



Designation: ~~E2251–11~~ E2251 – 14

Standard Specification for Liquid-in-Glass ASTM Thermometers with Low-Hazard Precision Liquids¹

This standard is issued under the fixed designation E2251; 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 The purpose of this standard is to specify liquid-in-glass ASTM thermometers using low hazard thermometric liquids defined in this standard.

1.2 This standard specifies liquid-in-glass thermometers graduated in degrees Celsius or degrees Fahrenheit that are frequently identified and used in methods under the jurisdiction of the various technical committees within ASTM. The current approved thermometers are listed in [Table 1](#).

1.3 The technical requirements for the thermometric liquids used in the thermometers in [Table 1](#) are specified in [Annex A1](#). Tests for conformity to the technical requirements are also found in [Annex A1](#).

NOTE 1—It has been found by experience that ASTM Thermometers, although developed in general for specific tests, may also be found suitable for other applications, thus precluding the need for new thermometer specifications differing in only minor features. However, it is suggested that technical committees contact E20.05 before choosing a currently designated thermometer for a new method to be sure the thermometer will be suitable for the intended application.

1.4 For full rationale, see [Appendix X1](#).

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 requirements prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*²

[E1 Specification for ASTM Liquid-in-Glass Thermometers](#)

[E77 Test Method for Inspection and Verification of Thermometers 1-14](#)

[E344 Terminology Relating to Thermometry and Hydrometry](#)

[E563 Practice for Preparation and Use of an Ice-Point Bath as a Reference Temperature](#)

3. Terminology

3.1 *Definitions*—The definitions given in Terminology [E344](#) apply.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *bulb length, n*—the distance from the bottom of the bulb to the junction of the bulb and the stem tubing.

3.2.2 *contraction chamber, n*—an enlargement of the capillary, located below the main scale or between the main scale and the auxiliary scale, that serves to reduce the scale length or to prevent contraction of all the liquid column into the bulb.

3.2.3 *diameter, n*—the largest outside dimension of the glass tubing as measured with a ring gage.

3.2.4 *expansion chamber, n*—an enlargement at the top of the capillary to provide protection against breakage caused by excessive gas pressure.

3.2.5 *faden thermometer, n*—a thermometer with a long, thin bulb used to determine emergent stem temperatures.

¹ This specification is under the jurisdiction of ASTM Committee [E20](#) on Temperature Measurement and is the direct responsibility of Subcommittee [E20.05](#) on Liquid-in-Glass Thermometers and Hydrometers.

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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.

3.2.6 *interval error, n*—the deviation of the nominal value of a temperature interval from its true value; either for the total range (total interval) or for a part of the range (partial interval).

3.2.7 *low-hazard liquid, n*—a liquid that is biodegradable, non-hazardous and considered non-toxic in thermometer quantities.

NOTE 2—It is the responsibility of the manufacturer to determine the suitability of a liquid for this standard. In marking the thermometer with the ASTM designation the manufacturer is confirming that the liquid in the thermometer is non-hazardous as defined by current OSHA (Occupational Safety and Health Administration) standards and non-toxic in thermometer quantities per current definitions of the United States Environmental Protection Agency.

3.2.8 *thermometric liquid, n*—the liquid in a liquid-in-glass thermometer that indicates the value of temperature.

3.2.9 *top of the thermometer, n*—the top of the finished instrument.

3.2.10 *total length, n*—~~the distance from the bottom of the bulb to the top of the finished thermometer, including any special finish at the top.~~ overall length of the finished instrument.

3.3 Other terms may be found in the Terminology sections of Specification E1 and Test Method E77.

4. Specifications

4.1 The individual thermometers shall conform to the detailed specifications given in Table 1, the general requirements specified in Sections 5 – 15, and Annex A1 and Annex A2.

NOTE 3—Thermometers manufactured to previous revisions of this standard shall retain the same ASTM status as those meeting current specifications.

NOTE 4—The encapsulation (jacketing) of the glass of liquid-in-glass thermometers with polyfluorinated hydrocarbons will change their performance and physical characteristics, including, but not limited to, response time, accuracy, and physical dimensions. Therefore, under no circumstances should an encapsulated or otherwise modified ASTM thermometer be used in performing tests that specify the use of an ASTM thermometer.

