

Invoice No. 919511
 Bill of Lading 301661
 Customer No. 6429
 Customer P.O. 116004

NUCOR-YAMATO STEEL CO.
 P.O. BOX 1228, BLYTHEVILLE, AR 72316

CERTIFIED MILL TEST REPORT
 100% Melted and Manufactured in U.S.A
 All Shapes produced by Nucor-Yamato Steel are cast and rolled to a fully killed and fine grain practice
 Date 2018-10-19

ASTM A992/A992M-11 A572/A572M GR50-15
 ASTM A709/A709M-11 GR50 (345)
 ASTM A709/A709M-11 GR50S (345S)
 CSA G40.21-13 50W (345W)
 ASTM A6/A6M-14

Item #	Item Description	QTY	Heat	Mechanical Properties										Chemical Properties													
				Yield to Tensile Ratio	Yield Strength		Tensile Strength		ELONG	Charpy Impact			C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Cb	CE	Sn	Ppm	Cl
					KSI	KSI	MPa	MPa		%	Temp	Impact Energy															
1	S24X121.0 50 ft 0 in 5610X180 (15.24 m)	1	495708	0.74 0.75	53 363 365	71 489 487	25 26					07	1.25	.012	.000	.25	.28	.10	.12	.03	.04	.001	.35	.01	.17		
2	S24X121.0 50 ft 0 in 5610X180 (15.24 m)	3	495715	0.77 0.77	57 390 379	73 504 495	23 23					06	1.21	.012	.025	.17	.32	.12	.10	.04	.04	.001	.33	.01	.16		
3	S24X121.0 50 ft 0 in 5610X180 (15.24 m)	1	495722	0.75 0.75	53 365 362	70 484 482	25 24					06	1.21	.012	.029	.28	.29	.12	.10	.04	.04	.001	.33	.01	.16		

ELONGATION BASED ON 8.00 INCH GAUGE LENGTH
 $P_{0.005} = C + S/30 + Mn/20 + Cu/20 + Ni/60 + Cr/20 + Mo/15 + V/10 + Sb(B) \approx 0.005$
 Corrosion Index: $26.01[Ni] + 3.88[Cu] + 1.21[Cr] + 1.49[Mo] + 17.28[Ni] - 7.29[Cu] + 0.91[Si]$
 $9.10[Ni] + 33.33[Cu]^2$
 (ISO 9001:2015 certified (Registration # 0985-07))
 All mechanical testing is performed by the Quality Testing Lab, which is independent of the production departments.
 The Charpy machine striker geometry used by Nucor-Yamato Steel is the 8 mm (D 815") striker (KV₂) per ASTM A370 Section 22.1.2 and ISO 148-1 Section 7.3

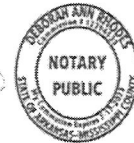
CARBON EQUIVALENT CE = $C + Mn/6 + Cr + Mo + V/5 + Ni + Cu/15$
 Mercury has not been used in the direct manufacturing of this material.
 This material was produced in accordance with the Nucor-Yamato Steel Quality Manual.

I hereby certify that the contents of this report are accurate and correct. All test results and operations performed by this material manufacturer are in compliance with the requirements of the material specifications, and when designated by the purchaser, meet the applicable specifications.

Doug Linnell
 Chief Metallurgist

State of Arkansas
 County of Mississippi
 Sworn to and subscribed before me

on 2018-10-19
 My commission expires on 07/17/2023



Invoice No. 915304
 Bill of Lading 043776
 Customer No. 4429
 Customer P.O. 116004

NUCOR-YAMATO STEEL CO.
 P.O. BOX 1218, BLYTHEVILLE, AR 72318

CERTIFIED MILL TEST REPORT
 100% Melted and Manufactured in U.S.A.
 All Shapes produced by Nucor-Yamato Steel are cast and rolled to a fully killed and fine grain practice
 Date 2018-10-02

ASTM A992/A992M-11 AS72/AS72M G450-15
 ASTM A709/A709M-15 G450 (345)
 ASTM A709/A709M-15 G450 (345S)
 CSA G40.21-13 50W (345W)
 ASTM A6/ASTM-14

