Designation: B 388 – 00

Standard Specification for Thermostat Metal Sheet and Strip[1]

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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 in inch-pound units are to be regarded as the standard. The metric equivalent to inch-pound units may be approximate.

2. Referenced Documents

2.1 *ASTM Standards:*

B 63 Test Method for Resistivity of Metallically Conducting Resistance and Contact Materials [2]

B 106 Test Method for Flexivity of Thermostat Metals [2]

B 223 Test Method for Modulus of Elasticity of Thermostat Metals (Cantilever Beam Method) [2]

B 362 Mechanical Troque Rate of Spiral Coils of Thermostat Metals

B 389 Thermal Deflection Rate of Spiral and Helical Coils of Thermostat Metals

B 478 Test Method for Cross Curvature of Thermostat Metals [2]

B 753 Specification for Thermostat Component Alloys [2]

C 351 Test Method for Mean Specific Heat of Thermal Insulation [3]

E 92 Test Method for Vickers Hardness of Metallic Materials [4]

E 384 Test Method for Microhardness of Materials [4]

3. Terminology

3.1 *Definition:*

3.1.1 *thermostat metal*—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 B 753.

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 reference as they are lot-to-lot variable to produce required flexivity and resistivity.

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 2a and Table 3b. Component materials designated in Specification B 753 shall,

[1] This test method 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.

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[2] *Annual Book of ASTM Standards*, Vol 03.04.

[3] *Annual Book of ASTM Standards*, Vol 04.06.

[4] *Annual Book of ASTM Standards*, Vol 03.01.

in thermostat metal combinations, yield product in conformance with the values designated in Table 2a and Table 3b.

TABLE 1 Composition

		Element	ASTM Type							
			TM1	TM2	TM3	TM4	TM5	TM6	TM7	TM8
Nominal chemical composition, weight,%	high-expansive component	nickel	22	10	25	25	25	22	14	10
		chromium	3	...	8.5	8.5	8.5	3	...	...
		manganese	...	72	...	...	...	...	9.5	72
		copper	...	18	...	...	...	...	...	18
		iron	75	...	66.5	66.5	66.5	75	71.5	...
		aluminum	...	...	...	...	...	...	5	...
		carbon	...	...	...	...	...	...	...	...
	intermediate component	nickel	...	...	...	...	...	...	...	...
		manganese	...	...	...	...	...	...	...	...
	low-expansive component	nickel	36	36	42	45	50	40	36	36
		iron	64	64	58	55	50	60	64	64
		cobalt	...	...	...	...	...	...	...	...
Component ratio, thickness, %	high-expansive component		50	53	50	50	50	50	50	80
	intermediate component		...	...	...	...	...	...	...	...
	low-expansive component		50	47	50	50	50	50	50	20

		Element	ASTM Type							
			TM9	TM10	TM11	TM12	TM13	TM14	TM15	TM16
Nominal chemical composition, weight,%	high-expansive component	nickel	22	22	22	22	22	22	22	22
		chromium	3	3	3	3	3	3	3	3
		manganese	...	...	...	...	...	...	...	...
		copper	...	...	...	...	...	...	...	...
		iron	75	75	75	75	75	75	75	75
		aluminum	...	...	...	...	...	...	...	...
		carbon	...	...	...	...	...	...	...	...
	intermediate component	nickel	100	100	100	100	100	100	100	100
		manganese	...	...	...	...	...	...	...	...
	low-expansive component	nickel	36	36	36	36	36	36	36	36
		iron	64	64	64	64	64	64	64	64
		cobalt	...	...	...	...	...	...	...	...
Component ratio, thickness, %	high-expansive component		27	34	36	40	42	44	47	48
	intermediate component		46	32	28	20	16	12	6	4
	low-expansive component		27	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

TABLE 1 *Continued*

		Element	ASTM Type						
			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	...	...	...	...	...	...	...
	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	...	...	...	...	...	...	...

		Element	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

8.3.1 The flexivity shall be determined by Test Method B 106, 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 Table 2.

8.4 *Electrical Resistivity*—The electrical resistivity shall conform to the values given in Table 2a and Table 3b. Component materials designated in Specification B 753 shall, in thermostat metal combinations, yield product in conformance with the values designated in Table 2a and Table 3b.

8.4.1 The electrical resistivity shall be determined by Method B 63 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 2a and Table 3b. These are nominal values presented to aid users in designing devices and shall not be used for rejection or acceptance purposes.

8.5.1 The modulus of elasticity shall be determined by Test Method B 223.

8.6 *Specific Heat*—The nominal specific heat of the designated thermostat metals is 0.12 BTU/lb°F (500 J/kg°K). This nominal value is presented to aid users in designing devices and shall not be used for rejection or acceptance purposes.

8.6.1 The specific heat shall be determined by Test Method C 351.

8.7 *Density*—The nominal densities of designated thermostat metals are given in Table 2a and Table 3b. These are nominal values presented to aid users in designing devices and shall not be used for rejection or acceptance purposes.

8.8 *Hardness*—The hardness of the components of a designated thermostat metal shall conform to those specifications established by the producer and shall be as mutually agreed upon between the producer and the user. In the case of three or more components, the hardness of the outer components only are determined.

8.8.1 The hardness shall be determined by Test Method E 92, when test loads of 1 kgf (9.8 N) or higher are used. For thinner materials requiring the use of test loads between 1 kgf, hardness shall be determined by Test Method E 384.

8.8.1.1 When using Test Method E 384, the preferred unit of measurement shall be Vickers hardness (HV) as defined in 3.3 of that method.

8.8.1.2 When testing thermostat metals, the thickness of an individual component shall be at least one and one-half times the diagonal length of the hardness indenter impression.

8.8.1.3 The center of the impression shall not be closer to any edge of test specimen or to another impression than a distance equal to two and one-half times the length of diagonal of the impression. When laminated material is tested, a bond interface shall be considered as an edge for spacing of indentation calculations.

9. Dimensions and Permissible Variations

9.1 *Thickness*—The thickness shall be that specified in the purchase order or drawing and the tolerance shall be as specified in Table 4.

9.2 *Width*—The width shall be that specified in the purchase order or drawing and the tolerance shall be as specified in Tables 5 and 6.

9.3 *Coils*—Material furnished in the form of coils shall be supplied as mutually agreed upon between the producer and the user. The inner diameter and the outer diameter or the inner diameter and the maximum or minimum weight may be specified. As mutually agreed upon between the producer and the user a specified maximum percentage may be supplied less than the minimum outer diameter or weight specified.