BMT Welding Guide for Stratusteel used in transportation and other heavy equipment industries.

In this guide you will find suggestions for using Stratusteel tubing in transportation and heavy equipment. This is intended to be a general guideline only—please always refer to your tube manufacturer or raw steel provider's specifications where necessary.

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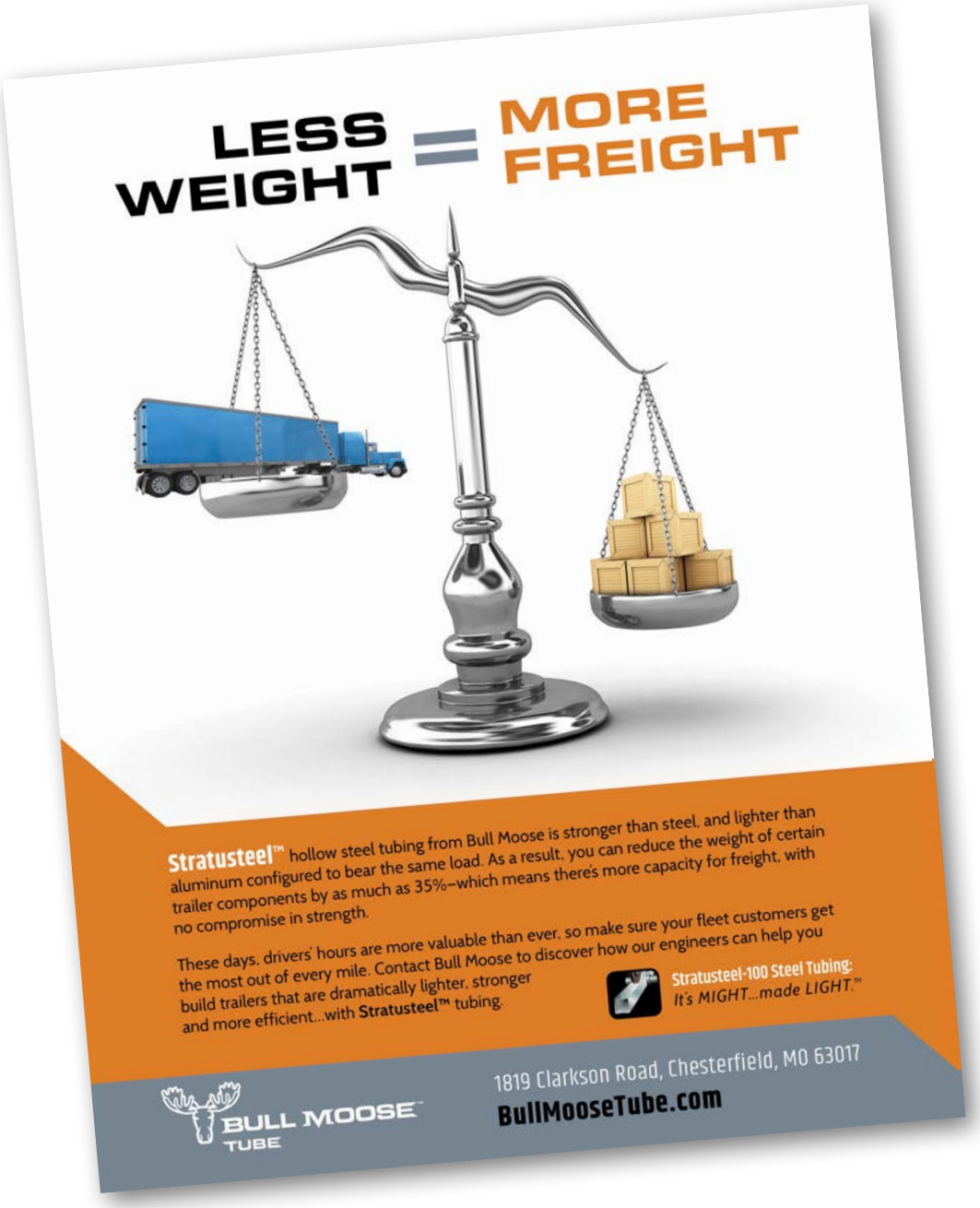
Introduction

Welding of Stratusteel will be different than typical A500 50MY – 80MY tubing. Stratusteel is greater than or equal to 100MY, and as a result, welding requirements are slightly different. When welded properly, Stratusteel will ensure long-lasting performance while making your designs lighter, stronger and more efficient to manufacture.



1. Preparation

All well-established methods or processes of preparation can be used with Stratusteel. However, attention should be paid to any potential buildup of materials on the surface of weld joint, such as thin oxides films from thermal cutting. Make sure all joints are well cleaned prior to welding. If using a plasma cutting for joint preparation, oxygen should be used to minimize risk of porosity in the weld material during welding.

