Designation: B313/B313M – 09

Standard Specification for Aluminum and Aluminum-Alloy Round Welded Tubes[1]

This standard is issued under the fixed designation B313/B313M; 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 aluminum and aluminum-alloy tubes made from formed sheet and seam welded by continuous methods.

1.2 Alloy (Note 1) and temper designations are in accordance with ANSI H35.1/H35.1(M). The equivalent Unified Numbering System alloy designations are those of Table 1 preceded by A9, for example, A91100 for aluminum 1100 in accordance with Practice E527.

NOTE 1—Throughout this specification use of the term *alloy* in the general sense includes aluminum as well as aluminum alloy.

NOTE 2—For the requirements for sheet see Specification B209.

1.3 For acceptance criteria for inclusion of new aluminum and aluminum alloys in this specification, see A1.2.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.4.1 *SI Units*—The SI units are shown either in brackets or in separate tables.

1.5 *This standard does not purport to address all of the safety concerns, 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 The following documents of the issue in effect on the date of material purchase form a part of this specification to the extent referenced herein:

2.2 *ASTM Standards:*[2]

B209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate

B557 Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products

B557M Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products (Metric)

B660 Practices for Packaging/Packing of Aluminum and Magnesium Products

B666/B666M Practice for Identification Marking of Aluminum and Magnesium Products

B881 Terminology Relating to Aluminum- and Magnesium-Alloy Products

B918 Practice for Heat Treatment of Wrought Aluminum Alloys

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E34 Test Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys

E227 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique (Withdrawn 2002)[3]

E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

E607 Test Method for Atomic Emission Spectrometric Analysis Aluminum Alloys by the Point to Plane Technique Nitrogen Atmosphere (Withdrawn 2011)[3]

E716 Practices for Sampling and Sample Preparation of Aluminum and Aluminum Alloys for Determination of Chemical Composition by Spectrochemical Analysis

E1251 Test Method for Analysis of Aluminum and Aluminum Alloys by Spark Atomic Emission Spectrometry

2.3 *ANSI Standards:*

H35.1/H35.1(M) Alloy and Temper Designation Systems for Aluminum[4]

[1] This specification is under the jurisdiction of the ASTM Committee B07 on Light Metals and Alloys and is the direct responsibility of Subcommittee B07.03 on Aluminum Alloy Wrought Products.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from Aluminum Association, Inc., 1525 Wilson Blvd., Suite 600, Arlington, VA 22209, http://www.aluminum.org.

***A Summary of Changes section appears at the end of this standard**

TABLE 1 Chemical Composition Limits[A,B,C]

NOTE 1—In case of a discrepancy in the values listed in Table 1 with those listed in the "International Alloy Designations and Chemical Composition Limits for Wrought Aluminum and Wrought Aluminum Alloys" (known as the "Teal Sheets"), the composition limits registered with the Aluminum Association and published in the "Teal Sheets" should be considered the controlling composition. The "Teal Sheets" are available at http://www.aluminum.org/tealsheets.

Alloy	Silicon	Iron	Copper	Manganese	Magnesium	Chromium	Zinc	Tita-nium	Other Elements[D]		Aluminum
									Each	Total[E]	
1100	[F]	[F]	0.05–0.20	0.05	...	...	0.10	...	0.05	0.15	99.0 min[G]
3003	0.6	0.7	0.05–0.20	1.0–1.5	...	...	0.10	...	0.05	0.15	remainder
3004	0.30	0.7	0.25	1.0–1.5	0.8–1.3	...	0.25	...	0.05	0.15	remainder
Alclad 3004	3004 clad with alloy 7072			...	...	...	...	...	...	...	...
3005	0.6	0.7	0.30	1.0–1.5	0.20–0.6	0.10	0.25	0.10	0.05	0.15	remainder
5050	0.40	0.7	0.20	0.10	1.1–1.8	0.10	0.25	...	0.05	0.15	remainder
5052	0.25	0.40	0.10	0.10	2.2–2.8	0.15–0.35	0.10	...	0.05	0.15	remainder
5086	0.40	0.50	0.10	0.20–0.7	3.5–4.5	0.05–0.25	0.25	0.15	0.05	0.15	remainder
5154	0.25	0.40	0.10	0.10	3.1–3.9	0.15–0.35	0.20	0.20	0.05	0.15	remainder
6061	0.40–0.8	0.7	0.15–0.40	0.15	0.8–1.2	0.04–0.35	0.25	0.15	0.05	0.15	remainder
7072[H]	[I]	[I]	0.10	0.10	0.10	...	0.8–1.3	...	0.05	0.15	remainder

