

Evaluation Report

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Product Manufacturer

Rytec Corporation
One Cedar Parkway
Jackson, WI 53037

Product Series, Model and/or Description

Spiral Rollup Doors
Models SST-HZ and SSN-HZ

Code: Current Edition of the Florida Building Code including the 8th Edition (2023) Florida Building Code

Compliance Methods: Product Approval Rule 61G20-3.005(1)(d) – Product Evaluation Report by a Licensed Professional Engineer

Product Name, Model and/or Designation

- Spiral Rollup Doors, Models SST-HZ and SSN-HZ

Background and Evaluation Scope

Due to supply chain issues, Rytec is finding it challenging to find and purchase galvanized sheet metal for their Hurricane door builds. A substitute carbon steel sheet metal of equivalent gauge and strength properties and finish the material in powder coat paint for Bill of Material Items No. 1 and 2, Side Columns, LH and RH respectively is evaluated in this report.

This substitution also applies to non-BOM itemized components used in assembly but not necessarily related to the wind load resisting components of the door assemblies. The same substitution recommendations for the side columns will also be applied to the non-BOM itemized components including using the same gauge materials.

Rytec's perspective is that this is an improvement as galvanized coating is applied pre-fabrication leaving cuts, punches, and drilled holes with raw edges while powder coating in post fabrication will completely cover of said features.

Therefore, the purpose of this evaluation and subsequent NOA revision request is to revise the Bill of Materials to allow for substitute materials for galvanized carbon steel left and right support columns.

Additionally, we will be revising the NOA drawing BOM to replace the ASTM A446 Galvanized callout with ASTM A653 CS-B G90 as ASTM A446 was replaced by ASTM A653 in 1994.

MD Product Approval (current)

- MD Notice of Acceptance No. 22-0927.11, expiration date 11/8/27 with PTC Product Design Group Drawing No. 9B963_HVHZ, Rev. 10, dated 9/12/22, Spiral Rollup Doors, Models SST-HZ and SSN-HZ, Installation Anchorage Details, signed and sealed by Robert J. Amoruso, P.E., FL No. 49752.

Limitations & Conditions of Use

- This product has been evaluated for use inside the HVHZ (High Velocity Hurricane Zone). This product is Impact Resistance, therefore a protective impact-rated device (i.e., shutter(s)) is not required.
- Refer to Product Installation Instructions noted above for:



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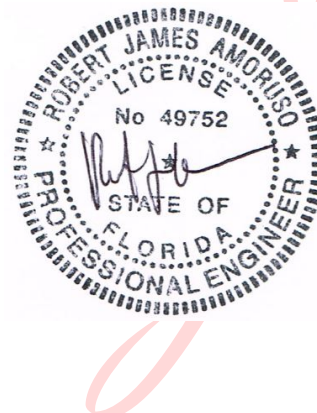
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- Maximum allowable wind loads at related maximum allowable size(s).
- Overall dimensions and material/grade of main product components, accessories, etc.
- Illustrated diagrams of the attachment of the product to the structure.
- Anchor type(s), size(s), substrate(s), embedment, edge distance, and spacing/locations.
- Site wind pressures shall be determined by a licensed professional engineer in accordance with the current edition of the Florida Building Code (and/or ASCE 7 as referenced in the current edition of the Florida Building Code) for components and cladding based on allowable stress design.
- Site conditions not covered in this product evaluation document are subject to additional engineering analysis by a licensed professional engineer or registered architect as required by the authority having jurisdiction.
- Adequacy of the existing structural substrates as a main wind force resisting system capable of withstanding and transferring applied product loads to the foundation is the responsibility of the licensed professional engineer or registered architect acting as the design professional of record for the project of installation.

Certificate of Independence per Product Approval Rule 61G20-3.009

PTC Product Design Group, LLC and Robert J. Amoruso, P.E. does not have, nor will acquire, any financial interest in the company manufacturing or distributing product(s) covered by this Product Evaluation Report.

PTC Product Design Group, LLC and Robert J. Amoruso, P.E. do not have, nor will acquire any financial interest in any other entity involved in the approval process or testing of the product(s) covered by this Product Evaluation Report.



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Robert J
Amoruso

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Evaluated by:
Robert J. Amoruso, P.E.
FL PE License No. 49752



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ASTM A446 Superseded by ASTM A653

References:

- 1) Structure Magazine, August 2007, *Frequently Asked Questions Regarding Cold-Formed Steel*, by Roger A. LaBoube, Ph.D., P.E. (<https://www.structuremag.org/wp-content/uploads/2014/09/SF-FAQ-CFS-Aug071.pdf>)

What ASTM specification should be specified for cold-formed steel studs?

