

Eliminating Hydrogen Embrittlement per ASTM B633

- Zinc
- Stress Relieve
- Post Bake

ASTM B633

Electrodeposited Coatings of Zinc on Iron and Steel

6.4 Pretreatment of Iron or Steel for the Purpose of Reducing the Risk of Hydrogen Embrittlement—All steel parts having an ultimate tensile strength greater than 1000 MPa (31 HRC) and that have been machined, ground, cold formed, or cold straightened, shall be heat treated for stress relief to reduce the risk of hydrogen embrittlement in the part before clean and electroplate processes. If these heat treatments are not required, the purchaser shall specify in the ordering information their exception, (5.2.5). If the purchaser does not specify an exception to heat treatment, then the plater shall use Table 1 in B849 to determine the appropriate heat treatment for the steel based on its tensile strength.

ASTM B849

Pre-Treatments of Iron or Steel for Reducing Risk of Hydrogen Embrittlement

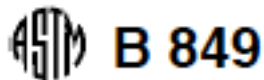


TABLE 1 Classes of Stress Relief Requirements for High-Strength Steels (See Sections 4 through 6 for Details on the Use of Table 1)

Class	Stress-Relief Heat-Treatment Classes for High-Strength Steels		
	Steels of Tensile Strength (R_m), MPa	Temperature, °C	Time, h
SR-0	not applicable		
SR-1	over 1800	200–230	min 24
SR-2 ^A	over 1800	190–220	min 24
SR-3	1401 to 1800	200–230	min 18
SR-4 ^A	1450 to 1800	190–220	min 18
SR-5 ^A	1034 or greater	177–205	min 3
SR-6	1000 to 1400	200–230	min 3
SR-7 ^A	1050 to 1450	190–220	min 1
SR-8	surface-hardened parts \leq 1400	130–160	min 8

^A Classes SR-2, SR-4, SR-5, and SR-7 are traditional treatments used in Federal Standard QQ-C-320. They do not apply to any other standard.

ASTM B633

Electrodeposited Coatings of Zinc on Iron and Steel

6.5 Post Coating Treatments of Iron and Steel for the Purpose of Reducing the Risk of Hydrogen Embrittlement—All electroplated steel parts having a tensile strength greater than 1000 MPa (31 HRC) as well as surface hardened parts, shall be baked to reduce the risk of hydrogen embrittlement. If these heat treatments are not required, the purchaser shall specify in the ordering information their exception (5.2.5). If the purchaser does not specify an exception to heat treatment, then the plater shall use Table 1 in B850 to determine the appropriate heat treatment for the steel based on its tensile strength. The baking treatment shall be done before the application of the supplementary treatments and within 4 h of removal from the last process.

ASTM B850

Post-Coating Treatments of Steel for Reducing the Risk of Hydrogen Embrittlement

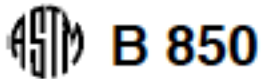


TABLE 1 Classes of Embrittlement-Relief Heat Treatment (See Sections 4 through 64-6 for details on the Use of Table 1)

Hydrogen Embrittlement-Relief Treatment Classes for High-Strength Steels				
Class	Steels of Tensile Strength (R_m), MPa	Temperature, °C	Time, h	
ER-0	not applicable			
ER-1	1701 to 1800	190–220	min 22	
ER-2	1601 to 1700	190–220	min 20	
ER-3	1501 to 1600	190–220	min 18	
ER-4	1401 to 1500	190–220	min 16	
ER-5	1301 to 1400	190–220	min 14	
ER-6	1201 to 1300	190–220	min 12	
ER-7 ^A	1525 or greater	177–205	min 12	
ER-8	1101 to 1200	190–220	min 10	
ER-9	1000 to 1100	190–220	min 8	
ER-10 ^A	1250 to 1525	177–205	min 8	
ER-11 ^A	1450 to 1800	190–220	min 6	
ER-12 ^A	1000 to 1500	177–205	min 4	
ER-13	1000 to 1800 unpeened items and for engineering chromium plated items	440–480	min 1	
ER-14 ^A	surface-hardened parts <1401	130–160	min 8	
ER-15 ^A	surface-hardened parts 1401 to 1800 plated with cadmium, tin, zinc, or their alloys	130–160	min 8	
ER-16	surface-hardened parts <1401 plated with cadmium, tin, zinc, or their alloys	130–160	min 16	

^AClasses ER-7, ER-10, ER-11, ER-12, ER-14, and ER-15 are traditional treatments used in Federal Standard QQ-C-320. They do not apply to any other standard.

ASTM B633

Electrodeposited Coatings of Zinc on Iron and Steel

ASTM B633 – 13 BAKING SCHEDULE

Stress Relief per ASTM B 849

Rc Scale	Temp	Time
31 – 42	392/446 °F	3 hrs min.
43 – 50	392/446 °F	18 hrs min.

Post Bake per ASTM B 850

Rc Scale	Temp	Time
31 – 34	374/428 °F	8 hrs min.
35 – 37	374/428 °F	10 hrs min.
38 – 40	374/428 °F	12 hrs min.
41 – 42	374/428 °F	14 hrs min.
43 – 44	374/428 °F	16 hrs min.
45 – 46	374/428 °F	18 hrs min.
47 – 48	374/428 °F	20 hrs min.