WELCOME

UNDERSTANDING HSS SPECIFICATIONS

CLEARCALCS WEBINAR

Atlas Tube
A DIVISION OF ZEKELMAN INDUSTRIES

11.15.23

INDUSTRY LEADER

ATLAS TUBE

Largest size range in North Am

0.5”–22” square, up to 1.0” wall

0.084” – 28” round, up to 1.0” w

Shortest rolling cycle in the indu

2 – 3 weeks for common sizes

Able to roll **custom lengths** to mi

Rolled lengths up to 135 ft. for r

Seven production facilities in Nort

Leading producer of ASTM A500, A1085

In-House Heat Treating

Leading producer of CSA Class

Products stocked by service cent

HSS AVAILABILITY CHART – SQUARES

OD	NOMINAL WALL THICKNESS															
in.	.065	.083	.100	.120	.125	.134	.188	.238	.250	.313	.375	.500	.625	.750	.875	1.000
0.5 x 0.5	0.335	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
0.75 x 0.75	0.605	0.765	–	1.028	–	–	–	–	–	–	–	–	–	–	–	–
1 x 1	0.827	1.035	1.160	1.437	1.488	–	–	–	–	–	–	–	–	–	–	–
1.25 x 1.25	1.048	1.317	1.490	1.845	1.912	–	–	–	–	–	–	–	–	–	–	–
1.5 x 1.5	1.270	1.600	1.820	2.252	2.200	2.687	3.060	–	4.250	–	–	–	–	–	–	–
2 x 2	1.712	2.164	2.580	3.068	3.060	3.801	4.320	–	5.410	–	–	–	–	–	–	–
2.125 x 2.125	–	–	–	–	3.266	3.874	4.647	–	–	–	–	–	–	–	–	–
2.5 x 2.5	–	2.630	–	3.760	3.900	4.372	5.500	6.830	7.110	8.460	–	–	–	–	–	–
3 x 3	–	–	–	4.580	4.750	5.222	6.970	8.665	8.810	10.580	12.370	–	–	–	–	–
3.5 x 3.5	–	–	–	5.520	5.630	5.980	8.150	10.070	10.510	12.700	14.720	–	–	–	–	–
4 x 4	–	–	–	6.530	6.460	6.880	9.420	–	12.210	14.830	17.270	21.630	–	–	–	–
4.5 x 4.5	–	–	–	–	7.310	7.810	10.700	–	13.910	16.960	19.820	24.630	–	–	–	–
5 x 5	–	–	–	–	8.160	8.720	11.970	–	15.620	19.080	22.370	28.630	–	–	–	–
6 x 6	–	–	–	–	9.860	–	14.530	–	19.030	23.334	27.480	35.240	42.330	–	–	–
7 x 7	–	–	–	–	–	–	17.080	–	22.420	27.590	32.580	42.050	50.870	–	–	–
8 x 8	–	–	–	–	–	–	19.630	–	25.820	31.840	37.690	48.860	59.320	–	–	–
9 x 9	–	–	–	–	–	–	22.180	–	29.230	36.100	42.790	55.660	67.820	–	–	–
10 x 10	–	–	–	–	–	–	24.730	–	32.630	40.350	47.900	62.460	76.330	88.500	–	–
12 x 12	–	–	–	–	–	–	–	–	38.430	48.860	58.100	76.070	93.360	109.180	125.790	–
14 x 14	–	–	–	–	–	–	–	–	–	57.360	68.310	89.680	110.160	130.530	149.620	168.180
16 x 16	–	–	–	–	–	–	–	–	–	65.870	78.520	103.300	127.370	150.750	173.450	195.400
18 x 18	–	–	–	–	–	–	–	–	–	–	88.730	116.910	144.290	171.360	197.260	222.630
20 x 20	–	–	–	–	–	–	–	–	–	–	98.940	130.520	161.400	191.580	221.060	249.850
22 x 22	–	–	–	–	–	–	–	–	–	–	–	144.130	178.430	212.000	244.900	277.070

Rolled every 2-6 weeks.
Rolled every 6-12 weeks; some sizes may be subject to accumulation.
Not rolled regularly; sizes subject to minimum orders. Inquire.

Includes ASTM A513, ASTM A1085, ASTM A500, ASTM A252 and CSA G40. Please contact Atlas Tube for additional details on specifications or if the size you are looking for is not listed.
For rectangular sections, the weld seam is located on the first dimension listed for each size.

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STATE-OF-THE-ART MANUFACTURING

Atlas Tube
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Blytheville, Arkansas

OUR NEWEST MILL

Centrally located in the heart of the nation, our newest facility is a tech-forward marvel, the result of decades of experience in the industry always searching for new ways to optimize production and find efficiencies for customers.

- Over half a million square feet
- Largest ERW tube mill in the world
- Rolling the biggest hollow sections available in North America

HIGH-TECH HSS

- New welding technology allows 1"-thick sections
- Fully automated warehouse makes inventory management a cinch
- Quick-change tech enables roller and stand change-out in under 60 minutes

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NEW JUMBO HSS

Atlas Tube Jumbo HSS — rolled in our new mill in Blytheville, Arkansas. Build taller and wider, with all the HSS weight and efficiency advantages.

The largest HSS made anywhere in the world

- Squares up to 22" x 1" wall
- Rectangles up to 34" x 10" x 1" wall
- Rounds up to 28" OD x 1" wall

SPECIFICATIONS

ASTM A500 | ASTM A1085 | CSA G40

APPLICATIONS

Bridges | Warehouses & Distribution Centers | Airports

Multistory Buildings | Stadiums

DOT Signs & Bridges | And More

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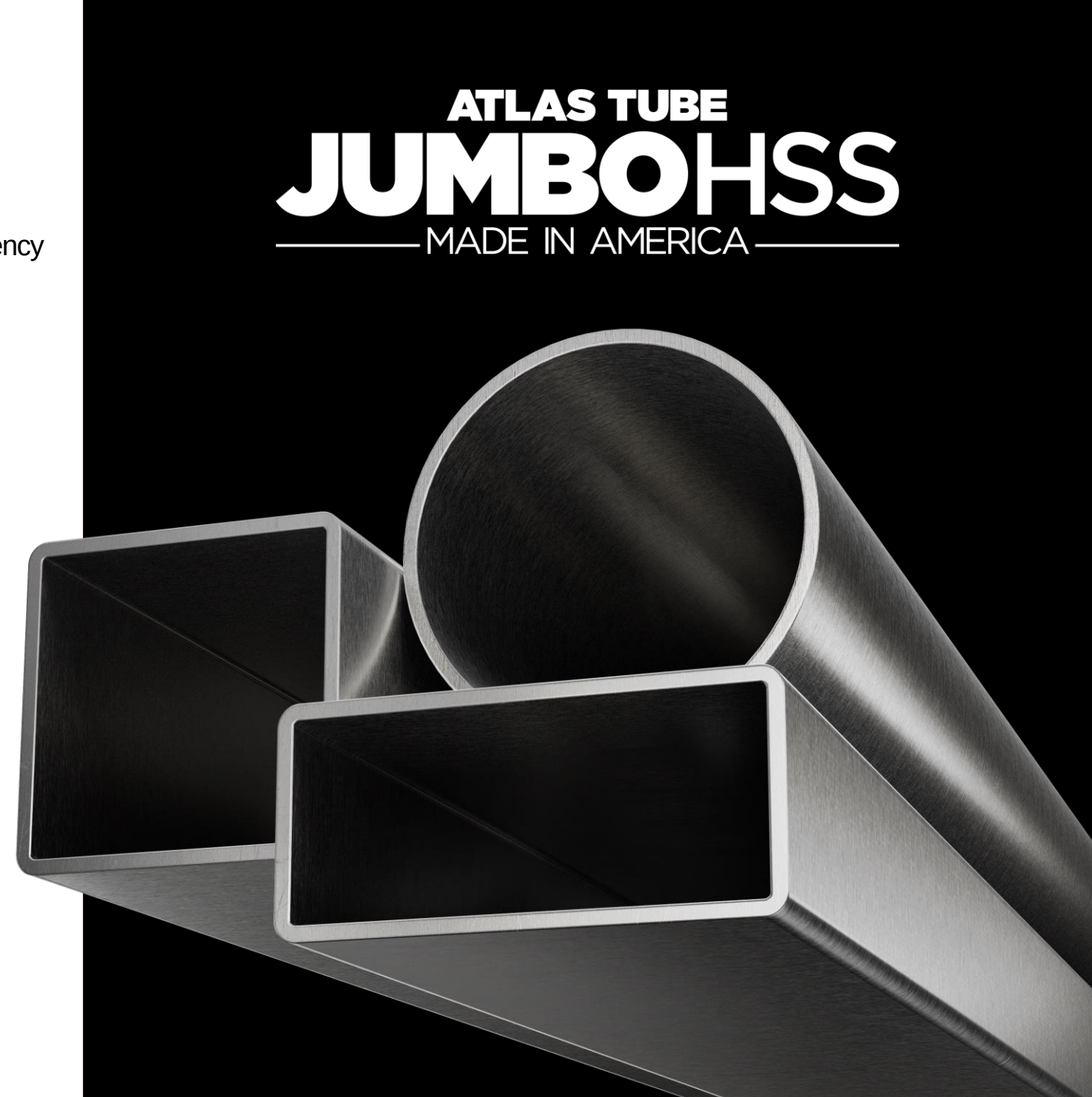


