by shielding bearings from contaminants in even the harshest environments
5. Special shaft runouts for ball bearing motors of 0.0010 inches for shafts up to 1.625 inches and 0.0015 inches for larger shafts.
6. Same size oversized bearings on each end. Cast iron inner bearing caps
7. Brass breather drains
8. Oversized, double-gasketed and rotatable conduit box to protect against contaminants and correctly position non-braided, non-wicking motor leads
9. Foot flatness machined to within 0.005 inch tolerance ensures easy installation and proper alignment
10. Corrosion-resistant mill and chemical duty paint capable of withstanding a 500-hour salt spray test



### Options and Accessories

Nidec Motor Corporation offers the following custom-design options on the U.S. MOTORS brand 841 PLUS motor:

- Cylindrical roller bearings where applicable
- Horizontal or vertical mounting
- Vibration detectors
- Sealed insulation treatments, available on form wound, medium voltage motors above 200 HP, to help shield motor windings

- Winding and bearing thermal protection for motors 50 HP and up
- Inpro/Seal™ MGS grounding shaft rings
- API 661 Duty

#### 841 Plus Stock Motors

- 1 – 200 HP
- 2, 4, 6 pole designs
- 460 and 575 Volts
- Constant or variable torque
- 1–10 HP C-Face Footless

#### Custom and Conversion Motors

- 1 – 500 HP
- 2, 4, 6, 8 pole designs
- 200, 230, 460, 575, 2300, 4000 Volts
- Constant or variable torque
- C & D flange kits available 140 – 440 frame

### Testing and Inspection

Nidec Motor Corporation conducts extensive testing and inspections on each of its U.S. MOTORS brand 841 PLUS motors.

- No load current, power and speed
- High-potential test on stator windings

- Insulation resistance test by megohmmeter and polarization index
- Precision balanced to typical vibration levels of less than 0.05 inches per second

- Optional complete test, including full load test

For additional information, please refer to our Full Line Standard Motor Catalog (FL600) or contact your Nidec Motor Corporation representative.

† All marks shown within this document are properties of their respective owners.

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# General Information for Integral Horsepower (IHP) Motors on Variable Frequency Drives (VFDs)

## Variable Frequency Drives (VFD)

A VFD is a type of controller used to vary the speed of an electric motor. The VFD takes a fixed AC voltage and frequency and allows it to be adjusted in order to get different speeds from the motor. Motor speed can be varied by changing the frequency of the input power waveform. The equation below shows how the frequency affects the speed of a three phase induction motor.

$$\text{Speed} = \frac{120 * \text{Fundamental Input Frequency}}{\text{Number of Motor Poles}}$$

## How does a VFD work?

A VFD takes the fixed frequency and voltage sine wave from the power grid or power station and puts it through a few steps in order to allow the VFD user to vary the frequency and in turn control the motor speed. First it rectifies the AC power into DC Power. Because of this step, a term commonly used instead of VFD is inverter. This only describes one step of what the VFD does to the power waveform. Once rectified into a DC voltage the drive sends the power through a set of transistors or switches. These switches can take the DC waveform and by opening and closing at certain speeds and durations can create an output waveform that mimics the sine wave that is required to drive a three phase electric motor. The output wave form is known as a Pulse Width Modulation (PWM) waveform because the waveform is created by multiple pulses of the switches at short intervals.

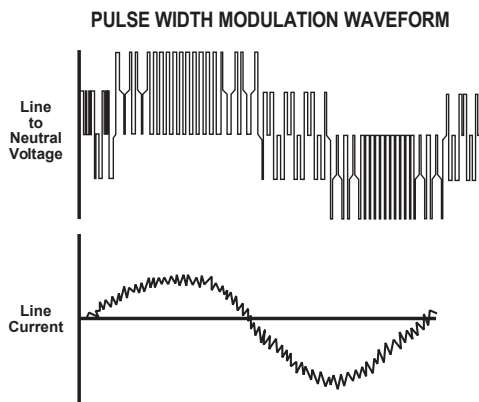


Figure 1 PWM Waveform

## What variables should be considered when deciding whether to power a motor with a VFD?

VFD compatibility with motors is complex. As a result, many variables must be considered when determining the suitability of a particular motor for use with a VFD. These variables include:

- Torque requirements (Constant or Variable)
- Speed Range
- Line / System Voltage
- Cable length between the VFD and the motor
- Drive switching (carrier) frequency
- Motor construction

- VFD dv/dt - winding end turn differential in voltage versus differential in time
- High temperatures or high humidity
- Grounding system

Wider speed ranges, higher voltages, higher switching frequencies, insufficient grounding and increased cable lengths all add to the severity of the application and, therefore, the potential for premature motor failure.

## How does a VFD affect the motor?

There are many things to consider when a motor is powered using a VFD or PWM power. When a motor is powered by a PWM waveform the motor windings very often see a large differential voltage, either from phase to phase or turn to turn. When the voltage differential becomes large enough it creates a reaction at the molecular level that converts available oxygen into O<sub>3</sub>. This phenomenon is called partial discharge or corona. This reaction creates energy in the form of light and heat. This energy has a corrosive effect on the varnish used to protect the motor windings. PWM waveforms can also magnify shaft voltages which lead to arcing across the bearing and causing premature bearing failure. Corrective action must be taken to mitigate these issues that arise when using an electric motor with a VFD.

## How do I protect the motor?

Nidec Motor Corporation (NMC) has developed specific motor designs to decrease the harmful affects that a VFD can have on a motor. NMC's INVERTER GRADE<sup>®</sup> insulation system is the first line of defense against corona and phase to phase faults that can be common when a motor is powered using a PWM waveform. The INVERTER GRADE<sup>®</sup> insulation system is standard on all of NMC's Inverter Duty products. Along with the INVERTER GRADE<sup>®</sup> insulation, thermostats are installed as a minimum protection against over heating the motor. Special consideration must also be given to bearings in motors powered by VFD's. In order to create a low resistance path to ground for built up shaft voltages a shaft grounding device can be used. On larger horsepower motors an insulated bearing system should be used in conjunction with the shaft grounding device when installed, to force the stray shaft voltages to ground. The bearing failures are more prominent on motors with thrust handling bearings. NMC has created an Inverter Duty vertical motor line that not only uses the INVERTER GRADE<sup>®</sup> insulation system, but that also comes standard with a shaft grounding device. On motors that are 100 HP and greater the thrust bearing is also insulated for additional protection.

## What does "Inverter Duty" mean?

An Inverter Duty motor should describe a motor that helps mitigate potential failure modes of a motor that is powered by a VFD. Inverter duty motor windings should be able to withstand the voltage spikes per NEMA MG1 Part 31.4.4.2 and protect against overheating when the motor is run at slow speeds. On thrust handling bearings it is apparent that the bearings require additional protection. Inverter Duty vertical motors should have a shaft grounding device to protect the motor bearings from fluting due to voltage discharge through the bearing. On larger motors (100HP and larger) the shaft should also be electrically isolated from the frame in order to aid the shaft grounding ring in discharging the shaft voltages to ground.

\*This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL<sup>®</sup> & CSA<sup>®</sup> listings where indicated.

# Motor / Inverter Compatibility

## Thermal Overloads and Single Phase Motors

Motors with thermal overloads installed may not operate properly on a VFD. The current carrying thermal overload is designed for sine wave power. Operation on a VFD may cause nuisance tripping or potentially not protect the motor as would be expected on line power. Thermostats or thermistors installed in the motor and connected properly to the VFD may provide suitable thermal overload protection when operating on a VFD. (consult codes for installation requirements)

Single phase motors and other fractional horsepower ratings are not designed to be operated on a VFD. Within Nidec Motor Corporation standard products, all motors NEMA® 48 frame (5.5" diameter) and smaller are not suitable for VFD applications. Three phase 56 and 143/145 frame applications should be noted on the catalog price page; or if in doubt ask a Nidec Motor Corporation technical representative for recommendations on compatibility with a VFD.

## Slow Speed Motors

Motors with a base design of slower than six poles require special consideration regarding VFD sizing and minimizing harmonic distortion created at the motor terminals due to cable installation characteristics. Additional external PWM waveform filters and shielded motor cables designed for PWM power may be required to provide acceptable motor life. Harmonic distortion on the output waveform should be kept to a minimum level (less than 10%) mismatch impedance.

## 690V Applications

Motors that are rated for 690VAC and that will be powered by 690VAC PWM VFDs require the use of an external filter to limit peak voltage spikes and the use of an INVERTER GRADE® motor. Where available, an alternative to using an output filter is to upgrade to a 2300V insulation system.

## Low Voltage TITAN® Motors

When using 449 frame and larger motors on PWM type VFDs consider the use of an external filter and shielded motor cables designed for PWM power to minimize harmonic distortion and peak voltages at the motor terminals. Harmonic distortion on the output waveform should be kept to a minimum level (less than 10%).

## Bearing Currents Related to PWM Waveforms

Protection of the motor bearings from shaft currents caused by common mode voltages is becoming a standard feature on Inverter Duty motor products. Some installations may be prone to a voltage discharge condition through the motor bearings called Electrical Discharge Machining (EDM) or fluting. Vertical HOLLOSHAFT and HOSTILE DUTY World Motor come with grounding devices installed as standard. EDM damage is related to characteristics of the PWM waveform, and the VFD programming, and installations factors.

### Bearing Protection on Inverter Duty Vertical Motors

All U.S. MOTORS® brand "Inverter Duty" vertical products have a shaft grounding system that allows damaging shaft currents a low resistance path to ground. **Bearings on vertical motors fed by VFD power without this bearing protection are not covered under any warranty.** All other bearing failure is covered per NMC's standard warranty. An electric motor repair shop approved to service U.S. MOTORS® brand motors must verify that the cause of the bearing failure was not due to EDM damage.

## Guideline For Insulated Anti-Friction Bearings

Bearing insulation is required to prevent circulating shaft currents which can damage bearings. Circulating shaft current can be caused by use of improper power and/or ground cables, improper grounding systems and higher switching frequencies. Finding and correcting the external condition(s) is the responsibility of the system designer or specifying engineer. To prevent circulating shaft current in motors with anti-friction bearings, Nidec Motor Corporation's standard practice is to insulate the non-drive end bearing.

Adjustable Speed Drives produce a common mode voltage condition. To interrupt common mode voltage on induction motors of all sizes, NEMA MG1-2018 Part 31 recommends insulating both bearings. In cases where both anti-friction bearings are insulated, the system designer or specifying engineer should determine whether to apply one or more of the following options to prevent or reduce shaft currents: sinewave filters, line reactors or mechanical devices, such as shaft grounding or an insulated half coupling. Motors with shaft grounding devices are not suitable for installation in hazardous locations unless housed in an enclosure suitable for the specified Division (or Zone), Class and Group(s).

## Multiple Motors on a Single VFD

Special considerations are required when multiple motors are powered from a single VFD unit. Most VFD manufacturers can provide guidelines for proper motor thermal considerations and starting/stopping of motors. Cable runs from the VFD and each motor can create conditions that will cause extra stress on the motor winding. Filters may be required at the motor to provide maximum motor life.

## Grounding and Cable Installation Guidelines

Proper output winding and grounding practices can be instrumental in minimizing motor related failures caused by PWM waveform characteristics and installation factors. VFD manufacturers typically provide detailed guidelines on the proper grounding of the motor to the VFD and output cable routing. Cabling manufacturers provide recommended cable types for PWM installations and critical information concerning output wiring impedance and capacitance to ground.

## Integrated Motor and Inverter

By integrating the motor and inverter at NMC's manufacturing facility, many of the motor compatibility problems are minimized or eliminated. During the manufacturing process, the motor is matched to the inverter characteristics which ensures the winding temperature and torque levels meet the design specification. Since the inverter output wiring to the motor is nearly eliminated, bearing currents are rarely experienced. When the unit is properly grounded, reducing the output cable lengths in conjunction with an inverter grade insulation system and low factory setting of the switching frequency of the inverter drive, results in low risk of voltage peaks produced by the PWM waveform.

## Vertical Motors on VFDs

Vertical motors operated on VFD power present unique conditions that may require consideration by the user or installation engineer:

- Locked rotor and drive tripping caused by non-reversing-ratchet operation at low motor speeds. It is not recommended to operate motors at less than 1/4 of synchronous speed. If slow speeds are required contact NMC engineering.
- Unexpected / unacceptable system vibration and or noise levels caused by the torque pulsation characteristics of the PWM waveform, a system critical frequency falling inside the variable speed range of the process or the added harmonic content of the PWM waveform exciting a system component
- Application related problems related to the controlled acceleration/deceleration and torque of the motor on VFD power and the building of system pressure/ load.
- The impact the reduction of pump speed has on the down thrust reflected to the pump motor and any minimum thrust requirements of the motor bearings
- Water hammer during shutdown damaging the non-reversing ratchet

## Humidity and Non-operational Conditions

The possible build-up of condensation inside the motor due to storage in an uncontrolled environment or non-operational periods in an installation, can lead to an increased rate of premature winding or bearing failures when combined with the stresses associated with PWM waveform characteristics. Moisture and condensation in and on the motor winding over time can provide tracking paths to ground, lower the resistance of the motor winding to ground, and lower the Corona Inception Voltage (CIV) level of the winding.

Proper storage and maintenance guidelines are important to minimize the potential of premature failures. Space heaters or trickle voltage heating methods are the common methods for drying out a winding that has low resistance readings. **Damage caused by these factors are not covered by the limited warranty provided for the motor unless appropriate heating methods are properly utilized during non-operational periods and prior to motor start-up.**

NEMA® Application Guide for AC Adjustable Speed Drive Systems: <http://www.nema.org/stds/acadjustable.cfm#download>

\* This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL® & CSA® listings where indicated.

# Warranty Guidelines for Integral Horsepower (IHP)\* Motors on Variable Frequency Drives

## Warranty Guidelines

The information in the following section refers to the motor and drive application guidelines and limitations for warranty.

### Hazardous Location Motors

Use of a variable frequency drive with the motors in this catalog, intended for use in hazardous locations, is only approved for Division 1, Class I, Group D hazardous location motors with a T2B temperature code, with a limitation of 2:1 constant torque or 10:1 variable torque output. **No other stock hazardous location motors are inherently suitable for operation with a variable frequency drive.** If other requirements are needed, including non-listed Division 2, please contact your Nidec Motor Corporation territory manager to conduct an engineering inquiry.

### 575 Volt Motors

575 volt motors can be applied on Inverters when output filters are used. Contact the drive manufacturer for filter selection and installation requirements.

### Applying INVERTER GRADE® Insulated Motors on Variable Frequency Drives (2, 4, 6 pole)

The products within this catalog labeled "Inverter Duty" or "Vector Duty" are considered INVERTER GRADE® insulated motors. INVERTER GRADE® motors exceed the NEMA® MG-1 Part 31 standard. Nidec Motor Corporation provides a three-year limited warranty on all NEMA® frame INVERTER GRADE® insulated motors and allows long cable runs between the motor and the VFD (limited to 400 feet without output filters). Cable distance can be further limited by hot and humid environments and VFD manufacturers cable limits. These motors may be appropriate for certain severe inverter applications or when the factors relating to the end use application are undefined (such as spares).

Nidec Motor Corporation's U.S. Motors® brand is available in the following INVERTER GRADE® insulated motors:

- Inverter Duty NEMA® frame motors good for 20:1 Variable Torque & 5:1 Constant Torque, including Vertical Type RUSI (10:1 V.T.)
- Inverter Duty motors rated for 20:1 Constant Torque
- ACCU-Torq® and Vector Duty Motors with full torque to 0 Speed or 5000:1
- 841 Plus® NEMA® Frame Motors

### Applying Premium Efficient motors (that do not have INVERTER GRADE® insulation) on Variable Frequency Drives (2, 4, 6 pole)

Premium efficient motors without INVERTER GRADE insulation meet minimum NEMA® MG-1, Section IV, Part 31.4.4.2. These motors can be used with Variable Frequency Drives (with a reduced warranty period) under the following parameters:

- On NEMA® frame 447 and smaller motors, 20:1 speed rating on variable torque loads & 4:1 speed range on constant torque loads.
- On TITAN® 449 and larger frame motors, 10:1 speed rating on variable torque loads.