5. Type

5.1 Each thermometer in Table 1 shall be of the liquid-in-glass type filled with a low hazard thermometric liquid that meets the specifications in Annex A1. The gas filling above the liquid shall be nitrogen or other suitable inert gas. The filling gas shall be chosen to have very low solubility in the thermometric fluid.

6. Stem

6.1 *Stem*—The stem shall be made of suitable thermometer tubing and shall have a plain front and enamel back.

6.2 *Top Finish*—The top of all thermometers specified in Table 1 shall have a plain rounded finish, except the following, which shall have the top finish indicated below: Any special top finish shall be included in the total length of the thermometer.

6.2.1 *Special Finish*:

6.2.1.1 Any finish suitable for assembly in a standard 304.8-mm (12-in.) non-sparking metal armor with open face; in a cup case assembly; or in a flushing case assembly as defined in standards the thermometers are used in:

Thermometers S58C, S58F, S59C, S59F, S130C, S130F

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7. Bulb

7.1 The bulb shall be made of glass having a viscosity of at least $10^{14.6}$ poises at 490°C (914°F) and at least $10^{13.4}$ poises at 520°C (968°F).

NOTE 5—Thermometers made with bulb glasses having properties close to these minimum requirements should not be subjected to temperatures above 405°C (760°F) or be continuously exposed to temperatures above 370°C (700°F).

8. Capillary Clearances

8.1 The following distances between graduations and the bulb, and between graduations and enlargements in the capillary, are minimum limits acceptable for thermometers in this standard.

NOTE 6—In order for a thermometer to be usable over its entire graduated range, graduation marks must not be placed too close to any enlargement in the capillary. Insufficient immersion of the thermometric liquid in the main bulb or capillary enlargement, graduation marks placed over parts of the capillary that have been changed by manufacturing operations, or graduations so close to the top of the thermometer that excessive gas pressure results when the thermometric liquid is raised to this level, may lead to appreciable errors.

8.1.1 A 13-mm length of unchanged capillary between the bulb and the immersion line or lowest graduation, if the graduation is not above 100°C (212°F); a 30-mm length if the graduation is above 100°C (212°F).

8.1.2 A 5-mm length of unchanged capillary between an enlargement and the graduation next below, except at the top of the thermometer.

8.1.3 A 10-mm length of unchanged capillary between an enlargement, other than the bulb, and the immersion line or the graduation next above, if the graduation is not above 100°C (212°F); a 30-mm length if the graduation is above 100°C (212°F).

8.1.4 A 10-mm length of unchanged capillary above the highest graduation, if there is an expansion chamber at the top of the thermometer; a 30-mm length if there is no expansion chamber. For the purposes of this requirement, “an expansion chamber” is interpreted as an enlargement at the top end of the capillary bore that shall have a capacity equivalent to not less than 20 mm of unchanged capillary.

8.2 Due to a change in the methods used for scale placement, it is possible to manufacture thermometers that comply with the specifications given in **Table 1**, but not meet the requirements for capillary clearances given above. In any case, the distances given in this section are the governing factor. Under no circumstances shall the scales on thermometers be placed closer than these minimum distances.

9. Graduations and Inscriptions

9.1 All graduation lines, figures, and letters shall be clearly defined, suitably colored, and permanent. The width and the sharpness of the graduation lines shall be designed in accordance with necessary space between the graduations and the desired accuracy of interpolation. The middle of the graduation line shall be accurately determinable.

9.1.1 A suitably etched thermometer with the etched lines and figures filled with a suitable colorant shall be considered permanently marked provided it passes the test for permanency of pigment in ~~Test Method Specification~~ **E77E1**.