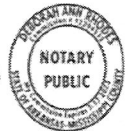
Item	Item Description	QTY	Heat#	Mechanical Properties								Chemical Properties														
				Yield to Tensile Ratio	Tensile Strength		ELONG	Charpy Impact			C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Cb	CE	Sn	Pbm	O	
					KSI	ksi		%	Temp	Impact Energy																Loc
1	S24X121.0 30 ft 0 in S610X180 (15.24 m)	3	495708	0.74 0.75	53 53	72 71	26 26						.07	1.25	.012	.030	.25	.28	.10	.12	.03	.04	.003	.35	.01	.17
2	S24X121.0 50 ft 0 in S610X180 (15.24 m)	1	495715	0.77 0.77	57 55	73 72	21 23						.06	1.21	.012	.025	.27	.32	.12	.10	.04	.04	.001	.33	.01	.16
3	S24X121.0 50 ft 0 in S610X180 (15.24 m)	2	495722	0.75 0.75	53 53	70 70	15 14						.06	1.21	.012	.029	.28	.29	.10	.10	.04	.04	.001	.33	.01	.16

ELONGATION BASED ON 8.00 INCH GAUGE LENGTH
 Pcm = C + S/30 + Mn/20 + Cu/20 + Ni/50 + Cr/20 + Mo/15 + V/10 + Nb/10 + Ti/10 (B=Approx. .0005)
 Corrosion Index = 26.01(%Cu) + 3.88(%Ni) + 1.1(%Cr) + 1.49(%S) + 17.28(%P) + 7.29(%C) + (%Ni) + 0.10(%Nb) + 0.33(%V) + 0.39(%Ti) + 2
 (ISO 3001:2015 certified (Registration # 0985-07)).
 The Charpy machine striker geometry used by the Quality Testing Lab, which is independent of the production departments.
 The Charpy machine striker geometry used by Nucor-Yamato Steel is the 8 mm (0.315") striker (KVg) per ASTM A370 Section 22.1.2 and ISO 148-1 Section 7.1.
 CARBON EQUIVALENT CE = C + Mn/6 + Cr + Mo + V/5 + (Ni + Cu)/15
 Mercury has not been used in the direct manufacturing of this material.
 This material was produced in accordance with the Nucor-Yamato Steel Quality Manual.

I hereby certify that the contents of this report are accurate and correct. All test results and operations performed by this material manufacturer are in compliance with the requirements of the material specifications, and when designated by the purchaser, meet the applicable specifications.

Doug Bonnell
 Chief Metallurgist

State of Arkansas
 County of Mississippi
 Sworn to and subscribed before me
 on 2018-10-02
 My commission expires on 07/17/2023



Invoice No. 915394
 Bill of Lading 344776
 Customer No. 4129
 Customer P.O. 11004

NUCOR-YAMATO STEEL CO.
 P.O. BOX 1228 BLYTHEVILLE, AR 72316

CERTIFIED MILL TEST REPORT
100% Melted and Manufactured in U.S.A.
 All Shapes produced by Nucor-Yamato Steel are cast and rolled to a fully
 killed and fine grain practice.
 Date: 2018-10-02

ASTM A709/A709M-15 A572/A572M GR50-55
 ASTM A709/A709M-15 GR50 (345)
 ASTM A709/A709M-15 GR50 (345L)
 CSA G40.21-13 50WM (345WM)
 ASTM A6/AS6M-14

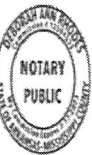
Item Description	QTY	Heat#	Mechanical Properties							Chemical Properties													
			Yield to Tensile Ratio	Tensile Strength		ELONG %	Charpy Impact Temp Impact Energy		Loc	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Cb	Se	Pb	Cl
				ksi	MPa		ksi	MPa															
1 S24X121.0 50 lb/in 5610X1.80 (13.24 m)	3	495708	0.74 0.75	53 53 363 365	71 71 489 487	26				07	1.25	0.12	0.30	25	.28	.10	.12	.03	.04	.002	.15	.01	.17
2 S24X121.0 50 lb/in 5610X1.80 (13.24 m)	1	495715	0.77 0.77	57 55 390 379	73 71 504 495	21 23				06	1.22	0.12	0.25	27	.32	.12	.10	.04	.04	.002	.18	.01	.16
3 S24X121.0 50 lb/in 5610X1.80 (13.24 m)	2	495722	0.75 0.75	53 51 365 362	70 70 484 482	25 24				06	1.21	0.12	0.29	.28	.29	.12	.10	.04	.04	.002	.18	.01	.16