- On TITAN® frame motors, inquiry required for suitability on constant torque loads.

Cable distances are for reference only and can be further limited by hot and humid environments (refer to Table 1). Refer to specific VFD

| Table 1 - Cable Distances           |          |          |          |
|-------------------------------------|----------|----------|----------|
| Maximum Cable Distance VFD to Motor |          |          |          |
| Switching Frequency                 | 460 Volt | 230 Volt | 380 Volt |
| 3 KHz                               | 127 ft   | 400 ft   | 218 ft   |
| 6 KHz                               | 90 ft    | 307 ft   | 154 ft   |
| 9 KHz                               | 73 ft    | 251 ft   | 126 ft   |
| 12 KHz                              | 64 ft    | 217 ft   | 109 ft   |
| 15 KHz                              | 57 ft    | 194 ft   | 98 ft    |
| 20 KHz                              | 49 ft    | 168 ft   | 85 ft    |

manufacturers cable limits. Refer to the Motor/ Inverter Compatibility page for special consideration of vertical motor bearings.

## Warranty Period Clarifications and Exceptions

### Standard Energy Efficient Exclusion

Applying Standard & Energy Efficient Motors on Variable Frequency Drives is not recommended. VFD related failures on standard and energy efficient motors will not be covered under warranty.

### Vertical Motor Windings

Premium efficient vertical motors without INVERTER GRADE® insulation that are installed using the criteria described in this document and applied in the correct applications shall have a warranty while powered by a VFD for 12 months from date of installation or 18 months from date of manufacturing whichever comes first. See limited warranty page for horizontal motor warranty periods.

### Bearing Exclusion for Thrust Handling Bearings

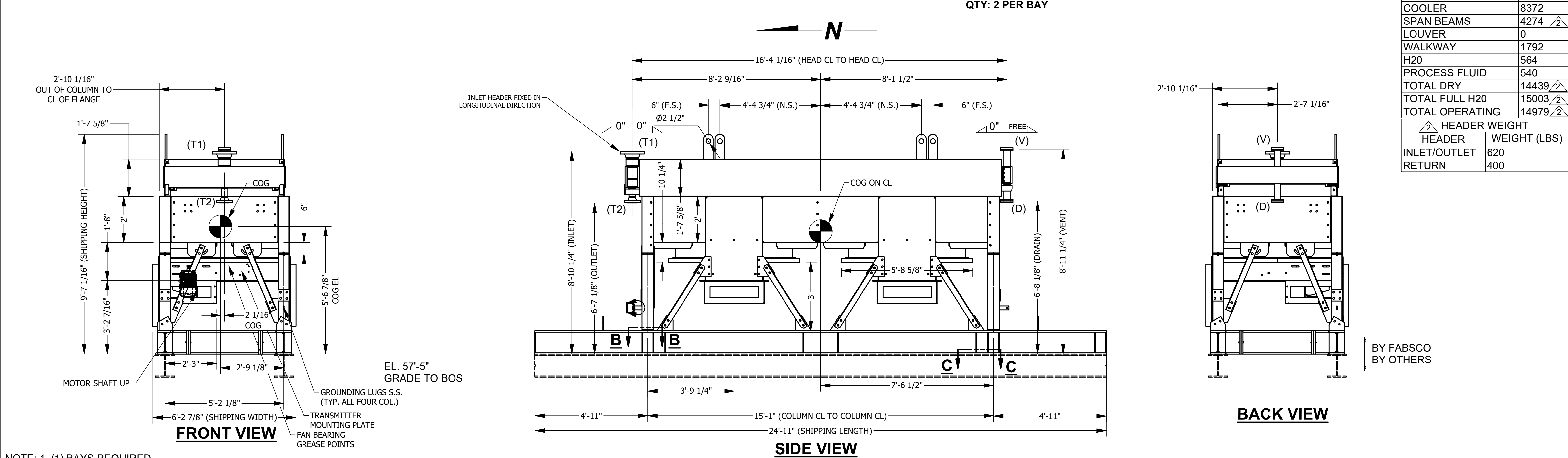
Bearings used in premium efficient vertical motors, and all thrust handling bearings, that are powered by VFDs without shaft grounding devices or insulated bearings (when required) will not be covered under any warranty for damages caused from being powered by a VFD. All other bearing failure is covered per NMC's standard warranty. An electric motor repair shop approved to service U.S. MOTORS® brand motors must verify that the cause of the bearing failure was not due to Electrical Discharge Machining.

### Medium Voltage and Slow Speed Considerations

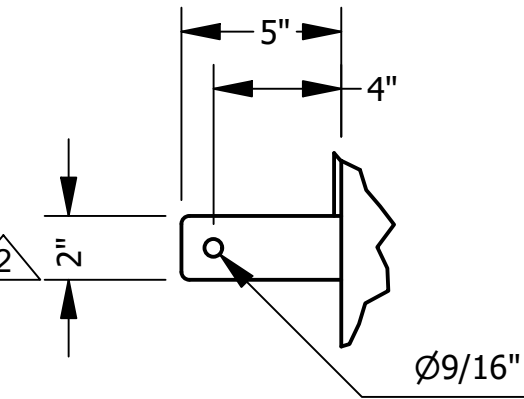
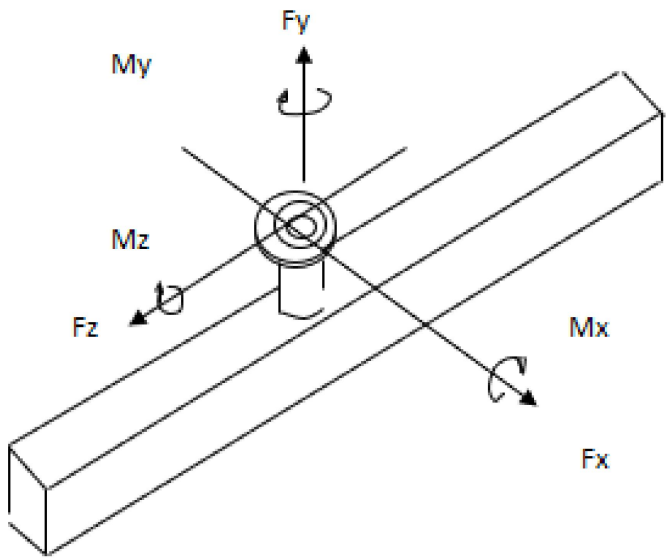
Motors that are rated above 700 VAC or that are eight pole and slower require special consideration and installation and are not covered under the warranty guidelines in this document. Motors that are rated above 700VAC have special cable length and voltage differential issues that are specific to the VFD type and manufacture. The motor construction and cost may vary dramatically depending on the VFD topology and construction. Contact your NMC representative with VFD manufacturer name and model type for application and motor construction considerations. Motors that are designed eight pole and slower also require special installation and filters per the drive manufacturer.

\* This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL® & CSA® listings where indicated.

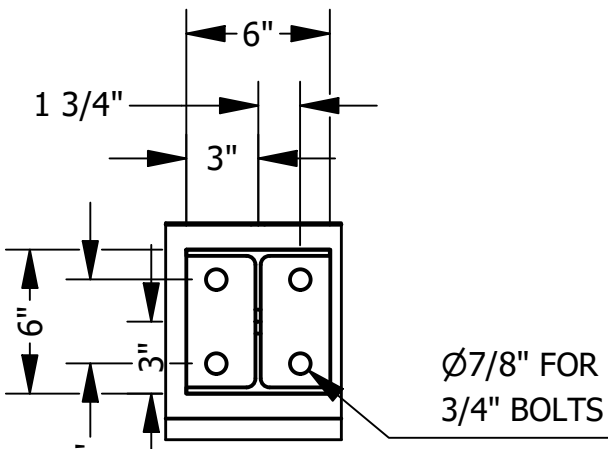
| SECTION / DESCRIPTION   | MAWP  | TEST PRESS | DESIGN TEMP | MDMT  | CONN NPS  | RATING | BUNDLE VOL | BUNDLE WT | LOUVER | HAILSCREENS | MOTOR HP: 5       | FAN MFGR: MOORE | DIAM (FT): 5    | SPECIFICATION NOTES:                    | COOLER WT #: SEE TABLE                     |
|-------------------------|-------|------------|-------------|-------|-----------|--------|------------|-----------|--------|-------------|-------------------|-----------------|-----------------|-----------------------------------------|--------------------------------------------|
| UNITS                   | PSIG  | PSIG       | DEG F       | DEG F | INCH      | SEE    | CU FT      | LBS       |        |             | TYPE: TEFC        | CLASS: 10000    | ACFM/FAN: 20806 | VIBE TRANS.: WILCOXON                   | STRUCTURE FINISH: PER A8KM-PP-000-500540-A |
| FLASHED STEAM CONDENSER | 50/FV | 65         | 300         | 32    | SEE TABLE | TABLE  | 9          | 5444      | NONE   | NONE        | RPM: 1800         | BLADES: 3       | HP@ DES.: 1.69  | VIBE TRANS. MODEL NO.: 786A-D2          | GALVANIZED                                 |
| 18-XF-370               |       |            |             |       |           |        |            |           |        |             | VAC: 460/3/60     | PITCH: 12.22    |                 | HEADER FINISH: PER A8KM-PP-000-500520-A | HEADER FINISH: PER A8KM-PP-000-500520-A    |
|                         |       |            |             |       |           |        |            |           |        |             | FRAME: 184T       | RPM: 500        | DRIVE: HTD      | QTY: 2 PER BAY                          | COATING SYSTEM 1 AFTER HYDRO               |
|                         |       |            |             |       |           |        |            |           |        |             | SHAFT: 1.125      | SERIES: 18      | RATIO: 3.6:1    |                                         |                                            |
|                         |       |            |             |       |           |        |            |           |        |             | MOTOR WT: 124 lbs | TYPE: SC        | DRIVE WIDTH: 30 |                                         |                                            |
|                         |       |            |             |       |           |        |            |           |        |             | QTY: 2 PER BAY    | TIP: VT         | AIR BRAKE: YES  |                                         |                                            |
|                         |       |            |             |       |           |        |            |           |        |             | QTY: 2 PER BAY    |                 |                 |                                         |                                            |



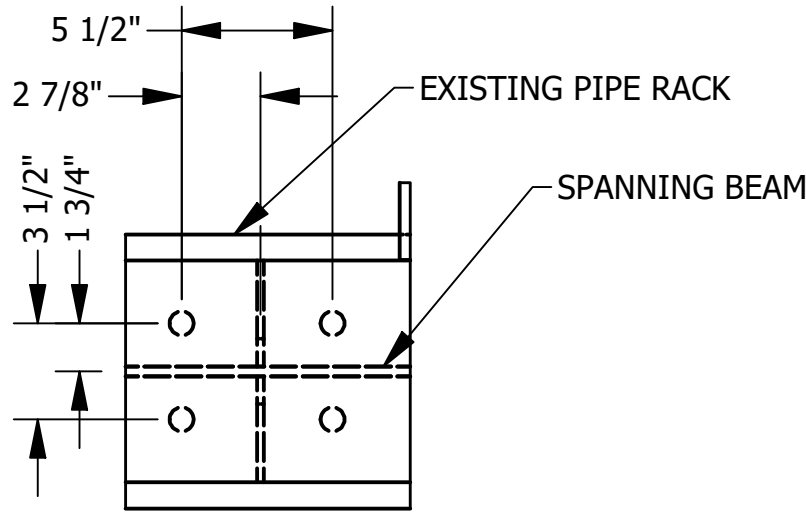
- NOTE: 1. (1) BAYS REQUIRED  
2.SPANNING BEAMS, STUB COLUMNS, TRANSV & LONL DIAG BRACES REMOVED FOR SHIPPING.  
3.ALL MOTORS ARE VFD COMPATIBLE, NO SPACE HEATER.  
4.MOTOR REMOVAL BEAM  
5.MOTORs SHALL BE RATED FOR CLASS 1, DIV. 2, GROUPS B,C,D AND A T3C TEMPERATURE CODE



DETAIL D  
GROUNDING LUG



SECTION B-B



SECTION C-C

APPROVED BY: \_\_\_\_\_  
DATE: \_\_\_\_\_

GENERAL ARRANGEMENT

| REV. | DATE      | DESCRIPTION    |
|------|-----------|----------------|
| 0    | 4/20/2022 | FOR APPROVAL   |
| 1    | 9/28/2022 | PER CUST COMM. |
| 2    | 2/1/2023  | PER CUST COMM. |
|      |           |                |
|      |           |                |

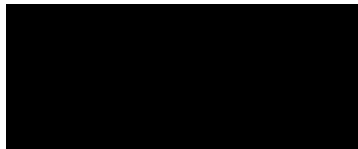
| FLANGES PER ASME B16.5 |                |     |                   |
|------------------------|----------------|-----|-------------------|
| NOZZLE SCHEDULE        |                |     |                   |
| ITEM                   | ITEM           | QTY | FLANGE            |
| T1                     | PROCESS INLET  | 1   | 6" 300# RFWN      |
| T2                     | PROCESS OUTLET | 1   | 3" 300# RFWN      |
| V                      | VENT           | 1   | 2" 300# RFLWN/BLD |
| D                      | DRAIN          | 1   | 2" 300# RFLWN/BLD |

|                   |                                  |
|-------------------|----------------------------------|
| PROJECT NAME:     | World Energy Renewables Project  |
| PROJECT NO./UNIT: | EN-20-7120 / PRU                 |
| CUSTOMER/CLIENT:  | World Energy Paramount           |
| EQUIPMENT OWNER:  | Air Products Manufacturing LLC   |
| ITEM NO.:         | 18-XF-370                        |
| SERVICE:          | Flashed Steam Condenser          |
| LOCATION:         | World Energy, Paramount, CA, USA |
| PO NO.:           | 4505606037 / A8KM-4-406-PO-2     |
| FABSCO JOB NO.:   | A22-13313-1                      |

|             |                                                                                                                                 |      |
|-------------|---------------------------------------------------------------------------------------------------------------------------------|------|
| DRAWN BY:   | <div><b>FABSCO</b><br/>Fin-Air, LLC.</div> |      |
| DATE:       |                                                                                                                                 |      |
| 4/20/2022   |                                                                                                                                 |      |
| CHECKED BY: | DRAWING NO:                                                                                                                     | REV: |
|             | A22-13313-1-100                                                                                                                 | 2    |

| NOZZLE LOADS |      | QTY/HEAD |      | SIZE  | CLASS, # | 2 X API 661 |  |
|--------------|------|----------|------|-------|----------|-------------|--|
| FRONT HEAD   |      | 1        | 3    | 300   |          |             |  |
| SIZE         | FX   | FY       | FZ   | MX    | MY       | MZ          |  |
|              | LBS  | LBS      | LBS  | FT LB | FT LB    | FTLB        |  |
| 6            | 1800 | 2260     | 2260 | 3160  | 4500     | 2400        |  |
| 3            | 900  | 760      | 900  | 600   | 900      | 600         |  |
| COMBINED     | 3600 | 3780     | 4060 | 4360  | 6300     | 3600        |  |
| MAX API      | 2250 | 4500     | 3750 | 4500  | 6000     | 3000        |  |
| DESIGN LOAD  | 2250 | 4500     | 3750 | 4500  | 6000     | 3000        |  |

| REFERENCE DOCUMENTS |                        | EQ. TAGS #S |            |
|---------------------|------------------------|-------------|------------|
| FABSCO DOC. #       | APCI DOC. #            | COOLER      | EQUIPMENT  |
| A22-13313-1A-300    | EN207120-FAB-9V3-00084 | 18-XF-370   | MOTOR      |
| A22-13313-1A-ASME   | EN207120-FAB-9V3-00119 | 18-XF-370   | MOTOR      |
| A22-13313-1A-LL     | EN207120-FAB-9V3-00090 | 18-XF-370   | FAN        |
| A22-13313-1A-NOTES  | EN207120-FAB-9V3-00269 | 18-XF-370   | FAN        |
| A22-13313-1-WV      | EN207120-FAB-9V3-00268 | 18-XF-370   | VIB SENSOR |
| A22-13313-1-STR     | EN207120-FAB-9V3-00097 | 18-XF-370   | VIB SENSOR |



