



SURFACE VEHICLE INFORMATION REPORT

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Protective Coatings for Fasteners

RATIONALE

This Information Report covers technology, products, or processes for which technical expertise no longer resides in the owning committee. Current finish specifications for additional information include the following: ASTM F1941/1941M (Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric); ASTM F2833 (Standard Specification for Corrosion Protective Fastener Coatings with Zinc Rich Base Coat and Aluminum Organic/Inorganic Type); ASTM F3019/F3019M (Standard Specification for Chromium Free Zinc-Flake Composite, with or without Integral Lubricant, Corrosion Protective Coatings for Fasteners); ISO 4042 (Fasteners - Electroplating Systems), ISO 10683 (Fasteners - Non-Electrolytically Applied Coatings), ISO 10684 (Fasteners - Hot Dip Galvanized Coatings), ISO 16048 (Passivation of Corrosion-Resistant Stainless-Steel Fasteners), and ISO 11408 (Chemical Conversion Coatings - Black Oxide Coating on Iron and Steel - Specification and Test Methods).

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This document has been declared "Stabilized" by the SAE Fasteners Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

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Foreword—This Document has not changed other than to put it into the new SAE Technical Standards Board Format.

Protective coating finishes for fasteners not only enhance resistance to corrosion and appearance, but they are very important in the consideration of stresses developed and in the torque-tension tightening of the applied assembly. The effect of the coating on fastener torque-tension relationship is covered in a separate SAE Information Guide J1701.

1. **Scope**—This SAE Information Report is provided as an advisory guide. Careful discretion as to application is recommended. The content has been presented as accurately as possible, but responsibility for its application lies with the user. It covers finishes applied to fasteners and related topics, corrosion resistance, lubricity, electrical grounding, ultraviolet light, and embrittlement.

Table 1 lists these coatings and their properties so that finish selection can be reasonably made in accordance with known and anticipated fastener assembly applications.

Application of protective coatings will affect fastener dimensions. This is especially critical for the thread fit of mating parts because the pitch diameter increases by four times the coating thickness. Explanation is covered in Section 5.

2. References

- 2.1 **Applicable Publications**—The following publications form a part of this specification to the extent specified herein. Unless otherwise specified, the latest issue of SAE publications shall apply.

- 2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J995—Mechanical and Material Requirements for Steel Nuts
SAE J1701—Torque-Tension Tightening for Fasteners

TABLE 1—PROTECTIVE FINISHES FOR FASTENERS

Coat or Finish	For Use on Fastener	Surface	Corrosion Resistance ⁽¹⁾ Environment Salt Spray Protection	Corrosion Resistance ⁽¹⁾ Environment Salt Spray Hours Min	Description and Requirements	Specification Finish Reference	Thickness Micrometer µm	Temperature Resistance in Degrees
Nickel Electroplate	bolts, nuts, rivets, screws, studs, washers	steel	very mild indoor	2	Decorative silver appearance, good wear	ASTM F 871M	2.5	(204 °C)
Zinc Electroplate	bolts, nuts, rivets, screws, studs, washers	steel	moderate suburban sacrificial	32	Bright blue or white appearance. Smooth sacrificial.	ISO 2001	5.0	(177 °C)
Zinc Mechanical Plate	bolts, nuts, rivets, screws, studs, washers	steel	moderate suburban	48	Less susceptible to hydrogen embrittlement than electroplated zinc.	ASTM F 871M ASTM B 633 ASTM B 695	7.5	(149 °C)
Zinc Electroplate with Bright Chromate	bolts, nuts, rivets, screws, studs, washers	steel	moderate suburban	40 (R) 12 (W)	Thin bright conversion coating over the plate can be dyed for paint bonding.	ASTM B 201 ASTM B 633 ISO 4520	5.0	(120 °C)
Zinc Electroplate with Yellow Chromate	bolts, nuts, rivets, screws, studs, washers	steel	very severe industrial	144 (R) 72 (W)	Thicker conversion than clear with same characteristics and increased corrosion resistance.	ASTM B 201 ASTM B 633 ISO 4520	6.0	(120 °C)
Zinc Electroplate with Olive Drab Chromate	bolts, nuts, rivets, screws, studs, washers	steel	very severe industrial	240 (R) 96 (W)	Thicker coating than yellow and better corrosion resistance.	ASTM B 201 ASTM B 633 ISO 4520	5.0	(120 °C)
Zinc Electroplate with Chromate + Organic	bolts, nuts, rivets, screws, studs, washers	steel	very severe Industrial	240 (R) 120 (W)	Additional organic coating provokes greater corrosion resistance.	ASTM F 1136	13.0	(190 °C)
Zinc Mechanical with Bright Chromate	bolts, nuts, rivets, screws, studs, washers	steel	moderate suburban	40 (R) 12 (W)	Thin bright conversion coating over the plate can be dyed for paint bonding.	ASTM B 201 ASTM B 695 ISO 4520	5.0	(120 °C)
Zinc Mechanical with Yellow Chromate	bolts, nuts, rivets, screws, studs, washers	steel	Industrial	144 (R) 72 (W)	Thicker conversion than clear with same characteristics and increased corrosion resistance.	ASTM B 201 ASTM B 695 ISO 4520	5.0	(120 °C)

