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Supersedes
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RD T Standard

CLASS 1 VALVES FOR LIQUID METAL SERVICE

MAY 1975

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FOREWORD

This standard supersedes the February 1971 issue of RDT E 1-18T and incorporates those changes to that issue that were approved and published as Amendments 1 through 4 and additional changes that were approved for publication in this revision. Due to extensive reorganization of the standard to improve the format and to give visibility to the ASME Code design specification requirements, marginal notation of changes have not been included.

RDT STANDARD

RDT E 1-18T

U. S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
DIVISION OF REACTOR RESEARCH AND DEVELOPMENT

DATE May 1975

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U. S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
DIVISION OF REACTOR RESEARCH AND DEVELOPMENT

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DATE May 1975
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CLASS 1 VALVES FOR LIQUID METAL SERVICE

1. SCOPE

This standard establishes the requirements for throttle, isolation, and check valve assemblies for liquid metal service constructed in accordance with the Class 1 requirements of the ASME Boiler and Pressure Vessel Code, Section III, Division 1, Nuclear Power Plant Components, and special requirements that are additive or more restrictive. These valves are for applications in which the valve passes or stops the flow of liquid metal coolant in a nuclear reactor primary or secondary heat transfer system, or for other applications in which the valve is subject to severe operating conditions and where loss of function may impair the safety of the system in which the valve is installed.

1.1 Definitions.

1.1.1 Back Seat. A seat comprised of the contact area between the valving element and the bonnet with the valve in the open position.

1.1.2 Backup Stem Seal. A packing type seal used to assure containment of the working fluid within the valve in event of a stem seal failure.

1.1.3 Bellows Seal. A method of sealing the valve stem in which the ends of a metal bellows are fastened to the bonnet and to the stem. The bellows expands and contracts with the stem travel.

1.1.4 Bonnet. A pressure retaining boundary part that is attached to the valve body to close the opening through which the valve internals are assembled.

1.1.5 Check Valve. A valve that permits flow in one direction only, checking reverse flow.

1.1.6 Hands-on-Maintenance. The direct handling of tools by personnel rather than the use of remote manipulators or slave devices.

1.1.7 Isolation Valve. A valve normally used in only two positions - either closed or fully open.

1.1.8 Liquid Metal. Molten sodium or sodium-potassium alloy.

1.1.9 Maintainability. Those inspection, servicing, testing, and repair characteristics of an item which affect the operating continuity of the facility and affect the effort required to restore the function of the item to its in-tolerance state.

1.1.10 Pressure Retaining Boundary. The barrier between the liquid metal contained within the valve and the exterior environment that is comprised of the valve body, bonnet, stem seals, and related assembled joints.

1.1.11 Remote Manual Maintenance. Operations that require the use of tools that extend the normal reach of the operator and that transmit the action of the operator's hand to the work-piece. Each action of the tool requires a direct action of the operator. Slave devices such as master-slave manipulators and simple extended shanks on tools such as wrenches are examples of devices used for remote manual operations that permit personnel to work through shielding, enclosures, and greater than normal distances.

1.1.12 Remote Machine - Manual Setup Maintenance. Remote machine operations that do not require operator action during execution of the task. The machine is set up in the work location and prepared for the performance of the task by personnel having direct access and control.

1.1.13 Remote Machine - Remote Setup Maintenance. Machine operations that do not require operator action during execution of the tasks. The machine is set up in the work location and prepared for the performance of the task without direct personnel access or control.

1.1.14 Stem Freeze Seal. A seal obtained by freezing liquid metal such as sodium between the valve stem and the stem housing.

1.1.15 Stem Seal. A bellows or freeze seal located at the stem penetration of the working fluid interface.

1.1.16 Throttle Valve. A valve which controls flow rate and has an infinite number of operating positions.

1.1.17 Valve. The assembled pressure retaining boundary parts and internals including the body, bonnet, disk, stem, and stem-retaining structure.

1.1.18 Valve Assembly. A valve completely equipped with a manual or power operator, accessories, and instrumentation.

1.1.19 Valving Element. The moving element of a valve which controls flow either by proximity to a seat or to a closure port.

2. APPLICABLE DOCUMENTS

The following documents form 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 apply unless otherwise specified.

Where this standard appears to conflict with the requirements of a reference document, the supplier shall call it 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)
- RDT F 2-2 Quality Assurance Program Requirements
- RDT F 3-15T Requirements for Inspection of Dimensional Characteristics
- RDT F 4-20T Operation and Maintenance Manuals
- RDT F 5-1T Cleaning and Cleanliness Requirements for Nuclear Components
- RDT F 7-2T Preparations for Sealing, Packaging, Packing and Marking of Components for Shipment and Storage
- RDT F 7-3T Marking of Components and Parts
- RDT F 8-1T Preloading Threaded Fasteners and Closures
- RDT F 8-6T Hoisting and Rigging of Critical Components and Related Equipment
- 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 6-2T Mechanical Locking Devices

RDT M 12-1T Test Requirements for Thermal Insulating Materials for Use on Austenitic Stainless Steel

RDT M 12-2T Calcium Silicate Block and Pipe Thermal Insulation (ASTM C533 with Additional Requirements)

2.2 American National Standards (ANSI).

ANSI B1.1 Unified Screw Threads

ANSI B16.25 Buttwelding Ends

ANSI B30.9 Slings, Safety Code for
ANSI C1 National Electrical Code
ANSI Y14 Drafting Manual

2.3 American Society of Mechanical Engineers (ASME) Publications.

ASME Boiler and Pressure Vessel Code

Section III, Division 1, Nuclear Power Plant Components

Code Case 1539, Metal Bellows and Metal Diaphragm Stem Sealed Valves, Section III Class 1, 2, and 3.

Code Case 1592, Class 1 Components in Elevated Temperature Service. Section III.

Code Case 1593, Fabrication and Installation of Elevated Temperature Components. Section III, Class 1.

Code Case 1594, Examination of Elevated Temperature Components. Section III, Class 1.

Code Case 1595, Testing of Elevated Temperature Components, Section III, Class 1.

Section V, Nondestructive Examination

3. TECHNICAL REQUIREMENTS

3.1 General Requirements.

3.1.1 Description of Application. The plant system in which the valve assembly will be installed, the system fluid, and the location and function of the valve assembly will be described in the Ordering Data. Where applicable, the normal operating position of the valve (open or closed) will be specified in the Ordering Data.

3.1.2 Fluid Design Basis. The valve shall be designed for service with liquid metal, gases saturated with metal vapor, or both as specified in the Ordering Data. The valve shall be designed based on the maximum and minimum values and the normal operating range for pressure, temperature, and flow rate of the specified fluid that will be specified in the Ordering Data.

3.1.3 Valve Assembly Description. The valve size, type, body configuration, operator type(s), and accessories shall be as specified in the Ordering Data. Special design features and any restrictions on design that result from system or reactor plant considerations shall be

as specified in the Ordering Data. The installed position, limiting dimensions of connecting piping, and other interface requirements for the valve assembly shall be as specified in the Ordering Data.

3.1.4 Basis of Construction*. Valves shall be constructed in accordance with the Class 1 rules of the ASME Boiler and Pressure Vessel Code, Section III, Division 1, Nuclear Power Plant Components (herein after referred to as the Code); the supplementary requirements of RDT E 15-2NB; and Code Case Interpretations and Special Rulings specified herein or in the Ordering Data. Where the metal temperature exceeds those temperatures for which allowable stress values are given by the Code, the requirements of Code Cases 1592, 1593, 1594, and 1595 and the supplemental requirements of RDT F 9-4 shall apply. For valves with a bellows stem seal, Code Case 1539 shall apply.

3.1.5 Functional Operation. The valve assembly shall be capable of functional operation under all design conditions and the normal and upset operating conditions specified in 3.3.1 and 3.3.2. In addition, when specified in the Ordering Data, the valve assembly shall be designed to assure functional operation under the emergency conditions, faulted conditions, or both (3.3.2).

