Designation: B388 – 06 (Reapproved 2012)

Standard Specification for Thermostat Metal Sheet and Strip[1]

This standard is issued under the fixed designation B388; 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 thermostat metals in the form of sheet or strip that are used for the temperature-sensitive elements of devices for controlling, compensating, or indicating temperature and is intended to supply acceptance requirements to purchasers ordering this material by type designation.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *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 become familiar with all hazards including those identified in the appropriate Material Safety Data Sheet (MSDS) for this product/material as provided by the manufacturer, to establish appropriate safety and health practices, and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

B63 Test Method for Resistivity of Metallically Conducting Resistance and Contact Materials

B106 Test Methods for Flexivity of Thermostat Metals

B223 Test Method for Modulus of Elasticity of Thermostat Metals (Cantilever Beam Method)

B362 Test Method for Mechanical Torque Rate of Spiral Coils of Thermostat Metal

B389 Test Method for Thermal Deflection Rate of Spiral and Helical Coils of Thermostat Metal

B478 Test Method for Cross Curvature of Thermostat Metals

B753 Specification for Thermostat Component Alloys

C351 Test Method for Mean Specific Heat of Thermal Insulation (Withdrawn 2008)[3]

E92 Test Method for Vickers Hardness of Metallic Materials (Withdrawn 2010)[3]

E384 Test Method for Knoop and Vickers Hardness of Materials

3. Terminology

3.1 *Definitions:*

3.1.1 *thermostat metal, n*—a composite material comprising two or more metallic layers of differing coefficients of thermal expansion such that the radius of curvature of the composite changes with temperature change.

4. Ordering Information

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

4.1.1 Type designation (Table 1 and Table 2),

4.1.2 Thickness (see 9.1),

4.1.3 Width (see 9.2),

4.1.4 Temper (designated as percent cold reduction as needed),

4.1.5 Marking to identify vendor, type, high-expansion side or low-expansion side,

4.1.6 Weight.

5. Material Segregation

5.1 The thermostat metal shall be supplied segregated into two groups after slitting: (*1*) the burr on the low-expansive component, and (*2*) the burr on the high-expansive component. These two groups shall be identified and packaged separately or together as mutually agreed upon between the producer and the user.

6. Chemical Composition

6.1 The nominal composition of component materials is given in Table 1.

6.1.1 The component alloys shall be as specified in Specification B753.

7. Component Ratio

7.1 The typical thickness ratio of the component materials is given in Table 1. The component thickness ratios are given for

[1] This specification is under the jurisdiction of ASTM Committee B02 on Nonferrous Metals and Alloys and is the direct responsibility of Subcommittee B02.10 on Thermostat Metals and Electrical Resistance Heating Materials.

Current edition approved May 1, 2012. Published May 2012. Originally approved in 1962. Last previous edition approved in 2006 as B388 – 06. DOI: 10.1520/B0388-06R12.

[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.

TABLE 1 Composition

NOTE 1—TM6 and TM7 are no longer manufactured due to availability, difficulty to produce, commercial interest, or combinations thereof.

			ASTM Type						
		Element	TM1	TM2	TM3	TM4	TM5	TM8	TM9
Nominal chemical composition, weight,%	high-expansive component	nickel	22	10	25	25	25	10	22
		chromium	3	...	8.5	8.5	8.5	...	3
		manganese	...	72	...	...	...	72	...
		copper	...	18	...	...	...	18	...
		iron	75	...	66.5	66.5	66.5	...	75
		aluminum	...	...	...	...	...	...	...
		carbon	...	...	...	...	...	...	...
	intermediate component	nickel	...	...	...	...	...	...	100
		manganese	...	...	...	...	...	...	...
	low-expansive component	nickel	36	36	42	45	50	36	36
		iron	64	64	58	55	50	64	64
		cobalt	...	...	...	...	...	...	...
Component ratio, thickness, %	high-expansive component		50	53	50	50	50	80	27
	intermediate component		...	...	...	...	...	...	46
	low-expansive component		50	47	50	50	50	20	27

			ASTM Type						
		Element	TM10	TM11	TM12	TM13	TM14	TM15	TM16
Nominal chemical composition, weight,%	high-expansive component	nickel	22	22	22	22	22	22	22
		chromium	3	3	3	3	3	3	3
		manganese	...	...	...	...	...	...	...
		copper	...	...	...	...	...	...	...
		iron	75	75	75	75	75	75	75
		aluminum	...	...	...	...	...	...	...
		carbon	...	...	...	...	...	...	...
	intermediate component	nickel	100	100	100	100	100	100	100
		manganese	...	...	...	...	...	...	...
	low-expansive component	nickel	36	36	36	36	36	36	36
		iron	64	64	64	64	64	64	64
		cobalt	...	...	...	...	...	...	...
Component ratio, thickness, %	high-expansive component		34	36	40	42	44	47	48
	intermediate component		32	28	20	16	12	6	4
	low-expansive component		34	36	40	42	44	47	48

