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SIGNATURE M. J. Stein
M. J. Stein
LMEC Standards Coordinator

DISCLAIMER

RDT E 4-5T

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RDT E 4-5T, December 1970

RDT Standard

FORCED-CIRCULATION COLD TRAP ASSEMBLY FOR REMOVAL OF SODIUM IMPURITIES

JANUARY 1976

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FOREWORD

This standard supersedes the December 1970 issue of RDT E 4-5T and incorporates those changes to that issue of the standard that were approved and published as Amendments 1 through 3. These changes are identified by the following marginal notations:

A1	Amendment 1, September 1971
A2	Amendment 2, October 1973
A3	Amendment 3, November 1973

Editorial changes that were made during preparation of this revision to update the standard to conform to RDT F 1-1 format and the latest issues of reference documents are not identified.

FORCED-CIRCULATION COLD TRAP ASSEMBLY FOR REMOVAL OF SODIUM IMPURITIES

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FORCED-CIRCULATION COLD TRAP ASSEMBLY FOR REMOVAL OF SODIUM IMPURITIES

1. SCOPE

This standard delineates the requirements for the design, materials, fabrication, examination, acceptance testing, and delivery of a cold trap assembly to remove impurities from liquid sodium by crystallization.

1.1 Classification. Cold trap assemblies covered by this standard shall be classified according to type of cooling system used (liquid or gaseous) and by the characteristics of the cooling and crystallization zones.

1.2 Definitions.

1.2.1 Cold Trap. An assembly of an economizer plus a crystallizer tank.

1.2.2 Cold Trapping. The crystallization of impurities from liquid sodium by cooling a portion of the sodium system below the saturation temperature of the impurity in the system.

1.2.3 Crystallization Element. The knitted wire mesh packing used to fill the annular sodium cooling zone, or the sodium return line, of the crystallizer tank, or both. The element serves as nucleation sites for impurities crystallizing out of the cooling sodium, and as a filter to trap suspended impurity crystals.

1.2.4 Crystallizer Tank. That vessel of the cold trap which provides low temperature and extended surfaces for promoting precipitation of dissolved sodium impurities. The processes of cooling, crystallization, settling and filtration occur in this tank.

1.2.5 Crystallizer Tank Cooling System. An auxiliary cooling system, gas or liquid, used to remove heat from cold traps.

1.2.6 Economizer. A regenerative heat exchanger used as part of a forced-circulation cold trap assembly to minimize system heat losses, reduce thermal shock, and reduce total heat removal requirements of the trap.

1.2.7 Residence Time, Crystallizer Tank. The average time in minutes that an element of fluid remains within the packed zone of the crystallizer tank. It is determined by dividing the crystallizer tank volume packed with knitted wire mesh, by the sodium flow rate.

1.2.8 Residence Time, Economizer. The average time in seconds that an element of fluid remains within the shell side of the economizer. It is determined by dividing the economizer shell side volume by the sodium flowrate.

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 invitation to bid, including any amendments or other published changes also in effect, 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.

RDT E 15-2NB-T	Class 1 Nuclear Components (Supplement to ASME Boiler and Pressure Vessel Code, Section III, Subsections NA and NB)	A1
RDT E 15-2NC-T	Class 2 Nuclear Components (Supplement to ASME Boiler and Pressure Vessel Code, Section III, Subsections NA and NC)	
RDT E 15-2ND-T	Class 3 Nuclear Components (Supplement to ASME Boiler and Pressure Vessel Code, Section III, Subsections NA and ND)	
RDT F 2-2	Quality Assurance Program Requirements	
RDT F 3-6T	Nondestructive Examination (Supplement to ASME Boiler and Pressure Vessel Code, Section V)	
RDT F 6-5T	Welding and Brazing Qualifications (Supplement to ASME Boiler and Pressure Vessel Code, Section IX)	A1
RDT F 5-1T	Cleaning and Cleanliness Requirements for Nuclear Components	
RDT F 7-2T	Packaging, Packing and Marking of Components for Shipment and Storage	
RDT F 8-6T	Hoisting and Rigging of Critical Components and Related Equipment	A2
RDT F 9-4T	Requirements for Construction of Nuclear System Components at Elevated Temperatures (Supplement to ASME Code Cases 1592, 1593, 1594, 1595, and 1596)	

RDT M 1-1T Stainless Steel Covered Welding Electrodes (ASME SFA-5.4 with Additional Requirements)

RDT M 1-2T Stainless Steel Welding Rods and Bare Electrodes (ASME SFA-5.9 with Additional Requirements)

RDT M 2-4T Alloy Steel Forgings (ASME SA-336 with Additional Requirements)

RDT M 2-5T Austenitic Stainless Steel Welding Fittings (ASME SA-403 with Additional Requirements)

RDT M 3-2T Stainless and Alloy Steel Seamless Tubes (ASME SA-213 with Additional Requirements)

RDT M 3-3T Austenitic Stainless Steel Seamless Pipe (ASME SA-376 with Additional Requirements)

RDT M 3-5T Austenitic Stainless Steel Welded Tubing (ASME SA-249 with Additional Requirements)

RDT M 3-6T Austenitic Stainless Steel Pipe (ASME SA-312 with Additional Requirements)