3.1.6 Qualification of Valves. Subject to the concurrence of the purchaser, the valve design or operator design may be considered qualified based on documented successful operating or test experience for items of similar design under conditions equivalent to or more severe than the design and operating conditions for which functional capability is required (3.1.5). When acceptable experience is not available, qualification tests of a prototype valve or lead production unit, the operator, or both shall be performed in accordance with 4.7.2.3.

3.2 Performance Requirements. The performance characteristics of the valves shall meet the stated minimum, maximum, or minimum and maximum values for each performance characteristic specified in the Ordering Data, as measured using the specified fluid at the specified system operating or design conditions of temperature, pressure, and flow, for the specified number of valve operating cycles. The performance characteristics shall be determined by testing a prototype valve or lead production unit (4.7.2.1 or 4.7.2.3). When specified in the Ordering Data, performance tests may be conducted using water or other fluid where the fluid conditions can be adjusted to simulate the specified liquid metal conditions.

*The term "construction" is used in this standard as defined as in the Code, viz, an all inclusive term pertaining to materials, design, fabrication, examination, testing, inspection and certification required in the manufacture and installation of components, parts, and appurtenances.

3.3 Design Requirements.

3.3.1 Design Conditions.

3.3.1.1 Design Pressure. The internal and external design pressure, the static and dynamic pressure heads that apply, and the maximum differential pressure across the valving element shall be as specified in the Ordering Data.

3.3.1.2 Design temperature. The design temperature shall be as specified in the Ordering Data.

3.3.1.3 Design Mechanical Loads. The design mechanical loads shall be as specified in the Ordering Data. Earthquake data for the operating basis earthquake (3.3.2) shall be used where applicable to the analysis of design conditions.

3.3.2 Operating Conditions. The normal, upset, emergency, and faulted conditions shall be as specified in the Ordering Data. Any data required for the calculation of secondary and peak stress, for analysis of cyclic operation, and for assessing conformance to special stress limits of the Code will be provided in the Ordering Data for each operating condition. Seismic loading criteria for the operating basis earthquake (OBE) and the safe shutdown earthquake (SSE) will be provided in the Ordering Data.

3.3.3 Testing Conditions. Testing conditions shall be as specified in 3.3.9, 4.7.1, and in the Ordering Data.

3.3.4 Load Histograms. When the metal temperature exceeds those temperatures for which allowable stress values are given by the Code, expected loading histories or load histograms for normal and upset events, testing conditions, and emergency events will be provided in the Ordering Data in accordance with the requirements of the applicable Code Cases specified in 3.1.4.

3.3.5 Environmental Conditions. The valve assemblies shall be designed for the environmental conditions specified in the Ordering Data. These conditions will include, but not be limited to:

1. Pressure, temperature, and composition of the ambient external atmosphere.
2. Nuclear radiation intensity in the system fluids and from plateout of radioactive materials.
3. Exposure to neutron radiation or other radiation from external sources.

3.3.6 Service Life. The valve assembly shall be designed for the service life specified in the Ordering Data. Valve assembly parts

that cannot be designed for the full design service life shall be itemized in the interim design report (3.7.2) with the recommended service life for each, for approval by the purchaser.

3.3.7 Maintainability. Valve assemblies shall be designed to provide accessibility for necessary surveillance and inservice inspection, location of leaks, preventative maintenance that includes replacement of limited service life items (3.3.6), and repair with the valve in the installed position in accordance with the guidelines listed in the Ordering Data. The provisions for inspection and maintenance of the valve assemblies shall be described in the interim design report (3.7.2).

3.3.7.1 Schedules. Schedules for inspection and preventative maintenance shall be recommended by the supplier for purchaser approval.

3.3.7.2 Techniques and Procedures. Qualified techniques and procedures for inspection, location of leaks, packing replacement, and other servicing operations for the valve assemblies shall be established by the supplier and provided in the operation and maintenance manual (3.7.4). Hands-on-maintenance shall be emphasized in these procedures without precluding the application of remote techniques such as remote manual, remote machine - manual setup, or remote machine - remote setup.

3.3.7.3 Remote Cutting and Welding. Any requirement for remote cutting and welding will be specified in the Ordering Data. If remote cutting and welding procedures for maintenance on the internal parts of the valves are required, automatic welding processes, weld preparation methods, and special machines for seal weld cutting to obtain access to the internal parts of the valve shall be designed and demonstrated by the supplier. It may be assumed that the valves and adjacent horizontal pipe runs will be drained for these operations.

3.3.8 Structural Design.

3.3.8.1 Corrosion Allowance. The pressure retaining parts of the valves and the valve internals shall be designed to accommodate the environmental degradation of material properties resulting from decarburization, carburization, radiation damage, and the loss of material due to corrosion, erosion, and other surface wastage effects that may occur in service. An allowance for all pressure retaining boundary parts and valve internals shall be established by the supplier based upon criteria and formulae provided in the Ordering Data. The allowance(s) and the bases and supporting data shall be included in the design report (3.7.1).

3.3.8.2 Differential Thermal Expansion. The valve shall be designed to preclude loss of mechanical function due to differential thermal expansion resulting from steady state and transient conditions. This requirement pertains to all conditions categorized as normal or upset (3.3.2) and to conditions categorized as emergency or faulted when

assurance of valve function under the latter categories is specified in 3.1.5. The analysis shall be included in the design report (3.7.1).

3.3.8.3 Vibration. The valve assembly shall withstand all vibrational forces resulting from flow-induced vibrations generated within the valve and imposed systemic vibrational forces specified in the Ordering Data. The engineering vibration analyses of the valve assembly shall be included in the design report (3.7.1).

3.3.8.4 Mechanical and Hydraulic Shock. The valve assembly shall be designed to withstand shock forces resulting from valve operation and from any system-imposed effects defined in the Ordering Data.

3.3.9 Dry Operation. Valves shall be capable of operating without damage with air or inert gas as the contained fluid under the functional test conditions (4.7.1.5) and the preoperational system test conditions specified in the Ordering Data.

3.3.10 Fluid Properties. The physical properties of the liquid metal and saturated gases identified in 3.1.2 as the system fluids will be provided in the Ordering Data. The extent and type of contaminants in the system fluids will be specified in the Ordering Data.

3.3.11 Liquid Metal Drainage. Valves shall be designed to drain freely and to minimize the retention of liquid metal in the installed position with the valve open. When not specified in the Ordering Data, the incremental position adjustment required to promote drainage shall be recommended for purchaser approval. Limits of drainability shall be identified in the design report (3.7.1).

3.3.12 Heating System. The requirements for a system for heating the valve, empty and filled with liquid metal, at the rate and to the maximum temperature specified in the Ordering Data, shall be determined by the supplier. The purchaser's heating system design shall be reviewed by the supplier to assure proper valve heating.

3.3.13 Thermal Insulation. The requirements for thermally insulating the valve using the thermal insulation material specified in 3.4.2, such as insulation thickness, areas to be covered, and method of attachment, shall be determined by the supplier. Conditions to be achieved through use of insulation will be specified in the Ordering Data.

3.3.14 Flow Passages. Flow passages shall be shaped with the objective of minimizing:

1. Vibration of internal parts due to flowing sodium.
2. Deposition and collection of particulate matter in pockets and dead flow spaces.

3. Erosion of surfaces.

3.3.15 Construction of Valve Internals. Positive locking devices or integral or welded construction shall be used to avoid the occurrence of loose valve internal parts or to retain any potential loose parts from being released into flowing liquid metal. Designs employing threaded joints exposed to liquid metal shall be submitted to the purchaser for approval. Internal crevices which are not inherent to required design features shall be avoided. Necessary crevices shall be designed to avoid narrow and deep annuli that are susceptible to deposition of impurities and to crevice corrosion.

3.3.16 Seals. Mechanical joints in the pressure retaining boundary shall be sealed by seal welding or the use of welded seal membranes. Seal welds and welded seal membranes shall be designed to accommodate the loads due to internal pressure and the relative deflection of mating parts under the operating conditions with the closure fully secured.