WORLD ENERGY RENEWABLE FUELS CONVERSION PROJECT

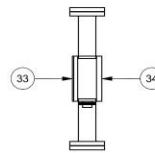
Project No: A8KM

Vendor Input to PCMS

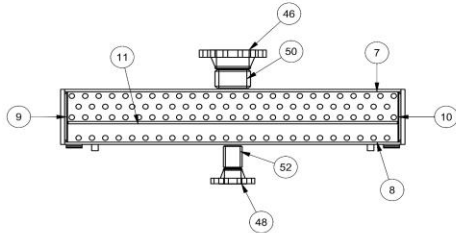
Doc number: A8KM-PCMS-001, Rev. 1

Vendor Doc Number: EN207120-FAB-9V3-00093  
PCMS\_PO Number: 4505606037  
Rev: 1

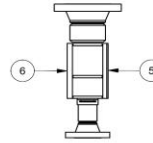
|                               |                |  |  |  |                   |
|-------------------------------|----------------|--|--|--|-------------------|
| <b>Identification</b>         |                |  |  |  |                   |
| 1: Tag No.                    | 18-XF-370      |  |  |  |                   |
| 2: Model No.                  |                |  |  |  |                   |
| 3: Serial No.                 | A22-13313-1A   |  |  |  |                   |
| 4: Registration No.           | 11512          |  |  |  | Code Vessels Only |
| 5: Code Stamped               | yes            |  |  |  | Drop Down         |
| <b>General Design</b>         |                |  |  |  |                   |
| 15: Build Date                | 2024           |  |  |  |                   |
| 17: Manufacturer              | FABSCO FIN AIR |  |  |  |                   |
| 19: General Material          | CS             |  |  |  |                   |
| 20: Insulation Type           | None           |  |  |  | Drop Down         |
| 21: Support Type              | Baseplate      |  |  |  | Drop Down         |
| 22: External Coating          | Epoxy          |  |  |  | Drop Down         |
| 23: MAWP (psig)               | 50             |  |  |  |                   |
| 24: MAWT (F)                  | 300            |  |  |  |                   |
| 25: Design Pressure (psig)    | 50             |  |  |  |                   |
| 26: Full Vacuum               | yes            |  |  |  | Drop Down         |
| 27: Design Temp (F)           | 300            |  |  |  |                   |
| 28: MDMT (F)                  | 32             |  |  |  |                   |
| 29: Weight Empty (lbs)        | 14439          |  |  |  |                   |
| 30: Weight Full (lbs)         | 15003          |  |  |  |                   |
| 31: Equipment Length (inches) | 24'-11"        |  |  |  |                   |
| 32: Orientation               | Horizontal     |  |  |  | Drop Down         |
| 33: Equipment Width (inches)  | 6'-3"          |  |  |  |                   |
| 34: Equipment Height (inches) | 9'-8"          |  |  |  |                   |
| 35: Storage Volume (bbls)     | NA             |  |  |  | Vessels Only      |
| 36: Outer Diameter (inches)   | NA             |  |  |  |                   |
| 37: PWHT                      | yes            |  |  |  |                   |
| 38: Fire Proofing             | no             |  |  |  |                   |
| 39: Heat Tracing              | None           |  |  |  |                   |
| 40: Test Medium               | Water          |  |  |  | Pressure Testing  |



**BACK TUBE SHEET SIDE**



**FRONT PLUG SHEET SIDE**

[illegible]

**CUSTOMER:** AIR PRODUCTS MANUFACTURING, LLC.

**PO NO:** 4505606037/A8KM-4-406-PO-2

DATE \_\_\_\_\_

ITEM NO: 18-XF-370

AC



**FABSCO**  
SHELL & TUBE, LLC

DWG No

REV

A22-13313-1A-HS

0

# SSAB

12400 Highway 43 North, Axis, Alabama 36505, US

## Test Certificate

**WARNING:** This product can expose you to chemicals including nickel and nickel compounds, which are known to the State of California to cause cancer. For more information go to [www.P65Warnings.ca.gov](http://www.P65Warnings.ca.gov).

Form TC1: Revision 4: Date 6 Feb 2019

| <b>Customer:</b><br>DELTA STEEL, INC.<br>5599 SAN FELIPE-STE 600<br>P.O BOX 2289<br>HOUSTON<br>TX 77252                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |          | <b>Customer P.O.No.:</b> OFT-40203<br><b>Product Description:</b> ASME SA516-70/SA516-65/SA516-60(17)<br>ASTM A516-70/SA516-65/SA516-60(17)<br>2"ELG.LCVN 15/12FT.LBS @ -80FA673-P<br>MAX 0.010% S, 0.020% P, 0.43% CEV<br><b>Size:</b> 1.000 X 120.0 X 382.0 (IN) |         | <b>Mill Order No.:</b> 41-572842-04<br><b>Shipping Manifest:</b> AR289290<br><b>Ship Date:</b> 30 May 19<br><b>Cert Date:</b> 30 May 19<br><b>Cert No:</b> 081724815<br>(Page 1 of 1)<br><b>Heat Treat Type:</b> NORMALIZED |           |        |                 |         |          |                    |           |          |         |         |        |      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|--------|-----------------|---------|----------|--------------------|-----------|----------|---------|---------|--------|------|
| <b>Tested Pieces:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |          | <b>Tensiles:</b>                                                                                                                                                                                                                                                   |         | <b>Charpy Impact Tests:</b>                                                                                                                                                                                                 |           |        |                 |         |          |                    |           |          |         |         |        |      |
| Heat Id                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Piece Id | Piece Dimensions                                                                                                                                                                                                                                                   | Tst Loc | YS (KSI)                                                                                                                                                                                                                    | UTS (KSI) | %RA    | Elong % 2in 6in | Tst Dir | Hardness | Abs. Energy (FTLB) | % Shear   | Tst Temp | Tst Dir | Tst Str | BOWTT  |      |
| E9E225                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | E21      | 1.008 (DISCRT)                                                                                                                                                                                                                                                     | C51     | 76                                                                                                                                                                                                                          |           | 50     |                 | T       |          | 84 76 73 78        | 1 2 3 Avg | -60F     | L       | 10.     |        |      |
| E9E225                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | E22      | 1.007 (DISCRT)                                                                                                                                                                                                                                                     | C50     | 74                                                                                                                                                                                                                          |           | 57     |                 | T       |          | 66 91 81 79        | 1 2 3 Avg | -60F     | L       | 10.     |        |      |
| <b>Chemical Analysis</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          |                                                                                                                                                                                                                                                                    |         |                                                                                                                                                                                                                             |           |        |                 |         |          |                    |           |          |         |         |        |      |
| Heat Id                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | C        | Mn                                                                                                                                                                                                                                                                 | P       | S                                                                                                                                                                                                                           | Si        | Tot Al | Sol Al          | Cu      | Ni       | Cr                 | Mo        | Cb       | V       | Ti      | B      | INW  |
| E9E225                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | .19      | 1.01                                                                                                                                                                                                                                                               | .011    | .002                                                                                                                                                                                                                        | .25       | .027   | .025            | .27     | 1.14     | 1.12               | .03       | .002     | .004    | .008    | 1.0002 | 1.42 |
| KILLED STEEL<br>MERCURY IS NOT A METALLURGICAL COMPONENT OF THE STEEL AND NO MERCURY WAS INTENTIONALLY ADDED DURING THE MANUFACTURE OF THIS PRODUCT.<br>KILLED STEEL, PRODUCED TO A FINE GRAIN PRACTICE<br>CEV (IITW) = C + Mn/5 + (Cr+Mo+V)/5 + (Ni+Cu)/15<br>NACE MR0175/ISO15156-2:2015 ANNEX A2.1.2 COMPLIANT<br>NACE MR0103/ISO 17495-1:2016 13.1.1(A) AND 13.1.1(C) COMPLIANT<br>MTR EN 10204:2004 INSPECTION CERTIFICATE 3.1 COMPLIANT<br>100% MELTED AND MANUFACTURED IN THE USA.<br>NO WELD REPAIR HAS BEEN PERFORMED ON THIS MATERIAL.<br>NORMALIZED PLATES. HEATED AT 1665F FOR 44 MINUTES.<br>TEST COUPONS TAKEN FROM HEAT TREATED PLATE.<br>PRODUCTS SHIPPED:<br>E9E225 E21 40012650 PCES: 1, LBS: 13000 E9E225 E21 40012651 PCES: 1, LBS: 13000<br>E9E225 E22 40012654 PCES: 1, LBS: 13000 E9E225 E21 40012653 PCES: 1, LBS: 13000<br>E9E225 E21 40012652 PCES: 1, LBS: 13000 |          |                                                                                                                                                                                                                                                                    |         |                                                                                                                                                                                                                             |           |        |                 |         |          |                    |           |          |         |         |        |      |
| (P) Cust Part #: _____                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |          |                                                                                                                                                                                                                                                                    |         |                                                                                                                                                                                                                             |           |        |                 |         |          |                    |           |          |         |         |        |      |
| WE HEREBY CERTIFY THAT THIS MATERIAL WAS TESTED IN ACCORDANCE WITH, AND MEETS THE REQUIREMENTS OF, THE APPROPRIATE SPECIFICATION <u>Justin Ward</u><br>SENIOR METALLURGIST - PRODUCT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                                                                                                                                                                                                                                                                    |         |                                                                                                                                                                                                                             |           |        |                 |         |          |                    |           |          |         |         |        |      |

ANTHONY CARDWELL  
06/19/2023

Q.A. APPROVED  
By Jue Date 6/16/2023

5  
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Customer Name  
PORT CITY PLATE, INC. DIV. MET/ 129867  
Customer PO#  
Shipper No  
362414  
Heat Number  
E9E225 E21

NOT  
STEEL

# Certificate of Mill Test Results

TUL-008000-000

Pg 1/1

PO/Re:

Attn:

PART NO.

## SSAB

### Test Certificate

12400 Highway 43 North, Axis, Alabama 36505, US

**WARNING:** This product can expose you to chemicals including nickel and nickel compounds, which are known to the State of California to cause cancer. For more information go to [www.P65Warnings.ca.gov](http://www.P65Warnings.ca.gov).

Form TC1: Revision 4; Date 6 Feb 2019

|                                                                                             |                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                             |
|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Customer:</b><br>CHAPEL STEEL CORPORATION<br>PO BOX 1000<br><br>SPRING HOUSE<br>PA 19477 | <b>Customer P.O.No.:</b> TUL-320<br><b>Product Description:</b> ASME SA516-70/SA516-65/SA516-60(21)<br>ASTM A516-70/AS16-65/AS16-60(17)<br>VACUUM DEGAUS; C.23%,S.015% MAX;ELG 2"<br>LCVN 20 FT.LBS. @ -60F/A673-P<br><b>Size:</b> 0.600 X 96.00 X 480.0 (IN) | <b>Mill Order No.:</b> 41-673801-02<br><b>Shipping Manifest:</b> AR357250<br><b>Ship Date:</b> 22 May 22<br><b>Cert Date:</b> 22 May 22<br><b>Heat Treat Type:</b> NORMALIZED<br><b>Cert No:</b> 081047524<br>(Page 1 of 1) |
|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

| Tested Pieces: |          |                  |         | Tensiles: |           |     |         | Charpy Impact Tests: |                    |           |          |
|----------------|----------|------------------|---------|-----------|-----------|-----|---------|----------------------|--------------------|-----------|----------|
| Heat Id        | Piece Id | Tested Thickness | Tst Loc | YS (KSI)  | UTS (KSI) | %RA | Elong % | Tst Dir              | Abs. Energy (FTLB) | % Shear   | Tst Temp |
|                |          |                  |         |           |           |     |         |                      | 1 2 3 Avg          | 1 2 3 Avg |          |
| E2D332         | D07      | 0.602 (DISCRT)   | C:55    | 77        |           | 35  | 1       |                      | 44 108 104 85      |           | -80F     |
| E2D333         | D08      | 0.602 (DISCRT)   | C:66    | 76        |           | 40  | 1       |                      | 112 80 55 82       |           | -60F     |

| Chemical Analysis |     |      |      |       |     |          |        |     |     |     |     |      |      |      | ORGN |
|-------------------|-----|------|------|-------|-----|----------|--------|-----|-----|-----|-----|------|------|------|------|
| Heat Id           | C   | Mn   | P    | S     | Si  | Total Al | Sol Al | Cu  | Ni  | Cr  | Mo  | Co   | V    | Ti   |      |
| E2D332            | .19 | 1.03 | .010 | <.001 | .24 | .032     | .031   | .27 | .13 | .13 | .02 | .002 | .003 | .006 | USA  |
| E2D333            | .18 | 1.02 | .010 | .001  | .25 | .031     | .030   | .26 | .14 | .13 | .03 | .002 | .003 | .008 | USA  |

**KILLED STEEL.**  
 MERCURY IS NOT A METALLURGICAL COMPONENT OF THE STEEL AND NO MERCURY WAS INTENTIONALLY ADDED DURING THE MANUFACTURE OF THIS PRODUCT.  
 KILLED STEEL, PRODUCED TO A FINE GRAIN PRACTICE  
 CEV (IIW) - C + MN/6 + (CR+MO+V)/5 + (NI+CU)/15  
 MACE HRO175/ISO15156-2:2015 ANNEX A2.1.2 COMPLIANT  
 MACE HRO103/ISO 17495-1:2015 13.1.1(A) AND 13.1.1(C) COMPLIANT  
 MTR EN 10204:2004 INSPECTION CERTIFICATE 3.1 COMPLIANT  
 100% MELTED, POURED, AND ROLLED IN THE USA  
 NO WELD REPAIR HAS BEEN PERFORMED ON THIS MATERIAL.  
 NORMALIZED PLATES. HEATED AT 1665F FOR 22 MINUTES.  
 TEST COUPONS TAKEN FROM HEAT TREATED PLATE.

**PRODUCTS SHIPPED:**

|            |          |       |         |      |            |          |       |         |      |
|------------|----------|-------|---------|------|------------|----------|-------|---------|------|
| E2D332 D07 | 40084899 | PCES: | 1, LBS: | 6534 | E2D332 D07 | 40084897 | PCES: | 1, LBS: | 6534 |
| E2D332 D07 | 40084901 | PCES: | 1, LBS: | 6534 | E2D333 D08 | 40084893 | PCES: | 1, LBS: | 6534 |
| E2D332 D07 | 40084898 | PCES: | 1, LBS: | 6534 | E2D332 D07 | 40084900 | PCES: | 1, LBS: | 6534 |

Q.A. APPROVED

By: *[Signature]* Date: 11/30/22

WE HEREBY CERTIFY THAT THIS MATERIAL WAS TESTED IN ACCORDANCE WITH, AND MEETS THE REQUIREMENTS OF, THE APPROPRIATE SPECIFICATION

Jason Thomas  
 Director Technical Services

ANTHONY CARDWELL

06/19/2023

Just Part #:

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*mm  
E/29/22*

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**SSAB**

**Test Certificate**

12400 Highway 43 North, Asta, Alabama 35505, US

**WARNING:** This product can expose you to chemicals including nickel and nickel compounds, which are known to the State of California to cause cancer. For more information go to [www.p66.org/cheminfo/cancer](http://www.p66.org/cheminfo/cancer).