Regarding ASTM specifications, ASTM A446 was replaced by ASTM A653. The relatively new ASTM A1003 was developed specifically for cold-formed steel framing, and provides a common standard for A653, A792, A875 and other materials as a means to simplify the process for the specifier and supplier. Therefore, the appropriate reference for framing members is ASTM A1003; however, materials furnished to A653, A792, and A875 would meet the requirements of the new A1003 standard. Note that the correct reference for steel deck and other coated non-framing member applications is ASTM A653.

- 2) www.matweb.com

The ASTM A446/A446M specification was discontinued in 1994 and replaced with ASTM A653/A653M.

<https://www.matweb.com/search/datasheet.aspx?matguid=472639bb60754114b115d60a0db34659&ckck=1>

- 3) ASTM Website

A446/A446M-93 Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality (Withdrawn 1994)

<https://www.astm.org/jurisdiction-a0511>

- 4) ClarkDietrich Building Systems Data Sheet

ASTM SPECIFICATIONS STEEL SHEET COATED BY THE HOT-DIP PROCESS CONVERSION TABLE - OLD TO NEW ASTM DESIGNATIONS - These changes took effect in 1994

https://www.clarkdietrich.com/sites/default/files/imce/pdf/SupportDocs/Recycle_CoatingInfo/CDBS_ASTM_SteelSheetCoated_Hot-Dip-Process.pdf



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- 5) Viking Materials Inc. (Rytec's material supplier) Test Certificate for ASTM A653-CS-B-G90. See document *Typical ASTM A653 Rytec Order.pdf*.
- 6) Alro Steel (www.alro.com)

A1011 CS Type B Steel Sheet

Properties: A1011/1018 CS TYPE B is typically bought to meet chemistry requirements rather than physical requirements. For that reason, physical properties are generally not provided unless requested prior to production. Any material can be sent to a third party after production to be tested for physical properties.

https://www.alro.com/divsteel/metals_gridpt.aspx?gp=0056&gpn=A1011

[THE ABOVE DOCUMENTS ARE IN THE ADDITIONAL MATERIALS DIRECTORY OF THE CDROM AND ADDITIONAL MATERIALS SECTION OF THE PAPER SUBMITTAL.]

Discussion and Evaluation of ASTM A446 to ASTM A653:

ASTM A446 is not readily available as it has been withdrawn. The references above provide insight of how ASTM A446 material has been substituted by ASTM A653. The Grade #'s for ASTM A653 in Reference 4 above correspond with the yield strength of the material. Hence ASTM A446 Structural Quality Grade 33 is a 33 ksi yield strength material.

ASTM A446 specification did not provide for a Commercial Steel (CS) designation only Structural Steel (SS).

ASTM A653 provides for CS TYPE A, B or C which is typically bought to meet chemistry requirements rather than physical requirements. For that reason, physical properties are generally not provided unless requested prior to production. Any material can be sent to a third party after production to be tested for physical properties. [Reference 6]

To gauge the materials used in testing (TAS 201/202/203) for the (a) original NOA No. 06-1017.07 dated 4/17/06 and test report ETC-06-844-17497.1, (b) NOA No. 10-0913.03 and test report ETC-05-844-16366.0 dated 4/17/06, through the current NOA No. 22-0927.11 and test report ETC-05-844-16366.0 dated 4/17/06; ASTM A446 has been referenced in the drawing BOM.

As ASTM A446 was withdrawn in 1994 and superseded by ASTM A653, testing conducted in 2006; a full 12 years after ASTM A446 was withdrawn; would mean that Rytec would have been using ASTM A653 for testing.

Test report ETC-05-844-16366.0 does not identify the material of the side columns used in testing.



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Discussions with Rytec have confirmed that ASTM A653 CS-B G90 was used in testing and current fabrication.

As such, ASTM A653 CS-B G90 will be the basis of this evaluation going forward.

Discussion and Evaluation of ASTM A653 CS-B G90 Substitution

Commercial steel designations do not have specific minimum mechanical property requirements required by the ASTMs. They have nonmandatory mechanical property ranges.

For this evaluation, ASTM A1011 CS-B will be used. ASTM A1008 was also reviewed and included, the ASTM 1011 will be the chosen substitution with ASTM A1008 CS Type B limited to Yield Strength (Fy) a minimum of 30 ksi as explained below.

