Liquid Metal Engineering Center

Operated for

the U.S. Atomic Energy Commission by Atomics International

A Division of North American Rockwell Corporation

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	RDT F 6-11T, Fabrication and Installation of Piping Subassemblies for Liquid Metal Service Amendment 2, June 1973 <div style="text-align: center;"><p>This document is PUBLICLY RELEASABLE <i>Hugh Kinner</i> Authorizing Official Date: <u>1/30/09</u></p></div>	D	
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<i>E. F. Sheaffer</i> E. F. Sheaffer LMEC Cognizant Engineer			

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UNITED STATES ATOMIC ENERGY COMMISSION
DIVISION OF REACTOR RESEARCH AND DEVELOPMENT

RDT F 6-11T, Amendment 2

Date June 1973

Page 1 of 1

FABRICATION AND INSTALLATION OF PIPING SUBASSEMBLIES FOR LIQUID METAL SERVICE

A M E N D M E N T 2

This amendment forms a part of RDT F 6-11T
dated August 1971

1. Page 6, 4.3.1: Second line, change "hydrostatically" to "pressure".
2. Page 7, 4.3.1.1: Substitute the following:

"4.3.1.1 Pressure Test Fluid. The test fluid shall be subject to purchaser approval. If hydrostatic testing is used, the test fluid shall be water which shall conform to Grade B as defined in RDT F 5-1."
3. Page 7, 4.3.1.2: Delete "hydrostatic" from title and sentence.
4. Page 7, 4.3.1.4: Substitute the following:

"4.3.1.4 Post Pressure Test Cleaning and Sealing. Following the pressure test the piping subassembly shall be cleaned (if further cleaning is required) in accordance with 3.4.6, immediately dried (if required) and packaged in accordance with Section 5."
5. Page 7, 4.4.1, Item 3: Substitute "pressure" for "hydrostatic".
6. Page 10, third item: Delete "hydrostatic".

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E. F. Sheaffer

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R D T S T A N D A R D

UNITED STATES ATOMIC ENERGY COMMISSION
DIVISION OF REACTOR RESEARCH AND DEVELOPMENT

RDT F 6-11T, Amendment 2

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Page 1 of 1

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NUMBER	DESCRIPTION		ACTION
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E. F. Sheaffer

LMEC SW Cognizant Engineer

FABRICATION AND INSTALLATION OF PIPING SUBASSEMBLIES FOR LIQUID METAL SERVICE

A M E N D M E N T 1

This amendment forms a part of RDT F 6-11T
dated August 1971

1. Change title to read:

FABRICATION AND INSTALLATION OF PIPING SUBASSEMBLIES FOR LIQUID METAL
SERVICE

2. Page 1, 1: Change to read:

This standard delineates the requirements for fabrication of piping
subassemblies and installation of piping subassemblies and their
appurtenances into a liquid metal piping system.

3. Page 1, 1.2: Change title of first definition from "Fabricated Piping
Subassembly" to "Piping Subassembly."
4. Page 1, 1.2: In the second definition, delete the words "person or"
from the first sentence.
5. Page 1, 1.2: Add the following:

Installer - The organization which installs and joins components,
piping subassemblies, and appurtenances in the field.

6. Page 1, 2: Change last sentence to read:

Manufacturing or installation shall not proceed until the conflict
is resolved.

7. Page 1, 2.1: Change to read:

2.1 Exceptions. When the applicable documents to be employed in the
manufacture or installation of any part are not identified by this standard
or the documents referenced herein, the fabricator or installer or both
shall submit for purchaser approval the documents he proposes to use.

8. Page 1, 2.2: Change second item in list to:
RDT F 2-2T Quality Assurance Program Requirements
9. Page 1, 2.2: Add new item at end of list:
RDT F 8-6T Hoisting and Rigging of Critical Components and
Related Equipment
10. Page 2, 3.1: Second line, after "fabrication" add "and installation";
after "subassemblies" add "and appurtenances."
11. Page 2, 3.2: First line after "fabrication" add "and installation."
12. Page 2, 3.2.1: Substitute the following:

3.2.1 Code Stamps and Data Reports. Each pipe subassembly and the
installed system shall be marked with the applicable code stamp in
accordance with NA-8000 of the Code. The certification of design
needed to complete the required Data Report will be furnished to the
fabricator and installer by the purchaser or his agent.
13. Page 2, 3.4: Change paragraph heading to read as follows:

3.4 Fabrication and Installation
14. Page 2, 3.4.1: Substitute the following:

3.4.1 Fabrication and Installation Procedures. Detailed procedures for
fabrication or installation shall be submitted by the fabricator or in-
staller, respectively, to the purchaser for his approval. The procedures
shall include, but not be limited to, sequences and procedures for mate-
rial ordering, bending, forming, welding, heat treatment, cleaning, main-
taining cleanliness, machining, cutting, nondestructive examination, weld
joint preparation, weld joint fit-up, closure welds, weld joint identifi-
cation, cold spring, temporary supports, expansion joint installation,
materials control, examination, and testing of all components and the
installed system. The fabrication procedures shall also indicate whether
fabricating operations on the subassemblies are to be performed in the
fabricator's shop or at the jobsite. Standard fit-up, and closure weld
requirements shall be as specified in the Ordering Data. Prior to the
initiation of any work, the fabricator or installer shall obtain from the
purchaser a written release to proceed.
15. Page 3, 3.4.2.2: Substitute the following:

3.4.2.2 Additional requirements for weld-end preparation, weld joint
details, or welding procedures may be given in the Ordering Data.
Backing rings and weld inserts shall be used only as permitted in the
Ordering Data and as specified in RDT E 15-2.

16. Page 3, 3.4.2.3: Substitute the following for the first paragraph:

3.4.2.3 Weld Repair. In addition to meeting the Code requirements, the fabricator or installer shall obtain purchaser approval before making weld repairs to remove defects that recur:

17. Page 3, 3.4.2.4: Substitute the following:

3.4.2.4 Repair of Material Defects. Elimination and repair of material defects discovered during fabrication or installation shall require purchaser approval. After approval, such repairs shall be performed according to a procedure approved by the purchaser, inspected according to a procedure approved by the purchaser, and shall meet Code requirements.

18. Page 3, 3.4.3: Substitute the following:

3.4.3 Heat Treatment. All heat treatment used during fabrication or installation shall be in accordance with the Code, RDT E 15-2, and any supplemental requirements stated in the Ordering Data.

19. Page 3, 3.4.4: End of fourth line, delete "and." Fifth line, after "storage", add: "and installation."

20. Page 4, 3.4.5: First line after "fabricator" add "and installer"; delete the word "fabrication."

21. Page 4, 3.4.6: Add a second paragraph as follows:

The installation of piping subassemblies shall be conducted in a manner to facilitate cleaning, inspection for cleanliness, and to minimize contamination during installation and in the completed system. The installer shall submit, for purchaser approval prior to installation, detailed procedures for cleanliness control during all phases of installation.

22. Page 4, 3.5: Change to a stand-alone title as follows:

3.5 Drawing Requirements

23. Page 4, 3.5: Change present paragraph number to 3.5.1; change item 1. under 3.5.1 to read as follows:

1. The arrangement and part numbers of all parts in the sub-assembly, with dimensions, dimensional tolerances, and section views showing internal details, if any.

24. Page 5: Add a new paragraph as follows:

3.5.2 Installation Drawings. The installer shall prepare detail installation drawings based on design information furnished in the Ordering

Data unless such drawings are provided by the purchaser. Each drawing shall include the configuration of the to-be-installed system showing the relationship of all components and appurtenances to the completed system and to each other. Purchaser approval of the installation drawings shall be obtained by the installer prior to the start of installation. Drawings shall include as a minimum the following information:

1. The arrangement and part numbers of all components, piping subassemblies and appurtenances in the system.
2. A bill of material showing for each component, piping sub-assembly and appurtenance a complete description, including material dimensions as required, and applicable material specification.
3. Details of each closing weld and a weld map which identifies and clearly indicates all welds and the inspections they are to receive.
4. Location, description, and setting, if required, of each temporary and permanent support or restraint, with cross-reference to the applicable support specification.
5. Type and thickness of insulation and heater information with cross-reference to the respective installation documents.
6. System dimensions and dimensional tolerances including locations of bench marks, targets, and triangulation references.
7. Final inspection and testing requirements coordinated with the inspection and test plan required by Section 4 herein.
8. Cold spring.
 - a. Location of joints requiring cold spring.
 - b. Locations for applying the necessary forces and moments.

25. Page 5, 3.6: Substitute the following:

3.6 Identification and Marking. Identification of materials from receiving inspection through finished product shall be in accordance with requirements herein specified in the Quality Assurance Requirements. Marking requirements for the subassemblies shall be in accordance with RDT F 7-3, except that only marking by electrochemical etching shall be used directly on the product. Locations and type of identification marking shall be as indicated on the fabricator's drawing.

