Aluminized Type 1 STEELS

AK Steel

Aluminized Steel Type 1 is continuously hot dip coated on both sides with an aluminum/silicon alloy coating. The hot dip process, pioneered by AK Steel, provides a tight metallurgical bond between the steel and the alloy coating. This process results in a material with the strength of steel plus the corrosion protection of aluminum, and the synergistic heat protection of an aluminum/silicon alloy.

AK Steel's #4 Aluminized line is the most productive aluminizing line in the world. The primary features of this line include a ceramic coreless induction coating pot, the ability to finish with either air or nitrogen, closed-loop computer controlled X-ray gauges for coating weights, and in-line surface conditioning.

PRODUCT FEATURES

- **Corrosion Resistance**

  Aluminized Steel Type 1 has superior performance compared to zinc coated materials for resistance to atmospheric, salt spray and muffler condensate corrosion.

- **Formability**

  Aluminized Steel Type 1 can be used to produce parts containing simple bends to parts with extreme deep drawing requirements.

- **Heat Reflectivity**

  Aluminized Steel Type 1 has excellent heat reflectivity during exposures to temperatures below 800°F (427°C), reflecting up to 80% of the radiant heat that impinges upon it.

- **High Temperature Properties**

  Aluminized Steel Type 1 is an excellent heat resistant material effective to at least 1250°F (677°C). For applications above 800°F (427°C) where alloying of the coating can be a problem, AK Steel's DQHT grade has been specially formulated to resist alloying at temperatures up to 1000°F (538°C).

COATING CHARACTERISTICS

Aluminized Type 1 coating contains approximately 91% aluminum and 9% silicon that is metallurgically bonded to the low-carbon steel substrate. The hot dip coating process assures a tightly adherent, uniform coating on both sides of the product. A thin alloy layer readily permits normal fabrication practices without incurring significant coating damage. A schematic of the coating cross-section is shown in Figure 1*.

Aluminized Steel Type 1 is supplied in coating weights ranging from T1 13 (0.13 oz/ft ^{2}) to T1 60 (0.60 oz/ft ^{2}) as shown in Table 1. Most common are T1 25 and T1 40. Lighter coating weights (T1 13 or T1 25) are recommended for severe forming applications.

TABLE 1 – COATING WEIGHT

Coating Designation	Min. Ctg. Weight oz/ft^2 (Inch-Pound)	Min. Ctg. Weight g/m^2 (SI)	Avg. Ctg. Thickness per side (Mils)
T1 13	0.13	40	0.25
T1 25	0.25	76	0.50
T1 40	0.40	122	0.80
T1 60	0.60	183	1.25

Coating Weight is the total of both sides and is determined according to ASTM A 463.

1 oz/Sq. Ft. Coating = .00398 inches coating thickness total both sides.

FIGURE 1 – COATING CROSS SECTION

* Layers not shown to actual size.

SURFACE PROTECTION AND LUBRICATION

To prevent rusting in transit and storage, it is recommended that Aluminized Steel Type 1 be supplied with a protective oil. Rust preventative oil is a combination of a rust preventative and a mineral oil and is available in two different viscosities. In some cases, a pre-applied press forming lubricant can be supplied which provides uniform lubrication and eliminates housekeeping problems associated with at-press lubrication. A dry film (acrylic/polymer) lubricant can also be supplied by further processing Aluminized Steel Type 1 through a coil coating facility. These specialty organic coatings are easily removed with a mild alkaline cleaner.

To further enhance protection against storage stain, Aluminized Steel Type 1 can be provided with a chemical surface treatment (chromate) which retards the formation of "white rust". This treatment is not recommended, however, if you are planning to paint your final product.

FORMABILITY AND MECHANICAL PROPERTIES

The formability of all steel products is a result of the interaction of many variables, the main ones being the mechanical properties of the steel, the forming system (tooling) used to manufacture parts, and the lubrication used during forming. Of these three, AK Steel can only directly affect the mechanical properties of the steel. Tight control over chemical composition, hot rolling parameters, amount of cold reduction, in-line annealing time and temperature, and the amount of additional processing allows the production of high quality Aluminized Steel Type 1 to meet customers' requirements.

