Designation: B 601 – 01

Standard Classification for Temper Designations for Copper and Copper Alloys—Wrought and Cast[1]

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This standard has been approved for use by agencies of the Department of Defense.

1. Scope *

1.1 This is a classification of temper designations for copper and copper alloys—wrought and cast. The temper designations are classified by the process or processes used in manufacturing the product involved and its resulting qualities. It is not a specification of copper and copper alloy products.

1.2 The property requirements for the tempers are given in the applicable product specification.

2. Referenced Documents

2.1 *ASTM Standards:*

B 846 Terminology for Copper and Copper Alloys[2]

3. Terminology

3.1 For terminology related to copper and copper alloys, refer to Terminology B 846.

4. Significance and Use

4.1 *Significance*—This classification establishes an alphanumeric code of the tempers of copper and copper alloy products.

4.2 *Use*—The alphanumeric code is used to designate product tempers in specifications and published data.

4.2.1 The letters in the code identify the type of process used to produce the product temper. For example, "H" indicates a temper resulting from cold working.

NOTE 1—These letters are frequently the same as those used in temper systems of other metal products.

5. Classification of Tempers

5.1 *Annealed Tempers, O*—Tempers produced by annealing to meet mechanical property requirements.

5.2 *Annealed Tempers, OS*—Tempers produced by annealing to meet standard or special grain size requirements.

5.3 *Manufactured Tempers, M*—Tempers produced in the product by the primary manufacturing operations of casting and hot working and controlled by the methods employed in the operations.

5.4 *Cold-Worked Tempers, H*—Tempers produced by controlled amounts of cold work.

5.5 *Cold-Worked (Drawn), Stress-Relieved Tempers, HR*—Tempers produced by controlled amounts of cold work followed by stress relief.

5.5.1 *Order-Strengthening Tempers, HT*—Tempers produced by controlled amounts of cold work followed by a thermal treatment to produce order strengthening.

5.6 *Heat-Treated Tempers, T*—Tempers that are based on heat treatments followed by rapid cooling.

5.6.1 *Quench-Hardened Tempers, TQ*—Tempers produced by quench-hardening treatments.

5.6.2 *Solution Heat-Treated Temper, TB*—Tempers produced by solution heat-treating precipitation hardenable or spinodal hardenable alloys.

5.6.3 *Solution Heat-Treated and Cold-Worked Tempers, TD*—Tempers produced by controlled amounts of cold work of solution heat-treated precipitation hardenable or spinodal hardenable alloys.

5.6.4 *Precipitation Heat-Treated Temper, TF*—Tempers produced by precipitation heat treatment of precipitation-hardenable alloys.

5.6.5 *Spinodal Heat Treated Temper, TX*—Tempers produced by spinodal heat treatment of spinodal hardenable alloys.

5.6.6 *Cold-Worked and Precipitation Heat-Treated Tempers, TH*—Tempers produced in alloys that have been solution heat treated, cold worked, and precipitation heat treated.

5.6.7 *Cold-Worked and Spinodal Heat-Treated Tempers, TS*—Tempers produced in alloys that have been solution heat treated, cold worked, and spinodal heat treated.

5.6.8 *Mill-Hardened Tempers, TM*—Tempers of heat-treated materials as supplied by the mill resulting from combinations of cold work and precipitation heat treatment or spinodal heat treatment.

5.6.9 *Precipitation Heat-Treated or Spinodal Heat-Treated and Cold-Worked Tempers, TL*—Tempers produced by cold working the precipitation heat-treated or spinodal heat-treated alloys.

[1] This classification is under the jurisdiction of ASTM Committee B05 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.91 on Editorial and Publications.

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[2] *Annual Book of ASTM Standards*, Vol 02.01.

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

5.6.10 *Precipitation Heat-Treated or Spinodal Heat-Treated, Cold-Worked, and Thermal Stress-Relieved Tempers, TR*—Tempers produced in the cold-worked precipitation heat-treated or spinodal heat-treated alloys by thermal stress relief.

5.7 *Tempers of Welded Tubes, W*—(Welded tubes are produced from strip of various tempers and essentially have the temper of the strip except in the heat-affected zone.)