9.2 *Graduation Lines*—All graduation lines shall be straight, of uniform width, and perpendicular to the axis of the thermometer. The width of the graduation lines shall be as follows:

9.2.1 *Group 1*—Maximum line width 0.10 mm; for thermometers that may read to fractions of a division, often with magnifying aids:

Thermometers S56C, S56F, S62C, S62F, S63C, S63F, S64C, S64F,
S65C, S65F, S66C, S66F, S67C, S67F, S91C, S116C, S117C,
S120C

9.2.2 *Group 2*—Maximum line width 0.15 mm; for thermometers that may be read to the nearest half division or where the congestion of scale dictates the use of a scale to moderate fineness:

Thermometers S5C, S5F, S12C, S12F, S15C, S15F, S18C, S18F,
S22C, S22F

9.2.3 *Group 3*—Maximum line width 0.20 mm; for thermometers with more open scales, usually read to the nearest division, often times under adverse conditions where a bold graduation is therefore desired:

Thermometers S58C, S58F, S59C, S59F, S130C, S130F

9.3 *Immersion Line*—On partial immersion thermometers an immersion line shall be permanently marked on the front of the thermometer at the distance above the bottom of the bulb as specified in **Table 1** within a tolerance of ± 0.5 mm. The immersion inscription shall be written in capital letters and abbreviated (for example, 76 mm immersion shall be written 76 MM IMM.)

9.4 *Terminal Numbers*—The terminal number shall be in full when there are one or more numbered graduations between it and the next full number. This rule need not necessarily be followed for:

9.4.1 *Precision Thermometers:*

S65F, S66F, S67C, and S67F

9.5 *Scale Below Zero*—When a scale extends both above and below 0°C or 0°F, the two parts of the scale shall be differentiated by some means. Examples of suitable means are:

9.5.1 Different colorants for the graduations for the two parts of the scale,

9.5.2 Different style of numerical characters for the two parts of the scale, and

9.5.3 Use of minus signs before appropriate numbers below 0°C or 0°F.

10. Special Inscription

10.1 The special inscription specified in **Table 1** shall be marked on the thermometer in capital letters and Arabic numbers without the use of periods. Include year of current revision in the ASTM designation (for example ASTM S56C-03).

10.1.1 Each thermometer shall be permanently marked with a unique serial number and the manufacturer's tradename or mark.

10.1.2 Each thermometer shall have the average coefficient of thermal expansion of the liquid permanently marked.

10.1.3 When the length of the thermometer permits, the words "TOTAL IMMERSION" may also be inscribed on the back of thermometers calibrated for total immersion.

11. Permanency of Pigment

11.1 The test for permanency of pigment shall be performed on any convenient portion of the scale section of the thermometer. The pigment shall not chalk, burn out, or loosen as a result of this test (see ~~Test Method Specification~~ **E77E1**).

12. Bulb Stability

12.1 No test for bulb stability is necessary for any thermometers currently in this standard. However, should there be in the future, the bulb stability test as found in Specification **E1** shall be used.

13. Scale Error

13.1 Thermometers shall be verified and calibrated at the temperatures specified in **Table 4**. Partial immersion thermometers shall be calibrated for the emergent stem temperatures specified in **Table 4** using faden thermometers.

13.1.1 At the time of purchase, the scale errors must be within the maximum scale error found in **Table 1**. The indications of many high temperature and fractionally graduated thermometers may change with time and continued use, due to minute changes in bulb volume. Periodic verification of these thermometers either over the entire scale or reverification at the reference temperature (ice point or steam point), in accordance with procedures set forth in Test Method **E77**, is recommended.

13.2 Due to the application requirements for range and construction of the following thermometer(s) do not have reference points such as ice and steam points:

S91C

14. Case and Instructions

14.1 Each thermometer shall be supplied in a suitable case on which shall appear the following marking (except when a transparent case is used): the letters “ASTM,” the thermometer number (S59C, S59F, etc.), and the temperature range.

14.2 Each thermometer shall be supplied with suitable user instructions. See **Appendix X2** for Sample User Instructions.

15. Methods of Verification and Calibration

15.1 Thermometers shall be verified and calibrated at the specified immersion in accordance with Test Method **E77**. For partial immersion thermometers careful consideration to emergent stem temperatures shall be observed.

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TABLE 1 Specification for E2251 ASTM Thermometers

All dimensions are in millimeters.
See Table 4 for Verification and Calibration Temperatures.