RDT M 3-7T Austenitic Stainless Steel Welded Pipe, Large Diameter (ASME SA-358 with Additional Requirements)

RDT M 4-2T Austenitic Stainless Steel Castings (ASME SA-351 with Additional Requirements)

RDT M 5-1T Stainless Steel Plate, Sheet, and Strip (ASME SA-240 with Additional Requirements)

RDT M 7-3T Stainless Steel Bars and Shapes (ASME SA-479 with Additional Requirements)

2.2 American National Standards (ANSI).

ANSI B16.25 Buttwelding Ends

ANSI Y14 Drafting Manual

2.3 American Society of Mechanical Engineers (ASME) Publications. A3

ASME Boiler and Pressure Vessel Code

Section III Nuclear Power Plant Components

Section VIII Pressure Vessels

Section IX Welding and Brazing Qualifications

Code Case 1481 Elevated Temperature Design of Section III Class 2 and 3 Components A3

Code Case 1592 Class 1 Components in Elevated Temperature Service

2.4 Other Documents.

Standards of Tubular Exchanger Manufacturers Association (TEMA)

American Institute of Steel Construction (AISC) Specifications

Specification for Design, Fabrication and Erection of Structural Steel for Buildings

Code of Standard Practice for Steel Buildings and Bridges

3. TECHNICAL REQUIREMENTS

3.1 General. The sodium forced-circulation cold trap assembly is part of a sodium purification system. The cold trap is used to remove dissolved impurities from radioactive or nonradioactive sodium. An economizer is used as a regenerative heat exchanger to lower the inlet sodium temperature to the crystallizer tank within design conditions and thereby require a smaller load for the cold trap coolant. Each cold trap assembly will include piping, structural supports, heaters, lifting lugs, insulation clips, and special tools required to install or service the unit.

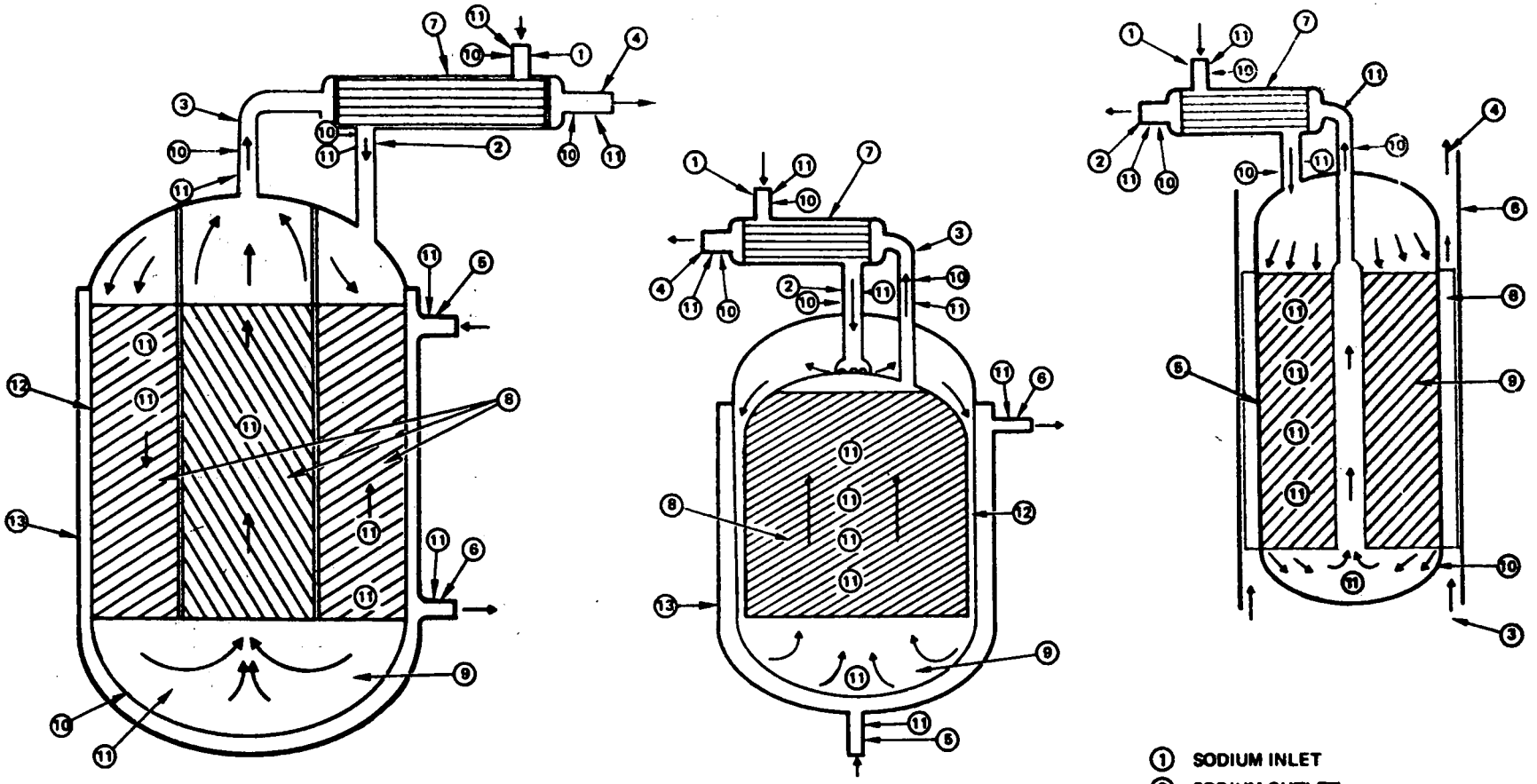
Schematics, typical of cold trap assemblies that have been designed and operated successfully are shown in Figure 1. Detailed envelope dimensions, drawings and system descriptions for the cold trap assembly are presented in the Ordering Data.