ASTM A1011 Mechanical Properties

TABLE 3 Typical Ranges of Mechanical Properties^A
(Nonmandatory)^B
For Hot-Rolled Steel Sheet and Strip Designations CS and DS

Designation	Yield Strength ^C		Elongation in 2 in. [50 mm] % ^C
	ksi	MPa	
CS Types A, B, and C	30 to 50	[205 to 340]	≥ 25
DS Types A and B	30 to 45	[205 to 310]	≥ 28

^A The yield strength tends to increase and the elongation tends to decrease as the sheet thickness decreases. These properties represent those typical of material in the thickness range of 0.100 to 0.150 in. [2.5 to 3.5 mm].

^B The typical mechanical property values presented here are nonmandatory. They are provided to assist the purchaser in specifying a suitable steel for a given application. Values outside these ranges are to be expected.

^C Yield strength and elongation are measured in the longitudinal direction in accordance with Test Methods A 370.

ASTM A1008 Mechanical Properties

TABLE 3 Typical Ranges of Mechanical Properties^A
(Nonmandatory)^B
For Cold Rolled Steel Sheet Designations CS, DS, DDS and EDDS

Designation	Yield Strength ^C		Elongation in 2 in. [50 mm] % ^C	r_m Value ^D	n -Value ^E
	ksi	MPa			
CS Types A, B, and C	20 to 40	[140 to 275]	≥ 30	^F	^F
DS Types A and B	22 to 35	[150 to 240]	≥ 36	1.3 to 1.7	0.17 to 0.22
DDS	17 to 29	[115 to 200]	≥ 38	1.4 to 1.8	0.20 to 0.25
EDDS	15 to 25	[105 to 170]	≥ 40	1.7 to 2.1	0.23 to 0.27

^A These typical mechanical properties apply to the full range of steel sheet thicknesses. The yield strength tends to increase, the elongation decreases and some of the formability values tend to decrease as the sheet thickness decreases.

^B The typical mechanical property values presented here are nonmandatory. They are provided to assist the purchaser in specifying a suitable steel for a given application. Values outside of these ranges are to be expected.

^C Yield Strength and elongation are measured in the longitudinal direction in accordance with Test Methods A 370.

^D Average plastic strain ratio (r_m value) as determined by Test Method E 517.

^E The strain hardening exponent (n -value) as determined by Test Method E 646.

^F No typical properties have been established.



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ASTM A1008 Mechanical Properties

TABLE 4 Mechanical Property Requirements^A
For Cold Rolled Steel Sheet Designations SS, HSLAS, and HSLAS-F

Designation	Yield Strength, min		Tensile Strength, min		Elongation in 2 in. or 50 mm, min, %
	ksi	[MPa]	ksi	[MPa]	
SS:					
Grade 25 [170]	25	[170]	42	[290]	26
Grade 30 [205]	30	[205]	45	[310]	24
Grade 33 [230] Types 1 and 2	33	[230]	48	[330]	22
Grade 40 [275] Types 1 and 2	40	[275]	52	[360]	20
Grade 80 [550]	80 [#]	[550]	82	[565]	^c

ASTM A653 Mechanical Properties (steel A1008 and A1011 is being compared to)

TABLE 5 Typical Ranges of Mechanical Properties^{A, B} (Nonmandatory)

Designation	(Longitudinal Direction)		Elongation in 2 in. [50 mm], %	r_m Value ^C	n Value ^D
	Yield Strength				
	ksi	[MPa]			
CS Type A	25/55	[170/380]	≥20	E	E
CS Type B	30/55	[205/380]	≥20	E	E
CS Type C	25/60	[170/410]	≥15	E	E
FS Types A and B	25/45	[170/310]	≥26	1.0/1.4	0.17/0.21
DDS Type A	20/35	[140/240]	≥32	1.4/1.8	0.19/0.24
DDS Type C	25/40	[170/280]	≥32	1.2/1.8	0.17/0.24
EDDS ^F	15/25	[105/170]	≥40	1.6/2.1	0.22/0.27

^AThe typical mechanical property values presented here are nonmandatory. They are intended solely to provide the purchaser with as much information as possible to make an informed decision on the steel to be specified. Values outside of these ranges are to be expected. The purchaser may negotiate with the supplier if a specific range or a more restrictive range is required for the application.