[A] Limits are in percent maximum unless shown as a range or stated otherwise.
[B] Analysis shall be made for the elements for which limits are shown in this table.
[C] For purposes of determining conformance to these limits, an observed value or a calculated value attained from analysis shall be rounded to the nearest unit in the last righthand place of figures used in expressing the specified limit, in accordance with the rounding method of Practice E29.
[D] *Others* includes listed elements for which no specific limit is shown as well as unlisted metallic elements. The producer may analyze samples for trace elements not specified in this specification. However, such analysis is not required and may not cover all metallic *Others* elements. Should any analysis by the producer or the purchaser establish that an *Others* element exceeds the limit of *Each* or that the aggregate of several *Others* elements exceeds the limit of *Total*, the material shall be considered nonconforming.
[E] *Other Elements—Total* shall be the sum of unspecified metallic elements 0.010 % or more, rounded to the second decimal before determining the sum.
[F] Iron plus silicon shall not exceed 0.95 %.
[G] The aluminum content shall be calculated by subtracting from 100.00 % the sum of all metallic elements present in amounts of 0.010 % or more each, rounded to the second decimal before determining the sum.
[H] Composition of cladding alloy as applied during the course of manufacture. Samples from finished tube shall not be required to conform to these limits.
[I] Iron plus silicon shall not exceed 0.7 %.

H35.2 Dimensional Tolerances for Aluminum Mill Products[4]
H35.2M Dimensional Tolerances for Aluminum Mill Products (Metric)[4]

2.4 *Military Standard:*
MIL-STD-129 Marking for Shipment and Storage[5]

2.5 *AMS Specification:*
AMS 2772 Heat Treatment of Aluminum Alloy Raw Materials[6]

2.6 *Federal Standard:*
Fed. Std. No. 123 Marking for Shipment (Civil Agencies)[5]

2.7 *Other Standards:*
EN 14242 Aluminum and Aluminum Alloys – Chemical Analysis – Inductively Coupled Plasma Optical Emission Spectral Analysis[7]

3. Terminology

3.1 *Definitions*—Definitions: Refer to Terminology B 881 for definitions of product terms used in this specification.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *capable of*—The term *capable of* as used in this specification means that the test need not be performed by the producer of the material. However, should testing by the purchaser establish that the material does not meet these requirements, the material shall be subject to rejection.

4. Ordering Information

4.1 Orders for material to this specification shall include the following information:

4.1.1 This specification designation (which includes the number, the year, and the revision letter, if applicable),

NOTE 3—For inch-pound orders specify Specification B313; for metric orders specify Specification B313M. Do not mix units.

4.1.2 Quantity in pieces or pounds, [kilograms]

4.1.3 Alloy (6.1),

4.1.4 Temper (Section 8),

4.1.5 Size (outside diameter, wall thickness, and length),

4.2 Additionally, orders for material to this specification shall include the following information when required by the purchaser:

4.2.1 Whether heat treatment in accordance with Practice B918 is required,

4.2.2 Special tension tests required other than tension tests performed on specimens taken from the sheet prior to welding (8.2),

4.2.3 Whether pressure or burst test is required and test description if methods 1, 2, or 3 of 9.1 are not suitable,

[5] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://dodssp.daps.dla.mil.
[6] Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, http://www.sae.org.
[7] Available from European Committee for Standardization (CEN), 36 rue de Stassart, B-1050, Brussels, Belgium, http://www.cenorm.be or http://www.cen.eu/esearch.

