

MSS SP-54-1999

**Quality Standard for Steel  
Casting for  
Valves, Flanges and  
Fittings and Other  
Piping Components**

**Radiographic Examination Method**

Standard Practice  
Developed and Approved by the  
Manufacturers Standardization Society of the  
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## FOREWORD

This standard practice provides methods and acceptance standards for the film method of radiographic examination of steel castings for valves, flanges, and fittings and other piping components. It is applicable to examination of repairs as well as to the initial examination of castings.

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**RADIOGRAPHIC EXAMINATION METHOD****1. SCOPE**

1.1 The methods of Section 4 provide uniform procedures which will produce satisfactory and consistent results upon which the acceptance standards of Section 5 maybe used.

1.2 This examination guide may be used on a voluntary basis or when specified in the inquiry, contract, or order and when mutually agreed upon by the manufacturer and the purchaser. It is difficult to rigidly interpret radiographs to a set of acceptance standards; consequently, there is a need for close cooperation between the manufacturer and the purchaser in applying radiographic acceptance standards.

**2. DEFINITIONS**

2.1 For definitions of terms relating to radiography see ASTM E 94 Appendix X1 and ASTM E 142 Paragraph 2.

**3. BASIS FOR USE**

3.1 Critical sections of pressure containing castings shall be radiographed. These section will be selected by the valve or fitting manufacturer on the basis of previous experiences. These sections will be those which are critical in any one of three senses:

- a) Casting solidification
- b) Stress concentration
- c) Ability to contain pressure

3.2 Inspection guide ASTM E 94 includes radiographs of various types and degrees of discontinuities encountered in steel castings. Radiographs of castings up to 2 in. (51 mm) wall thickness shall be interpreted to ASTM E 446, from 2 in. up to 4½ in. (51 mm up to 114 mm) to ASTM E 186) and from 4½ in. to 12 in. (114 mm to 305 mm) to ASTM E 280.

#### 4. RADIOGRAPHIC PROCEDURE

4.1 ASTM E 94 "Standard Guide for Radiographic Testing," and ASTM E 142 "Standard method for Controlling Quality of Radiographic Testing," shall be used as a guide,

4.2 Areas to be radiographed shall be in accordance with Section 3.1.

4.3 The film shall be as close as practical to the casting being radiographed.

4.4 Any commercial available intensifying screen except those of the fluorescent type may be used.

4.5 All film shall bear identification marking to properly orient the film for interpretation and to denote the actual casting under examination. Film shall be marked to identify the organization producing the radiograph and the date exposed.

4.6 Penetrameters shall be used on each radiograph and shall conform to the requirements of ASTM E 142.

4.7 Any commercially available film may be used provided it is equal or finer grained than Type 2, ASTM E 94.

4.8 Radiographs may be made using multiple film technique and either single or multiple viewing so as to cover a greater latitude in casting thickness with a single exposure.

4.9 Radiographs shall be within the following photographic (H&D) density range:

- a) Single film viewing – 1.5 minimum, 4.0 maximum
- b) Superimposed viewing of double film, each single film – 1.00 minimum, 2.5 maximum, with a double film – 4.0 maximum

4.10 Surface shall be such that radiographic contrast due to surface condition cannot mask or be confused with that of any indication.

4.11 Single wall thicknesses shall be radiographed wherever practical.

4.12 The radiographic sensitivity shall be 2-4T for thickness up to and including 0.75 in. (19 mm) and 2-2T for thickness greater than 0.75 in. (19 mm).

4.13 The manufacturer shall be responsible for assigning qualified personnel to perform and interpret radiographic examinations in conformance with the requirements of this standard practice.

4.14 A qualification record of personnel considered suitable by the manufacturer to perform and interpret examinations in accordance with this standard practice shall be available upon request. ASNT Recommended Practice No. SNT-TC-1A provides a recommended procedure for qualifying personnel.

#### 5. ACCEPTANCE STANDARDS

5.1 Acceptance criteria for castings for body and bonnet (cover) and end pieces (of multi-piece valve bodies, e.g. ball valves) shall be based on wall thickness as indicated below.

##### 5.1.1 Wall thicknesses less than 2 in. (51 mm).

The following comparative plates of ASTM E 446 define acceptable indications:

Discontinuity Type	Category	Acceptable Comparative
		ASTM E 446
Gas	A	A2
Sand	B	B3
Shrink, Type 1		C CA2
2	C	CB3
3	C	CC3
4	C	CD3
Hot Tears & Cracks	D&E	None
Inserts (Chills, Chaplets)	F	None
Mottling	G	Reference Only

5.1.2 Wall thickness from 2 in. up to 4½ in. (51 mm up to 114 mm). The following comparative plates of ASTM E 186 define acceptable indications:

Discontinuity Type	Category	Acceptable Comparative Plates
		ASTM E 186
Gas Porosity	A	A3
Sand and Slag	B	B3
Inclusions		
Shrink, Type 1	C	CA3
2	C	CB3
3	C	CC3
Cracks	D	None
Hot Tears	E	None
Inserts	F	None

5.1.3 Wall thickness from 4½ in. through 12 in. (114 mm through 305 mm). The following comparative plates of ASTM E 280 define acceptable indications:

Discontinuity Type	Category	Acceptable Comparative Plates
		ASTM E 280
Gas Porosity	A	A3
Sand and Slag	B	B3
Inclusions		
Shrink, Type 1	C	CA3
2	C	CB3
3	C	CC3
Cracks	D	None
Hot Tears	E	None
Inserts	F	None

## 6. REMOVAL AND REPAIR OF DISCONTINUITIES

6.1 Pieces rejected through the application of these standards may be repaired. If welding is required, it shall be in accordance with the requirement specified in the applicable steel casting specifications.

6.2 Discontinuities in excess of those represented by acceptable indications shall be removed by suitable means. If removal of surface discontinuities to acceptable level does not result in reducing the wall thickness below acceptable minimum, the area shall be blended smoothly into surrounding surface. Where removal of discontinuities results in a wall thickness below the acceptable minimum, the resultant cavity may be repaired by welding. Welded areas shall be blended smoothly into surrounding surface.

6.3 Areas which as a result of radiographic examination have been weld repaired or from which discontinuities have been removed without requirement for weld repair shall be re-examined by the radiographic method.

6.4 Acceptance standards for porosity and slag inclusions in welds shall be in accordance with UW-51, ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

| ANNEX A |  
REFERENCE STANDARDS AND APPLICABLE DATES

This Annex is an integral part of this Standard Practice and is placed after the main text for convenience.

Standard Name or Description

ASME, ANSI/ASME, ANSI, ASME/ANSI

Section VIII Division 1-1998	Boiler and Pressure Vessel Code
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ASTM

Specifications for:

E 94-1993 E 142-1992 E 186-1993  E 280-1993  E 446-1993	Standard Guide for Radiographic Testing Standard Method for Controlling Quality of Radiographic Testing Standard Reference Radiographs for Heavy Walled [2 to 4½ in (51 to 114 mm)] Steel Castings Standard Reference Radiographs for Heavy Walled 4½ to 12in. (114 to 305 mm) Steel Castings Standard Reference Radiographic for Steel Castings up to 2in. (51mm) in thickness
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ASNT

SNT-TC-1A-1996	Recommended Practice for Personnel Qualifications and Certification in Nondestructive Testing
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Publications of the following organizations appear in the above list:

ASME	The American Society of Mechanical Engineers 3 Park Ave., New York, NY, 10016-5990
ASTM	American Society for Testing and Materials 100 Bar Harbor Drive, West Conshohocken, PA 19428-2959
ASNT	The American Society for Nondestructive Testing Inc. 1711 Arlington Lane, Columbus, OH 43228-0518

