

Appendix L:

Sample Technical Specifications for Weld Repairs

FERMILAB
MAIN INJECTOR
MECHANICAL SUPPORT DEPARTMENT

**Welding Technical Specification for
Welding of Schedule 10 Piping in the
MI LCW System**

SPECIFICATION #

1404 -ES- 333080

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**Welding Technical Specification
for
Welding of Schedule 10 Piping in the MI LCW System**

PG Hurh
2-20-98

I. General

A. Scope

(1) The following specification describes the requirements for welding Schedule 10 piping in the Main Injector LCW System. It covers manual welding of 304L Stainless Steel pipe and components with 316L Stainless Steel filler material.

(2) In addition to and/or reinforcement of the requirements of the Governing Codes described below, this document specifies requirements and recommendations to ensure quality weld production. If conflicts arise between this specification and the Governing Codes' requirements, it shall be brought to the attention of Fermilab engineering staff for evaluation.

B. Governing Code and Weld Procedure Specifications

(1) All welding shall be performed in accordance with ANSI/ASME B31.3 Process Piping Code. The MI LCW system shall be considered as "Category D Fluid Service" when interpreting Code requirements.

(2) Suitable Weld Procedure Specifications (WPS) and their accompanying Procedure Qualification Records (PQR) shall be provided by the fabricator and approved by Fermilab engineering personnel before welding begins. WPS and PQR forms should follow ASME Boiler and Pressure Vessel Code (BPV) Section IX suggested formats and include all information required by BPV Code Section IX.

C. Inspection Requirements

(1) As set forth in the Governing Code (ANSI/ASME B31.3), visual examination of welds will be performed. This visual examination will be performed by Fermilab's approved inspectors to the extent required to convince the inspectors of conformance to this technical specification and the Governing Code.

(2) Additional inspection methods will be used as set forth in this specification (see section V below). All required approvals or sign-offs will be made by Fermilab's approved inspectors or their approved designees.

(3) Weld defects as identified by any of the examination methods shall be repaired as described in the Governing Code at the fabricator's cost.

D. Welder Qualification

(1) All welders performing welding on this system shall be qualified by the Welding Bureau using an appropriate WPS (Austenitic Stainless Steel Pipe Weld, 2" Schedule 40 and up pipe size, 6G position recommended). Welder Qualification Records (WQR) of these tests shall be provided by the fabricator and approved by Fermilab engineering staff before the welder in question begins any welding on the system.

(2) In addition, each welder will be required to perform one field weld on the actual system under the observation of a Fermilab designated welding inspector. Satisfaction of the inspection will be based on visual examination and subsequent radiographic examination or sectioning if deemed necessary. Successful completion of the test field

welds will be documented by Fermilab personnel for future use in monitoring qualified welders.

E. Materials and Supplies

- (1) All piping materials (including fittings and valves) will be supplied by Fermilab.
- (2) All consumable materials (argon purge gas, filler metals, etc.) shall be provided by the fabricator and billed to Fermilab at cost (prior estimate is required).
- (3) All welding equipment and tools will be provided by the fabricator.
- (4) Equipment rented by the fabricator to complete the job may be back-charged to Fermilab only if prior approval is given by Fermilab engineering staff, Business Services, and Main Injector Project management.

F. Changes to this Specification

- (1) During the course of this work, as unexpected developments occur, modifications to this specification may be required. Any and all changes to this specification must be approved in writing by the Fermilab Project Engineer or authorized representative. Any and all changes shall be documented on the cover sheet of the original of this specification.