The design, fabrication and assembly of the cold trap shall be in accordance with the ASME Boiler and Pressure Vessel Code (the Code), Section III, and the cold traps shall be Code stamped.

3.2 Design Parameters.

3.2.1 Structural Design Requirements. The cold trap assembly shall be constructed in accordance with Section III of the Code as supplemented by RDT E 15-2NB, NC, or ND as applicable. The classification of the cold trap assembly under Section III of the Code shall be as specified in the Ordering Data. A3

For Class 1 construction, Code Case 1592 as supplemented by RDT F 9-4 shall be used for the high-temperature design criteria for temperatures exceeding those specified in the Code. For Class 2 and 3 construction, Code Case 1481 shall be used for the high-temperature design criteria for temperatures exceeding those specified in the Code.



① SODIUM INLET
② COOLED SODIUM INLET TO CRYSTALLIZER TANK
③ PURIFIED SODIUM OUTLET FROM CRYSTALLIZER TANK
④ SODIUM OUTLET
⑤ LIQUID COOLANT INLET
⑥ LIQUID COOLANT OUTLET
⑦ ECONOMIZER
⑧ CRYSTALLIZER ELEMENT
⑨ SETTLING REGION
⑩ PRESSURE SENSOR
⑪ PROCESS THERMOCOUPLE
⑫ CRYSTALLIZER TANK
⑬ COOLANT JACKET

TYPES OF LIQUID-COOLED COLD TRAPS

① SODIUM INLET
② SODIUM OUTLET
③ COOLING GAS INLET
④ COOLING GAS OUTLET
⑤ CRYSTALLIZER TANK
⑥ COOLANT JACKET
⑦ ECONOMIZER
⑧ COOLING FINS
⑨ CRYSTALLIZER ELEMENT (WIRE MESH)
⑩ PRESSURE SENSOR
⑪ PROCESS THERMOCOUPLE

TYPICAL GAS-COOLED COLD TRAP

Fig. 1. Cold Trap Assemblies

The Ordering Data will specify the design pressure and temperature and all additional operating conditions required to permit the design analyses for the particular pressure vessel classification. The Ordering Data will also specify whether Class 2 vessels are to be designed to Division 1 or Division 2 of Section VIII of the Code. A3

3.2.1.1 Seismic Criteria. The cold trap assembly shall be designed for the seismic loading criteria specified in the Ordering Data, and shall be designed to resist the combined effect of horizontal and vertical seismic loadings together with external loads, pressure loads, and temperature loads.

3.2.1.2 Vibration. The cold trap and all its parts shall be analyzed and designed so that they will not be damaged or caused to malfunction by internally generated vibrations, such as flow-induced vibrations or by environmental vibrations. Baffles and tube support plates, tie rods, impingement plates, etc. shall be provided so that the natural frequencies of all unsupported tube spans are sufficiently removed from both hydrodynamically and environmentally generated fluid pulsations to avoid damage.

3.2.1.3 Piping Reactions. The cold trap assembly shall be designed to accommodate the forces and moments exerted by the piping on the economizer and crystallizer tank cooling jacket (if applicable) as specified in the Ordering Data and Figure 2.

3.2.1.4 Corrosion Allowance. Corrosion allowances for both sodium-containing materials and coolant-containing materials shall be as specified in the Ordering Data.

3.2.1.5 Life. The cold trap assembly shall be structurally capable of operating for the life specified in the Ordering Data.

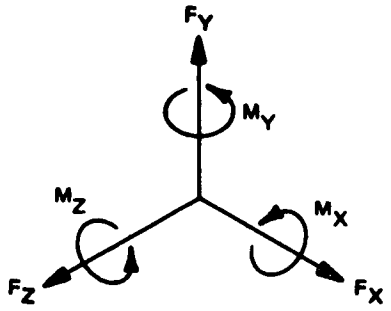
3.2.2 Size and Weight. Weight and overall dimensions shall be the minimum consistent with the requirements specified herein. Overall dimensions of the cold trap assembly shall not exceed the limitations specified in the Ordering Data.

3.2.3 Thermal and Hydraulic Design. The cold trap piping shall be designed so that the average velocities and pressure losses will be within limits specified in the Ordering Data. The cold trap assembly shall be designed to permit freezing and programmed melting of its contents without being damaged.

3.2.3.1 Residence Time. Maximum economizer residence time shall be 30 seconds, and minimum residence time in the crystallizer tank shall be 5 minutes.

