AEROSPACE
MATERIAL SPECIFICATIONS
SOCIETY OF AUTOMOTIVE ENGINEERS, Inc. 485 Lexington Ave., New York 17, N.Y.

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Revised

FREE FERRITE CONTENT
Method For Determining Percent

1. ACKNOWLEDGMENT: A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.

2. APPLICATION: Primarily for the determination of free ferrite content in iron base alloys for which control of free ferrite content is required to assure meeting minimum mechanical properties after heat treatment.

3. PROCEDURE:

3.1 Sampling: The sampling procedure described in 3.1.1 shall be performed by the producer for heat release; procedures on the product shall be as described in 3.1.2.

3.1.1 Heat Qualification: Unless otherwise agreed upon, samples shall be taken from a product representing the top and bottom of the first ingot and last usable ingot from heats having not over 10 ingots or not over 30 tons; and representing the top and bottom of the first ingot, the approximately middle ingot, and the last usable ingot of heats having more than 10 ingots or over 30 tons. No further sampling by the producer shall be required on product from a qualified heat.

3.1.2 Final Rolled Product: Stock to provide specimens shall be taken from each size of material from each heat in the shipment. Not less than 3 specimens shall be selected at random to represent each size.

3.1.2.1 Location of Specimens:

3.1.2.1.1 Round, Hexagonal, or Square Products: Specimens shall be selected from an area midway between the edge and the center of a slice cut from the end of the product. Each specimen shall be marked in such a manner that its orientation with respect to the direction of rolling is easily identified.

3.1.2.1.2 Flat Rolled Products: Specimens of sufficient size to provide approximately 0.5 sq in. examining area shall be selected from an area midway between the longitudinal edge and center of the product from a strip cut from the end. Each specimen shall be marked in such a manner that its orientation with respect to the direction of rolling is easily identified.

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3.1.2.1.3 Tubing and Other Hollow Shapes: Specimens of sufficient size to provide approximately 0.5 sq in. examining area shall be selected from a slice cut from the end of the product and shall include the full wall thickness. Each specimen shall be marked in such a manner that its orientation with respect to the direction of rolling or drawing is easily identified.

3.2 Specimen Preparation:

3.2.1 Heat Treatment: Specimens shall be austenitized at the normal recommended temperature for the grade of steel being examined and adequately quenched. The quenched specimens shall be tempered at a sufficiently high temperature to develop good metallographic contrast.

3.2.2 Polishing: Unless otherwise agreed upon, after heat treatment as in 3.2.1, the face of each specimen perpendicular to the direction of rolling shall be ground and polished to produce a surface suitable for microscopic examination, using standard metallographic polishing techniques.

3.2.3 Etching: The polished surface of each specimen shall be suitably etched to reveal ferrite.

3.3 Determination of Free Ferrite Content: Unless otherwise agreed upon, the percent of free ferrite in each polished and etched specimen shall be determined at 250 diameters magnification under tinted illumination using the method described in 3.3.1 or 3.3.2. In determining percent ferrite by either method, partially occupied squares are added into the sum of fully occupied squares on the basis of an estimate of portions of squares occupied, using not closer than multiples of 1/4.

3.3.1 Superimpose on the image on a ground glass screen or on a representative photomicrograph of the specimen a transparent overlay grid containing small squares within a large square at a ratio of 100 to 1, such as large squares 1 cm on a side divided into smaller squares 1 mm on a side.

3.3.1.1 Calculation of Percent Free Ferrite: For each specimen, count the number of small squares occupied by free ferrite in each of a minimum of 15 large squares. Calculate the average number "n" of occupied small squares per large square (sum of occupied small squares divided by number of large squares used). Convert the number "n" to volume percent free ferrite "N", correcting for variations in particle shape, as follows: $N = 1.16n$. Applying a standard deviation "d" with a value of 0.08n, the final value of percent free ferrite in the specimen becomes: $N \pm d = 1.16n \pm 0.08n$.