II. Preparation for Welding

A. Cleanliness

- (1) All pipes and fittings shall be clean of dirt and debris before pipe fitting begins. All interior surfaces shall be free of chips, grindings, oils, and other contaminants that may be produced by the fitting process before welding begins.
- (2) Mill finish shall be removed from the interior and exterior surfaces of the pipe and fitting ends where welding will take place using 60-100 grit flapper wheels or similar tools. Under no circumstances shall tools be used which can introduce carbon steels or other ferritic contaminants into the stainless steel surfaces. To this end, tools that have been used previously on materials other than austenitic stainless steel shall not be used.
- (3) The work area around each weld site shall be cleaned after work in that area is completed. The work area shall be left free of metal chips, grindings, and other debris which may be produced by the pipe fitting and welding processes. Use of protective cover devices such as plastic sheeting and/or containment trays is allowed and encouraged. Fermilab personnel will assist the fabricator in this area.
- (4) Fire resistant welding 'blankets' shall be used to cover equipment in the area of the weld site. Fermilab shall provide these protective covers to the fabricator.

B. Edge Preparation

- (1) Edges of pipes and fittings to be welded shall be prepped with the features required by the approved WPS (for this application, manual V groove weld) The resulting surfaces shall be smooth, clean, and free of chips and burrs.

C. Alignment

- (1) Alignment of pipe ends shall be within the tolerances specified in the approved WPS (for this application, 1/16" maximum offset).
- (2) Use of custom and/or commercial fixturing devices ("Hi-Lo" gauge, pipe rounder devices, etc.) to achieve alignment required is allowed and encouraged. Fermilab personnel may assist the fabricator to develop these devices at the fabricator's request.

FERMILAB
MAIN INJECTOR
MECHANICAL SUPPORT DEPARTMENT

Welding Technical Specification for
Weld Overlay Repair of Schedule 10 Girth Welds in the
MI LCW System

SPECIFICATION #

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**Welding Technical Specification
for
Weld Overlay Repair of Schedule 10 Girth Welds in the MI LCW System**

PG Hurh
3-4-98

I. General

A. Scope

(1) The following specification describes the requirements for weld overlay repairs on girth welds in the Main Injector Low Conductivity Water System. It covers manual and automatic overlay welding of existing welds on 304L Stainless Steel pipe and components with 316L Stainless Steel filler material.

(2) In addition to and/or reinforcement of the requirements of the Governing Code described below, this document specifies requirements and recommendations to ensure quality weld production. If conflicts arise between this specification and the Governing Code's requirements, it shall be brought to the attention of Fermilab engineering staff for evaluation.

B. Governing Code and Weld Procedure Specifications

(1) The purpose of the welding described in this technical specification is to repair corrosion damage (pitting) due to microbiologically influenced corrosion on existing welds. Therefore the Governing Code shall be the same code as for the original welding, ANSI/ASME B31.3 Process Piping Code. The MI LCW system shall be considered as "Category D Fluid Service" when interpreting Code requirements. However, the repairs described here are not intended to bring all existing welds up to the Governing Code. The repairs are intended to restore the existing welds to their previous quality.

(2) Suitable Weld Procedure Specifications (WPS) and their accompanying Procedure Qualification Records (PQR) shall be provided by the fabricator and approved by Fermilab engineering personnel before welding begins. Because the welding described in this technical specification does not conform to any standard WPS, a suitable WPS will be considered to be one which would be suitable for making a new weld on the same size and schedule pipe. WPS and PQR forms should follow ASME Boiler and Pressure Vessel Code (BPV) Section IX suggested formats and include all information required by BPV Code Section IX.

C. Inspection Requirements

(1) Although not required by the Governing Code (ANSI/ASME B31.3), radiography of 5% of all repaired welds will be performed. This radiography will be performed under Fermilab's direction and Fermilab's cost.

(2) Additional inspection methods will be used as set forth in this specification (see section V below). All required approvals or sign-offs will be made by Fermilab's approved inspectors or their approved designees.

(3) Weld repair defects, as identified by any of the examination methods, *not* related to corrosion pitting or the original state of the welds shall be repaired as directed by Fermilab personnel at the fabricator's cost.

(4) Weld repair defects, as identified by any of the examination methods, related to corrosion pitting or the original state of the welds shall be repaired at Fermilab's discretion and at Fermilab's cost.