^BThese typical mechanical properties apply to the full range of steel sheet thicknesses. The yield strength tends to increase and some of the formability values tend to decrease as the sheet thickness decreases.

^C r_m Value—Average plastic strain ratio as determined by Test Method E517.

^D n Value—Strain-hardening exponent as determined by Test Method E646.

^ENo typical mechanical properties have been established.

^FEDDS Sheet will be free from changes in mechanical properties over time, that is, nonaging.



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ASTM A653 vs. Substitute Material Comparison Chart

				ASTM Typical Nonmandatory Ranges of Mechanical Properties				
	Steel Description	Ordered Min 11 Gauge	Gauge with Galvanization	Specification	Yield Strength (ksi)	Yield Strength (ksi) Average	Ultimate Strength (ksi)	Elongation in 2 in. %
Substitute Material	Hot-Rolled, P&O, Commercial Steel	.114"	n/a	ASTM A1011 CS Type B	30/50	40	n/a	25%
	Cold Rolled Commercial Steel	.114"	n/a	ASTM A1008 CS Type B	20/40	30	n/a	30%
	Cold Rolled Commercial Steel	.114"	n/a	ASTM A1008 CS Type B (Fy = 30 ksi)	30	30	n/a	30%
	Cold Rolled Commercial Steel	.114"	n/a	ASTM A1008 CS GR 30	30	30	45	24%
	Cold Rolled Commercial Steel	.114"	n/a	ASTM A1008 CS GR 40	40	40	52	20%
Tested Material	Galvanized Commercial Steel	Range 0.1116" to 0.1276" ----- Average 0.1196"	Range 0.1143" to 0.1323" ----- Average 0.1233"	ASTM A653 CS Type B G90	30/55	42.5	n/a	20%



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As noted in the table above, ASTM A653 CS-B has an average Yield Strength of 42.5 ksi, ASTM A1011 CS-B has an average Yield Strength of 40 ksi and ASTM A1008 CS-B has an average Yield Strength of 30 ksi.

The table below demonstrates the overlapping of the yield strengths. Note that ASTM A1011 vs. ASTM A653 overlaps more than ASTM A1008 vs. ASTM A653. To accommodate selection options, ASTM A1008 options will be expanded to include Structural Steel (SS) and well as limiting A1008 CS Type B to the minimum Yield Strength of 30 ksi.

Material	Yield Strength (ksi)								Yield Strength Basis
	20	25	30	35	40	45	50	55	
ASTM A1011 CS Type B									ASTM A1011, Table 3
ASTM A1008 CS Type B									ASTM A1008, Table 3
ASTM A1008 CS Type B (Fy = 30 ksi)									ASTM A1008, Min. Yield Strength specified in ordering.
ASTM A1008 CS GR 30									ASTM A1008, Table 4
ASTM A1008 CS GR 40									ASTM A1008, Table 4
ASTM A653 CS Type B G90									ASTM A653, Table 5



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Next consider the % change in Yield Strength high-to-low average and lowest using the following formula.

$$\% \text{ change} = 100 \times \frac{(\text{final} - \text{initial})}{|\text{initial}|}$$

Comparison of ASTM A653 to Proposed Substitute Material % Change in Average Yield Strength (ksi)					
From	To	Initial Value (ASTM A653)	Average Final Value (Substitute Material)	Yield Strength % Change	Yield Strength Difference (ksi)
ASTM A653 CS Type B G90	ASTM A1011 CS Type B	42.5	40	-5.88	-2.5
ASTM A653 CS Type B G90	ASTM A1008 CS Type B	42.5	30	-29.41	-12.5
ASTM A653 CS Type B G90	ASTM A1008 CS Type B (Fy = 30 ksi)	42.5	30	-29.41	-12.5
ASTM A653 CS Type B G90	ASTM A1008 CS GR 40	42.5	40	-5.88	-2.5



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Comparison of ASTM A653 to Proposed Substitute Material % Change in Lowest Yield Strength (ksi)					
From	To	Initial Value (ASTM A653)	Lowest Final Value (Substitute Material)	Yield Strength % Change	Yield Strength Difference (ksi)
ASTM A653 CS Type B G90	ASTM A1011 CS Type B	30	30	0.00	0
ASTM A653 CS Type B G90	ASTM A1008 CS Type B	30	20	-33.33	-10
ASTM A653 CS Type B G90	ASTM A1008 CS Type B (Fy = 30 ksi)	30	30	0.00	0
ASTM A653 CS Type B G90	ASTM A1008 CS GR 40	30	40	33.33	10

Basing the comparisons on the average Yield Strength discussed above, going from ASTM A653 to A1011 presents a theoretical reduction of < 6%. Whereas, going from ASTM A653 to ASTM A1008 presents a theoretical reduction of almost 30%. To accommodate usage of ASTM A1008, a CS Type B will be limited to a Fy $\geq$ 30 ksi; or to a Grade 30 or Grade 40.

