Designation: B753 – 07

StandardSpecification for Thermostat Component Alloys[1]

This standard is issued under the fixed designation B753; 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 describes requirements for alloys to be used as components in the manufacture of bonded multi-component thermostat metal strip. More specifically it describes alloys having composition, and thermal expansion suitable for application in thermostat metal sheet and strip.

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

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]

A480/A480M Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

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

B152/B152M Specification for Copper Sheet, Strip, Plate, and Rolled Bar

B162 Specification for Nickel Plate, Sheet, and Strip

B388 Specification for Thermostat Metal Sheet and Strip

E18 Test Methods for Rockwell Hardness of Metallic Materials

E228 Test Method for Linear Thermal Expansion of Solid Materials With a Push-Rod Dilatometer

3. Ordering Information

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

3.1.1 Alloy type,

3.1.2 Size,

3.1.3 Surface finish,

3.1.4 Marking and packaging, and

3.1.5 Certification, if required.

4. General Requirements

4.1 The material shall be free of scale, slivers, cracks, seams, corrosion and other defects as best commercial practice will permit. Surfaces shall be uniform and sufficiently clean so that commonly used methods of surface preparation, or pre-bond cleaning will allow bonding of the entire mating surfaces. Since surface condition can vary for different alloys and because bonding practices vary, product surface condition can be agreed upon between supplier and purchaser.

5. Chemical Composition

5.1 The material shall be manufactured to the chemical compositions shown in Table 1.

5.2 The manufacturer will insure uniformity of composition throughout a heat lot to provide uniform thermal expansion and electrical resistivity properties. See Specifications B152/B152M and B162.

6. Thermal Expansion Requirements

6.1 Samples tested in accordance with 6.2 shall exhibit thermal expansion properties described in Table 2.

6.2 One test sample representing each heat lot shall be machined to a suitable specimen configuration, heat treated in accordance with instructions in Table 2 and Test Method E228.

7. Electrical Resistivity

7.1 The electrical resistivity measured at room temperature as in Test Method B63 on suitably prepared and annealed specimens shall conform to Table 3.

8. Temper

8.1 This product will be supplied in the condition agreed upon by purchaser and seller.

[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.

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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.

TABLE 1 Suggested Compositions For Thermostat Alloys All Elements Indicated As Weight Percent

NOTE 1—Composition requirements show major elements as being nominal. These nominal requirements indicate they are to be adjusted by the manufacturer so that the alloys meet the requirements for thermal expansion shown in Table 2. Other elements not shown, may be present in residual amounts. These shall not be present in sufficient quantity as to significantly affect the performance in the intended application.

Alloy Description	T-10	T-20	T-22	T-18	T-19	T-14	T-25
Carbon	0.1 max	0.05 max	0.12 nom	0.15 max	0.5 nom	0.5 max	0.15 max
Manganese	72.0 nom	6.5 nom	0.60 max	0.80 max	1.0 nom	9.0 nom	1.0 max
Silicon, max	0.25	0.3	0.30	0.50	0.40	0.30	1.0
Phosphorus, max	0.030	0.02	0.025	0.025	0.025	0.025	0.025
Sulfur, max	0.030	0.01	0.025	0.025	0.025	0.025	0.025
Chromium	0.25 max	...	3.0 nom	11.0 nom	2.0 nom	...	8.0 nom
Nickel, nom	10.0	20.0	22.0	18.0	19.0	14.0	25.0
Copper	18.0 nom	...	...	...	...	...	...
Aluminum	...	...	...	...	...	5.0 nom	...
Cobalt	...	...	...	...	...	...	...
Iron	1.0 max	balance	balance	balance	balance	balance	balance
Alloy Description	**T-50**	**T-45**	**T-42**	**T-40**	**T-39**	**T-36**	**T-99**
Carbon, max	0.15 max	0.15	0.15	0.15	0.15	0.15	0.15
Manganese, max	0.60 max	0.60	0.60	0.60	0.60	0.60	0.35
Silicon, max	0.40	0.40	0.40	0.40	0.40	0.40	0.35
Phosphorus, max	0.025	0.025	0.025	0.025	0.025	0.025	0.015
Sulfur, max	0.025	0.025	0.025	0.025	0.025	0.025	0.010
Chromium, max	0.50 max	0.50	0.50	0.50	0.50	0.25	0.50
Nickel, nom	50.0 nom	45.0	42.0	40.0	39.0	36.0	99.5
Copper	...	...	...	...	...	...	0.25 max
Aluminum	...	...	...	...	...	...	...
Cobalt, max	0.50 max	0.50	0.50	0.50	0.50	0.50	0.50
Iron	balance	balance	balance	balance	balance	balance	0.40 max
Alloy Description	**T-38**	**T-19A**	**T-00**				
Carbon, max	0.12 max	0.15 max	...				
Manganese, max	0.75 max	1.0 max	...				
Silicon, max	0.30 max	0.3 max	...				
Phosphorus, max	0.025 max	0.025 max	...				
Sulfur, max	0.025 max	0.025 max	...				
Chromium, max	7.0–7.5	7 nom	...				
Nickel, nom	38 nom	19 nom	...				
Copper	...	...	94 min				
Aluminum	...	...	...				
Cobalt, max	0.5 max	...	...				
Iron	balance	balance	...				