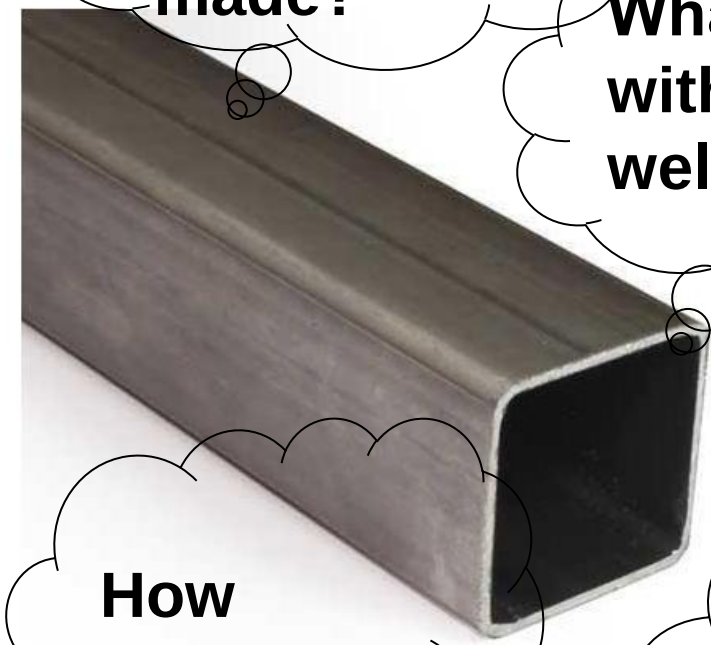
ASTM UPDATE

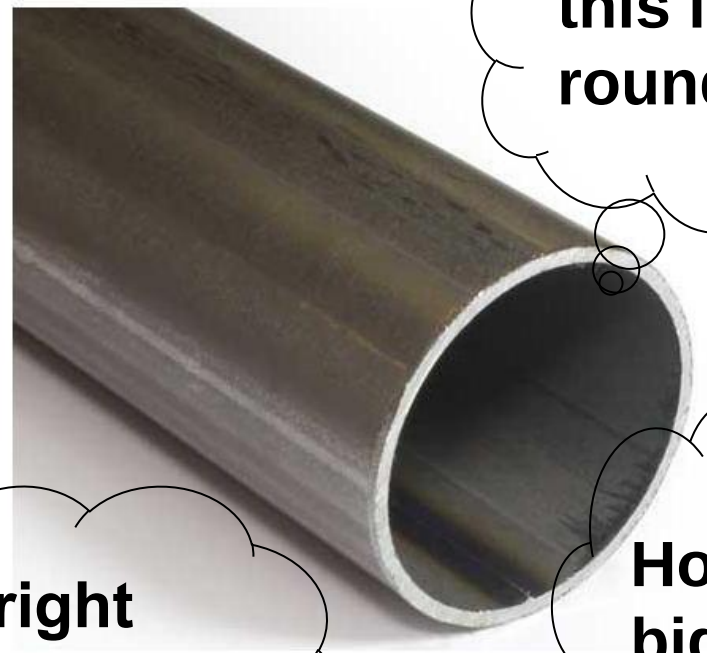
A500 (2021) – All shapes have same min Fy

TABLE 2 Tensile Requirements

Round, Square, Rectangular, and Special Tubular Shapes			
	Grade B	Grade C	Grade D
Tensile strength, min, psi [MPa]	58 000 [400]	62 000 [425]	58 000 [400]
Yield strength, min, psi [MPa]	46 000 [315]	50 000 [345]	36 000 [250]
Elongation in 2 in. [50 mm], min, %[C]	23[A]	21[B]	23[A]

LEARNING OBJECTIVES





What is this? How is it made?

What's up with the weld?

Can I get this in round?

How strong is it?

What's the right specification? Does spec matter?

How big can I get it?

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WHAT ARE HSS?
WHY ARE HSS USED?

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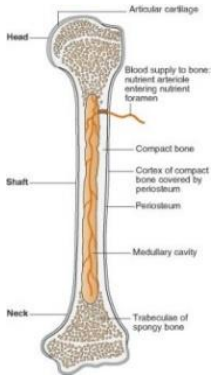
THE USE OF TUBULAR SHAPES IS EXTREMELY POPULAR WITH ENGINEERS AND NATURE

Tube-like structures are naturally occurring

Bones of animals

Bamboo

Stems of flowers



Hollow structural sections are cold-formed, welded steel tube used for welded or bolted construction of buildings, bridges, and other structures and a wide variety of manufactured products.

Hollow structural sections are produced in square, round, and rectangular shapes to meet structural design requirements.

HSS are the same as TS or ST

WHY ARE HSS USED?

HSS ADVANTAGES

ECONOMICAL

HSS deliver exceptional torsional resistance and compressive strength, but they also have less surface area than open sections and can weigh less in many applications, reducing the amount of steel making your building greener and reducing project costs.

AESTHETICS

HSS are favored architecturally because of their smooth sides, rounded corners and closed sections making them an ideal choice when exposing the structure is desired.

VARIETY

Comes in a wide range of shapes and sizes: square, rectangular, and round.

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HSS ADVANTAGES

MORE STRENGTH, LESS STEEL

HSS offer excellent strength-to-weight ratios, allowing for greater axial capacity, more efficient utilization of the cross section and longer unbraced spans. That means they provide exceptional structural support, often with less total steel required to do the job. Less surface area decreases finishing costs.

HIGH TORSION RESISTANCE

HSS deliver exceptional torsion resistance, 200 times greater than that of traditional W or H sections. That makes them an ideal choice for curved members, edge members that support seismic loads and any other designs with high torsional loads.

SPEED AND FLEXIBILITY

Atlas Tube's six facilities have the shortest cycle times and fastest order turnaround in the industry. We roll more than 1.2 million tons a year at our strategically located plants in Arkansas, Illinois, Alabama, Michigan and Ontario, Canada.

HOLLOW SECTIONS MADE TO ORDER

To minimize cost, waste and lost time, Atlas Tube can deliver product prepared to your specifications and ready for use upon delivery. A wide variety of services are available, including custom lengths, ID flash removal, specialty steel chemistries, and thermal stress relief.

UNBRACED LENGTH

Unbraced length is the distance between bracing points of a member

- For columns, this is generally the distance between floor framing

Unbraced length has a direct impact on the vertical load carrying capacity of a column

For columns of the same cross-sectional area, a short column will carry more load than a long column

- Capacity of short columns is controlled more by the load carrying area of the column
- Capacity of longer columns is controlled more by its slenderness (i.e., its tendency to buckle, or bend out of plane)

