STEEL FOUNDERS' SOCIETY OF AMERICA

Tentative Specification for

STEEL CASTINGS FOR CONTROLLED QUALITY LEVEL, -GENERAL INDUSTRIAL STEEL CASTING GRADES FOR VALVES- VISUAL SURFACE INSPECTION AND SCHEDULED RADIOGRAPHIC INSPECTION

SFSA Designation: 40T-78

ISSUED: 1978

This Tentative Specification has been approved by the Society's Specifications Committee. The Tentative Specification shall be in effect for two (2) years and, if not revised in that time, it shall be advanced to Standard. Suggestions for revisions should be addressed to the Steel Founders' Society at Cast Metals Federation Building, 20611 Center Ridge Road, Rocky River, Ohio 44116.

1. Description

This standard offers guidelines covering pressure containing castings, and non-pressure boundary castings used in the construction of general industrial grade valves. Specifically, this standard is aimed at the class of castings whose quality level is controlled by the following types of inspection:

a) Visual and Radiographic Inspections of Pilot Castings (paragraph 10 of this Standard).

b) Visual Examination of Each Production Casting (paragraph 11.1 of this Standard).

c) Hydrostatic Test of Each Pressure Containing Casting (paragraph 11.2 of this Standard).

d) Radiographic Testing of Production Castings in Accordance With a Sampling Plan and Purchase Order (paragraph 11.3 of this Standard) .

2. Background

This standard is the result of joint efforts of the Valve Manufacturers Association and the Steel Founders' Society of America.

3. Objectives

3.1 To facilitate communications between valve manufacturers and steel foundries.

3.2 To provide a document that may replace comparable in-house specifications with similar requirements for the purpose of standardization.

3.3 It is neither the Valve Manufacturers Association's, nor the Steel Founders' Society's intent to impose requirements, and thereby interfere in a company's control over design quality and inspection requirements; rather, the objectives are to offer this standard for consideration where either the foundry or the valve manufacturer deem its use to be beneficial.

4. Scope

4.1 The requirements of this standard apply to general industrial grade valves regularly produced in-the standardized pressure classes established by The American National Standards Institute (ANSI) and The American Petroleum Institute (API). Products to which this standard applies are covered by, but not limited to the following:

ANSI B16.5-Steel Pipe Flanges and Flanged Valves and Fittings.
ANSI B16.34-Steel Butt-Welding End Valves
API 6A-Specification for Wellhead Equipment
API 6D-Pipeline Valves
API 599-Steel Plug Valves
API 600-Steel Gate Valves
API 602-Compact Carbon Steel Gate Valves
API 603-1 50-Pound Light Wall Corrosion Resistant Gate Valves

4.2 This standard supplements the requirements of applicable materials specifications for both the pressure boundary castings and the structural castings used in construction of valves.

4.3 The methods, extent, and acceptance standards for non-destructive examinations listed herein shall be the minimum requirements for general industrial grade valves. Any additional requirements shall be established by mutual agreement between the foundry and the purchaser.

5. References

5.1 Material Specifications

ASTM A-216 Carbon Steel Castings Suitable for Fusion Welding for High Temperature Service.

ASTM A-217 Martensitic Stainless Steel and Alloy Steel Castings for Pressure-Containing Parts Suitable for High-Temperature Service.

ASTM A-296 Corrosion Resistant Iron-Chromium, Iron-Chromium-Nickel and Nickel Base Alloy Castings for General Application.

ASTM A-351 Austenitic Steel Castings for High Temperature Service.

ASTM A-352 Ferritic Steel Castings for Pressure-Containing Parts Suitable for Low-Temperature Service.

ASTM A-389 Alloy Steel Castings Specially Heat Treated for Pressure-Containing Parts Suitable for High Temperature Service.

ASTM A-487 Steel Castings Suitable for Pressure Service.

ASTM A-494 Nickel and Nickel Alloy Castings.

ASTM A-643 Steel Castings, Heavy-Walled, Carbon and Alloy, for Pressure Vessels.

ASTM A-703 General Requirements Applicable to Steel Castings for Pressure-Containing Parts.