4.2.4 Whether inspection or witness of inspection and tests by the purchaser's representative is required prior to material shipment (Section 13),

4.2.5 Whether certification of the material is required (Section 17),

4.2.6 Whether marking for identification is required (15.1), and

4.2.7 Whether Practices B660 applies, if so, the levels of preservation, packaging, and, packing required (16.3).

5. Responsibility for Quality Assurance

5.1 *Responsibility for Inspection and Tests*—Unless otherwise specified in the contract or purchase order, the producer is responsible for the performance of all inspection and test requirements specified herein. Except as otherwise specified in the contract or order, the producer may use his own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless disapproved by the purchaser. The purchaser shall have the right to perform any of the inspections and tests set forth in this specification where such inspections are deemed necessary to assure that material conforms to prescribed requirements.

5.2 *Lot Definition*—An inspection lot shall be defined as follows:

5.2.1 For heat-treated tempers, an inspection lot shall consist of an identifiable quantity of material of the same mill form, alloy, temper, and nominal dimensions traceable to a heat-treat lot or lots and subjected to inspection at one time.

5.2.2 For nonheat-treated tempers, an inspection lot shall consist of an identifiable quantity of material of the same mill form, alloy, temper, and nominal dimensions subjected to inspection at one time.

6. Chemical Composition

6.1 The tubes shall conform to the chemical composition limits prescribed in Table 1. Conformance shall be determined by the producer by analyzing samples taken at the time the ingots are poured in accordance with E716 and analyzed in accordance with E607, E1251, E34 or EN 14242. At least one sample shall be taken for each group of ingots poured simultaneously from the same source of molten metal. If the producer has determined the chemical composition of the material during pouring of ingots, they shall not be required to sample and analyze the finished product.

NOTE 4—It is standard practice in the United States aluminum industry to determine conformance to the chemical composition limits prior to further processing of ingots into wrought products. Due to the continuous nature of the process, it is not practical to keep a specific ingot analysis identified with a specific quantity of finished material.

6.2 If it becomes necessary to analyze the finished or semifinished product for conformance to chemical composition limits, the method used to sample the finished or semifinished product for the determination of chemical composition shall be by agreement between the producer and the purchaser. Analysis shall be performed in accordance with E716, E607, E1251, E34 or EN 14242 (ICP method). The number of samples taken for determination of chemical composition shall be as follows:

6.2.1 When samples are taken from the finished or semifinished product, a sample shall be taken to represent each 4000 lb [2000 kg] or fraction thereof, of material in the lot, except that not more than one sample shall be required per piece.

6.3 Other methods of analysis or in the case of dispute may be by agreement between the producer and the purchaser.

NOTE 5—It is difficult to obtain a reliable analysis of each of the components of clad materials using material in its finished state. A reasonably accurate determination of the core composition can be made if the cladding is substantially removed prior to analysis. The cladding composition is more difficult to determine because of the relatively thin layer and because of diffusion of core elements to the cladding. The correctness of cladding alloy used can usually be verified by a combination of metallographic examination and spectrochemical analysis of the surface at several widely separated points.

7. Heat Treatment

7.1 Unless specified in 7.2, producer or supplier heat treatment for the applicable tempers in Table 2 [Table 3] shall be in accordance with AMS 2772.

7.2 When specified, heat treatment of applicable tempers in Table 2 [Table 3] shall be in accordance with Practice B918.

8. Tensile Properties

8.1 *Limits*—The temper of the tubes shall be that of the sheet from which the tubes are formed, and the sheet shall conform to the tensile property requirements prescribed in Table 2 [Table 3].

8.2 The following tension tests are capability tests and will be required only when so specified on the contract or purchase order.

8.2.1 Tubes shall be capable of compliance with the tensile and yield strength requirements prescribed in Table 2 [Table 3] when a full-section specimen tube is tested.

8.2.2 Longitudinal specimens cut from tubes 2 in. [50 mm] or greater in diameter and 90° from the weld shall be capable of meeting the requirements of Table 2 [Table 3].

8.2.3 Longitudinal specimens cut from the weld area of tubes shall be capable of meeting not less than 80 % of the tensile and yield requirements applicable to the parent material prescribed in Table 2 [Table 3].