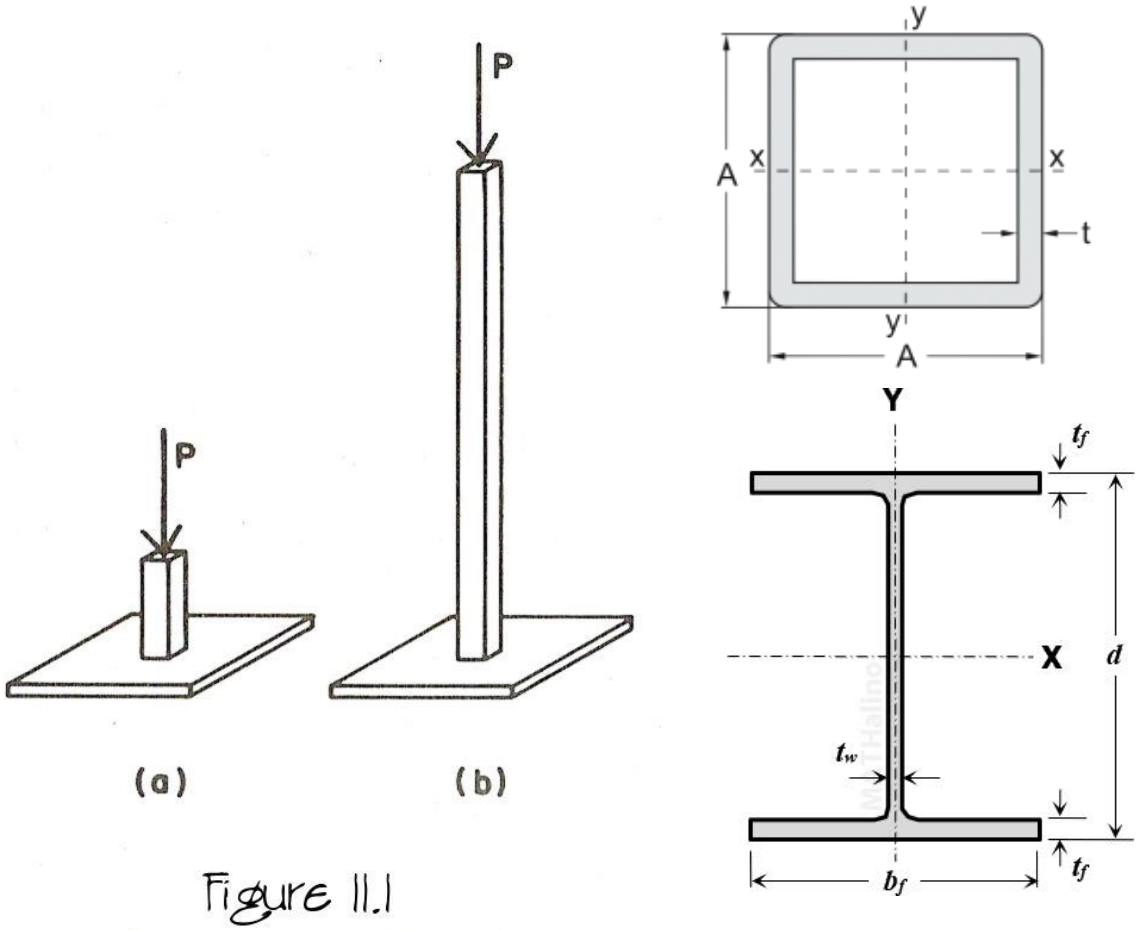
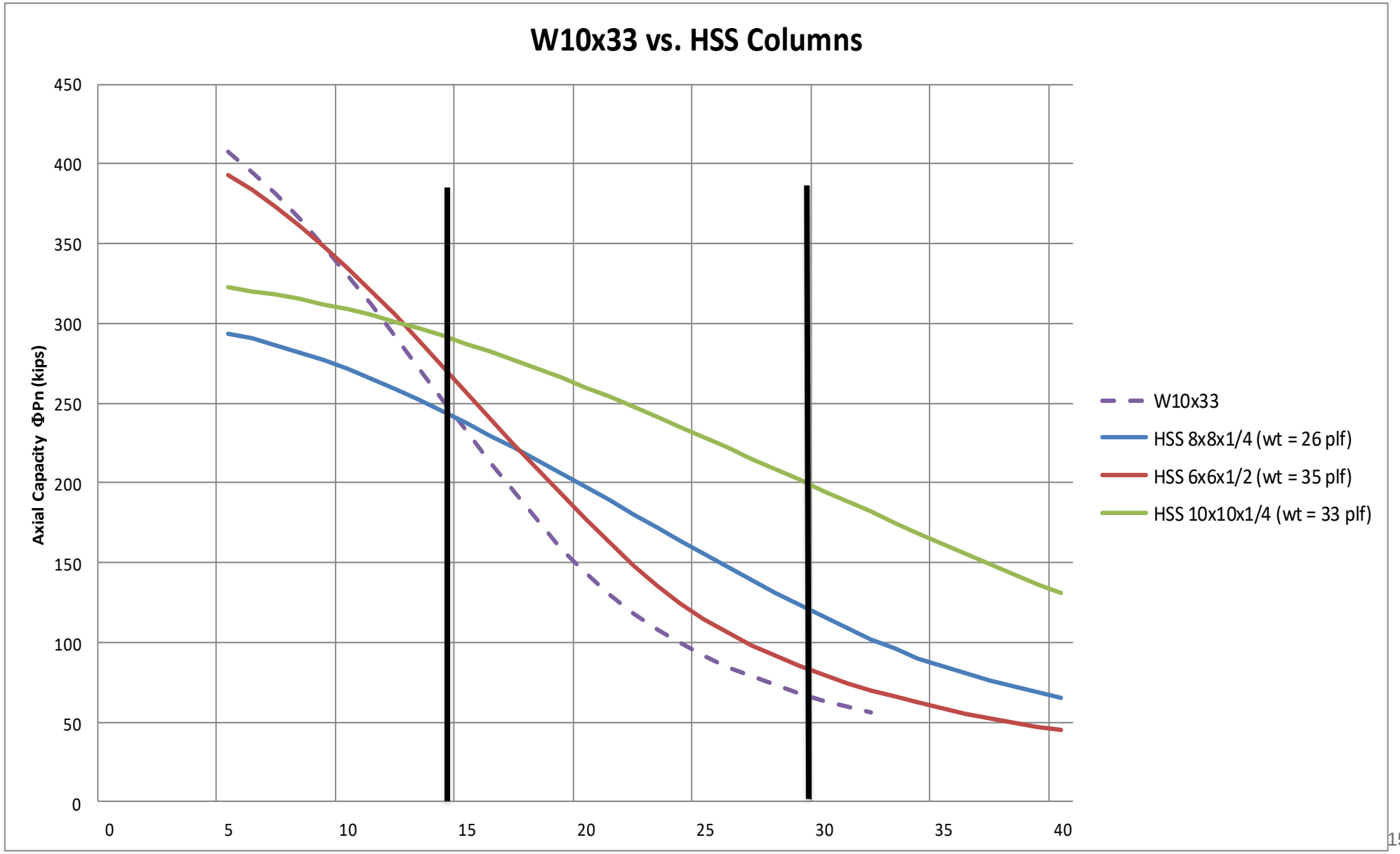


Figure 11.1

UNBRACED LENGTH



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HOW ARE HSS MADE?

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Production Processes

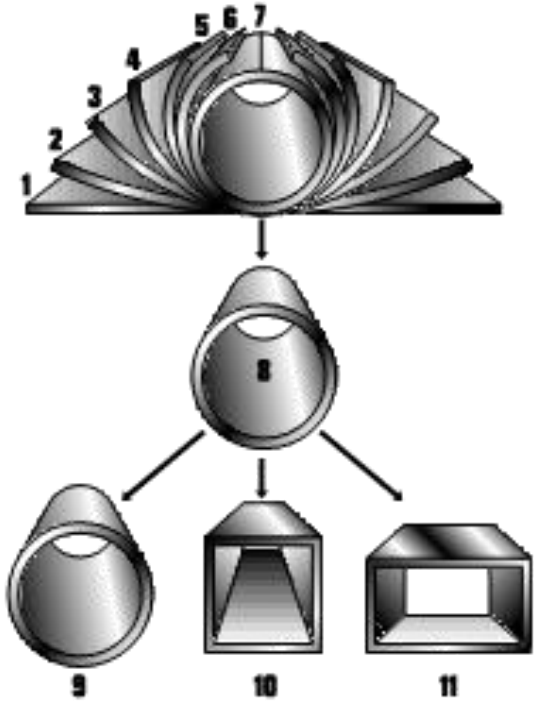
Welded Processes

Electric Resistance Welding (ERW), Electric Fusion Welding (EFW), High Frequency Welding (HFW)

Straight Single Seam Weld

Weld Round Form Square (Most Common)

Weld Square Form Square (Direct Form)