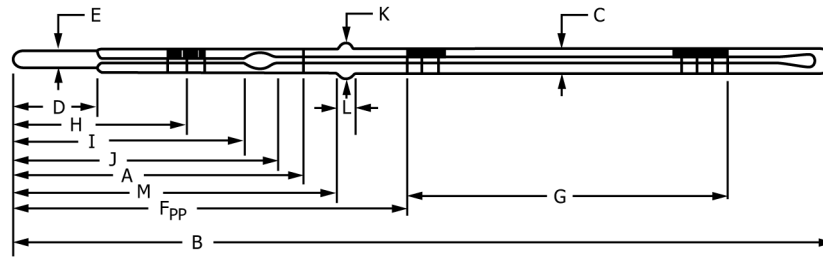


FIG A. General Reference Figure for Table 1
(Specific figures associated with individual thermometers are found at the end of Table 4)

Explanatory Notes for Table 1 (numbers correspond to those found in Table 1 of Specification E1 whenever possible):

^A An expansion chamber is provided for relief of gas pressure to avoid distortion of the bulb at higher temperatures. It is not for the purpose of joining thermometric liquid separations and under no circumstances should the thermometer be heated above the highest temperature reading.

^G The test temperatures shall be indicated by an arrow whether the graduation corresponding to that point is numbered or not.

^M For kinematic viscosity thermometers, the ice-point reading shall be taken within 1 h after being at the test temperature for not less than 3 min. The ice-point reading shall be expressed to the nearest 0.01°C or 0.02°F and applied as explained in Test Method E77, Section 13.

^O Capillary clearances must conform to Section 8.

^Y Over any interval of 2°C the change in calibration correction shall not exceed 0.02°C.

^Z Over any interval of 4°F the change in calibration correction shall not exceed 0.05°F.

^{AA} Special finish, see 6.2.1.

^{BB} The bulb diameter shall not be more than 0.5 mm greater than the stem.

^{FF} For Fahrenheit thermometers, dimension G (length of graduated portion) shall be measured as the length of graduated portion corresponding to the nominal Celsius range.

^{OO} Bulb length as necessary for the thermometric liquid and meeting capillary clearances found in Section 8.

^{PP} Distance "F" may be to top temperature for thermometers. See individual thermometer reference figure numbers.

^{RR} Contraction chamber necessary for the thermometric liquid and conforming to capillary clearances found in Section 8.

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TABLE 1 Continued

ASTM No.	S5C-11	S5F-11 ^{FF}	S12C-03	S12F-03 ^{FF}	S15C-11	S15F-11 ^{FF}	S18C-11	S18F-11 ^{FF}	S22C-11	S22F-11 ^{FF}
IP No.										
Name	Cloud and Pour		Density-Wide Range		Low Softening Point		Reid Vapor Point		Oxidation Stability	
Reference Fig. No.	5		2		2		6		6	
Range	-38 to 50°C	-36 to 120°F	-20 to 102°C	-5 to 215°F	-2 to +80°C	30 to +180°F	34 to +42°C 37.8°C ^G	94 to +108°F 100°F ^G	95 to 103°C 98.9 and 100°C ^G	204 to 218°F 210°F ^G
For test at										
A Immersion, mm	108		TOTAL		TOTAL		TOTAL		TOTAL	
Graduations:										
Subdivisions	1°C	2°F	0.2°C	0.5°F	0.2°C	0.5°F	0.1°C	0.2°F	0.1°C	0.2°F
Long lines at each	5°C	10°F	1°C	1°F	1°C	1°F	0.5°C	1°F	0.5°C	1°F
Numbers at each	10°C	20°F	2°C	5°F	2°C	5°F	1°C	2°F	1°C	2°F
Scale error, max	0.5°C	1°F	0.15°C	0.25°F	0.2°C	0.4°F	0.1°C	0.2°F	0.1°C	0.2°F
Special inscription	ASTM S5C-11 or S5F-11 108 MM IMM		ASTM S12C-03 or S12F-03		ASTM S15C-11 or S15F-11		ASTM S18C-11 or S18F-11		ASTM S22C-11 or S22F-11	
Expansion chamber:										
Permit heating to	70°C ^A	158°F ^A	130°C ^A	266°F ^A	100°C ^A	212°F ^A	70°C ^A	158°F ^A	125°C ^A	257°F ^A
B Total length, mm	254 to 264		435 to 445		395 to 400		295 to 305		295 to 305	
C Stem OD, mm	6.0 to 7.0		6.0 to 8.0		6.0 to 7.0		6.0 to 7.0		6.0 to 7.0	
D Bulb length, mm	∞		∞		∞		∞		∞	
E Bulb OD, mm	bulb size [ngt]stem size		not > stem		bulb size [ngt]stem size		bulb size [ngt]stem size		bulb size [ngt]stem size	
Scale location:										
Bottom of bulb to line at	50°C	120°F	102°C	215°F	80°C	180°F	42°C	108°F	103°C	218°F
F Distance, mm	195 to 205		370 to 385		328 to 343		210 to 222		210 to 222	
G Length of graduated portion, mm	65 to 85 ^O		305 to 350 ^O		245 to 276 ^O		60 to 90 ^O		60 to 90 ^O	
Ice-point scale:										
Range										
H Bottom of bulb to ice-point, mm										
Contraction chamber:							RR		RR	
I Distance to bottom, min, mm							RR		RR	
J Distance to top, max, mm										
Stem enlargement:										
K OD, mm							8 to 9		8 to 9	
L Length, mm							4 to 7		4 to 7	
M Distance to bottom, mm							112 to 116		112 to 116	