3.3.17 Threaded Connections. Threaded connections in the valve, where permitted, shall conform to the following requirements:

1. Unless otherwise specified in the Ordering Data, screwthreads shall be in accordance with ANSI B1.1 and the thread fits shall be Class 2A or 2B.
2. Lubricants applied to threaded parts not exposed to liquid metal vapor shall be in accordance with RDT F 8-1. Lubricants shall not be used for fasteners exposed to liquid metal or metal vapor without prior purchaser approval.
3. Stainless steel fasteners shall be designed to prevent galling.
4. Mechanical and thermal straining shall be in accordance with RDT F 8-1.
5. Threaded fasteners shall have locking devices conforming to the requirements of RDT M 6-2.

3.3.18 Plating. Internal parts exposed to liquid metal or metal vapor shall not be plated.

3.3.19 Surface Roughness. Unless otherwise specified in the Ordering Data, the maximum surface roughness shall not exceed:

1. 63 microinch (AA) for aligning surfaces between mating parts.
2. 125 microinch (AA) for other machined surfaces.
3. 250 microinch (AA) for unmachined surfaces.

3.3.20 Electrical Equipment. Unless otherwise specified in the Ordering Data, electrical equipment for the valve assembly shall conform to the requirements of ANSI C1.

3.3.21 Interchangeability. The valve assemblies shall be designed to achieve the interchangeability and replaceability of parts and subassemblies. Items that require fitting at the time of assembly shall be described in the interim design report (3.7.2).

3.3.22 Component Design.

3.3.22.1 Body-Bonnet Joint. The body-bonnet joint construction shall be one of the following:

1. Full penetration weld.
2. Bolted flange with welded seal membrane.
3. Screwed and seal welded.
4. Bolted flange with seal weld.

Full penetration welded body-bonnet joints are preferred. Use of a sealed, mechanical joint configuration shall require purchaser approval. Recommended mechanical joint designs shall be submitted with a technical justification for the design selected, which shall discuss such aspects as the response to thermal cycling, the fabrication and examination of seal welds, leak testing, and prior qualifying service.

Mechanical body-bonnet joints shall be sealed in accordance with 3.3.16.

3.3.22.2 Positive Stops. The design of the valve shall provide positive stops to limit travel of the valving element.

3.3.22.3 Seats, Backseats, and Stem Guides. Contact surfaces of the seats, backseats, and valve element, and the bearing surfaces of the stem guides shall be protected from wear by one of the following methods as specified in the Ordering Data or approved by the purchaser:

1. Deposition of hard surfacing material by welding.
2. Full penetration weld attachment of alloy rings.
3. High temperature brazing of alloy rings.

The selected method shall be qualified using the same type and grade of wear surface and base materials to be used for valve construction. The qualification procedure shall be submitted to the purchaser for approval.

3.3.22.4 Stem Seals. The valve shall be provided with a stem seal and a backup stem seal. The seal configuration shall be one of the following as specified in the Ordering Data:

<u>Seal Configuration</u>	<u>Stem Seal</u>	<u>Backup Stem Seal</u>
1	Bellows	Packing
2	Freeze Seal	Packing

In each seal configuration, both the stem seal and the backup stem seal shall be capable of retaining the design pressure. The allowable leakage rates for seals shall be as specified in the Ordering Data.

3.3.22.4.1 Bellows Seal. When specified in the Ordering Data, valves equipped with bellows seals shall have back seating to provide for temporary sealing in case of stem seal leakage due to a bellows failure. Bellows travel greater than 10 percent of the free length in either compression or tension shall require purchaser approval. A seamless, formed bellows is the preferred type; use of other bellows types shall require special justification and prior purchaser approval. Direct impingement of flowing liquid metal upon the bellows is unacceptable. Bellows installed in a valve to be delivered shall not have been subjected to tests or assembly operations resulting in stresses exceeding the yield strength of the bellows material.

3.3.22.4.2 Freeze Seals. Use of freeze seals shall be limited to valves to be installed with the valve stem orientation in or above the horizontal plane. The freeze seal shall be designed such that liquid sodium does not contact the secondary seal during valve operation at design pressure and temperature conditions and that the frozen sodium plug will not obstruct the gas port. Natural convection cooling of the freeze stem is the preferred method; other methods require justification and prior purchaser approval. The freeze seal design method and the final design shall be approved by the purchaser. Freeze seal maintenance requirements such as required blowdown frequency shall be described in the interim design report (3.7.2).

3.3.22.4.3 Packing. Packing materials shall be nonhygroscopic; shall not contain alloys or compounds of lead, cadmium, mercury, or halogens in excess of 200 ppm each; and shall be compatible with the liquid metal, valve construction materials in contact with the packing, the retained inert gas, and external atmosphere under maximum temperature conditions. Minimum service life will be specified in the Ordering Data. Documentation such as test data and technical reports describing the extent of packing compatibility shall be submitted for purchaser approval prior to release for procurement of the packing material.

3.3.22.5 Operators. Operators shall consist of an assembly of components of proven design. Complete specifications and informational data substantiating the adequacy of the operator and delineating the operational characteristics, installation requirements, and service

requirements - including lubrication, of the operator, shall be provided as a basis for purchaser approval of the operator design.

3.3.22.5.1 Actuation Force. Operators shall be sized to provide a minimum actuation force equal to one and one-quarter times the maximum total force required to actuate the valve. When computing the total force required for valves equipped with freeze seals, the calculated sodium shear force shall be doubled to compensate for the increase in shear strength of pure sodium due to oxidation.

3.3.22.5.2 Manual Operators. Valve manual operators shall be designed such that rotation of the handwheel in the clockwise direction closes the valve. A visual valve position indicator shall be provided. Means to prevent valve damage from excessive applied force shall be provided.

3.3.22.5.3 Power Operators. The design of power operators shall prevent seat and other valve damage from excessive actuation force during normal operation. A method of limiting the valve operating speed shall be provided as required to meet the applicable performance requirements of 3.2. The methods of preventing seat damage and of controlling valve operating speed shall be described in the interim design report (3.7.2). Capability for manual override shall be provided. When specified in the Ordering Data, valve operators other than the manual type shall include any or all of the following features:

1. Manual override equipment.
2. A fail-safe device to actuate the valve to the specified fail position upon loss of power or control signal.
3. A local visual valve position indicator.
4. End position switches.
5. Continuous remote electrical valve position indicator.

Specific requirements for other valve operator equipment and accessories such as flow control positioners and pressure regulators will be specified in the Ordering Data.

3.3.22.6 Dash Pots. Any specific requirements for dash pot construction will be specified in the Ordering Data. Unless otherwise specified, dash pots may be either incorporated as part of the valve internals or as part of the valve operator.

3.3.22.7 Leak Detector or Purge Port. When specified in the Ordering Data, the valve shall be provided with a leak detector port or a purge port located between the stem seal and the backup stem seal. The type and configuration of the required port shall be as specified in the Ordering Data.

3.3.22.8 Connections and Appurtenances.

3.3.22.8.1 Support Attachments. Clamps, pads, clevises, or tabs for attaching valve assembly supports shall be as specified in the Ordering Data.

3.3.22.8.2 Heater Supports. Provisions for supporting the heater system (3.3.12) on the exterior of the valve shall be as specified in the Ordering Data.

3.3.22.8.3 Insulation Supports. Provisions for supporting thermal insulation (3.3.13) on the exterior of the valve shall be as specified in the Ordering Data.

3.3.22.8.4 Lifting Provisions. Each valve assembly or part thereof that weighs more than 50 pounds and which must be handled separately during installation or maintenance operations shall be designed for, or provided with means for, lifting and handling using standard hoisting equipment. Lifting attachments shall be designed for a working load of at least 150 percent of the weight of the item to be lifted.

3.3.22.8.5 Piping Connections. Unless otherwise specified in the Ordering Data, piping connections shall be prepared for butt welding in accordance with ANSI B16.25.

3.3.22.8.6 Auxiliary Lines. Any auxiliary lines or connections for auxiliary lines such as required for venting or draining shall be as specified in the Ordering Data.

3.3.22.8.7 Available Services. The electrical power supply and compressed air supply available for supplying the heater system and valve operators will be described in the Ordering Data.

3.3.22.8.8 Instrumentation. Any instrumentation required shall be as specified in the Ordering Data.

3.3.22.9 Other Requirements. Any additional requirements pertaining to the construction of the valve assembly or parts thereof will be specified in the Ordering Data.