It is also possible to use a grinding method, which would remove the risk of porosity in the weld material. It's recommended to grind down by at least 0.2mm if using this method post plasma cutting.

2. Welding

All common fusion welding methods can be used for welding Stratusteel, such as:

- MAG/MIG – Welding
- MMA-Welding
- TIG-Welding
- Plasma Welding
- Submerged Arc Welding
- Laser Welding

While other methods can be used, these are the most common for Stratusteel. Of these, MAG/MIG welding is the most commonly used welding technique known today.

When T-joint welds are close to the edge with a thickness ≥ 8 mm, there should be no sharp defects at the edge. Such defects can lead to stresses in the thickness direction, which can lead to cracking during welding. These welds should be avoided. Shearing is not expected in the use of Stratusteel due to its shape and size. However, if shearing is used, welding should not occur near the sheared area, as it gives increases in stress at the shear location (which can lead to cracking at the weld location in contact with the shear location). It's recommended that if the location must be used, that it's thermally cut instead of sheared.

3. Recommended Welding Materials for Stratusteel

Stratusteel should be welded with high strength solid welding wire	MAG-Welding (GMAW)	MAG Cored Wire	MMW Coated Electrode	Submerged Arc Welding
	AWS:A5.28 ER100S-X	AWS:A5.29 E11XT-X	AWS:A5.5 E11018	AWS:A5.23 F11X
	AWS:A5.28 ER110S-X	EN 18726(-A)T69X	EN757 E69X	EN26304(-A) S69X
	EN 16834(-A) 69X			

Table #1: Recommended weld wire for Stratusteel

4. Preheat and Inter-pass Temperature Considerations

Multi-pass welding may cause the temperature in the welded joint to rise to a level that causes the strength to drop. This is most critical for welds below 500mm, because the temperature will drop between weld bead formations. The maximum inter-pass temperature for Stratusteel is 100 degrees C. For short welds, it is recommended to allow the temperature to cool 150 degrees C prior to starting the next weld bead.

For best results, it is recommended for Stratusteel to be at standard room temperature (temp **≥ 23 degrees C ≤100 degrees C)** prior to welding.

5. Hydrogen Cracking Risks

This risk of hydrogen cracking is very low; however, it can occur under very specific conditions. Hydrogen cracking will occur if European Standard 1011-2 is met, whereby a very high hydrogen content > 15 ml/100g of weld metal material and an extremely low heat input of < 0.5Kj/mm are applied, with a combined thickness of 30mm of Stratusteel. These conditions are very rare—however, it is critical to monitor and prevent these conditions in order avoid risk of hydrogen cracking during welding. To avoid this risk, it's recommend that you use weld materials with low hydrogen content ≤ 10 ml/100g weld metal.

When welding Stratusteel it's important to also follow good general welding practice to avoid increased risk of hydrogen cracking.

Rules of thumb to follow to minimize hydrogen cracking are:

Minimize the hydrogen content in and around the prepared joint.	Minimize the stresses in the weld join.
Use the correct pre-heat and inter pass temperatures.	Do not use welding consumables of a higher strength than is necessary.
Use welding consumables with low hydrogen content.	Arrange the weld sequence so that the residual stresses are reduced during the welding process along the weld seem nor in the welded joints.
Keep impurities out of the weld area.	Set the gap in the joint to a maximum of 3mm.

Table #2: Rules of thumb for handling prior to welding

6. Heat Affected Zone (HAZ) or Soft Zones

When using Stratusteel, soft zones can form in the HAZ. This can happen as a result of changes in the microstructure during welding. However, if normal heat inputs are used, then these soft zones typically do not influence the strength of the weld. For example, if an inter-pass temperature of 150 degrees C is maintained using a single pass, then the heat input which would affect Stratusteel could be increased by 10 – 15% for a butt weld, and approximately 40 – 50% for a filet weld. Following the inter-pass temperature limits will reduce if not eliminate any impact in HAZ leading to soft zones.

7. Direction and Passes for Welding

When using Stratusteel we recommend that you start your weld bead in the larger section of the parent material and then work towards the joint. For two pass welds we recommend that once at the joint, the welder restart from the larger section going into the joint (as opposed to returning from the joint to larger section). Please see figure #1 as a representation of starting welds at joint locations.