Commercial Steel (CS Type B) should be used for moderate forming or bending applications. CS products are produced from aluminum-killed continuously cast slabs and have a carbon content of less than 0.15%.

For more severe forming applications, Deep Drawing Steel (DDS), should be ordered. DDS has a controlled carbon content (<0.06%) and is produced in such a manner that parts formed from DDS should not exhibit stretcher strain.

Extra Deep Drawing Steel (EDDS) or Extra Deep Drawing Steel Plus (EDDS+) should be ordered for the most demanding forming applications. These steels (also known as Interstitial Free or I-F® steels) are produced from vacuum degassed (<0.010%C), titanium stabilized grades. EDDS+ has the lowest carbon content available and has been specially formulated to be AK Steel's most ductile product.

For high strength or structural applications, Aluminized Steel Type 1 is also available in yield strengths up to 50 ksi as shown in Table 3.

Aluminized Steel Type 1 can also be specified as DQHT for applications above 900°F (482°C) where alloying of the coating can be a problem. AK Steel's DQHT grade has been specially formulated to resist alloying at temperatures up to 1000°F (538°C).

Typical mechanical properties are shown in Table 2. The n-value, i.e. strain hardening exponent, has been shown to correlate with stretch forming behavior, while the r-value, r_m, is a measure of deep drawing capability.

TABLE 2 – TYPICAL MECHANICAL PROPERTIES – STANDARD GRADES

Quality Designation	Description	YS ksi	YS MPa	UTS ksi	UTS MPa	Elong. %	"n"	"r_m"
Commercial Steel (CS Type B)	May be moderately formed. A specimen cut in any direction can be bent flat on itself without cracking.	47	324	56	386	34	–	–
Deep Drawing Steel (DDS)	DDS is made by adding aluminum to the molten steel and may be used in drawing applications.	33	228	49	338	41	0.21	1.2
Extra Deep Drawing Steel (EDDS)	Interstitial Free (I-F) steels are made by adding titanium and/or columbium to the molten steel after vacuum degassing and offer excellent drawability.	25	172	45	310	43	0.22	1.6
Extra Deep Drawing Steel Plus (EDDS+)		24	165	45	310	44	0.22	1.8

Typical properties produced by AK Steel for these grades.
Commercial Steel, Deep Drawing Steel, and Extra Deep Drawing Steel are designations of the various steels described in the ASTM Specification A 463 "Steel sheet, Aluminum Coated by the Hot Dip Process." Each of these steel sheet designations is associated with unique requirements for chemical composition and with nonmandatory, typical mechanical properties.

TABLE 3 – ASTM SPECIFIED PROPERTIES – HIGHER STRENGTH GRADES

Quality Designation	Description	Min. YS ksi	Min. YS MPa	Min. UTS ksi	Min. UTS MPa	Min. Elong. %
Structural Steel (SS)	ASTM A 463 Grade 40/SAE J1392 040 AHK	40	280	55	380	16
High Strength Low Alloy Steel (HSLAS)	Grade 50/ SAE J1392 050 XLK	50	340	60	415	20

PAINTABILITY

For best results, Aluminized Steel Type 1 should be cleaned with a mild alkaline cleaner to remove dirt and oil, followed by phosphating with a zinc phosphate. Chromium and aluminum oxides also give good results as a pretreatment on coil coating lines. Mild abrasion prior to pretreating may also be used to enhance mechanical bonding of the paint.

WELDABILITY

A variety of welding processes can be used to join Aluminized Steel Type 1, provided that welding procedures are adapted to the special properties of the material.

Resistance spot and projection welding processes are especially suited for Aluminized Steel. High frequency resistance welding and various arc welding processes are also compatible with Aluminized Steel.

Special attention is required when welding Aluminized Steel; for example, loss of coating in the weld area may require a post-weld treatment to restore corrosion resistance in the weld area.

For more assistance concerning your particular welding parameters, contact your AK Steel Technical Representative.