Identification marking indicated on the fabricator's drawings shall be repeated on the installation drawings plus the addition of any required installation sequence marking.

26. Page 5, 3.7.1: Change the first sentence to read:

The fabricator and installer, respectively, shall prepare drawings in accordance with 3.5.1 and 3.5.2.

27. Page 5, 3.7.2: Change to read:

3.7.2 Quality Assurance Documents. The fabricator and installer shall prepare and submit quality assurance documents based on the requirements specified under Quality Assurance Requirements. The time and approval requirements of submittals to the purchaser and the number of copies shall be as specified in the Ordering Data.

28. Page 5, 3.7.3: Substitute the following:

3.7.3 Storage. Storage requirements for items which may require storage for a significant period before use, shall be as specified in the Ordering Data. The Ordering Data will list the items, expected storage duration, storage site, and organization responsible. The organization having storage responsibility shall prepare written storage procedures which shall be subject to purchaser approval.

29. Page 5, 3.7.4: Substitute the following:

3.7.4 Handling. Handling of piping subassemblies and appurtenances shall be in conformance with RDT F 8-6. Additional requirements including any necessary precautions to avoid overstress or other damage will be specified by the purchaser in the Ordering Data. Written procedures, subject to purchaser approval, shall be prepared:

- a. By the fabricator to cover handling during fabrication and delivery.
- b. By the installer to cover handling during installation.

Handling functions to be considered shall include support, loading, transfer, and unloading hardware, and attendant document transmittal.

30. Page 5, 3.7.5: Substitute the following:

3.7.5 Fabrication and Installation Reports. The fabricator and installer shall prepare reports in accordance with 4.4.1 and 4.4.2, respectively.

31. Page 5, 3.7.6: Change to read:

3.7.6 Weld Record. The fabricator and installer shall each prepare a weld record as specified in 4.3.3.

32. Page 5, 3.7.7: Change to read:

3.7.7 Data Report. Data reports by the fabricator and installer shall be prepared as required by 3.2.1.

33. Page 5, 3.7.8: Delete.

34. Page 6, 4.1: Change to read:

4.1 Quality Assurance Program. The fabricator and installer shall each establish and implement a quality assurance program in accordance with the Code; RDT E 15-2; and the applicable paragraphs of RDT F 2-2 as defined in the Ordering Data.

35. Page 6, 4.1.1: Substitute the following:

4.1.1 Quality Assurance Plan. The fabricator and installer shall each prepare and submit to the purchaser for approval quality assurance plans and procedures as required for their quality assurance programs. The purchaser will define in the Ordering Data the schedule for submitting the quality assurance plans and procedures.

36. Page 6, 4.1.2: Change to read:

4.1.2 Measurement and Test Instrument Calibration. The fabricator and installer shall each establish and use a calibration system in accordance with RDT F 3-2 for all measurement and test instruments used in examination and testing.

37. Page 6, 4.2: Add the following sentence:

The fabricator's and the installer's records shall include the identity of the person(s) performing and accepting the results of examination of the welds.

38. Page 6, 4.2.2: Add to end of sentence, "in accordance with RDT E 15-2."

39. Page 6, 4.2.4: Change to read:

4.2.4 Helium Leak Test. Helium leak testing shall be conducted in accordance with RDT F 3-6. The types of test and maximum allowable leakage rates will be specified in the Ordering Data. All subassemblies shall be helium leak tested by the fabricator. All closing welds shall be helium leak tested by the installer.

40. Page 6, 4.3.1: Change title to:

4.3.1 Subassembly Test

41. Page 7, 4.3.1.1: Change "Grade A" to "Grade B."

42. Page 7, 4.3.2: Change number of this paragraph to 4.3.3; add new paragraph 4.3.2 as follows:

4.3.2 System Test. Following cleaning in accordance with 3.4.6 herein, the completely installed system shall be pressure tested in accordance with the Code and RDT E 15-2. The test fluid shall be subject to purchaser approval.

43. Page 7, 4.3.2, now 4.3.3 Welding Qualification and Records: Change the second sentence to read:

The records of the fabricator and of the installer shall comply with NA-4900 of the Code. In addition, records shall be made of the joints and of the identity of the welder or welding operator making the joints. These records shall be submitted to the purchaser as specified in the Ordering Data.

44. Page 7, 4.3.3: Change number to 4.3.4 Notification of Tests: After "fabricator" in the first sentence add: "and installer."