^A An expansion chamber is provided for relief of gas pressure to avoid distortion of the bulb at higher temperatures. It is not for the purpose of joining thermometric liquid separations and under no circumstances should the thermometer be heated above the highest temperature reading.

^G The test temperatures shall be indicated by an arrow whether the graduation corresponding to that point is numbered or not.

^O Capillary clearances shall conform to Section 8.

^{FF} For Fahrenheit thermometers, dimension G (length of graduated portion) shall be measured as the length of graduated portion corresponding to the nominal Celsius range.

[∞] Bulb length as necessary for the thermometric liquid and meeting capillary clearances found in Section 8.

^{RR} Contraction chamber necessary for the thermometric liquid and conforming to capillary clearances found in Section 8.

TABLE 1 Continued

ASTM No.	S56C-03	S56F-03 ^{FF}	S58C-11	S58F-11 ^{FF}	S59C-03	S59F-03 ^{FF}	S62C-03	S62F-03 ^{FF}	S63C-03	S63F-03 ^{FF}
IP No.	Bomb Calorimeter		Tank		Tank		Precision		Precision	
Name	4		2 ^{AA}		2 ^{AA}		2		2	
Reference Fig. No.	4		2 ^{AA}		2 ^{AA}		2		2	
Range	19 to 35°C	66 to 95°F	-34 to +49°C	-30 to +120°F	-18 to 82°C	0 to 180°F	-38 to +2°C	-36 to 35°F	-8 to 32°C	18 to 89°F
For test at	TOTAL		TOTAL		TOTAL		TOTAL		TOTAL	
A Immersion, mm	TOTAL		TOTAL		TOTAL		TOTAL		TOTAL	
Graduations:										
Subdivisions	0.02°C	0.05°F	0.5°C	1°F	0.5°C	1°F	0.1°C	0.2°F	0.1°C	0.2°F
Long lines at each	0.1°C	0.1 and 0.5°F	1°C	5°F	1°C	5°F	0.5°C	1°F	0.5°C	1°F
Numbers at each	0.2°C	1°F	5°C	10°F	5°C	10°F	1°C	2°F	1°C	2°F
Scale error, max	0.10°C ^Y	0.20°F ^Z	0.3°C	0.5°F	0.3°C	0.5°F	0.1°C	0.2°F	0.1°C	0.2°F
Special inscription	ASTM		ASTM		ASTM		ASTM		ASTM	
	S56C-03 or S56F-03		S58C-11 or S58F-11		S59C-03 or S59F-03		S62C-03 or S62F-03		S63C-03 or S63F-03	
Expansion chamber:										
Permit heating to	45°C ^A	113°F ^A	100°C ^A	212°F ^A	100°C ^A	212°F ^A	55°C ^A	131°F ^A	55°C ^A	131°F ^A
B Total length, mm	610 to 622		300 to 305		300 to 305		401 to 411		401 to 411	
C Stem OD, mm	7.0 to 8.0		6.0 to 7.0		6.0 to 7.0		7.0 to 8.0		7.0 to 8.0	
D Bulb length, mm	∞		∞		∞		∞		∞	
E Bulb OD, mm	BB		bulb size [ngt]stem size		not > stem		not > stem		not > stem	
Scale location:										
Bottom of bulb to line at	35°C	95°F	49°C	120°F	82°C	180°F	0°C	32°F	32°C	89°F
F Distance, mm	510 to 550		245 to 260		245 to 260		306 to 324		319 to 344	
G Length of graduated portion, mm	323 to 385 ^O		155 to 185 ^O		165 to 195 ^O		239 to 283 ^O		239 to 289 ^O	
Ice-point scale:										
Range										
H Bottom of bulb to ice-point, mm										
Contraction chamber:										
I Distance to bottom, min, mm	O									
J Distance to top, max, mm	110									
Stem enlargement:										
K OD, mm										
L Length, mm										
M Distance to bottom, mm										