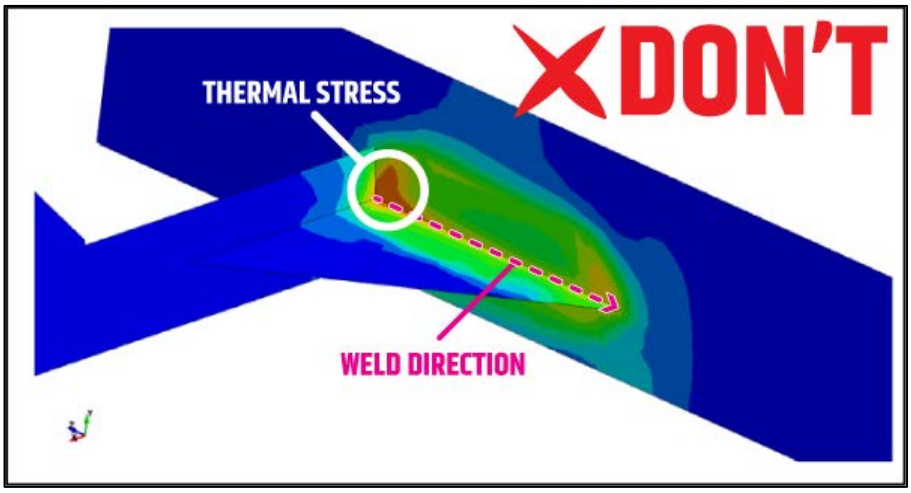


Figure #1: Impact of starting welds in joint locations

Restarting second pass welds in the larger parent material allows for inter pass cooling and reduction of stresses at the joint. If welding a plate, it is recommended that the plate use a notch of at least 1" in radius at the joint to prevent concentration of stresses at the joint and follow the inter pass recommendations above.

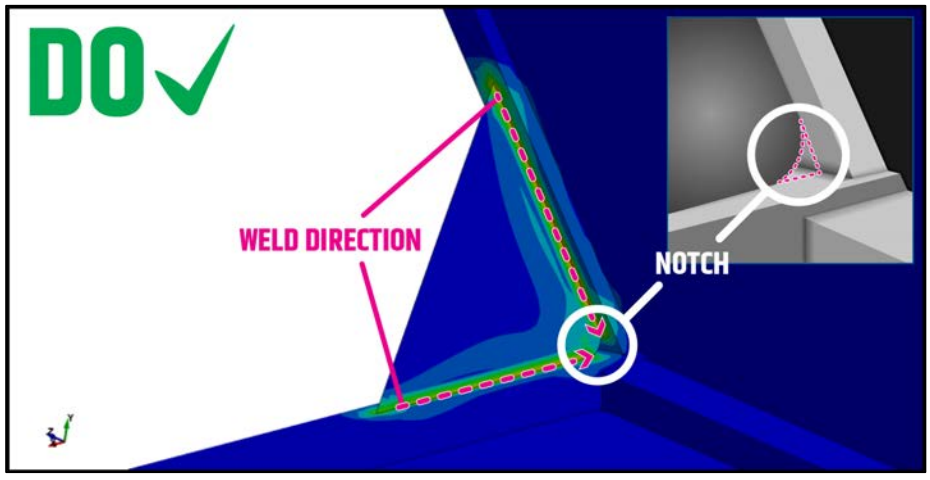


Figure #2: Improved impact of starting welds in parent material

7.1. Welding Parameters Analyzed

As part of this guide, extensive thermal analysis was performed in order to generate stress analysis curves and impact of welding conditions. Below is the table of welding parameters used for this section:

Material: ¼ wall Stratusteel
Weld Type: MIG – Non-Pulsed
Voltage: 23-25V
Amperage: 300-360A
Weld Speed: 24-26 in/min
Preheat: N/A (25 C)
Weld Size: 3/16” fillet +/-.03125

Table #3: Weld parameters used for thermal stress analysis

7.2 Real-World Example of Welding Parameters Used in Construction of Trailer Frames

Below is a table of real-world welding parameters which yielded the best results for the gauge of tubing applied:

Material: 8-gauge 3”x5” Stratusteel
Weld Type: MIG – Non-Pulsed
Voltage: 28V
Amperage: 245A
Weld Wire Speed: 420 ipm (i.e., welder speed should still be as above)
Weld Wire Size: .035 weld wire

Table #4: Weld Parameters used during real-world construction of 8-gauge 3”x5” Stratusteel

8. Fabrication Considerations

When fabricating (welding) Stratusteel HSS, consideration should be taken to reduce the residual stresses imparted into the HSS from the shop/field welding process. The weld seam on the HSS should be oriented, if possible, where thermal stresses will not affect the weld seam. For example, orienting the HSS weld seam in a restrained position under a reinforcement plate, bracket, etc., to minimize buildup of residual stresses. Cutouts and holes, where possible, should be placed away from or opposite the weld seam face.

9. Final Considerations

All steps mentioned above should be taken when welding Stratusteel. In addition, you should make every effort to have a clean, moisture-free weld area for best results. Condensation, dirt, and any other foreign material should be removed prior to welding. Always monitor and prevent conditions that could cause hydrogen cracking.

Please feel free to contact us at Bull Moose Tube Technical Support with any questions or concerns. Bull Moose maintains an unwavering commitment to quality, precision, and technical expertise. For reliable technical support, or capable collaboration with product development, please call 888.227.5430, or email techsupport@bullmoosetube.com.