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An American National Standard

Standard Specification for Cast Steel Wheels for Railway Service[1]

This standard is issued under the fixed designation A 583; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers one-wear, two-wear, and multiple-wear cast carbon steel wheels for use on locomotives and cars, designated Class U, untreated, and Classes L, A, B, and C, heat-treated wheels.

1.2 The service for which the various classes are intended is as follows:

1.2.1 Class B or C wheels shall be used for freight cars in interchange service.

1.2.2 Class B or C wheels are recommended for use on locomotives.

1.2.3 For passenger car service, the various classes are intended generally as follows:

1.2.3.1 *Class L*—High speed with more severe braking conditions than other classes and light wheel loads.

1.2.3.2 *Class A*—High speed service with severe braking conditions, but moderate wheel loads.

1.2.3.3 *Class B*—High speed service with severe braking conditions and heavier wheel loads.

1.2.3.4 *Class C*—(*1*) Service with light braking conditions and heavier wheel loads.

1.2.3.5 *Class C*—(*2*) Service with heavier braking conditions where off-tread brakes are employed.

1.2.4 *Class U*—Wheels may be used in service in which the wheel load and braking are low.

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

E 59 Practice for Sampling Steel and Iron for Determination of Chemical Composition[2]

E 350 Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron[2]

E 415 Test Method for Optical Emission Vacuum Spectrometric Analysis of Carbon and Low-Alloy Steel[3]

E 1019 Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel and in Iron, Nickel, and Cobalt Alloys[3]

2.2 *AAR Standard:*

AAR Wheel and Axle Manual, Section G-M-208[4]

2.3 *SAE Documents:*

J442 Standard for Test Strip, Holder and Gage for Shot Peening[5]

J443 Recommended Practice for Procedures for Using Standard Shot Peening Test Strip[5]

J827 Recommended Practice for Cast Steel Shot[5]

2.4 *Military Standard:*

MIL-S-13165B Shot Peening of Metal Parts[6]

3. Ordering Information

3.1 The inquiry, order, or contract for material under this specification shall include:

3.1.1 Quantity (number of pieces),

3.1.2 Class (see Section 1),

3.1.3 Full identification of wheel design, including tread and flange contour, and dimensional drawing if required,

3.1.4 Rough bore size,

3.1.5 Intended service (see Section 1),

3.1.6 ASTM designation and year of issue, and

3.1.7 Supplementary requirements (if any).

4. Manufacture

4.1 *Melting Practice*— The steel shall be melted in electric furnaces.

4.2 *Temperatures*— During the processes of manufacture, necessary care in regulation of temperature gradients shall be exercised to obtain the mechanical properties to be expected from the chemical composition and to prevent the development of internal discontinuities and injurious stresses.

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[1] This specification is under the jurisdiction of Committee A-1 on Steel, Stainless Steel, and Related Alloysand is the direct responsibility of Subcommittee A01.18on Castings

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[2] *Annual Book of ASTM Standards*, Vol 03.05.

[3] *Annual Book of ASTM Standards*, Vol 03.06.

[4] Available from the Association of American Railroads, 50 F St. N.W., Washington, DC 20001.

[5] Available from the Society of Automotive Engineers, Inc., 400 Commonwealth Dr., Warrendale, PA 15906.

[6] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

4.3 *Heat Treatment*:

4.3.1 For Class L, A, B, and C wheels, the heat treatment shall consist of treatment of the rim only.

4.3.2 *Rim-Quenching Treatment*—The wheels shall be uniformly reheated to the proper temperature to refine the grain and then the rims shall be quenched. Following quenching, the wheel shall be charged into the furnace for tempering to meet the mechanical requirements described in Section 7, and subsequently cooled under controlled conditions.

5. Shot Peening

5.1 The plate surfaces of all wheels shall be shot-peened in accordance with the following requirements:

5.1.1 *Shot*—The shot shall be SAE No. 550 or larger hardened steel, as specified in SAE Recommended Practice J827.

5.1.2 *Shot Size Control*—The peening machines shall be equipped with a separator for continuously removing broken shot. Sufficient new shot shall be added to ensure that a minimum of 85 % of SAE No. 550 or larger shot is maintained in the machine at all times.

5.1.3 *Peening Intensity*—The peening intensity shall be sufficient to produce an average arc height of not less than 0.008 (0.20 mm) C Standard Almen gage No. 2 on the front plate near the hub fillet and on the back plate near the rim fillet of wheels of the standard design and at the back plate hub fillet and front plate rim fillet of the reverse plate design.

5.1.3.1 *Arc Height Measurement*—Measurement of arc height shall be made in accordance with SAE Standard J442 and SAE Recommended Practice J443.

5.1.4 *Coverage*—The minimum peening time shall be sufficient to ensure that full coverage is attained on the Almen C-2 strip as defined in the alternative procedure of SAE Recommended Practice J443, or 6.11 of Military Standard MIL-S-13165B.

5.1.5 *Sequence*—Shot peening shall be performed on all wheels and after any corrective surface preparation in the plate area.

