RDT Standard

CORE RESTRAINT MECHANISM
FOR SODIUM COOLED REACTORS
(FABRICATION ONLY)

OCTOBER 1972

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Division of Reactor Development and Technology
United States Atomic Energy Commission

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CORE RESTRAINT MECHANISM FOR SODIUM COOLED REACTORS (FABRICATION ONLY)

1. SCOPE

This standard sets forth the requirements for the fabrication, quality assurance, packaging and delivery of the Core Restraint Mechanism for use in a liquid metal cooled reactor and is not applicable to water cooled reactors. The Ordering Data establishes the specific requirements for a particular Core Restraint Mechanism.

1.1 Components and Services to be Provided. All components and services to be provided by the manufacturer are as specified in the Ordering Data.

1.2 Compliance. The Core Restraint Mechanism shall be certified by the manufacturer to be correct and complete with respect to the requirements of the standards and other documents referenced herein and in the Ordering Data.

1.3 Definitions.

Core Restraint Mechanism - The complete unit including in-reactor assemblies, head mounted actuator and associated control equipment, which applies radial restraint at the core perimeter.

Purchaser - The person, corporation, or duly authorized representative who purchases services or deliverable items in accordance with this standard.

Manufacturer - A contractor or subcontractor actually performing the services or producing the contracted for deliverable items in accordance with this standard.

Designated Site - That location at which transportation of the Core Restraint Mechanism and associated components terminates in accordance with purchaser's instructions, and the purchaser or purchaser's representative accepts delivery of all deliverable items.

Deliverable Items - The Core Restraint Mechanism and associated components, their shipping containers and those special tools and special handling devices that are required for any subsequent operation.

Special Handling Devices - Those deliverable items associated with the handling of the Core Restraint Mechanism which may be required for subsequent handling operations and which can be delivered. Examples of such items include lifting frames, pallets, spreader bars and slings.

Manufacturing Drawings - Supplementary drawings prepared by the manufacturer to aid in the fabrication and assembly of the Core Restraint Mechanism.

Special Tools - Those nonstandard tools which are required to carry out repair or replacement of Core Restraint Mechanism components.

Sensitization - The intergranular precipitation of chromium carbide in austenitic stainless steels when exposed to temperatures in the approximate range of 800 F to 1600 F. The depletion of chromium content in the thin envelope surrounding each grain promotes susceptibility to corrosive attack.

Ordering Data - The design conditions and other requirements that are specified in the specification package. The Ordering Data supplements this standard in defining the requirements for procurement of the Core Restraint Mechanism.

Interfacing Hardware Items - Those components which have a common boundary with the Core Restraint Mechanism. Examples of such components are core support structure, radial shield, core instrumentation, etc.

2. APPLICABLE DOCUMENTS

The following documents are a part of this standard to the extent specified in the text. The issue of a document in effect on the date of invitation to bid, including any amendments also in effect on that date, shall apply unless otherwise specified. Where the standard appears to conflict with the requirements of a reference document, the manufacturer shall call such conflict to the attention of the purchaser for resolution. Where the materials or specifications to be employed in the manufacture of any part are not identified in this standard or the documents referenced herein, the manufacturer shall submit for purchaser approval the material specifications or standards he proposes to use. The Ordering Data supplements the corresponding applicable sections of this standard.

2.1 RDT Standards

C 17-4T, General Instrumentation

E 15-2T, Requirements for Nuclear Components (Supplement to ASME Boiler and Pressure Vessel Code, Section III)

F 2-2T, Quality Assurance Program Requirements

F 2-4T, Quality Verification Program Requirements

F 3-6T, Nondestructive Examination

F 3-37T, Special Requirements for Metal Products

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- F 4-20T, Operation and Maintenance Manuals
 - F 5-1T, Cleaning and Cleanliness Requirements for Nuclear Components
 - F 6-5T, Welding Qualifications (Supplement to ASME Boiler and Pressure Vessel Code, Section IX)
 - F 6-10T, Repair of Materials by Welding
 - F 7-2T, Preparations for Sealing, Packaging, Packing, and Marking of Components for Shipment and Storage
 - F 7-3T, Requirements for Identification Marking of Reactor Plant Components and Piping
 - F 8-1T, Preloading Threaded Fasteners and Closures
 - F 8-6T, Hoisting and Rigging of Critical Components and Related Equipment
 - M 1-1T, Stainless Steel Covered Welding Electrodes (ASME SFA-5.4 with Additional Requirements)
 - M 1-2T, Stainless Steel Welding Rods and Bare Electrodes (ASME SFA-5.9 with Additional Requirements)
 - M 1-5T, Welding Rods and Electrodes Surfacing (AWS A5.13 with Additional Requirements)
 - M 1-6T, Mild Steel Electrodes and Welding Rods (ASME SFA-5.18 with Additional Requirements)
 - M 1-11T, Nickel and Nickel-Alloy Bare Welding Rods and Electrodes (ASME SFA-5.14 with Additional Requirements)
 - M 1-19T, Nickel-Chromium-Molybdenum-Columbium Bare Welding Rods and Electrodes (ASME SFA-5.14 with Additional Requirements)
 - M 2-2T, Stainless and Low Alloy Steel Forgings (ASME SA-182 with Additional Requirements)
 - M 2-4T, Alloy Steel Forgings (ASME SA-336 with Additional Requirements)
 - M 2-7T, Carbons and Alloy Steel Forgings, Vacuum Treated (ASME SA-508 with Additional Requirements)
 - M 2-15T, Nickel-Chromium Alloy Bars, Forgings, and Forging Stock (ASTM A637 with Additional Requirements)
 - M 3-2T, Stainless and Alloy Steel Seamless Tubes (ASME SA-213 with Additional Requirements)