D. Welder Qualification

(1) All welders performing welding on this system shall be qualified by the Welding Bureau using an appropriate WPS (Austenitic Stainless Steel Pipe Weld, 2" Schedule 40 and up pipe size, 6G position recommended). Welder Qualification Records (WQR) of these tests shall be provided by the fabricator and approved by Fermilab engineering staff before the welder in question begins any welding on the system.

(2) In addition, each welder will be required to perform one field weld repair on the actual system under the observation of a Fermilab designated welding inspector. Satisfaction of the inspection will be based on visual examination and subsequent radiographic examination or sectioning if deemed necessary. Successful completion of the test field weld repairs will be documented by Fermilab personnel for future use in monitoring qualified welders.

E. Materials and Supplies

(1) All piping materials (including fittings and valves) will be supplied by Fermilab.

(2) All consumable materials (argon purge gas, filler metals, etc.) shall be provided by the fabricator and billed to Fermilab at cost (prior estimate is required).

(3) All welding equipment and tools will be provided by the fabricator.

(4) Equipment rented by the fabricator to complete the job may be back-charged to Fermilab only if prior approval is given by Fermilab engineering staff, Business Services, and Main Injector Project management.

F. Changes to this Specification

(1) During the course of this work, as unexpected developments occur, modifications to this specification may be required. Any and all changes to this specification must be approved in writing by the Fermilab Project Engineer or authorized representative. Any and all changes shall be documented on the cover sheet of the original of this specification.

II. Preparation for Welding

A. Cleanliness

(1) All pipes and fittings shall be clean of dirt and debris before pipe fitting begins. All interior surfaces shall be free of chips, grindings, oils, and other contaminants that may be produced by the fitting process before welding begins.

(2) The work area around each weld site shall be cleaned after work in that area is completed. The work area shall be left free of metal chips, grindings, and other debris which may be produced by the pipe fitting and welding processes. Use of protective cover devices such as plastic sheeting and/or containment trays is allowed and encouraged. Fermilab personnel will assist the fabricator in this area.

(3) Fire resistant welding 'blankets' shall be used to cover equipment in the area of the weld site. Fermilab shall provide these protective covers to the fabricator.

B. Original Weld External Surface Preparation

(1) The crown of the original girth weld shall be removed by grinding to leave a smooth and clean surface at the original pipe outer diameter.

(2) The area 1" to either side of the original weld shall be cleaned using 60-100 grit flapper wheels or other similar tools to remove original weld tint/scale, surface corrosion, mill finish and other contaminants. Under no circumstances shall tools be used

which can introduce carbon steels or other ferritic contaminants into the stainless steel surfaces. To this end, tools that have been used previously on materials other than austenitic stainless steel shall not be used.

C. Alignment

(1) Misalignment is not addressed by this type of weld repair. Original alignment will be deemed adequate for the welding described in this technical specification.

D. Shielding and Backing Gas

(1) All welding shall be performed with argon shielding gas as required in the approved WPS.

(2) All welding shall be performed with argon backing gas as required in the approved WPS. Oxygen monitors shall be used wherever possible to ensure oxygen content local to the weld area is reduced to less than 1%. In areas in which monitoring is not available due to lack of accessibility, backing gas flow rates and purge times shall be determined by tests in similar conditions performed by the fabricator in locations available to monitoring. In addition, suspect areas may be internally inspected by borescope by Fermilab inspectors to ensure proper purge was attained (see section V).

(3) Use of purge devices such as movable purge dams and disintegrating "rice" paper is allowed and encouraged to ensure good purges.

III. Welding

A. Procedure

(1) All welding shall be performed in accordance accepted good welding practice.

(2) **MANUAL ONLY:** The first pass shall be a fusion pass on the center of the original weld to re-fuse the existing weld metal. The welder shall attempt to use current settings appropriate to re-fuse metal at the pipe inner diameter. The welder shall also attempt to observe any pitting visible during the fusion pass and fill those voids with existing weld metal.

(3) **MANUAL ONLY:** The second pass shall be a stringer bead placed on top of the fusion weld, using 316L filler material. The welder shall attempt to identify visible pitting and adjust the location of the second bead to fill those voids with filler metal.

