

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

Visual Method
for
Evaluation of Surface Irregularities

Standard Practice
Developed and Approved by the
Manufacturers Standardization Society of the
Valve and Fittings Industry, Inc.
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This MSS Standard Practice was developed under the consensus of the MSS Technical Committee 304 and the MSS Coordinating Committee. The content of this Standard Practice is the result of the efforts of competent and concerned volunteers to provide an effective, clear, and non-exclusive specification that will benefit the industry as a whole. This MSS Standard Practice is intended as a basis for common practice by the manufacturer, the user, and the general public. The existence of an MSS Standard Practice does not in itself preclude the manufacture, sale, or use of products not conforming to the Standard Practice. Mandatory conformance is established only by reference in a code, specification, sales contract, or public law, as applicable.

Unless otherwise specifically noted in this MSS SP, any standard referred to herein is identified by the date of issue that was applicable to the referenced standard(s) at the date of issue of this MSS SP. (See Annex A).

In this Standard Practice all notes, annexes, tables, and figures are construed to be essential to the understanding of the message of the standard, and are considered part of the text unless noted as "supplemental". All appendices appearing in this document are construed as "supplemental". "Supplemental" information does not include mandatory requirements.

U.S. customary units in this SP are the standard; metric units are for reference only.

Non-toleranced dimensions in this Standard Practice are nominal, and, unless otherwise specified, shall be considered "for reference only".

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FOREWORD

The MSS SP-55, Quality Standard for Steel Castings for Valves, Flanges, Fittings, and Other Piping Components - Visual Method for Evaluation of Surface Irregularities, was originally adopted in 1961. It was developed for the purpose of providing the industry with a uniform means for identifying various types of casting surface irregularities.

A set of 60 reference photographs illustrating these casting surface irregularities is included in the standard to permit a visual comparison of an actual casting surface with the reference photographs for the purpose of establishing acceptable/unacceptable casting surface irregularities.

The format of this standard was revised in 1996 to be consistent with other MSS Standards.

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**QUALITY STANDARD
FOR STEEL CASTINGS FOR VALVES, FLANGES, FITTINGS, AND OTHER PIPING
COMPONENTS - VISUAL METHOD FOR EVALUATION OF SURFACE IRREGULARITIES**

1. SCOPE

1.1 This standard is intended to supplement the requirements of ASTM Specifications A 216/A 216M, A 217/A 217M, A 351/A 351M, A 352/A 352M, A 389/A 389M, A 487/A 487M, and A 744/A 744M and to provide a series of reference photographs typical of the various surface irregularities common to steel pressure castings and illustrations of generally acceptable and generally rejectable quality. Table 1 of Section 5 is provided to show MSS interpretation as to the relationship between this standard practice and the levels of surface quality illustrated by the comparators and photographs of the SCRATA Comparators for the Definition of Surface Quality of Steel Castings.

1.2 For additional nondestructive examinations defining quality of steel castings, this standard may be supplemented by MSS Standard Practices SP-53 for magnetic particle examination method, SP-54 for radiographic examination method, SP-93 for liquid penetrant examination method, SP-94 for ultrasonic examination method and SP-112 for visual and tactile method.

2. DEFINITION OF SURFACE QUALITY BY VISUAL INSPECTION

2.1 Twelve general types of surface irregularities are characterized in the collection, five examples being included of each type. The two examples in each case shown to the left illustrate acceptable degrees of the particular type of irregularity. The three examples to the right are characterized as containing unacceptable defects.

2.2 It is recognized that problems may be encountered in evaluating surfaces of castings over a wide range of size and section thickness using the same set of standards. **This guide attempts to minimize the size effect and is intended for general use for any 4"x 5" (100mm x 125mm) area.**

3. REFERENCE PHOTOGRAPHS

3.1 A set of 60 reference photographs illustrating various casting surface irregularities which can be observed by visual inspection, is included herewith. These photographs are actual-size examples of gradations in acceptable and non-acceptable irregularities. It is intended that irregularities less pronounced than those shown as non-acceptable shall be accepted under this guide.

3.2 Photographs included are of actual castings and may exhibit surface irregularities other than the type characterized in the heading. Each type of surface irregularity shall be judged only against the series of photographs identified with the type.

4. TERMINOLOGY FOR REFERENCE PHOTOGRAPHS

4.1 It should be noted that all definitions and discussions of terminologies apply only to surface irregularities and not to internal defects. The types of surface irregularities illustrated in the reference photographs are as follows:

- a) *Type I - Hot Tears and Cracks.*
Linear surface discontinuities or fractures caused by either internal or external stresses or a combination of both acting on the casting. They may occur during or subsequent to solidification. In general, visible surface cracks and/or hot tears are not acceptable.