45. Page 7, 4.4: After "fabricator" in the first sentence, add: "and installer."

46. Page 7, 4.4.1, Item 4, Change "4.3.2" to "4.3.3."

47. Page 7, Add new paragraph 4.4.2 as follows:

4.4.2 Installation Report. The installer shall prepare an installation report which shall be submitted to and approved by the purchaser prior to the acceptance of the system. The report shall contain the following information as a minimum:

1. Inspection and test plan updated to show any approved deviations from the initial plan.
2. Description of all nonconformances discovered during field fabrication, installation, and inspection with a description of approved action taken.
3. Helium and pressure test reports.
4. Weld record of 4.3.3.
5. Identification of welds and the results of the nondestructive examination of each.
6. Cold reference position, as built, of all piping with installation drawings updated to show final installed dimensions.

48. Page 8, 5.1.3.1: Substitute the following:

5.1.3.1 Hoisting and Rigging. All handling, hoisting, and rigging of piping subassemblies and their appurtenances during fabrication or installation shall be performed in accordance with the requirements of RDT F 8-6.

49. Page 8, 5.1.3.2: Change to read:

5.1.3.2 Ductility of Lifting Devices. Lifting, handling, shipping fixtures, and lifting attachments, provided with the pipe subassemblies or provided by the installer, which are fabricated from ferritic materials, shall be sufficiently ductile to permit safe handling at an ambient temperature of -10 F. If such lifting devices will be used where the ambient temperature can be less than -10 F, the fabricator or installer shall take special precautions to prevent brittle fracture of the material. All welds on lifting devices shall be heat treated as necessary to comply with the above requirements.

50. Page 8, 5.1.3.3: Delete.

51. Page 8, 5.1.3.4: Delete.

52. Page 9, 5.1.3.5: Delete.

53. Page 9, 6.1: In the first line after "fabricate," add "install,".

54. Page 9, 6.2: Change fourth entry from: "Backing-ring and weld insert usage" to: "Weld end preparation details and procedure; backing-ring and weld insert usage." Change sixth entry Applicable Section Number to "3.5.1." Change eighth entry from "Items and duration of storage, and storage site," to "Storage requirements, items to be stored, storage duration, site, and organization responsible." Change tenth entry from "Quality Verification Plan submission schedule" to "Quality Assurance Plans and Procedures submission schedule." Add to the check-list in their proper sequence:

<u>Item</u>	<u>Applicable Section No.</u>
Fit-up, closure welds	3.4.1
Special heat treatment	3.4.3
Cleaning procedures	3.4.6
Installation drawings	3.5.2
Handling requirements	3.7.4
Applicable paragraphs of RDT F 2-2	4.1

55. Page 10: Change Applicable Section No. of fourth item from 4.3.2 to 4.3.3. Delete sixth (last) item.

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RDT Standard

FABRICATION OF PIPING SUBASSEMBLIES FOR LIQUID METAL SERVICE

August 1971

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Division of Reactor Development and Technology
United States Atomic Energy Commission

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NUMBER	DESCRIPTION		ACTION
	The following tentative RDT standard has been approved for trial use: RDT F 6-11T, Fabrication of Piping Subassemblies for Liquid Metal Service, August 1971		
	RDT Sr. Site Rep., <u>W</u>		
SIGNATURE

E. F. Sheaffer			

Standard Writer
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FABRICATION OF PIPING SUBASSEMBLIES FOR LIQUID METAL SERVICE

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FABRICATION OF PIPING SUBASSEMBLIES FOR LIQUID METAL SERVICE

1. SCOPE

This standard delineates the requirements for fabrication of piping sub-assemblies to be used in liquid metal piping systems.

1.2 Definitions

Fabricated Piping Subassembly - Sections of a piping system consisting of components, fittings, pipe or tubes which are fabricated as subassemblies in a shop or in the field before they are installed in a system.

Fabricator - The person or organization which forms and joins piping components into integral pieces ready for assembly into a system. This includes bending, forming, welding, or other operations upon these components.

Liquid Metal Piping Systems - Piping systems which may contain liquid metal or liquid metal vapor.

Purchaser - A person or corporation who purchases services or articles in accordance with this standard.

2. APPLICABLE DOCUMENTS

The documents listed in this section form a part of this standard to the extent specified herein. The issue in effect on the date of order, together with any addenda or amendments also in effect on that date, shall apply. Any conflict noted in this standard or in any document referenced herein shall be brought to the attention of the purchaser with a proposed recommendation for resolving the conflict. Resolution of the conflict shall be the responsibility of the purchaser. Manufacturing shall not proceed until the conflict is resolved.