3.4 Materials of Construction. The specific material to be used for each part or component of the valve assembly, including type, grade, and any additional requirements such as optional requirements of the material standard that are to apply shall be as specified in the Ordering Data or as recommended by the supplier and approved by the purchaser.

3.4.1 Pressure Retaining Boundary Parts and Valve Internals. Materials for parts within the boundaries of Code jurisdiction or in contact with liquid metal or metal vapor shall be in accordance with the

Code and the supplemental requirements of RDT E 15-2NB. Where the valves are to be constructed for elevated temperature service, only those materials permitted by the applicable Code Cases specified in 3.1.4 shall be used for pressure retaining boundary parts. Except where the use of Code material specifications is specified or approved by the purchaser, material specifications to be used shall be limited to those RDT standards listed in Tables NNB-2120-1 and NNB-2120-2 of RDT E 15-2NB.

Unless otherwise specified in the Ordering Data, pressure retaining parts of the valve shall be fabricated of either 304 or 316 stainless steel. Selection of alternate materials shall be based on the mechanical properties, metallurgical stability, sodium compatibility, and response to radiation under the applicable design and environmental conditions. When recommending alternate materials, the supplier shall document the justification, which shall include, as a minimum, a summary of available test or operating experience data and a discussion of the adequacy of the recommended materials relative to 304 or 316 stainless steel or other purchaser-specified material.

3.4.1.1 Wear Applications. Except for alternate material combinations approved by the purchaser, metal inserts or weld-deposited hard surfacing materials for wear applications in liquid metal or metal vapor environments shall conform to one of the following material combinations for the contacting surfaces:

1. Stellite¹ 12 in contact with Stellite 12 or 6.
2. Stellite 6, 6B, 6H, or 156 in contact with Stellite 6, 6B, 6H or 156.
3. Tribaloy² 700 in contact with Tribaloy 700.
4. Tribaloy 400 and 800 in contact with Tribaloy 400 and 800.

Any special composition or other requirements for weld-deposited material or cast inserts will be specified in the Ordering Data.

3.4.2 Other Applications. Materials for structural and non-structural applications not within the scope of 3.4.1 shall be as specified in the Ordering Data or as recommended by the supplier and approved by the purchaser, except that thermal insulation shall conform to the requirements of RDT M 12-1 and RDT M 12-2. Where a specific material standard has not been specified, nationally recognized standards shall be recommended by the supplier for purchaser approval.

¹Trade name, Cabot Corporation

²Trade name, E. I. Dupont

3.4.2.1 Operator Components. Except where otherwise approved by the purchaser, operator structural and mechanical parts shall be manufactured from wrought or cast steel or ductile (nodular) iron. Gray cast iron is unacceptable. When approved by the purchaser for specific applications, aluminum alloys that are suitably protected against corrosion may be used to reduce operator weight.

3.4.3 Archive Samples. When specified in the Ordering Data, archive samples of valve material used in the pressure retaining boundaries or exposed to liquid metal shall be provided by the supplier. Such material samples shall be selected from parent material lots and in-process valve parts as specified in the Ordering Data. The archive samples shall be accumulated, individually identified as to the source (material or valve part) and location, and preserved to maintain the material characteristics prevailing at the time of sampling. Sample identification shall be adequate to provide traceability to material certifications for the parent material lot.

3.5 Fabrication.

3.5.1 Fabrication Release. The fabrication of component parts or assemblies shall not be initiated without prior purchaser approval. Completion and approval of applicable design, fabrication, and quality assurance documents tabulated in the Ordering Data will usually be required for release to fabricate.

3.5.2 Welding, Brazing, Hard Surfacing, and Thermal Cutting. Welding, brazing, hard surfacing, and thermal cutting of the valve or parts thereof shall be in accordance with the Code as supplemented by RDT E 15-2NB.

3.5.2.1 Weld Repair. Purchaser approval is required prior to making weld repairs to remove defects that recur:

1. After the first cycle of weld repair of defects in the fusion zone or the adjacent base metal where the welds are not heat treated following repair.
2. After the second cycle of weld repair of defects in welds where the weld is heat treated after each repair cycle.

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

3.5.2.2 Weld Repair Records. Weld repair records that include the dimensions and location of the repair welds in the valve shall be made a part of the Manufacturer's Data Report.

3.5.3 Heat Treatment. Heat treatment, including stress relief, shall be in accordance with the applicable material standard or Code requirements. Heat treatment of austenitic stainless steel shall be

limited to solution annealing in accordance with the material standard. Unless omission of thermal treatment is approved by the purchaser, the major valve parts shall be heat treated or stress-relieved after welding and rough machining is complete, but prior to final machining.

3.5.3.1 Sensitization. Austenitic stainless steel which has been exposed to sensitizing conditions such as welding or hot forming shall be solution annealed in accordance with the applicable standard or be protected from contaminants and moisture during subsequent manufacturing and storage operations.

The method of protecting austenitic stainless steel which is not solution annealed subsequent to sensitizing operations shall be recommended by the supplier for approval by the purchaser.

3.5.4 Bending and Forming. Bending and forming shall be performed in accordance with procedures prepared by the supplier and approved by the purchaser. The supplier shall evaluate the need for heat treatment after bending or forming to ensure the dimensional stability of the valve parts under service conditions.

3.5.5 Cleaning and Cleanliness. The fabrication of a part, combination of parts, subassembly, or completed valve shall be conducted to facilitate cleaning and inspection for cleanliness, and to minimize contamination. Shop practices and restrictions on the use of materials shall be in accordance with RDT F 5-1. The supplier shall include the appropriate instructions and restrictions in his fabrication procedures and other documents defining acceptable shop practices.

The surfaces of valve parts shall be cleaned to meet the cleanliness requirements of RDT F 5-1 and shall be maintained in a clean condition throughout any subsequent assembly and test operations. The valve shall not require re-cleaning to meet these cleanliness requirements prior to installation by the purchaser.

External surfaces of carbon steel or other valve assembly materials that are not corrosion-resistant shall be protected from atmospheric corrosion in accordance with the supplier's practices. Methods of passivating or protecting machined mating surfaces shall be approved by the purchaser.

3.5.6 Assembly. Valves and valve assemblies shall be assembled in accordance with a detailed assembly procedure prepared by the supplier and approved by the purchaser.

The procedure shall contain as a minimum:

1. Assembly sequence.
2. Cleaning procedures, sequence, and precautionary rules including detailed cleaning requirements for any bellows.

3. Any special machining or fitting-at-assembly instructions.
4. Intermediate and final inspection criteria and hold points.
5. Handling methods and precautions.
6. Tightening torques for threaded parts.
7. Procedures for actuating locking devices, tack welding, or both.
8. Drawings or photographs as required to illustrate assembly problems or techniques.
9. Special data, measurements, or observations to be recorded in quality control records.
10. Any other instructions, precautions, or record requirements deemed necessary by the supplier.

3.5.7 Marking. The marking of materials, parts, components, and assemblies for both in-process and permanent identification shall be in accordance with RDT F 7-3 subject to the provision that die-stamping of pressure retaining boundary or valve internals shall not be permitted.

Globe valves shall be marked on the nameplate with the bridge symbol shown below.

The bridge symbol denotes flow under the plug when the process fluid is moving from left to right.

Other valves will be marked with "Port A" on the inlet nozzle and "Port B" on the outlet nozzle. Normal flow direction shall be permanently marked on check valves.

A nameplate that conforms to the following requirements shall be permanently attached to the valve:

1. The plate shall be of a corrosion-resistant material compatible with the surface to which it is fastened.

2. Caustic-resistant enamel shall be used to fill the markings on the nameplate.
3. The plate shall be attached to these components in accordance with the Code. Location and attachment of the nameplate shall not result in distortion or other defects that would impair proper functioning of the valve.
4. The nameplates shall contain the information specified in the Ordering Data.
5. Nameplates shall not be painted over or otherwise covered or concealed by thermal insulation or adjacent parts.

3.6 Drawings. Drawings shall be prepared in accordance with ANSI Y14. The time and approval requirements for submittals to the purchaser and the number of copies required will be specified in the Ordering Data.