- b) **Type II - Shrinkage.**
A void left in cast metals as a result of solidification shrinkage and the progressive freezing of metal, which is exposed upon cutting off risers and gates.
- c) **Type III - Sand Inclusions.**
Sand that becomes entrapped in the molten metal and shows on the surface of the casting.
- d) **Type IV - Gas Porosity.**
Voids in cast metal caused by entrapment of gas during solidification.
- e) **Type V - Veining.**
Features on the surface of castings appearing as a ridge and associated with movement or cracking of sand.
- f) **Type VI - Rat Tails.**
Features on the surface of castings appearing as a depression resulting from faulting or buckling of the mold surfaces.
- g) **Type VII - Wrinkles, Laps, Folds, and Coldshuts.**
Surface irregularities caused by incomplete fusing or by folding of molten metal surfaces.
- h) **Type VIII - Cutting Marks.**
Irregularities in casting surfaces resulting from burning or mechanical means used in the cleaning of castings.
- i) **Type IX - Scabs.**
Slightly raised surface blemishes that are usually sand crusted over by a thin porous layer of metal.
- j) **Type X - Chaplets.**
Evidence of chaplets on surface of casting disclosing incomplete fusion, which likewise can apply to internal chills.
- k) **Type XI - Weld Repair Areas.**
Evidence of improper surface preparation after welding.
- l) **Type XII - Surface Roughness.**
Surface texture due to design, pattern, gating, and sand conditions.
5. **COMPARISON OF MSS SP-55 ACCEPTANCE CRITERIA WITH SCRATA STANDARD COVERING TEXTURE QUALITY STANDARDS**
- 5.1 MSS and other societies have published standards illustrating various levels of surface texture and irregularities classified by type. The SCRATA standard discussed in this section does not identify specific levels as being acceptable, leaving the issue to the product specification or contract.
- 5.2 Table 1 has been included for the purpose of showing MSS interpretation as to the levels of discontinuity by type which would be met by castings conforming to SP-55.
- 5.3 The SCRATA comparators are plastic replicas of actual casting surfaces, each of which is also represented by photograph. The standard suggests designating acceptance criteria on drawings.
- 5.4 MSS SP-55 acceptance criteria have been reviewed against the SCRATA standard to designate the acceptance criteria of each type, which are equivalent to SP-55 acceptance criteria. Comparisons published in Table 1 represent the MSS interpretation. They are intended to be of assistance to those interpreting the SCRATA standard.

TABLE 1 - Acceptance Levels in the Scrata Comparators Considered Equivalent to the Acceptance Criteria of MSS SP-55.

MSS SP-55 CLASSIFICATION	SCRATA COMPARATORS EQUIVALENT
TYPE I Hot tears and cracks (None acceptable)	None acceptable
TYPE II Shrinkage	NO EXAMPLES Use MSS SP-55
TYPE III Sand Inclusions	COMPARATOR B2 or better
TYPE IV Gas Porosity	COMPARATOR C2 or better
TYPE V Veining	NO EXAMPLES Use MSS SP-55
TYPE VI Rat Tails	NO EXAMPLES Use MSS SP-55
TYPE VII Wrinkles, Laps, Folds, and Cold Shuts	COMPARATOR D2 or better
TYPE VIII Cutting Marks	COMPARATOR G2 or better COMPARATOR H4 or better
TYPE IX Scabs	COMPARATOR E1 or better
TYPE X Chaplets	COMPARATOR F2 or better
TYPE XI Weld Repair Areas	COMPARATOR J3 or better
TYPE XII Surface Roughness	COMPARATOR A3 or better

ANNEX A
Referenced 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 Designation

ASTM

SPECIFICATIONS FOR:

A 216/A 216M-93 (R98)	Steel Castings, Carbon, Suitable for Fusion Welding for High Temperature Service
A 217/A 217M-99	Steel Castings, Martensitic Stainless and Alloy for Pressure Containing Parts, Suitable for High Temperature Service
A 351/A 351M-94A (R99)	Steel Castings, Austeritic, for High Temperature Service
A 352/A 352M-93 (R98)	Steel Castings, Ferritic and Martensitic, for Pressure Containing Parts, Suitable for Low Temperature Service
A 389/A 389M-93 (R 98)	Steel Castings, Alloy, Specially Heat Treated, for Pressure Containing Parts, Suitable for High Temperature Service
A 487/A 487M-93 (R 98)	Steel Castings, Suitable for Pressure Service
A 744/A 744M-98A	Castings, Iron-Chromium-Nickel Base, Corrosion Resistant, for Severe Service

MSS

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-93-1999	Quality Standard for Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components - Liquid Penetrant Examination Method
SP-94-1999	Quality Standard for Ferritic and Martensitic Steel Castings for Valves, Flanges and Fittings and Other Piping Components - Ultrasonic Examination Method
SP-112-1999	Quality Standard for Evaluation of Cast Surface Finishes - Visual and Tactile Method

SCRATA

Comparators for the Definition of Surface Quality of Steel Castings

Publications of the following organizations appear on the above lists:

ASTM	American Society for Testing and Materials 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. 127 Park Street, N.E., Vienna, VA 22180
SCRATA	Steel Castings Research and Trade Association 5 East Bank Road, Sheffield S2 3PT, England

or

Steel Founders Society of America
205 Park Avenue, Barrington, IL 60010

ACCEPTABLE



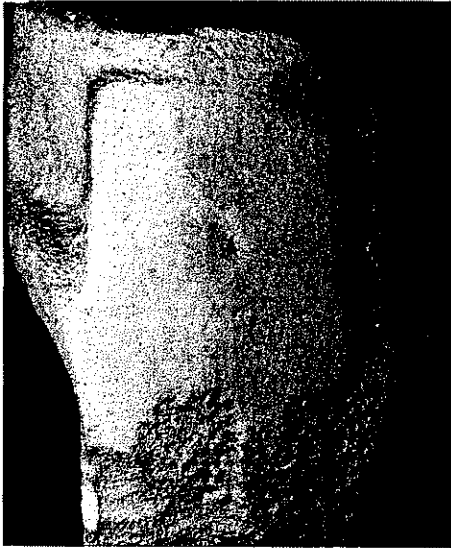
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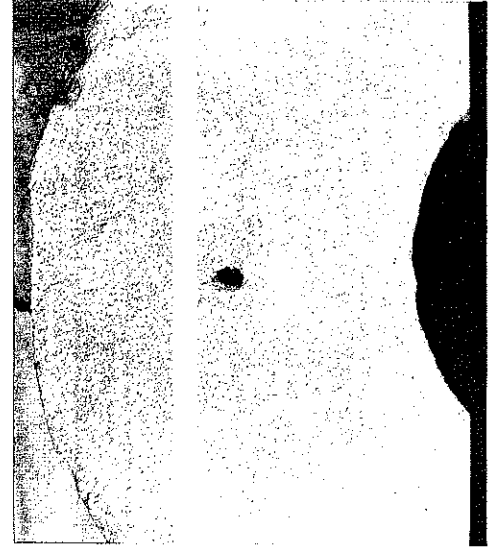
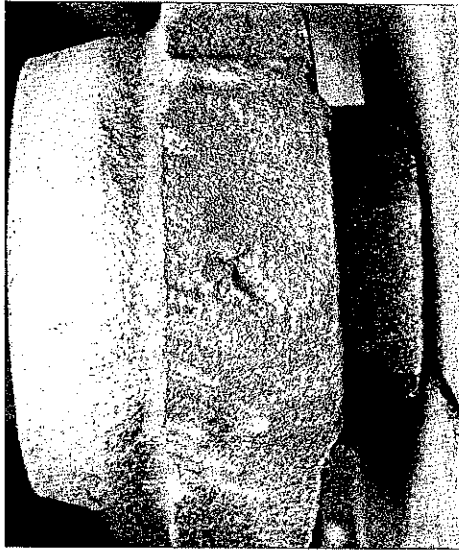
NOTE: The two acceptable examples of this type do not show hot tears or cracks. No irregularities of this Type are acceptable under this standard.

TYPE I
HOT TEARS AND CRACKS

ACCEPTABLE



NON ACCEPTABLE



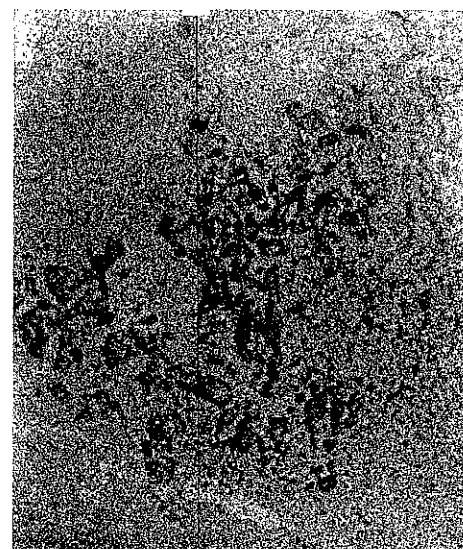
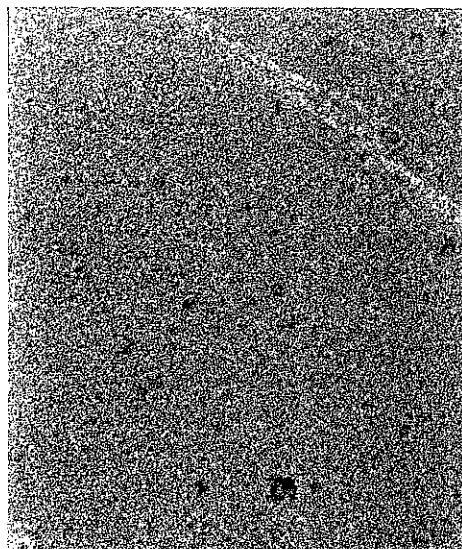
TYPE II
SHRINK

PRTO. IN U.S.A.