- M 3-3T, Austenitic Stainless Steel Seamless Pipe (ASME SA-376 with Additional Requirements)
- M 3-6T, Austenitic Stainless Steel Pipe (ASME SA-312 with Additional Requirements)
- M 5-1T, Stainless Steel Plate, Sheet and Strip (ASME SA-240 with Additional Requirements)
- M 5-20T, Nickel-Chromium-Molybdenum-Columbium Alloy Plate, Sheet, and Strip (AMS 5597 with Additional Requirements)
- M 5-21T, Nickel-Chromium-Molybdenum-Columbium Alloy Plate, Sheet, and Strip (AMS 5596 with Additional Requirements)
- M 6-1T, Alloy Steel Bolting Material for Low Temperature Service (ASME SA-320 with Additional Requirements)
- M 6-2T, Mechanical Locking Devices
- M 6-3T, Alloy Steel Bolting Material for High Temperature Service (ASME SA-193 with Additional Requirements)
- M 6-4T, Alloy Steel Nuts for Bolting for High Temperature Service (ASME SA-194 with Additional Requirements)
- M 7-3T, Stainless Steel Bars and Shapes (ASME SA-479 with Additional Requirements)
- M 7-4T, Nickel-Chromium-Iron Alloy Rod and Bar (ASME SB-166 with Additional Requirements)
- M 7-7T, Cobalt-Chromium Alloy Bars and Shapes
- M 9-1T, Material and Fabrication Requirements for Ni-Cr-Fe Alloy Seal Applications
- M 9-2T, Examination Requirements and Acceptance Standards for Seal Membranes
- M 11-1T, Non-metallic Seal Materials

2.2 American National Standards Institute (ANSI)

ANSI B46.1 - Surface Texture

ANSI Y14 - Drafting Manual

ANSI B1.1 - Unified Screw Threads

2.3 American Society of Mechanical Engineers (ASME)

Boiler and Pressure Vessel Code

Section III Nuclear Power Plant Components

Section IX Welding Qualifications

2.4 American Society for Testing and Materials (ASTM)

ASTM E 29, Recommended Practices for Indicating Which Plates of Figures Are to be Considered Significant in Specified Limiting Values.

2.5 Drawings. Drawings as listed in Ordering Data.

2.6 Other Documents. Other codes, standards and specifications will be as specified in the Ordering Data.

3. TECHNICAL REQUIREMENTS

3.1 General. The Core Restraint Mechanism consists of a core radial circumference loading device and associated actuating linkages, shielding and monitoring instrumentation. All in-vessel portions of the mechanism are mounted on the core support structure and spaced at regular intervals around the core circumference. The ex-vessel portions of the mechanism are supported from the head and are spaced at regular intervals around the outer head circumference.

3.2 Materials. Materials and materials standards for Core Restraint Mechanism are listed in Table 1. Additional specific material requirements shall be as specified on applicable drawings and in the Ordering Data. Purchaser approval is required for the use of alternate materials.

3.3 Fabrication. The Core Restraint Mechanism shall be fabricated in accordance with the ASME Boiler and Pressure Vessel Code Section III (hereafter referred to as the Code) for Class 1 vessel, (except that an "N" stamp is not required), and in accordance with RDT Standards and other documents referenced in section 2, the Ordering Data, and the following:

An NPT stamp is required for all parts of the Core Restraint Mechanism that form a part of the pressure boundary as specified in the Ordering Data. An NPT stamp is not required for parts not defined as part of the pressure boundary. The design condition shall be as specified in the Ordering Data.