3.2.3.2 Pressure Drop. The pressure drop through the cold trap assembly shall be a minimum consistent with the requirements of this

DESIGN TEMPERATURE °F (°C)



NOZZLE IDENTIFICATION		FORCES, lb (N)			MOMENTS, ft-lb (N·m)		
		F_X	F_Y	F_Z	M_X	M_Y	M_Z
ECONOMIZER SHELL SIDE:	SODIUM INLET						
	SODIUM OUTLET						
ECONOMIZER TUBE SIDE:	SODIUM INLET						
	SODIUM OUTLET						
CRYSTALLIZER TANK:	SODIUM INLET						
	SODIUM OUTLET						
	COOLANT INLET						
	COOLANT OUTLET						

Fig. 2. Piping Reactions at Nozzles

standard, and shall not exceed the maximum value specified in the Ordering Data.

3.2.3.3 Sodium Temperature. The cold trap assembly shall be capable of cooling the design flow of sodium to a temperature at the coldest part of the crystallizer tank of 230°F (166°C). The temperature drop in the crystallizer tank shall be a maximum of 100°F (38°C).

3.2.3.4 Flow Rate. The cold trap assembly shall be capable of processing sodium at the flow rate specified in the Ordering Data.

3.2.4 Economizer. The economizer (tubular heat exchanger) shall be designed in conformance with TEMA Class R requirements. The economizer shall be external to the crystallizer tank. Detailed design requirements for the economizer shall conform to the requirements of the Ordering Data and the following:

1. Nozzles and connections shall be of the size, type, and orientation specified in the Ordering Data.

2. Supports shall be adequate for supporting the unit when filled and subjected to the seismic loading of 3.2.1.1.

3. The system sodium inlet stream shall be on the shell side.

3.2.5 Crystallizer Tank. The crystallizer tank shall be designed to give the fluid residence time specified in 3.2.3.1. The physical properties, pressure, and temperature of the coolant to be used in the cooling system will be specified in the Ordering Data.

3.2.5.1 Crystallization Element. The crystallization element shall be made with continuous-strand stainless steel knitted wire mesh; the wire shall be 0.003 to 0.015 in. (0.07 to 0.38 mm) in diameter. The mesh shall be wound in spiral pads forming right circular cylinders with dimensions as specified in the Ordering Data, and shall be packed to a density of 10 to 25 lb/ft^3 (160 to 400 kg/m^3) to give the surface area per unit volume specified in the Ordering Data. The compacted mesh pads shall be stacked to give the total thickness, in the direction of sodium flow, specified in the Ordering Data. The packing shall be supported by a rigid framework designed to hold it in place against the maximum specified pressure drop.

3.2.6 Venting. The cold trap assembly shall be self-venting with vent locations approved by the purchaser.

3.2.7 Instrumentation Provisions. A minimum of two thermowells shall be provided in the crystallizer tank, extending from the top of the tank through the knitted wire mesh into the lower plenum. The number and locations of other thermowells shall be as specified in the Ordering Data. If the thermocouples are to be provided by the supplier, their requirements will be specified in the Ordering Data.

3.2.8 Connections and Appurtenances. All connections (heaters, thermocouples, insulation supports, sodium and crystallizer tank coolant piping) shall be as specified in the Ordering Data.

There shall be no interconnection between systems that could result in the mixing of the sodium with the crystallizer tank coolant.

All cold trap assembly piping stub connections shall extend to the assembly interface boundary specified in the Ordering Data, and shall be designed for buttwelding in accordance with ANSI B16.25.

3.2.9 Insulation. Any internal insulation and clips where required on the exterior of the equipment for support of external insulation shall be provided. The required insulation thickness to provide a maximum external temperature of 140°F (60°C) shall be recommended. The value used for sizing system heaters shall be provided.

3.2.10 Handling Fixtures. Lifting lugs, supports, handling fixtures, and framing shall be as specified in the Ordering Data.

3.2.11 Heaters. A recommendation shall be provided for the size and location of all heaters required for a programmed preheat of the cold trap assembly, full of solid sodium, from ambient to preheat temperature as specified in the Ordering Data. Heaters shall be designed to operate at one-half their rated voltage.

The use of electrical heaters in contact with sodium shall not be permitted.

3.2.12 Environmental Conditions. Normal ambient conditions to which the cold trap assembly will be exposed are specified in the Ordering Data, and include temperature and pressure ranges, humidity, wind, precipitation, and other conditions which could influence the operation of the assembly.

3.2.13 Structural Supports. The cold trap assembly shall be supported from a steel structure as specified in the Ordering Data. Structural steel design, fabrication, and erection shall be in accordance with the AISC Manual and the AISC Code. Structural members shall be designed to exclude field welding. Bolted structures are preferred.

3.3 Materials of Construction. Sodium-containing (pressure boundary) materials and all internal parts that are welded to the pressure boundary shall be Type 304 or 316 stainless steel, and shall conform to the requirements of the appropriate RDT material standards as specified in the Ordering Data. Knitted wire mesh used in the crystallization element shall be continuous strand, austenitic stainless steel wire mesh. Other internal parts not welded to the pressure boundary shall be Type 304 or 316 stainless steel and shall meet material requirements established by the Code. A3

Structural supports may be of carbon steel construction.