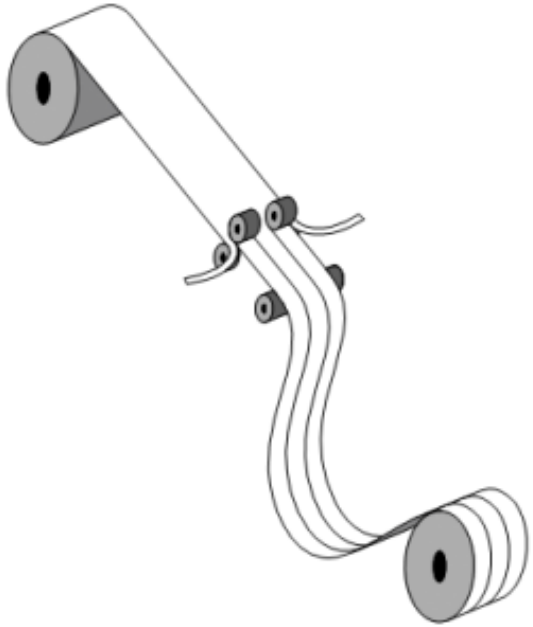


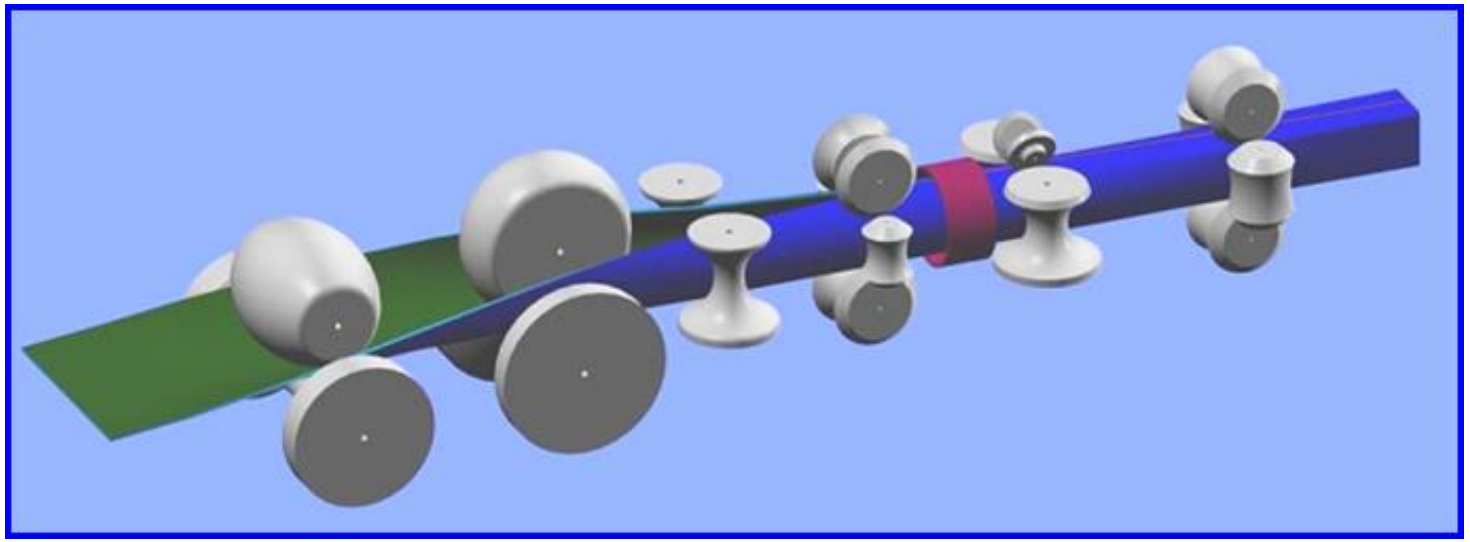
HSS ERW PRODUCTION PROCESS

Hot-Rolled Coil (HRC) manufactured to either EAF or BOF process

Coil slit to proper width for desired HSS size

Cut strip passes through a series of rolls that progressively cold form it into a round tubular form





HSS ERW PRODUCTION PROCESS

Round tube passes through an electric resistance welder (ERW) using high frequency induction (HFI)

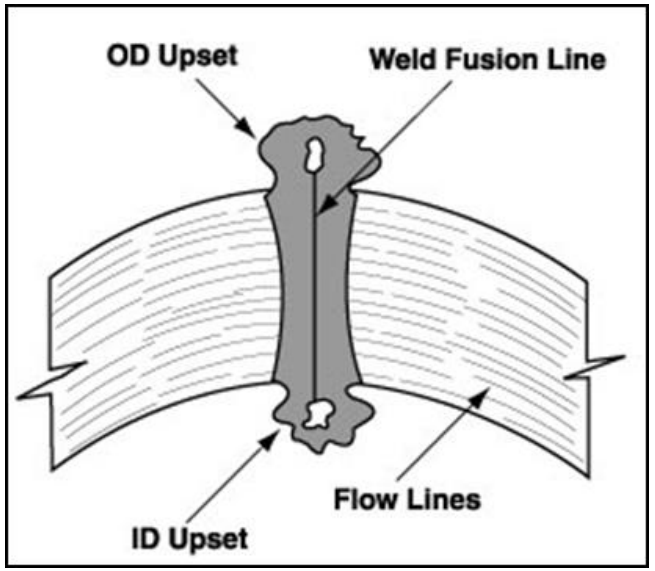
Tube is cooled and processed through a set of sizing/shaping rolls which cold form it into its final round, square or rectangular shape

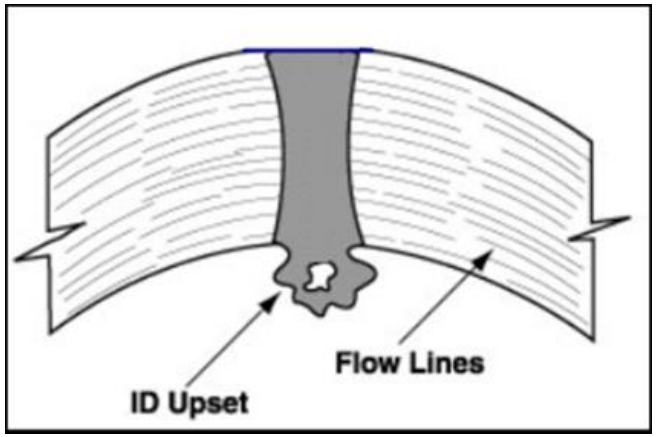
Tube is cut to final mill length

HSS ERW PRODUCTION PROCESS

An integral part of obtaining a sound weld is to ensure the strip edges are prepared properly prior to welding

Burnish the strip edges to clean them for welding
Bevel edges to the proper angle
High Frequency Induction (HFI): low voltage, high current with pressure; uses no consumables in welding process
Achieve an even amount of extrusion (squeeze out) without mismatch
Ensure that enough molten metal is extruded out of top and bottom of joint
Proper alignment and pressure produces a high integrity metallurgical bond



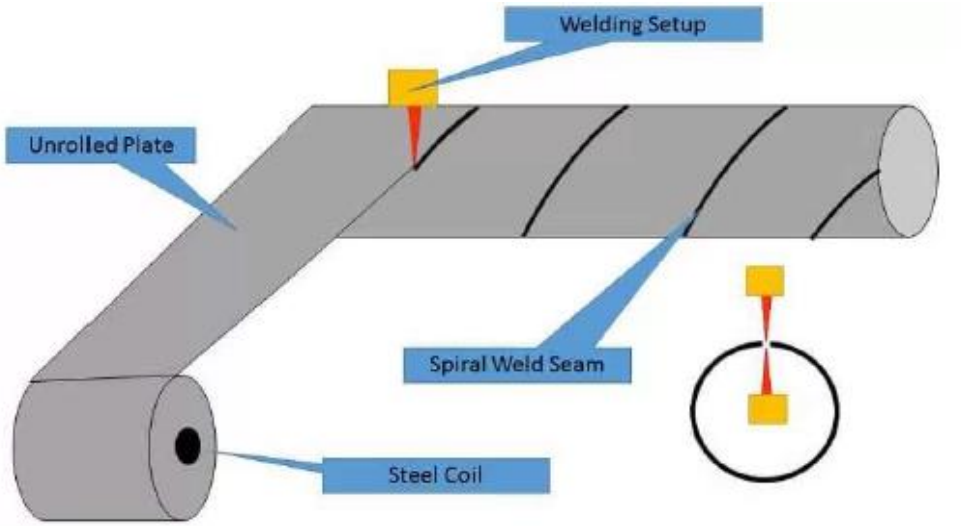


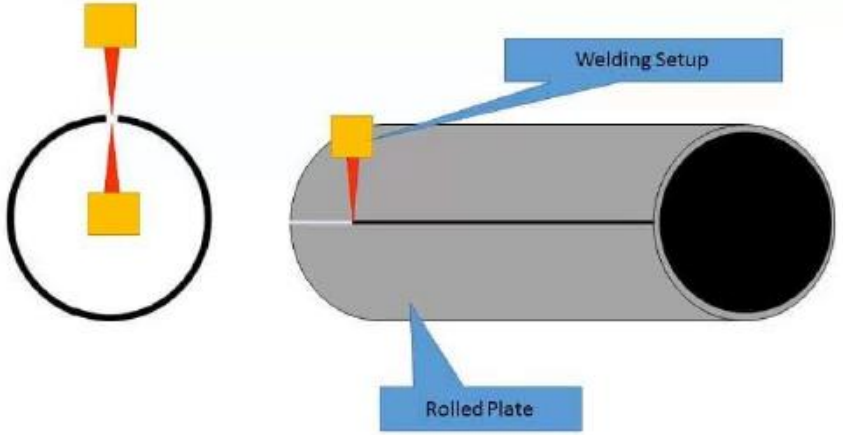
Production Processes

Welded Processes

Submerged Arc Welding (SAW)