ELONGATION BASED ON 8.00 INCH GAUGE LENGTH
 Carbon Equivalent CE = C+Mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15
 Pcm = C+57/30(Mn)+20/41(C)+20/60(Si)+20/20(Mo)+15/30(Ni)+10/20(B)+Approx .0005
 Mercury has not been used in the direct manufacturing of this material
 Crossover Index = 31.01%(C)+3.89%(Mn)+1.37%(Ni)+1.49%(Si)+17.28%(P)+7.29%(S)+19.12%(Nb)+33.39%(Cu)+2
 This material was produced in accordance with the Nucor-Yamato Steel Quality Manual.
 ISO 9001:2015 certified (Registration # 0505-07).
 All mechanical testing is performed by the Quality Testing Lab, which is independent of the production departments.
 The Charpy machine striker geometry used by Nucor-Yamato Steel is the 8 mm (0.315") striker (ft-lbf) per ASTM A370 Section 12.2.2 and ISO 148-1 Section 7.3.

I hereby certify that the contents of this report are accurate and correct. All test results and operations performed by this material manufacturer are in compliance with the requirements of the material specifications, and when designated by the purchaser, meet the applicable specifications.

Ray Samuell
 Chief Metallurgist

State of Arkansas
 County of Mississippi
 Sworn to and subscribed before me



en 2018-10-02
 My commission expires on 07/17/2023

Invoice No.	
Bill of Lading	349635
Customer No.	4429
Customer P.O.	116004

NUCOR-YAMATO STEEL CO.
P.O. BOX 1228; BLYTHEVILLE, AR 72316

CERTIFIED MILL TEST REPORT
100% Melted and Manufactured in U.S.A
All Shapes produced by Nucor-Yamato Steel are cast and rolled to a fully killed and fine grain practice

Date	2018-10-05
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ASTM A992/A992M-11 A572/A572M GR50-15
ASTM A709/A709M-15 GR50 (345)
ASTM A709/A709M-15 GR50S (345S)
CSA G40.21-13 50WM (345WM)
ASTM A6/A6M-14

Item#	Item Description	QTY	Heat#	Mechanical Properties						Chemical Properties															
				Yield to Tensile Ratio	Yield Strength	Tensile Strength	ELONG	Charpy Impact			C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Cb	CE	Sn	Pcm	Cl
					KSI	KSI		%	Temp	Impact Energy															
					MPa	MPa	%	° F	ft-lbf																
1	S24X121.0 50 ft 0 in S610X180 (15.24 m)	3	495724	0.76 0.76	53 54 369 369	70 70 484 486	24 23					.07	1.21	.015	.026	.24	.30	.13	.13	.04	.04	.001	.34	.01	.16
2	S24X121.0 50 ft 0 in S610X180 (15.24 m)	3	495726	0.81 0.76	60 56 414 385	74 73 510 505	21 23					.07	1.23	.014	.028	.28	.28	.12	.13	.04	.04	.001	.35	.01	.17

ELONGATION BASED ON 8.00 INCH GAUGE LENGTH
 $P_{cm} = C + Si/30 + Mn/20 + Cu/20 + Ni/60 + Cr/20 + Mo/15 + V/10 + 5B (B = \text{Approx. } .0005)$
Corrosion Index = $26.01(\%Cu) + 3.88(\%Ni) + 1.2(\%Cr) + 1.49(\%Si) + 17.28(\%P) - 7.29(\%Cu)(\%Ni) - 9.10(\%Ni)(\%P) - 33.39(\%Cu)^2$
 ISO 9001:2015 certified (Registration # 0985-07).
 All mechanical testing is performed by the Quality Testing Lab, which is independent of the production departments.
 The Charpy machine striker geometry used by Nucor-Yamato Steel is the 8 mm (0.315") striker (KV_g) per ASTM A370 Section 22.1.2 and ISO 148-1 Section 7.3.