3.4 Fabrication.

3.4.1 Fabrication Criteria. Detailed fabrication procedures meeting the requirements of Section III of the Code as supplemented by RDT E 15-2NB, NC, or ND, as applicable, shall be submitted to the purchaser for review prior to the start of fabrication. The fabrication procedures shall include the proposed sequences and procedures for material procurement, fabrication, cleaning, maintaining cleanliness, examination, in-process inspection, and testing of all parts of the cold trap assembly that are to be provided by the supplier. | A1

3.4.2 Welding and Thermal Cutting. Tube-to-tubesheet welds in the cold trap economizer shall meet the requirements of NB-4350 (Special Qualification Requirements for Tube-to-Tubesheet Welds) of the Code. All other welding and all brazing, hard surfacing, and thermal cutting procedures shall be in accordance with RDT E 15-2NB, NC, or ND, as applicable, for all classes of welds. | A3

3.4.2.1 Dissimilar Metal Welds. Carbon or low alloy steel parts shall not be welded directly to a stainless steel pressure containment part.

3.4.2.2 Weld Repair. Purchaser approval shall be required to make weld repairs to remove defects that recur:

1. After the first cycle of weld repair of defects at the fusion zone and/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 shall not require purchaser approval.

3.4.3 Heat Treatment. All heat treatment including stress relieving shall be in accordance with the requirements of the applicable material standards.

3.4.3.1 Sensitization. Austenitic stainless steel which has become sensitized during heat treatment, welding, or forming shall be solution annealed in accordance with the applicable material standard; or, sensitized austenitic stainless steel, which has not been solution annealed in accordance with the applicable standard, shall be maintained in a dry, controlled, monitored environment subsequent to sensitization. Alternate techniques for handling sensitized materials shall require the written concurrence of the purchaser.

3.4.4 Bending and Forming. Bending and forming procedures for shaping tubes, shells, heads, etc., shall be in accordance with the

applicable standards or procedures prepared by the supplier and approved by the purchaser. The wall thickness at the outer radius of the bend after the bending and forming operations shall not be less than the minimum design thickness. The out-of-roundness in any circular cross section of pipes and tubes after bending shall not exceed 8% of the outside diameter. The need for heat treatment to ensure dimensional stability following bending or forming operations shall be evaluated by the supplier. | A3

3.4.5 Cleaning. Surfaces shall be clean and free of pitting, corrosion products, and oxides. The cleaning of materials and the degree of cleanliness shall be in accordance with RDT F 5-1, as specified in the Ordering Data. Before conducting cleaning operations, the following shall be submitted for purchaser approval:

1. General cleaning procedures to be employed.
2. Flushing procedures.
3. Acceptance standards for contamination.
4. Drying methods to be employed on cleansed equipment.
5. Inhibitors employed for minimizing corrosion when applicable and procedures for their removal.

3.4.6 Assembly. The assembly of component parts including economizer and crystallizer tank assembly shall be in accordance with a detailed assembly procedure prepared by the supplier. The procedure shall contain as a minimum:

1. Any special machining or fitting-at-assembly instructions.
2. Intermediate and final inspection criteria and hold points.

3.4.7 Identification. Identification procedures shall conform to the following requirements.

3.4.7.1 Marking. Raw materials and in-process marking shall be in accordance with the applicable material standard and NB-4122 of Section III of the Code. When raw material is cut or sectioned, all markings shall be transferred to the unmarked portion of the material. | A1

3.4.7.2 Nameplates. Permanent nameplates shall be attached to the crystallizer tank and economizer. The nameplate shall show the following information as a minimum:

1. Code class.
2. Manufacturer's name.
3. Manufacturer's drawing or part number.
4. Manufacturer's serial number.

5. Purchase order or contract number.
6. RDT E 4-5T.
7. Design pressure, ____ psig at coincident temperature ____°F (°C).
8. Design temperature, °F (°C).
9. Design sodium flowrate, ____ lb/hr (N/h) at design temperature.
10. Material of construction.
11. Year built.

The nameplates shall be of a corrosion resistant material compatible with the surface to which they are fastened. Caustic resistant enamel shall be used to fill the markings on the nameplate. The plate support brackets shall be attached by welding in accordance with NA-8300 and NB-4435 of the Code. Nameplates shall not be painted over or otherwise covered. Nameplates shall not be attached directly to the vessel, pipe, or component. A standoff using the same base material, shall be welded to the item using full penetration welds. The standoff height shall be equal to the insulation thickness plus 1/4 in. (6.35 mm). A1

3.4.8 Handling. Handling, hoisting and rigging of the cold trap assembly or major parts and components of the assembly that are designated as "critical" in the Ordering Data shall satisfy the requirements of RDT F 8-6. Hoisting and materials handling equipment used for handling critical items shall meet the requirements of RDT F 8-6. A2

3.5 Drawings. Drawings shall be prepared in accordance with ANSI Y14 and submitted to the purchaser. The submittal time, approval requirements, and number of copies shall be as specified in the Ordering Data.

3.5.1 Assembly Drawings. These drawings shall include the following information, where applicable.

1. Information required for the preparation of mechanical supports.
2. Size and location of all connections and fittings.
3. Thermal and pressure movement of all connections with respect to the equipment support.
4. Dry weight and center of gravity locations.
5. A complete list of reference drawings.
6. A bill of material which includes location, identity (drawing and part numbers), and material type of each part.
7. Dimensions establishing size, shape, fits and clearances of each major part.
8. Pressure and temperature data, including design pressure and temperature, and test pressure.