TABLE 1—PROTECTIVE FINISHES FOR FASTENERS (CONTINUED)

Coat or Finish	For Use on Fastener	Surface	Corrosion Resistance ⁽¹⁾ Environment Salt Spray Protection	Corrosion Resistance ⁽¹⁾ Environment Salt Spray Hours Min	Description and Requirements	Specification Finish Reference	Thickness Micrometer µm	Temperature Resistance in Degrees
Zinc Mechanical with Olive Drab Chromate	bolts, nuts, rivets, screws, studs, washers	steel	very severe industrial	168 (R) 96 (W)	Thicker coating than yellow and better corrosion resistance.	ASTM B 201 ASTM B 695 ISO 4520	5.0	(120 °C)
Zinc Mechanical with Chromate + Organic	bolts, nuts, rivets, screws, studs, washers	steel	very severe Industrial	336 (R) 100 (W)	Additional organic coating (cured) provides greater corrosion resistance.	ASTM F 1135	13.0	(190 °C)
Black Oxide + Oil	bolts, nuts, rivets, screws, studs, washers	steel	very mild Indoors	1	Porous thin; hydrogen embrittlement susceptible; oiling may be necessary.		2.5	(93 °C)
Brass Plate, Lacquered	bolts, nuts, rivets, screws, studs, washers	steel	very mild indoors	1	Decorative electroplated finish recommended for indoor use.	ASTM F 871M	2.5	(93 °C)
Chromium Electroplate	bolts, nuts, rivets, screws, studs, washers	steel and other metals	very mild indoors	2	Bright lustrous blue - white finish.	ASTM F 871M	7.5	(204 °C)
Chromium Electroplate with Copper and Nickel Undercoat	bolts, nuts, rivets, screws, studs, washers	steel and other metals	very mild indoors	8	Surface is hard and abrasive resistant. Primarily for decorative use.	ASTM B 456 ISO 1456	7.5	(260 °C)
Cadmium (Electroplate/Mechanical Plate)	bolts, nuts, rivets, screws, studs, washers	steel	nonindustrial urban and marine applications	144	Bright silvery gray, dull gray, has lubricating (reduction of friction) property.	ASTM B 766 ASTM F 871M ASTM B 696 ISO 2082	5.0	(177 °C)
With Clear Chromate	bolts, nuts, rivets, screws, studs, washers	steel	nonindustrial urban and marine applications	192 (R) 12 (W)	Thin conversion coating base over the plate, bright, can be dyed for paint bonding.	ASTM B 201 ASTM B 696 ASTM B 766 ISO 4520	5.0	(120 °C)
With Yellow Chromate	bolts, nuts, rivets, screws, studs, washers	steel	nonindustrial urban and marine applications	240 (R) 72 (W)	Thicker conversion coating than clear with same characteristics.	ASTM B 201 ASTM B 696 ASTM B 766 ISO 4520	5.0	(120 °C)