2.1 Exceptions. When the applicable documents to be employed in the manufacture of any part are not identified by this standard or the documents referenced herein, the fabricator shall submit for purchaser approval the documents he proposes to use.

2.2 AEC-Reactor Development and Technology (RDT) Standards

RDT E 15-2T	Requirements for Nuclear Components (Supplement to ASME Boiler and Pressure Vessel Code, Section III)
RDT F 2-4T	Quality Verification Program Requirements
RDT F 3-2T	Calibration System Requirements

RDT F 3-6T	Nondestructive Examination
RDT F 5-1T	Cleaning and Cleanliness Requirements for Nuclear Reactor Components
RDT F 7-2T	Preparations for Sealing, Packaging, Packing, and Marking of Components for Shipment and Storage
RDT F 7-3T	Requirements for Identification Marking of Reactor Plant Components and Piping

2.3 American National Standards Institute (ANSI) Standards

ANSI Y14 Drafting Manual

2.4 American Society of Mechanical Engineers (ASME) Codes

ASME Boiler and Pressure Vessel Code, Section III, Nuclear Power Plant Components

3. TECHNICAL REQUIREMENTS

3.1 General. The work includes the performance of all operations necessary for the fabrication of piping subassemblies in accordance with this RDT standard, and with supplemental information included in the Ordering Data.

3.2 Code and Classification. All piping fabrication shall be performed in accordance with the requirements of Section III of the ASME Boiler and Pressure Vessel Code, hereinafter referred to as the Code, and with the supplemental requirements of RDT E 15-2 and this standard. The code classification for the piping will be specified in the Ordering Data.

3.2.1 Code Stamp and Data Report. Each pipe subassembly shall be marked with the applicable NPT code symbol in accordance with Article NA-8000 of the Code. The certification of design needed to complete the required Data Report, Form NPP-1, will be furnished to the fabricator by the purchaser.

3.3 Materials. All materials will be specified in the Ordering Data. Use of materials other than those designated in the Ordering Data shall require written approval of the purchaser.

3.4 Fabrication

3.4.1 Fabrication Procedures. Detailed fabrication and handling procedures shall be submitted by the fabricator to the purchaser for his approval. Prior to initiation of fabrication of any portion of the piping subassemblies, the fabricator shall obtain from the purchaser a written release to fabricate. The fabrication procedures shall include but not be limited to sequences and procedures for material ordering, bending and forming, welding, heat treatment, cleaning, maintaining cleanliness, machining, NDT examination, weld joint

identification, materials control, and testing of all parts of the piping subassemblies. The fabrication procedures shall also indicate whether fabricating operations on the subassembly are to be performed in the fabricator's shop or at the job site.

3.4.2 Welding. Welding shall meet the requirements of the Code as supplemented by RDT E 15-2.

3.4.2.1 Only concave fillet welds shall be permitted. The concavity of the fillet welds shall conform to Figure NB-4427-1 of the Code. Inspection and documentation necessary to show conformance with the above requirement shall be provided by the fabricator as required by paragraph 4.4.1.

3.4.2.2 Backing rings and weld inserts shall be used only as permitted in the Ordering Data.

3.4.2.3 Weld Repair. In addition to meeting Code requirements, the fabricator shall obtain purchaser approval before making weld repairs to remove defects that recur:

1. After the first cycle of weld repair of defects at the fusion zone or adjacent base metal.
2. After the second cycle of weld repair in welds that are heat treated after each repair cycle.

Repair of crater cracks restricted to the crater of the weld pass does not require purchaser approval.

3.4.2.4 Repair of Material Defects. Elimination and repair of material defects discovered during fabrication shall require purchaser approval. After approval, such repairs shall be performed to a procedure approved by the purchaser, and shall meet the Code requirements.

3.4.2.5 Dissimilar Metal Welds. Welds joining dissimilar metals shall not be permitted unless specifically authorized in writing by the purchaser. This provision shall include temporary attachments such as handling attachments and shop tooling.