- Double Straight Seam Welds
- Spiral Weld
- Large Fabricated Pipes

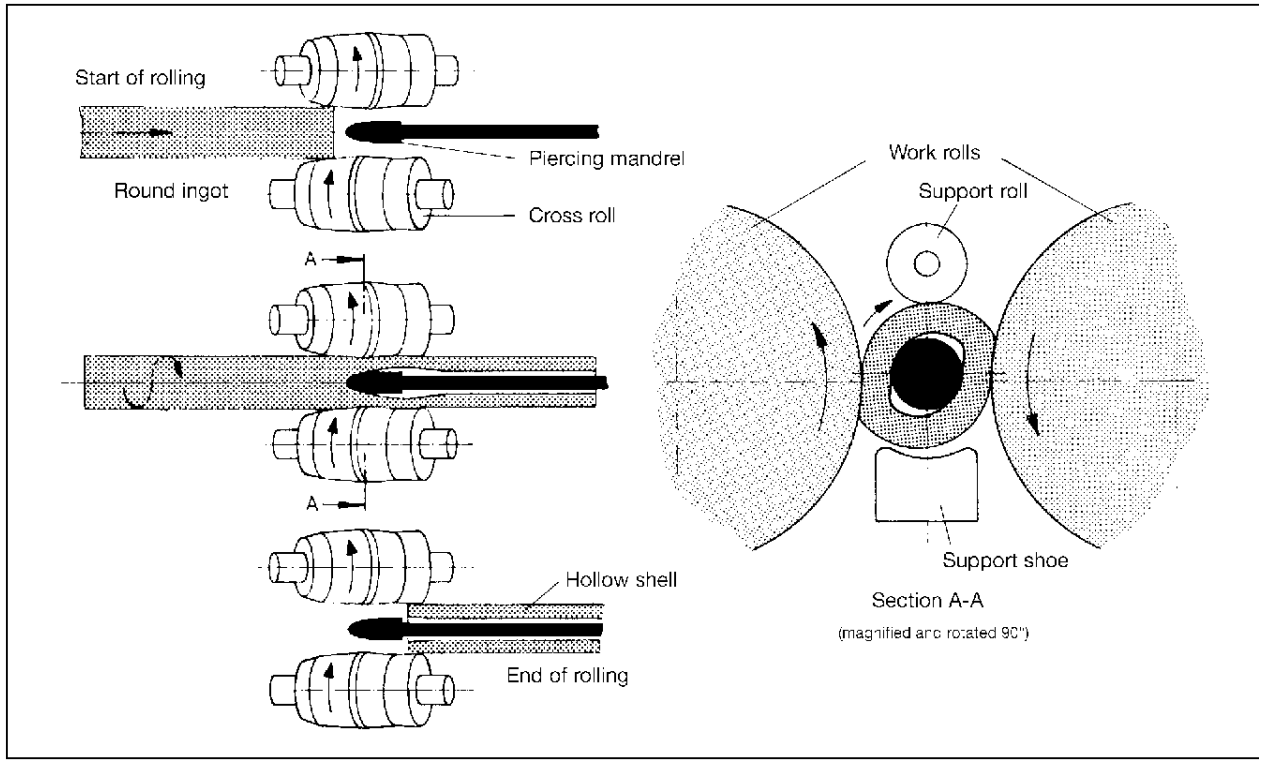




Production Processes

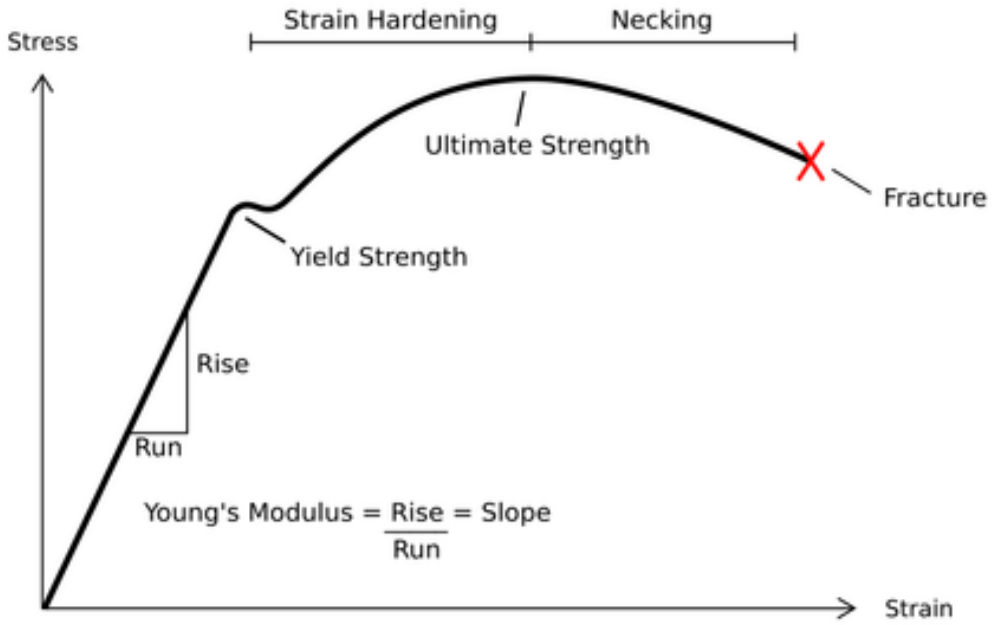
Seamless Processes

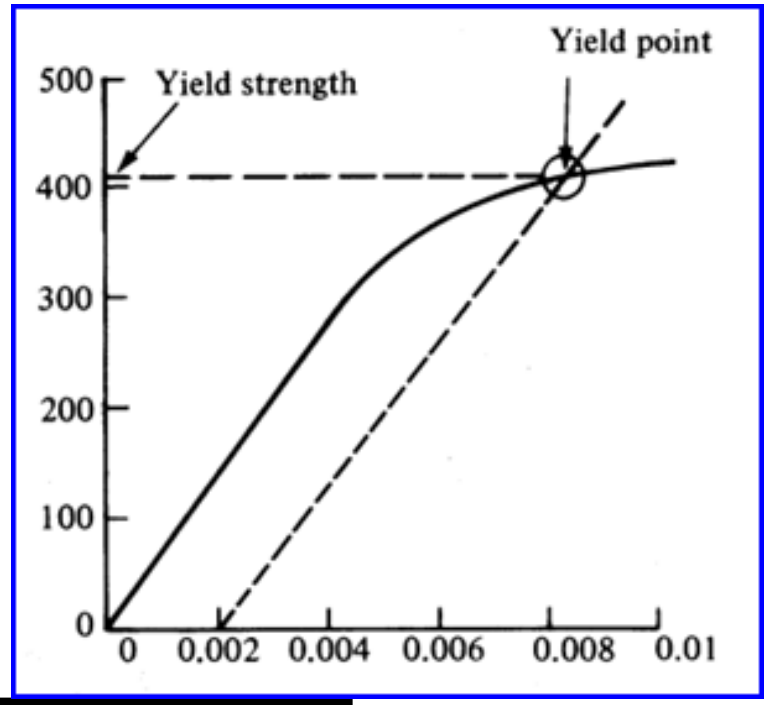
- Extruded
- Cold Drawn
- Hot Finished
- Only Rounds Available



WHAT AFFECTS TUBING PROPERTIES?

Metal Composition
Steel Making Process
Coil Processing
Plastic Deformation in the ERW Tube
Localized Work Hardening in Tube





HSS PRODUCTION AND SUSTAINABILITY

Approximately 70% of HSS in North America is produced using EAF coil

- 90% of the impact on GWP comes from type of coil used
- EAF coil is produced from scrap and has approximately 50-60% recycled content.
- You can specify HSS to be produced from EAF coil

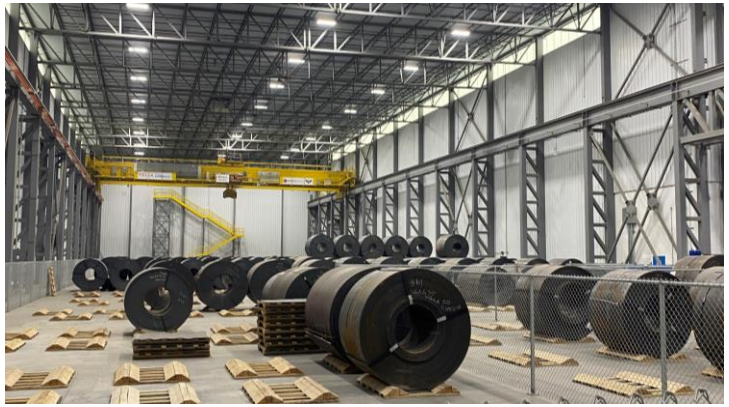
Energy usage to run machines/welders

- Impacts will be based on type of energy source

All scrap is recycled

No wastewater

- Coolant is closed loop system



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HSS SPECIFICATIONS

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ASTM A500-21 (Cold-formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes)

Manufacturing methods

- Cold-formed welded (ERW)
- Seamless

4 grades (A, B, C & D)

2021 Changes

- Grade A was removed
- F_y for rounds and sq/rec was unified

Domestically only C is produced (Typically Dual certified)

