GalvInfoNote	Zinc Grades Used for Continuous Hot-Dip Galvanizing
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Introduction

Zinc plays a crucial role in continuous hot-dip galvanizing. Using the correctly specified grade of zinc, continuous galvanizing grade (CGG) alloy, or master alloy is key to producing a galvanized product that meets the requirements of the marketplace[i]. For example, and as described in GalvInfoNote 2.4, close control of the amount of aluminum in the zinc is critical to achieving good adhesion to the steel substrate. To accomplish this, the galvanizer must be able to depend on a supply of raw zinc ingots that meet specific composition limits. This is accomplished through a series of ASTM standards that cover zinc products. This GalvInfoNote reviews the zinc grades available for continuous hot-dip galvanizing and the ASTM documents that govern them.

ASTM Zinc Standards

There are a number of ASTM standards that specify, not only the chemistry of zinc and various zinc alloys used in hot-dip galvanizing, but the configuration of zinc jumbo and block ingots, and the color codes used for visual identification of zinc and zinc alloy ingots. These standards are available at www.astm.org.

B6 Standard Specification for Zinc

- Specifies the chemical requirements and other delivery conditions for 5 zinc grades, including Special High Grade (SHG), High Grade (HG), and Prime Western Grade (PW). These grades, and scores of nonstandard variations of them, were once all that were available for use by the continuous galvanizing industry. Some are still employed in certain instances, e.g., SHG (99.990% Zn) is used to reduce the aluminum content in coating line zinc baths. The grades in this standard are also used in the general galvanizing and zinc die-casting industries. The compositions of SHG and HG are shown in Table 1 below.

B852 Standard Specification for Continuous Galvanizing Grade (CGG) Zinc for Hot-Dip Galvanizing of Sheet Steel

- This standard specifies eight CGG grades of zinc having aluminum levels from 0.25% to 1.0%. Recognizing that lead is, for the most part, an unwanted impurity in galvanize coatings, it restricts lead content to a maximum of 0.007% in all but one of these grades. The chemistries of each grade are shown in Table 1. While this specification does allow for other compositions, it has achieved a significant reduction in the number of custom grades of zinc that were once in use by galvanizing lines.

B860 Standard Specification for Zinc Master Alloys for Use in Hot-Dip Galvanizing

- This specification covers zinc-aluminum and zinc-antimony alloys, one of the uses of which is to modify the composition of zinc baths on continuous coating lines. The two main alloy types are 90% zinc-10% aluminum and 95% zinc-5% aluminum (see Table 1).

B897 Standard Specification for the Configuration of Zinc and Zinc Alloy Jumbo and Block Ingot

- Specifies the dimensions of 2400 lb (1089 kg) jumbo and block ingots designed for use with automatic handling systems that add zinc to the baths on continuous galvanizing lines. The introduction of this specification standardized the dimensions of these products, allowing a reduction in the multiple ingot designs that were specific to individual coating lines.

B914 Standard Practice for Color Codes on Zinc and Zinc Alloy Ingot for Use in Hot-Dip Galvanizing of Steel

- This practice specifies the color code system used to identify zinc and zinc alloy ingots. There is a unique color code for each zinc and zinc alloy grade to avoid confusion in the user's plant.

Zinc Grades for Continuous Galvanizing

Table 1 lists the chemical composition requirements for the grades of zinc and zinc alloys that are used in the continuous galvanizing industry.

Table 1 Chemical Composition Limits for Zinc & Zinc Alloys Used in Continuous Galvanizing
(Wt%, Range or Max)

ASTM	Grade (UNS*)	Al	Pb	Cd	Fe	Cu	Others
B6 - SHG	Z13001	0.002	0.003	0.003	0.003	0.002	0.010 (all)
B6 - HG	Z15001	0.01	0.03	0.01	0.02	-	0.10 (all)
B852 CGG	Z80310	0.22 - 0.28	0.007	0.01	0.0075	0.01	0.01
	Z80411	0.31 - 0.39	0.007	0.01	0.0075	0.01	0.01
	Z80511	0.40 - 0.50	0.007	0.01	0.0075	0.01	0.01
	Z80531	0.40 - 0.50	0.01-0.03	0.01	0.0075	0.01	0.01
	Z80610	0.49 - 0.61	0.007	0.01	0.0075	0.01	0.01
	Z80710	0.58 - 0.72	0.007	0.01	0.0075	0.01	0.01
	Z80810	0.67 - 0.83	0.007	0.01	0.0075	0.01	0.01
	Z80910	0.90 - 1.10	0.007	0.01	0.0075	0.01	0.01
B750**	Z38510	4.2 - 6.2	0.005	0.005	0.075	-	0.04
B860-A-1	Z30750	9.5-10.5	0.005	0.004	0.05	0.035	0.01
B860-A-2	Z31710	9.5-10.5	0.4	-	0.15	0.5	0.25
B860-A-3	Z30503	4.5-5.5	0.005	0.004	0.05	0.035	0.01
B860-A-4	Z31510	4.5-5.5	0.4	-	0.15	0.5	0.25

* UNS designation in accordance with ASTM E 527 Practice for Numbering Metals and Alloys in the Unified Numbering System
** Zn-5% Al alloy – includes mischmetal addition of Ce + La - 0.03 - 0.10% total

Note that there are seven separate aluminum levels available in the B852 CGG series of zinc grades. Zinc is available with aluminum levels ranging from 0.22% to 1.10%. The purpose of having this series of increasing aluminum compositions is to give sheet galvanizers the ability to change their bath aluminum levels as required for the product being run. As explained in detail in GalvInfoNote 2.4, the rate of aluminum extraction from a zinc bath on a continuous line varies as a function of such factors as coating weight, line speed, bath temperature, and steel type. Most coating lines use sophisticated monitoring methods and computer models to test for and forecast aluminum levels, which in turn dictate the composition of, and rate at which zinc ingots are added to the bath.

[i] Lynch, Richard F., New ASTM Zinc Standards, 2000 Galvanizers Association Conference, Toronto, ON