ACCEPTABLE



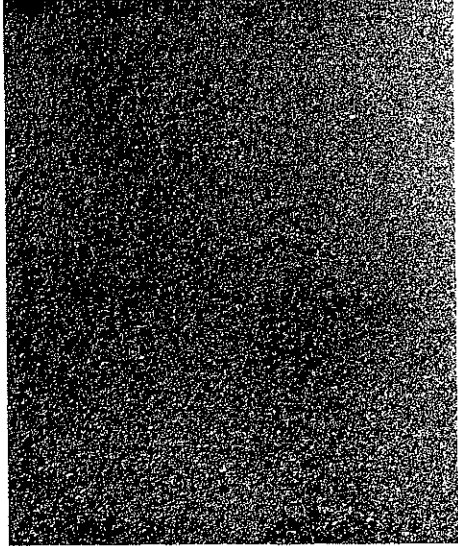
NON ACCEPTABLE



TYPE III
SAND INCLUSIONS

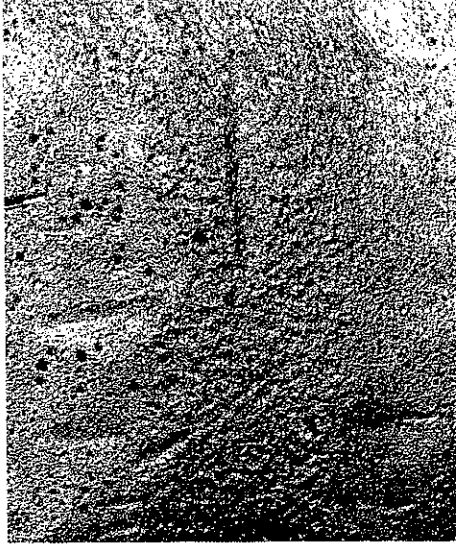
PRD. IN U.S.A.

ACCEPTABLE

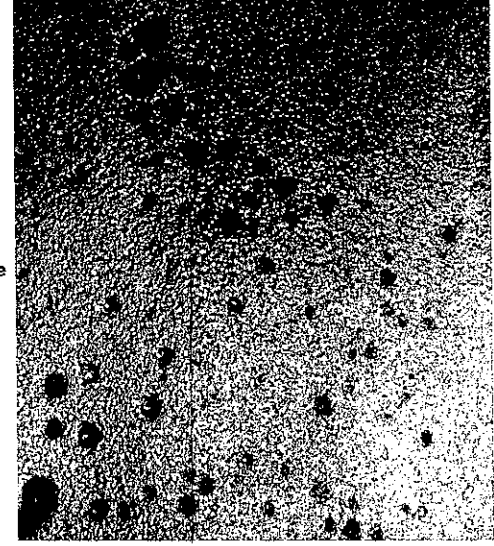


a

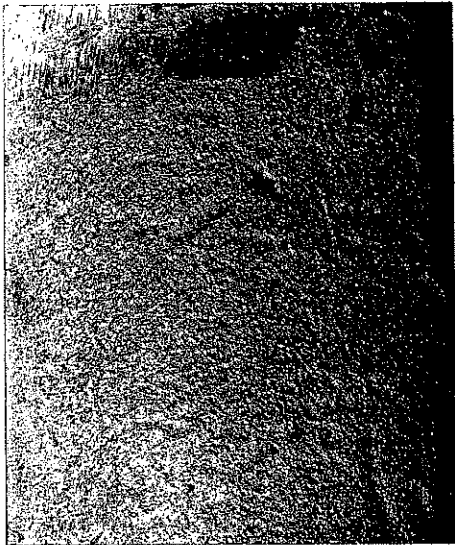
NON ACCEPTABLE



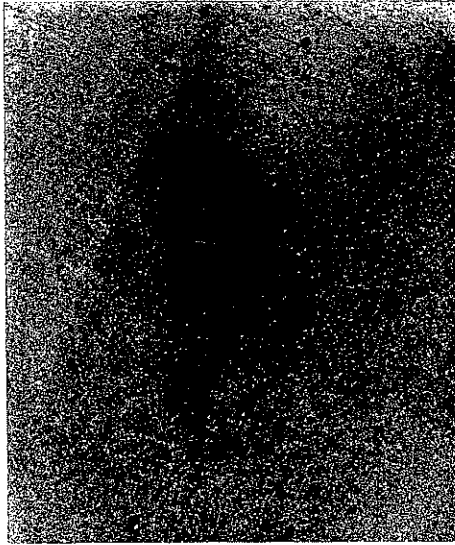
c



e



b



d

TYPE IV
GAS POROSITY

PRTO. IN U.S.A.

