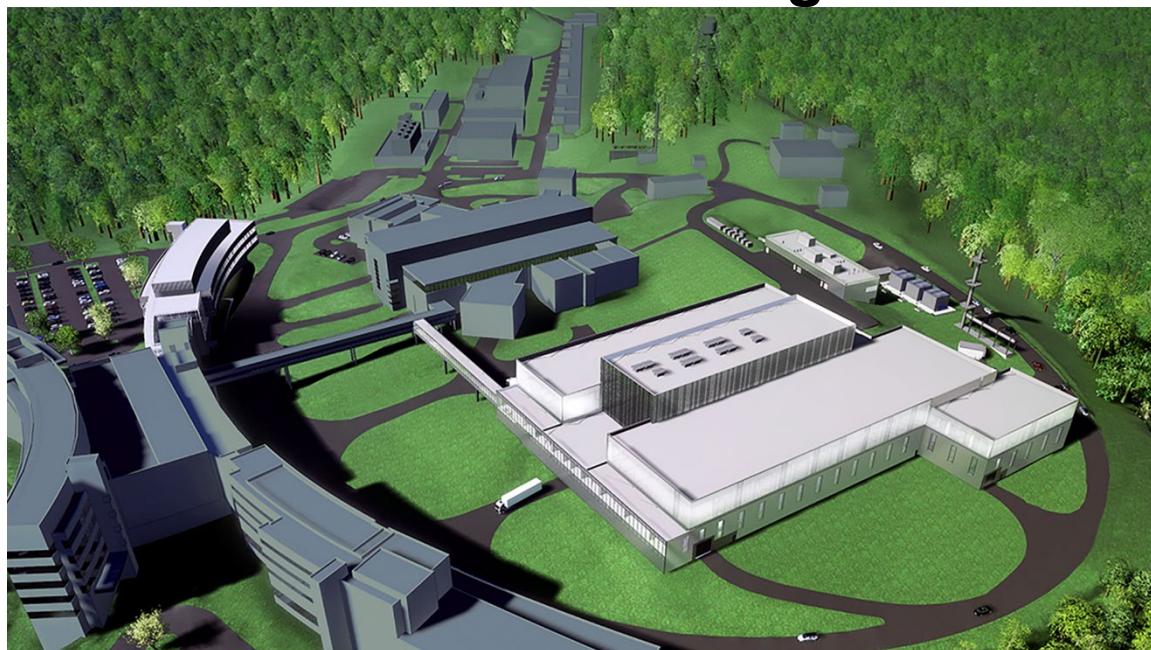


Second Target Station Specification for Electron Beam Welding



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Second Target Station Project

SPECIFICATION FOR ELECTRON BEAM WELDING

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1. **SCOPE**

This document defines the additional requirements specific to **Electron Beam Welding (EBW)** for components and assemblies.

All general welding requirements shall be per **ORNL 000017743 – General Welding Specification, except as modified or supplemented** by this document.

Electron beam welding shall comply with:

- **AWS C7.1 / C7.1M – Recommended Practices for Electron Beam Welding**
- **AWS B2.1/B2.1M – Procedure and Performance Qualification**
- **ASME Section IX**, when pressure-retaining components are involved
- Project-specific drawings and purchase documents

ORNL 000017743 remains the governing welding document unless this document explicitly overrides a requirement.

2. **GENERAL REQUIREMENTS**

000017743 – General Welding Specification, section 3 (Vendor Responsibilities) with the following **EBW-specific modifications**:

1. Vendor shall be a qualified EBW facility with properly maintained vacuum chambers, beam columns, and calibration records.
2. Vendor is responsible for all **vacuum compatibility, beam alignment, part fixturing, and beam parameter control**.
3. Vendor is responsible for achieving **post-weld dimensions** shown on the drawing.
4. Vendor shall ensure appropriate beam power stability, focus checks, and vacuum levels before welding.
5. Subcontracting EBW requires written approval.