AISC 360-16 now has preferred spec as Grade C

Available in Round, Square & Rectangle

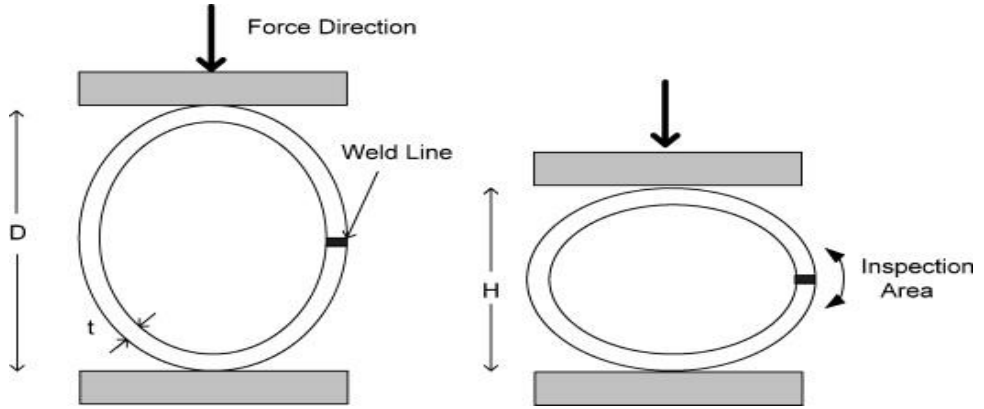
Max size 88” periphery, 1.00” wall thickness

- 22” sq, 28” OD

TABLE 2 Tensile Requirements

Round, Square, Rectangular, and Special Tubular Shapes			
	Grade B	Grade C	Grade D
Tensile strength, min, psi [MPa]	58 000 [400]	62 000 [425]	58 000 [400]
Yield strength, min, psi [MPa]	46 000 [315]	50 000 [345]	36 000 [250]
Elongation in 2 in. [50 mm], min, %[C]	23[A]	21[B]	23[A]

ASTM A500-21

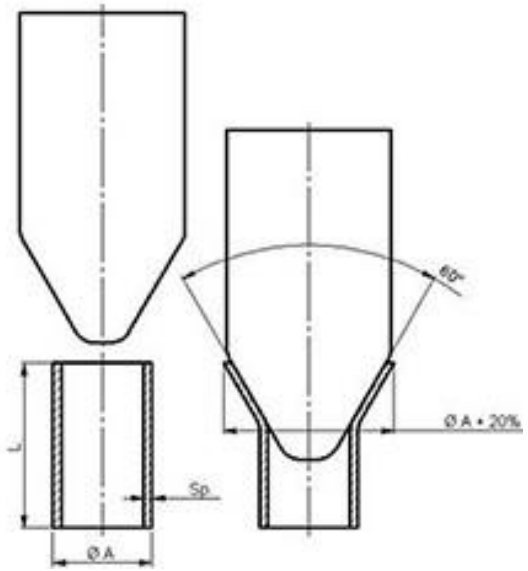


Wall thickness tolerance +/- 10%

per AISC design wall thickness = 0.93*Nominal thickness

→ reduced section properties in AISC Manual

Strength of weld – "welded across its thickness in such a manner that the structural design strength of the tubing section is assured"



Flattening test (required for round sections)
Flaring test (Not required by spec, but typically performed)

→ material fails somewhere other than at the weld

ASTM A847-21 (COLD-FORMED WELDED AND SEAMLESS HIGH-STRENGTH, LOW-ALLOY STRUCTURAL TUBING WITH IMPROVED ATMOSPHERIC CORROSION RESISTANCE)

Manufacturing methods

- Cold-formed welded (ERW)
- Seamless

Available in Round, Square & Rectangle

Provides "substantially better" corrosion resistance compared to carbon steel

TABLE 1 Tensile Requirements for Round and Shaped Tubing

Tensile strength, min, psi [MPa]	70 000 [485]
Yield strength, min, psi [MPa]	50 000 [345]
Elongation in 2 in. or [50 mm] min, %	19[A]

ASTM A847-21

- **Same tolerances as A500**
- **Max sizes**
  - ERW: 88” periphery, 1.0” wall (22” sq, 28” OD)
  - Seamless: 32” periphery, 0.500” wall (10” OD)
- **2021 Changes**
  - Supplement S1 Added (Customer specified CVN test)
    - Can generally get reasonable CVNs to pass due to HSLA nature of input coil
  - Testing Required (Up to 10”)
    - Flattening required for rounds
    - Either flattening, flaring or wedge test on square/rectangle

ASTM A1085-15 (COLD-FORMED WELDED CARBON STEEL HOLLOW STRUCTURAL SECTIONS)

Manufacturing methods

Cold formed Welded (ERW)

Available in round, square & rectangle

One grade (Min & Max Yield)

Max sizes (same as A500)

88” periphery, 1.00” wall (22” sq, 28” OD)

TABLE 2 Tensile Requirements

	Round and Shaped HSS
Yield Strength, psi [MPa]	50 000 [345] – 70 000 [485]
Tensile Strength, psi [MPa], min.	65 000 [450]
Elongation in 2 in. [50 mm], min. %[A]	21

[A] The minimum elongation values specified apply only to tests performed prior to shipment of the tubing.

ASTM A1085

Wall thickness tolerances (Half of A500 (-5%))

Added mass tolerance (-3.5%)

→ Can use nominal wall thickness when calculating section properties (No 0.93 reduction) per AISC 360-16

Upper limit on yield stress (Fy) (70 ksi max)

→ Better control of overstrength. Ry = 1.25 per AISC 341-16

CVN test required per lot (25 ft-lb @ 40 deg F)

→ Meets AASHTO, Zone 2, Fracture Critical Elements

ASTM A1085 – AVAILABILITY

Not routinely stocked by service centers

Mills will produce – typically with minimum size order

Best availability in larger sizes (6” and larger)

Jumbo HSS size range is available in A1085

ASTM A53-22 (PIPE, STEEL, BLACK AND HOT-DIPPED, ZINC-COATED, WELDED AND SEAMLESS)

"1.3 Pipe ordered under this specification is intended for mechanical and pressure applications and is also acceptable for ordinary uses in steam, water, gas, and air lines"

Not intended as a structural specification

Three types

Type F – Furnace butt-welded, continuous welded Grade A & B

Type E – Electric Resistance Welded (ERW), Grades A & B

Type S – Seamless, Grades A & B

Max size: 26 NPS (26" OD), Max wall thickness depends on NPS

TABLE 2 Tensile Requirements

	Grade A	Grade B
Tensile strength, min, psi [MPa]	48 000 [330]	60 000 [415]
Yield strength, min, psi [MPa]	30 000 [205]	35 000 [240]
Elongation in 2 in. or 50 mm	*A,B*	*A,B*

ASTM A53-22

Tolerances

Wall thickness (-12.5%)

Mass (+/- 10%)

→ Subject to 0.93 reduction on wall thickness per AISC 360

“12.6 The finished pipe shall be reasonably straight”