SPECIFICATIONS

Aluminized Steel Type 1 conforms to ASTM Specification A 463. For other specifications, please consult your AK Steel Sales or Technical Representative.

ENGINEERING PROPERTIES

FIGURE 3 – MAXIMUM SERVICE TEMPERATURE

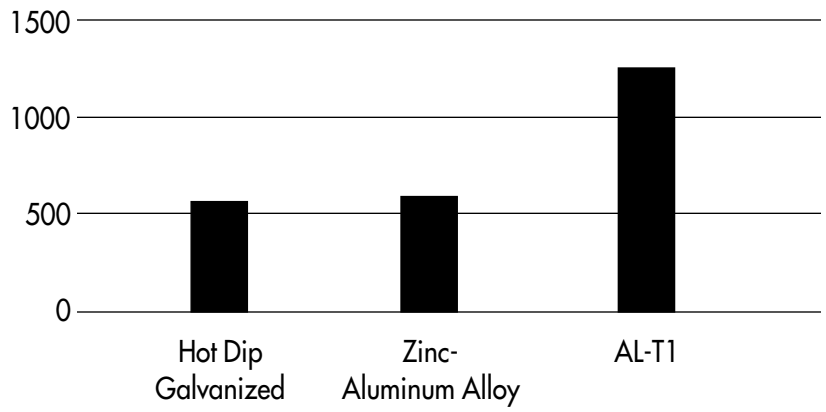


TABLE 4 – ELEVATED TEMPERATURE SHORT TIME MECHANICAL PROPERTIES

AL-T1 Commercial Steel Temperature (°F)	YS (ksi)	TS (ksi)
70	46.6	58.8
1000	15.2	20.7
1200	8.1	10.3

TABLE 5 – PHYSICAL PROPERTIES VERSUS TEMPERATURE

Temperature (°F)	Poisson's Ratio	Young's Modulus of Elasticity (ksi)*
70	0.29	29,200
200	0.29	28,200
400	0.29	27,500
600	0.30	26,500
800	0.30	25,000
1000	0.30	17,800
1200	0.31	12,800