TABLE 2 Linear Expansion Coefficients For Thermostat Alloys Values Shown Are 10^{-6}/°F From 77°F (25°C) To Temperatures Indicated[A]

Alloy Description	200°F (93°C)	300°F (149°C) [B]	500°F (260°C)	700°F (371°C)	Anneal Temperature °F (°C) [C]
T-10	15.1	15.4 (±4 %)	15.6	16.6	1450 (788)
T-20	10.9	11.1 (±1–4 %)	11.4	11.5	1600 (871)
T-22	10.7	10.75 (±4.5 %)	10.9	10.9	1600 (871)
T-18	10.0	10.0 (±4 %)	10.2	10.4	2000 (1093)
T-19	11.1	10.8 (±4 %)	11.2	11.2	1900 (1038)
T-14	9.8	10.4 (±4 %)	10.7	10.9	2000 (1093)
T-25	9.8	9.8 (±4 %)	10.0	10.1	1800 (982)
T-50	5.7	5.6 (±8 %)	5.7	5.6	1600 (871)
T-45	4.4	4.3 (±8 %)	4.1	4.0	1600 (871)
T-42	3.1	3.0 (±8 %)	2.9	3.0	1600 (871)
T-40	2.0	2.2 (±8 %)	2.2	3.0	1600 (871)
T-39	1.3–1.9	1.4–2.0	1.5–2.0	2.8–3.3	1600 (871)
T-36	0.5–1.1	0.8–1.4	2.0–2.7	3.7–4.4	1600 (871)
T-99	7.4	7.5 (±4 %)	7.8	8.2	1300 (704)
T-19A	10.2	10.4 (±5 %)	10.5	10.7	2000 (1093)
T-38	3.5	3.8 (±6 %)	5.3	6.7	1700 (927)
T-00	...	9.6 (±5 %)	...	...	1200 (649)

[A] Linear Thermal Expansion Coefficients shown in English units in the above table can be converted to metric units (10^{-6}/°C) by multiplying the value in the table by 1.8.
[B] Required thermal expansion coefficient for each alloy class at 300°F (149°C) are shown with allowable tolerance. Values shown at 200°F (93°C). 500°F (260°C) and 700°F (371°C) are typical and are provided for information only.
[C] Anneal temperature is shown for each class of alloy to be treated prior to thermal expansion testing. Anneal to be performed in protective atmosphere (Non-oxidizing) for minimum one (1) hour, using heating rates up to 1000°F/h, (538°C/h) and cooling at rates 100 to 500°F (38 to 260°C) per hour.

8.2 Hardness shall be measured on representative samples from each heat treat lot and reported as Rockwell B hardness.

8.3 Hardness values in the annealed condition shall conform to the requirements in Table 4 tested as in Test Methods E18.