

1. SCOPE

- 1.1 Scope. This standard defines minimum requirements for the detection and evaluation of internal discontinuities in wrought metals by ultrasonic inspection and defines acceptability of parts and materials.
- 1.2 Classification. Ultrasonic inspection shall be of the following classes:
- Grade AA – No. 3 Acceptance Standard (See Para. 3.1.6) – No. 3 for maximum size of both single and multiple indicated discontinuities.
- Grade A – No. 3 and No. 5 Acceptance Standards – No. 5 for maximum size of single indicated discontinuities and No. 3 for maximum size of multiple indicated discontinuities.
- Grade B – No. 5 and No. 8 Acceptance Standards – No. 8 for maximum size of single indicated discontinuities and No. 5 for maximum size of multiple indicated discontinuities.
- Grade C – No. 8 Acceptance Standard – No. 8 for maximum size of both single and multiple indicated discontinuities.

2. APPLICABLE DOCUMENTS

- 2.1 The following documents form a part of this standard and, unless otherwise indicated, the issue in effect on date of invitation for bid shall apply.

ASTM International

ASTM E127 Fabricating and Checking Aluminum Alloy Ultrasonic Standard Reference Blocks.

Copies can be obtained from ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959. www.astm.org

ASME International

ASME B46.1 Surface Texture (Surface Roughness, Waviness and Lay)

Copies can be obtained from ASME, Three Park Ave., New York, NY 10016-5990. www.asme.org

2. REQUIREMENTS

3.1 Equipment

- 3.1.1 Ultrasonic instruments. Ultrasonic electronic instruments shall be capable of producing, receiving and displaying (on an oscilloscope) stable high-frequency electrical pulses at the required frequency and energy level. Sensitivity, resolution and reproducibility shall be adequate to detect discontinuities defined in this standard.

- 3.1.2 Transducers. Transducers shall be capable of reversibly transforming electrical energy to sound vibrations within themselves, as well as transmitting to and receiving ultrasonic vibrations from materials and parts through a liquid couplant.

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PROCUREMENT SPECIFICATION NONE	TITLE INSPECTION, ULTRASONIC, WROUGHT METAL	CLASSIFICATION SPECIFICATION DAS824 SHEET 1 OF 5

- 3.1.3 Scanning unit. The mechanical scanning unit for immersed testing shall consist of a transducer, search tube and manipulator supported on a carriage so that its locations with respect to materials and parts being inspected is adjustable and can be manually or motor driven along a scanning track. The search unit assembly shall have adjustments for rotating the search unit in two perpendicular-vertical planes at least ± 30 degrees from the vertical position. Water distance travel shall be adjustable. Hand scanners, immersed and contact, may be used for scanning irregular surfaces and for scanning parts that cannot be submerged in a tank of water.
- 3.1.4 Tank. The tank shall be suitable to permit immersion of the parts to be inspected and the scanning head of the search unit.
- 3.1.5 Couplant. Water shall be used as the couplant for immersed inspection. Wetting agents and corrosion inhibitors shall be used to prevent air entrapment and corrosion.
- 3.1.5.1 Couplant temperature. The temperature of the couplant in the tank shall be maintained as close to the temperature of the part being tested as practical.
- 3.1.5.2 Couplant thickness. The layer of couplant shall be thick enough to prevent signal distortion resulting from turbulence as the transducer is moved through the water and to prevent a second front reflection between the first front reflection and first back reflection.
- 3.1.6 Standard reference test blocks. Aluminum alloy and magnesium alloy reference blocks shall be used for inspecting aluminum and magnesium alloy materials respectively. Reference blocks made from 4130 or 4340 steel alloy shall be used for inspection of low-alloy steels and may be used for inspection of CRES or high-temperature alloys, providing the attenuation or multiple back reflections is within ± 50 percent of that of the material being tested and an appropriate attenuation correction is utilized (see 3.4.4.2). Special test blocks shall be prepared from one of the parts being tested or of a similar material when necessary because of geometry, size, surface condition or attenuation. Special test blocks are mandatory when attenuation differences between standard blocks and part being tested is not within ± 50 percent or when correction factor is not used. Special test blocks may be required when inspecting parts with convex or concave surfaces. The surface roughness of special test blocks shall be approximately the same as that of the part being tested. The use of standard flat test blocks for inspecting parts with curved or non-parallel surfaces shall be subject to procurer approval. Complex die forgings, in most instances, will probably require a special test block fabricated from one of the parts being tested. Standard reference test blocks for aluminum alloys shall be fabricated in accordance with ASTM E127. Standard reference test blocks for other materials shall be fabricated and standardized in accordance with the procedures of ASTM E127. Reference blocks shall be designated No. 3 Acceptance Standard ($\varnothing 3/64$ inch flat bottom hole), No. 5 Acceptance Standard ($\varnothing 5/64$ inch flat bottom hole), No. 8 Acceptance Standard ($\varnothing 8/64$ inch flat bottom hole).
- 3.2 Specifying grades. Design drawings or specifications should specify the desired grade of ultrasonic inspection. When more than one grade of inspection is required for a particular part or when certain areas of a part do not require ultrasonic inspection, design drawings should be zoned and grades specified for each zone.
- 3.2.1 Wrought metals 1/4 inches thick and over. When the grades are not specified on design drawing or specifications, wrought metals 1/4 inch thick and over shall be inspected per Grade A or Grade B in accordance with Table I and 3.2.2.

TABLE I – ULTRASONIC GRADES FOR WROUGHT METALS

Wrought Product	Thickness (inches)	Grade A	Grade B
Plate	.250 to 1.499		X
Plate	1.499 to 3.000	X	
Plate	3.001 to 4.500		X
Extrusions	.375 to 1.500		X
Extrusions	over 1.500	X	
Die Forgings	over .375		X
Hand Forgings	All	X	
Bar Stock	All	X	

- (a) For extrusions, applicable only to sections with width-to thickness ratio of less than 10 to 1.

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REVISION
2
NAS824
SHEET 2



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