ASTM A-732 Carbon and Low Alloy Steel Investment Castings.

ASTM A-743 Corrosion Resistant Fe-Cr, Fe-Cr-Ni, and Ni Base Castings for General Application.

ASTM A-744 Corrosion Resistant Fe-Cr-Ni, and Ni Base Castings for Severe Service.

ASTM A-747 Precipitation Hardening Stainless Steel Castings.

ASTM A-757 Ferritic and Martensitic Steel Castings for Pressure-Containing and Other Applications.

5.2 Non-Destructive Examination.

5.2.1 Visual Examination.

MSS SP-55 Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components (Visual Method).

5.2.2 Radiographic Examination.

ASTM E-94 Recommended Practice for Radiographic Testing.

ASTM E-142 Standard Method for Controlling Quality of Radiographic Testing.

ASTM E-186 Standard Reference Radiographs for Heavy-Walled (2 to 4½ in.) Steel Castings.

ASTM E-280 Standard Reference Radiographs for Heavy-Walled (4½ to 12 in.) Steel Castings.

ASTM A-390 Reference Radiographs for Steel Fusion Welds.

ASTM E-446 Standard Reference Radiographs for Steel Castings up to 2 in. in Thickness.

5.2.3 Ultrasonic Examination.

ASTM A-609 Standard Specification for Longitudinal Beam Ultrasonic Inspection of Carbon and Low-Alloy Steel Castings.

ASTM E-500 Definition of Terms Relating to Ultrasonic Testing.

5.3 Welding and Procedure Qualification.

ASME Boiler and Pressure Vessel Code, Section IX -Welding and Brazing Qualifications.

ASTM A-488 Qualification of Procedures & Personnel for Welding Steel Castings.

6. Definitions and Terms

6.1 Discontinuity-A non-uniformity in the metal. For example, cracks, hot tears, shrinkage, inclusions, gas porosity.

6.2 Defect-A discontinuity unacceptable under requirements of the applicable specification.

6.3 Acceptance Criteria-A classification of severity levels for each type and category of discontinuities which are acceptable without repair.

6.4 Severity Level-Extent and/or size of the type of discontinuity.

6.5 Critical Area-Those sections of castings which are subject to high stress.

6.6 Dimensional Inspection-Verification that casting dimensions are within tolerances agreed upon or specified on the drawings.

6.7 Extent of Examination-That portion of a casting which is to be examined by a particular non-destructive examination method.

6.8 Non-Destructive Examination-The examination of a casting for surface and/or subsurface discontinuities without impairing its usefulness.

6.9 Pilot Casting-A casting made and tested as part of the initiation and development of the production method, i.e., the first casting(s) from a new pattern, using the identical foundry practice, i.e., risering, gating, chilling, coring and molding as the production castings it is intended to represent.

6.10 Pressure Testing-Application of hydrostatic or pneumatic pressure to test for leakage through the walls of a casting.

6.11 Pressure Containing Casting-Body, bonnet or cover, and wedge or disc excluding the yoke portion of a bonnet when yoke and bonnet are cast together and structural parts of the body such as feet unless otherwise specified.

7. General Requirements

7.1 All castings shall be produced in accordance with a written Quality Assurance Program.

7.2 All pressure containing castings shall be marked in accordance with the purchase order and material specification.

7.3 The responsibility for pattern maintenance shall be as agreed by the foundry and the purchaser.

8. Quality Assurance

8.1 Castings shall be manufactured in accordance with a written Quality Assurance Program. This program shall consist of, but is not limited to:

8.1.1 Organization-Personnel, Authority & Responsibility.

An organization chart normally satisfies this requirement.

8.1.2 Drawing and Specification Control.

Description of record-keeping system and of applicable revisions, implementation of corrective measures.

8.1.3 Material Control.

Description of methods used for chemical and mechanical testing and of methods for maintaining their accuracy.

8.1.4 Foundry Practice Control.

Description of system for recording foundry practices and changes in planning (risering, gating, chilling, etc.).

