

**MSS SP-94-1999**  
**Reaffirmed 2004**

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

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**Ultrasonic Examination Method**

**COMPLIMENTARY  
COPY**

**Standard Practice**  
**Developed and Approved by the**  
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U.S. customary units in this SP are the standard; the metric units are for reference only.

Substantive changes in this 1999 edition are "flagged" by parallel bars as shown on the margins of this paragraph. The specific detail of the change may be determined by comparing the material flagged with that in the previous edition.

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-94 Standard for Ferritic and Martensitic Steel Castings for Valves, Flanges and Fittings and other Piping Components, Ultrasonic Examination Method, was first adopted in 1983. It was developed to provide industry with a uniform method of applying the Ultrasonic Examination procedure and interpretation of the results.

The standard was reaffirmed in 1987 with essentially no changes.

The third edition issued in 1992 was revised to include a surface finish requirement for the calibration blocks. This was necessary as the previously referenced surface comparator of the Alloy Casting Institute was no longer available.

The 1999 edition includes minor revisions and was formatted to conform to current MSS practices.

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## **ULTRASONIC EXAMINATION METHOD**

### **1. SCOPE**

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

1.2 The methods of Section 8 describe uniform procedures which will provide satisfactory and consistent results upon which the acceptance standards of Section 11 may be used.

1.3 It is recognized that ultrasonic examination and radiographic examination are not directly comparable. This standard practice is intended to provide a casting of functionally equivalent quality to those accepted by the method of MSS SP-54.

### **2. DEFINITIONS**

For definitions of terms relating to ultrasonic testing see ASTM E 1316.

### **3. BASIS FOR USE**

Critical sections of pressure containing castings shall be examined ultrasonically. These sections will be selected by the purchaser of the castings on the basis of previous experience. They may be considered critical in any one of three senses:

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

### **4. EQUIPMENT**

#### **4.1 Electronic Apparatus**

4.1.1 An ultrasonic, pulsed, reflection type of instrument which shall be capable of generating, receiving, and amplifying frequencies of at least 1MHz to 5MHz.

4.1.2 The ultrasonic equipment shall provide linear presentation (within  $\pm 5$  percent) for at least 75 percent of the screen height (sweep line to top

of screen). Linearity shall be determined in accordance with ASTM E 317 or equivalent electronic means.

4.1.3 The electronic apparatus shall contain a single attenuator or calibrated gain control which shall be accurate over its useful range to  $\pm 10$  percent of the nominal attenuation or gain ratio to allow measurement of signals beyond the linear range of the instrument.

#### **4.2 Search Units**

4.2.1 Longitudinal Wave internally grounded search units having 1/2 to 1-1/8 inch (13mm to 29mm) diameter or 1 inch (25mm) square piezoelectric elements shall be used. Based on the signal to noise ratio of the response pattern of the casting, a frequency in the range of 1MHz to 5MHz shall be used. The background noise shall not exceed 25 percent of the distance amplitude correction (DAC) curve. Transducers shall be utilized at their rated frequencies.

4.2.2 Dual element 5MHz search units are recommended for sections 1 inch (25mm) and under in thickness.

4.2.3 Angle beam search units shall produce a shear wave beam in steel in the range of 40° to 75° inclusive, measured to the perpendicular of the entry surface of the casting being examined and have a frequency of 1MHz to 5MHz.

4.2.4 Other frequencies and sizes of search units may be used for evaluating and pinpointing indications.

#### **4.3 Reference Blocks**

4.3.1 Reference blocks shall be used to establish test sensitivity.

4.3.2 Reference blocks shall be made from cast steels that give an acoustic response similar to the castings being examined.

4.3.3 For single and dual element longitudinal wave transducers the design of reference blocks