		Element	ASTM Type						
			TM17	TM18	TM19	TM20	TM21	TM22	TM23
Nominal chemical composition, weight,%	high-expansive component	nickel	22	19.4	19.4	18	18	100	10
		chromium	3	2.25	2.25	11.5	11.5	...	...
		manganese	...	...	...	...	...	...	72
		copper	...	...	...	...	...	...	18
		iron	75	78.3	78.3	70.5	70.5	...	...
		aluminum	...	...	...	...	...	...	...
		carbon	...	0.5	0.5	...	...	...	...
	intermediate component	nickel	100	...	...	...	...	...	...
		manganese	...	...	...	...	...	...	...
	low-expansive component	nickel	36	42	39	36	42	36	42
		iron	64	58	61	64	58	64	58
		cobalt	...	...	...	...	...	...	...
Component ratio, thickness,%	high-expansive component		49	50	50	50	50	50	54
	intermediate component		2	...	...	...	...	...	...
	low-expansive component		49	50	50	50	50	50	46

			ASTM Type						
		Element	TM24	TM25	TM26	TM27	TM28	TM29	TM30
Nominal chemical composition, weight, %	high-expansive component	nickel	22	22	22	22	22	20	22
		chromium	3	3	3	3	3	...	3
		manganese	...	...	...	...	...	6.5	...
		copper	...	...	...	...	...	...	...
		iron	75	75	75	75	75	73.5	75
		aluminum	...	...	...	...	...	...	...
		carbon	...	...	...	...	...	...	...

TABLE 1 *Continued*

		Element	ASTM Type						
			TM24	TM25	TM26	TM27	TM28	TM29	TM30
	intermediate component	copper	100	100	100	100	100	...	...
		manganese	...	...	...	...	...	...	...
	low-expansive component	nickel	36	36	36	36	36	36	42
		iron	64	64	64	64	64	64	58
		cobalt	...	...	...	...	...	...	...

		ASTM Type						
		TM24	TM25	TM26	TM27	TM28	TM29	TM30
	resistivity ohm cir mil/ft	20	30	50	70	90	477	415
Component ratio, thickness, %	high-expansive component	10	20	31	38	42	50	50
	intermediate component	53	35	20	14	10	...	...
	low-expansive component	37	45	49	48	48	50	50

		Element	ASTM Type					
			TM31	TM32	TM33	TM34	TM35	TM36
Nominal chemical composition, weight, %	high-expansive component	nickel	10	10	10	10	19	25
		chromium	...	...	...	...	2	8
		manganese	72	72	72	72	...	...
		copper	18	18	18	18	...	...
		iron	...	...	...	...	79	67
		aluminum	...	...	...	...	...	...
		carbon	...	...	...	...	...	...
	intermediate component	copper	100	100	100	100	...	...
		manganese	...	...	...	...	...	...
	low-expansive component	nickel	36	36	36	36	36	36
		iron	64	64	64	64	64	64
		cobalt	...	...	...	...	...	...

		ASTM Type					
		TM31	TM32	TM33	TM34	TM35	TM36
	resistivity ohm cir mil/ft	30	150	50	70	482	500
Component ratio, thickness, %	high-expansive component	26	50	42	45	50	50
	intermediate component	38	6	21	15	...	...
	low-expansive component	36	44	37	40	50	50

reference as they are lot-to-lot variable to produce required flexivity and resistivity. Barrier(s) layer(s) for stability of resistivity is (are) allowable. Flexivity may vary.

8. Physical Requirements

8.1 *Maximum Sensitivity Range*—The temperature ranges of maximum thermal response of designated types of thermostat metals are given in Table 2 and Table 3. These are nominal values presented only to aid users in designing devices.

8.2 *Maximum Recommended Temperature*—The maximum recommended temperatures of use of designated types of thermostat metals are given in Table 2 and Table 3. These values are presented to aid users in designing devices.

8.3 *Flexivity*—The flexivity of a designated thermostat metal shall conform to the values in Table 2 and Table 3. Component materials designated in Specification B753 shall, in thermostat metal combinations, yield product in conformance with the values designated in Table 2 and Table 3.

8.3.1 Flexivity shall be determined by Test Methods B106, Method A.

8.3.2 Residual stress loading can affect flexivity test results. Specimens shall be stabilized prior to testing by stress relief for 1 h at 500°F (260°C). Suitable stress relief conditions must be determined for individual end use applications. Initial condition recommendations are given in Table 2.

8.4 *Electrical Resistivity*—The electrical resistivity shall conform to the values given in Table 2 and Table 3. Component materials designated in Specification B753 shall, in thermostat metal combinations, yield product in conformance with the values designated in Table 2 and Table 3.

8.4.1 Electrical resistivity shall be determined by Test Method B63 at 75°F (24°C).

8.5 *Modulus of Elasticity*—The nominal moduli of elasticity of designated thermostat metals at a temperature of 75°F (24°C) are given in Table 2 and Table 3. These are nominal values presented to aid users in designing devices and shall not be used for rejection or acceptance purposes.

8.5.1 Modulus of elasticity shall be determined by Test Method B223.