8.1.5 Inspection Program.

A list of inspection procedures used, including nondestructive examination. Statement on Personnel Qualification.

8.1.6 Heat Treat Procedure Control.

Listing of specific temperatures, time at temperature and cooling methods for each material produced.

8.1.7 Calibration of Equipment and Gauges.

Written procedure, listing all equipment and gauges and the time intervals between calibration.

8.1.8 Record Retention.

Chemical and mechanical properties records and all non-destructive examination records shall be retained by the manufacturer for a period of three years from date of test.

8.1.9. Corrective Action Procedures.

Must cover actions to be taken as a result of failure of castings to meet the required standards listed for chemical testing, or mechanical testing, or non-destructive examination.

8.1.10 Provision for Purchaser Access

The manufacturer shall afford the purchaser's inspector all reasonable facilities necessary to satisfy that the material is being produced and furnished in accordance with this standard. Foundry inspection by the purchaser shall not interfere unnecessarily with the manufacturer's operations.

9. Materials

9.1 Castings shall be made of carbon and alloy steels complying with the referenced ASTM specifications.

10. Mandatory Requirements for Pilot Castings

10.1 Visual Examination.

10.1.1 All accessible internal and external surfaces shall be visually examined. Visual method MSS SP-55 or other visual standards may be used to define acceptable surface discontinuities and finish. Unacceptable surface discontinuities shall be removed and their removal verified by visual examination of the resultant cavities. Cosmetic repairs may be made prior to the visual examination.

10.2 Radiographic Examination.

10.2.1 All areas defined by the purchaser and foundry as those most important from a design and foundry practice consideration shall be radiographed to determine the presence and/or degree of shrinkage. Examination procedure shall be in accordance with ASTM E-94 and E-142. For acceptance, shrinkage discontinuities of designated critical areas shall not exceed severity level 3 of ASTM E-446 and/or E-186 and/or E-280, as applicable.

10.3 Foundry practices and/or design shall be revised as required if pilot castings do not comply with the requirements of this standard. Results of revisions in practices and design must be verified by resampling.

11. Mandatory Requirements for Production Castings

11 .1 Visual Examination.

11.1.1 Each casting shall be visually examined on all accessible internal and external surfaces. Examination and acceptance shall be in accordance with MSS SP-55.

11.2 Hydrostatic Test.

11.2.1 Each pressure containing casting shall be hydrostatically tested at 1.5 times its 100°F rating. Any visible leakage shall be cause for the casting to be unacceptable and call for corrective action.

11.2.2 It is realized that the foundry may be unable to perform the hydrostatic test on the rough casting; however, the foundry is responsible for satisfactory performance of the castings under final hydrostatic shell test by the purchaser.

11.3 Radiography Sampling.

11.3.1 Production castings shall be subject to a sampling program as identified by requirements supplied by the purchaser. Records cf the results of the program shall be made available to the purchaser on request. See Table I for an example of a sampling plan.

11.3.2 The purchaser shall maintain the test frequency records needed to comply with 11.3.1 and shall notify the manufacturer via purchase order when sampling is required.

11.3.3 When, or if, a casting is rejected on the basis of radiography results obtained as part of the radiography sampling plan, the acceptance of castings produced up to that point shall be governed only by the mandatory visual inspection and hydrostatic test criteria of paragraphs 11.1 and 11.2 respectively.

11.3.4 Corrective action shall be taken whenever radiography sampling indicates that the mandatory requirements of paragraph 10.2 are not being attained. The radiography sampling plan shall be resumed with the "pilot casting" stage of Table I when major changes in design or practice are made which may affect the soundness of the casting. See paragraph 10.3.

TABLE I

Example of a
Radiographic Examination Frequency
For Production Castings

A. Pilot Casting
B. 100th Casting
C. 200th Casting
D. 400th Casting
E. Each 400th Casting Thereafter

NOTE 1: If any casting is found to be unacceptable with regard to shrinkage, the sequence shall revert to "Pilot Casting."

NOTE 2: Regardless of the number of castings produced from a given pattern, a minimum of one casting shall be radiographed every five years.