3.3.1 Fabrication Release. The release to fabricate component parts and assemblies, including all deliverable items, requires prior purchaser approval. Prior to receiving a fabrication release, the manufacturer must submit the following documents to the purchaser for approval, and have received such approval:

1. Quality Assurance Program Plan
2. Inspection and Test Plan
3. Assembly Procedure
4. Fabrication Plan (including heat treatment)
5. Welder Qualification and Welding Procedures
6. Cleaning and Cleanliness Control Procedures

Fabrication release as described in this paragraph in no way abrogates the requirements to qualify welders and welding procedures prior to start of component fabrication.

3.3.2 Threaded Elements and Bolts. Threaded connections shall conform to the following requirements:

1. All screwthreads shall be in accordance with ANSI B1.1.
2. Threads shall conform to the Unified-Thread Form, unless otherwise specified.
3. Thread fits shall be Unified 2A-2B or National Class 2, unless otherwise specified.
4. The use of cap bolts for closures is not permitted.
5. All threaded fasteners shall be a minimum of 1/2 inch diameter, nominal.
6. Lubricants applied to threaded parts exposed to sodium shall be approved by the purchaser.
7. Torquing and thermal straining shall be in accordance with RDT F 8-1.
8. All threaded fasteners shall have locking devices in accordance with RDT M 6-2.

3.3.3 Welding and Thermal Cutting. All welding and thermal cutting operations shall comply with the Code and as supplemented by RDT E 15-2. Purchaser approval is required to make weld repairs to remove weld 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 repair in welds that are heat treated after each repair cycle, and
3. After the third cycle of weld repair for all other welds.

Welds shall be designed to permit radiographic examination, whenever practicable. Purchaser approval is required for all structural welds that cannot be radiographed.

3.3.4 Heat Treatment. All heat treatment for starting materials (Table 1) shall be in accordance with the applicable material standards. The heat treatments which are to be applied to the structure after welding, machining, bending, forming and straightening operations shall be in accordance with the provisions of the Ordering Data. Austenitic stainless steel which has undergone sensitization during heat treatment, welding or forming shall be solution heat treated per the applicable standard unless otherwise specified in the Ordering Data. If the structure is of such geometry as to preclude solution heat treatment, the proposed heat treat or corrosion protection plans shall be submitted to the purchaser for approval.

3.3.5 Bending and Forming. Bending and forming procedures for shaping tubes, plates, bars, etc., shall be in accordance with the procedures prepared by the manufacturer and approved by the purchaser. The wall thickness after the bending and forming operations shall be not less than the minimum design thickness. The out-of-roundness in any circular cross section of pipes and tubes after bending is to be in accordance with the Code.

3.3.6 Surface Finish. The manufacturer shall select fabrication processes to give the following surface finishes unless otherwise specified in the Ordering Data.

1. Surfaces in contact with sodium - 250 microinches or better
2. Mating surfaces - 63 microinches or better
3. Welds in accordance with the requirements of the code as supplemented by RDT E 15-2.
4. Heat transfer tubing - 63 microinches or better
5. Tubesheet holes - 125 microinches or better
6. All machined surfaces shall be 250 microinches or better
7. Where plate surfaces will not be subsequently machined or otherwise finished during fabrication the material shall be ordered hot rolled, solution annealed, surface cleaned and polished in accordance with RDT M 5-1.

Surface finish shall be measured in accordance with ANSI B46.1.

3.3.7 Special Processes. The following processes are prohibited, except for specific applications for which prior purchaser approval has been obtained.

1. Plating
2. Weld peening
3. Hard surfacing

TABLE 1. MATERIAL REQUIREMENTS CHART

Material Product Form	Material Type or Grade	RDT Standard or Other Description of Material	Required Options in RDT Standards
Weld Electrode	E-308-15 or 16	RDT M 1-1	--
Weld Wire	ER-308	RDT M 1-2	--
Weld Wire	Inconel 718	RDT M 1-19	--
Weld Wire	Inconel 718	RDT M 1-11	--
Forgings	F-304	RDT M 2-2	--
Forgings	F-8	RDT M 2-4	3
Forgings	SA-508	RDT M 2-7	--
Tubes	TP-304	RDT M 3-2	2
Pipe	TP-304	RDT M 3-3	3
Pipe	304	RDT M 3-6	1
Plate, Sheet, Strip	304	RDT M 5-1	3
Sheet, Strip, Plate	Inconel 718	RDT M 5-21	--
Bolting Material	B8	RDT M 6-1	--
Bolting Material	B8	RDT M 6-3	--
Bars and Shapes	304	RDT M 7-3	--
Bars, Rods	Inconel 600	RDT M 7-4	--
Bars and Shapes	Stellite 6B	RDT M 7-7	--
Bars, Forgings	Inconel 718	RDT M 2-15	--
Mechanical Locking Devices	--	RDT M 6-2	--
Seal Materials	--	RDT M 11-1	--

3.3.8 Cleanliness and Cleaning. Shop practices and restrictions on the use of materials shall be in accordance with RDT F 5-1. The manufacturer shall include the appropriate instruction and restrictions in his fabrication procedures and other documents defining acceptable shop practices.