3.4.3 Heat Treatment. All heat treatment used during fabrication shall be in accordance with the Code and RDT E 15-2.

3.4.4 Sensitization. Austenitic stainless steel which could possibly be sensitized as a result of heat treatment, welding, or hot forming, shall be solution annealed per the applicable standard or shall be protected against corrosion and moisture during all subsequent manufacturing, testing, and storage operations, unless it can be proved that the material has not become sensitized. Whenever possible, solution annealing shall be used. The method of protecting sensitized material which is not solution annealed subsequent to heat treatment, welding, or hot forming shall be subject to the approval of the purchaser.

3.4.5 Surface Finish. The fabricator shall select fabrication processes to provide surface finishes as specified in the Ordering Data. Unspecified sharp edges shall be relieved to 1/64-in. radius minimum.

3.4.6 Cleaning. The fabrication of a pipe subassembly shall be conducted to facilitate cleaning and inspection for cleanliness, and to minimize contamination during fabrication. Surfaces shall be cleaned in accordance with RDT F 5-1 and shall be maintained in a clean condition throughout all fabrication procedures. Written cleaning procedures shall be prepared by the fabricator in accordance with RDT F 5-1. Once fabrication of the subassembly has proceeded such that visual inspection of all internal surfaces, for cleanliness, is not possible, the fabricator shall seal all openings of the subassembly in accordance with F 7-2 to prevent contamination. Except as required during the normal course of fabrication, the seals shall not be broken. For these cases, appropriate precautions, including use of clean rooms, clean areas, glove boxes, etc., shall be employed to preclude entry of foreign material into the subassembly during the fabrication operations. If the seal should be lost and there is no assurance that foreign matter has not entered the subassembly, then the subassembly shall be recleaned to meet the requirements of RDT F 5-1. The pipe subassembly shall be suitable for installation without additional cleaning. The fabricator furnishing components that meet the requirements of RDT F 5-1 shall be responsible for ensuring that all items furnished by his subcontractors conform to the same cleanliness requirements.

3.5 Shop Drawings. Unless provided by the purchaser, detail drawings shall be prepared by the fabricator from design drawings and information supplied by the purchaser in the Ordering Data. Such design drawings and information will include an identifying number, configuration, and limits of each subassembly, internals if any, special weld details, and welding and preparation requirements. Drawings by the fabricator shall be in accordance with ANSI Y14 and shall be complete in such detail as to permit all parts to be duplicated by any other qualified fabricator. Purchaser approval of the respective drawings shall be obtained by the fabricator prior to start of fabrication of any given pipe subassembly. Drawings shall include the following information:

1. The arrangement and part numbers of all piping components in the subassembly, with section views showing internal details, if any.
2. A bill of material showing for each part number a complete description, including material dimensions as required, and applicable material specification.
3. Details of each weld and a weld map which identifies and clearly indicates all welds and the type of inspection they are to receive.
4. Details of temporary welded attachments such as those for handling and shop tooling.

5. Subassembly weight (may be actual or calculated); accuracy shall be stated.
6. Inspection and testing requirements coordinated with the Inspection and Test Plan required by Section 4 herein.
7. Location of lifting points.

3.6 Identification and Marking. Identification of materials from receiving inspection through finished product shall be in accordance with the requirements of the Code and RDT F 2-4. Marking requirements for the subassemblies shall be in accordance with RDT F 7-3, except that only marking by electrochemical etching or vibrating marking tool shall be used directly on the product. Locations and type of identification marking shall be indicated on the fabricator's drawing.

3.7 Reports and Documentation

3.7.1 Drawings. The fabricator shall prepare shop drawings in accordance with paragraph 3.5. The time and approval requirements of submittals to the purchaser and the number of copies required shall be as specified in the Ordering Data.

3.7.2 Quality Verification Documents. The fabricator shall prepare quality verification documents based on the requirements of RDT F 2-4. The time and approval requirements of submittals to the purchaser and the number of copies required shall be as specified in the Ordering Data.

3.7.3 Storage. The purchaser will specify which items will be stored at the designated site for a significant period before use. The fabricator shall provide written procedures for the storage and support of all such items.

3.7.4 Loading and Unloading. The fabricator shall provide written procedures for loading and unloading of subassemblies for which he has delivery responsibility. Such procedures shall specify handling and support required for the subassemblies to prevent overstressing the material, and shall be submitted to the purchaser for approval. The fabricator shall provide all documentation necessary to release the component to an authorized site representative.