3.6.1 Design Evaluation Drawings. The design evaluation drawings, which may include design layout drawings, interface control drawings, and others, shall provide a complete basis for independent design review prior to detailing. These drawings shall include, but not be limited to:

1. Overall and critical interface dimensions that establish the size, shape, fit, and clearances of each major part and sub-assembly; calculated weight and center of gravity; space envelopes for thermal insulation, heater system, and maintenance access. Features and dimensions required for interface control shall be identified with a symbol.
2. Type, size, location, and normal operating temperature of the connections and fittings.
3. Range of thermal and pressure movements of the connections with respect to the valve assembly support points.
4. Minimum material design thickness of pressure retaining boundary parts.
5. Selected materials grouped by product form with the material standards to be used.
6. Referenced special fabrication processes such as heat treatment, welding, and brazing.
7. The location and type of welds using simplified drafting notation.
8. Referenced nondestructive examination requirements.

9. Design provisions for maintainability, support attachment, lifting and handling.
10. Design provisions for accommodating differential thermal expansion.
11. Weights and centers of gravity (3.6.7).
12. Operator schematic.

3.6.2 Detail Drawings. Detail drawings shall define the features of each part shown including, as applicable:

1. Tolerance block.
2. Detailed dimensions, tolerances, and surface roughness of each surface.
3. Material specifications and any special requirements for non-destructive examination, heat treatment, physical properties.
4. Fabrication instructions including welding, hard surfacing, cleaning, and inspection symbols, and reference to assembly procedure requirements.
5. Such additional information as required to describe special features or characteristics.
6. A listing of the documents required to supplement the drawing through definition of material, fabrication, inspection, and test requirements.

3.6.3 Assembly Drawings. The assembly drawings shall include the following, as applicable:

1. A bill of materials that includes location, identity (drawing and part number), and material type for each part.
2. Lubricants to be used during assembly, and where permitted.
3. The location of final closure welds and seal welds with referenced procedures.
4. Dimensions establishing size, shape, fits and clearances of each major part and connections for piping, auxiliary lines, etc. Features and dimensions required for interface control shall be identified with a symbol.
5. Pressure and temperature data, including design pressure and temperature, and test pressure.

6. Electrical characteristics and ratings.
7. Pertinent references to cleaning, marking, torquing, locking, handling, and packaging instructions.
8. Reference to pertinent operation and maintenance manuals.
9. Weights and centers of gravity (3.6.7).

3.6.4 As-Built Drawings. Both assembly and detail drawings revised to show the final configuration of the valve assemblies at time of acceptance shall be provided. Tabulated drawings may be used to show variation in operators and accessories supplied with a basic valve design.

3.6.5 Drawing and Specification Lists. A current listing of the drawings associated with the components of this standard shall be maintained by the supplier. Each drawing number shall include the current revision number or letter.

A current list of specifications shall be maintained by the supplier. 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.

3.6.6 Parts List. A complete list of parts keyed to drawing numbers and organized by assemblies shall be prepared by the supplier. Each referenced drawing number shall include the current revision number. A copy of the parts list, which shall serve as a reference against which further changes may be monitored, shall be provided by the supplier.

3.6.7 Weights and Centers of Gravity. The design evaluation drawings and assembly drawings shall indicate the following:

1. The dry weight and center of gravity of valve and valve assembly.
2. The weight and center of gravity of the valve and of the valve assembly when filled with liquid metal.
3. The weights and centers of gravity of the subassemblies into which the valve assembly will be divided for shipping purposes.

3.7 Reports and Documentation. The following reports, technical documentation, and lists shall be prepared by the supplier. The time and approval requirements for submittals to the purchaser and the number of copies of each document required will be specified in the Ordering Data.

3.7.1 Design Report. The design report shall cover the design of the valve body, valve internals, operators, and auxiliary equipment and shall include, as a minimum:

1. A design description which defines and integrates the various technical, operational, and safety considerations.
2. A thermal analysis for the temperature transient and differential thermal expansion conditions.
3. Analysis of the forces required to operate the valve under the conditions specified, including power operator characteristics where applicable.
4. A stress report, including calculations, satisfying the requirements of the Code and the guidelines of Appendix C of the Code, which shall be mandatory for stress report preparation.
5. A stress analysis of the valve operator to operator support regions and specification of the support requirements external to the valve assembly.
6. Known parameters, assumptions, approximations, calculations and references.

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

The supplier shall be responsible for making such additions or corrections to the report as are required to keep the information correct and current. These revisions shall be numbered and dated.

3.7.2 Interim Design Reports. Interim design reports shall be submitted as specified and when early purchaser approval is required for proceeding with design, procurement, or manufacture. Interim design reports shall include, as applicable, but are not limited to:

1. Structural evaluation plan or reports required by RDT F 9-4 for design for elevated temperature service (3.1.4).
2. Analyses of valve response to thermal and flow transients.
3. Vibration or shock load analyses.
4. New or unusual analytical techniques or fabrication practices.

5. Heating system and thermal insulation requirements.

3.7.3 Periodic and Progress Reports. Reports of progress in design, fabrication, inspection, testing and shipping shall be prepared at the intervals specified in the Ordering Data. 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 shall 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. Breakthroughs of significance should be discussed.

3.7.4 Operation and Maintenance Manual. An operation and maintenance manual for the valve assembly prepared in accordance with the applicable paragraphs of RDT F 4-20 specified in the Ordering Data shall be provided by the supplier. This manual shall reflect the as-built configuration of the valve assembly. Information shall include as a minimum:

1. A detailed description of the valve assembly and instructions for installation, preoperational tests, operation, preventive maintenance, and repair of equipment, such as valve seats, valve discs, stems, seals, operator, and instrumentation, including the use of special tools.
2. Procedures for replacing valve disc, stem, seals, operator parts, and other replaceable components.
3. Instructions for use of lifting and handling fixtures, and special tools and equipment.
4. Reduced size drawings for operation, maintenance, and instructional purposes, including drawings of special tools and equipment.
5. A list of recommended spare parts.
6. Schedules for inspection and servicing.

3.7.5 Special Tool List. A list of special tools, including gages, required for installation and maintenance shall be prepared and kept current by the supplier. The list shall identify each tool by name, drawing number, function, and operation(s) for which it is required.

3.7.6 Spare Parts List. A list of recommended spare parts to be stocked at the plant site shall be provided by the supplier. This list is to contain those parts and tools likely to be damaged or expended during installation or plant operations.

3.8 Installation and Field Services Requirements. The supplier shall provide technical advice and assistance and shall monitor quality assurance implementation during the installation and subsequent repair, replacement, and alteration of equipment, to the extent specified herein and in the Ordering Data. Unless otherwise specified, documentation required by the following paragraphs shall be included in the operation and maintenance manual (3.7.4).

3.8.1 Handling. When other than normal means of handling such as standard hoisting equipment or forklifts is required for unloading or handling packed valves or valve assemblies, written handling instructions shall be provided by the supplier. Special lifting devices, if required, shall be provided by the supplier.

3.8.2 Storage. Instructions for maintaining environmental control of packaged valves or valve assemblies for extended storage in the field shall be provided by the supplier.

3.8.3 Preparation for Installation. Written instructions for unpacking the valves or valve assemblies, for removing packaging, blocking, cushioning, preservatives, desiccant canisters, etc., as required to prepare the items for installation in an operable condition, and any reassembly of components required shall be provided by the supplier. Location of lifting attachments or lift points to be used in handling major components or complete assemblies shall be identified in these instructions.

3.8.4 Installation. Any special procedures or precautions that are required to prevent potential damage to the valve or valve assembly during installation shall be provided by the supplier. When specified in the Ordering Data, installation procedures prepared by the purchaser or his agent shall be reviewed by the supplier.

3.8.5 Preoperational Testing. The supplier shall identify required preinstallation and preoperational tests and provide test instructions.

4. QUALITY ASSURANCE REQUIREMENTS

4.1 Quality Assurance Program. The supplier shall plan, establish, implement, and maintain a documented quality assurance program that fulfills the requirements of the Code, Sections 1, 2, 3, 4, 5 and 8 of RDT F 2-2, and the additional quality assurance requirements of this standard.