5.1.6 *Quality Assurance Provisions*:

5.1.6.1 *Wheel Surface Condition*—The peened appearance of rim and hub shall not be cause for rejection.

5.1.6.2 *Frequency of Test*—Arc height determinations shall be made on Almen strips attached to a test wheel at the beginning and end of each production run, but not less than once in each 8-hour operating period.

5.1.6.3 *Retest*—If a test fails to meet the arc height requirement of 0.008 (0.20 mm) C Standard Almen gage No. 2, two retests shall be made. These retests shall be averaged with the first determination. The average shall be not less than 0.008 and no more than one value of the three shall be less than 0.008.

5.1.6.4 *Repeening*—When test values fail to meet the provisions of 5.1.6.3, corrective action shall be initiated and satisfactory test values secured before proceeding with production peening. If the average Almen value of the unsatisfactory test is 0.006 or 0.007 (0.16 or 0.19 mm), the last half of the wheels peened prior to the unsatisfactory test, but subsequent to a satisfactory test, shall be repeened with at least one-half exposure time. If the average Almen value is less than 0.006, all of the wheels peened since the last satisfactory test shall be repeened with full exposure.

6. Chemical Composition

6.1 The steel shall conform to the requirements of Table 1 as to chemical composition.

6.2 *Heat Analysis*— An analysis of each heat of steel shall be made by the manufacturer to determine the percentage of the elements specified in Table 1. This analysis shall be made on a test specimen taken during the pouring of the heat. The chemical composition thus determined, together with such identifying records as may be desired, shall be reported to the purchaser or the purchaser's representative, and shall conform to the requirements specified in Table 1.

6.3 *Product Analysis*— An analysis may be made by the purchaser from a sample furnished by the manufacturer representing the day's heats, or from finished wheels selected from heats in question by the purchaser's representative. The chemical composition thus determined shall conform to the requirements specified in Table 1 with a permissible carbon variation of −0.02 or +0.03 percentage points. Samples from a finished wheel shall be obtained at a location in the hub in such a manner as not to impair the usefulness of the wheel. No drilling of the finished wheel shall be permitted for chemical analysis. Each sample shall be thoroughly mixed together and shall be clean and free of scale, oil, and other foreign substances.

6.4 *Alternate Sampling Method*—When wheel blocks are not available for chemical analysis, the laboratory conducting the chemical analysis shall follow a standard sampling method in accordance with Practice E 59.

6.5 *Chemical Analysis Method*—Chemical analysis shall proceed as described in 6.5.1 or 6.5.2. All analyses should note which method is used for the carbon or chemical determinations, or both.

6.5.1 *Test Method I*— Apply one of the procedures in 6.5.1.1 through 6.5.1.3 to make the carbon determinations:

6.5.1.1 Total carbon by the Combustion Gravimetric Method, Test Method E 350,

6.5.1.2 Total carbon by the Combustion Thermal Conductivity Method, Test Methods E 1019, or

6.5.1.3 Total carbon by Combustion, followed by quantitative infrared analysis, Test Methods E 1019, or report standardization method used.

6.5.2 *Test Method II*—Apply the procedures in Test Method E 415 to make the carbon determinations.

7. Mechanical Properties

7.1 *Hardness Tests*:

TABLE 1 Chemical Requirements

	Composition, %
Carbon:	
Class U	0.65 to 0.77
Class L, max	0.47
Class A	0.47 to 0.57
Class B	0.57 to 0.67
Class C	0.67 to 0.77
Manganese	0.60 to 0.85
Phosphorus, max	0.05
Sulfur, max	0.05
Silicon, min	0.15

7.1.1 *Requirements*— The hardness of the rim, when measured in accordance with the requirements of the following section, shall show the value prescribed in Table 2.

7.1.2 *Number of Tests*—Where continuous heat-treating furnaces are used in connection with Class L, A, B, and C wheels, Brinell hardness measurements shall be made on 10 % of the wheels from each heat. Where batch-type, heat-treating furnaces are used, Brinell hardness measurements shall be made on 10 % of the wheels from each heat-treatment lot, provided that at least one wheel is selected for test from each heat represented in the heat-treatment lot. For either process, when there are less than 20 wheels from a heat, a minimum of two wheels shall be checked for hardness except when there is only one wheel from a heat, in which case a Brinell hardness measurement shall be made on the one wheel.

7.1.2.1 If all the wheels tested meet the requirements of 7.1.1, all of the wheels represented shall be accepted.

7.1.2.2 If any wheel tested fails to meet the requirements of 7.1.1, it shall be checked by making two additional hardness measurements, one on each side of the point first measured, and each approximately 1 in. (25.4 mm) from that point. If both of these check measurements meet the requirements of 7.1.1, the wheel shall be considered to have met the requirements of that section.