3. **REQUIRED SUBMITTALS**

See **000017743 – General Welding Specifications - Section 4 (Submittals)** with the following **EBW-specific additions**:

3.1 **ELECTRON BEAM WELDING PROCEDURE SPECIFICATION (EBW WPS)**

WPS shall include EBW-specific parameters (required by AWS C7.1), including:

1. Accelerating voltage
2. Beam current
3. Focus setting and beam focus technique
4. Travel speed
5. Vacuum level and pressure profile

6. Beam oscillation patterns (if used)
7. Start/stop and crater fill method
8. Fixturing and alignment considerations (summary)

3.2 PROCEDURE QUALIFICATION RECORD (PQR)

See **000017743** Section 4.2; PQR must meet AWS C7.1 EBW qualification requirements.

3.3 OPERATOR/TECHNICIAN QUALIFICATIONS

Operators must be trained in EBW machine operation per AWS C7.1 and facility requirements.

3.4 VACUUM COMPATIBILITY MATERIAL LIST

Only vacuum-safe materials are permitted. Vendor shall list all materials entering the vacuum chamber, including:

- lubricants
- cleaning agents
- temporary fasteners, tapes, or shims
- marking agents

4. JOINT PREPARATION AND FIT-UP

See ORNL 000017743 Section 6 (Fit-Up, Joint Preparation, Dimensional Control) with the following EBW-specific modifications:

1. Joint preparation shall meet AWS C7.1 guidance unless otherwise specified.
2. Joint fit must meet any **light-tight** requirement if defined in the WPS.
3. All weld zones must be cleaned per AWS C7.1 (solvent, ultrasonic, or vacuum bakeout as required).
4. Parts shall not be touched with bare hands after final cleaning.
5. Vendor is responsible for all **bevels, gaps, root openings, and joint alignment**.

5. EBW PROCESS REQUIREMENTS

See ORNL 000017743 Section 7 (Preheat/Interpass/Environmental) with the following EBW-specific requirements:

1. The vacuum level during welding must remain within limits defined in the WPS.
2. Beam alignment and focus checks shall be performed prior to production welding.
3. Run-off samples (verification coupons) shall be produced as required by the WPS or contract.
4. Essential variables for EBW per AWS C7.1 shall not be changed without requalification.
5. Weld sequencing must account for EBW-specific distortion and shrinkage.

6. INSPECTION AND TESTING

See ORNL 000017743 Section 8 (Inspection and Testing) with the following EBW-specific additions:

6.1 VISUAL INSPECTION

EB welds shall be free from:

- keyhole instability indicators
- surface porosity
- excessive underfill or reinforcement
- beam “wobble” marks
- misalignment of weld penetration
- discoloration indicative of vacuum issues

6.2 NDE

NDE of welds shall be in accordance with ASME Sec VIII, Div 2 for the methods specified on the contract drawings.

When not specified:

- RT for full-penetration welds
- UT when geometry permits
- PT for surface flaws
- Macro-etch sections if required to verify penetration and weld profile

6.3 LEAK TESTING (WHEN REQUIRED)

Leak testing shall follow drawing or contract requirements (e.g., helium leak rate testing).

6.4 REPAIR WELDING

See ORNL 000017743 Section 8.3 (Repair Welding) with the following EBW-specific restrictions:

1. **No repair welding is permitted unless approved in writing.**
2. A Repair WPS (RWPS) must be submitted and approved before performing EBW or alternative repair processes.
3. All repairs shall receive the same NDE requirements as original welds.
4. Excessive grinding of EB weld crowns or roots is not permitted.

6.5 DOCUMENTATION AND TRACEABILITY

See ORNL 000017743 Section 10 with the following EBW-specific additions:

1. Vendor shall document beam parameters (current, voltage, focus, oscillation, travel speed and vacuum readings) for each weld when required by contract or QA.
2. Any deviation from approved parameters shall be cause for rejection unless formally approved.