External carbon-steel structural support members shall be protected from atmospheric corrosion by suitable methods in accordance with the manufacturer's practices. Machined mating surfaces shall be protected from corrosion and damage by suitable passivation and protective devices to be approved by the purchaser.

3.3.9 Assembly Procedure. The assembly of component parts is to be done in accordance with a detailed assembly procedure prepared by the manufacturer and approved by the purchaser. The time and approval requirements of submittals to the purchaser shall be as specified in the Ordering Data. The procedure shall contain as a minimum:

1. Assembly sequence
2. Cleaning procedures, sequence, and precautionary rules
3. Any special machining or fitting-at-assembly instructions
4. Intermediate and final inspection criteria and hold points
5. Handling methods, equipment and precautions
6. Procedures for the locking of locking devices
7. Drawings or photographs as required to illustrate assembly problems or techniques
8. Special data, measurements, or observations to be recorded in quality control records
9. Welding procedures
10. Tightening torques for threaded parts
11. Heat treatment procedures.

3.3.10 Identification. Identification procedures shall conform with the following requirements in accordance with the applicable material standard:

1. Materials. All materials shall be identified in accordance with the requirements of the applicable material standard. When raw material is cut or sectioned, all markings shall be transferred to the unmarked portion of the material.

2. Parts. Components of the Core Restraint Mechanism and all deliverable items shall be identified and permanently marked in accordance with RDT F 7-3. The identification of parts shall include order or contract number, drawing number and revision number and part number; if applicable, component identification and other special information necessary to clearly identify the part. The use of metal stamping is prohibited except as specifically approved for each application by the purchaser.

3. Interfaces. The manufacturer shall provide a complete list of connectors and mating connectors (electrical or mechanical) for each component which is connected to an external service (i.e., motor power, instrumentation, etc.).

3.3.11 Precautionary Measures. Shop practices and restrictions on use of potentially harmful materials shall meet the requirements of RDT F 5-1 as supplemented by the Ordering Data.

3.3.12 Interchangeability. The manufacturer shall furnish information necessary to assure the purchaser of interchangeability of parts purchased to the same design. The manufacturer shall identify and mark on the component drawings the reference surfaces used during fabrication to achieve or maintain perpendicularities or concentricities.

Identification and match marks shall be shown on drawing and on the articles themselves.

3.3.13 Surveillance and Archive Specimens. Specimens of materials used in the fabrication of reactor core components shall be accumulated, identified and preserved for use as test reference specimens. Surveillance specimens shall have the same metallurgical and environmental histories as the parent materials.

The required quantity and location of sample materials shall be as specified in the Ordering Data. Records shall be maintained on all parts of the Core Restraint Mechanism to provide traceability of all material to materials certifications.

3.3.14 Instrumentation and Controls. The requirements and provisions for instruments and controls shall be as specified in the Ordering Data.

3.4 Manufacturing Drawings. Drawings shall be prepared by the manufacturer in accordance with ANSI Y-14. The time and approval requirements of submittals to the purchaser and the number of copies required shall be as specified in the Ordering Data.

3.4.1 Arrangement Drawings. The arrangement drawings of the Core Restraint Mechanism shall, as a minimum, illustrate the following:

1. Identification by index or piece number and nomenclature of all component parts and their relative locations.
2. Overall plan and elevation dimensions.
3. Identification of sub-components with manufacturer's drawings and part or model number.
4. Manufacturer's recommended anchor details and support requirements.
5. Assembly weight.

3.4.2 Sectional Assembly Drawings. The manufacturer's assembly drawings shall depict, in cross section, components, sub-assemblies or parts thereof and include the following and any additional information needed for fabrication of the Core Restraint Mechanism.

1. A bill of material which includes index or piece number of parts required, nomenclature of each part, material, material specification, form specification or standard and detail or subassembly drawing number for each part and sub-assembly shown on the assembly drawing.
2. The location of final closure and seal welds with appropriate procedure designations.

3. Dimensions establishing size, shape, fits and clearances between parts.
4. Pertinent references to cleaning, marking, torque, locking, handling and packaging instructions.
5. Assembly requirements.
6. The dry weight and center of gravity of the Core Restraint Mechanism.
7. The weights and centers of gravity of the subassemblies into which the Core Restraint Mechanism would be divided for shipping purposes.

3.4.3 Detail Drawings. Detail drawings shall include, as appropriate, the following information:

1. Tolerance block, including geometric tolerances.
2. Detailed dimensions, tolerances, and maximum roughness of each surface.
3. Material specification and any special requirements including nondestructive testing, heat treatment, and hardness.
4. Fabrication instructions, including welding, procedure numbers, cleaning, inspection symbols, and references to assembly procedure requirements.