^A An expansion chamber is provided for relief of gas pressure to avoid distortion of the bulb at higher temperatures. It is not for the purpose of joining thermometric liquid separations and under no circumstances should the thermometer be heated above the highest temperature reading.

^O Capillary clearances shall conform to Section 8.

^Y Over any interval of 2°C the change in calibration correction shall not exceed 0.02°C.

^Z Over any interval of 4°F the change in calibration correction shall not exceed 0.05°F.

^{AA} Special finish, see 6.2.1.

^{BB} The bulb diameter shall not be more than 0.5 mm greater than the stem.

^{FF} For Fahrenheit thermometers, dimension G (length of graduated portion) shall be measured as the length of graduated portion corresponding to the nominal Celsius range.

^{OO} Bulb length as necessary for the thermometric liquid and meeting capillary clearances found in Section 8.

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TABLE 1 Continued

ASTM No.	S64C-03	S64F-03 ^{FF}	S65C-03	S65F-03 ^{FF}	S66C-03	S66F-03 ^{FF}	S67C-03	S67F-03 ^{FF}
IP No.								
Name	Precision		Precision		Precision		Precision	
Reference Fig. No.	1		1		1		1	
Range	25 to 55°C	77 to 131°F	50 to 80°C	122 to 176°F	75 to 105°C	167 to 221°F	95 to 155°C	203 to 311°F
For test at								
A	TOTAL		TOTAL		TOTAL		TOTAL	
Immersion, mm								
Graduations:								
Subdivisions	0.1°C	0.2°F	0.1°C	0.2°F	0.1°C	0.2°F	0.2°C	0.5°F
Long lines at each	0.5°C	1°F	0.5°C	1°F	0.5°C	1°F	1°C	1°F
Numbers at each	1°C	2°F	1°C	2°F	1°C	2°F	2°C	5°F
Scale error, max	0.1°C	0.2°F	0.1°C	0.2°F	0.1°C	0.2°F	0.2°C	0.5°F
Special inscription	ASTM		ASTM		ASTM		ASTM	
	S64C-03 or S64F-03		S65C-03 or S65F-03		S66C-03 or S66F-03		S67C-03 or S67F-03	
Expansion chamber:								
Permit heating to	75°C ^A	167°F ^A	100°C ^A	212°F ^A	125°C ^A	257°F ^A	180°C ^A	355°F ^A
B	401 to 411		401 to 411		401 to 411		401 to 411	
C	7.0 to 8.0		7.0 to 8.0		7.0 to 8.0		7.0 to 8.0	
D	∞		∞		∞		∞	
E	not > stem		Not > stem		not > stem		not > stem	
Scale location:								
Bottom of bulb to line at	25°C	77°F	50°C	122°F	75°C	167°F	95°C	203°F
F	115 to 135		115 to 135		115 to 135		115 to 135	
G	189 to 229 ^O		189 to 229 ^O		189 to 229 ^O		189 to 229 ^O	
portion, mm								
Ice-point scale:								
Range	-0.5 to 0.5°C ^O	31 to 33°F ^O	-0.5 to 0.5°C ^O	31 to 33°F ^O	-0.5 to 0.5°C ^O	31 to 33°F ^O	-1 to +1°C ^O	30 to 34°F ^O
H	Bottom of bulb to ice-point, mm							
I	Contraction chamber:							
	Distance to bottom, min, mm		o		o		o	
J	Distance to top, max, mm		102		102		87	
K	Stem enlargement:							
L	OD, mm							
M	Length, mm							
	Distance to bottom, mm							