# **List of MSS Standard Practices** **(Price List Available Upon Request)**

## **Number**

SP-6-1996	Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings
SP-9-1997	Spot Facing for Bronze, Iron and Steel Flanges
SP-25-1998	Standard Marking System For Valves, Fittings, Flanges and Unions
SP-42-1999	(R 95) Class 150 Corrosion Resistant Gate, Globe, Angle and Check Valves with Flanged and Butt Weld Ends
SP-43-1991	(R 96) Wrought Stainless Steel Butt-Welding Fittings
SP-44-1996	Steel Pipeline Flanges
SP-45-1998	Bypass and Drain Connections
SP-51-1991	(R 95) Class 150LW Corrosion Resistant Cast Flanges and Flanged Fittings
SP-53-1999	Quality Standard for Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components - Magnetic Particle Examination Method
SP-54-1999	Quality Standard for Steel Castings for Valves, Flanges, and Fittings and Other Piping Components - Radiographic Examination Method
SP-55-1996	Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components - Visual Method for Eval. of Surface Irregularities
SP-58-1993	Pipe Hangers and Supports - Materials, Design and Manufacture
SP-60-1999	Connecting Flange Joint Between Tapping Sleeves and Tapping Valves
SP-61-1999	Pressure Testing of Steel Valves
SP-65-1999	High Pressure Chemical Industry Flanges and Threaded Stubs for Use with Lens Gaskets
SP-67-1995	Butterfly Valves
SP-68-1997	High Pressure Butterfly Valves with Offset Design
SP-69-1996	Pipe Hangers and Supports - Selection and Application
SP-70-1998	Cast Iron Gate Valves, Flanged and Threaded Ends
SP-71-1997	Gray Iron Swing Check Valves, Flanged and Threaded Ends
SP-72-1999	Ball Valves with Flanged or Butt-Welding Ends for General Service
SP-73-1991	(R 96) Brazing Joints for Wrought and Cast Copper Alloy Solder Joint Pressure Fittings
SP-75-1998	Specification for High Test Wrought Butt Welding Fittings
SP-77-1995	Guidelines for Pipe Support Contractual Relationships
SP-78-1998	(R 92) Cast Iron Plug Valves, Flanged and Threaded Ends
SP-79-1999a	Socket-Welding Reducer Inserts
SP-80-1997	Bronze Gate, Globe, Angle and Check Valves
SP-81-1995	Stainless Steel, Bonnetless, Flanged, Knife Gate Valves
SP-82-1992	Valve Pressure Testing Methods
SP-83-1995	Class 3000 Steel Pipe Unions, Socket-Welding and Threaded
SP-85-1994	Cast Iron Globe & Angle Valves, Flanged and Threaded Ends
SP-86-1997	Guidelines for Metric Data in Standards for Valves, Flanges, Fittings and Actuators
SP-87-1991	(R 96) Factory-Made Butt-Welding Fittings for Class 1 Nuclear Piping Applications
SP-88-1993	Diaphragm Type Valves
SP-89-1998	Pipe Hangers and Supports - Fabrication and Installation Practices
SP-90-1986	(R 91) Guidelines on Terminology for Pipe Hangers and Supports
SP-91-1992	(R 96) Guidelines for Manual Operation of Valves
SP-92-1999	(R 92) MSS Valve User Guide
SP-93-1999	(R 92) Quality Standard for Steel Castings and Forgings for Valves, Flanges, and Fittings and Other Piping Components - Liquid Penetrant Examination Method
SP-94-1999	Quality Std for Ferritic and Martensitic Steel Castings for Valves, Flanges, and Fittings and Other Piping Components - Ultrasonic Examination Method
SP-95-1999	(R 91) Swage (d) Nipples and Bull Plugs
SP-96-1996	Guidelines on Terminology for Valves and Fittings
SP-97-1995	Integrally Reinforced Forged Branch Outlet Fittings - Socket Welding, Threaded and Buttwelding Ends
SP-98-1996	Protective Coatings for the Interior of Valves, Hydrants, and Fittings
SP-99-1994	Instrument Valves
SP-100-1997	Qualification Requirements for Elastomer Diaphragms for Nuclear Service Diaphragm Type Valves
SP-101-1989	Part-Turn Valve Actuator Attachment - Flange and Driving Component Dimensions and Performance Characteristics
SP-102-1989	Multi-Turn Valve Actuator Attachment - Flange and Driving Component Dimensions and Performance Characteristics
SP-103-1995	Wrought Copper and Copper Alloy Insert Fittings for Polyethylene Systems
SP-104-1995	Wrought Copper Solder Joint Pressure Fittings
SP-105-1996	Instrument Valves for Code Applications
SP-106-1990	(R 96) Cast Copper Alloy Flanges and Flanged Fittings, Class 125, 150 and 300
SP-107-1991	Transition Union Fittings for Joining Metal and Plastic Products
SP-108-1996	Resilient-Seated Cast Iron-Eccentric Plug Valves
SP-109-1996	Welded Fabricated Copper Solder Joint Pressure Fittings
SP-110-1996	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
SP-111-1996	Gray-Iron and Ductile-Iron Tapping Sleeves
SP-112-1993	Quality Standard for Evaluation of Cast Surface Finishes - Visual and Tactile Method. This SP must be sold with a 10-surface, three-dimensional Cast Surface Comparator, which is a necessary part of the Standard. Additional Comparators may be sold separately at \$19.00 each. Same quantity discounts apply on total order.
SP-113-1999	Connecting Joint between Tapping Machines and Tapping Valves
SP-114-1995	Corrosion Resistant Pipe Fittings Threaded and Socket Welding, Class 150 and 1000
SP-115-1999	Excess Flow Valves for Natural Gas Service
SP-116-1996	Service Line Valves and Fittings for Drinking Water Systems
SP-117-1996	Bellows Seals for Globe and Gate Valves
SP-118-1996	Compact Steel Globe & Check Valves - Flanged, Flangeless, Threaded & Welding Ends (Chemical & Petroleum Refinery Service)
SP-119-1996	Bell End Socket Welding Fittings, Stainless Steel and Copper Nickel
SP-120-1997	Flexible Graphite Packing System for Rising Stem Steel Valves (Design Requirements)
SP-121-1997	Qualification Testing Methods for Stem Packing for Rising Stem Steel Valves
SP-122-1997	Plastic Industrial Ball Valves
SP-123-1998	Non-Ferrous Threaded and Solder-Joint Unions for Use With Copper Water Tube
(R-YEAR)	Indicates year standard reaffirmed without substantive changes

A large number of former MSS Practices have been approved by the ANSI or ANSI Standards, published by others. In order to maintain a single source of authoritative information, the MSS withdraws its Standard Practices in such cases.

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