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |              |                                  |            |                                                                                                                                       |              |                                               |            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------------------------|------------|---------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------------------------------------------|------------|
| <b>Customer:</b><br>LEEKO STEEL PRODUCTS, INC.<br>1011 WARRENVILLE ROAD<br>SUITE 500<br>LISLE<br>IL 60532                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |              | <b>Customer P.O. No.:</b> V28145 |            | <b>Bill Order No.:</b> 41465336-01                                                                                                    |              | <b>Form TCT: Revision 3: Date 22 Aug 2022</b> |            |
| <b>Product Description:</b> ASME SA516-70SA516-65SA516-60(21)<br>ASTM A516-70SA516-65SA516-60(21)<br>UNV 2018 FT LBS @ 52/AS73-P<br>CEV 420 MAX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |              | <b>Ship Date:</b> 31 Oct 22      |            | <b>Cert No.:</b> 081077078                                                                                                            |              | <b>Shipping Manifest:</b> AS38/113            |            |
| <b>Size:</b> 0.500 X 96.00 X 480 0 (IN)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |              | <b>Cert Date:</b> 31 Oct 22      |            | <b>(Page 1 of 1)</b>                                                                                                                  |              | <b>Heat Treat Type:</b> NORMALIZED            |            |
| <b>Tested Pieces:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |                                  |            |                                                                                                                                       |              |                                               |            |
| <b>Heat</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Piece</b> | <b>Tested</b>                    | <b>Yst</b> | <b>UTS</b>                                                                                                                            | <b>YMA</b>   | <b>Elong %</b>                                | <b>Yst</b> |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Id</b>    | <b>Thickness</b>                 | <b>Loc</b> | <b>(KSI)</b>                                                                                                                          | <b>(KSI)</b> | <b>2in 8in</b>                                | <b>Dt</b>  |
| W21744                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | D69          | 0.500 (0.500)                    | C154       | 77                                                                                                                                    |              | 29                                            | 7          |
| <b>Charpy Impact Tests</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              |                                  |            |                                                                                                                                       |              |                                               |            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |              |                                  |            | <b>Abs. Energy (FT-LB)</b>                                                                                                            |              | <b>% Shear</b>                                |            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |              |                                  |            | <b>1 2 3 Avg</b>                                                                                                                      |              | <b>1 2 3 Avg</b>                              |            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |              |                                  |            | 113 130 121 121                                                                                                                       |              | 60F 1 10                                      |            |
| <b>Chemical Analysis</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |              |                                  |            |                                                                                                                                       |              |                                               |            |
| <b>Heat</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>C</b>     | <b>Mn</b>                        | <b>P</b>   | <b>S</b>                                                                                                                              | <b>Si</b>    | <b>Al</b>                                     | <b>Cr</b>  |
| W21744                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0.03         | 0.02                             | 0.01       | 0.01                                                                                                                                  | 0.02         | 0.02                                          | 0.02       |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 18           | 1.03                             | 0.01       | 0.01                                                                                                                                  | 0.02         | 0.02                                          | 0.02       |
| <b>Notes:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |              |                                  |            |                                                                                                                                       |              |                                               |            |
| KILLED STEEL.<br>MERCURY IS NOT A METALLURGICAL COMPONENT OF THE STEEL AND NO MERCURY WAS INTENTIONALLY ADDED DURING THE MANUFACTURE OF THIS PRODUCT.<br>KILLED STEEL, PROCURED TO A FINE GRAIN PRACTICE.<br>CEV (134) = C + Mn/8 + (Cr+Ni)/3 + (Cu+Ni)/13<br>RACE: W21744/180115156-2/2015 ABIDE X2-1.2 COMPLIANT<br>RACE: W21744/180115156-2/2015 13.1-1(A) AND 13.1-1(C) COMPLIANT<br>MPL IN 180A-204 THERMOCOUPLER CERTIFICATE 3.1 COMPLIANT<br>100% MELTED, FORGED, AND ROLLED IN THE USA<br>NO WELD REPAIRS HAVE BEEN PERFORMED ON THIS MATERIAL.<br>NORMALIZED PLATES. HEATED AT 1645F FOR 21 MINUTES.<br>TEST COUPONS TAKEN FROM HEAT TREATED PLATE.<br>PRODUCTS SHIPPED:<br>W21744 D69 40093396 PCS: 1, LBS: 6534 W21744 D69 40093395 PCS: 1, LBS: 6534 |              |                                  |            |                                                                                                                                       |              |                                               |            |
| <b>Part Part #:</b> 050086480A516-70N                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |                                  |            | <b>WE HEREBY CERTIFY THAT THIS MATERIAL WAS TESTED IN ACCORDANCE WITH AND MEETS THE REQUIREMENTS OF THE APPROPRIATE SPECIFICATION</b> |              |                                               |            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |              |                                  |            | <b>Jason Thomas</b><br>Director Technical Services                                                                                    |              |                                               |            |

ANTHONY CARDWELL  
06/19/2023

Q.A. APPROVED  
By *[Signature]* Date *10/10/22*

*My  
blat*

PORT CITY PLATE BURNING INC  
PLATE: ASTM A36 / ASME SA36 - MELT & MFG. USA  
1/4" X 96.0000" X 240.0000"  
PART NO.

PO/Ref 126364

/DAVE

# Certificate of Mill Test Results

SO TUL-002650-003

19 May 22  
Pg 1/1

15

Attn:

## SSAB

1770 Bill Sharp Boulevard, Muscatine, IA 52751-9412, US

## Test Certificate

WARNING: This product can expose you to chemicals including nickel and nickel compounds, which are known to the State of California to cause cancer. For more information go to [www.P65Warnings.ca.gov](http://www.P65Warnings.ca.gov).

Form TC1: Revision 4: Date 6 Feb 2019

|                                                                                      |                                                                                                                                                                                     |                                                                                                                                                   |
|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Customer:<br>CHAPEL STEEL CORPORATION<br>PO BOX 1000<br><br>SPRING HOUSE<br>PA 19477 | Customer P.O.No.: TUL-317<br>Product Description: ASTM A36(19)/A709(21)36/ASME SA36(21)<br>MIN 0.14% C, 0.80-1.20% MN<br>MAX 0.05% SI, 0.010% S<br>Size: 0.250 X 96.00 X 240.0 (IN) | Mill Order No. 41-673735-03<br>Shipping Manifest: MR451073<br>Ship Date: 29 Apr 22<br>Cert Date: 29 Apr 22<br>Cert No: 061164200<br>(Page 1 of 1) |
|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|

| Tested Pieces: |          |                  |         | Tensiles: |           |     |                 | Charpy Impact Tests |          |                             |                   |         |         |              |                |
|----------------|----------|------------------|---------|-----------|-----------|-----|-----------------|---------------------|----------|-----------------------------|-------------------|---------|---------|--------------|----------------|
| Heat Id        | Piece Id | Tested Thickness | Tst Loc | YS (KSI)  | UTS (KSI) | %RA | Elong % 2in 8in | Tst Dir             | Hardness | Abs. Energy(FILB) 1 2 3 Avg | % Shear 1 2 3 Avg | Tst Tmp | Tst Dir | Tst Siz (mm) | BDWTT Tmp %Shr |
| A2D239         | D16      | 0.244 (DISCRT)   | L 53    | 70        |           | 32  |                 | T                   |          |                             |                   |         |         |              |                |
| A2D239         | D21      | 0.370 (DISCRT)   | L 49    | 69        |           | 38  |                 | T                   |          |                             |                   |         |         |              |                |

| Heat Id | C   | Mn  | P    | S    | SI  | Tot Al | Sol Al | Cu  | Ni  | Cr  | Mo  | Co   | V    | Ti   | B     | N     | ORGN |
|---------|-----|-----|------|------|-----|--------|--------|-----|-----|-----|-----|------|------|------|-------|-------|------|
| A2D239  | .16 | .83 | .005 | .002 | .04 | .025   | .024   | .30 | .12 | .11 | .03 | .091 | .004 | .006 | .0001 | .0083 | USA  |

KILLED STEEL  
MERCURY IS NOT A METALLURGICAL COMPONENT OF THE STEEL AND NO MERCURY WAS INTENTIONALLY ADDED DURING THE MANUFACTURE OF THIS PRODUCT.

KILLED STEEL, PRODUCED TO A FINE GRAIN PRACTICE  
NTR EN 10204:2004 INSPECTION CERTIFICATE 3.1 COMPLIANT  
100% MELTED, POURED, AND ROLLED IN THE USA  
PRODUCTS SHIPPED:  
A2D239 D19 PCS: 4, LBS: 6536

FABSCO  
PO#A22-13313-1-HW1  
SO#446522

HT#A2D239  
ITEM#2 2PCS  
3 2PCS  
6 2PCS  
7 2PCS

PO#126364  
05-20-2022

ANTHONY CARDWELL  
06/19/2023

Q.A. APPROVED

By: [Signature] Date: 5/15/22

(P) Cust Part #:

WE HEREBY CERTIFY THAT THIS MATERIAL WAS  
TESTED IN ACCORDANCE WITH, AND MEETS THE  
REQUIREMENTS OF, THE APPROPRIATE SPECIFICATION

Brian Wales

PRINCIPAL METALLURGIST

Mr Elson

PO/Ref:

Attn:

PART NO.



Test Certificate

WARNING: This product can expose you to chemicals including nickel and nickel compounds, which are known to the State of California to cause cancer. For more information go to [www.P65Warnings.ca.gov](http://www.P65Warnings.ca.gov)

Form TC1: Revision 5, Date 22 Aug 2022

|                                                                                  |  |                                                                                                                                |  |                                                                             |  |                                                                    |  |
|----------------------------------------------------------------------------------|--|--------------------------------------------------------------------------------------------------------------------------------|--|-----------------------------------------------------------------------------|--|--------------------------------------------------------------------|--|
| Customer:<br>CHAPEL STEEL CORPORATION<br>PO BOX 1000<br>SPRING HOUSE<br>PA 19477 |  | Customer P.O.No.: TUL-424<br>Product Description: ASTM A36(19)/A709(21)36/ASME SA36(21)<br>SILICON 0.15% - 0.25%, 0.010% MAX S |  | Mill Order No. 41-559876-09<br>Ship Date: 28 Feb 23<br>Cert Date: 28 Feb 23 |  | Shipping Manifest: AR374424<br>Cert No: 081097933<br>(Page 1 of 1) |  |
| Size: 1.250 X 96.00 X 480.0 (IN)                                                 |  |                                                                                                                                |  |                                                                             |  |                                                                    |  |

| Tested Pieces:    |          |                  | Tensiles: |          |           |     |                    | Charpy Impact Tests |          |                   |   |   |     |         |   |   |     |         |         |              |                |
|-------------------|----------|------------------|-----------|----------|-----------|-----|--------------------|---------------------|----------|-------------------|---|---|-----|---------|---|---|-----|---------|---------|--------------|----------------|
| Heat Id           | Piece Id | Tested Thickness | Tst Loc   | YS (KSI) | UTS (KSI) | %RA | Elong %<br>2in 8in | Tst Dir             | Hardness | Abs. Energy(FTLB) |   |   |     | % Shear |   |   |     | Tst Tmp | Tst Dir | Tst Siz (mm) | BOWTT Tmp %Shr |
|                   |          |                  |           |          |           |     |                    |                     |          | 1                 | 2 | 3 | Avg | 1       | 2 | 3 | Avg |         |         |              |                |
| E3B184            | A34      | 1.254 (DISCRT)   | L 51      | 73       |           |     | 45                 | T                   |          |                   |   |   |     |         |   |   |     |         |         |              |                |
| E3B184            | A35      | 1.252 (DISCRT)   | L 50      | 74       |           |     | 45                 | T                   |          |                   |   |   |     |         |   |   |     |         |         |              |                |
| Chemical Analysis |          |                  |           |          |           |     |                    |                     |          |                   |   |   |     |         |   |   |     |         |         |              |                |

| Heat Id | C   | Mn  | P    | S    | Si  | Total Al | Sol Al | Cu  | Ni  | Cr  | Mo  | Cb   | V    | Ti   | B     | N     | ORGN |
|---------|-----|-----|------|------|-----|----------|--------|-----|-----|-----|-----|------|------|------|-------|-------|------|
| E3B184  | .17 | .83 | .008 | .002 | .19 | .026     | .025   | .27 | .15 | .10 | .03 | .003 | .019 | .008 | .0001 | .0071 | USA  |

KILLED STEEL.  
MERCURY IS NOT A METALLURGICAL COMPONENT OF THE STEEL AND NO MERCURY WAS INTENTIONALLY ADDED DURING THE MANUFACTURE OF THIS PRODUCT.  
KILLED STEEL, PRODUCED TO A FINE GRAIN PRACTICE  
NTR EN 10204:2004 INSPECTION CERTIFICATE 3.1 COMPLIANT  
100% MELTED, FURRED, AND ROLLED IN THE USA  
PRODUCTS SHIPPED:  
E3B184 A35 PCES: 2, LBS: 32670 E3B184 A34 PCES: 2, LBS: 32670

FABSCO HT#E3B184  
PO#A22-13313-1-HW1  
SO#446522 ITEM#4 2PCS  
8 2PCS

ANTHONY CARDWELL  
06/19/2023

Q.A. APPROVED  
By: *[Signature]* Date: 3/2/2023

|              |                                                                                                                                  |                                                                   |
|--------------|----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| Cast Part #: | WE HEREBY CERTIFY THAT THIS MATERIAL WAS TESTED IN ACCORDANCE WITH, AND MEETS THE REQUIREMENTS OF, THE APPROPRIATE SPECIFICATION | <i>[Signature]</i><br>Jason Thomas<br>Director Technical Services |
|--------------|----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|

*mm*  
*E3B184*

CLIENTE / Customer / Client  
ALLIED FITTING L.P.  
14723 FAIRWAY PINES DR.  
MISSOURI CITY TX 77489  
USA

# CERTIFICADO DE INSPECCION

## Inspection Certificate - Certificat de Réception

FECHA: 01/03/2022 N.º 218407 HOJA: 3  
Date: 01/03/2022 No. 218407 Page: 3



ULMA FORJAS S.COOP.