7.1.2.3 When continuous heat-treating furnaces are used, and if any of the wheels tested fail on check to meet the requirements of 7.1.1, the manufacturer may test, for individual hardness measurements, all of the wheels of that heat in the lot submitted for inspection, and those meeting the requirements of 7.1.1 shall be accepted. When batch heat-treating furnaces are used, and if any of the wheels tested fail on check test to meet the requirements of 7.1.1, the manufacturer may test all of the wheels in the heat-treatment lot for individual hardness measurement and those meeting the requirements of 7.1.1 shall be accepted.

7.1.3 *Test Locations and Orientation*— The Brinell test shall be made on the front face of the rim with the edge of the impression not less than 3⁄16 in. (4.8 mm) from the radius joining the face and the tread. Before making the impression, any decarburized metal shall be removed from the front face of the rim at the point selected for measurement. The surface of the wheel rim shall be properly prepared to permit accurate determination of hardness.

8. Nondestructive Testing

8.1 *Magnetic Particle Test*:

8.1.1 *Scope*—This test covers the wet fluorescent magnetic particle inspection of the plates of wheels ordered to this specification.

8.1.2 *Purpose*—To supplement visual inspection of the surface of new wheels by detecting discontinuities that may be harmful to wheel service.

TABLE 2 Rim Hardness Values

Class	Brinell Hardness, HB	
	min	max
L	197	277
A	255	321
B	277	341
C	321	363

8.1.3 *Equipment*:

8.1.3.1 *Magnetizing Apparatus*—The magnetizing apparatus shall be capable of inducing suitable magnetic fields within the entire plate area of the wheel to facilitate the disclosure of both circumferentially- and radially-oriented discontinuities. The magnetizing currents used shall be large enough to induce fields of sufficient intensity to disclose surface discontinuities exceeding 0.015 in. (0.38 mm) in depth and ¼ in. (6.35 mm) long. The use of prod-type contacts is prohibited.

8.1.3.2 *Lighting Apparatus*—The inspection shall be performed in a darkened booth with the areas of the wheel to be inspected illuminated with properly filtered black light. The black light shall have a predominant wavelength of 400 to 340 nm and the intensity of the black light, measured at the surface to be inspected, shall be a minimum of 75 fc (807 lx).

8.1.3.3 *Testing Medium*—The bath or solution should be prepared, using a suitable carrier fluid and fluorescent magnetic particles, and renewed monthly or more frequently, if contamination is noted in weekly tests. Each time the bath is renewed, the bath container should be cleaned and the agitation and circulation system should be flushed with 1 or 2 gal of clean carrier. Filtering screens should be removed and cleaned by blowing with air. In preparing the new bath, only recommended materials should be used. The amount of powder should be carefully weighed out in accordance with the material manufacturer's recommendation, and the powder should be added directly to the bath containing the correct amount of carrier. It is recommended that powder be added directly over the sump so that it will be drawn quickly into the pump and circulated. The amount of carrier and powder used and the date of preparation should be recorded on a regular form set up for this purpose as outlined in Paragraph (*e*).

(*a*) Concentration and contamination of the bath solution should be tested weekly as follows: Pump and agitation system should be circulated for 20 min, and then solution should be run through hose and nozzle for 30 s. Using a regular 100-mL centrifuge tube, fill the centrifuge tube with 100 mL of the solution. Allow bath solution to settle for the time recommended by the manufacturer of the type of powder used ensuring that the tube is not subjected to excessive vibration during the settling period. Each horizontal division represents 0.1 mL, and correct readings in volume of particles must be as stipulated by the powder manufacturer. Ensure that contamination does not occur from dirt, chips, or other foreign matter settling with the powder. Contamination is indicated when the carrier appears to acquire more than usual fluorescence or when the magnetic particles appear to have lost fluorescent qualities. This condition can be readily observed when the settling tube is exposed to ultraviolet light. The readings obtained are to be shown on the regular report form.

(*b*) The ultraviolet light should be tested weekly using a sight meter, such as a type having 75 fc (807 lx) scale with 10× multiplying disk or equivalent or a meter that responds specifically to the ultraviolet range of 365 nm. The latter type meters are calibrated in microwatts per square centimetre. The meter should be held a fixed distance of 15 in. (380 mm) from the light source (from black light filter surface to meter sensing

element) and should have a minimum meter reading of 525 $\mu W/cm^2$.

(*c*) The conversion factor from footcandles (for sight meters) to microwatts per square centimetre is 5.7 times the footcandle readings (at 15 in. (380 mm) distance).

(*d*) The maximum allowable footcandles will be left to the discretion of the user and is dependent on the degree of brilliance desired to obtain satisfactory inspection conditions. Before taking readings, it should be confirmed that the glass black light filters are clean. Reports of this test are to be shown in regular form.

(*e*) A regular form should be prepared embodying the information to be shown on monthly and weekly tests as outlined in paragraphs (*a*) through (*d*). This form should be on-hand at the wheel shop and available to customer's inspectors.

8.1.4 *Preparation for Testing*—The surface shall be scale-free before magnetic particle testing.

8.1.5 *Procedure for Detection of Discontinuities*—Perform the testing to detect discontinuities whose axes may be in any direction. Use continuous or residual magnetization with adequate coverage by the inspection medium.