3.4.4 Drawing and Specification Lists. The manufacturer shall maintain a current listing of all drawings associated with the components of this standard. Each drawing number shall include the current revision number.

The manufacturer shall maintain a current list of specifications. This list of specifications shall include as applicable, requirements for materials, fabrication, construction, installation, testing, inspection, maintenance, cleaning, packaging, shipping, storage, operation and quality assurance.

3.4.5 Parts List. The manufacturer shall provide a complete list of parts organized by assemblies. Each drawing number shall include the current revision number.

4. QUALITY ASSURANCE REQUIREMENTS

4.1 Quality Assurance Program. The manufacturer shall establish, implement and maintain a documented quality assurance program in accordance with Sections 1, 2, 4, 5 and 8 of RDT F 2-2.

4.2 Quality Assurance Documents. The manufacturer shall prepare the following documents based on the requirements of RDT F 2-2. Time and approval requirements of submittals to the purchaser and the number of copies required shall be specified in the Ordering Data.

4.2.1 Quality Assurance Program Plan. The manufacturer shall prepare a quality assurance program plan in accordance with RDT F 2-2, Paragraph 2.2.2.

4.2.2 Inspection and Test Plan. The manufacturer shall prepare an inspection and test plan in accordance with RDT F 2-2, Paragraph 5.3.

4.2.3 Special Process Control and Nondestructive Test Procedures The manufacturer shall prepare and qualify procedures and equipment for special processes (3.3.7) and nondestructive tests in accordance with RDT F 2-2, Paragraph 5.5.

4.2.4 Inspection, Test and Sample Plan Procedures. The manufacturer shall submit inspection and test procedures in accordance with RDT F 2-2, Paragraph 5.6.2. These procedures shall include the details of all sampling plans proposed by the manufacturer and the basis for selection of the proposed sampling plan in accordance with RDT F 2-2, Paragraph 5.9.

4.2.5 Nonconforming Item Documentation. The manufacturer shall establish, implement and maintain procedures, and document all nonconformances including corrective action and proposed rework/repair/retest procedures in accordance with RDT F 2-2, Paragraph 5.10.

4.2.6 Material Quality Verification Plans. The manufacturer shall require the material supplier to submit for approval prior to use (reference RDT F 2-4) the following:

1. Quality verification plan
2. Sampling plan, if proposed by the supplier
3. Special process controls
4. Inspection and test procedures (including NDT procedures)
5. Cleaning and packaging procedures

4.2.7 Handling, Preservation, Packaging and Storage Procedures. The manufacturer shall prepare handling, preservation, packaging and storage procedures in accordance with Section 5 of this document and RDT F 2-2, paragraph 5.12. These procedures shall include instructions for removing all items from packaging.

4.2.8 Quality Records. As a minimum the manufacturer shall submit the following documentation to the purchaser pertinent to each Core Restraint Mechanism and other deliverable items.

1. Parts List - List of deliverable items by part number, organized by assemblies, drawing number and revision, part name, serial number or lot or heat number.
2. Special Processes and Nondestructive Examination Qualifications - Certifications of special processes and nondestructive examination procedures and equipment qualifications as specified in RDT F 2-2, Paragraph 5.5

3. Nonconformance Records - A copy of each nonconformance and corrective action record including rework/repair/retest procedures as required by 4.2.5 above.
4. Certification - Certification of conformance as specified in RDT F 2-2, Paragraph 5.6.5, including:
 - a. Material Certifications - Chemical and mechanical test results, nondestructive test results, heat treatment data and test results of material test coupons. This data shall be traceable from the related finished components. Material certifications shall be included to form a part of the final report (Ref. 4.3.3).
 - b. Nondestructive Examination - Results of final nondestructive examination, including radiographic films, recorder charts and photographs.
 - c. Final Inspection - A copy of final inspection data and results including a list of purchaser specified key dimensions measured.
 - d. Test Reports - Certified copy of test results, analysis of test results and test fluid temperature and metal temperatures, including temperature corrections made to test temperature.
5. Drawings - A reproducible set of assembly drawings and final outline drawings identified as "as built". Drawings to be in accordance with ANSI Y-14.

4.2.9 Component Release Request. The manufacturer shall provide for purchaser approval the documentation listed in 4.2.7 to release the component to the purchaser.

4.3 Other Documents. The manufacturer shall prepare and submit for approval the following additional documents. The time and approval requirements of submittals to the purchaser and the number of copies required shall be as specified in the Ordering Data.