Management Systems certified by LRQA

Certified acc. IEC 2014/88/EU-AD2000 W0  
by TÜV Rheinland  
N.º 01 202 E/O 02 743

Bº Zubilaga, 3 - Apdo. 14  
20560 Oñati (Gipuzkoa) SPAIN  
Tel: 34 - 943 780552  
Fax: 34 - 943 781808  
E-mail: ulma@ulmatorge.com

MARCA DEL FABRICANTE  
Mark of factory  
Marque du fabricant

Packing List: 167299  
Expedition: 394354

DEPARTAMENTO QUALITY ASSURANCE  
Section

PRODUCTO FLANGES

SU PEDIDO N.º  
Your Order No. POS2367 MISSOURI  
Votre Cde. N.º

DE  
of - de 15/10/2021

NORMAS APLICABLES ASME B16.5-17  
Requirements - Normes Applicables

MATERIAL CORRESPONDIENTE ASME SA350LF2CL1-2-21/SA105M-21 ASTM A350LF2CL1-2-18/A105M-21  
Material Correspondent - Matière

MODO DE FUSION (\*) NACE MR0175/ISO 15156-2:2015, Clause 7.2.1.4, Figure 1, SSC Region 3 & Annex A.  
Steel Making - Elaboration de l'acier NACE MR0103:2015  
E - Elec. Y - Origine básico CSA-Z245.12-17 GR248 CAT HII - SS (WN & BLIND FLANGES ONLY)

| CSA-2245.12-17 GR248 CAT III - SS (WN & BLIND FLANGES ONLY) |                                  |                                           |                                              |                                      |                                                      |                                                      |                                                    |                                                  |                                                        | Departamento   |    |    |     |                              |     |  |  |  |  |
|-------------------------------------------------------------|----------------------------------|-------------------------------------------|----------------------------------------------|--------------------------------------|------------------------------------------------------|------------------------------------------------------|----------------------------------------------------|--------------------------------------------------|--------------------------------------------------------|----------------|----|----|-----|------------------------------|-----|--|--|--|--|
| PARTIDA<br>Item<br>Poste                                    | CANTIDAD<br>Quantity<br>Quantité | DESCRIPCION<br>Description<br>Description | OBSERVACIONES<br>Remarks<br>Observations (*) | COLADA N.º<br>Heat No.<br>N.º Coulée | PERISTECHO<br>T-Strength<br>T-Strength<br>T-Strength | UNITE ALAZ<br>Y-Strength<br>Y-Strength<br>Y-Strength | ALARGAM.<br>Elongation<br>Elongation<br>Elongation | ESTRECHON<br>Red. Area<br>Red. Area<br>Red. Area | RESILIENCIA<br>Impact test<br>Résistance<br>Résistance | CHAPY V 101011 |    |    |     | DUREZA<br>Hardness<br>Dureté |     |  |  |  |  |
|                                                             |                                  |                                           |                                              |                                      |                                                      |                                                      |                                                    |                                                  |                                                        |                |    |    |     |                              |     |  |  |  |  |
| 19 C3WRP6                                                   | 24                               | WN 6 300LB S160 RF A105N/A350LF2          | 03D112 NE                                    | ARSA                                 | 527                                                  | 319                                                  | 34,80                                              | 73,19                                            | 77                                                     | 92             | 77 | 82 | -50 | 146                          | 149 |  |  |  |  |
| 163 C3BR4                                                   | 10                               | BLIND 4 300LB RF A105N/A350LF2            | 03D112 NE                                    | 49AV0                                | 505                                                  | 309                                                  | 37,07                                              | 73,83                                            | 41                                                     | 35             | 96 | 57 | -50 | 140                          | 143 |  |  |  |  |
| 276 qfenc2                                                  | 57                               | WN 2 600LB XS/80 RF A105N/A350LF2         | 14F204 NE                                    | 43HC1                                | 510                                                  | 314                                                  | 37,40                                              | 69,59                                            | 45                                                     | 70             | 77 | 64 | -50 | 144                          | 146 |  |  |  |  |

| COLADA N.º<br>Heat No.<br>Ladle: L.<br>Product: P | COMPOSICION QUIMICA - STEEL MAKER'S LADLE ANALYSIS - ANALYSE CHIMIQUE |       |       |       |       |       |       |       |       |       |       |       |       |        | Origm of Steel |
|---------------------------------------------------|-----------------------------------------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|----------------|
|                                                   | C %                                                                   | SI %  | Mn %  | P %   | S %   | Cr %  | Ni %  | Mo %  | Nb %  | V %   | Cu %  | Al %  | Ti %  | B %    | CEq %          |
| ARSA1 L                                           | 0,191                                                                 | 0,240 | 1,100 | 0,010 | 0,003 | 0,090 | 0,100 | 0,030 | 0,002 | 0,004 | 0,240 | 0,030 | 0,001 | 0,0003 | 0,42           |
| 49AV0 L                                           | 0,188                                                                 | 0,226 | 1,070 | 0,011 | 0,003 | 0,052 | 0,031 | 0,005 | 0,001 | 0,001 | 0,074 | 0,031 | 0,001 | 0,0001 | 0,38           |
| 43HC1 L                                           | 0,180                                                                 | 0,230 | 1,100 | 0,011 | 0,001 | 0,050 | 0,120 | 0,020 | 0,001 | 0,004 | 0,180 | 0,026 | 0,001 | 0,0003 | 0,40           |

Las dimensiones y la condición superficial se hallaron satisfactorias.  
Dimension and surface condition were found acceptable.  
Les dimensions et états de surface sont satisfaisants.

Los materiales citados cumplen las normas aplicables.  
Manufacturing requirements are satisfied.  
Les normes applicables sont respectées.

EL INSPECTOR  
Works Inspector - L'Inspecteur  
**ULMA**  
ULMA FORJAS S.COOP.  
Dpto. de Control de Calidad  
Quality Control Dept.

(\*) OBSERVACIONES: NO WELD REPAIR  
Remarks: N.º NORMALIZED ABOVE 900°C AND COOLED UNIFORMLY IN STILL AIR  
Observations:

ANTHONY CARDWELL  
06/19/2023

no  
slush

CLIENTE / Customer / Client

INDUSTRIAL PIPING SPECIALISTS, INC.  
PO BOX 581270  
TULSA OK 74158-1270  
USA

## CERTIFICADO DE INSPECCION

Inspection Certificate - Certificat de Réception

DIN EN 10204 / 3.1  
ISO 10474 / 3.1

FECHA:  
Date:

19/02/2016

N.  
No.

178188

HOJA:  
Page: 2



Management Systems certified by LRQA

UIMA FORJA, S.COOP.

PRODUCTO  
Article - Produit

FLANGES

SU PEDIDO N.  
Your Order No.  
Votro Cde. N.

HP234003

DE  
of - de

03/02/2016

Certified acc. PED 97/23/EC + AD2000-W0  
by TÜV Rheinland  
N° 01 202 EQ 02 7443

Bº Zubiraga, 3 - Apdo. 14  
20500. ORMAI (Gipuzkoa) SPAIN  
Tel: 34 - 943 780552  
Fax: 34 - 943 781808  
E-mail: ulma@ulmapiping.com

NORMAS APLICABLES  
Requirements - Normes Applicables

ASME B16.5-13

MATERIAL CORRESPONDIENTE  
Material Correspondent - Qualité

ASME SA350LF2CL1-2-15, ASTM A350LF2CL1-2-15

MODO DE FUSION (\*)  
Steel Making - Elaboration duacier

NACE MR0175/ISO15156-02-09 &amp; MR0103-12

E = Elec. Y = Origeno básico

MARCA DEL FABRICANTE  
Mark of factory  
Marque du fabricant



Packing List: 122674

DEPARTAMENTO  
Secton  
Département

QUALITY ASSURANCE

| PARTIDA<br>Item<br>Posto | CANTIDAD<br>Quantity<br>Quantité | DESCRIPCION<br>Description<br>Description | LOTE  | OBSERVACIONES<br>Remarks<br>Observations (*) | Department                        |                                      |                                       |                                    |                                   |                                                    |                             |    |                                     |     |     |     |
|--------------------------|----------------------------------|-------------------------------------------|-------|----------------------------------------------|-----------------------------------|--------------------------------------|---------------------------------------|------------------------------------|-----------------------------------|----------------------------------------------------|-----------------------------|----|-------------------------------------|-----|-----|-----|
|                          |                                  |                                           |       |                                              | COLADA N.<br>Heat No<br>N° Coulee | TENSIL<br>T-Strength<br>Résist (MPa) | LONGITUD<br>Y-Strength<br>Allong (mm) | ALARGAM.<br>Elongation<br>(% 50mm) | ESFRIACION<br>Red Area<br>Section | RESILIENCIA<br>Impact test<br>Résilience<br>Joules | MEDIA<br>Average<br>Temp °C |    | DUREZA<br>Hardness<br>Dureté<br>HRC |     |     |     |
| 31                       | 32                               | WN 3 600LB XS/80 RF A350LF2               | 14S15 | NE                                           | B77A5                             | 497                                  | 303                                   | 33,90                              | 61,50                             | 38                                                 | 68                          | 48 | 51                                  | -50 | 152 | 155 |
| 32                       | 140                              | WN 4 600LB XS/80 RF A350LF2               | 01S15 | NE                                           | A50M4                             | 534                                  | 378                                   | 29,60                              | 51,30                             | 81                                                 | 79                          | 82 | 82                                  | -50 | 162 | 165 |
| 33                       | 72                               | WN 4 600LB XS/80 RF A350LF2               | 04L15 | NE                                           | B47A5                             | 507                                  | 307                                   | 34,00                              | 62,50                             | 57                                                 | 62                          | 06 | 62                                  | -50 | 151 | 154 |
| 37                       | 21                               | WN 2 150LB S160 RF A350LF2                | 23D15 | NE                                           | B95A5                             | 504                                  | 312                                   | 31,90                              | 58,70                             | 35                                                 | 36                          | 41 | 37                                  | -50 | 147 | 149 |
| 38                       | 84                               | WN 3 150LB S160 RF A350LF2                | 07M15 | NE                                           | A44A5                             | 519                                  | 303                                   | 30,30                              | 63,70                             | 58                                                 | 57                          | 60 | 58                                  | -50 | 140 | 159 |
| 41                       | 41                               | WN 3 300LB S160 RF A350LF2                | 05N15 | NE                                           | C04A5                             | 508                                  | 311                                   | 30,30                              | 49,00                             | 55                                                 | 61                          | 65 | 60                                  | -50 | 153 | 154 |
| 45                       | 30                               | WN 4 600LB S160 RF A350LF2                | 03J15 | NE                                           | B29A5                             | 505                                  | 310                                   | 29,60                              | 51,80                             | 58                                                 | 60                          | 70 | 63                                  | -50 | 154 | 157 |
| 49                       | 48                               | BLIND 6 150LB RF A350LF2                  | 21E16 | NE                                           | C45A5                             | 504                                  | 308                                   | 31,80                              | 51,50                             | 42                                                 | 51                          | 48 | 47                                  | -50 | 151 | 154 |

| COLADA N.<br>Heat No<br>N° Coulee | COMPOSICION QUIMICA - STEEL MAKER'S LADLE ANALYSIS - ANALYSE CHIMIQUE |       |       |       |       |       |       |       |       |       |       |       |       |       | Origin of Steel |  |
|-----------------------------------|-----------------------------------------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----------------|--|
|                                   | C %                                                                   | Si %  | Mn %  | P %   | S %   | Cr %  | Ni %  | Mo %  | Nb %  | V %   | Cu %  | Al %  | Ti %  | CEq % |                 |  |
| A44A5                             | 0,210                                                                 | 0,210 | 0,390 | 0,009 | 0,005 | 0,064 | 0,095 | 0,025 | 0,000 | 0,000 | 0,230 | 0,035 | 0,002 | 0,415 | Spain           |  |
| A50M4                             | 0,172                                                                 | 0,228 | 1,225 | 0,011 | 0,002 | 0,045 | 0,023 | 0,002 | 0,002 | 0,069 | 0,000 | 0,026 | 0,007 | 0,401 | Spain           |  |
| B29A5                             | 0,180                                                                 | 0,220 | 1,020 | 0,014 | 0,006 | 0,050 | 0,090 | 0,029 | 0,002 | 0,001 | 0,180 | 0,030 | 0,003 | 0,383 | France          |  |
| B47A5                             | 0,200                                                                 | 0,230 | 0,960 | 0,008 | 0,004 | 0,090 | 0,120 | 0,020 | 0,001 | 0,004 | 0,270 | 0,042 | 0,001 | 0,406 | France          |  |
| B77A5                             | 0,180                                                                 | 0,190 | 1,050 | 0,010 | 0,003 | 0,070 | 0,090 | 0,019 | 0,004 | 0,002 | 0,200 | 0,033 | 0,003 | 0,393 | France          |  |
| B95A5                             | 0,200                                                                 | 0,218 | 0,987 | 0,017 | 0,009 | 0,050 | 0,077 | 0,014 | 0,000 | 0,001 | 0,135 | 0,024 | 0,001 | 0,392 | Spain           |  |
| C04A5                             | 0,190                                                                 | 0,210 | 1,020 | 0,013 | 0,006 | 0,100 | 0,090 | 0,014 | 0,001 | 0,002 | 0,180 | 0,028 | 0,002 | 0,401 | France          |  |
| C45A5                             | 0,190                                                                 | 0,210 | 0,990 | 0,010 | 0,005 | 0,060 | 0,070 | 0,010 | 0,001 | 0,005 | 0,170 | 0,034 | 0,002 | 0,386 | France          |  |

- Los dimensionales y la condición superficial se hallaron satisfactorias  
- Dimension and surface condition were found acceptable  
- Les dimensions et l'état de surface sont satisfaisants

- Los materiales citados cumplen las normas aplicables  
- Manufacturing requirements are satisfied  
- Les normes applicables sont respectées

EL INSPECTOR  
Works Inspector - L'inspecteur



ULMA FORJA, S.COOP.  
Dpto. de Garantía de Calidad  
Quality Assurance Dept.

(\*) OBSERVACIONES:  
Remarks  
Observations

N. NORMALIZED AT 900 C AND ALLOWED TO COOL IN STILL AIR.

ANTHONY CARDWELL  
06/19/2023

mr  
Elbajh



2669 Martin Luther King Jr Blvd  
Youngstown, OH 44510

**VALLOUREC STAR LP**  
Seamless Tubular Products

Certified Test Report  
05/10/2022  
Revision: 0

|                                                                                                                                                                                                                                                                                                                         |                                             |                                         |                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-----------------------------------------|-----------------------|
| Order: Y-221121754-001                                                                                                                                                                                                                                                                                                  | Desc: Seamless Line Pipe- Normalized Rolled | Customer: Industrial Piping Specialists | SLN / Heat: ME0288    |
| Grade: A191 SL K42B NBBN PSL2 46th Edition May 01, 2019                                                                                                                                                                                                                                                                 |                                             | Customer Order: HR131756                | Split: 00             |
| OD(in): 6.625                                                                                                                                                                                                                                                                                                           | Wall(in): 0.719                             | Lbs/ft: 45.39                           | Length: Double Random |
| End Finish: Plain End Beveled                                                                                                                                                                                                                                                                                           |                                             |                                         |                       |
| Comments: Melted and Manufactured in Youngstown, Ohio USA                                                                                                                                                                                                                                                               |                                             |                                         |                       |
| Pipe is also manufactured to: ASTM A106B/C-19a, ASTM A53B-20, ASME SA106B/C-2021, ASME SA53B-2021. Vallourec Star's QA program meets the requirements of DIN EN10204-2004 Type 3.1. Satisfies NACE MR0175/ISO15156:2015 and ANSI/API SPEC 5L-2010. No repair welding has been conducted. Material is free from Mercury. |                                             |                                         |                       |

**Mechanical Properties**

|                                                  |       |          | Tensile Size                                   |            |             | Strength (ksi)                            |         |           | Elongation  |         |      |
|--------------------------------------------------|-------|----------|------------------------------------------------|------------|-------------|-------------------------------------------|---------|-----------|-------------|---------|------|
| Orientation                                      | Type  | Position | Width (in)                                     | Thick (in) | Area (sqin) | Yield                                     | Tensile | Y/T Ratio | Gage Length | % Elong | % RA |
| Longitudinal                                     | Strip | Load     | 1.000                                          | 0.750      | 0.7500      | 49.8                                      | 75.9    | 0.66      | 2           | 38.3    | 48.4 |
| Required Min/Max Yield Strength (ksi): 42 1/71.8 |       |          | Required Min/Max Tensile Strength (ksi): 70/95 |            |             | Calculated Max Internal Yield (psi): 9458 |         |           |             |         |      |

Required Min Elongation(%): 30

**Chemical Analysis**

Chem Spec: 68B

| WT%       | C    | Mn   | P     | S     | Si   | Co   | Ni   | Cr   | Mo   | Sn    | Nb    | V     | Al    | Ca     | B      | Ti    | W      | CE   |
|-----------|------|------|-------|-------|------|------|------|------|------|-------|-------|-------|-------|--------|--------|-------|--------|------|
| Heat      | 0.18 | 0.83 | 0.008 | 0.005 | 0.24 | 0.16 | 0.06 | 0.11 | 0.04 | 0.014 | 0.000 | 0.023 | 0.034 | 0.0030 | 0.0001 | 0.003 | 0.0075 | 0.38 |
| Product 1 | 0.19 | 0.82 | 0.008 | 0.004 | 0.23 | 0.16 | 0.06 | 0.11 | 0.04 | 0.012 | 0.000 | 0.023 | 0.033 | 0.0023 | 0.0001 | 0.003 | 0.0068 | 0.39 |
| Product 2 | 0.18 | 0.82 | 0.008 | 0.004 | 0.23 | 0.16 | 0.06 | 0.11 | 0.04 | 0.012 | 0.000 | 0.023 | 0.033 | 0.0023 | 0.0001 | 0.003 | 0.0061 | 0.38 |

**Charpy Impact Testing**

|            | Notch | Direction  | Size | Temp °F | Fl Lbf 1 | Fl Lbf 2 | Fl Lbf 3 | Fl Lbf Avg | Shear 1 | Shear 2 | Shear 3 | Shear Avg |
|------------|-------|------------|------|---------|----------|----------|----------|------------|---------|---------|---------|-----------|
| Min Target | ---   | Transverse | 1/1  | 32      | 15       | 15       | 15       | 20         | NR      | NR      | NR      | NR        |
| Actual     | V     | Transverse | 1/1  | 32      | 56       | 64       | 77       | 65         | 25      | 25      | 25      | 25        |

NR - Not Required

This material has been produced and tested in accordance with the requirements of applicable specifications unless otherwise listed below. We hereby certify that the above test results are representative of those contained in the records of the company. Any modification to this certification as provided by Vallourec Star without the expressed written consent of Vallourec Star negates the validity of this test report. Vallourec Star is not responsible for the inability of this material to meet specific applications.