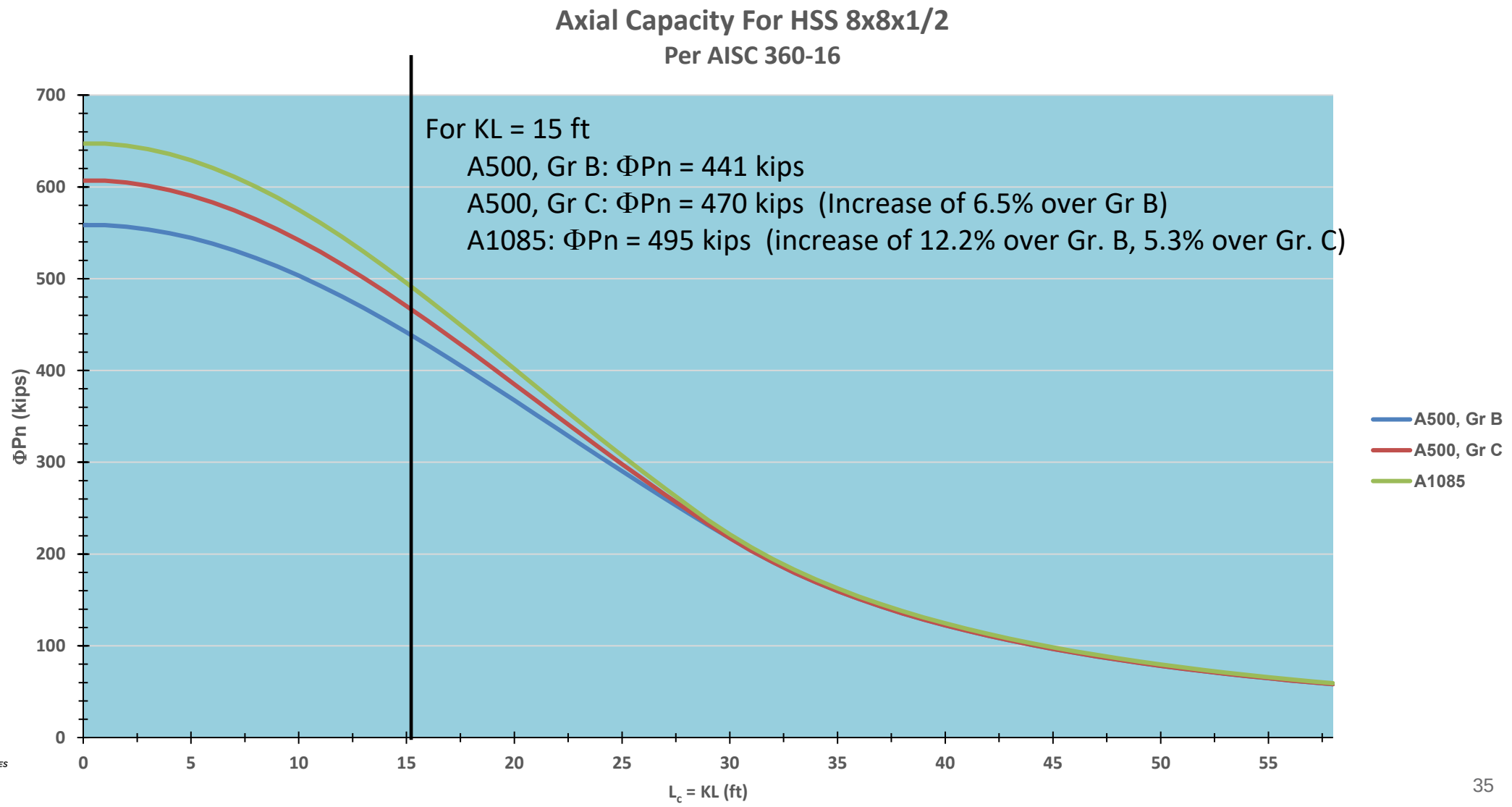
Hydrostatic test – Pressure test

“Black Pipe” – Generally comes with a lacquer finish. Can’t weld through.

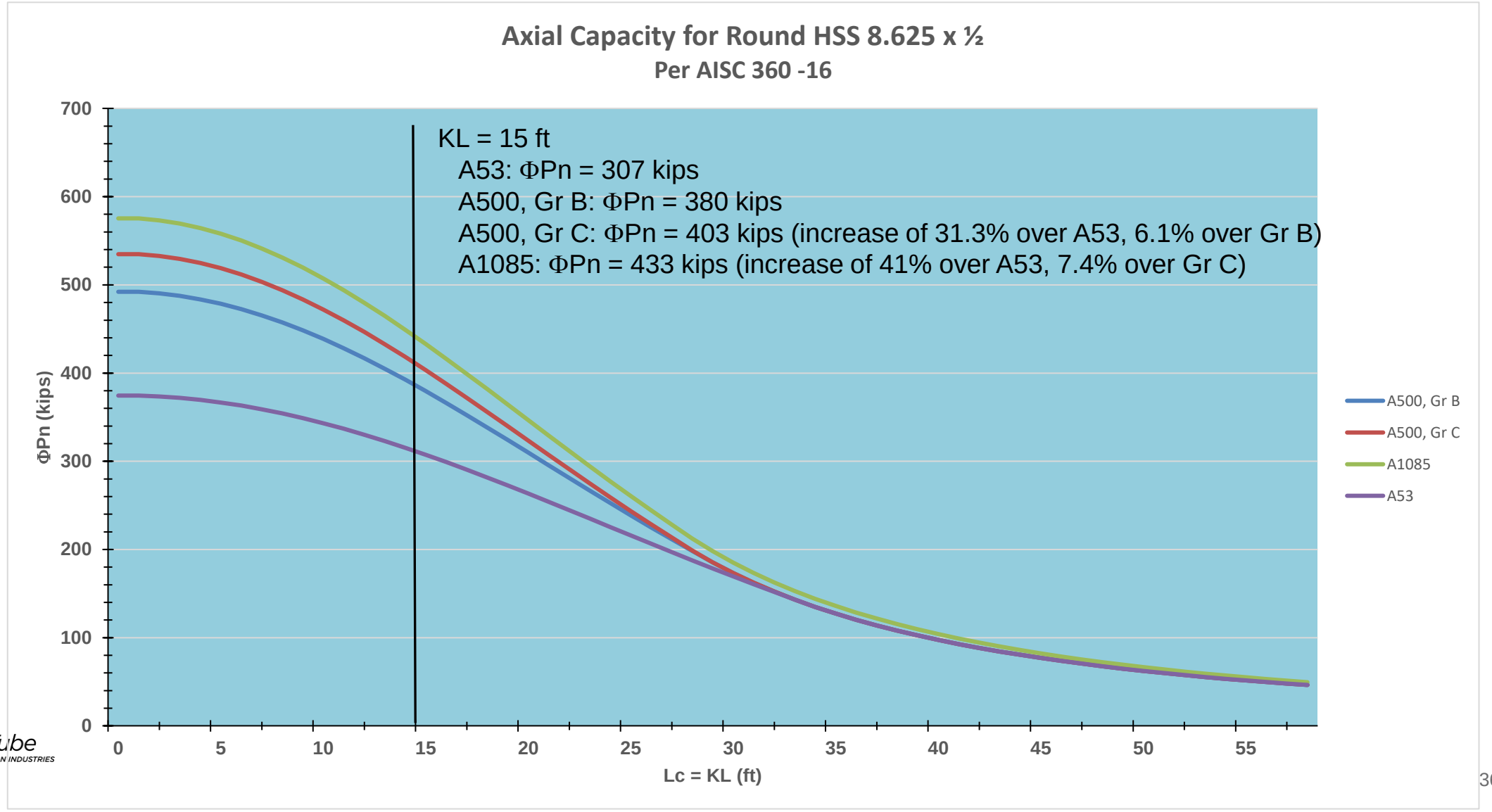
Higher grades (API, etc) tend to get downgraded to A53

→ Unintended consequences: Avoid use in Seismic Force Resisting Systems

EFFECT ON AXIAL CAPACITY



EFFECT ON AXIAL CAPACITY



CSA G40.20/G40.21 – GENERAL REQUIREMENTS FOR ROLLED OR WELDED STRUCTURAL QUALITY STEEL

Covers all structural steel (plate, shapes, sheet, bar, HSS, cold-formed, etc.)

HSS produced by either seamless or ERW process

Class C – Cold-formed, seamless or ERW

Class H

- Seamless or ERW and hot-formed to final shape
- Seamless or ERW, cold-formed to final shape and heat-treated (stress-relieved) – Common to North America
- Different column curve in CSA S16

HSS available in Square, Rectangular and Round

No size limits

Does include listing of “available” sizes

CSA G40.20/G40.21

Common Grades:

350W - Weldable

350WT – Weldable, Notch Toughness (CVN) - Five CVN categories to specify

350AT – Weldable, Atmospheric Corrosion Resistant, Notch Toughness (CVN)

Other strengths – not as available (special order)

Wall thickness tolerance: -5%/+10%

Mass tolerance: -3.5%/+10%

Strength of weld: *“The longitudinal joint in Class C and Class H hollow sections welded by the electric resistance welding process is welded across its thickness so as to produce a weld that provides the structural design strength of the hollow section.”*

Testing requirements are similar to ASTM A500

ASTM A1065-18 (COLD-FORMED ELECTRIC-FUSION (ARC) WELDED HIGH-STRENGTH, LOW-ALLOY STRUCTURAL TUBING IN SHAPES, WITH 50 KSI MIN YIELD POINT)