4.2 Quality Assurance Documents. Quality assurance documents and quality records required by the Code and RDT F 2-2 shall be submitted by the supplier as specified in the Ordering Data. Documents and records required by the Code and RDT F 2-2 for which submittal is not required shall be prepared and maintained by the supplier.

4.3 Marking and Identification.

4.3.1 Materials. The materials used in the manufacture of the valve shall be examined to ensure compliance with the traceability requirements of Code and the marking requirements of 3.5.7.

4.3.2 Permanent Marking. The finished components, spare parts, and special handling fixtures to be delivered as part of the contractual requirements shall be examined to ensure that they are permanently marked for purposes of identification in accordance with 3.5.7. Material samples shall be examined for conformance to the marking requirements of 3.4.3.

4.4 Nondestructive Examination Requirements.

4.4.1 Required Examinations, Methods, and Acceptance Criteria. Materials and fabricated items shall be nondestructively examined as required by and in accordance with the Code as supplemented by RDT E 15-2NB and the additional requirements of this standard. Acceptance criteria shall be in accordance with the Code as supplemented by RDT E 15-2NB.

4.4.2 Equipment Calibration. Instrumentation, reference blocks and other physical standards, and measuring equipment used in conjunction with nondestructive examinations shall be calibrated and controlled in accordance with RDT F 2-2.

4.5 Examination of Materials. Prior to use in fabrication, materials shall be:

1. Visually examined for conformance to cleanliness requirements and to detect obvious defects.
2. Nondestructively examined in accordance with the requirements of 4.4.1 and any additional requirements specified in 3.4. If the examinations were performed and properly documented by the material supplier, they need not be repeated in the supplier's plant.

4.6 Examination of Fabricated Items.

4.6.1 General. Each item shall be visually examined and measured to verify conformance to detail and assembly drawings (3.6.2 and 3.6.3). Inspection of dimensional characteristics shall conform to the requirements of RDT F 3-15. Any requirements for recording measurements other than required by RDT F 3-15 shall be as specified in the Ordering Data. The dimensional limits depicted on the approved drawings shall be interpreted as absolute as defined by RDT F 3-15. The thickness of the pressure retaining boundary wall shall be measured to ascertain that the minimum required thickness has been obtained in all

parts of the body and bonnet. Measurements may be made by means of calipers or ultrasonic examination.

4.6.2 Welds. Visual, dimensional, and nondestructive examination of welds, weld repairs, and hard surfacing deposits shall be in accordance with the Code as supplemented by RDT E 15-2NB and the additional requirements of this standard.

4.6.3 Brazed Joints. Brazed joints shall be examined in accordance with Code and any special requirements specified in the Ordering Data.

4.7 Testing. The acceptance tests described in 4.7.1 shall be performed on each production valve or valve assembly and on any prototype valve that is to be used for qualification tests. The qualification tests described in 4.7.2 shall be performed using a prototype valve or lead production unit that conforms to all production valve requirements. Where separate qualification of the operator is permitted, nonprototypic operators may be used for valve qualification tests. Test plans and test procedures for the acceptance tests and any qualification tests required shall be submitted for approval by the purchaser.

4.7.1 Acceptance Tests.

4.7.1.1 Pressure Test. Either a pneumatic or hydrostatic pressure test shall be conducted in accordance with the Code and the supplementary requirements of RDT E 15-2NB. The type of pressure test to be conducted shall be as specified in the Ordering Data or recommended by the supplier and approved by the purchaser.

Prior to testing, the interior surfaces of the valve shall be cleaned to meet the cleanliness requirements of RDT F 5-1.

Prior to and during the performance of the pressure test, the material temperature of materials for which the Code requires impact testing shall be maintained at least 60°F above the applicable RT_{NDT}, 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. The studs, bolts, nuts, washers and closure members furnished with the valve shall not be used for pressure tests unless specified in the Ordering Data.

The temperature of the valve shall be monitored during the test. Instruments used to monitor and record pressure and temperatures shall be calibrated in accordance with RDT F 2-2 for an overall system accuracy of ± 2 percent in the range of the test unless otherwise specified in the Ordering Data.

Any indication of leakage other than leakage from a packing-type backup stem seal shall be reported to the purchaser prior to any corrective action being taken.

Hydrostatic tests shall be made using water conforming to the grade A requirements of RDT F 5-1 or other fluid approved by the purchaser. Immediately following completion of the test, the component shall be thoroughly dried by purging with dry, oil-free air or gas, drying in an oven, or evacuation.

4.7.1.2 Helium Leak Tests. Except for valves with a full penetration welded body-bonnet joint and a stem freeze seal, the valve shall be helium leak tested in accordance with Section V of the ASME Boiler and Pressure Vessel Code. The maximum acceptable leak rate for the body-bonnet assembly and bellows used for the stem seal shall be as specified in the Ordering Data. Unless otherwise specified or approved by the purchaser, helium leak tests shall be performed after pneumatic pressure or leakage tests or prior to pressure or leakage tests using liquid. When helium leak testing is to be performed subsequent to introducing liquids in the valve, the procedure for drying the valve prior to helium leak testing shall be approved by the purchaser.

4.7.1.3 Packing-Type Seals. Packing-type seals shall be tested by pressurizing the seal with air, nitrogen, or inert gas to the pressure specified in the Ordering Data. The leakage flow shall not exceed the value specified in the Ordering Data.

Note: Where a bellows is used as the primary seal, the valve may be pressurized during the backup stem seal test in order to prevent distortion or other damage to the bellows.

4.7.1.4 Seat Leakage Tests. Seat leakage shall be determined by one of the following methods as specified in the Ordering Data.

4.7.1.4.1 Gas-Under-Water Method. The gas-under-water method may be used to leak test the seats of globe and gate valves. With the valve in the closed position, dry nitrogen gas shall be applied to the valve inlet and the pressure increased to the specified leakage pressure. A tube connected to the valve outlet shall be submerged under a water-filled, inverted graduated cylinder. Seat leakage shall be measured initially and at the end of five open-close cycles. The volume of collected gas shall not exceed the amount specified in the Ordering Data. The leakage test shall be repeated in a similar manner to obtain reverse seat leakage.

4.7.1.4.2 Hydrostatic Seat Leakage. The hydrostatic seat leakage test is conducted with the valve fully closed and with design seat loading force applied. The test is conducted with the specified shutoff pressure differential across the seat. Seat leakage shall be measured and recorded initially and at the end of five open-close cycles. Seat leakage in excess of the requirement given in the Ordering Data shall be cause for rejection.

4.7.1.4.3 Water-Flow Method. The water-flow method may be used to leak test the seat leakage of a butterfly valve. With the valve in the closed position and water pressurized to the maximum operating pressure on the inlet side of the valve, the flow to the outlet shall not exceed the value specified in the Ordering Data. The test shall be repeated in a similar manner to obtain reverse seat leakage. The maximum permissible leakage shall be the same for the forward and reverse directions.

4.7.1.4.4 Other Tests. Any other leakage tests to be performed will be specified in the Ordering Data.

4.7.1.5 Functional Operation. The valve assembly shall be tested by performing a minimum of five cycles of operation with the valve containing dry, oil-free air or gas. Test conditions shall be as specified in the Ordering Data. The torque or force required to perform the operating cycle at maximum speed shall be measured and reported in the test report. The valve assembly shall function normally in this dry condition without requiring more than 80 percent of the available operator force or as specified in the Ordering Data.

4.7.1.6 Other Acceptance Tests. Any other acceptance tests to be performed will be specified in the Ordering Data.

4.7.2 Qualification Tests. When valves are to be procured that are identical to valves previously manufactured and qualified in accordance with this standard, the purchaser shall have the option of waiving any of the following qualification tests or of permitting the use of lead production units for reconfirming specific characteristics or capabilities.

4.7.2.1 Fluid Flow Characteristics. A prototype valve shall be subjected to flow testing to determine the flow characteristics for comparison to specified performance characteristics. Specific requirements for flow tests will be specified in the Ordering Data. When water is used as the test fluid, the test data shall be reported as such but shall also be converted to liquid metal equivalents using conversion formulas approved by the purchaser.