9. Actual dimensions in critical areas as specified in the Ordering Data.

10. Pertinent references to cleaning, marking, torque, locking, handling, and packaging instructions.

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

1. Detailed dimensions, tolerances, and maximum roughness of each surface.

2. Material specification and any special requirements including nondestructive testing, heat treatment, and hardness.

3. Fabrication instructions, including welding, hardsurfacing, cleaning, inspection symbols, and references to assembly procedure requirements.

3.5.3 Drawing and Specification Lists. A current listing of all drawings associated with the components of this standard shall be maintained. Each drawing number shall include the current revision number.

A current list of specifications shall be maintained. This list of specifications shall include as applicable, requirements for design, materials, fabrication, construction, installation, testing, inspection, maintenance, cleaning, packaging, shipping, storage, operation, and quality assurance.

The drawings and specifications lists shall be maintained for the time specified in the Ordering Data.

3.6 Special Tools. One set of special tools required in operating and maintaining the equipment shall be supplied. The tools shall be new and unused.

3.7 Reports and Documentation.

3.7.1 Design Report. A design report related to the design of the cold trap and its component parts shall be prepared. The time and approval requirements of submittals to the purchaser and the number of copies required shall be as specified in the Ordering Data. The design report shall be submitted as the basis for approval of the cold trap assembly design by the purchaser. As a minimum for Section III Class 1 requirements of the Code, this design report shall include the following: | A1

1. A design description of the cold trap including operating characteristics, operational limitations, and safety considerations.

2. Heat transfer and fluid flow analyses.

3. A thermal transient stress analysis of regions of discontinuities and thick sections.

4. A stress report satisfying the rules of NA-3350 of the Code, Section III. This report shall include a discussion of the employed high-temperature design criteria. | A1

5. Vibration analyses.

6. Differential thermal expansion analysis.

7. Weight and center of gravity calculations of the cold trap and its component parts.

8. Corrosion allowance used in analysis.

9. Materials of construction.

All information furnished in the design report shall be in sufficient detail to permit independent checking. The references from which data or formulas are taken shall be identified. The validity of the data and the conclusion, which support the recommended design, shall be discussed. All computer programs used shall be identified and described in the report to enable independent verification.

Additions or corrections shall be made to the report as required to keep the information current. These revisions shall be numbered and dated, and shall be submitted to the purchaser for approval.

For Section III Class 2 requirements of the Code, the design report shall include those items from the above Class 1 listing that are specified in the Ordering Data. | A1

3.7.2 Quality Assurance Documents. The following documents based on the requirements of RDT F 2-2 shall be prepared. The time and approval requirements of submittals to the purchaser and the number of copies required shall be as specified in the Ordering Data.

3.7.2.1 Quality Assurance Program Plan. A quality assurance program plan in accordance with RDT F 2-2 shall be prepared.

3.7.2.2 Inspection and Test Plan. An inspection and test plan in accordance with RDT F 2-2 shall be prepared.

3.7.2.3 Special Process Control and Nondestructive Examination Procedures. Procedures and equipment for special processes and nondestructive examinations and test shall be prepared and qualified in accordance with RDT F 2-2.

3.7.2.4 Inspection and Test Procedures. Inspection and test procedures in accordance with RDT F 2-2 shall be prepared. These

procedures shall include the details of any sampling plans proposed by the supplier and the basis for selection of the proposed sampling plan in accordance with RDT F 2-2.

3.7.2.5 Nonconforming Item Documentation. All nonconformances including corrective action and proposed rework, repair, and retest procedures in accordance with RDT F 2-2 shall be documented.

3.7.2.6 Handling, Preservation, Packaging and Storage Procedures. Handling, preservation, packaging, and storage procedures in accordance with RDT F 2-2 shall be prepared.

3.7.2.7 Design Descriptions. Design descriptions in accordance with RDT F 2-2 shall be prepared.

3.7.2.8 Quality Records. As a minimum, a file of code records as required by NA-4000, Section III of the Code shall be maintained and the following documents shall be submitted to the purchaser pertinent to each cold trap assembly: A1

1. Parts List. List of items by part number, drawing number and revision, part name, serial number or lot or heat number.

2. Drawings. A reproducible set of assembly drawings.

3. Special Processes and Nondestructive Test Qualifications. Certifications of special processes and nondestructive testing procedures and equipment qualifications as specified in RDT F 2-2.

4. Nonconformance Records. A copy of each nonconformance and corrective action record including rework, repair, and retest procedures.

5. Certification. Certification of conformance as specified in RDT F 2-2, including:

   a. Material Certifications. Chemical and physical test results, nondestructive test results, heat treatment data, and test results of the test coupons.

   b. Nondestructive Examination. Certified results of final nondestructive examinations including radiographic films, recorder charts, and photographs.

   c. Test Reports. Certified copy of test results including analysis of test results, test fluid temperature, and metal temperatures, including temperature corrections made to test pressure.

d. Final Inspection. A copy of final inspection data and results.

4. QUALITY ASSURANCE REQUIREMENTS

4.1 Quality Assurance Program. A quality assurance program shall be established and implemented in accordance with Sections 1 through 5 and 8 of RDT F 2-2; this standard; and applicable standards, codes, and regulations.

