**D21 — Weld Specification**

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# GENERAL

This specification covers welding requirements applicable to fabrication of Proterra Inc. structures and components/assemblies by the contractor or manufacturer as specified by Proterra Engineering Drawing. It is to be used in conjuction with the appropriate complementary codes or specificaions outlined within. Any exceptions from these requirements must be made after obtaining written approval from Proterra Inc.

# REQUIREMENTS

The following requirements shall be met by contractor or manufacturer:

**2.1**  All welding shall be done to the applicable weld standards called out in Section 3.0, *Weld Standards*

**2.2** Welding symbols shall be those shown in the latest edition of AWS A2.4, *Symbols for Welding Brazing and Nondestructive Examination*.

**2.3** Minimum weld size shall be the size specified on the engineering drawing

**2.4** Maximum weld size shall be the size specified on the engineering drawing +20%

**2.5** Welds may go over in length up to 0.25inches [6.35mm] more than specified on the drawing.

**2.6** Welds shall be located within 0.125inches [3.18mm] of the specified weld start location on the engineering drawing.

**2.7** Welded structures and components/assemblies will be accepted as complete when the conditions the engineering drawing and Section 5.0, *Inspection* are met.

# WELD STANDARDS

Materials and part types require different welding requirements and those specific requirements are detailed with the appropriate complementary code in which they shall comply. All welded parts and components are required to comply with Section 4.0, *Weld Procedure Specifications* and be inspectable to Section 5.0, *Inspection.*

## 3.1 STRUCTURAL STEEL

Structural steel components/assemblies will be weld per the latest edition of AWS D1.1/D1.1M *Structural Welding Code – Steel.* Structural steel is defined as a carbon steel with a thickness of 0.125 inch[3.17mm] or greater with minimum yield strength no greater than 100 ksi[690MPa]. Materials are approved in accordance with AWS D1.1/D1.1M *Structural Welding Code - Steel*

## 3.2 STRUCTURAL STAINLESS STEEL

Stainless Steel components/assemblies will be welded per the latest edition of AWS D1.6/D1.6M *Structural Welding Code – Stainless Steel.*  Structural Stainless steel is defined as a stainless steel, by chemical composition, with a thickness of 0.0625 inch[1.5mm] or greater. Materials are approved in accordance with AWS D1.6/D1.6M *Structural Welding Code – Stainless Steel*

## 3.3 STRUCTURAL ALUMINUM

Aluminum components/assemblies will be welded per the latest edition of AWS D1.2/D1.2M *Structural Welding Code – Aluminum*. Structural Aluminum is defined as any aluminum alloy approved in accordance with AWS D1.2/D1.2M *Structural Welding Code – Aluminum*

## 3.4 SHEET STEEL

Sheet Steel components/assemblies will be welded per the latest edition of AWS D1.3/D1.3M *Structural Welding Code – Sheet Steel.* Sheet Steel is defined as carbon steel 0.188 inch [4.8mm] or less and having a minimum yield strength no greater than 80 ksi [550MPa]. Materials are approved in accordance with AWS D1.3/D1.3M *Structural Welding Code – Sheet Steel*

## 3.5 SHEET METAL

Non-strucrtural sheet metal should be arc welded or braze welded per the latest edition of the AWS D9.1 Sheet Metal Welding Code.

## 3.6 BRAZING AND SOLDERING

Braze and solder all applicable materials per the latest edition of AWS B2.2 *Standard for Brazing Prodecure and Performance Qualification*

# WELD PROCEDURE SPECIFICATIONS

The qualification requirements of this specification are to assure that the procedures actually used in production meet a recognized standard. To accomplish this objective, each contractor or manufacturer shall do the following:

(1) Prepare a written Welding Procedure Specification In accordance with AWS code for each condition.

(2) Qualify the procedure described by the Welding Procedure Specification in accordance with AWS code of this section using materials, equipment, cleaning and preparation methods, welding condition, etc. that are specified in the Welding Procedure Specification.

(3) Qualify the welders, welding operators, and tack welders in accordance with the appropriate AWS code before doing any production work.