3.7.5 Fabrication Report. The fabricator shall prepare a fabrication report in accordance with paragraph 4.4.1.

3.7.6 Weld Record. The fabricator shall prepare a weld record as specified in paragraph 4.3.2.

3.7.7 Data Report. A Data Report shall be prepared as required by paragraph 3.2.1.

3.7.8 Nonconformances. Where discrepancies are discovered to exist between the approved drawings and the actual subassembly, the discrepancies shall be immediately documented as a nonconformance and submitted to the purchaser,

together with justified technical recommendations necessary to resolve the nonconformance. Work on nonconforming items shall be placed in a "HOLD" status until the nonconformance is resolved.

3.8 Archive Samples. Samples of materials used shall be properly identified and retained as specified in the Ordering Data.

4. QUALITY ASSURANCE REQUIREMENTS

4.1 Quality Verification Program. The fabricator shall maintain and use a quality verification program in accordance with RDT F 2-4, RDT E 15-2, and the Code. The fabricator shall comply with the following additional provisions.

4.1.1 Quality Verification Plan. The fabricator shall prepare and submit a quality verification plan in accordance with RDT F 2-4 to the purchaser for approval. The purchaser will define in the Ordering Data the schedule for submitting the quality verification plan.

4.1.2 Measurement and Test Instrument Calibration. The fabricator shall establish and use a calibration system in accordance with RDT F 3-2 for all measurement and test instruments used in examination and testing.

4.2 Examination of Welds. All nondestructive examination shall be performed according to the methods defined in the Code as supplemented by RDT E 15-2. The extent of the examination will be specified in the Ordering Data.

4.2.1 Visual. Welded joints and repair welds shall be visually inspected for compliance with the Code and RDT E 15-2. Dimensional inspection of the welds shall be based upon a reference line which is permanently marked on the material at a known distance from the joint, in accordance with paragraph 3.6.

4.2.2 Liquid Penetrant Method. Liquid penetrant examination shall be performed using a solvent removable, visible dye penetrant method.

4.2.3 Post Pressure Test Penetrant Inspection. If liquid penetrant examination is required following hydrostatic testing, it will be specified in the Ordering Data. Post-test weld repairs shall be made only if authorized by the purchaser.

4.2.4 Helium Leak Test. A helium leak test shall be conducted in accordance with RDT F 3-6. The type of test and the maximum allowable leakage rate will be specified in the Ordering Data.

4.3 Tests

4.3.1 Hydrostatic Test. Following cleaning in accordance with paragraph 3.4.6 herein, each completed pipe subassembly shall be hydrostatically tested in accordance with the Code and RDT E 15-2. The fabricator shall identify in the test procedure all instrumentation used in the test.

4.3.1.1 Hydrostatic Test Water. The hydrostatic test water shall conform to Grade A as defined in RDT F 5-1.

4.3.1.2 Hydrostatic Test Pressure. The hydrostatic test pressure shall be as specified in the Ordering Data.

4.3.1.3 Reporting Leakage. The fabricator shall report to the purchaser any indication of leakage (end closures exempted) or physical distortions before corrective action is taken. The location of the leak and the corrective action taken shall be reported in the fabrication report.

4.3.1.4 Post Hydrostatic Test Cleaning and Sealing. Following the hydrostatic test, the pipe subassembly shall be cleaned (if further cleaning is required) in accordance with paragraph 3.4.6, and shall be immediately dried and packaged in accordance with Section 5.

4.3.2 Welding Qualification and Records. Qualification of the welding procedures to be used and of the performance of welders and welding operators shall comply with the requirements of the Code as supplemented by RDT E 15-2. The fabricator's records shall comply with paragraph NA-4900 of the Code, except that the fabricator will also include a record of joints and the identity of the welding operator making the joints as a part of documentation requirements specified in the Ordering Data.

4.3.3 Notification of Tests. The fabricator shall keep the purchaser informed of the progress of the work and shall notify him of any required tests or inspections at the time the Code Inspector is notified, but not less than five days in advance.

4.4 Quality Control Documentation Requirements. The fabricator shall provide the following documentation as evidence of quality control.

4.4.1 Fabrication Report. The fabricator shall prepare a fabrication report which shall be submitted to and approved by the purchaser prior to shipment of the pipe subassemblies. The report shall contain at least the following information:

1. Inspection and test plan updated to show any approved deviations from the initial plan.
2. Description of all nonconformances discovered during fabrication and inspection, with a description of approved action taken.
3. Hydrostatic test reports.
4. Weld record of paragraph 4.3.2.
5. Heat treatment, including certified furnace charts.
6. Identification of welds and the results of the nondestructive examination of each.
7. List of parts fabricated and their weights.