8.1.6 *Time of Testing*—The magnetic particle testing shall be performed following final machining.

8.1.7 *Rejection*—Interpretation of magnetic particle discontinuity indications is based upon their location, size, direction, and shape. Experience with service performance and destructive testing shall be used for evaluation. Discontinuities may be removed by machining or grinding where sufficient stock remains. Such wheels shall be retested by magnetic particle inspection.

8.2 *Ultrasonic Testing*:

8.2.1 For detecting internal discontinuities in the rims of all steel wheels, ultrasonic inspection shall be made by following the procedures described in 8.2.4 through 8.2.6.4 and by using equipment described in 8.2.2.

8.2.2 *Equipment*:

8.2.2.1 *Pulse Echo Receiver*—The instrument shall have a pulse echo receiver and shall operate at frequencies of 2¼ to 5 MHz required for the test method and type of equipment being used.

8.2.2.2 *Transducers*—The transducers shall be of the type whose composition and dimensions are appropriate for the test method used.

8.2.2.3 *Automatic Flaw Alarm System* to be used in conjunction with the ultrasonic instrumentation.

8.2.2.4 *Couplant*—A suitable couplant shall be used between the test surface and the transducer.

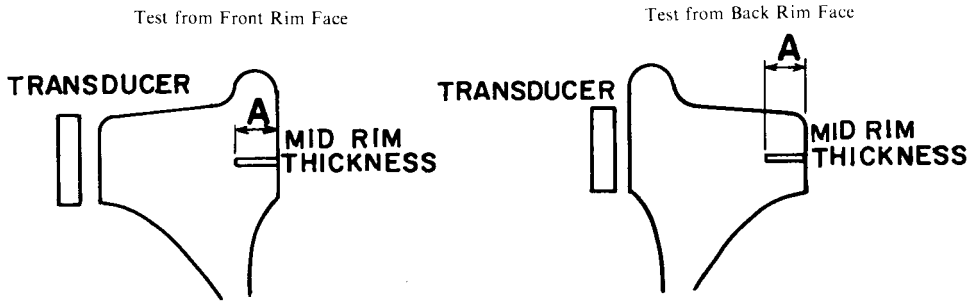
8.2.3 *Time of Inspection*—Inspection shall be performed after final thermal processing.

8.2.4 *Calibration*:

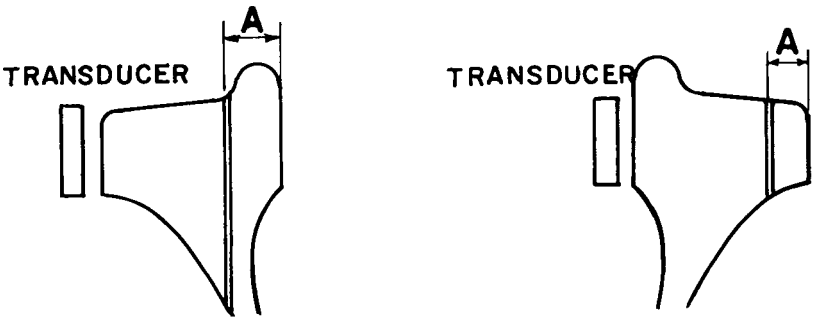
8.2.4.1 Conduct calibration using a reference standard of a wheel or portion of a wheel rim containing stimulated discontinuities. The instrument sensitivity level should be adjusted to produce an approximate one-half full-scale reflection from the reference standards of 8.2.4.2, 8.2.4.3, 8.2.4.4, and 8.2.4.5.

8.2.4.2 For axial testing the reference standard shall be a ⅛-in. (3.2-mm) diameter flat-bottom hole drilled perpendicular to the rim face and to a depth of 1 to 1½ in. (25.4 to 38.1 mm) at the mid-thicknesses of the rim (Fig. 1).

8.2.4.3 For radial testing the reference standard shall be a ⅛-in. (3.2-mm) diameter flat-bottom hole drilled from the



1(a) Reference Standard



1(b) Alternative Reference Standard

	in.	mm
A	1 1/2	38.1

FIG. 1 Typical Reference Standards for Rim Face Test

inside diameter of the rim essentially parallel to the rim face. It shall be a minimum of 1¼ in. (31.8 mm) from the tread surface (Fig. 2).

8.2.4.4 The side of a small diameter hole on the order of 1⁄16 to 1⁄8 in. (1.6 to 3.2 mm) in diameter may be used when it is drilled the same distance from the testing surface. The instrument shall be adjusted to give an equal test value to that of a 1⁄8-in. diameter flat-bottom hole. This practice is an alternative for the reference standards of 8.2.4.2 and 8.2.4.3 (Fig. 1 and Fig. 2).

8.2.4.5 For axial testing when determining loss of back reflection, the reference standard shall be a 3⁄8-in. (9.5-mm) diameter concave-bottom hole drilled to a depth of 1⁄8 in. (3.2 mm) at the front rim face and perpendicular to the back rim face (Fig. 3).