THIS CERTIFICATE IS NOTARIZED ONLY WHEN REQUESTED.

Signed: *Jeff Schultz*

Name: Jeff Schultz, Lab Supervisor

Date Approved: 05/10/2022

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ANTHONY CARDWELL  
06/19/2023

*Mr. E. J. 2/2/22*



2658 Martin Luther King Jr Blvd  
Youngstown, OH 44510

**VALLOUREC STAR LP**  
Seamless Tubular Products

Certified Test Report  
05/10/2022  
Revision: 0

|                                                       |                                              |                                         |                       |
|-------------------------------------------------------|----------------------------------------------|-----------------------------------------|-----------------------|
| Order: Y 221121754-001                                | Desc: Seamless Line Pipe - Normalized Rolled | Customer: Industrial Piping Specialists | SLN / Plant: ME0288   |
| Grade: API 6L X42B NBN PSL2 40th Edition May 01, 2015 |                                              | Customer Order: HR131719                | Split: 00             |
| OD (in): 8.625                                        | Wall (in): 0.719                             | Lbs/Ft: 45.30                           | Length: Double Random |
| End Finish: Plain End Sewing                          |                                              |                                         |                       |
| Inspection Company: L Bay                             |                                              |                                         |                       |

Non-Destructive Evaluation Criteria

| EM CHANNELS                      |                                                            |
|----------------------------------|------------------------------------------------------------|
| ID                               | 10% Longitudinal<br>10% Transverse                         |
| OD                               | 10% Longitudinal<br>10% Transverse                         |
| FULL LENGTH WALL THICKNESS CHECK |                                                            |
| Wall                             | 87.5% Wall Reduction<br>Required Volumetric Coverage: 100% |

| ADDITIONAL REQUIREMENTS |                                                                         |
|-------------------------|-------------------------------------------------------------------------|
|                         | Notch Length 1.5" Max<br>Notch Width .020" Max<br>Unfested Ends Cropped |
| OD                      | Visual Insp. Full Length - White Light                                  |
| ID                      | Visual Insp. Pipe Ends - White Light                                    |

A22-13313-1-PL | LN: 2 | T0527151-1 | D86160 | ME0288

ANTHONY CARDWELL  
06/19/2023

Mr  
8/28/22

| A22-13313-1-FL | | 1018318758 | LN: 4 | T0527151-1 | FSVAT3160PSL2 | |

## voestalpine Tubulars GmbH & Co KG

Alpinestrasse 17  
8652 Kindberg-Aumuehl  
T. +43/050304/23-0  
F. +43/050304/63-532  
www.voestalpine.com/tubulars

Legal Structure: Limited Partnership  
Location: Kindberg/Austria  
Company Registry Number 165400k  
Commercial Court of Leoben  
DPR0592684, VATNr. ATU 43630406

General Partner: voestalpine Tubulars GmbH  
Legal Structure: Limited Liability Company  
Location: Linz, Company Registry Number  
106933f  
Commercial Court of Linz

### MILL TEST CERTIFICATE 3.1

(according to EN 10204)

### ABNAHMEPRUEFZEUGNIS 3.1

(gem. EN 10204)

### CERTIFICAT DE CONTROLE DES PRODUITS PAR L'USINE 3.1

(selon EN 10204)

Hersteller: voestalpine Tubulars GmbH & Co KG, Austria  
Manufacturer:  
Producteur:

Besteller: VOEST-ALPINE TUBULAR CORPORATION  
Purchaser: HOUSTON, TEXAS 77077, US  
Archeteur: INDUSTRIAL PIPING SPECIALISTS, INC.  
P. O. BOX 581270  
TULSA OK 74158-1270, US

Pruefgegenstand: Seamless hot rolled carbon steel tubes  
Object of tests: Line Pipe LP-USA-STD-2-PSL-2  
Epreuve: LINEPIPE-04.0  
LP-USA-STD-2-PSL-2-1 Rev. 1  
non upset ends ( API-5-L ) - non upset  
UV coating  
A/SA 106 - GRADE-B  
A/SA 53 - GRADE-B  
API-5-L - GRADE-BN - PSL2  
API-5-L - GRADE X42N - PSL2  
NACE MR 0175 / ISO 15166  
NACE MR 0103 / ISO 17945  
Mechanical properties A/SA 106 GRADE-C ( if applicable )

Werkstoff: GRADE B / GRADE BN/X42N/ GRADE C  
Material:  
Matières:

Anforderungen: GRADE B acc. to ASTM A 106 / A 106M-2018  
Requirements: ASME SA 106-2017  
Exigence: GRADE B acc. to ASTM A 53 / A 53M - 2018  
ASME SA 53-2017  
GRADE-BN / GRADE X42N acc. to API-5-L, 45 ed.-2012 (PSL-2)  
NACE MR 0175 / ISO 15166-2015; NACE MR 0103 / ISO 17945-2015

Ausführung: NU PLAIN END, PE, BEB-API/ASTM (30°)  
Condition:  
Cond. de livraison:

Wärmebehandlung: NORMALIZED ROLLED  
Heat treatment:  
Traitement de chaleur:

Coupl. die stamped:  
Coupl. paint stencilling:  
Coupl. Colour coding: Fully painted: Bands:

Tube die stamped:

Kindberg, 21.02.2019

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No. 148527 Rev.: 0

Auftrags-Nr.: 30318 / 8  
Our works order No.:  
No usine:

Bestellnr.: HR092776/810652  
Your order No.:  
No de la commande:

Zeichen des Lieferwerks: va  
Marking of producer:  
Marque du fabricant:

Erschmelzungsart: BOF  
Melting process: fully killed, produced to  
Procédé d'élaboration: fine grain practice

voestalpine Tubulars GmbH & Co KG  
Qualitätsstelle / Quality Department

WEITZER

Abnahmebeauftragter  
authorized inspection representative  
représentant autorisé du controle

voestalpine

voestalpine

ANTHONY CARDWELL  
06/19/2023

M  
2/29/2

voestalpine Tubulars GmbH &amp; Co KG

Remarks: \*) Grade C without marking on tubes  
\*) SI units have been converted to US customary units

0 2 5 1 0 1 5 2 0 2 5 3 0 3 5 4 0 4 5 5 0 5 5 6 0 6 5 7 0 7 5 8 0 8 5 9 0 9 5 1 0 0 1 0 5 1 1 0 1 1 5 1 2 0 1 2 5 1 3 0 1 3 5 1 4 0 1 4 5 1 5 0 1 5 5 1 6 0 1 6 5 1 7 0 1 7 5 1 8 0 1 8 5 1 9 0 1 9 5 2 0 0 2 0 5 2 1 0 2 1 5 2 2 0 2 2 5 2 3 0 2 3 5 2 4 0 2 4 5 2 5 0 2 5 5 2 6 0 2 6 5 2 7 0 2 7 5 2 8 0 2 8 5 2 9 0 2 9 5 3 0 0 3 0 5 3 1 0 3 1 5 3 2 0 3 2 5 3 3 0 3 3 5 3 4 0 3 4 5 3 5 0 3 5 5 3 6 0 3 6 5 3 7 0 3 7 5 3 8 0 3 8 5 3 9 0 3 9 5 4 0 0 4 0 5 4 1 0 4 1 5 4 2 0 4 2 5 4 3 0 4 3 5 4 4 0 4 4 5 4 5 0 4 5 5 4 6 0 4 6 5 4 7 0 4 7 5 4 8 0 4 8 5 4 9 0 4 9 5 5 0 0 5 0 5 5 1 0 5 1 5 5 2 0 5 2 5 5 3 0 5 3 5 5 4 0 5 4 5 5 5 0 5 5 5 5 6 0 5 6 5 5 7 0 5 7 5 5 8 0 5 8 5 5 9 0 5 9 5 6 0 0 6 0 5 6 1 0 6 1 5 6 2 0 6 2 5 6 3 0 6 3 5 6 4 0 6 4 5 6 5 0 6 5 5 6 6 0 6 6 5 6 7 0 6 7 5 6 8 0 6 8 5 6 9 0 6 9 5 7 0 0 7 0 5 7 1 0 7 1 5 7 2 0 7 2 5 7 3 0 7 3 5 7 4 0 7 4 5 7 5 0 7 5 5 7 6 0 7 6 5 7 7 0 7 7 5 7 8 0 7 8 5 7 9 0 7 9 5 8 0 0 8 0 5 8 1 0 8 1 5 8 2 0 8 2 5 8 3 0 8 3 5 8 4 0 8 4 5 8 5 0 8 5 5 8 6 0 8 6 5 8 7 0 8 7 5 8 8 0 8 8 5 8 9 0 8 9 5 9 0 0 9 0 5 9 1 0 9 1 5 9 2 0 9 2 5 9 3 0 9 3 5 9 4 0 9 4 5 9 5 0 9 5 5 9 6 0 9 6 5 9 7 0 9 7 5 9 8 0 9 8 5 9 9 0 9 9 5 1 0 0 0

ANTHONY CARDWELL  
06/19/2023

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E/29/17

| A22-13313-1-FL | | 1018318758 | LN: 4 | T0527151-1 | FSVAT3160PSL2 | |

**voestalpine Tubulars GmbH & Co KG**

**Umfang der Lieferung / Volume of delivery / Contenu de la livraison:**

|                                                              |                       |                                                  |                                         |                                     |                                |                               |                      |
|--------------------------------------------------------------|-----------------------|--------------------------------------------------|-----------------------------------------|-------------------------------------|--------------------------------|-------------------------------|----------------------|
| Versandanzeige:<br>Dispatch advice No.<br>Avis d'expédition: | Pos.:<br>Pos.<br>Pos. | Abmessung:<br>Dimension:<br>Dimension:           | Bundnr.:<br>Bundle No.:<br>Nombre Fret: | Stückzahl:<br>Number Of:<br>Pièces: | Länge:<br>Length:<br>Longueur: | Gewicht:<br>Weight:<br>Poids: | Los:<br>Lot:<br>Lot: |
|                                                              | 8                     | 3,500 In x 0,438 In<br>14,33 lbs/ft<br>SCHED 160 | 1-6                                     | 72                                  | 2918,416 ft                    | 19048,00 kg                   |                      |

**Volume of delivery**

| Heat       | Lot    | Remark |
|------------|--------|--------|
| 1018317620 | 238474 | -- 01  |
| 1018318758 | 238475 | -- 01  |

Kindberg, 21.02.2019

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**WEITZER**

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authorized inspection representative  
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voestalpine

Druck auf dem Abdruck

ANTHONY CARDWELL  
06/19/2023

nm  
2/25/19

## voestalpine Tubulars GmbH & Co KG

### Additional tests and inspections performed on pipe

- 1 Abtrennen der ungeprüften Rohrenden (beidseitig)/Cut-Off of uninspected pipe ends (both ends): bestanden/passed
- 2 Dimensionskontrolle/ Dimensional inspection: bestanden/passed
- 3 Ringfaltversuch/Flattening test: bestanden/passed
- 4 Streuflussprüfung/Diluted flux acc. API 5 L (old version - SR 4) OD + ID, longitudinal 12.5 %: bestanden/passed
- 5 Streuflussprüfung gem. ASTM E570/Flux leakage testing acc. to ASTM E570: bestanden/passed
- 6 Ultraschallprüfung gem. Norm (Wanddicke - 100 % Umfang)/Ultrasonic inspection acc. to standard (wallthickness - 100 % circumference): bestanden/passed
- 7 Visuelle Inspektion/ Visual inspection: bestanden/passed
- 8 Wasserinnendruckversuch/Hydrostatic test: bestanden/passed, Mindestprüfdruck/min test pressure: 2970 PSI, min. Haltezeit/min duration: 5 sec
- 9 Restmagnetismus acc. DB (max. 3,0 mT) / Residual magnetism acc. data Sheet(max. 3,0 mT): bestanden/passed

### Test remarks

Wir bestätigen, dass die gelieferten Erzeugnisse den Anforderungen der Bestellung entsprechen.  
We hereby certify that the goods delivered are in compliance with the requirements of the order.

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voestalpine

CE 15 10 17 10 17 10 17

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06/19/2023

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2/25/19

# voestalpine Tubulars GmbH & Co KG

## Tensile testing

| Lot No | Test Type |          | Heat treatment    | Loc. Temp |    | Specimen |            | Yield Strength                       | Tensile Strength | Elong. gage length in area | Reduct.Rt/Rm |       |       |        |      |
|--------|-----------|----------|-------------------|-----------|----|----------|------------|--------------------------------------|------------------|----------------------------|--------------|-------|-------|--------|------|
|        |           |          |                   |           |    |          |            | {                                    | PSI              |                            | PSI          |       | [%]   | [inch] | [%]  |
|        |           |          |                   |           |    |          |            | Requ. from                           | 42061            |                            | 60190        |       | 30.00 |        |      |
|        |           |          |                   |           |    |          |            | Requ. to                             | 71793            |                            | 94989        |       |       |        |      |
| 238474 | AD01      | Standard | normalized rolled | Rear      | 68 | 1        | Strip-long | 0.74 x 0.44                          | R10.50           | 47572                      | 72954        | 35.70 | 2     |        | 0.65 |
| 238475 | AD01      | Standard | normalized rolled | Rear      | 68 | 1        | Strip-long | 0.74 x 0.45                          | R10.50           | 48557                      | 72518        | 36.00 | 2     |        | 0.64 |
|        |           |          |                   |           |    |          |            | yield strength:                      |                  |                            |              |       |       |        |      |
|        |           |          |                   |           |    |          |            | Gr B: min. 35000 PSI                 |                  |                            |              |       |       |        |      |
|        |           |          |                   |           |    |          |            | BN - PSL-2: 35500 - 71800 PSI        |                  |                            |              |       |       |        |      |
|        |           |          |                   |           |    |          |            | X42N - PSL-2: 42100 - 71800 PSI      |                  |                            |              |       |       |        |      |
|        |           |          |                   |           |    |          |            | Gr C (if applicable): min. 40000 PSI |                  |                            |              |       |       |        |      |
|        |           |          |                   |           |    |          |            | Tensile strength:                    |                  |                            |              |       |       |        |      |
|        |           |          |                   |           |    |          |            | Gr B: min. 60000 PSI                 |                  |                            |              |       |       |        |      |
|        |           |          |                   |           |    |          |            | BN - PSL-2: 60200 - 95000 PSI        |                  |                            |              |       |       |        |      |
|        |           |          |                   |           |    |          |            | X42N - PSL-2: 60200 - 95000 PSI      |                  |                            |              |       |       |        |      |
|        |           |          |                   |           |    |          |            | Gr C (if applicable): min. 70000 PSI |                  |                            |              |       |       |        |      |