5. PREPARATION FOR DELIVERY

5.1 Preparation. Upon completion of all shop inspection, the fabricator shall prepare the piping subassemblies for delivery to the designated site.

5.1.1 Packaging and Packing. Pipe subassemblies shall be protected against corrosion and mechanical damage. Sealing, packaging, packing, and identification marking shall be in accordance with RDT F 7-2. Packaging shall be adequate to protect the pipe subassemblies while at the fabricator's facilities awaiting shipment, during transportation to the designated site, and at the designated site prior to unpacking. Inside and outside surfaces shall be considered critical as defined in RDT F 7-2. Piping subassemblies shall be packaged, insofar as practical, in accordance with paragraph 8.2 of RDT F 7-2, except that the weight limitation shall not apply. Plastic sheet or other nonmetallic wrapping materials in contact with the pipe shall conform to the restrictions of Section 5 of RDT F 7-2. The fabricator's materials and methods of packaging shall be submitted to the purchaser for approval before packaging is begun.

5.1.2 Shipping. The fabricator shall be responsible for the items discussed in the following paragraphs.

5.1.2.1 Shipping Instructions. The fabricator shall prepare suitable instructions to the shipper for handling, shipping, in-transit storage, and storing of all items for which the fabricator has delivery responsibility.

5.1.2.2 Documentation. The fabricator shall provide a shipping list which includes identification of all technical documentation identified in the Ordering Data, to accompany deliverable items during shipment.

5.1.3 Handling

5.1.3.1 Handling Fixtures. Special lifting or handling fixtures, lifting slings, and cables shall be designed or sized for a static load of five times normal anticipated static loads, based upon ultimate material strength.

5.1.3.2 Ductility of Lifting Devices. Lifting, handling, shipping fixtures, and lifting attachments provided with the pipe subassemblies, and which are fabricated from ferritic materials, shall be sufficiently ductile to permit safe handling and shipment at an ambient temperature of -10 F. If shipment is scheduled for the winter months (October through March inclusive), and the anticipated ambient temperature may be less than -10 F, the fabricator shall take special precautions to prevent brittle fracture of the material. All welds shall be heat treated as necessary to comply with the above requirements.

5.1.3.3 Upending. If the pipe subassembly to be handled requires upending, points of attachments for chain falls, trunnions, or other features shall be provided so that upending can be done in a safe, controlled manner.

5.1.3.4 Prohibited Materials. Use of cast iron, cast steel or bronze, in any lifting or handling fixture is prohibited.

5.1.3.5 Proof Testing. If required in the Ordering Data, proof tests shall be performed on, and documented for, shipping fixtures and all lifting slings, cable and all other lifting and handling equipment used in handling the sub-assemblies, prior to use on components to ensure safe handling of these components. All lifting and handling equipment and all shipping fixtures shall be tested statically to 150 percent of the total load to be lifted, and at 125 percent of the total load to be lifted at the speeds and motions which would be expected during actual handling operations. Following proof load testing, all structural welds of these items shall be examined by the magnetic particle or liquid penetrant method in accordance with the requirements of paragraph 4.2 herein. All slings and hooks not containing structural welds, used in lifting the subassemblies, shall as a minimum be visually examined for structural defects, both prior to and subsequent to proof loading tests.

6. NOTES AND ORDERING DATA

6.1 Ordering Data. The detailed requirements necessary to fabricate, examine, test, and deliver a pipe subassembly in accordance with this standard are included in the Ordering Data. These requirements are also listed in the Ordering Data Checklist. The list includes topics to which the standard makes specific reference, and supplemental information which must be defined by the purchaser.

6.2 Ordering Data Checklist

<u>Item</u>	<u>Applicable Section No.</u>
Piping subassemblies to be fabricated	3.1
Code classification	3.2
Specific materials	3.3
Backing-ring and weld insert usage	3.4.2.2
Surface finish	3.4.5
Design drawings and information	3.5
Reports and documentation, time and approval requirements	3.7
Items and duration of storage, and storage site	3.7.3
Material archive sample requirements	3.8
Quality Verification Plan submission schedule	4.1.1
Nondestructive examination methods and extent of examination to be applied	4.2

<u>Item</u>	<u>Applicable Section No.</u>
Post pressure test penetrant inspection requirements	4.2.3
Helium leak test type and maximum allowable leakage rate	4.2.4
Hydrostatic test pressure	4.3.1.2
Weld record requirements	4.3.2
Shipping list documentation	5.1.2.2
Proof testing, whether or not required for lifting fixtures	5.1.3.5