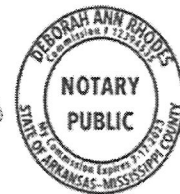
CARBON EQUIVALENT CE = $C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15$
 Mercury has not been used in the direct manufacturing of this material.
 This material was produced in accordance with the Nucor-Yamato Steel Quality Manual.

I hereby certify that the contents of this report are accurate and correct. All test results and operations performed by this material manufacturer are in compliance with the requirements of the material specifications, and when designated by the purchaser, meet the applicable specifications.

Doug Lammell
Chief Metallurgist

State of Arkansas
County of Mississippi
Sworn to and subscribed before me

on 2018-10-05
My commission expires on 07/17/2023



Invoice No. 916250
Bill of Lading 349288
Customer No. 4429
Customer P.O. 116004

NUCOR-YAMATO STEEL CO.
P.O. BOX 1226; BLYTHEVILLE, AR 72316

CERTIFIED MILL TEST REPORT
100% Melted and Manufactured in U.S.A
All Shapes produced by Nucor-Yamato Steel are cast and rolled to a fully killed and fine grain practice

Date 2018-10-04
ASTM A992/A992M-11 A572/A572M-GR50-15
ASTM A709/A709M-15 GR50 (345)
ASTM A709/A709M-15 GR50S (345S)
CSA G40.21-13 50WM (345WM)
ASTM A6/A6M-14

Item #	Item Description	QTY	Heat #	Mechanical Properties								Chemical Properties															
				Yield to Tensile Ratio	Yield Strength		Tensile Strength	ELONG	Charpy Impact			C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Cb	CE	Sn	Pcm	Cl	
KSI	MPa	%	Temp		Impact Energy	Loc			F	J	C																
1	S24X121.0 50 ft 0 in S610X180 (15.24 m)	5	495222	0.75 0.75	53 365 362	70 484 482	25 24							.06	1.21	.012	.029	.28	.29	.12	.10	.04	.04	.001	.33	.01	.16
2	S24X121.0 50 ft 0 in S610X180 (15.24 m)	1	495224	0.76 0.76	53 54 369	70 70 484 486	24 23							.07	1.23	.015	.026	.24	.30	.13	.13	.04	.04	.001	.34	.01	.16

ELONGATION BASED ON 8.00 INCH GAUGE LENGTH
 $Pcm = C + S/30 + Mn/20 + Cu/20 + Ni/50 + Cr/20 + Mo/15 + V/10 + 5B$ (B=Approx. .0005)
Corrosion Index= $26.01\{ \%Cu\} + 3.88\{ \%Ni\} + 1.2\{ \%Cr\} + 1.49\{ \%Mn\} + 17.28\{ \%P\} - 7.29\{ \%Cu\} \{ \%Ni\} - 9.10\{ \%Ni\} \{ \%P\} - 33.39\{ \%Cu\}^2$
ISO 2001:2015 certified (Registration # 0985-07).

CARBON EQUIVALENT CE= $C + Mn/6 + \{Cr + Mo + V\}/5 + \{Ni + Cu\}/15$
Mercury has not been used in the direct manufacturing of this material.
This material was produced in accordance with the Nucor-Yamato Steel Quality Manual.

All mechanical testing is performed by the Quality Testing Lab, which is independent of the production departments.
The Charpy machine striker geometry used by Nucor-Yamato Steel is the 8 mm (0.315") striker (KV_g) per ASTM A370 Section 22.1.2 and ISO 148-1 Section 7.3.

I hereby certify that the contents of this report are accurate and correct. All test results and operations performed by this material manufacturer are in compliance with the requirements of the material specifications, and when designated by the purchaser, meet the applicable specifications.

Doug Lowell
Chief Metallurgist

State of Arkansas
County of Mississippi
Sworn to and subscribed before me

on 2018-10-04
My commission expires on 07/17/2023