^A An expansion chamber is provided for relief of gas pressure to avoid distortion of the bulb at higher temperatures. It is not for the purpose of joining thermometric liquid separations and under no circumstances should the thermometer be heated above the highest temperature reading.

^O Capillary clearances shall conform to Section 8.

^{FF} For Fahrenheit thermometers, dimension G (length of graduated portion) shall be measured as the length of graduated portion corresponding to the nominal Celsius range.

^{OO} Bulb length as necessary for the thermometric liquid and meeting capillary clearances found in Section 8.

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ASTM E2251-14

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TABLE 1 Continued

ASTM No.	S91C-03	S116C-03	S117C-03	S120C-03	S130C-10	S130F-10 ^{FF}
IP No.						
Name	Solidification Point	Bomb Calorimeter	Bomb Calorimeter	Kinematic Viscosity ^M		Tank
Reference Fig. No.	3	4 and 5	4 and 5	1		2 ^{AA}
Range	20 to 50°C	18.9 to 25.1°C	23.9 to 30.1°C	38.6 to 41.4°C	-7 to +105°C	20 to +220°F
For test at				40°C		
A	Immersion, mm	76 MM	TOTAL	TOTAL	TOTAL	TOTAL
	Graduations:					
	Subdivisions	0.1°C	0.01°C	0.01°C	0.05°C	0.5°C
	Long lines at each	0.5°C	0.05°C	0.05°C	0.1 and 0.5°C	1°C
	Numbers at each	1°C	0.1°C	0.1°C	1°C	5°C
	Scale error, max	0.1°C	0.1°C ^{JJ}	0.1°C ^{JJ}	0.1°C	0.5°C
	Special inscription	ASTM	ASTM	ASTM	ASTM	ASTM
		S91C-03	S116C-03	S117C-03	S120-03	S130C-10 or S130F-10
		76 MM IMM				
	Expansion chamber:					
	Permit heating to	70°C ^A	35°C ^A	40°C ^A	60°C ^A	125°C ^A
B	Total length, mm	390 to 400	615 to 625	615 to 625	300 to 310	300 to 305
C	Stem OD, mm	6.0 to 7.0	7.0 to 8.2 ^{KK}	7.0 to 8.2 ^{KK}	6.0 to 8.0	6.0 to 7.0
D	Bulb length, mm	OO	OO, KK	OO, KK	OO	OO
E	Bulb OD, mm	not < 5.0 and not > stem	BB	BB	not > stem	bulb size [ngt]stem size
	Scale location:					
	Bottom of bulb to line at	50°C	19°C	24°C	38.6°C	105°C
F	Distance, mm	315 to 335	220 to 240	220 to 240	140 to 210	245 to 260
G	Length of graduated portion, mm	185 to 219 ^O	300 to 350 ^O	300 to 350 ^O	40 to 90 ^O	162 to 197 ^O
	Ice-point scale:					
	Range				-0.3 to +0.3°C ^O	
H	Bottom of bulb to ice-point, mm					
	Contraction chamber:					
I	Distance to bottom, min, mm	o	o	o	100	
J	Distance to top, max, mm	63	110	110	130	
	Stem enlargement:					
K	OD, mm					
L	Length, mm					
M	Distance to bottom, mm					

^A An expansion chamber is provided for relief of gas pressure to avoid distortion of the bulb at higher temperatures. It is not for the purpose of joining thermometric liquid separations and under no circumstances should the thermometer be heated above the highest temperature reading.

