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RDT E 6-33T

Supersedes
RDT E 6-33T, May 1973

RDT Standard

CONTROL ROD ASSEMBLY FOR LIQUID METAL FAST BREEDER REACTORS

MARCH 1977

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FOREWORD

This standard supersedes the May 1973 issue of RDT E 6-33T and incorporates those changes to that issue of the standard that were approved and published as Amendments 1 and 2 and those changes that were approved for publication in this revision. These changes are identified by the following marginal notations:

A1	Amendment 1, December 1973
A2	Amendment 2, March 1974
C	Change Approved March 1977
D	Deletion approved March 1977
N	Addition approved March 1977

Editorial changes that were made during preparation of this revision are not identified.

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DATE March 1977

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CONTROL ROD ASSEMBLY FOR LIQUID METAL FAST BREEDER REACTORS

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1. SCOPE

This standard establishes the requirements for fabrication, testing, and inspection of control rod assemblies for use in liquid metal fast breeder reactors.

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2. APPLICABLE DOCUMENTS

The following documents are a part of this standard to the extent specified in Sections 3 through 5. The issue of a document in effect on the date of the invitation to bid, including any amendments or other published changes also in effect on that date, shall be as specified in the Ordering Data. Where this standard appears to conflict with the requirements of a referenced document, such conflict shall be brought to the attention of the purchaser for resolution.

2.1 RDT Standards.

| D

RDT E 6-38T	Low Friction Hard Surfaces for Core Components	
RDT F 2-2	Quality Assurance Program Requirements	
RDT F 2-4T	Quality Verification Program Requirements	N
RDT F 3-2T	Calibration Program Requirements	
RDT F 3-15T	Requirements for Inspection of Dimensional Characteristics	D A2
RDT F 5-1T	Cleaning and Cleanliness Requirements for Nuclear Components	
RDT F 6-2T	Welding of Reactor Core Components and Test Assemblies	
RDT F 7-2T	Packaging, Packing, and Marking of Components for Shipment and Storage	
RDT F 7-3T	Marking of Components and Parts	
RDT F 8-6T	Hoisting and Rigging of Critical Components and Related Equipment	
RDT F 11-3T	Analytical Chemistry Methods for Metallic Core Components	N

2.2 American Society for Testing and Materials (ASTM) Publications.

ASTM E 29 Indicating Which Places of Figures are to be Considered
Significant in Specified Limiting Values

2.3 American National Standards (ANSI).

ANSI B46.1 Surface Texture

3. TECHNICAL REQUIREMENTS

3.1 Control Rod Assembly. Control rod assemblies shall be fabricated and assembled using components meeting the requirements of the standards, specifications, and drawings as specified in the Ordering Data.

3.2 Dimensions. Control rod assemblies and components thereof shall meet the dimensional requirements of the drawings as specified in the Ordering Data.

3.3 Control Rod Assembly Absorber Pin. The location, weight if required in the Ordering Data, and absorber isotopes content of each finished absorber pin (by serial number) within each control rod assembly shall be recorded and submitted with each assembly. Pins from a pellet lot shall not be mixed with pins from other pellet lots in more than one assembly without the purchaser's approval. Pins containing mixed pellet lots shall be considered as part of one of the parent lots.

3.4 Control Rod Assembly Absorber Isotopes Content. The absorber isotopes and the content of each absorber isotope in each control rod assembly shall be as specified in the Ordering Data. The uncertainty of the absorber isotopes content in each assembly shall be reported at the 95 percent confidence level.

3.5 Control Rod Assembly Welds. Control rod assembly weld types and configurations shall meet the requirements of the drawings as specified in the Ordering Data.

Welding procedure qualification, performance qualification, and production welding shall meet the requirements of RDT F 6-2, Sections 1, 2, 3, and 6. All welds shall be examined in accordance with the requirements and acceptance criteria as specified in the Ordering Data.

3.6 Control Rod Assembly Weight. The weight of each completed assembly shall be submitted with each assembly delivered.

3.7 Surface Conditions.

3.7.1 Cleanliness. Finished control rod assemblies and components thereof shall be visually clean and free of chips, weld spatter, and other foreign material. Procedures and acceptance criteria for cleanliness and cleaning shall comply with RDT F 5-1 and additional cleaning and cleanliness requirements as specified in the Ordering Data.

Hard surfaced areas of components and finished control rod assemblies shall be maintained in a clean condition. Cleaning of such surfaces shall be in accordance with RDT E 6-38.

3.7.2 Surface Roughness. The control rod assembly surfaces shall not exhibit roughness greater than that specified on the applicable drawings.