ACCEPTABLE



b

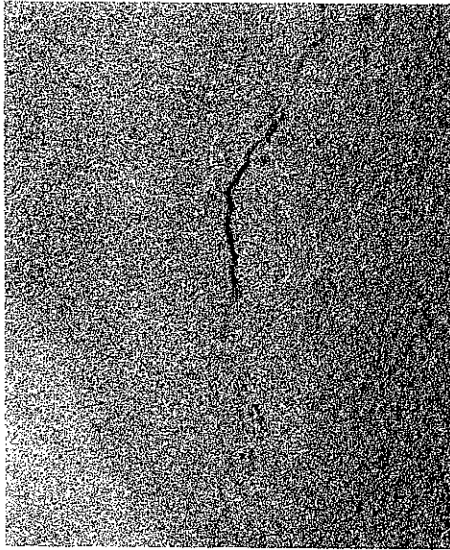


b

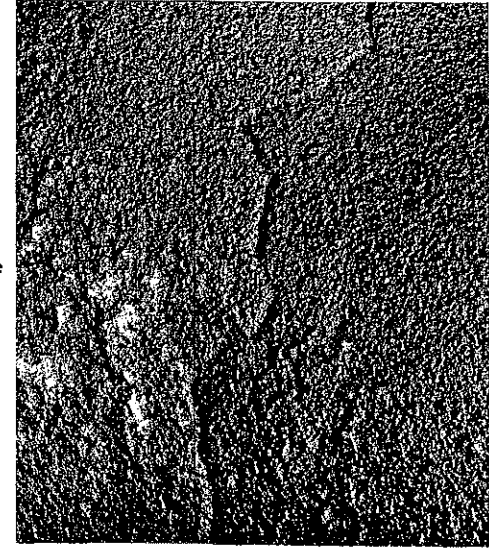
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u



p

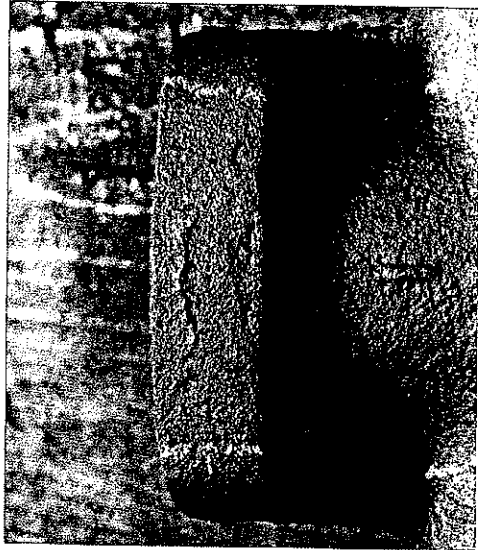


e

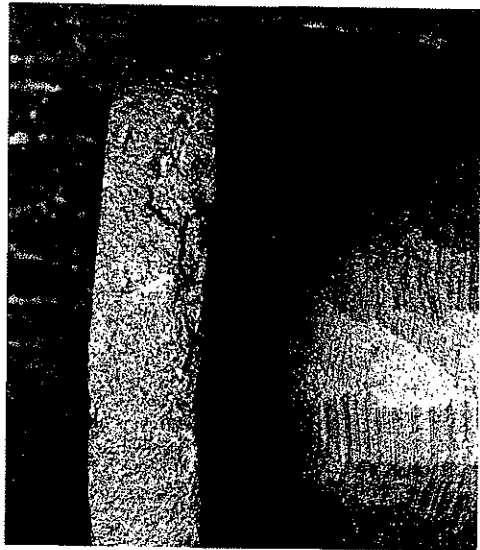
TYPE V
VEINING

PRTO. IN U.S.A.