4.3.1 Periodic and Progress Reports. Reports of progress in fabrication inspection, testing (quality status), and shipping shall be made at specified intervals. These reports shall relate the progress made since the last report with only enough repetition of previously reported events to frame the contents of the present report. These periodic reports should also include difficulties encountered (such as failures and malfunctions) and the efforts made or planned for overcoming them. Problems foreseen as possible disruptions of the schedule shall be brought to the attention of the purchaser as early as possible.

4.3.2 Special Tool List. The manufacturer shall prepare and keep current a list of all special tools, including gages, required for this contract. This list will identify each tool by name, drawing number, function, operation(s) for which it is required, and whether it is a fabrication in-process tool or a deliverable item.

4.3.3 Final Report. The final report shall present a description of the fabrication, testing, and shipping of the Core Restraint Mechanism and its auxiliary equipment. The report shall include a discussion of any anomalies in material behavior and of any significant problems encountered in fabrication. In addition to detailed accounts of the areas listed above, the final report should include the following:

1. Copies of drawings specified in this standard of the as built configuration reduced to convenient sizes for binding in the final report.
2. Illustrations, sketches, schematic diagram and photographs of major stages of fabricating, assembling, inspecting, cleaning, testing, packaging, and shipping.
3. Material certification (4.2.7).

4.3.4 Shipping Documents. The manufacturer shall submit shipping instructions and documentation as specified in 5.1.3.

4.3.5 Repair and Replacement Parts List. The purchaser shall identify a list of spare parts to be provided by the manufacturer as specified in 1.1. The manufacturer shall prepare and submit to the purchaser for approval a list of suggested replacement tools likely to be damaged or expended during delivery and installation.

4.3.6 Operation and Maintenance Manual. An operation and maintenance manual shall be prepared in accordance with RDT F 4-20. Those portions of the manual required in RDT F 4-20 for which the manufacturer is responsible shall be as specified in the Ordering Data.

4.4 Marking and Identification of Materials and Parts. All materials and parts shall be visually examined to ensure compliance with requirements of 3.3.10.

4.5 General Requirements for Nondestructive Examination. Nondestructive examination of materials and fabricated components shall be in accordance with RDT E 15-2 and the additional requirements specified herein. Calibration and examination methods and procedures shall be in accordance with RDT F 3-6. In addition, each written procedure shall specify the certification levels (Level I, II, or III) required by personnel who:

1. Perform the nondestructive examinations, and
2. Interpret and evaluate the results.

Acceptance criteria shall be as specified herein, or as specified in RDT E 15-2 or RDT F 3-37, as applicable. Equipment used for nondestructive examinations shall be calibrated and controlled in accordance with RDT F 2-2.

Following nondestructive examination, affected areas shall be thoroughly cleaned in accordance with RDT F 5-1 before proceeding to the next weld pass, or the next fabrication step.

4.6 Examination of Materials. Prior to use in fabrication, all raw materials shall be examined:

1. Visually to assure specified cleanliness and detect obvious defects, and
2. Nondestructively in accordance with the requirements specified for the product form.

Repaired areas in materials shall be examined as required by RDT E 15-2 (welding not required), or RDT F 6-10 (welding required). For defects detected using methods other than liquid penetrant, magnetic particle, or radiography, the repaired area shall also be re-examined by the method, and to the acceptance criteria, which revealed the original defect.

4.6.1 Overcheck of Materials. Overcheck on materials shall be made in accordance with RDT F 2-2.

4.7 Examination During Fabrication. Prior to use in fabrication, all items shall be subjected to visual and dimensional examination to verify compliance with applicable drawings and specifications and Table 2. Examination of welds shall be in accordance with the requirements of RDT E 15-2 and as specified herein. During fabrication, all final machined surfaces shall be liquid penetrant examined using the examination and acceptance criteria of RDT F 3-37 for the final material product form.

Welds which cannot be adequately examined by either radiography or ultrasonics, or a combination of both, shall be progressively examined by a liquid penetrant or magnetic particle method at the intervals specified in RDT E 15-2. For welds where this interval is not specified in RDT E 15-2, the progressive liquid penetrant (or magnetic particle) examination shall be performed after the root pass and each successive 1/2 inch or 1/3 T (whichever is smaller) of deposited weld metal, where T is the thickness of the finished weld.

After proof load testing of lifting, handling, and shipping fixtures, and attachment lugs, all structural welds of these items shall be examined by a magnetic particle or liquid penetrant method.