NOTE 1—Paragraphs 8.2.4.4 and 8.2.4.5 are applicable in certain cases when agreed to by the manufacturer and the purchaser.

8.2.4.6 Fabricate reference standards for the inspection of heat-treated and untreated wheels from heat-treated and untreated wheel steel, respectively. The reference standard need not be the same design as the wheels being inspected.

8.2.5 *Scanning*:

8.2.5.1 Inspect the wheels axially from either the front or the back rim face and radially from the tread surface.

8.2.5.2 Design and locate one or more transducers to give maximum coverage of the rim section, both radially and axially.

8.2.5.3 Use a scanning speed that will permit detection of reference standards.

8.2.6 *Rejection*:

8.2.6.1 Any wheel with a discontinuity indication equal to or larger than that from the reference discontinuity shall be cause for rejection.

8.2.6.2 Any indication from a discontinuity giving a loss of back reflection equal to or greater than the reference standard (covered in 8.2.4.5) during axial scanning may be cause for rejection (Note 1).

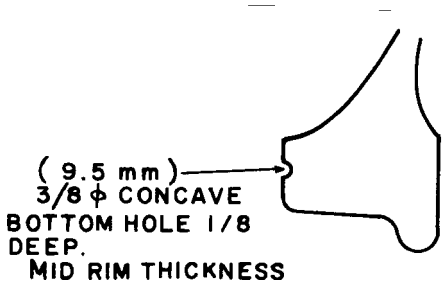


FIG. 3 Typical Reference Standard to Determine Loss of Back Reflection

8.2.6.3 Ultrasonic indications that result from wheel geometry or spurious electrical signals shall not be valid cause for rejection.

8.2.6.4 It should be recognized that detection of discontinuities near the test surface is limited by the ultrasonic test frequency.

8.2.6.5 When automated equipment is used the final disposition of rejectable wheels may be determined by manual testing of questioned areas.

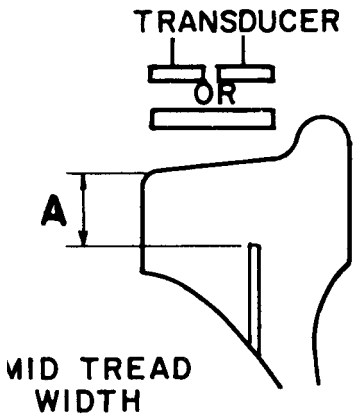
9. Rework and Retreatment

9.1 Any wheel failing to meet the hardness requirements of 7.1.1 may be retreated and tested in accordance with 7.1.2.

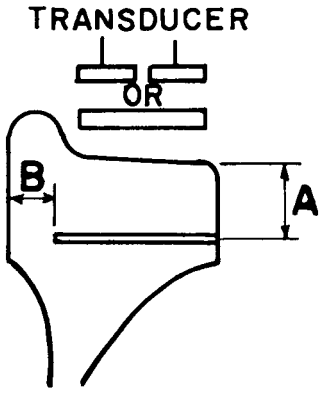
10. Permissible Variations in Dimensions

10.1 The wheels shall conform to the permissible dimension variations specified in Table 3. When the permissible dimension variations in Table 3 allow a certain percentage of the wheels to vary by a given amount from standard dimensions for type size, the percentage of such wheels shipped by any manufacturer shall not exceed this percentage during a calendar year. No individual purchaser may receive more than this percentage in daily shipments of such wheels except by agreement with the manufacturer.

10.2 *Mating Requirements*—Wheels shall be measured and marked to the lower tape number until the next graduation is