ACCEPTABLE



a



b

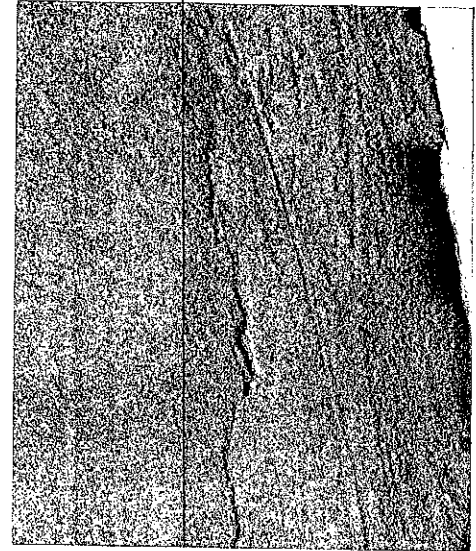
NON ACCEPTABLE



c



d

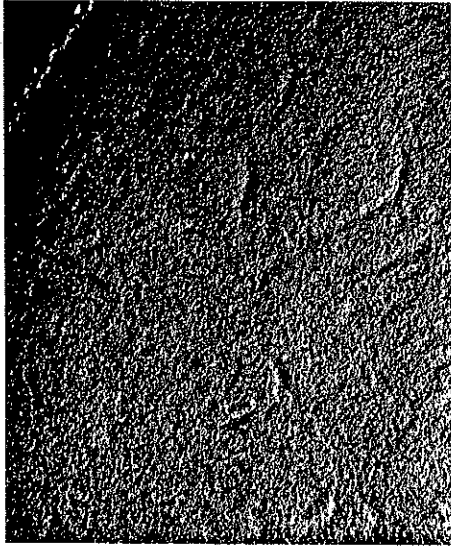


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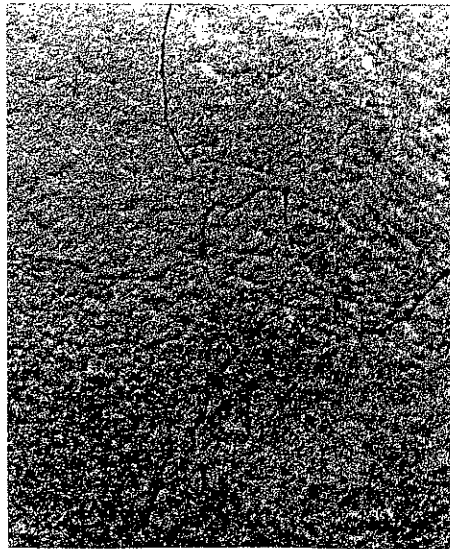
TYPE VI
RAT TAILS

PRTD. IN U.S.A.

ACCEPTABLE



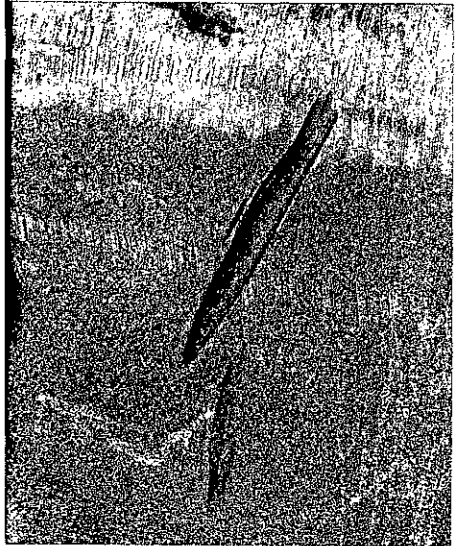
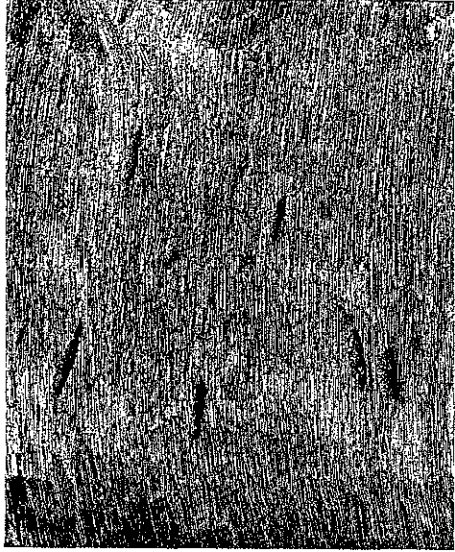
NON ACCEPTABLE



TYPE VII
WRINKLES, LAPS, FOLDS
AND COLDSHUTS

PRTD. IN U.S.A.

ACCEPTABLE



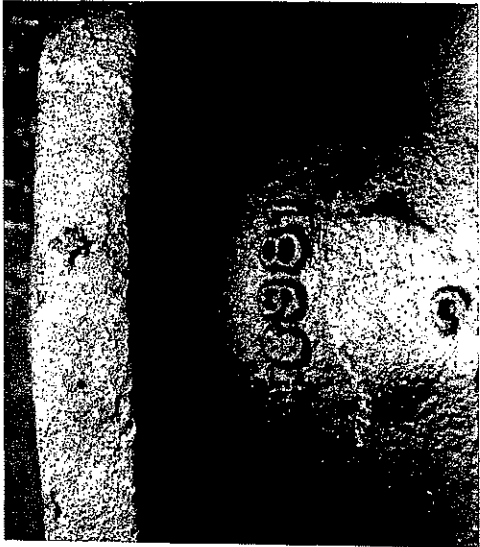
NON ACCEPTABLE



TYPE VIII
CUTTING MARKS

PRTD. IN U.S.A.