8.3 *Number of Specimens*—One tension test specimen shall be taken from a random coil of sheet or tube representing each 2000 lb [1000 kg] of the same alloy, temper, and thickness in the shipment, or such other quantity as may be agreed upon by the producer and the purchaser.

8.4 *Test Specimens*—Geometry of test specimens and the location in the product from which they are taken shall be as specified in Test Methods B557, B557M.

8.5 *Test Methods*—The tension tests shall be made in accordance with Test Methods B557, B557M.

9. Pressure Tests

9.1 When specified by the purchaser at the time of placing the order, each tube shall be tested by one of the following methods at the option of the producer:

TABLE 2 Tensile Property Limits, Inch-Pound Units[A,B,C]

Temper	Specified Thickness, in.	Tensile Strength, ksi		Yield Strength (0.2 % offset), ksi		Elongation in 2 in., or 4× Diameter, min,%
		min	max	min	max	
			Aluminum 1100			
O	0.032–0.050	11.0	15.5	3.5	...	25
	0.051–0.125	11.0	15.5	3.5	...	30
H12	0.032–0.050	14.0	19.0	11.0	...	6
	0.051–0.113	14.0	19.0	11.0	...	8
	0.114–0.125	14.0	19.0	11.0	...	9
H14	0.032–0.050	16.0	21.0	14.0	...	4
	0.051–0.113	16.0	21.0	14.0	...	5
	0.114–0.125	16.0	21.0	14.0	...	6
H16	0.032–0.050	19.0	24.0	17.0	...	3
	0.051–0.125	19.0	24.0	17.0	...	4
H18	0.032–0.050	22.0	...	...	...	3
	0.051–0.125	22.0	...	...	...	4
			Alloy 3003			
O	0.032–0.050	14.0	19.0	5.0	...	23
	0.051–0.125	14.0	19.0	5.0	...	25
H12	0.032–0.050	17.0	23.0	12.0	...	5
	0.051–0.113	17.0	23.0	12.0	...	6
	0.114–0.125	17.0	23.0	12.0	...	7
H14	0.032–0.050	20.0	26.0	17.0	...	4
	0.051–0.113	20.0	26.0	17.0	...	5
	0.114–0.125	20.0	26.0	17.0	...	6
H16	0.032–0.050	24.0	30.0	21.0	...	3
	0.051–0.125	24.0	30.0	21.0	...	4
H18	0.032–0.050	27.0	...	24.0	...	3
	0.051–0.125	27.0	...	24.0	...	4
			Alloy 3004			
O	0.032–0.050	22.0	29.0	8.5	...	16
	0.051–0.125	22.0	29.0	8.5	...	18
H32	0.032–0.050	28.0	35.0	21.0	...	4
	0.051–0.113	28.0	35.0	21.0	...	5
	0.114–0.125	28.0	35.0	21.0	...	6
H34	0.032–0.050	32.0	38.0	25.0	...	3
	0.051–0.113	32.0	38.0	25.0	...	4
	0.114–0.125	32.0	38.0	25.0	...	5
H36	0.032–0.050	35.0	41.0	28.0	...	3
	0.051–0.125	35.0	41.0	28.0	...	4
H38	0.032–0.050	38.0	...	31.0	...	3
	0.051–0.125	38.0	...	31.0	...	4
			Alloy Alclad 3004			
O	0.032–0.050	21.0	28.0	8.0	...	18
	0.051–0.125	21.0	28.0	8.0	...	16
H32	0.032–0.050	27.0	34.0	20.0	...	4
	0.051–0.113	27.0	34.0	20.0	...	5
	0.114–0.125	27.0	34.0	20.0	...	6
H34	0.032–0.050	31.0	37.0	24.0	...	3
	0.051–0.113	31.0	37.0	24.0	...	4
	0.114–0.125	31.0	37.0	24.0	...	5
H36	0.032–0.050	34.0	40.0	27.0	...	3
	0.051–0.125	34.0	40.0	27.0	...	4
H38	0.032–0.050	37.0	...	...	...	3
	0.051–0.125	37.0	...	...	...	4
			Alloy 3005			
O	0.032–0.050	17.0	24.0	6.5	...	18
	0.051–0.125	17.0	24.0	6.5	...	20