4.8 Inspection and Test Responsibility. Unless otherwise specified, the manufacturer shall be responsible for the performance of all tests and inspections required prior to the submission to the purchaser of any item for acceptance. The performance of such tests and inspections does not limit

TABLE 2 DETERMINATION OF COMPLIANCE & DATA RECORDING
FOR INSPECTION AND TEST

REQUIREMENTS FOR MEASUREMENTS & FOR THE RECORDING
OF CHARACTERISTICS HAVING SPECIFIED TOLERANCE LIMITS

Examples of Specified Tolerance Limits	Insp/Test Instrument To Have Units of Measurement Minimum Increments of	Characteristics Shall be Recorded As Follows Unless Otherwise Req'd Or Approved by the Purchaser
<u>Decimals</u>		
+ .X	.0X0 Times 2	OK if in tol. Actual value recorded if not
+ .0X	.00X Times 2	OK if in tol. Actual value recorded if not
+ .00X	.000X Times 2	Actual value
+ .00X - .000	.000X	Actual value
X.X Min.	.0X	OK if in tol. Actual value recorded if not
X.XX Max.	.00X	OK if in tol. Actual value recorded if not
X.XXX Min.	.000X	Actual value
<u>Fractions</u>		
+ 1/4	1/16	OK if in tol. Actual value recorded if not
+ 1/4 - 0	1/32	OK if in tol. Actual value recorded if not
+ 1/32	1/64	OK if in tol. Actual value recorded if not
+ 1/32 - 0	1/64	OK if in tol. Actual value recorded if not
<u>Min. or Max.</u>		
Less than 36 in.	1/64	OK if in tol. Actual value recorded if not
36 in. thru 71 in.	1/32	OK if in tol. Actual value recorded if not
72 in. thru 143 in.	1/16	OK if in tol. Actual value recorded if not
Over 144 inches	1/8	OK if in tol. Actual value recorded if not
<u>Angles</u>		
+ 1°	5'	OK if in tol. Actual value recorded if not
+ 0°30'	5'	OK if in tol. Actual value recorded if not
+ 0°30' - 0°0'	5'	OK if in tol. Actual value recorded if not
+ 0°5'	1"	Actual value
+ 0°5' - 0°0'	1"	Actual value
+ 0°0'30"	1"	Actual value
Surface Finish Gaged (Go-No-Go)		OK if in tol. Actual value recorded if not and record gage number used

continued

NOTES FOR TABLE 2 DETERMINATION OF COMPLIANCE & DATA RECORDING
FOR INSPECTION AND TEST

1. Tolerance Limit Interpretation - The tolerance limits specified on the purchaser's drawings and specifications shall be interpreted as "Absolute" values as defined in ASTM E 29-67. The practices of "rounding off" measurements within the tolerance range to determine the specified requirements shall not be used.

Example: A tolerance value specified as $\pm .001$ shall be interpreted as ± 0.0010 .

2. Equipment/Technique Accuracy - Unless otherwise required or approved by the purchaser, determinations shall be made with equipment or techniques reading accurately as noted below:

Decimal Numbers - Use device measuring in units no greater than 10% of the specified tolerance range.

Limits specified as "min" or "max" - Use device measuring in units to one decimal place beyond the characteristic specified (See Table 2, Page 16 for examples).

Fractional Numbers - Use device measuring units no greater than one-eighth of the specified tolerance range but no smaller than 1/64 inch.

Angles - Use device measuring in the increments of 5 minutes when tolerance is specified in degrees. When the tolerance spread is 5 minutes or less, the measuring instrument shall indicate increments of 1 second.

the right of the purchaser to conduct such other tests and inspections as the purchaser deems necessary to assure that all items are in conformance with all requirements of this standard. The manufacturer shall keep the purchaser informed of the progress of the work and shall notify him of any required tests or inspections not less than five days in advance of the test.

4.9 Functional Tests. Each Core Restraint Mechanism shall be subjected to functional tests as specified in the Ordering Data.

5. PREPARATION FOR DELIVERY

5.1 Delivery Requirements. The manufacturer shall be responsible for the delivery of all items to be provided to the designated site as specified in the Ordering Data. The manufacturer shall submit for the purchaser's approval a Packaging and Shipment Plan presenting the practices, procedures, and instructions to be followed in meeting the requirements of 5.1.1, 5.1.2, 5.1.3, and 5.1.4 and any additional requirements as specified in the Ordering Data.

5.1.1 Preparation. Upon completion of all shop inspection data and acceptance tests, the manufacturer shall prepare the Core Restraint Mechanism for delivery to the designated site. Following preparation, the Core Restraint Mechanism shall be packaged in accordance with the requirements of 5.1.2.

5.1.2 Packaging and Packing. Items subject to deterioration, corrosion or damage shall be packaged in a manner to preserve them. All sealing, packaging, packing and identification marking shall be in accordance with RDT F 7-2 and as specified in the Ordering Data. Packaging shall be adequate to protect the item while at the manufacturer's facilities, during transportation to the designated site, and at the designated site. The center of gravity of the loaded shipping container shall be marked on the external surface of the container. The manufacturer shall prepare handling, preservations, packaging and storage procedures in accordance with RDT F 2-2, Paragraph 5.1.2. These procedures shall include instructions for removing all items from packaging.