* Commercial Steel Base Metal

FIGURE 4 – THERMAL CONDUCTIVITY VERSUS TEMPERATURE

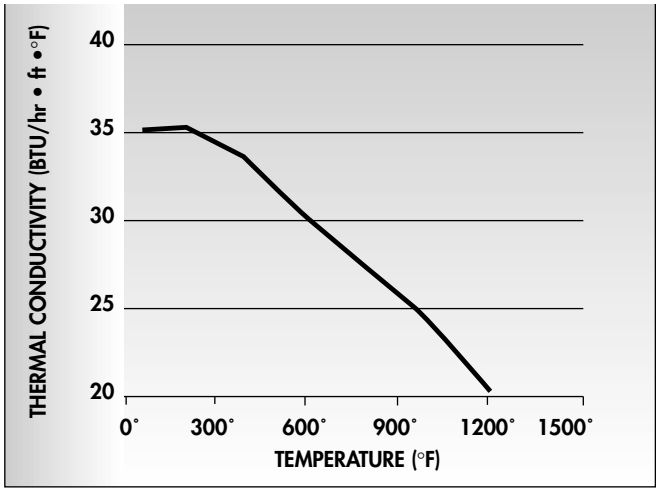


FIGURE 5 – SPECIFIC HEAT VERSUS TEMPERATURE

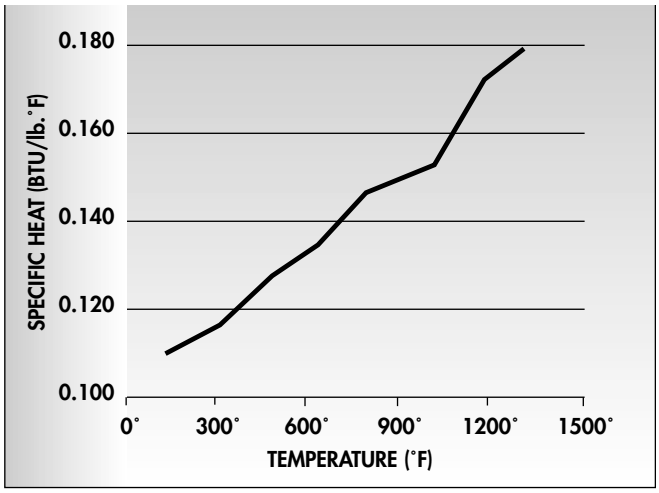


FIGURE 6 – COEFFICIENT OF THERMAL EXPANSION

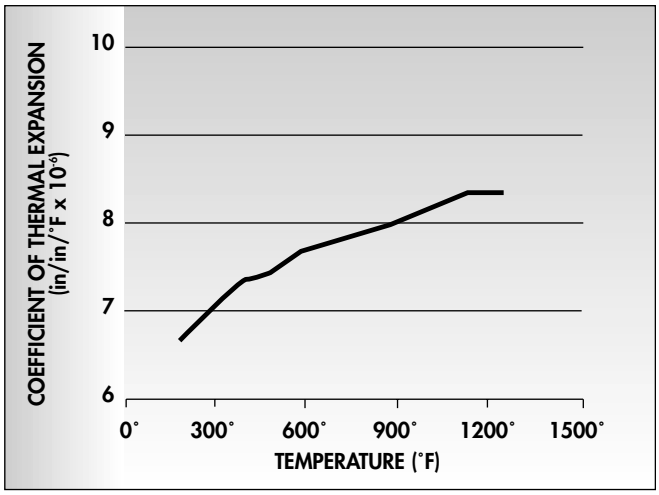
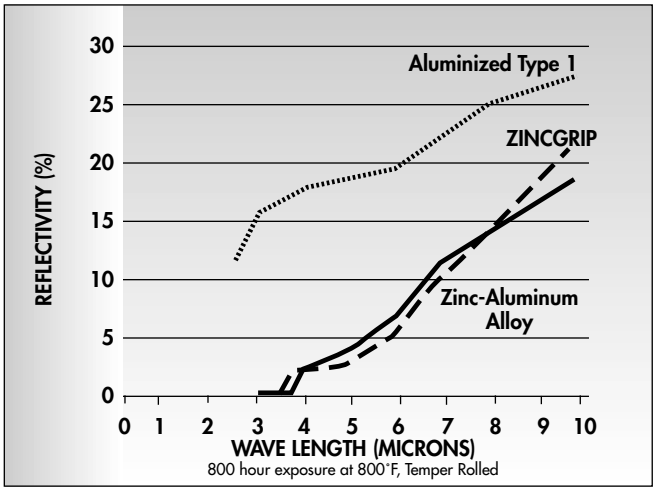


TABLE 6 – CORROSION RESISTANCE

	Aluminized Type 1-40	Zinc-Aluminum Alloy G50	ZINCGRIP G90
Muffler Condensate Corrosion Rate, Mils/yr	8	16	27
Salt Spray–Approx. Hours to Red Rust	500	1000	200
Atmospheric–Mild Industrial, 1 yr loss, mg/cm^2	0.25	0.98	1.5
Atmospheric–Marine, 1 yr loss, mg/cm^2	0.62	1.16	4.5

FIGURE 7 – HEAT REFLECTIVITY



OUTSIDE PROCESSING

Tension leveling, re-squaring, slitting, coil coating, and cutting to length are available from AK Steel via arrangements with outside processors.

MORE INFORMATION/TECHNICAL ASSISTANCE

AK Steel's Technical Representatives can provide you with more detailed information concerning this product. They also are available to assist you in solving any welding, forming, painting, or other material selection issue.

MILL LIMITS

Aluminized Steel Type 1 is available in thickness ranging from 0.017" (.43mm) through 0.140" (3.56 mm) and widths up to 60" (1524 mm), depending on thickness. Coils are supplied with an inside diameter of 24" (609 mm).

Customer Service 800-331-5050

AK Steel Corporation
9227 Centre Pointe Drive
West Chester, OH 45069

www.aksteel.com