4.2 Inspection. The performance of all inspections, including visual examinations shall be the responsibility of the supplier.

Cold trap assemblies furnished to this standard shall be subject to verification or inspection at the supplier's facility by a purchaser representative. All such inspections shall be scheduled in advance. Such inspection may include, at purchaser's option, witnessing of various processes, inspections, tests, preservation, cleaning, marking, packaging, and any associated inspection of other records pertaining to this standard.

Source inspection by the purchaser or his designated representative shall in no way relieve the supplier of his responsibility for meeting requirements of this standard.

Evidence of source inspection shall be shown on shipping documents.

4.3 Nondestructive Examination. All nondestructive examinations shall be in accordance with the applicable material and process standards, codes and RDT F 3-6. If alternate or additional acceptance standards are needed, criteria shall be recommended to the purchaser for his written approval prior to proceeding with the examinations.

4.4 Examination of Materials. Acceptance standards and calibration levels shall be as specified in the applicable material standard.

4.4.1 Visual Examination of Materials. All raw materials shall be examined visually for defects and state of cleanliness in accordance with the requirements of the applicable material standards.

4.4.2 Nondestructive Examination of Materials. When requirements for examination of materials are specified by nondestructive testing, examinations shall be accomplished using RDT F 3-6. A1

4.4.3 Material Repairs. Where the applicable material standard and procurement specification allows the use of welding processes for repair of defects in the material, the quality assurance provisions of the repair weld shall be accomplished in accordance with the requirements of the Code, Section III, and RDT E 15-2NB, NC, or ND as applicable. A2

The examination of the weld repair shall be in accordance with the requirements of RDT F 3-6. The weld repaired area shall be re-examined by the inspection methods which revealed the original defect and in addition, where necessary, other nondestructive test methods which will ensure that the quality of the material has been maintained.

4.5 Examination During Fabrication. Examinations of welds, both visual and dimensional, and nondestructive testing, shall be in accordance with the requirements of the Code, Section V, and RDT F 3-6. A1

4.5.1 Visual and Dimensional Examination. All items shall be subject to visual and dimensional examination to verify conformance with approved drawings. After forming operations, any shells or heads shall be 100% examined for conformance to prescribed shape and thickness. Nozzles and attachments shall be examined for proper fit to the curvature of the shell surface.

4.5.2 Liquid Penetrant Examination. Nonmagnetic materials shall be examined by liquid penetrant methods. Welds shall be examined in accordance with the requirements of RDT E 15-2NB, NC, or ND, as applicable, by liquid penetrant. The use of liquid penetrant materials from aerosol spray cans using halogenated compounds as propellants is prohibited. Following liquid penetrant examination, weld areas shall be cleaned in accordance with the requirements of RDT F 5-1. A1

4.5.3 Radiographic Examination. All completed welds that are required to be radiographed shall be examined by radiography in accordance with the requirements of RDT F 3-6.

4.5.4 Examination of Weld Repairs. Weld repairs shall be examined in accordance with the requirements of the Code, Section III, and RDT E 15-2NB, NC, or ND, as applicable.

4.5.5 Examination of Lifting, Handling, and Shipping Fixtures. Following proof load testing of lifting, handling, and shipping fixtures, and attachment lugs in accordance with RDT F 8-6, all structural welds of these items shall be examined by the magnetic particle or liquid penetrant method depending upon material in accordance with the requirements of RDT F 3-6. A2

All slings and hooks, not containing structural welds, used in lifting the cold trap assembly shall, as a minimum, be visually examined for structural defects.

4.6 Acceptance Tests.

4.6.1 Strength Tests. The strength test performed shall be pneumatic, using a test gas of purity specified in the Ordering Data. Pneumatic tests shall be based upon NB-6300 of Section III of the Code. The supplier's procedure shall include all requirements of that paragraph plus those of this section. A1

Prior to and during the performance of the strength test, the material temperature shall be maintained at least 60°F (16°C) above the highest of the impact test temperatures required to meet the impact values of Section III of the Code, Table I of Appendix I, taking into account materials and welds at the fluid and gas boundary and the materials of the parts welded directly to either the inside or the outside surfaces. A1

The temperatures of the cold trap material and gas shall be continuously monitored during the test. Instruments used to monitor and record pressure and temperatures shall be calibrated in accordance with RDT F 2-2 for the overall system accuracy of ±2% in the range of the test unless otherwise specified in the Ordering Data. Temperature corrections shall be made to the test pressure. A1

Upon completion of the pneumatic tests, the cold trap assembly shall be protected from contamination by maintaining the sealed conditions and by keeping the internal environment of test gas at 5 to 7 psig (34 to 48 kPa) pressure, until the helium leak test, if required, is performed.

4.6.2 Helium Leak Test. Helium leak testing of the cold trap assembly pressure boundaries shall be performed in accordance with RDT F 3-6. The type of helium leak test to be used and the maximum permissible helium leak rate are specified in the Ordering Data.

The completed economizer, the crystallizer tank (both before and after cooling jacket welding) and the completed cold trap assembly shall be helium leak tested after the strength test of 4.6.1 has been completed.

4.6.3 Repair and Retest. Upon failure of either the pneumatic or helium leak test, and with prior purchaser approval, the defect shall be repaired and the cold trap assembly retested.