4.7.2.2 Special Tests. When required by the Ordering Data, the supplier shall propose a testing program to perform applicable vibration, shock, or other special tests. For each test proposed and approved, the supplier shall recommend test conditions such as environment and loading for purchaser approval. For each test performed, a test report that includes the test data, analyses of the data, and interpretation of the data relative to design objectives shall be submitted to the purchaser.

4.7.2.3 Qualification for Liquid Metal Service. One prototype of each new valve design or design concept that is to be qualified shall be tested as specified in the Ordering Data using liquid metal as

the test fluid. The tests shall be performed at a facility capable of imposing upon the valve stress and environmental conditions equivalent to those expected to be experienced during the valve's service lifetime. Unless otherwise specified in the Ordering Data, where the valve operator to be supplied with valve has not been qualified, a prototype operator shall be used in this test to establish operator qualification.

Measurements shall be taken to verify performance characteristics as specified in the Ordering Data. Operation without malfunction for the duration of the test and the absence of visible defects or other irregularities as determined by the post-test inspection shall constitute successful completion of the test.

A valve or valve operator used for a liquid metal qualification test shall be unacceptable for further use except when written approval of the purchaser is obtained.

4.7.2.4 Alternate Operator Qualification. When qualification of the operator in the liquid metal service test (4.7.2.3) is not mandatory, the operator may be qualified separately at the supplier's facility in accordance with the requirements for test conditions, number of operating cycles, and test data to be taken specified in the Ordering Data.

4.7.2.5 Lifting and Handling Attachments. Lifting lugs or other integral attachments provided for lifting or handling major components or assemblies shall be tested at 150 percent of the design working load (3.3.22.8.4). Permanent deformation and relevant liquid penetrant indications are unacceptable.

4.7.2.6 Thermal Cycle Test. When specified in the Ordering Data, one or more prototype valves or lead production units shall be subjected to a thermal cycle test. The thermal cycle test shall consist of operating the valve through open and close cycles during a period in which the valve temperature is cycled between room temperature and the valve design temperature, and then repeating the acceptance tests for seat leakage and isothermal functional operation (4.7.1.4 and 4.7.1.5). The number of valves to be tested and the test conditions, including rate of heating and cooling, number of thermal and operating cycles, and the test fluid, shall be as specified in the Ordering Data.

4.7.2.7 Other Qualification Tests. Any other qualification tests to be performed such as qualification of the freeze seal design or packing material will be specified in the Ordering Data.

4.7.3 Test Precautions. The following restrictions shall apply to the performance of tests:

1. No mercury or mercury-containing instrument shall be used during testing.

2. Soft metals, such as lead, copper, and aluminum shall not be brought in direct contact with valve parts.
3. Halogens and halogenous materials shall not be used.
4. Sulfur and sulfur compounds shall not be used.

5. PREPARATION FOR DELIVERY

The supplier shall be responsible for the delivery of each item in an acceptable condition to the delivery point specified in the Ordering Data. The supplier shall submit for the purchaser's approval a Packaging and Shipment Plan presenting the practices, procedures, and instructions to be followed in meeting the following requirements and any additional requirements specified in the Ordering Data.

5.1 Preparation. Upon completion of shop testing and inspection, the supplier shall prepare the valve or valve assembly for packaging. This shall include, but is not limited to, disassembly (as required), recleaning (if necessary), surface preparation, and re-examination.

5.2 Packaging and Packing. Valve assemblies or components thereof shall be packaged and packed as required to prevent deterioration or physical damage during shipment and during storage at the delivery point under the conditions and for the period specified in the Ordering Data. Sealing, packaging, packing, and identification marking shall be in accordance with RDT F 7-2 and the specific methods specified or approved by the purchaser.

5.3 Shipping. When approved by the purchaser, the supplier shall make the arrangements necessary to ship the valve assemblies or components in accordance with this standard and the terms of the contract. The supplier shall prepare instructions to the shipper for handling, loading, securing the packs in the vehicle, and for in-transit storage. The supplier shall supervise or monitor loading of the vehicle.

5.4 Handling. In addition to the requirements of the federally-imposed Occupational Safety and Health Act or equivalent state regulations that apply to hoisting and rigging of items, any slings used shall meet the requirements of ANSI B30.9.

Each item weighing more than 50 pounds and which must be handled individually shall be provided with means for lifting and handling using standard cranes and hoisting equipment. Any lifting cradles or shipping fixtures needed for handling or maintaining the position of unpacked items shall be provided by the supplier. Shipping fixtures shall be provided with points of attachment for lifting and tie-down, and, where applicable, for upending in a safe, controlled manner. Lifting cradles and shipping fixtures shall be designed, load tested, and inspected in accordance with RDT F 8-6.

Any special requirements such as requirements for proof testing equipment or limiting allowable equipment loadings to less than the certified capacity will be specified in the Ordering Data.

6. NOTES AND ORDERING DATA CHECKLIST

6.1 Notes. The specification for the valve assemblies, which will consist of this standard, modifications (if any), and the Ordering Data, must be certified by a registered professional engineer representing the purchaser to be correct, complete, and in compliance with the Design Specification requirements of subsubarticle NA-3250 of the ASME Boiler and Pressure Code, Section III, Division 1, Nuclear Power Plant Components.

6.2 Ordering Data Checklist. The detailed requirements and conditions necessary to design, fabricate, examine, test, and deliver valve assemblies in accordance with this standard are to be included in the Ordering Data. These requirements are also indicated in the following Ordering Data checklist. The list includes topics to which the standard makes specific reference and other supplemental information needing definition by the purchaser.

The applicable paragraph number of the standard is used herein to identify information and its location. Any omission of a paragraph number in this checklist indicates that the particular paragraph of the standard is believed to adequately specify the requirement.

1. Scope. This section should include a statement indicating that this document is the Ordering Data which supplements this standard. In addition, include a brief presentation of basic information which will aid the supplier in performing his work. Coverage should include:
 - a. A brief description of the nature of the application.
 - b. The location of the installation site as may be required for Code purposes.
 - c. Summary of the components and services to be furnished.
2. Applicable Documents. List the documents which are specifically called out in Section 3, 4, or 5 of the Ordering Data and this standard. Identify the applicable issues, amendments, addenda, etc., as required to clarify what documents are in effect or are to apply. List applicable drawings.
3. Technical Requirements.
 - 3.1.1 Describe application. Identify normal operating position for isolation or check valves.

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- 3.1.2 Specify fluid(s) for which the valve is to be designed. Tabulate fluid design parameters, which shall include, as a minimum:
- a. Design flow rate, gpm.
 - b. Flow range at normal operating conditions, gpm.
 - c. Design pressure, psig.
 - d. Maximum operating pressure, psig.
 - e. Normal operating pressure, psig.
 - f. Minimum operating pressure, psig.
 - g. Design temperature, °F.
 - h. Maximum fluid operating temperature, °F.
 - i. Normal fluid operating temperature, °F.
 - j. Minimum fluid operating temperature, °F.
- 3.1.3 Describe valve operator, accessories, and any special features or design limitations. Describe or provide drawings for configuration limits and interfaces.
- 3.1.4 Specify any additional Code Cases required.
- 3.1.5 Specify whether valve assembly function is required under emergency or faulted system conditions.
- 3.2 Tabulate required performance characteristics and the conditions at which conformance is required. These should include, as applicable:
- a. Maximum pressure loss (psi) at the design flow rate and the temperature (°F) at which Δp will be determined.
 - b. For throttle valves, the throttle range (gpm).
 - c. Flow coefficient, C_v , versus valve position.
 - d. Allowable leakage in normal flow direction at shutoff (cc/min. of specified test fluid) and the pertinent pressure difference (psi).
 - e. Allowable leakage in reverse flow direction at shutoff (cc/min. of specified test fluid) and the pertinent pressure difference (psi).
 - f. Valve closing time (seconds) and the pertinent flow (gpm) and pressure (psig).