2 (*a*) Reference Standard



2 (*b*) Alternative Reference

	in.	mm
A	1 1/4 min	31.8 min
B	1–1 1/2	25.4–38.1

FIG. 2 Typical Reference Standards for Rim Tread Test

TABLE 3 Permissible Variations in Wheel Dimensions

	Narrow Flange Type		Wide Flange Type	
	in.	mm	in.	mm
Flange:				
Height of flange	+ 1/16 –0	+1.6–0	+ 1/16 –0	+1.6–0
Thickness of flange	+ 1/16 –0	+1.6–0	+ 1/32 – 3/32	+0.8–2.4
Radius of throat	± 1/16	±1.6	± 1/16	±1.6
Rim:				
Tape sizes, less than 44 in. (1117.6 mm)	+14–0[A]	+14–0[A]	+14–0[A] 5 %–5	+14–0[A] 5 %–5
Inside diameter (back face of rim) (×) maximum governed by rim thickness and tape size	(×)– 3/8	(×)–9.5	(×)– 3/8	(×)–9.5
Inside diameter (front face of rim) maximum variation from back face diameter	+0– 1/4	+0–6.5	± 1/4	±6.5
Thickness of rim (measured with AAR Steel wheel gage or equivalent)	[B]	[B]	[B]	[B]
Corner at inside diameter of back rim face, radius, max (sharp corner preferable)	1/8	3.2	1/8	3.2
Rotundity, opening in ring gage max	1/32	0.8	1/32	0.8
Width of rim	± 1/8	±3.2	± 1/8	±3.2
Plane of back face, distance from straight edge:				
Over entire rim face, max	. . .	. . .	1/16	1.6
Over rim face more than 1 1/4 in. (31.9 mm) from inside edge, max	1/32	0.8	. . .	. . .
Plate:				
Thickness of plate (may vary)	–0	–0	–0	–0
Hub:				
Diameter of hub	+1–0	+25.4–0	+1–0	+25.4–0
Wall thickness, max variations:				
Outer surface machined	1/8	3.2		
Not machined	3/8	9.5	3/8	9.5
Length of hub	± 1/8	±3.2	± 1/4	±6.4
Depress of hub:				
Back rim face to front hub face	+0– 1/8	+0–3.2	+0– 1/4	+0–6.4
Projection of hub (back rim face to back hub face)	± 1/8	±3.2	± 1/8	±3.2
Bore:				
Diameter of bore				
Rough bore (finished bore not specified)	+ 1/16 – 1/8	+1.6–3.2	+ 1/16 – 1/8	+1.6–3.2
Rough bore (1/4 in. (6.5 mm) less than finished bore)	+ 1/16 – 1/8	+1.6–3.2	+– 1/8	+1.6–3.2
Eccentricity of bore—between rough bore and tread, max	1/16 [C]	1.6[C]	1/16 [C]	1.6[C]

[A] Tape sizes are not in inches or millimetres.
[B] Not less than specified and in any one wheel shall not vary more than ⅛ in. (3.2 mm).
[C] 5 % of wheels delivered may be over 1/16 in. (1.6 mm) total dial indicator reading (TDIR), and these must not exceed 3/32 in. (2.4 mm) TDIR.

reached. Wheels shall be shipped in pairs of the same measured tape size.

10.3 The gages and tapes used shall be based on the standards of the Association of American Railroads.

11. Workmanship, Finish, and Appearance

11.1 Wheels shall be rough-bored and shall not have black spots in the rough bore. Front hub face of wheels (1-W, 2-W, MW) shall be parallel to the plane of the vertical reference line and may be as cast or machined. The back hub face may be as cast or machined.

11.2 The contour of tread and flange shall be as shown on drawings of the purchaser, and shall be as cast, machined, or ground to a smooth finish.

11.3 Wheels shall be given a thorough surface examination and gaging at the place of manufacture. They shall have a workmanlike finish and must be free of discontinuities liable to develop in or cause removal from service. No discontinuities shall be corrected by welding. Spot grinding or machining for the removal of surface discontinuities shall not exceed a depth of ⅛ in. (3.2 mm), nor shall it reduce any section below the minimum dimensional requirements. The depression produced by grinding shall be uniformly feathered into the surrounding contour. "As cast'' surfaces shall be free of abrupt changes in section or grooves and in a clean condition free of scale prior to final inspection. Where corrective machining or grinding has been employed such surfaces shall not exceed a roughness of 500 µin. (12.7 µm) prior to final shot peening, and a uniform transition from the machined or ground surface into the plane of the "as cast'' surface must be provided.

11.4 Wheels shall not be covered with any substance to such an extent as to hide defects.

11.5 All scale shall be removed from the entire wheel prior to final inspection.

12. Inspection

12.1 The manufacturer shall afford the purchaser's inspector all reasonable facilities necessary to satisfy that the material is being produced and furnished in accordance with this specification. Mill inspection by the purchaser shall not interfere unnecessarily with the manufacturer's operations. All tests and inspections shall be made at the place of manufacture, unless agreed to otherwise.

13. Rejection

13.1 Unless otherwise specified, any rejection based on tests

made in accordance with this specification shall be reported to the manufacturer within ten working days from the receipt of samples by the purchaser.

13.2 Material that shows discontinuities subsequent to its original inspection and acceptance at the manufacturer's works or elsewhere will be rejection and the manufacturer shall be notified.

14. Rehearing

14.1 Samples tested in accordance with this specification that represent rejected material shall be preserved for two weeks from the date of the test report. In case of dissatisfaction with the results of the tests, the manufacturer may request a rehearing within that time.

15. Certification and Report of Testing

15.1 Upon request by the purchaser in the contract or order, a manufacturer's certification that the material was manufactured and tested in accordance with this specification, together with a report of the test results, shall be furnished at the time of shipment. The specific year of issue and revision letter, if any, shall be included in the certification.

16. Marking

16.1 Identification markings shall be legibly marked as shown in Fig. 4, Fig. 5, or Fig. 6. Wheels for freight service must be hot- or cold-stamped on the back hub face. If any stamped characters are missing or illegible, these shall be replaced by cold stamping in the proper place in the marking sequence. Passenger car wheels may be hot- or cold-stamped on front or back (as specified by purchaser) hub face. When ordered, locomotive wheels may be hot- or cold-stamped on the back rim face or hot- or cold-stamped on the front hub face or hot- or cold-stamped on the back hub face provided finish machining will completely remove the markings on the back hub face. Locomotive wheels that are to receive final hub machining by the purchaser may be ordered with markings paint stenciled on the wheel plate. After final machining, the purchaser will cold stamp the markings on the front hub face. For wheels having raised cast-on markings, the markings shall be legible characters and as shown in Fig. 5.