(4) Maintain records of each of the above items.

## 4.1 QUALIFICATION OF WELDING PROCEDURES

Only procedures qualified in accordance with the appropriate AWS code shall be recognized as approved procedures.

4.1.1 All Nondestructive Examination and Mechanical testing used for welding procedure qualification is to be in compliance with the appropritate welding code to be used.

## 4.2 QUALIFICATION OF WELDERS

All welders are to be qualified prior to production in accordance with AWS code and specific WPS. Proper documented evidence of previous qualification in accordance with AWS code must be maintained.

## 4.3 QUALIFICATION RESPONSIBILITY

Each contractor or manufacturer shall conduct the tests required by this standard to qualify the welding procedures and the welders, welding operators,and tack welders who will apply these procedures. A weld procedure qualified for any contract at any contractor site shall be considered as being qualified for all of that contractor’s sites and for all their approved suppliers. A welder qualified at any contractor site shall be considered as being qualified for all of that contractor’s sites.

## 4.4 RECORDS

Each contractor or manufacturer shall maintain a record of all welding procedure and performance qualifications of welders, welding operators, tack welders and robotic programs. These records shall be maintained by the contractor or manufacturer and shall be made available upon request to those authorized to examine them.

# 5.0 INSPECTION

Inspection responsibilities and qualifications for inspectors are defined as:

5.1 Fabrication/erection inspection shall be the responsibility of the contractor.

5.2 Verification inspection shall be performed by Proterra Inc quality personnel.

5.3 Visual examination for appearance is required for procedure qualification and performance qualification for each component.

5.4 Acceptance Criteria:

The criteria listed below is in addition to the acceptance criteria of the appropriate welding code.

* Burn Thru: None Permitted.
* Under Cut: None Permitted.
* Porosity: Holes up to 1/16” per inch permitted in Standard Welds only. Must be able to see the bottom of the hole.
* Cracks: No weld cracks allowed.
* Inclusions: Nonmetallic inclusions must be considered as porosity.
* The contractor shall comply with all requests of the Inspector to correct deficiencies in materials and workmanship as required.
* Only 2 rework cycles allowed per joint. Reworked welds must meet acceptance criteria for the original weld.

5.5 Welded joints shall not be painted until after welding has been completed and the weld accepted by the inspector.

5.6 Slag shall be removed from all completed welds, and the weld and adjacent base metal shall be cleaned by brushing or other suitable means. Tightly adherent spatter remaining after the cleaning operation is acceptable, unless its removal is required for the purpose of nondestructive testing or personnel safety.

5.7 Qualification of Inspectors;

* Welding inspectors shall meet the provisions of the AWS QC1, *Standard and Guide for Qualification and Vertification of Welding Inspectors.* (AWS Certified Welding Inspector)
* Welding Inspectors shall meet the requirments of the internal Proteria welding inspection program, and be designated as a Proteria Certified Welding Inspector.

# 6.0 EQUIPMENT CALIBRATION

The manufacturer is required to develop and maintain a welding equipment calibration program. This program shall consist of, as a minimum, an annual comparison check of the machine output with instrumentation calibrated using standards traceable to the National Institute of Standards and technology (NIST). The standard may be a load bank,voltmeter/ammeter, clamp-on meter, etc.

# 7.0 CERTIFICATE OF CONFORMANCE

All external suppliers must submit a Certificate of Conformance (CoC), to the buyer for each component/ fabrication stating that the component/ fabrication was processed in accordance with the requirements of this specification and other applicable documents. The certificate shall be signed and dated by an authorized supplier representative and shall as minimum include the following information:

* Supplier Name, Address, and Proterra Assigned Supplier Number.
* Proterra Purchase Order No. and Date.
* Proterra Drawing/ Part No.
* Weld Procedure Specifications(WPS) and welder qualification documents
* Materials Certificates

Proterra requires CoC’s be maintained by the supplier and be available upon request or audit.

# 8.0 AUDIT

Proterra reserves the right to periodically audit supplier facilities and practices. This audit can be unannounced.