^M For kinematic viscosity thermometers, the ice-point reading shall be taken within 1 h after being at the test temperature for not less than 3 min. The ice-point reading shall be expressed to the nearest 0.01°C or 0.02°F and applied as explained in Test Method E77, Section 13.

^O Capillary clearances shall conform to Section 8.

^{AA} Special finish, see 6.2.1.

^{BB} The bulb diameter shall not be more than 0.5 mm greater than the stem.

^{FF} For Fahrenheit thermometers, dimension G (length of graduated portion) shall be measured as the length of graduated portion corresponding to the nominal Celsius range.

^{JJ} Over any interval of 1°C the change in correction shall not exceed 0.01°C.

^{KK} The capillary bore shall be large enough in relation to the bulb to ensure that (without tapping) jumping of the meniscus does not exceed one-half of the smallest scale division, when the temperature is rising at a uniform rate not exceeding 0.05°C/min.

^{OO} Bulb length as necessary for the thermometric liquid and meeting capillary clearances found in Section 8.

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TABLE 2 E2251 ASTM Thermometers Listed Alphabetically According to Application

NOTE 1—The specifications appear in numeric sequence in this standard.

Thermometer Name	Thermometer No.		Thermometer Name	Thermometer No.	
	°C	°F		°C	°F
Bomb calorimeter	S56C	S56F	Precision	S63C	S63F
Bomb calorimeter	S116C		Precision	S64C	S64F
Bomb calorimeter	S117C		Precision	S65C	S65F
Cloud and Pour	S5C	S5F	Precision	S67C	S67F
Density-Wide Range	S12C	S12F	Reid Vapor Pressure	S18C	S18F
Kinematic Viscosity	S120C	...	Solidification point	S91C	...
Low Softening Point	S15C	S15F	Tank	S58C	S58F
Oxidation Stability	S22C	S22F	Tank	S59C	S59F
Precision	S62C	S62F	Tank	S130C	S130F

TABLE 3 List of ASTM Low-Hazard Thermometers by Temperature Range

Celsius Range	Immersion, mm	Scale Error, max	ASTM Thermometer Number	Fahrenheit Range	Immersion, mm	Scale Error, max	ASTM Thermometer Number
Graduated in 0.01°C							
18.9 to 25.1°C	total	0.1	S116C				
23.9 to 30.1°C	total	0.1	S117C				
Graduated in 0.02°C				Graduated in 0.05°F			
19 to 35°C	total	0.1	S56C	66 to 95°F	total	0.2	S56F
Graduated in 0.05°C				Graduated in 0.1°F			
38.6 to 41.4°C	total	0.1	S120C
Graduated in 0.1°C				Graduated in 0.2°F			
-38 to +2°C	total	0.1	S62C	-36 to +35°F	total	0.2	S62F
-8 to +32°C	total	0.1	S63C	18 to 89°F	total	0.2	S63F
20 to 50°C	76	0.1	S91C
25 to 55°C	total	0.1	S64C	77 to 131°F	total	0.2	S64F
34 to 42°C	total	0.1	S18C	94 to 108°F	total	0.2	S18F
50 to 80°C	total	0.1	S65C	122 to 176°F	total	0.2	S65F
75 to 105°C	total	0.1	S66C	167 to 221°F	total	0.2	S66F
95 to 103°C	total	0.1	S22C	204 to 218°F	total	0.2	S22F
Graduated in 0.2°C				Graduated in 0.5°F			
-20 to 102°C	total	0.15	S12C	-5 to 215°F	total	0.25	S12F
-2 to 80°C	total	0.2	S15C	30 to 180°F	total	0.4	S15F
95 to 155°C	total	0.2	S67C	203 to 311°F	total	0.5	S67F
Graduated in 0.5°C				Graduated in 1°F			
-34 to +49°C	total	0.3	S58C	-30 to 120°F	total	0.5	S58F
-18 to +82°C	total	0.3	S59C	0 to 180°F	total	0.5	S59F
-7 to +105°C	total	0.5	S130C	20 to 220°F	total	1	S130F
Graduated in 1°C				Graduated in 2°F			
-38 to 50°C	108	0.5	S5C	-36 to 120°F	108	1	S5F