Using the lowest Yield Strength in the Typical Range, going from ASTM A653 to A1011 presents a theoretical reduction of 0%. Whereas, going from ASTM A653 to ASTM A1008 presents a theoretical reduction of almost 34%. Again, to accommodate usage of ASTM A1008, a CS Type B will be limited to a Fy $\geq$ 30 ksi; or to a Grade 30 or Grade 40.

Additionally shown in the overlapping table/graph above, ASTM A1011 overlaps the full range of ASTM A653 Yield Strength except for the highest end >50 ksi. Considering that ASTM A653 CS Type B mechanical properties will generally never meet a Yield Strength at that high a level, ASTM A1011 CS Type B can be considered an acceptable alternative to ASTM A653 CS Type B.

Furthermore, allowing ASTM A1008 CS Type B (Fy $\geq$ 30 ksi) or Grade 30 or Grade 40 will maintain equivalence with the original tested material.



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Discussion ASTM A653 CS-B G90 Galvanization

References:

- 1) The Influence of Hot-Dip Galvanizing on the Mechanical Properties of High-Strength Steels, by Milan Šmak,* Jaroslav Kubíček, Jiří Kala, Kamil Podaný, and Jan Vaněrek

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8467660/>

The above article indicates that in the case of high strength steels, the yield strength decreased by up to 18%, the tensile strength by up to 13%, and the hardness by up to 55%.

- 2) Study of the Mechanical Properties of the Hot Dip Galvanized Steel and Galvalume

<https://www.scielo.br/j/jbsmse/a/NcWxhsMGgmr3LphpsRZgVkf/?lang=en&format=pdf>

This study generally concluded that “The steel sheets coated either with zinc or 55%Al-Zn alloy showed lower specific yield and tensile strengths compared to the stripped sheets.”

For stripped tensile tests, the coating was removed

Reference 2 indicates in general, a zinc coated (galvanized) steel will yield lower mechanical properties.

Reference 1 indicated the same in the case of high-strength steels. ASTM A653 CS Type B is not considered a high strength steel, therefore if any changes to material strength occurred, it was a reduction in strength due to the galvanization process.

From my research, it appears that galvanization mostly affects the mechanical properties of high-strength steels by reducing them.

As such, we can expect that ASTM A653 CS Type B with G90 galvanization will yield the same or somewhat lower mechanical properties. The important consideration is that the G90 is not increasing the mechanical properties.

Conclusions

- ASTM A1008 (when limited to minimum yield strength of 30 ksi) and ASTM A1011 provide an acceptable alternative to the ASTM A653 CS Type B G90 used in testing.
- ASTM A446 originally specified in the first NOA of this product appears to be in error as ASTM A446 was superseded by ASTM A653 in 1994.
- Galvanized metals generally do not exhibit an increase in mechanical properties.

Based on the forgoing evaluation, it is proposed that the following changes be made to the NOA Drawing BOM table to allow for substitute materials as well as correcting the originally tested material designation. See next section below.



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Proposed Drawing BILL OF MATERIALS Revision

BILL OF MATERIAL - CURRENT			
Item No.	Description	QTY	Material
1	Side Column, LH	1	Galvanized Steel, ASTM A446
2	Side Column, RH	1	Galvanized Steel, ASTM A446

BILL OF MATERIAL - PROPOSED			
Item No.	Description	QTY	Material
1	Side Column, LH	1	Galvanized Steel, ASTM A653 CS Type B G90
			Powder Coated, ASTM A1011 CS Type B
			Powder Coated, ASTM A1008 CS Type B (Fy = 30 ksi)
			Powder Coated, ASTM A1008 CS GR 30
			Powder Coated, ASTM A1008 CS GR 40
2	Side Column, RH	2	Galvanized Steel, ASTM A653 CS Type B G90
			Powder Coated, ASTM A1011 CS Type B
			Powder Coated, ASTM A1008 CS Type B (Fy = 30 ksi)
			Powder Coated, ASTM A1008 CS GR 30
			Powder Coated, ASTM A1008 CS GR 40