3.7.3 Surface Defects. Exterior surfaces of finished control rod assemblies and of finished components shall be free of scratches, dents, or mars except as permitted in the component standards and in the Ordering Data. Removal of defects by methods such as grinding, buffing, or polishing is considered a rework subject to the requirements of 3.11, but is permitted provided that all other dimensions and surface finish requirements are maintained. The bottom of the reworked defects shall be visible, rounded, and well faired in.

3.7.4 Surface Halides. Residual chloride and fluoride on the exterior surfaces of the control rod assembly after final assembly inspection shall each be less than $0.5 \mu\text{g}/\text{in}^2$ ($0.8 \text{ mg}/\text{m}^2$).

3.8 Identification. Each control rod assembly shall be identified with a legible serial number in conformance with drawing requirements and as specified in the Ordering Data. The method of identification shall conform to RDT F 7-3 and shall be approved by the purchaser prior to use.

3.9 Assembly Air Flow and Pressure Drop. The air flow and pressure drop through each completed control rod assembly shall be measured as specified in the Ordering Data. Air flow and pressure drop shall be recorded and submitted with each assembly delivered.

3.10 Fabrication.

3.10.1 Assembly. Assembly procedures shall be approved before the start of work. Any changes to the purchaser-approved assembly procedures shall have prior approval by the purchaser. The procedures shall contain the following as a minimum:

1. Assembly sequence.
2. Cleaning procedures, sequence and precautionary rules.
3. Any special machinery or fitting-at-assembly instructions.
4. Intermediate and final inspection criteria and holdpoints.
5. Handling methods, equipment, and precautions.
6. Special data, measurements, or observations to be recorded in quality control records.
7. Nondestructive examination procedures.

An assembly sequence shall show the steps and operations that are a part of the control rod assembly or component fabrication effort and shall be submitted to and approved by the purchaser. The assembly sequence shall include a process flow diagram which shows the inspection holdpoints.

3.10.2 Handling and Storage During Processing. Completed and partially completed control rod assemblies shall be handled and stored in a manner to maintain conformance with this standard, the Ordering Data, and RDT F 8-6. Handling and storage procedures shall be approved by the purchaser prior to use.

3.11 Repair and Rework. Nonconforming absorber assemblies and components may be repaired or reworked. Repair and rework shall be in accordance with RDT F 2-2 and with purchaser-approved procedures. All areas affected by repair or rework shall be reinspected (by methods acceptable to the purchaser) to demonstrate compliance with the requirements of this standard.

4. QUALITY ASSURANCE REQUIREMENTS

4.1 Quality Assurance Program. A documented quality assurance program shall be established and implemented that fulfills all requirements of Sections 1, 2, 4, 5, and 8 of RDT F 2-2 and any additional requirements imposed by the Ordering Data. Individual components may be fabricated to RDT F 2-4 as specified on the drawings.

4.2 Quality Assurance Documents. The quality assurance documents tabulated in the Ordering Data shall be prepared and submitted for approval or information. The number of copies, the purpose, and the time of submittal for these documents shall be as specified in the Ordering Data.

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4.3 Records. Records showing complete assembly sequence shall be maintained for each assembly and shall be traceable to components, design documents and revision numbers, material heat, lot number, and operating procedure and revision number. Such information shall be provided with the reports on tests made on each delivered assembly. Minimum records shall include special processes or nondestructive examination (NDE) qualifications, nonconformance reports, certifications of material, NDE records, and other inspection records as specified in the Ordering Data which verify conformance with specifications. Records of all tests and examinations shall be kept complete and available to the purchaser.

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4.3.1 Certification Records Review. Before assemblies are released for shipment, certification records shall be reviewed for compliance with Sections 3 and 4. Specific records shall be as defined in the Ordering Data.

N

4.4 Inspection Requirements. Inspection requirements are listed in Table 1. Additional inspection requirements (if any) shall be as specified in the Ordering Data. Test methods used shall be the reference method or an equivalent method approved by the purchaser before use.

4.4.1 Tolerance Limit Interpretation.

a. Chemical Composition. For purposes of determining conformance with chemical composition requirements, an observed value or a calculated value shall be rounded off "to the nearest unit" in the last right-hand place of figures used in expressing the limiting value, in accordance with the rounding-off method of ASTM E 29.

b. Tensile Requirements. For purposes of determining conformance with tensile requirements, an observed value or a calculated value shall be rounded off to the nearest 100 psi (700 kPa) for tensile strength and to the nearest 0.1 percent for elongation, in accordance with the rounding-off method of ASTM E 29.

c. Dimensional Requirements. The method for determining conformance with dimensional requirements shall be the absolute method as defined in ASTM E 29. Measuring equipment accuracy shall comply with RDT F 3-15.