ACCEPTABLE

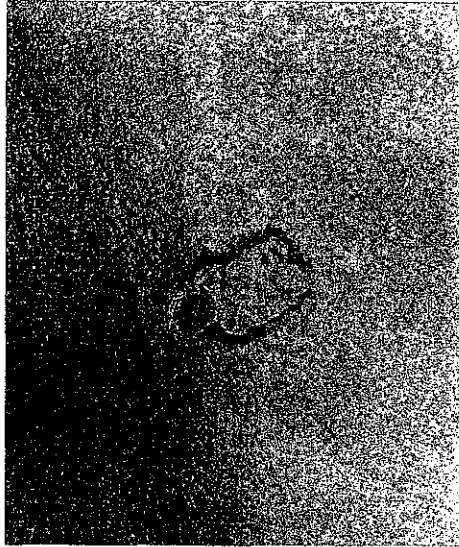


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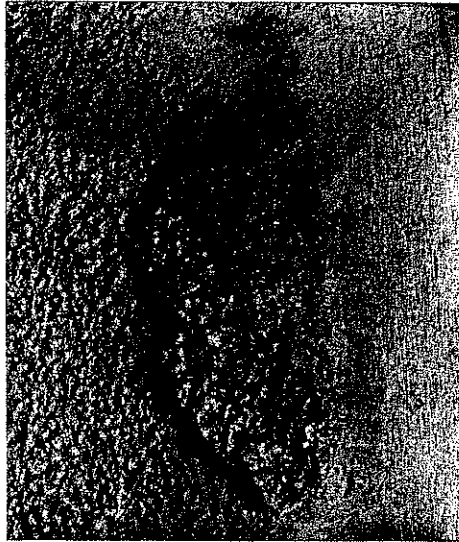


b

NON ACCEPTABLE



c



d

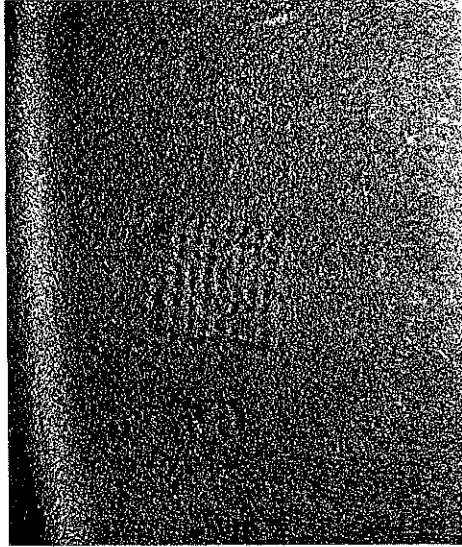


e

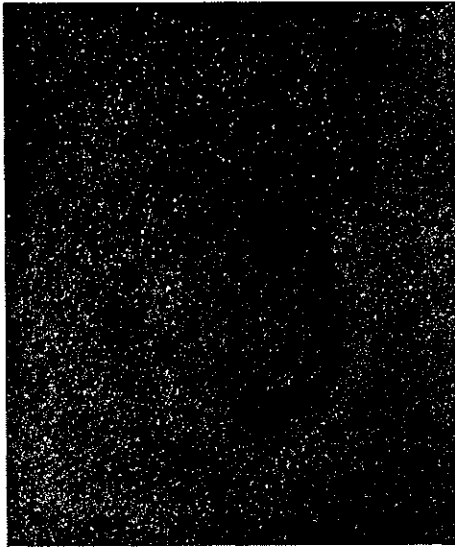
TYPE IX
SCABS

PRTO. IN U.S.A.

ACCEPTABLE



a

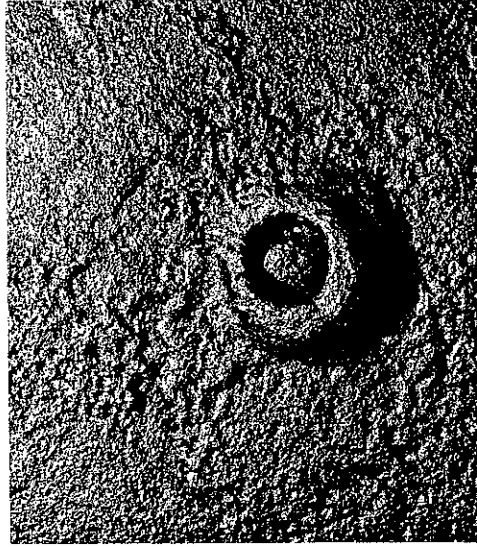


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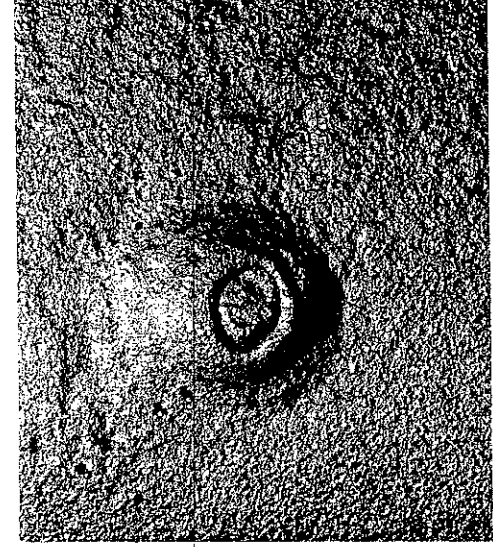
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d