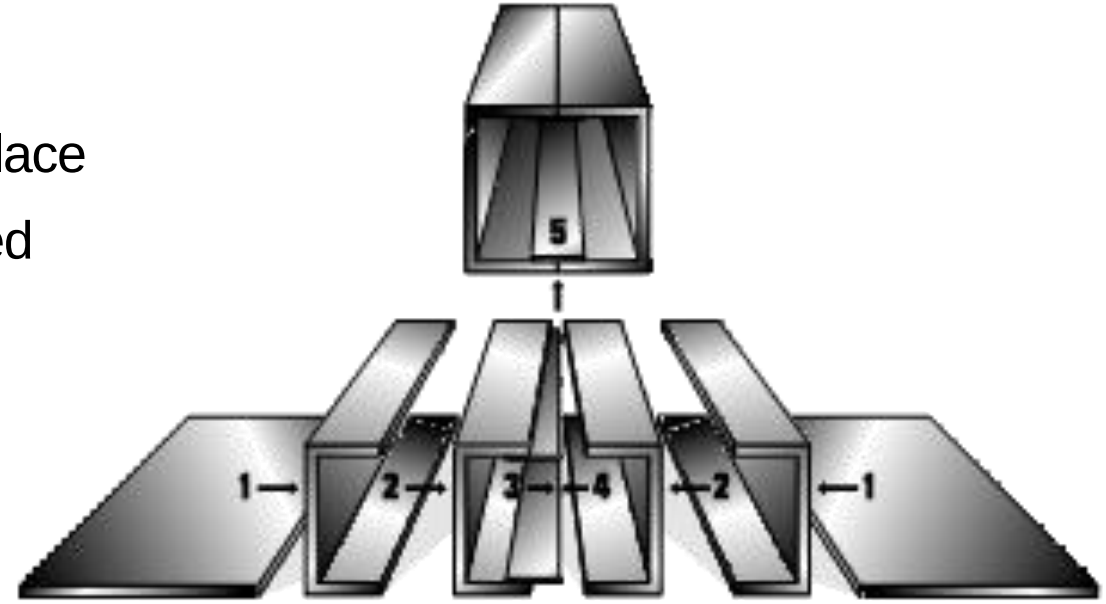
Square & Rectangular Sections

Max Periphery 200” (50” sq)

Max Wall Thickness 1.00”

Three Types

- Type 1 – welded with backing, backing left in place
- Type 2 – welded with backing, backing removed
- Type 3 – welded without backing



ASTM A1065

ASTM A1065

- **Two Grades**
  - Grade 50
  - Grade 50W – enhanced atmospheric corrosion resistance
- **Electric Fusion (Arc) Weld (SAW, FCAW, GMAW)**
- **Standard Weld – PJP (80% depth)**
- **Supplement S2 – CJP with testing**
- **Supplement S1 – CVN: testing on the source plate**

TABLE 2 Tensile Requirements

	Grade 50 [345]	Grade 50W [345W]
Tensile strength, min, psi [MPa]	60 000 [415]	70 000 [480]
Yield strength, min, psi [MPa]	50 000 [345]	50 000 [345]
Elongation in 2 in. [50 mm], min. %	21	21

ASTM A252-19 (WELDED AND SEAMLESS STEEL PIPE PILES)

Manufacturing Methods

- Seamless
- Electric Resistance (ERW)
- Flash Welded
- Fusion Welded (SAW, etc)

Welds may be:

- Longitudinal (straight seam)
- Helical-butt (spiral)
- Helical-lap (spiral)

“Note 1—For welded pipe piles, the weld should not fail when the product is properly fabricated and installed and subjected to its intended end use.”

ASTM A252

Tolerances

Wall thickness (-12.5%)

Mass (-5%, +15%)

→ Wall thickness will be nominal thickness due to mass tolerance

TABLE 1 Tensile Requirements

NOTE 1—Where an ellipsis (...) appears in this table, there is no requirement.

	Grade 1	Grade 2	Grade 3
Tensile strength, min, psi (MPa)	50 000 (345)	60 000 (415)	66 000 (455)
Yield point or yield strength, min, psi (MPa)	30 000 (205)	35 000 (240)	45 000 (310)
Basic minimum elongation for nominal wall thicknesses 5/16 in. (7.9 mm) or more:			
Elongation in 8 in. (203.2 mm), min, %	18	14	. . .
Elongation in 2 in. (50.8 mm), min, %	30	25	20
For nominal wall thicknesses less than 5/16 in. (7.9 mm), the deduction from the basic minimum elongation in 2 in. (50.08 mm) for each 1/32 - in. (0.8 mm) decrease in nominal wall thickness below 5/16 in. (7.9 mm), in percentage points	1.50[A]	1.25[A]	1.0[A]

[A] Table 2 gives the computed minimum values:

API 5L (SPECIFICATION FOR LINE PIPE)

Generally, only used in structural applications that require sizes larger than can be obtained under other specifications

Covers two product specification levels (PSL1 & PSL2)

Manufacturing methods

Seamless

Longitudinally Welded (CW, HFW, LFW, SAWL,COWL)

Helical (Spiral) Welded (SAWH, COWH)

API 5L

Table 1 — Pipe grades, steel grades and acceptable delivery conditions

PSL	Delivery condition	Pipe grade/steel grade [a,b]
PSL 1	As-rolled, normalizing rolled, normalized or normalizing formed	L175 or A25
		L175P or A25P
		L210 or A
	As-rolled, normalizing rolled, thermomechanical rolled, thermomechanical formed, normalizing formed, normalized, normalized and tempered; or, if agreed, quenched and tempered for SMLS pipe only	L245 or B
	As-rolled, normalizing rolled, thermomechanical rolled, thermomechanical formed, normalizing formed, normalized, normalized and tempered or quenched and tempered	L290 or X42
		L320 or X46
		L360 or X52
		L390 or X56
		L415 or X60
		L450 or X65
		L485 or X70
PSL 2	As-rolled	L245R or BR
		L290R or X42R
	Normalizing rolled, normalizing formed, normalized or normalized and tempered	L245N or BN
		L290N or X42N
		L320N or X46N
		L360N or X52N
		L390N or X56N
		L415N or X60N
	Quenched and tempered	L245Q or BQ
		L290Q or X42Q
		L320Q or X46Q
		L360Q or X52Q
		L390Q or X56Q
		L415Q or X60Q
		L450Q or X65Q
		L485Q or X70Q
		L555Q or X80Q
		L625Q or X90Q [c]
		L690Q or X100Q [c]

Table 1 — Pipe grades, steel grades and acceptable delivery conditions *(continued)*

PSL	Delivery condition	Pipe grade/steel grade [a,b]
PSL 2	Thermomechanical rolled or thermomechanical formed	L245M or BM
		L290M or X42M
		L320M or X46M
		L360M or X52M
		L390M or X56M
		L415M or X60M
		L450M or X65M
		L485M or X70M
		L555M or X80M
	Thermomechanical rolled	L625M or X90M
		L690M or X100M
		L830M or X120M

[a] For intermediate grades, the steel grade shall be in one of the following formats: (1) The letter L followed by the specified minimum yield strength in MPa and, for PSL 2 pipe, the letter describing the delivery condition (R, N, Q or M) consistent with the above formats. (2) The letter X followed by a two or three digit number equal to the specified minimum yield strength in 1000 psi rounded down to the nearest integer and, for PSL 2 pipe, the letter describing the delivery condition (R, N, Q or M) consistent with the above formats.

[b] The suffix (R, N, Q or M) for PSL 2 grades belongs to the steel grade.

[c] Seamless only.

API 5L

Testing

- Hydrostatic Tests
- Bend Tests
- Flattening Tests
- CVN Tests (PSL2) – on pipe body and on weld

Significant cost

Square/Rectangle Specifications				
	A500	**A847**	**A1085**	**A1065**
	Standard specification for structural applications	**Enhanced atmospheric corrosion resistance**	**Improved performance for higher demand applications (i.e., Seismic, Bridge)**	**Larger Fabricated Sections**
Yield	**Grade C Fy = 50 ksi**	**Fy = 50 ksi**	**Fy = 50 ksi Fy (Max) = 70 ksi**	**Grade 50 Grade 50W Fy = 50 ksi**
Max size	**88" (22" SQ)**	**88" (22" SQ)**	**88" (22" SQ)**	**200” (50” sq)**
Max wall	**1.00"**	**1.00"**	**0.875"**	**1.00”**
Reduced Design Wall Thickness	**Yes**	**Yes**	**No**	**No**
CVN	**No**	**Yes, per S1**	**25 ft-lb @ 40 deg F**	**Yes, per S1 On Plate**

Round Specifications						
	A500	**A847**	**A1085**	**A252**	**A53**	**API 5L**
	Standard specification for structural applications	**Enhanced atmospheric corrosion resistance**	**Improved performance for higher demand applications (i.e., Seismic, Bridge)**	**Pipe Piles**	**Standard Pipe**	**Line Pipe**
Yield	**Grade C Fy = 50 ksi**	**Fy = 50 ksi**	**Fy = 50 ksi Fy (Max) = 70 ksi**	**Grade 1 Fy = 30 ksi Grade 2 Fy = 35 ksi Grade 3 Fy = 45 ksi**	**Grade A Fy = 30 ksi Grade B Fy = 35 ksi**	**Varies**
Max size	**88" (28" OD)**	**88" (28" OD)**	**88" (28" OD)**	**None Given**	**26 NPS (26" OD)**	**None Given**
Max wall	**1.00"**	**1.00"**	**0.875"**	**None Given**	**Varies per NPS**	**None Given**
Reduced Design Wall Thickness	**Yes**	**Yes**	**No**	**No**	**Yes**	**No**
CVN	**No**	**Yes, per S1**	**25 ft-lb @ 40 deg F**	**No**	**No**	**Yes, For Some Grades**

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THANK YOU

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