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voestalpine

CE 14 002 000-0000-0000

ANTHONY CARDWELL  
06/19/2023

Mr  
E/29/23

**voestalpine Tubulars GmbH & Co KG**

**Hardness testing**

| Lot No     | Test Type |          | Heat treatment    |           | Specimen Test |          |        |         | Hardness Number |         | Mean Hardness Number |           | Variation     |
|------------|-----------|----------|-------------------|-----------|---------------|----------|--------|---------|-----------------|---------|----------------------|-----------|---------------|
|            |           |          |                   |           | Loc. No       | Location | Method |         | from            | to      | from                 | to        |               |
| 238474     | AD01      | Standard | normalized rolled |           | Rear 1        | Body     | HRB    | Requ.:  | 79.40           | 80.80   | 79.77                | 99.50     |               |
| Quadrant 1 | 1_Outer   | 2_Outer  | 3_Outer           | AVG_Outer | 1_Mid         | 2_Mid    | 3_Mid  | AVG_Mid | 1_Inner         | 2_Inner | 3_Inner              | AVG_Inner | AVG_Variation |
|            | 79.70     | 80.20    | 79.40             | 79.77     | 80.30         | 80.80    | 80.60  | 80.57   | 80.70           | 80.50   | 80.30                | 80.50     | 0.80          |
| 238475     | AD01      | Standard | normalized rolled |           | Rear 1        | Body     | HRB    |         | 80.00           | 81.20   | 80.27                | 81.00     | 0.73          |
| Quadrant 1 | 1_Outer   | 2_Outer  | 3_Outer           | AVG_Outer | 1_Mid         | 2_Mid    | 3_Mid  | AVG_Mid | 1_Inner         | 2_Inner | 3_Inner              | AVG_Inner | AVG_Variation |
|            | 80.00     | 80.60    | 80.20             | 80.27     | 80.70         | 81.20    | 81.10  | 81.00   | 80.50           | 80.40   | 80.30                | 80.40     | 0.73          |

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ANTHONY CARDWELL  
06/19/2023

Mr. Elzoh

voestalpine Tubulars GmbH & Co KG

Impact testing

| Requirement:             |           |          | Length<br>[inch]  | Wide<br>[inch] | Height<br>[inch] | Specimen<br>Orientation Type    |      | Temp.<br>[°F]   | [       | Single<br>ft-lbs | ]       | [      | Average<br>ft-lbs | Factor |
|--------------------------|-----------|----------|-------------------|----------------|------------------|---------------------------------|------|-----------------|---------|------------------|---------|--------|-------------------|--------|
|                          |           |          | 2.165             | .394           | .394             | long.                           | CH-V | - 20            |         |                  |         |        |                   |        |
| Lot No                   | Test Type |          | Heat Treatment    |                | Loc. No. Pipe    |                                 |      | Single1         | Single2 | Single3          | Average | Unit   |                   |        |
| 238474                   | AD01      | Standard | normalized rolled |                | Rear 1 long      | Imp. Values:                    |      | 84              | 113     | 106              | 101     | ft-lbs |                   |        |
| Results for information! |           |          |                   |                |                  | Including Factor:               |      |                 |         |                  |         |        |                   |        |
|                          |           |          |                   |                |                  | Shear-Area [%]:                 |      |                 |         |                  |         |        |                   |        |
|                          |           |          |                   |                |                  | Lateral Expansion (un-/broken): |      |                 |         |                  |         |        |                   |        |
|                          |           |          |                   |                |                  | Lateral Expansion: [inch]       |      | H: 0.394 [Inch] |         |                  |         |        |                   |        |

| Requirement: |           |          | Length<br>[inch]  | Wide<br>[inch] | Height<br>[inch] | Specimen<br>Orientation Type    |      | Temp.<br>[°F]   | [       | Single<br>ft-lbs | ]       | [      | Average<br>ft-lbs | Factor |
|--------------|-----------|----------|-------------------|----------------|------------------|---------------------------------|------|-----------------|---------|------------------|---------|--------|-------------------|--------|
|              |           |          | 2.165             | .394           | .394             | long.                           | CH-V | - 49            |         | 10               |         |        | 13                |        |
| Lot No       | Test Type |          | Heat Treatment    |                | Loc. No. Pipe    |                                 |      | Single1         | Single2 | Single3          | Average | Unit   |                   |        |
| 238474       | AD01      | Standard | normalized rolled |                | Rear 2 long      | Imp. Values:                    |      | 82              | 77      | 60               | 73      | ft-lbs |                   |        |
|              |           |          |                   |                |                  | Including Factor:               |      |                 |         |                  |         |        |                   |        |
|              |           |          |                   |                |                  | Shear-Area [%]:                 |      |                 |         |                  |         |        |                   |        |
|              |           |          |                   |                |                  | Lateral Expansion (un-/broken): |      |                 |         |                  |         |        |                   |        |
|              |           |          |                   |                |                  | Lateral Expansion: [inch]       |      | H: 0.394 [Inch] |         |                  |         |        |                   |        |

| Requirement:             |           |          | Length<br>[inch]  | Wide<br>[inch] | Height<br>[inch] | Specimen<br>Orientation Type    |      | Temp.<br>[°F]   | [       | Single<br>ft-lbs | ]       | [      | Average<br>ft-lbs | Factor |
|--------------------------|-----------|----------|-------------------|----------------|------------------|---------------------------------|------|-----------------|---------|------------------|---------|--------|-------------------|--------|
|                          |           |          | 2.165             | .394           | .394             | long.                           | CH-V | - 20            |         |                  |         |        |                   |        |
| Lot No                   | Test Type |          | Heat Treatment    |                | Loc. No. Pipe    |                                 |      | Single1         | Single2 | Single3          | Average | Unit   |                   |        |
| 238475                   | AD01      | Standard | normalized rolled |                | Rear 1 long      | Imp. Values:                    |      | 103             | 87      | 117              | 102     | ft-lbs |                   |        |
| Results for information! |           |          |                   |                |                  | Including Factor:               |      |                 |         |                  |         |        |                   |        |
|                          |           |          |                   |                |                  | Shear-Area [%]:                 |      |                 |         |                  |         |        |                   |        |
|                          |           |          |                   |                |                  | Lateral Expansion (un-/broken): |      |                 |         |                  |         |        |                   |        |
|                          |           |          |                   |                |                  | Lateral Expansion: [inch]       |      | H: 0.394 [Inch] |         |                  |         |        |                   |        |

| Requirement: |           |          | Length<br>[inch]  | Wide<br>[inch] | Height<br>[inch] | Specimen<br>Orientation Type    |      | Temp.<br>[°F]   | [       | Single<br>ft-lbs | ]       | [      | Average<br>ft-lbs | Factor |
|--------------|-----------|----------|-------------------|----------------|------------------|---------------------------------|------|-----------------|---------|------------------|---------|--------|-------------------|--------|
|              |           |          | 2.165             | .394           | .394             | long.                           | CH-V | - 49            |         | 10               |         |        | 13                |        |
| Lot No       | Test Type |          | Heat Treatment    |                | Loc. No. Pipe    |                                 |      | Single1         | Single2 | Single3          | Average | Unit   |                   |        |
| 238475       | AD01      | Standard | normalized rolled |                | Rear 2 long      | Imp. Values:                    |      | 105             | 67      | 47               | 73      | ft-lbs |                   |        |
|              |           |          |                   |                |                  | Including Factor:               |      |                 |         |                  |         |        |                   |        |
|              |           |          |                   |                |                  | Shear-Area [%]:                 |      |                 |         |                  |         |        |                   |        |
|              |           |          |                   |                |                  | Lateral Expansion (un-/broken): |      |                 |         |                  |         |        |                   |        |
|              |           |          |                   |                |                  | Lateral Expansion: [inch]       |      | H: 0.394 [Inch] |         |                  |         |        |                   |        |

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voestalpine

ANTHONY CARDWELL  
06/19/2023

Mr  
Ehler



voestalpine Tubulars GmbH & Co KG

Chemical testing

Product analysis

| C                                                  | Si     | Mn     | P      | S      | Cr     | Ni     | Cu     | Al     | Ti     | Mo     | V      | Sh     | B      | Nb     | CEQ    |        |
|----------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Lot No. 238474 AD 01 1 Standard Heat No 1018317620 |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| 0.1989                                             | 0.2019 | 1.0845 | 0.0132 | 0.0069 | 0.0327 | 0.0193 | 0.0230 | 0.0383 | 0.0015 | 0.0028 | 0.0029 | 0.0020 | 0.0003 | 0.0057 | 0.0000 | 0.3882 |
| Lot No. 238474 AD 01 2 Standard Heat No 1018317620 |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| 0.1989                                             | 0.2019 | 1.0827 | 0.0132 | 0.0078 | 0.0327 | 0.0196 | 0.0224 | 0.0383 | 0.0015 | 0.0026 | 0.0027 | 0.0017 | 0.0003 | 0.0057 | 0.0000 | 0.3878 |
| Lot No. 238475 AD 01 1 Standard Heat No 1018318758 |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| 0.1894                                             | 0.2018 | 1.0755 | 0.0123 | 0.0113 | 0.0166 | 0.0173 | 0.0198 | 0.0313 | 0.0014 | 0.0032 | 0.0027 | 0.0013 | 0.0002 | 0.0056 | 0.0000 | 0.3761 |
| Lot No. 238475 AD 01 2 Standard Heat No 1018318758 |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| 0.1893                                             | 0.2008 | 1.0774 | 0.0121 | 0.0115 | 0.0165 | 0.0168 | 0.0195 | 0.0313 | 0.0014 | 0.0029 | 0.0027 | 0.0014 | 0.0003 | 0.0057 | 0.0000 | 0.3757 |

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Qualitätsstelle / Quality Department

WEITZER

Abnahmebeauftragter  
authorized inspection representative  
représentant autorisé du contrôle

voestalpine

Signature of Mr. Weitzer

ANTHONY CARDWELL  
06/19/2023

Mr. Weitzer

| A22-13313-1-FL | | DV4 | LN: 5 | T0527151-1 | D230RFLN9NL2 | |

**Ameriforge**

An AFG Holdings Company

**Material Test Report****Heat Code: DV4****Forged Vessel Connections (FVC)**

13770 Industrial Rd. Houston, TX 77015

Sales: (713) 393-4200

ISO 9001:2015 Certified

|                                                                                         |         |                                      |                      |          |
|-----------------------------------------------------------------------------------------|---------|--------------------------------------|----------------------|----------|
| Industrial Piping                                                                       | IPS0003 | PO: TP777700                         | Sales Order: 190710S | Line: 12 |
| P. O. Box 581270                                                                        |         | Item Code: LWN020300090A002A1        | Qty Shipped: 100     |          |
| Tulsa, OK 74158                                                                         |         | Item Desc: 2 X 300 X 9 LWN RF SA105N |                      |          |
|                                                                                         |         | Mill Heat: C216031                   |                      |          |
| Spec: ASTM A350(18)/ASME SA350(21)- LF2 CL1 & ASTM A105/A105M(21)/ASME SA105/SA105M(21) |         |                                      |                      |          |

| Element       | (%wt) | Ladle | Product | EPCRA | CAS#      | Element       | (%wt)  | Ladle | Product | EPCRA     | CAS# |
|---------------|-------|-------|---------|-------|-----------|---------------|--------|-------|---------|-----------|------|
| C Carbon      | 0.19  |       |         |       |           | Mo Molybdenum | 0.01   |       |         |           |      |
| Mn Manganese  | 1.15  |       |         | Y     | 7439-96-5 | V Vanadium    | 0.03   |       |         |           |      |
| P Phosphorous | 0.010 |       |         |       |           | Cb Columbium  | 0.001  |       |         |           |      |
| S Sulphur     | 0.007 |       |         |       |           | B Boron       | 0.0003 |       |         |           |      |
| Si Silicon    | 0.23  |       |         |       |           | Ti Titanium   | 0.001  |       | Y       | 7440-02-0 |      |
| Cu Copper     | 0.13  |       |         | Y     | 7440-50-8 | Al Aluminum   | 0.023  |       |         |           |      |
| Ni Nickel     | 0.05  |       |         | Y     | 7440-02-0 | C.E.          | 0.42   |       |         |           |      |
| Cr Chromium   | 0.07  |       |         | Y     | 7440-47-3 |               |        |       |         |           |      |

| Mechanical Testing              |                    |  |  |  |  | Heat Treat                  |        |
|---------------------------------|--------------------|--|--|--|--|-----------------------------|--------|
| Test Lab                        | AFG                |  |  |  |  | Norm. Temp. (F)             | 1675   |
| Test Bar Size                   | SACRIFICIAL PIECE  |  |  |  |  | Norm. (Hrs)                 | 3.30   |
| HBW                             | 143 - 143          |  |  |  |  | Norm. Cooling Type          | AIR    |
| Eig (%)                         | 34                 |  |  |  |  | Other                       |        |
| RA (%)                          | 66                 |  |  |  |  | Country of Melt             | USA    |
| Tensile Specimen Size (in)      | .490               |  |  |  |  | Country of Finish Machining | USA    |
| Tensile (ksi)                   | 80.8               |  |  |  |  | Country of Forging          | USA    |
| Yield (ksi)                     | 52.2               |  |  |  |  | Vacuum Degassed             | YES    |
| Gauge Length (in)               | 2                  |  |  |  |  | Gr. Sz                      | 10.333 |
| Charpy Orientation              | LONGITUDINAL       |  |  |  |  |                             |        |
| Charpy Temp (F)                 | -50                |  |  |  |  |                             |        |
| Charpy Specimen Size (mm)       | 10X10              |  |  |  |  |                             |        |
| Charpy (ft lbs)                 | 68 - 62 - 50       |  |  |  |  |                             |        |
| Avg Energy 3 Specimens (ft-lbs) | 60                 |  |  |  |  |                             |        |
| Min Energy 1 Specimens (ft-lbs) | 50                 |  |  |  |  |                             |        |
| % Shear                         | 50 - 50 - 40       |  |  |  |  |                             |        |
| Lat. Exp. (in)                  | .056 - .053 - .048 |  |  |  |  |                             |        |

The recording of false, fictitious, or fraudulent statement or entries on this document may be punishable as a felony under federal statute.

EPCRA Supplier Notification: This product may contain one or more toxic chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act (Title III of the Superfund Amendments and Reauthorization Act of 1986) and 40 C.F.R. Part 372. Potentially reportable chemicals are indicated with a checkmark in the "EPCRA" column and a Chemical Abstract Services (CAS) registry number is provided for each such chemical in addition to the percent by weight of the chemical present in this product. It is your responsibility alone to determine whether your facility is required to submit a Toxic Release Inventory Report under EPCRA Section 313.

Certification No.: 1621540

Certification Date: 1/17/2023

Issued By: Michelle Gutierrez

Page 1 of 2

This report is issued in compliance with the requirements of EN10204 3.1 / ISO 10474 3.1.b

ANTHONY CARDWELL  
06/19/2023M/G  
6/19/23

## Material Test Report

Heat Code: DV4

Forged Vessel Connections (FVC)

13770 Industrial Rd. Houston, TX 77016

ISO 9001:2015 Certified

Sales: (713) 393-4200

|                                                                                         |         |                                      |                      |          |
|-----------------------------------------------------------------------------------------|---------|--------------------------------------|----------------------|----------|
| Industrial Piping                                                                       | IPS0003 | PO: TP777700                         | Sales Order: 190710S | Line: 12 |
| P. O. Box 581270                                                                        |         | Item Code: LWN020300090A002A1        | Qty Shipped: 100     |          |
| Tulsa, OK 74158                                                                         |         | Item Desc: 2 X 300 X 9 LWN RF SA105N |                      |          |
|                                                                                         |         | Mill Heat: C216031                   |                      |          |
| Spec: ASTM A350(18)/ASME SA350(21)- LF2 CL1 & ASTM A105/A105M(21)/ASME SA105/SA105M(21) |         |                                      |                      |          |

Material is Fully Killed; Fine Grain Practice

Product compliant with NACE MR0175/ISO 15156-2:2015, Annex A (A.2.1.2, A2.1.3).  
Product compliant with NACE MR0103/ISO 17945:2015, Section 13.1.1 and 13.1.3.

We hereby certify that the material represented by this document has been tested and is in conformance with the Purchase Order and Specification Requirements.