(4) **AUTOMATIC ONLY:** The overlay pass shall be a overlay pass (+/- 1/8" weave suggested) over the original weld to re-fuse the existing weld metal and deposit a bead of new 316L weld metal. The welder shall attempt to use current settings appropriate to re-fuse metal at the pipe inner diameter. The welder shall also attempt to observe any pitting visible during the fusion pass and fill those voids with existing weld metal.

B. Welding Details

(1) Welding shall be done with experienced and qualified welders producing smooth weld beads which do not require grinding of the deposited weld beads to remove splatter or grapes from the weld area.

(2) The final weld surface should extend slightly above the original surface of the pipe by approximately 1/16" to 1/8".

(3) Welding machines shall be used that have RF arc start capability and foot pedals or other devices to taper arc current on starts and stops. Welding arc stops and starts shall be minimized and staggered.

IV. Post-Welding Exterior Surface Treatment

A. Cleaning

(1) All external surfaces in the weld area shall be cleaned of heat tint, slag, and other deposits using 60-100 grit flapper wheels or similar tools. Weld areas shall be allowed to cool (allowing bare hand touch) before performing this mechanical cleaning. Under no circumstances shall tools be used which can introduce carbon steels or other ferritic contaminants into the stainless steel surfaces. To this end, tools that have been used previously on materials other than austenitic stainless steel shall not be used.

B. Final Finish

(1) All external surfaces in the weld area shall be left in a condition suitable for all subsequent inspections (visual, bubble, and hydrostatic pressure tests).

(2) A weld label will be marked (R513-01 for example) adjacent to original welds by Fermilab personnel. Any weld label marking removed or rendered unreadable by the welding process shall be re-marked adjacent to the weld by the fabricator under guidance from Fermilab personnel.

V. Inspection

A. In Progress Inspection

(1) All weld repairs will be externally inspected by visual examination by Fermilab personnel as the work is in progress.

(2) Up to 100% of the weld repairs will be internally inspected by visual examination by Fermilab personnel as the work is in progress.

(3) 5% of all weld repairs will be radiographed at Fermilab's cost as the work is in progress.

(4) Welds that exhibit unacceptable surface finish condition, inclusions, and other flaws *not* related to porosity or the original weld state as outlined in this technical specification shall be repaired by the fabricator at the fabricator's cost by repair methods as directed by Fermilab personnel, or the identified, flawed weld may undergo further inspection (internal visual, radiography, etc.) at the option of Fermilab personnel.

(5) Welds that exhibit defects related to porosity or the original weld state as outlined in this technical specification shall be repaired by the fabricator at Fermilab's discretion and cost, or the identified, flawed welds may undergo further inspection (internal visual, radiography, etc.) at the option of Fermilab personnel.

B. Final Inspection

(1) A pneumatic bubble test shall be performed by the fabricator on all welds. This test will be observed by Fermilab personnel. Air pressure for the test shall be in the range of 10 to 15 psi. Under no circumstances shall the test pressure be allowed to rise over 15 psi. Appropriate safety relief valves (20 psi set pressure) shall be temporarily installed on the system. Fermilab will assist the fabricator with the test set up.

(2) A hydrostatic pressure test will be performed by Fermilab on all welds. The test pressure shall be 225 psi. The fabricator may observe the test and assist with the test set up.

(3) Welds that exhibit unacceptable surface finish condition, inclusions, and other flaws *not* related to porosity or the original weld state as outlined in this technical specification shall be repaired by the fabricator at the fabricator's cost by repair methods as directed by Fermilab personnel, or the identified, flawed weld may undergo further inspection (internal visual, radiography, etc.) at the option of Fermilab personnel.

(4) Welds that exhibit defects related to porosity or the original weld state as outlined in this technical specification shall be repaired by the fabricator at Fermilab's discretion and cost, or the identified, flawed welds may undergo further inspection (internal visual, radiography, etc.) at the option of Fermilab personnel.

(5) Repaired weld repairs shall be required to pass all inspections outlined in this technical specification.