4.7 Functional Tests. Requirements for functional tests, test provisions, and test equipment shall be as specified in the Ordering Data.

5. PREPARATION FOR DELIVERY

5.1 Delivery Requirements. The cold trap assembly shall be delivered to the site designated in the Ordering Data.

5.1.1 Preparation. Upon completion of all shop testing and inspection, the cold trap assembly shall be prepared for delivery to the designated site. This shall include, but not be limited to, recleaning (if necessary), surface preparation, and examination.

5.1.2 Packaging and Packing. All sealing, packaging, packing, and identification marking shall be in accordance with RDT F 7-2, with the level of packaging as specified in the Ordering Data. Packaging shall be adequate to protect the item from corrosion and damage while at

the supplier's facilities, during transportation to the designated site, and at the designated site, as specified in the Ordering Data.

5.1.3 Shipping. All technical documentation, instructions, drawings, reports, and manuals that are to accompany the cold trap during shipment shall be identified.

5.1.4 Handling. Hoisting and rigging of the cold trap assembly or major parts of the assembly during preparation for delivery and loading shall meet the requirements of RDT F 8-6. All tackle and handling fixtures shall meet the requirements of RDT F 8-6. Lifting points and tie down points shall be provided per the requirements of RDT F 8-6. A2

5.2 Caution Labels and Special Marking. When shipping containers or components are packed with desiccant and humidity indication card, a special caution notice label shall be applied.

Warning notices placed on the component or container shall indicate the location and quantity of desiccant in the unit and the location of the humidity indication card.

6. NOTES AND ORDERING DATA CHECKLIST

6.1 Compliance. When this standard is used as a basis for procurement, the purchase specification will be certified by a registered Professional Engineer representing the purchaser to be in compliance with the rules for a design specification of the Code, Section III. A1

6.2 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.

	Item	Refer to Paragraph
1.	Number of units required.	
2.	Issue dates and applicable amendments of documents.	2.
3.	Detailed envelope dimensions, system descriptions.	3.1
4.	Classification under Section III of the Code.	3.2.1
5.	Operating temperatures, pressures, and thermal transients for all applicable operating conditions.	3.2.1
6.	Seismic loading criteria.	3.2.1.1
7.	Piping reactions.	3.2.1.3

	Item	Refer to Paragraph
8.	Corrosion allowances.	3.2.1.4
9.	Life.	3.2.1.5
10.	Limiting overall dimensions.	3.2.2
11.	Sodium velocity.	3.2.3
12.	Residence times.	3.2.3.1
13.	Pressure drop.	3.2.3.2
14.	Flow rate of sodium to be purified.	3.2.3.4
15.	Economizer nozzle details.	3.2.4
16.	Coolant physical properties, pressure and temperature.	3.2.5
17.	Dimensions and packing density of crystallization element.	3.2.5.1
18.	Extra thermowells and thermocouples.	3.2.7
19.	Details of connections.	3.2.8
20.	Length of piping stub connections.	3.2.8
21.	Details of handling fixtures.	3.2.10
22.	Preheat temperature, time to reach it, program for rate of temperature rise.	3.2.11
23.	Normal ambient conditions.	3.2.12
24.	Materials of construction and their RDT material standards.	3.3
25.	Cleaning criteria from RDT F 5-1.	3.4.5
26.	"Critical" items to be handled.	3.4.8
27.	Drawings, design report, and quality assurance documents submittal time, approval requirements and number of copies.	3.5, 3.7.1, 3.7.2
28.	Maintenance time for drawing and specification lists.	3.5.3

	Item	Refer to Paragraph
29.	Design report requirements for Class 2 vessels.	3.7.1
30.	Purity of test gas for pneumatic strength test.	4.6.1
31.	Type of helium leak test, leak rate.	4.6.2
32.	Requirements for functional test.	4.7
33.	Delivery site.	5.1
34.	Level of packaging (RDT F 7-2).	5.1.2
35.	Storage conditions at delivery site.	5.1.2

COLD TRAP REQUIREMENTS	CRYSTALLIZER TANK SODIUM	COOLANT JACKET	ECONOMIZER	
			SHELL SIDE SODIUM	TUBE SIDE SODIUM
1. FLUID CIRCULATED DENSITY: THERMAL CONDUCTIVITY: SPECIFIC HEAT: VISCOSITY:				
2. TOTAL FLOWRATE, lb/hr (kg/h): SYSTEM STARTUP/CLEANUP: SYSTEM MAINTENANCE/POLISHING:				
3. RESIDENCE TIME: ECONOMIZER (SHELL SIDE): CRYSTALLIZER TANK:				
4. OPERATING TEMPERATURES, ^{o}F (^{o}C): INLET: OUTLET: MINIMUM:				
5. OPERATING PRESSURE, psia (kPa, absolute):				
6. OPERATING PRESSURE DROP, psi (kPa):				
7. DESIGN TEMPERATURE, ^{o}F (^{o}C):				
8. DESIGN PRESSURE, psig (kPa, gage):				
9. CORROSION ALLOWANCE:				
10. FOULING FACTOR:				
11. CODE DESIGN REQUIREMENTS:				
12. MATERIALS OF CONSTRUCTION:				
13. NOZZLES, SIZE AND TYPE:				
14. HELIUM LEAKAGE RATE:				