

# Certified Material Test Report

Cert #: 366198	Mill Order: 2119760	Heat #: A215663	Issued: 12/1/2021 17:02:27
Work Order:	Sales Order: 258466-1	Customer:	PO #: 20368-9
Load #: 390743	Reference #:	Reference Desc:	End Use:
Size: 4"	Shape: Round	Grade: A350/LF2 Chem	Length: 20'
Grain Practice: All Fine Grain (5-8) per ASTM A29		Reduction Ratio: 11.6 to 1	Disposition: Rolled Prime

**Ladle Chemistry Analysis (ASTM A29)**

C	Mn	P	S	Si	Al	Cu	Ni	Cr	Mo	Sn	N	V	Cb	B	Ca	W	Ti	DI
0.18	1.05	0.008	0.023	0.18	0.033	0.31	0.39	0.16	0.04	0.010	0.0087	0.001	0.000	0.0003	0.0010	0.000	0.000	0.86
Pb	Co	As	Sb	Zr	Bi	H (ppm)	O (ppm)	Ceq	J-Factor									
0.000	0.007	0.004	0.004	0.000	0.000	2.0		0.42	221									

**Product Check Analysis (ASTM A29)**

C	Mn	P	S	Si	Al	Cu	Ni	Cr	Mo	Sn	N	V	Cb	Ti	B	Ca	O
Front																	
Back																	

**Jominy (ASTM A255)**

	J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J12	J14	J16	J18	J20	J24	J28	J32
Calc'd Standard	1.5	3	5	7	9	11	13	15	20	25	30	35	40	45	50			
Calc'd Metric																		
Front	J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J12	J14	J16	J18	J20	J24	J28	J32
Back																		

**Microcleanliness (ASTM E45)**

Method A								Method C (SAE J422)				Method E	
AT	AH	BT	BH	CT	CH	DT	DH	S	O	SAM "B" SAM "D"			

**Microcleanliness (DIN 50602)**

K			M	
S	O	Tot	Tot	

**Decarb**

Depth	% of Diameter
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**Grainsize**

Austenitic	Ferritic
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**Macrostructure (ASTM E381)**

S	R	C
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**Magnetic Particle Inspection**

Frequency	Severity
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**Mechanical Properties (ASTM A370)**

Tensile Properties					Hardness	
Tensile Strength	0.2% Yield Strength	% Elong (2")	% ROA	0.35% EUL Yield Strength	(MR)	(Surf)

Steel Dynamics - Engineered Bar Products has a quality system in place which has been certified ISO 9001:2015 compliant, including PED certification.

**Comments/Specs**

Electric Arc Furnace Melted - Vacuum Tank Degassed ---- Material has been fully killed. ---- UT Tested to ASTM A388 1/8FBH ---- NACE MR-01-75 / ISO 15156 -2009 ---- Normalize ---- ASTM A696-90a Grade C ---- ASTM A675-19 Grade 70 ---- ASME SA350-04 LF-2 Class 1, 2 ---- ASME SA105-04 ---- ASME SA696-04 Gr C ---- ASME SA675-04 Gr 70 ---- DIN EN 10204:2004 Paragraph 3.1 ---- Cameron MR-005 Rev. C1 ---- NACE MRC103-2007 ---- NACE MR0103-2003 ---- Complies with EN 10204 type 3.1 ---- Pres Equip Direct(PED) 97/23/EC/7/2 Anx I, Par 4.3 ---- J.S. Alloys Spec LF2-HN dtd 12-17-18 ---- EAF Melted, Vacuum Tank Degas, Bloom Strand Cast ---- ASTM A576-17 ---- EAF Melted, Ladle Refined Vacuum Tank Degas ---- ASTM A420-19 WPL6 ---- ASTM A105/A105M -21

Condition: Normalize, Chamfer, Immersion UT

UT: Passed Ultrasonic Inspection

I hereby certify that the content of this report is correct and accurate, and that all tests and operations performed on this material were in compliance with applicable material specifications and purchaser designated requirements.

*Jonathan Vallosio*  
 Jonathan Vallosio - Rolling Mill Metallurgist (ES)

Any alteration to this report voids Steel Dynamic's warranting of results. No weld repair has been performed on this material. This material is not radioactive and has not been exposed to radioactivity while under the control of Steel Dynamics. This material has not been exposed to mercury while under the control of Steel Dynamics. Unless otherwise noted, this material was melted, continually cast, and rolled in the USA; w/ all testing performed by Steel Dynamics.

## Certified Material Test Report Heat Treatment Addendum

Cert #: 366198	Mill Order: 2119760	Heat #: A2 5663	Issued: 12/1/2021 17:02:27
Work Order:	Sales Order: 258466-1	Customer:	PQ #: 20368-9
Load #: 390743	Reference #:	Reference Desc:	End Use:
Size: 4"	Shape: Round	Grade: A350/LF2 Chem	Length: 20

Normalize		Austenitize		Quench Media			Temper		Stress Relieve	
Time	Temp	Time	Temp	Type	Time	Temp	Time	Temp	Time	Temp
	°F	hrs	°F		min	°F	hrs	°F	hrs	°F
3.5 hrs	1650 F									

\* Furnaces are calibrated to API 6A Annex M, and use atmospheric thermocouples.  
 \*\* Tensile and CVN from 12" prolongation from longitudinal orientation of Heat Treated Bar

**Charpy Impact (ASTM E23) (v-notch, 10mm x 10mm)**

Sample ID	Orientation	Location	Temp(F)	Impact Energy (ft-lbs)				Lateral Expansion (0.001")				% Shear			
				1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
42600	Longitudinal	Mid-Radius Q1	-50	40	55	69	55	36	47	56	46	20	40	70	43

**Hardness (ASTM A370)**

Sample ID	Location	HB
42600	Mid-Radius Q1	149
42610	Mid-Radius Q2	149

**Tensile (ASTM A370)**

Sample ID	Orientation	Location	Tensile	0.2% Yield	%ROA	%E (2")
42600	Longitudinal	Mid-Radius Q1	73,000 psi	47,200 psi	58	32

I hereby certify that the content of this report is correct and accurate, and that all tests and operations performed on this material were in compliance with applicable material specifications and purchaser designated requirements.

*Jonathan Vallosio*  
 Jonathan Vallosio - Bar Finishing Metallurgist

Any alteration to this report voids Steel Dynamic's warranting of results.