16.2 The markings to designate the class (L, A, B, or C) and method of treatment shall be:

L	Class L, rim-treated
A	Class A, rim-treated
B	Class B, rim-treated
C	Class C, rim-treated

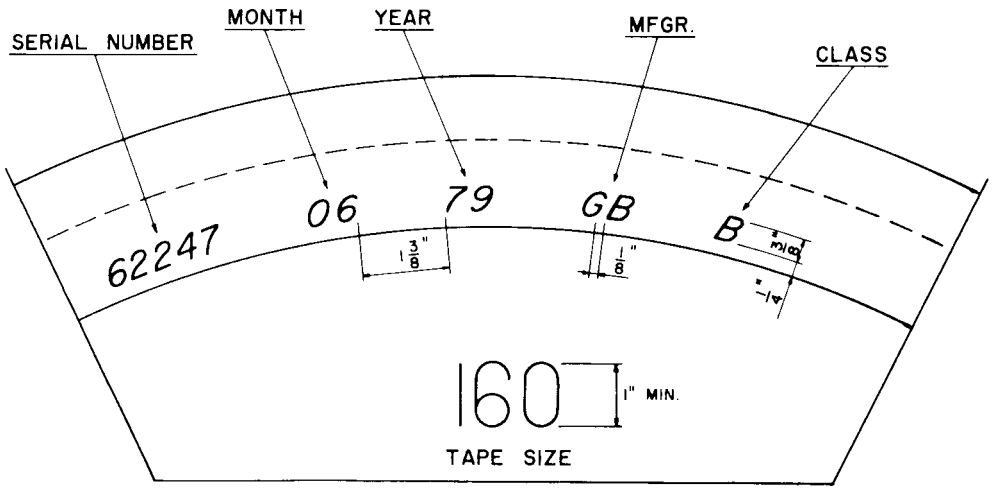
Class U (Untreated wheels) are not marked for class.

16.3 The tape size of all wheels shall be plainly paint-stenciled on back plates. An "H" shall be paint-stenciled on the front plate of curved plate, heat-treated interchange freight car wheels. The characters shall be at least one inch high. Stencil paint shall be zinc chromate primer or equivalent that will have a minimum service life of one year.

16.4 In addition to the above required markings, bar code tags may be applied to the wheels. If these tags are applied, it is recommended that Bar Code 39 be used. The size and location of the tags, as well as the information to be included, shall be agreed upon by the purchaser and the manufacturer.

17. Keywords

17.1 castings; rail applications; steel wheels



NOTE 1— Stamping shall consist of manufacturer's serial number, date of manufacture, manufacturer's identification, and class. Stamping is limited to 14 characters and the design designation shall be stenciled on the back plate with paint using characters at least 1 in. (25 mm) in height.

NOTE 2—Stamping shall be spaced a minimum of ⅛ in. (3.2 mm) between characters and 1¾ in. (35 mm) between groups. The stamping shall be located not less than ¼ in. (6.4 mm) from the inner edge of the rim.

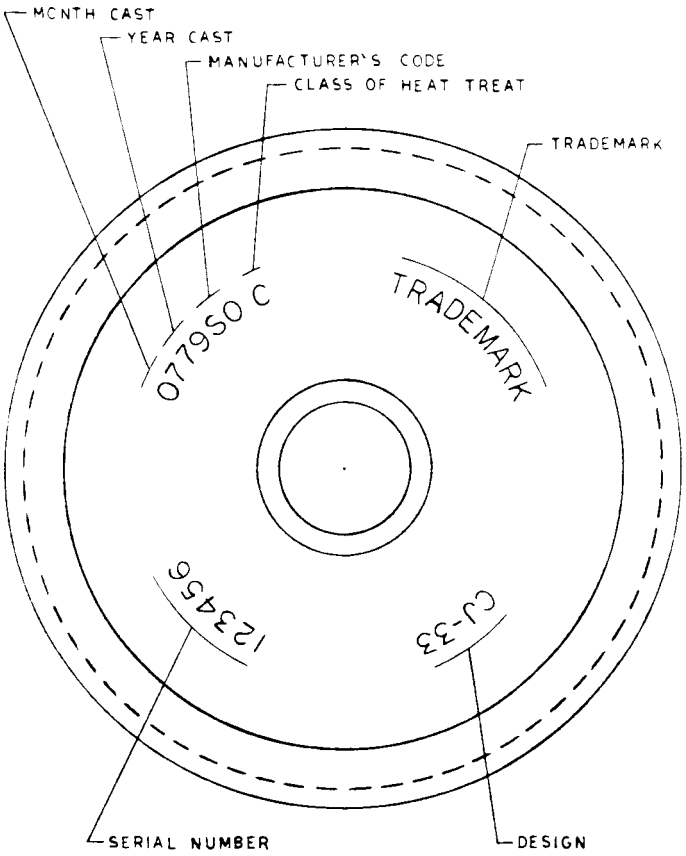
NOTE 3—Manufacturer identification is limited to two initials which are as follows: *GC-Chicago (1963 and earlier), GC-Columbus (1982 and later), *GL-Colton, GY-St. Hyacinthe, *GI-Kansas City, GT-Winnipeg, *GB-Bensenville, GS-Bessemer, GK-Keokuk, *FM-Fundiciones de Hierro Y Acero (Mexico).