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4.5 Measuring and Test Equipment. Measuring and test equipment and measuring standards shall be calibrated and controlled in accordance with RDT F 3-2.

D

Table 1. Quality Conformance Inspection

Characteristic	Requirement	Inspection Plan	Reference Test Method	
1. Control rod assembly				
a. Component material	3.1	Each assembly	Material certifications.	
b. Components	3.1	Each assembly	Certification of supplier's records.	
2. Dimensions				
a. Length	3.2	Each control rod assembly.	Standard gaging.	
b. Weld surfaces	3.2	Each control rod assembly.	Standard gaging.	
c. Concentricity	3.2	Each control rod assembly.	Standard gaging.	C
d. Straightness	3.2	Each control rod assembly.	Standard gaging.	D
3. Control rod assembly absorber pins				
a. Pin array	3.3	Each assembly	Certified supplier's records.	
b. Pin weight	3.3	Each absorber pin	Certification of pin supplier's records.	N

(continued)

Table 1. Quality Conformance Inspection (continued)

Characteristic	Requirement	Inspection Plan	Reference Test Method	
4. Control rod assembly absorber isotopes content	3.4	Each assembly	Summation of the certified absorber isotopes content in each absorber pin.	C
5. Control rod assembly welds	3.5	Each weld	Supplier's records and test results in accordance with RDT F 6-2.	
6. Control rod assembly weight	3.6	Each assembly	Weigh and record. Accuracy ± 0.5 lb (± 0.2 kg).	N
7. Cleanliness	3.7.1	Each control rod assembly	Visual inspection at 1X and wipe test per RDT F 5-1.	
a. Hard surface areas	3.7.1	Each control rod	Certification of supplier's records.	
8. Surface roughness	3.7.2	Each control rod assembly	Visual inspection and comparison with roughness standards (ANSI B46.1).	C
9. Surface defects	3.7.3	Each control rod assembly	Visual inspection as specified in the component standards and the Ordering Data.	

(continued)

Table 1. Quality Conformance Inspection (continued)

Characteristic	Requirement	Inspection Plan	Reference Test Method
10. Surface halides	3.7.4	Each control rod assembly	Chemical analysis per RDT F 11-3.
11. Identification	3.8	Each control rod assembly	Visual inspection at 1X and standard gaging for readability and compliance with specifications.
12. Assembly air flow and pressure drop	3.9	Each control rod assembly	As specified in the Ordering Data.

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5. PREPARATION FOR DELIVERY

A packaging and packing plan shall be submitted for approval. The plan shall describe the materials, methods, procedures, containers, and marking to be used to meet the requirements of RDT F 7-2. Finished control rod assemblies shall be handled in accordance with RDT F 8-6.

5.1 Packaging. Each control rod assembly shall be packaged in water-vaporproof envelopes in accordance with RDT F 7-2 for Level A methods. The assembly shall be packaged in dry air or nitrogen before sealing. Desiccants and humidity indicators shall not be used.

5.2 Packing. Packaged assemblies shall be packed and shipped in special containers as specified in the Ordering Data.

5.3 Marking. The packaging and shipping containers shall be marked in accordance with RDT F 7-2. Special marking includes the following.

5.3.1 Special Package Marking.

1. Control rod assembly serial number.
2. Control rod assembly type.
3. Absorber isotopic content.

5.3.2 Special Container Marking.

1. Number of assemblies.
2. Serial numbers of assemblies.
3. Drawing number, revision, and item.

6. NOTES AND ORDERING DATA CHECKLIST

6.1 Ordering Data Checklist. The following technical and procurement data will be furnished by the purchaser. Any necessary data not furnished with the purchase document, shall be requested from the purchaser before submitting a bid.

<u>Item</u>	<u>Refer to Paragraph</u>
1. Applicable documents	2.
2. Control rod assembly	3.1
3. Dimensions	3.2
4. Absorber pin weight	3.3
5. Control rod assembly absorber isotopes content	3.4
6. Control rod assembly welds	3.5
7. Cleanliness	3.7.1
8. Surface defects	3.7.3
9. Identification	3.8

<u>Item</u>	<u>Refer to Paragraph</u>
10. Assembly air flow and pressure drop	3.9
11. Quality assurance program requirements	4.1
12. Quality assurance documents	4.2
13. Records	4.3
14. Certification records	4.3.1
15. Inspection requirements	4.4
16. Surface defects	Table 1(9)
17. Assembly air flow and pressure drop	Table 1(12)
18. Packing	5.2