- \* No Weld repair performed.
- \* Ladle Chemical Analysis results are reported from the raw material suppliers MTR.
- \* Tensile taken from a round specimen. Measurement of elongation after fracture.
- \* Yield strength was determined using the .2% offset method, unless specified.
- \* All material supplied under this order is certified to be free of mercury contamination and no mercury bearing equipment was used in manufacturing, fabrication or testing.
- \* When reported on MTR: Tensile Testing Per ASTM E8; Brinell Hardness Per ASTM E10; Charpy Testing Per ASTM E23
- \* AF Global manufactures materials according to a certified Quality Management System conforming to ISO 9001:2015 and PED certified to 2014/68/EU, Annex 1, Section 4.3.
- Unless otherwise noted on PO, Dimensions of all standard pipe flanges and flange fittings (NPS 1/2 to NPS 24) per ASME B16.5-2020, large diameter steel flanges (NPS 26 to 60) per ASME B16.47-2020, Orifice flanges per ASME B16.36-2020.
- \* AFGlobal uses the latest edition of ASTM E29 (Standard practice for using significant digits in test data to determine conformance with specifications), to claim conformance or nonconformance to a specification. When a accept/reject determination is required AFGlobal uses a test uncertainty ratio (TUR) of 1:1 or higher as acceptable.
- \* DNV PED Certificate No 100C0425664-PA-ACCREDITIA-USA Valid thru December 03, 2023.

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Certification No.: 1621540

Certification Date: 1/17/2023

Issued By: Michelle Gutierrez

  
Dusty Bannon - Quality Analyst

This report is issued in compliance with the requirements of EN10204 3.1 / ISO 10474 3.1.b

Page 2 of 2

ANTHONY CARDWELL  
06/19/2023

*mt*  
*6/29/23*



# Inspection Certificate

Page 1 of:

2 Pages

acc to EN 10204/3.1

Certificate no.:

9221354

Purchaser: Webco Industries, Inc  
74063 Sand Springs OK  
Your order no.: 10075464  
Manufacturer: Mannesmann Precision Tubes Netherlands B.V  
NL-Helmond  
Our order no.: 3400033  
Product: Seamless cold drawn low-carbon steel heat exchanger and condenser tubes  
Specification: (S)A 179 / (S)A 450 / NACE MR0103-05 / NACE MR0175  
Steelgrade: A 179 acc. to norm: A179 Edition: 2021  
SA 179 SA179 2021  
Marking: On tubes / On tags

Manufacturer's mark: MPT-HE

Process: Basic oxygen steel

Stamp of the mill's inspector: (Q-MPT-NL)

Steelmarks: (S)A 179 + N

Shipping no.: 4400608  
Our shipping date: 01-06-2022

## Extent of the delivery:

| Item | Numbers | Dimension                     | Heat no. | Serial no.    |
|------|---------|-------------------------------|----------|---------------|
| 60   | 101     | 1,000" OD x 0,083" MW x 16'0" | 492,58 m | 636 kg 222306 |

### Shipping marks:

PO : 10075464  
Item : 00008  
Mat. : A320100008308  
Quantity : 101 pcs.  
Tag Nr : PO# A22-13313 T-1  
ASTM/ASME A/SA 179 SMLS  
Grade 1010  
OD: 1,0000" inches  
Wall: 0.0830 inches MW Wall  
Melling Western Europe  
Hot finished tube fabrication in Germany  
Cold drawn in The Netherlands  
Max. 1 heat per bundle - Max 1 heat per box

|                   | C         | Mn        | P      | S      | Cr   | Heat no |
|-------------------|-----------|-----------|--------|--------|------|---------|
| Requirements      | 0,06-0,18 | 0,27-0,63 | ≤0,035 | ≤0,035 |      |         |
| Heat analysis (%) | 0.16      | 0.51      | 0.009  | 0.002  | 0.03 | 222306  |

|                   | Mo   | V     | Cu   | Ni   | Sn    | Heat no |
|-------------------|------|-------|------|------|-------|---------|
| Requirements      |      |       |      |      |       |         |
| Heat analysis (%) | 0.01 | 0.002 | 0.01 | 0.02 | 0.001 | 222306  |

Heat treatment: Normalized at 920 °C

Remarks: It is certified that the products have been tested in accordance to purchase specifications and found satisfactory

Helmond(NL.) : 30-06-2022

Mannesmann Precision Tubes - NL  
Inspector  
B. van Lier

MF  
E/29/77

ANTHONY CARDWELL  
10/24/2022

1. Visual inspection and control of dimensions: OK
2. Eddy current test acc. to: E309: OK
3. Flattening test: OK  
Flaring test: OK
4. Hardness test: OK

| Mechanical data | Dimensions of<br>the test tube<br>mm | Hardness<br>HRB |
|-----------------|--------------------------------------|-----------------|
| Requirements:   |                                      | Max 72          |
| 1               | 26,40 x 2,26                         | 68              |
| 2               |                                      | 65              |

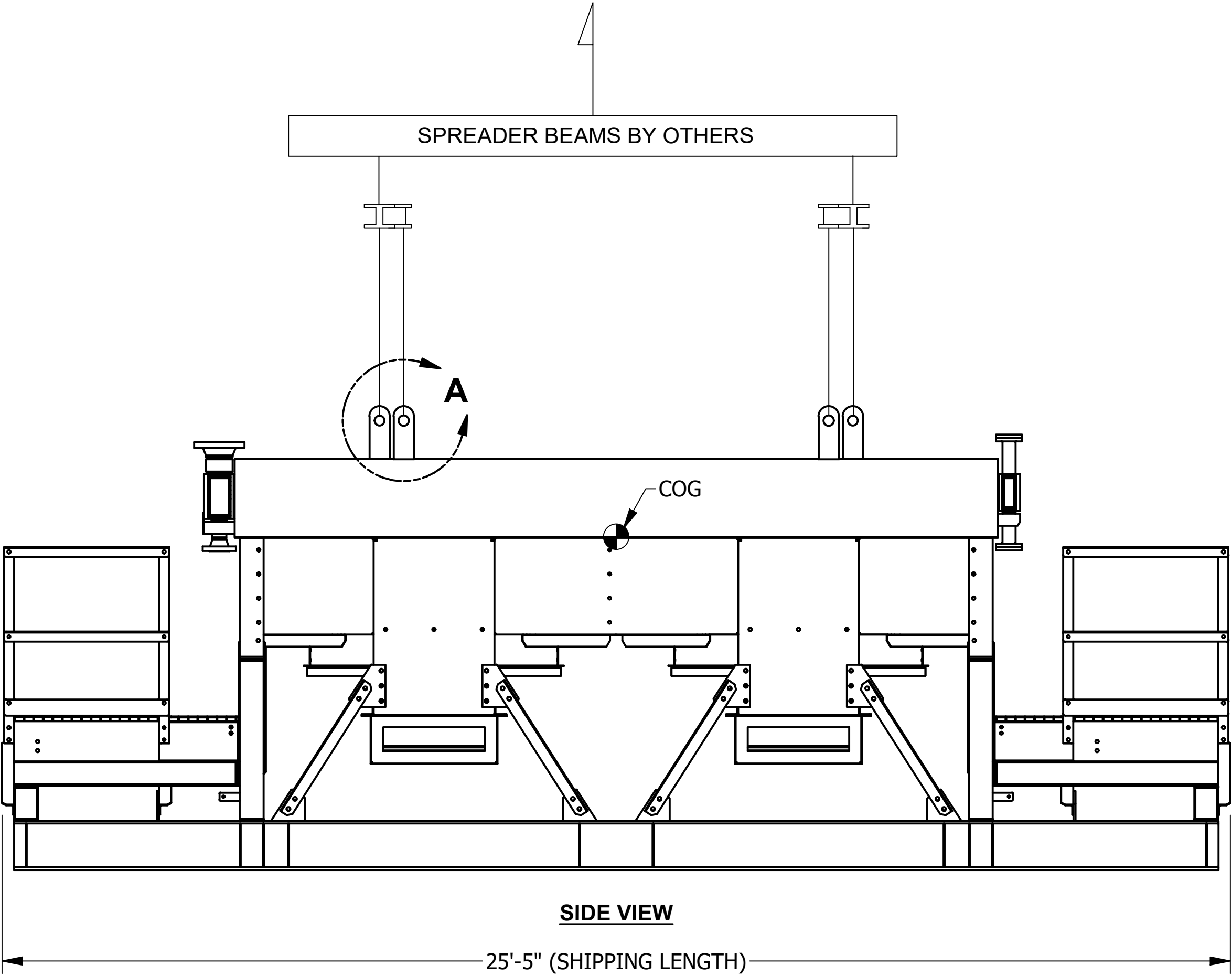
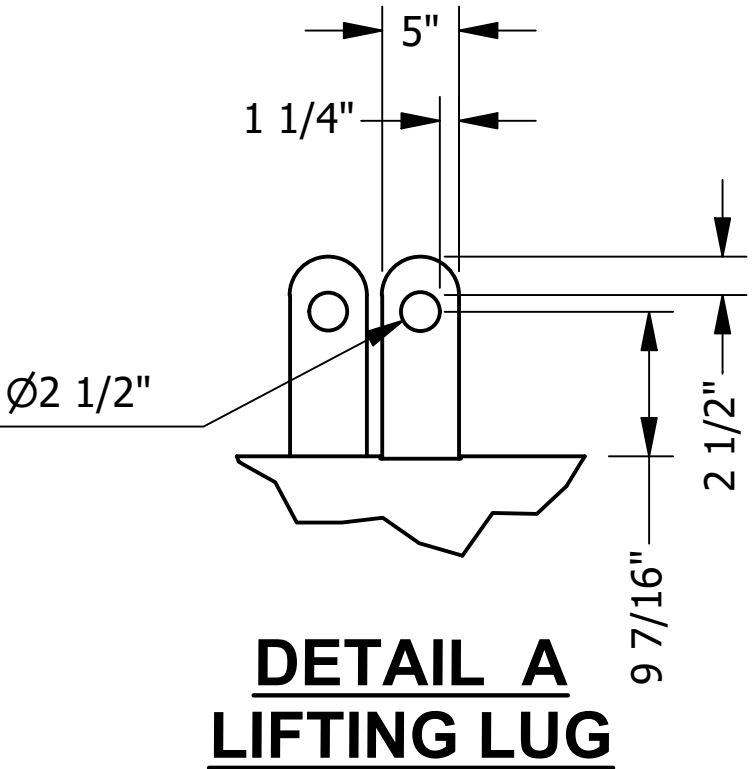
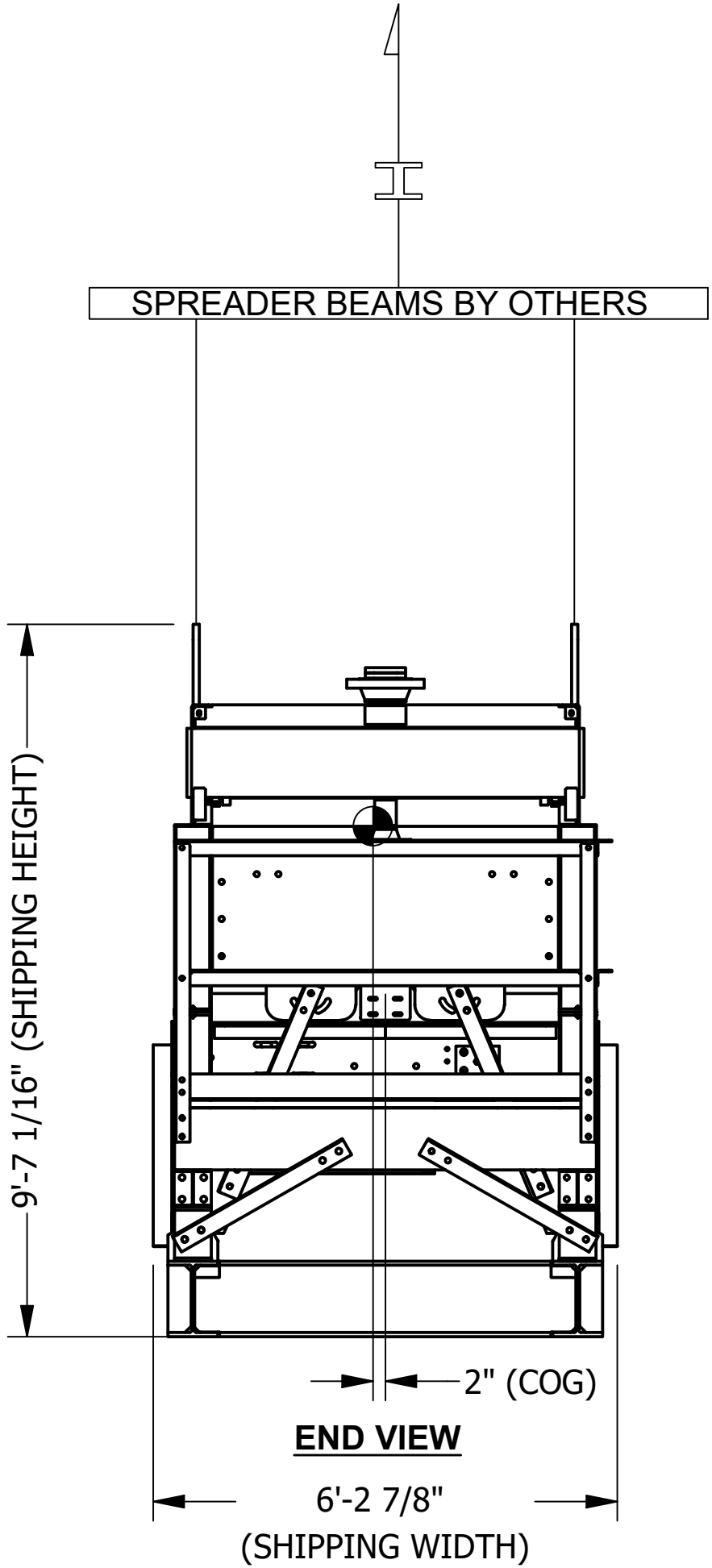
**Helmond: 30-08-2022**

**Mannesmann Precision Tubes - NL**  
**Inspector**  
**B. van Lier**



*mt  
8/20/2*

\*\*\* VERTICAL LIFT ONLY \*\*\*  
16,000 LB.



| WEIGHTS PER BAY(LBS) |        |
|----------------------|--------|
| ITEM                 | WEIGHT |
| COOLER               | 8372   |
| SPAN BEAMS           | 4274   |
| LOUVER               | 0      |
| WALKWAY              | 1792   |
| H2O                  | 564    |
| PROCESS FLUID        | 540    |
| TOTAL DRY            | 14439  |
| TOTAL FULL H2O       | 15003  |
| TOTAL OPERATING      | 14979  |

|                   |                                  |
|-------------------|----------------------------------|
| PROJECT NAME:     | World Energy Renewables Project  |
| PROJECT NO./UNIT: | EN-20-7120 / PRU                 |
| CUSTOMER/CLIENT:  | World Energy Paramount           |
| EQUIPMENT OWNER:  | Air Products Manufacturing LLC   |
| ITEM NO.:         | 18-XF-370                        |
| SERVICE:          | Flashed Steam Condenser          |
| LOCATION:         | World Energy, Paramount, CA, USA |
| PO NO.:           | 4505606037 / A8KM-4-406-PO-2     |
| FABSCO JOB NO.:   | A22-13313-1                      |

| LIFT DIAGRAM |            |              |  |
|--------------|------------|--------------|--|
| REV.         | DATE       | DESCRIPTION  |  |
| 0            | 10/25/2023 | FOR APPROVAL |  |
|              |            |              |  |
|              |            |              |  |
|              |            |              |  |
|              |            |              |  |

DRAWING PROPRIETARY TO FABSCO FIN-AIR, LLC AND IS NOT TO BE RELEASED TO ANY THIRD PARTY, EXCEPT WITH NOTIFICATION AND APPROVAL IN WRITING OF FABSCO FIN-AIR, LLC OFFICER.

DRAWN BY:

BMH

DATE:

4/20/2022

CHECKED BY:



DRAWING NO:

A22-13313-1-LIFT

REV:

0