TABLE 2 *Continued*

Temper	Specified Thickness, in.	Tensile Strength, ksi		Yield Strength (0.2 % offset), ksi		Elongation in 2 in., or 4× Diameter, min,%
		min	max	min	max	
H12	0.032–0.050	20.0	27.0	17.0	...	2
	0.051–0.113	20.0	27.0	17.0	...	3
	0.114–0.125	20.0	27.0	17.0	...	4
H14	0.032–0.050	24.0	31.0	21.0	...	2
	0.051–0.113	24.0	31.0	21.0	...	3
	0.114–0.125	24.0	31.0	21.0	...	4
H16	0.032–0.113	28.0	35.0	25.0	...	2
	0.114–0.125	28.0	35.0	25.0	...	3
H18	0.032–0.125	32.0	...	29.0	...	2
			Alloy 5050			
O	0.032–0.113	18.0	24.0	6.0	...	20
	0.113–0.125	18.0	24.0	6.0	...	22
H32	0.032–0.050	22.0	28.0	16.0	...	4
	0.051–0.125	22.0	28.0	16.0	...	6
H34	0.032–0.050	25.0	31.0	20.0	...	4
	0.051–0.125	25.0	31.0	20.0	...	5
H36	0.032–0.050	27.0	33.0	22.0	...	3
	0.051–0.125	27.0	33.0	22.0	...	4
H38	0.032–0.050	29.0	...	...	...	3
	0.051–0.125	29.0	...	...	...	4
			Alloy 5052			
O	0.032–0.050	25.0	31.0	9.5	...	18
	0.051–0.113	25.0	31.0	9.5	...	19
	0.114–0.125	25.0	31.0	9.5	...	20
H32	0.032–0.050	31.0	38.0	23.0	...	5
	0.051–0.113	31.0	38.0	23.0	...	7
	0.114–0.125	31.0	38.0	23.0	...	9
H34	0.032–0.050	34.0	41.0	26.0	...	4
	0.051–0.113	34.0	41.0	26.0	...	6
	0.114–0.125	34.0	41.0	26.0	...	7
H36	0.032–0.125	37.0	44.0	29.0	...	4
H38	0.032–0.125	39.0	...	32.0	...	4
			Alloy 5086			
O	0.032–0.050	35.0	44.0	14.0	...	15
	0.051–0.125	35.0	44.0	14.0	...	18
H32	0.032–0.050	40.0	47.0	28.0	...	6
	0.051–0.125	40.0	47.0	28.0	...	8
H34	0.032–0.050	44.0	51.0	34.0	...	5
	0.051–0.125	44.0	51.0	34.0	...	6
H36	0.032–0.050	47.0	54.0	38.0	...	4
	0.051–0.125	47.0	54.0	38.0	...	6
			Alloy 5154			
O	0.032–0.050	30.0	41.0	11.0	...	14
	0.051–0.113	30.0	41.0	11.0	...	16
	0.114–0.125	30.0	41.0	11.0	...	18
H32	0.032–0.050	36.0	43.0	26.0	...	5
	0.051–0.125	36.0	43.0	26.0	...	8
H34	0.032–0.050	39.0	46.0	29.0	...	4
	0.051–0.125	39.0	46.0	29.0	...	6
			Alloy 5154			
H36	0.032–0.050	42.0	49.0	32.0	...	3
	0.051–0.113	42.0	49.0	32.0	...	4
	0.114–0.125	42.0	49.0	32.0	...	5
H38	0.032–0.050	45.0	...	35.0	...	3
	0.051–0.113	45.0	...	35.0	...	4
	0.114–0.125	45.0	...	35.0	...	5

TABLE 2 *Continued*

Temper	Specified Thickness, in.	Tensile Strength, ksi		Yield Strength (0.2 % offset), ksi		Elongation in 2 in., or 4× Diameter, min,%
		min	max	min	max	
			Alloy 6061			
O	0.032–0.125	...	22.0	...	12.0	16
T4	0.032–0.125	30.0	...	16.0	...	16
T6	0.032–0.125	42.0	...	35.0	...	10

[A] Determination of tensile and yield strengths across the weld are not usually made on a routine basis. However, such determination, if made would show strength about 85 % of those of the parent material except for T6 temper of 6061 which would show 30.0 ksi ultimate tensile strength.
[B] To determine conformance with the values in this table each value for tensile and yield strength shall be rounded to the nearest 0.1 ksi and each value for elongation to the nearest 0.5 %, both in accordance with the rounding method of Practice E29.
[C] The basis for establishment of mechanical property limits is shown in Annex A1.