5.1.3 Shipping. The manufacturer shall be responsible for the delivery of all items covered by this standard to the designated site. These responsibilities include, but are not limited to the following:

5.1.3.1 Routing. The manufacturer shall determine routing to the designated site for all materials and components for which he is responsible and submit routing to the purchaser for approval. When approved by the purchaser, the manufacturer shall make all arrangements necessary to ship those materials and components in accordance with the terms of the contract and requirements of this standard.

5.1.3.2 Shipping Instructions. The manufacturer shall prepare and submit suitable instructions to the carrier for handling, shipping, in-transit storage, unloading, storing, and unpacking of all items purchased under this standard.

5.1.3.3 Loading. Required shipping position, supports and crating shall be determined by the manufacturer. The manufacturer shall provide supervision for loading the components on the transporting vehicle. All handling equipment shall be designed to prevent any damage to components during handling and shipping operations in accordance with the requirements of 5.1.3 and 5.1.4.

5.1.3.4 Documentation. The manufacturer shall identify all technical documentation, e.g., instructions, drawings, reports and manuals which are to accompany deliverable items during shipment.

5.1.4 Handling. All handling operations and fixtures shall be in compliance with RDT F 8-6.

5.1.4.1 Handling Fixtures. All special lifting and handling fixtures shall be designed for a static load of five times normal anticipated static loads, based upon ultimate material strength.

5.1.4.2 Ductility of Lifting Devices. Lifting, handling, and shipping fixtures and lifting attachments, provided with the components, fabricated from ferritic materials shall be sufficiently ductile to permit safe handling and shipment at an ambient temperature of minus 10°F. If shipment is scheduled for the winter months (October through March inclusive), and the anticipated ambient temperature may be less than minus 10°F, the manufacturer 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.

5.1.4.3 Lifting Points. Lifting points shall be provided on all shipping devices and components which permit safe handling of either the empty device or the device and component as a single unit. Location of permanently attached lugs shall be approved by the purchaser.

5.1.4.4 Upending. If the component 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.

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

5.1.4.6 Proof Testing. Proof tests shall be performed on, and documented for, all critical lifting, handling, supporting and shipping fixtures prior to use on components to assure safe handling of these components. All lifting, handling and shipping fixtures and attachment lugs shall be tested statically to 150 percent of the total load to be lifted and dynamically at 125 percent of the total load to be lifted at the speeds and motions which would be expected during actual handling operations. If painted, these items shall be stripped to base metal prior to testing by a suitable method which will not interfere with the interpretation of the examinations of 4.7.

6. NOTES AND ORDERING DATA CHECKLIST

6.1 Ordering Data Checklist. The detailed requirements and conditions necessary to fabricate, examine, test, and deliver a Core Restraint Mechanism in accordance with this standard are included in the Ordering Data. These requirements are also listed below in the Ordering Data Checklist. The list includes topics to which the standard makes specific reference, as well as other supplemental information which must be defined by the purchaser:

<u>Paragraph No.</u>	<u>Description of Information</u>
1.1	Components and services to be provided
2.0	Applicable Documents
2.5	Drawings
3.2	Materials
3.3	Fabrication
3.3.4	Heat Treatment
3.3.5	Bending & Forming
3.3.6	Surface Finish
3.3.9	Assembly Procedure
3.3.11	Precautionary Measures
3.3.13	Surveillance and Archive Specimens
3.3.14	Instrumentation and Controls
3.4	Manufacturing Drawings
4.2	Quality Assurance Documents
4.3	Other Documents
4.5	General Requirements for Nondestructive Examination
4.6	Examination of Materials
4.7	Examination During Fabrication
4.8	Acceptance Tests
5.1	Delivery Requirements
5.1.2	Packaging and Packing Instructions

R D T S T A N D A R D

UNITED STATES ATOMIC ENERGY COMMISSION
DIVISION OF REACTOR RESEARCH AND DEVELOPMENT

RDT E 6-17T, Amendment 1

DATE March 1974

PAGE 1 OF 1

CORE RESTRAINT MECHANISM FOR SODIUM COOLED REACTORS (FABRICATION ONLY)

A M E N D M E N T 1

This amendment forms a part of RDT E 6-17T
dated October 1972

1. Page 2, 2.1: Add the following RDT standard in sequence:

RDT F 3-15T Requirements for Inspection of Dimensional Characteristics

2. Page 15, 4.7: Delete "and Table 2" from the first sentence and add the following after the first sentence:

Inspection of dimensional characteristics shall be in accordance with the requirements of RDT F 3-15.

3. Pages 16 and 17: Delete Table 2.