

# Specifying HSS

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Knowing the basics about HSS specifications will help you avoid mistakes and misunderstandings on your next HSS project.

While Hollow Structural Sections (HSS) are increasingly popular, many designers still have questions about these sections, especially about the various grades of material available.

## Designating HSS

"HSS" is the correct designation for structural tubing, rather than "TS" (tube shape). In 1990, the industry adopted the term HSS to keep in step with producers around the world. In 1997, the Steel Tube Institute and AISC officially implemented this change with the publication of the *Specification for the Design of Steel Hollow Structural Sections* and the corresponding *AISC/STI/AISI HSS Connections Manual*.

HSS are available in round, square, or rectangular shapes. Round shapes are specified using decimal numbers and three decimal points. For example, HSS 5.563 × 0.258 indicates a round HSS with an outside diameter of 5.563" and a wall thickness of 0.258". Rectangular and square shapes are similarly specified but in terms of rational numbers. For example, HSS 5 × 4 × 3/8 indicates a rectangular HSS with a depth of 5", a width of 4", and a wall thickness of 3/8".

## Design Wall Thickness

It's important to note that the nominal wall thickness is not the design thickness for designing with HSS. As originally noted in the 1997 *HSS Specification* (and now incorporated into AISC's 2005 *Specification*), the design wall thickness should be taken as 0.93 times the nominal wall thickness. This 7% reduction in strength is due to the allowance given by ASTM A500, which allows for a minus 10% tolerance on wall thickness. Since HSS producers can procure flat-rolled steel at or near this tolerance, the resulting manufactured sections fall close to this lower bound tolerance on wall thickness. AISC incorporated this practice by reducing

the design wall thickness to 0.93 of the nominal thickness for all design tables in the *HSS Connections Manual* and the *LRFD Manual of Steel Construction*, third edition.

## Producing HSS

HSS is currently produced to four ASTM specifications (as noted in the 2005 *AISC Specification*), which also have accompanying qualifiers: grades, line item specifications, and requests. The most common AISC specifications are ASTM A500, ASTM A501, ASTM A618, and ASTM A847.

## ASTM A500 and ASTM A847

ASTM A500 and ASTM A847 are produced by the Electric Resistance Welding (ERW) process and the Form-Square Weld-Square process (a type of

ERW process). Electric Resistance Welding is a cold-formed process by which a flat steel strip is formed continuously around its longitudinal axis to produce a round tube by moving the strip through a progressive set of rolls. The strip edges are then heated by either high frequency induction or contact welding and then forged together by weld rolls to create a continuous longitudinal weld without the addition of filler metal.

The Form-Square Weld-Square Process is used in some HSS production shops. In the weld mill, driven forming dies progressively shape the flat strip of steel by forming the top two corners of the square or rectangular tube at the initial forming station. Subsequent stations form the bottom two corners of the shape. No cold working of the sides of the shape is performed, and the shape's

## HSS Tips and Tricks

Keep the following tips in mind when specifying HSS to minimize unnecessary costs.

- Specifying common sizes that are readily available over a custom size that may seem "more efficient" in terms of tonnage can achieve significant cost savings.
- When considering round HSS, it may be more practical to specify A53 Grade B pipe. Depending on the location, this pipe section may be more readily available.
- Architecturally Exposed Structural Steel (AESS) is a common application for HSS. Projects should reference the AESS provisions the *AISC Code of Standard Practice* when "true" AESS is required. Refer to the supplement "Architecturally Exposed Structural Steel" in the May 2003 issue of *Modern Steel Construction* ([www.modernsteel.com](http://www.modernsteel.com)) for a visual comparison of standard HSS fabrication results versus AESS steel.
- Eliminate extraneous notes that require unnecessary and costly practices. The note "All welds shall be ground flush" is a good example of this. The appearance of grinding the weld gives a smooth surface. However, there are many times when HSS connections are not at a location easily seen by the public. Also, grinding welds—especially fillet welds—sometimes will not significantly improve appearances but will significantly increase the cost of the connection. Often it is best to simply follow the HSS provisions, which require "reasonably smooth and uniform welds," when possible.

seam is welded by high-frequency contacts when the tube is near its final shape and size.

The Submerged Arc Welding (SAW) Process is also used to produce HSS, but is not supported by an ASTM designation. This process can be used to produce sizes larger than 64" in periphery. The hot-formed process, as designated by ASTM A501 and A618, is generally not produced in square and rectangular sizes in the United States, but round sections are typically available in mill quantities.

ASTM A500 is the standard designation for common structural applications of HSS. A500 is available in round, square, and rectangular sections and is commonly specified in grades B or C. Grade B is more commonly specified in square and rectangular shapes. Dual certification of both grades B and C can be requested to ensure more readily available supplies from the service centers. ASTM A500 also describes a grade D, which is commonly referred to as "stress relieved" or "heat treated" steel, and can be done at various HSS producer facilities. Grade D is not readily available "off the shelf."

"Flash" removal is another request

that can be made as a line item to the required grade. Flash is the upset portion on the inside of the HSS that remains on the back face of the weld. This process can be costly and is generally specified for mechanical uses such as telescoping applications rather than structural building applications.

Hollow structural sections are readily available in a large number of sizes, in terms of outside diameter, width, depth, and wall thickness. ASTM A500 limits the size of the section to a perimeter of 64" and a wall thickness of 5/8". The *AISC Manual of Steel Construction*, third edition, lists all common available sizes that can be ordered based on this limitation. It should be noted that special wall thickness requirements up to the A500 thickness limitation can be ordered, but minimum mill quantities may be required for order. Custom orders can be more costly and are only available from certain producers. For a complete list of producers of custom sizes, consult the Steel Tube Institute of North America at [www.steeltubeinstitute.org](http://www.steeltubeinstitute.org).

HSS are also available in atmospheric corrosion resistant steel, more com-

monly referred to as "weathering" steel. Produced from hot-formed ASTM A588 steel coil, this shape is available in round, square, or rectangular sizes. The mechanical properties of the material are higher than that of ASTM A500. This product is not as readily available in all sizes and at all locations in comparison to A500. Check for availability before specifying this product.

#### **ASTM A501 and ASTM A618**

ASTM A618 (lower-alloy/higher-strength HSS) and A501 are hot-formed product specifications that cover square, rectangular, and round HSS. Although square and rectangular products are not available domestically, round sections are available in mill quantities. Always check the availability of these two grades before specifying them. ★

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