

# ALUMINIZED STEEL TYPE 2

## GAUGE & DURABILITY

Technical Bulletin

### ENHANCED SERVICE LIFE WITH A LIGHTER GAUGE MATERIAL

Aluminized Type 2 Steel pipe offers service life competitive with non-metallic pipe.

### REASONABLE ACCURACY IN ESTIMATING SERVICE LIFE FOR VARIOUS ENVIRONMENTS AND PIPE THICKNESSES

Within the recommended ranges for Aluminized Steel Type 2, a 75 year minimum service life can be achieved with a high degree of confidence.



## EFFECTS OF GAUGE ON PIPE DURABILITY

Based on 75 Years Minimum Service Life at 16 Gauge – For Worst Case Conditions Within The Recommended pH/Resistivity Ranges

	Gauge					
	20	18	16	14	12	10
Nominal wall thickness, mils	40	52	64	79	109	138
Nominal coating thickness, mils (one side)	~2	~2	~2	~2	~2	~2
Nominal substrate thickness, mils	36	48	60	75	105	134
AK projected minimum pipe perforation time in years, based on worst-case substrate pitting rate, 0.85 mils/yr. and one-side coating penetration time, 10 years over the recommended environmental ranges	52	66.5	81	98	>100	>100
Suggested DOT minimum pipe perforation times in years, based on 75 years at 16 gauge and on linear effects of gauge changes	50	62.5	75	85	>100	>100
Suggested DOT gauge factors, 16 ga. std., based on minimum pipe perforation times	0.67X	0.83X	1.0X	1.13X	1.33X (min.)	1.33X (min.)

Because Aluminized Type 2 develops a stable long-term pit-penetration rate in the steel substrate under the influence of coating galvanic retardation, the effect of gauge thickness on penetration of a pipe wall can be estimated rather well. A conservative estimate is derived using the worst-case substrate pit-penetration rate observed in 30 year field exposures over the recommended pH/resistivity ranges. The worst-case rate was low, about 0.85 mils per year, and it was observed near the lower limits of recommended pH/resistivity ranges where average pit penetration of the ~2.0 mil Aluminized Type 2 coating on one side is about 10 years.

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## Product Description

### **ACCURACY IN THE ESTIMATION OF SERVICE LIFE AT WALL THICKNESSES OF 16 GAUGE AND GREATER**

Long-term pit penetration rates in the substrate can be used to project pipe wall penetration times to periods as long as the time of duration of coating galvanic retardation. The substrate penetration rate changes once galvanic retardation is gone. Cleveland-Cliffs field studies show no evidence of a limit on the duration of galvanic retardation at 42 – 43 years exposure in the field, so an assumed 75 year duration is quite reasonable. Thus substrate penetration times up to 75 years can be estimated with reasonable confidence, and the worst case pit-penetration rate applies to service-life projections up to 75 years. Projections to times beyond 75 years must be based largely on effects of increased wall thickness. Because the worst-case penetration rate projects to 81 years pipe-perforation time at 16 gauge, a 75 year minimum service life applies to 16 gauge; it is primarily additional wall thickness that determines how much additional service life is possible. Cleveland-Cliffs limits service life projections to 100 years; it is quite reasonable to extrapolate from 75 years at 16 gauge (0.064 in.) out to > 100 years at 12 gauge (0.109 in.) and 10 gauge (0.138 in.) largely on the basis of wall thickness. An interpolated value proportionate with wall thickness is easily and credibly assigned to 14 gauge material.

### **ACCURACY IN THE ESTIMATION OF SERVICE LIFE AT WALL THICKNESSES BELOW 16 GAUGE**

California has a 50 year design life policy for drainage structures. The CALTRANS Highway Design Manual states that 16 gauge Aluminized Type 2 provides the required 50 year service life throughout their recommended pH/resistivity ranges. Since field studies indicate that 16 gauge Aluminized Type 2 has a minimum 75 year service life throughout the Cleveland-Cliffs recommended pH/resistivity ranges, the CALTRANS 50 year minimum service life requirement can be met with a very high degree of certainty.

16 gauge Aluminized Steel Type 2 is designed to exceed the 50 year service life. The minimum gauge needed can be determined with reasonable accuracy. It was evident that low substrate pit-penetration rates associated with full galvanic retardation would endure for at least 50 years within recommended pH/resistivity ranges. Clearly, gauge requirements for meeting a 50 year perforation time criterion can be determined with confidence on the basis of worst-case pit-penetration rates determined from field studies. Thus, over a 50 year exposure time, worst-case pitting would penetrate the 2 mil coating on one side in 10 years and 34 mils of substrate in 40 years (34 mils ÷ 0.85 mils/yr.). A 20 gauge Aluminized Type 2 (40 mils, that is, 4 mils coating + 36 mils substrate) would resist pit perforation for more than 50 years. It should be evident that, even if an additionally conservative 50 year limit on normal coating galvanic action were utilized, 20 gauge material would still meet a 50 year service-life requirement with confidence.

### **ENVIRONMENTAL FACTORS**

All gauge recommendations apply only to the recommended pH 5–9 and  $\geq 1,500$  ohm·cm resistivity pH 4.5 – 5.0 with resistivity  $\geq 5,000$  ohm·cm, environmental limits, since the corrosion behavior of Aluminized Type 2 can change notably outside these limits. Observations from the 50 year durability study indicate that 16 gauge could have a service life that exceeds 100 years in the pH range 6 – 8 or over the full range if resistivity  $\geq 5,000$  ohm·cm. For pH between 4.5 – 5.0 minimum resistivity of 5,000 ohm·cm, 16 gauge would have an estimated service life of 75 years.



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## About Cleveland-Cliffs Inc.

Cleveland-Cliffs is the largest flat-rolled steel producer in North America. Founded in 1847 as a mine operator, Cliffs also is the largest manufacturer of iron ore pellets in North America. The Company is vertically integrated from mined raw materials, direct reduced iron, and ferrous scrap to primary steelmaking and downstream finishing, stamping, tooling, and tubing. The Company serves a diverse range of markets due to its comprehensive offering of flat-rolled steel products and is the largest supplier of steel to the automotive industry in North America. The Company is headquartered in Cleveland, Ohio with mining, steel and downstream manufacturing operations located across the United States and in Canada. For more information, visit [www.clevelandcliffs.com](http://www.clevelandcliffs.com).



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