9.1.1 *Method 1*—Each tube shall withstand without evidence of leakage an internal air pressure of not less than 60 psig [400 kPa] while immersed in water or other suitable liquid.

9.1.2 *Method 2*—Each tube shall be tested pneumatically at not less than 90 psig [600 kPa] air pressure for not less than 15 s while one end is sealed without evidence of any loss of pressure as measured by a gage.

9.1.3 *Method 3*—Each tube shall withstand without evidence of leakage hydrostatic pressure of not less than 90 psig [600 kPa].

9.2 When specified in the order or contract, tubes will be subjected to other pressure or burst tests as agreed upon by the producer and the purchaser.

10. Cladding Thickness

10.1 For Alclad 3004, the aluminum or aluminum-alloy plates which are bonded to the alloy ingot or slab preparatory to rolling to the specified thickness of sheet shall be of the composition shown in Table 1 and shall each have a minimum thickness not less than 5 % of the total composite sheet thickness.

10.2 When the thickness of the cladding is to be determined on finished material, not less than three transverse samples approximately ¾ in. [20 mm] in length shall be mounted to expose a transverse cross section and polished for examination with a metallurgical microscope. Using a magnification of 100×, the maximum and minimum coating thickness shall be measured in each of five fields approximately 0.1 in. [2.5 mm] apart along both sides of the cross section. The average of the ten thickness measurements on each side is the average coating thickness, and shall be not less than 80 % of the thickness calculated from the above requirements.

11. Dimensional Tolerances

11.1 Variations from the specified dimensions shall not exceed the permissible variations prescribed in the following tables of ANSI H35.2 [H35.2M]

Table No.	Title
12.41	Diameter Tolerances – Round Tube
12.43	Wall Thickness Tolerances – Round and Square Tube
12.44	Length Tolerances
12.47	Squareness of Cut Ends

11.2 All tubes, except those in the annealed temper, shall not vary from straight by an amount greater than that prescribed in Table 12.45 of ANSI H35.2 [H35.2M]. Tubes in the annealed temper shall be reasonably straight and free from kinks and sharp bends.

12. General Quality

12.1 Unless otherwise agreed upon by the producer and the purchaser, tubes shall be supplied in the mill finish and shall be of uniform quality and temper, clean, sound, and free from injurious defects. Grinding to remove minor surface imperfections shall not be cause of rejection. Discoloration that is characteristic of proper solution heat treatment shall not be cause for rejection.

13. Source Inspection

13.1 If the purchaser desires that his representative inspect or witness the inspection and testing of the material prior to shipment, such agreement shall be made by the purchaser and producer as part of the purchase contract.

13.2 When such inspection or witness of inspection and testing is agreed upon, the producer shall afford the purchaser's representative all reasonable facilities to satisfy him that the material meets the requirements of this specification. Inspection and tests shall be conducted so there is no unnecessary interference with the producer's operations.

14. Retest and Rejection

14.1 If any material fails to conform to all of the applicable requirements of this specification, it shall be cause for rejection of the inspection lot.

14.2 When there is evidence that a failed specimen was not representative of the inspection lot and when no other sampling plan is provided or approved by the purchaser through the contract or purchase order, at least two additional specimens shall be selected to replace each test specimen that failed. All specimens so selected for retest shall meet the requirements of the specification or the lot shall be subject to rejection.

14.3 Material in which defects are discovered subsequent to inspection may be rejected.

14.4 If material is rejected by the purchaser, the producer or supplier is responsible only for replacement of material to the purchaser. As much as possible of the rejected material shall be returned to the producer or supplier.