* No longer in production.

NOTE 4—Dies used to produce characters shall be not less than ⅜ in. (9.6 mm) in nominal height at crest and hot stamping shall be nominally 3⁄64 in. (1.2 mm) in depth. Italicized characters (sloped upward to right) shall be used.

NOTE 5—All wheels will be marked for class using letters, U, L, A, B, or C, as appropriate.

FIG. 4 Marking of Cast Carbon Steel Locomotive Wheels, Rim Stamping



NOTE 1—Characters shall be cast on back plate of wheels to at least show design designation, manufacturer's serial number, date of manufacture, and manufacturer's identification and class.

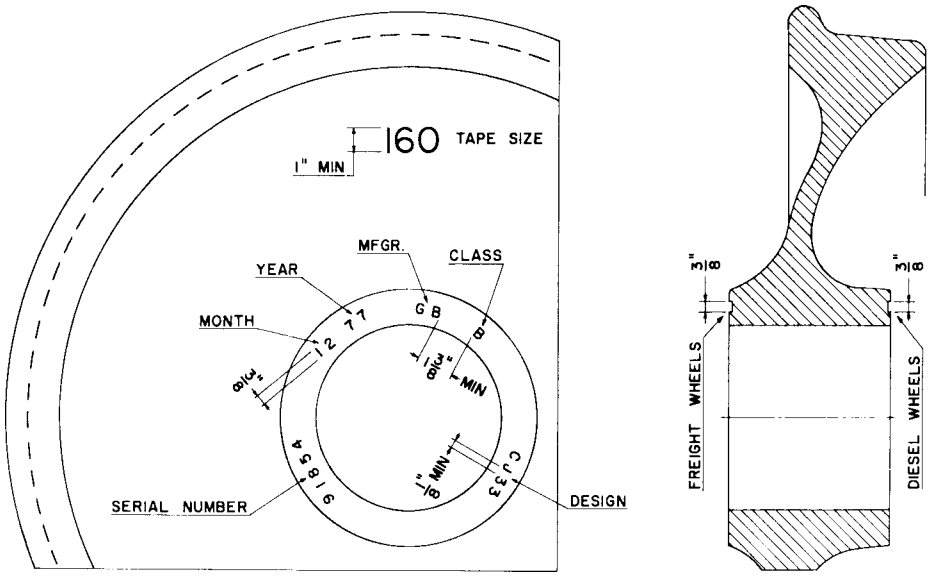
NOTE 2—Cast markings shall be legible characters at least 1 in. (25 mm) in height and so spaced to allow related characters to be readily distinguished as a group.

NOTE 3—Wheels manufactured by ABC Rail Corp. are identified as follows: SO—Calera, AL (previously "C'' accompanied by Southern®), and SJ—Johnstown, PA (no longer in production) cast on the back plate.

NOTE 4—All wheels will be marked for class using letters, U, L, A, B, or C, as appropriate.

NOTE 5—The three groups: (*1*) design, (*2*) serial number, and (*3*) date of manufacture, manufacturer, and class must be clearly separate.

FIG. 5 Raised Markings on Cast Carbon Steel Wheels



NOTE 1—When ordered, locomotive wheels may be stamped on the front or back (as specified by purchaser) hub face. Wheels for freight service are stamped on the back hub face. Wheels for passenger service are stamped on the front or back (as specified by purchaser) hub face.

NOTE 2—Stamping shall consist of manufacturer's serial number, date of manufacture, manufacturer's identification, class, and design designation. Stamping on locomotive wheels is limited to 14 characters and the design designation is stenciled on the back plate.

NOTE 3—Manufacturer identification is limited to two initials which are as follows: *GC-Chicago (1963 and earlier), GC-Columbus (1982 and later), *GL-Colton, GY-St. Hyacinthe, *GI-Kansas City, GT-Winnipeg, *GB-Bensenville, GS-Bessemer, GK-Keokuk, *FM-Fundiciones de Hierro Y Acero (Mexico).

* No longer in production.

NOTE 4—Stampings shall be spaced a minimum of ⅛in. (3.2 mm) between characters and 1⅜in. (35 mm) between groups and located approximately central to the hub face.

NOTE 5—All wheels will be marked for class using letters U, L, A, B, or C, as appropriate.

NOTE 6—The three groups: (*1*) design, (*2*) serial number, and (*3*) date of manufacture, manufacturer, and class will be spaced approximately equidistantly around the hub face.

FIG. 6 Marking of Cast Carbon Steel Wheels, Hub Stamping