5.7.1 *Tube, As-Welded Tempers, WM*—Tempers that result from forming and welding when producing tube.

5.7.2 *Tube, Welded and Annealed Temper, WO*—Temper that results from forming, welding, and annealing when producing tube.

5.7.3 *Tube, Welded and Cold-Worked Tempers, WH*—Tempers that result from forming, welding, and cold working when producing tube.

5.7.4 *Tube, Welded, Cold-Worked and Stress-Relieved Tempers, WR*—Tempers that result from forming, welding, cold working, and stress relieving when producing tube.

5.7.5 *Tube, Welded, and Fully Finished Tempers, O, OS, H*—Tempers that result from both annealing a welded and cold-worked tube, or cold working, a welded cold-worked and annealed tube. With these treatments, the weld area has been transformed into a wrought structure, and the usual temper designations apply.

6. Temper Designation Codes

6.1 *Annealed Tempers, O:*

6.1.1 *Annealed to Meet Mechanical Properties, O:*

Annealed Tempers—O	Temper Names
O10	Cast and Annealed (Homogenized)
O11	As Cast and Precipitation Heat Treated
O20	Hot Forged and Annealed
O25	Hot Rolled and Annealed
O30	Hot Extruded and Annealed
O31	Extruded and Precipitation Heat Treated
O40	Hot Pierced and Annealed
O50	Light Anneal
O60	Soft Anneal
O61	Annealed
O65	Drawing Anneal
O68	Deep Drawing Anneal
O70	Dead Soft Anneal
O80	Annealed to Temper—⅛ Hard
O81	Annealed to Temper—¼ Hard
O82	Annealed to Temper—½ Hard

6.1.2 *Annealed to Meet Nominal Average Grain Size, OS:*

Annealed Tempers, with Grain Size Prescribed—OS	Temper Designations Nominal Avg Grain Size, mm
OS005	0.005
OS010	0.010
OS015	0.015
OS025	0.025
OS035	0.035
OS045	0.045
OS050	0.050
OS060	0.060
OS065	0.065
OS070	0.070
OS100	0.100
OS120	0.120
OS150	0.150
OS200	0.200

6.2 *Cold-Worked Tempers, H:*

6.2.1 *Cold-Worked Tempers to Meet Standard Requirements Based on Cold Rolling or Cold Drawing, H:*

Cold-Worked Tempers—H	Temper Names
H00	⅛ Hard
H01	¼ Hard
H02	½ Hard
H03	¾ Hard
H04	Hard
. . .	. . .
H06	Extra Hard
. . .	. . .
H08	Spring
. . .	. . .
H10	Extra Spring
. . .	. . .
H12	Special Spring
H13	Ultra Spring
H14	Super Spring
. . .	. . .

6.2.2 *Cold-Worked Tempers to Meet Standard Requirements Based on Temper Names Applicable to Particular Products, H:*

Cold-Worked Tempers—H	Temper Names
H50	Extruded and Drawn
H52	Pierced and Drawn
H55	Light Drawn, Light Cold-Worked
H58	Drawn General Purpose
H60	Cold Heading, Forming
H63	Rivet
H64	Screw
H66	Bolt
H70	Bending
H80	Hard Drawn
H85	Medium Hard-Drawn Electrical Wire
H86	Hard-Drawn Electrical Wire
H90	As-finned

6.3 *Cold-Worked Tempers with Added Treatments:*

6.3.1 *Cold Worked and Stress Relieved, HR:*

	Temper Names
HR01	¼ Hard and Stress Relieved
HR02	½ Hard and Stress Relieved
HR04	Hard and Stress Relieved
HR06	Extra Hard and Stress Relieved
HR08	Spring and Stress Relieved
HR10	Extra Spring and Stress Relieved
HR12	Special Spring and Stress Relieved
HR20	As-finned

6.3.2 *Drawn and Stress Relieved, HR:*

	Temper Name
HR50	Drawn and Stress Relieved

6.3.3 *Cold Rolled and Order Strengthened, HT:*