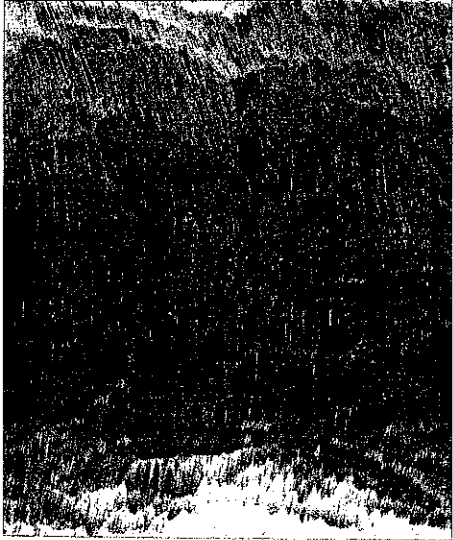


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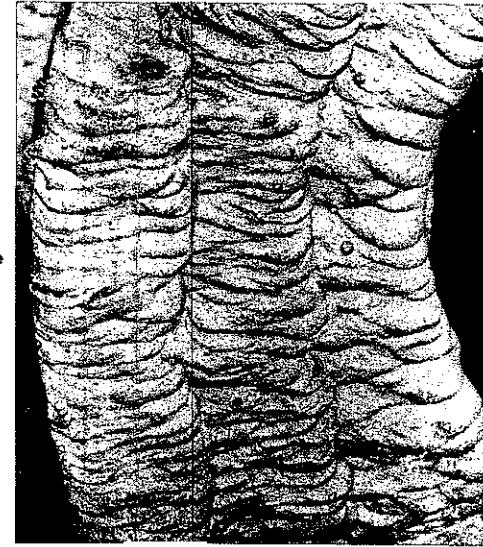
TYPE X
CHAPLETS

PRTD. IN U.S.A.

ACCEPTABLE



NON ACCEPTABLE



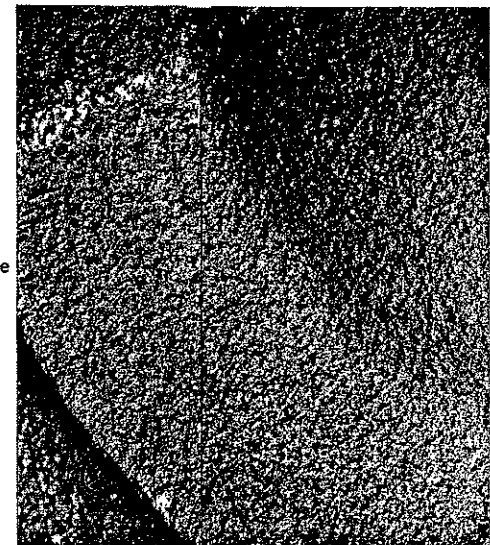
TYPE XI
WELD REPAIR AREAS

PRTD. IN U.S.A.

ACCEPTABLE



NON ACCEPTABLE



TYPE XII
SURFACE ROUGHNESS

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

Number	
SP-6-2001	Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings
SP-9-2001	Spot Facing for Bronze, Iron and Steel Flanges
SP-25-1998	Standard Marking System For Valves, Fittings, Flanges and Unions
SP-42-1999	Class 150 Corrosion Resistant Gate, Globe, Angle and Check Valves with Flanged and Butt Weld Ends
SP-43-1991	(R 01) Wrought Stainless Steel Butt-Welding Fittings
SP-44-1996	Steel Pipeline Flanges
SP-45-1998	Bypass and Drain Connections
SP-51-2000	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-55-2001	Quality Standard for Steel Castings for Valves, Flanges, Fittings, and Other Piping Components - Visual Method for Evaluation 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	(R 00) Guidelines for Pipe Support Contractual Relationships
SP-78-1998	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-81-2000	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	(R 01) Diaphragm Valves
SP-89-1998	Pipe Hangers and Supports - Fabrication and Installation Practices
SP-90-2000	Guidelines on Terminology for Pipe Hangers and Supports
SP-91-1992	(R 96) Guidelines for Manual Operations of Valves
SP-92-1999	MSS Valve User Guide
SP-93-1999	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-95-2000	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-98-2001	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 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	(R 00) Wrought Copper and Copper Alloy Insert Fittings for Polybutylene 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	(R 00) Transition Union Fittings for Joining Metal and Plastic Products
SP-108-1996	Resilient-Seated Cast Iron-Eccentric Plug Valves
SP-109-1997	Welded Fabricated Copper Solder Joint Pressure Fittings
SP-110-1996	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
SP-111-2001	Gray-Iron and Ductile-Iron Tapping Sleeves
SP-112-1999	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 \$25.00 each. Same quantity discounts apply on total order.
SP-113-2001	Connecting Joint between Tapping Machines and Tapping Valves
SP-114-2001	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	Bellied 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
SP-124-2001	Fabricated Tapping Sleeves
SP-125-2000	Gray Iron and Ductile Iron In-Line, Spring-Loaded, Center-Guided Check Valves
SP-126-2000	Steel In-Line Spring-Assisted Center Guided Check Valves
SP-127-2001	Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application
(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 Practice in such cases.

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