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- g. Valve opening time (seconds) and the pertinent flow (gpm) and pressure (psig).
 - h. The number of full open-close cycles and the number of partial operations to apply.
- 3.3.1.1 Specify internal and external design pressure, static and dynamic heads, and the maximum differential pressure across valving element.
 - 3.3.1.2 Specify design temperature.
 - 3.3.1.3 Specify design mechanical loads due to connected piping, valve and operator weight, vibration, etc.
 - 3.3.2 Specify normal, upset, emergency, and faulted conditions. Provide seismic criteria. Provide thermal transients including time/temperature histograms when applicable.
 - 3.3.3 Specify testing conditions other than for acceptance tests.
 - 3.3.4 Describe loading history for elevated temperature valves. At lower temperatures a histogram is optional.
 - 3.3.5 Specify environmental conditions for operating modes, tests (including preoperational), system fill and drain, etc.
 - 3.3.6 Specify design service life.
 - 3.3.7 Specify maintainability criteria.
 - 3.3.7.3 Specify requirements for remote cutting or welding.
 - 3.3.8.1 Specify criteria for determining the corrosion allowance.
 - 3.3.8.3 Specify any system-imposed vibrational forces.
 - 3.3.8.4 Specify any system-imposed shock forces.
 - 3.3.9 Specify conditions for dry operation and number of cycles.
 - 3.3.10 Provide or reference physical property data for contained fluids. Specify fluid contaminants.
 - 3.3.11 Specify allowance for angular displacement from horizontal to promote drainage (if desired).
 - 3.3.12 Specify heating conditions.

- 3.3.13 Specify conditions to be achieved through insulating.
- 3.3.17 Specify any alternate screw thread requirements.
- 3.3.19 Specify any alternate surface roughness requirements.
- 3.3.20 Specify any alternate electrical requirements.
- 3.3.22.1 Specify body-bonnet joint construction (optional).
- 3.3.22.3 Specify bearing surface method (optional).
- 3.3.22.4 Specify seal configuration, pressure retaining capability of backup stem seal, and maximum allowable leakage.
 - 3.3.22.4.1 Specify whether back seating is required.
 - 3.3.22.4.3 Specify minimum service life for packing.
- 3.3.22.5.3 Specify required power operator features.
- 3.3.22.6 Specify any requirements for dash pot construction.
- 3.3.22.7 Specify port type and configuration.
- 3.3.22.8.1 Specify type and configuration of attachments for connecting valve supports.
- 3.3.22.8.2 Specify heater system supports.
- 3.3.22.8.3 Specify insulation supports.
- 3.3.22.8.5 Specify any alternate weld preparation.
- 3.3.22.8.6 Specify requirements for auxiliary lines or connections.
- 3.3.22.8.7 Describe available electrical and pneumatic services.
- 3.3.22.8.8 Specify instrumentation requirements.
- 3.3.22.9 Specify any additional requirements for valve assembly construction.
- 3.4 Specify detailed material requirements or require supplier recommendations.

- 3.4.1.1 Specify any special requirements for weld-deposited hard surfacing material.
- 3.4.2 Specify material requirements for other applications (optional).
- 3.4.3 Specify archive sample requirements.
- 3.5.7 Specify nameplate information.
- 3.6 Specify submittal requirements for drawings.
- 3.7 Tabulate submittal requirements for technical reports and documentation (See Table 1).
- 3.7.4 Specify applicable paragraphs of RDT F 4-20.
- 3.8 Specify requirements for installation and field services.
- 3.8.4 Specify if supplier review of installation procedures is required.

4. Quality Assurance Requirements.

- 4.2 Specify submittal requirements for quality assurance documents and data. Identify the quality records required for each valve (See Table 1).
- 4.6.1 Specify any additional dimensional data to be recorded.
- 4.6.3 Specify any special braze examination requirements.
- 4.7.1.1 Specify hydrostatic or pneumatic pressure test (optional).

Specify if valve closure hardware may be used during pressure testing.

Specify any alternate instrumentation criteria.
- 4.7.1.2 Specify allowable helium leak rate(s).
- 4.7.1.3 Specify test pressure and allowable leakage for packing type seals.
- 4.7.1.4 Specify seat leakage test method, test conditions, and allowable leakage.

Table 1. Typical Document Submittal Requirements

1. The documents identified below are to be submitted to the purchaser for the applicable purpose at the indicated time^a. The number of copies and the distribution list will be specified in the purchase order.
2. The documentation listed below does not constitute all of the documentation required to be generated by the supplier.
3. Documents not required for submittal shall be made available to the purchaser on request.
4. The items denoted with an asterisk are required for supplier approval prior to fabrication release.

Item	Document	Reference Paragraph	Submit to Purchaser for		Time of Submittal
			Approval	Information	
1.	Mechanical Body-Bonnet Joint Recommendations	3.3.22.1	X		See Note #1
2.	Qualification Procedure for Hard Surfacing Method	3.3.22.3	X		

^aPrior to release of the Request for Quotation to the suppliers, the documents for which submittal is required shall be identified and an estimated submittal date indicated. This will provide a clearer understanding of the requirements between supplier and purchaser and will place all supplier proposals on an equal time basis. Finalization of the requirements and submittal dates can be accomplished during contract negotiations with the successful proposer.

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Table 1. Typical Document Submittal Requirements (continued)

Item	Document	Reference Paragraph	Submit to Purchaser for		Time of Submittal
			Approval	Information	
3.	Packing Compatibility Reports	3.3.22.4.3		X	
4.	Operator Specifications and Informational Data	3.3.22.5		X	
5.	Material Recommendation	3.4	X		
6.	Fabrication Release	3.5.1	X		
7.	Assembly Procedure	3.5.6	X		
8*.	Design Evaluation Drawings	3.6.1	X		
9*.	Detail Drawings	3.6.2	X		
10*.	Assembly Drawings	3.6.3	X		
11.	As-Built Drawings	3.6.4		X	
12.	Drawing and Specification List	3.6.5		X	
13*.	Parts List	3.6.6		X	

(continued)

Table 1. Typical Document Submittal Requirements (continued)

Item	Document	Reference Paragraph	Submit to Purchaser for		Time of Submittal
			Approval	Information	
14.	Design Report	3.7.1	X		
15*.	Structural Evaluation Plan	3.7.2	X		
16*.	Interim Design Reports	3.7.2		X	
17.	Periodic and Progress Reports	3.7.3		X	
18.	Operation and Maintenance Manual	3.7.4		X	
19.	Special Tool List	3.7.5		X	
20.	Spare Part Recommendation	3.7.6		X	
21.	Handling Instructions	3.8.1		X	
22.	Storage Procedures	3.8.2		X	
23.	Unpacking Instructions	3.8.3		X	
24.	Installation Requirements	3.8.4		X	

(continued)

Table 1. Typical Document Submittal Requirements (continued)

Item	Document	Reference Paragraph	Submit to Purchaser for		Time of Submittal
			Approval	Information	
25.	Preoperational Tests	3.8.5		X	
26.	Quality Assurance Program Index	4.2	X		
27*.	Inspection and Test Plan	4.2	X		
28*.	Fabrication Procedures (including welding)	4.2	X		
29*.	Inspection and Test Procedures (including NDE)	4.2	X		
30.	Nonconforming Item Documentation	4.2	X		
31.	Quality Records	4.2		X	
32.	Qualification Test Plan and Procedures	4.7	X		
33.	Qualification Test Reports	-		X	
34.	Packaging and Shipment Plan	5.	X		

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- 4.7.1.5 Specify conditions for functional testing and any alternate acceptance criterion.
 - 4.7.1.6 Specify any additional acceptance tests to be performed, test conditions, and acceptance criteria.
 - 4.7.2.1 Specify flow test requirements.
 - 4.7.2.2 Specify special tests to be performed, e. g., vibration, freeze seal function.
 - 4.7.2.3 Specify test requirements for qualification for liquid metal service.
 - 4.7.2.4 Specify test requirements for operators when separate testing is permitted.
 - 4.7.2.6 Specify number and type of valves and the test conditions.
 - 4.7.2.7 Specify any additional qualification tests to be performed.

5. Preparation for Delivery.

- 5.2 Specify specific packaging or packing methods (optional). Specify storage time and storage conditions.
- 5.4 Specify any special requirements for proof testing handling equipment or de-rating.