NEW ASTM A1085

Information Packet

- New specification was developed by the HSS industry in conjunction with AISC (American Institure of Steel Construction.
- Was developed to address performance issues related to HSS used in seismic and bridge applications.
- Will make HSS more economical and efficient and especially for bridge and seismic design.

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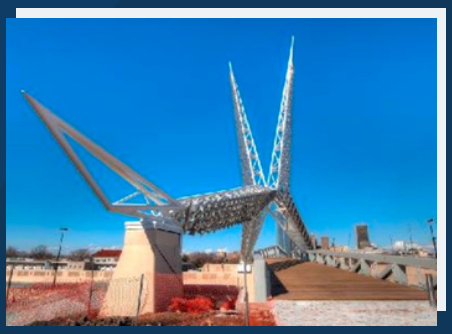
New ASTM A1085 Specification - Why?

Seismic Applications

- About half of the buildings designed and constructed in North America have some level of seismic design requirements.
- In North America, HSS are commonly used as bracing members in braced frames in seismic zones.
- Researchers are looking for more ways to use the advantages of HSS in building design

Dynamic Applications

- Vehicle and pedestrian bridges are governed by AASHTO.
- ASTM A709 has Charpy requirements
- HSS becoming more popular for bridges in US
- The AWS (American Welding Society) has recently formed a Tubular Task Group to develop a document for tubular bridge connections that is suitable for use by AASHTO. Provisions are to be tailored for use in welded tubular bridges.



Seismic Design Has Evolved

- 1994 Northridge, CA earthquake - spurred 10 years of research. ASTM A992 was developed in response to failures observed.
- Capacity Design – Steel members and associated connections are designed for member capacity rather than just the applied loads.
- Seismic designs now take into account variability of material properties.
- Over-strength factors (based on that variability) are applied to ensure ductile failures.

Required strength of members and connections is based on the expected yield and expected tensile stress:

Ry*Fy
Rt*Fu

ASTM A992 Ry= 1.1 Rt= 1.1
ASTM A500 Ry= 1.4 Rt= 1.3
ASTM A52 Ry= 1.6 Rt= 1.2

Up to 40% increase of design force for A500 HSS

Impact: Higher design force leads to larger, more expensive connections nd to increaser sizes of column and beam sections in steel frame. This leads to more cost associated with using HSS bracing members versus other types of steel sections.

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HSS Mechanical Properties

- Current HSS and pipe specs only specify minimum yield strength
- Maximum yield strength is required to lessen variability of material strength and lower over strength factors (Ry & Rt)

	Square, Rect & Round HSS - CSA G40	
	Grade 50W	
Yield Strength, min (ksi)	50	
Tensile Strength (ksi)	65 - 90	
Elongation in 2 in, min %	22	
	Square & Rect HSS - ASTM A500	
	Grade B	**Grade C**
Yield Strength, min (ksi)	46	50
Tensile Strength (ksi)	58	62
Elongation in 2 in, min %	23	21
	Round HSS - ASTM A500	
	Grade B	**Grade C**
Yield Strength, min (ksi)	42	46
Tensile Strength (ksi)	58	62
Elongation in 2 in, min %	23	21
	Round Pipe - ASTM A53	
	Grade B	
Yield Strength, min (ksi)	35	
Tensile Strength (ksi)	60	
Elongation in 2 in, min %	Varies	

Bridge Design

- CVN - Charpy V-Notch
  - High strain rate test
  - Measures amount of absorbed energy during fracture
  - Indicates material's toughness
  - Tool to study material's temperature dependent ductile-brittle transition
- AASHTO requires CVN of 25 ft-lb @40°F
- Some DOT design manuals do not allow A500 to be used, unless the min CVN requirements are met
- CVN's are also required for seismic design

Corner Radii

ASTM A500

- Outside corner radius not to exceed 3t
- No lower limit

Too tight of radius can lead to micro-cracking in the corners.

Cracking can lead to explosive release of residual stresses during operations such as welding or glavanizing

Tolerances

ASTM A500 Wall Tolerances

- +/- 10% on normal thickness

AISC 360 Specification for Structural Steel Buildings

- Requires design thickness for A500 HSS to be 0.93*nominal wall thickness

CISC Handbook of Steel Construction

- Requires design thickness for A500 HSS to be 0.90*nominal wall thickness

Net Result: Not able to fully utilize cross-sectional properties of A500 material, which diminishes economy of HSS

New ASTM A1085 Spec

- Note 1: "Products manufactured to this specification may not be suitable for those applications such as dynamically loaded elements in welded structures, etc., where low-temperature notch-toughness properties may be important."
- No Charpy impact requirenent
- Multiple grades with varying yield strengths based on shape
- No maximum yield stress
- Thickness tolerance of +/- 10%

Current ASTM A500 Spec

- Charpy impact test requirements added : 25 ft-lbs at 40°F
- Single yield strength of 50 ksi
- Yield strength range of 50-70 ksi : Only HSS specification in world to have a cap on yield strength
- Wall thickness tolerance tightened to -5%/+10%
- Mass tolerance of -3.5%/+10% added
- Supplement for heat treatment
- Revised corner radii to reduce corner cracking
- New chemistry to aid galvanizing, yield range and CVN

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HSS Spec Comparison Chart

	Yield Strength ksi	Tensile Strength ksi, min	Elongation %, min	CVN	Tolerance (Wall Thickness)	Tolerance (Mass)	Corner Radius
A500 GRADE B	Rnd min 42 Sq/Rec min 46 No Max	58 No Max	23	NA	-10% +10%	NA	3t Max
A500 GRADE C	Rnd min 46 Sq/Rec min 50 No Max	62 No Max	21	NA	-10% +10%	NA	3t Max
CSA G40 B	Min 50 NO Max	65-90	22	Cat 1: 20 ft-lb @ 32°F Cat 2: 20 ft-lb @ 0°F	-5% +5%	-3.5% +10%	<6x6x.5 Varies (2t-4t) >6x6x.5 3t max
A53 GRADE B	Min 35 No Max	60	-	NA	-12.5%	-10%	NA
API 5L PSL X52N	Min 52 No Max	67	-	20 ft-lb @ 32°F	-10% 1/4" <t<5/8"	-3.5% regular plain end	NA
EN101210 S355J2H	Min 51.5 for t<5/8" No Max	68	22	20 ft-lb @ 0°F	-10%	-6%	3t Max
EN10219 S35J2H	Min 51.5 for t<5/8" No Max	68	20	20 ft-lb @ 0°F	-10% t≤1/4" - 0.02" t≥ 1/4" & D≤16"	-6%	t<1/4" 1.6t-2.4t 1/4" <t<3/8" 2t-3t t>3/8" 2.4-3.6t
ASTM A1085	**50 min 70 max**	**65**	**21**	**25 ft-lb @ 40°F**	**-5% +10%**	**-3.5% +10%**	**t<.4" 1.6t - 3.0t t>.4" 1.8t - 3.0t**

ASTM A1085 - Benefits/Talking Points

Minimum and Maximum values for Yield Stress - expected for seismic design
Will hopefully result in lower Ry, which will make HSS a more economical choice for bracing members. If the upper yield stress in not controlled then it makes it difficult to pick HSS for energy-dissipating elements

Minimum Charpy notch toughness - expected for all dynamically loaded structures. The minimum requirements of AASHTO will be met.

Tighter thickness and mass tolerances - this will enable the 0.93t design thickness in the US and .90t in Canada to be abolished. Using nominal thickness as design thickness will increase HSS column capacity, making them more economical

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