

TIMMINCO EXTRUDED MAGNESIUM ANODES

End Configurations and Adaptor Caps

For magnesium anodes to provide protection, a positive electrical connection must be established and maintained between the anode and the structure being protected. To facilitate their use, anodes are furnished with various end configuration and/or adaptor caps.

The standard end configurations are:

- 1: Both ends plain (saw cut) - page 2.
- 2: One end plain, one end threaded - page 3.
- 3: One end plain, one end capped - page 6.
- 4: One end counterbored with core wire exposed (1.050" diameter and larger only) - page 7.
- 5: One end plain, one end with core wire exposed - page 3.
- 6: Core wire exposed on both ends - page 3.
- 7: Link-type anode, one end welded steel plug with 9" to 12" anode sections joined with flexible connector to desired length - page 7.

Areas of Application

There are four primary areas where extruded anodes offer important advantage in cost, performance, and ease of installation:

- Water heaters and water storage tanks, where a small diameter anode simplifies installation.
- Steel located in high resistivity electrolytes, where a small diameter anode gives a desirable current output-to-anode weight ratio.
- Gas service entrance piping, where a small diameter anode can be driven into the ground to provide convenient and inexpensive protection.
- Depolarization of structures in seawater, where a small diameter anode gives short-term, high-current output.

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COMPOSITION & CONDUCTIVITY

	GALVOROD™	GALVOMAG™ & GALVOLINE™
Mg %	Balance	Balance
Al %	2.5-3.5	0.010 Max
Mn %	0.20-1.0	0.50-1.3
Zn %	0.7-1.3	-
Ca max. %	0.04	-
Si max. %	0.05	-
Cu max. %	0.01	0.02
Ni max. %	0.0010	0.001
Fe max. %	0.002	0.03
Other Impurities max %		
Each	0.01	0.05
Total	0.30	0.30

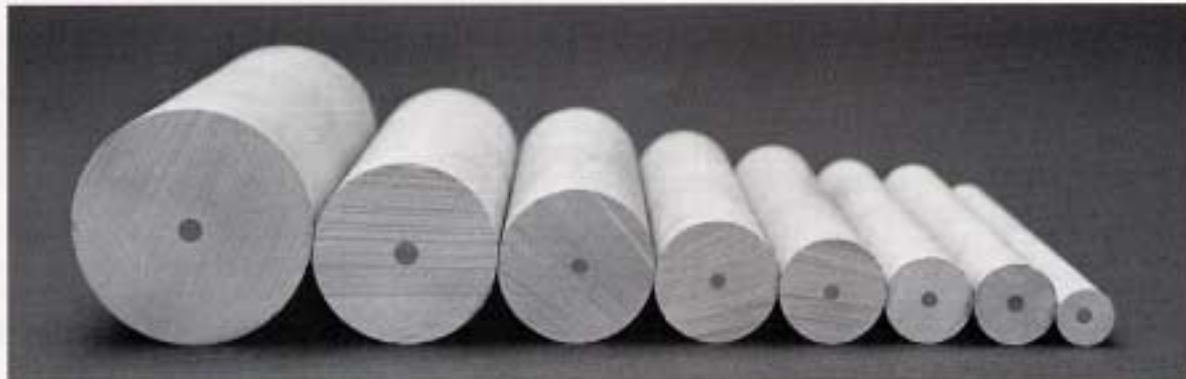
Anode rods are extruded in twelve standard diameters ranging from 0.500" to 2.562". GALVOLINE™ ribbon anode is extruded as a 3/8" x 3/4" ribbon. Each anode has a steel core running lengthwise through its center.

Anode rods are available as either the standard GALVOROD™ anode or the high-current output GALVOMAG™ anode. GALVOLINE™ ribbon anode is manufactured with the high-current output composition.

In most environments, the oxidation potential is 1.4 to 1.5 volts for GALVOROD™ and 1.6 to 1.7 volts for GALVOMAG™ (with respect to a copper-copper sulfate reference electrode). Because of its higher oxidation potential, GALVOMAG™ anodes of a given size deliver approximately 25% more current (milliamperes) than GALVOROD™ anodes of the same size. As electrolyte resistivity increases, the need for GALVOMAG™ anodes increases.

Current capacities for GALVOMAG™ and GALVOROD™ anodes are similar and will range from 450 to 550 ampere hours per pound, depending primarily on the operating rate (anode current density).

PHYSICAL TOLERANCES



Anode rods are extruded in twelve standard diameters ranging from 0.500 to 2.562", as shown above with plain ends.

Shape Identification Number	Diameter (inches)	Core Centering (inches)	Core Wire Diameter (inches)	Straightness (inches)	Approximate Weight
DC-4400	0.500-0.020	Within .040	0.135	0.060 in 2 ft	0.015 lbs/in
DC-6066	0.675-0.020	Within .050	0.135	0.060 in 2 ft	0.025 lbs/in
DC-6836	0.700-0.020	Within 1/16	0.135	0.040 in 2 ft	0.027 lbs/in
DC-1070	0.750-0.020	Within 1/16	0.135	0.040 in 2 ft	0.031 lbs/in
DC-8125	0.800-0.020	Within 1/16	0.135	0.040 in 2 ft	0.035 lbs/in
DC-983	0.840-0.020	Within 1/16	0.135	0.040 in 2 ft	0.038 lbs/in
DC-6826	0.900-0.020	Within 1/16	0.135	0.040 in 2 ft	0.043 lbs/in
DC-982	1.050-0.020	Within 1/16	0.135	0.040 in 2 ft	0.057 lbs/in
DC-980	1.315-0.020	Within 1/16	0.135	0.040 in 2 ft	0.089 lbs/in
DC-2376	1.561±0.016	Within 1/16	0.188	0.250 in 10 ft	1.5 lbs/ft
DC-2375	2.024±0.024	Within 1/8	0.188	0.250 in 10 ft	2.5 lbs/ft
DC-6772	2.562±0.024	Within 1/8	0.188	0.250 in 10 ft	4.0 lbs/ft
DC-1016 GALVOLINE™	3/8 x 3/4 in ±0.015 Rectangle (1/8 R corners)	Within 1/16	0.135	Furnished in coils with sheared ends	0.243 lbs/ft

LENGTH TOLERANCES

Plain Anode Rods:

Up through 4.999' + 1/8"-0

5' through 19.999' + 1/4"-0

20' and over +1"-0

Threaded or Capped Rods:

± 1/4"

GALVOLINE™ Anodes

1000' ± 25' coils random wound

Coils are 32" OD x 18" ID x 8"

transverse steel banded.

SHIPPING TOLERANCES

Rods: ± 3% of pieces ordered

Packaged in cardboard cartons on wood pallets.

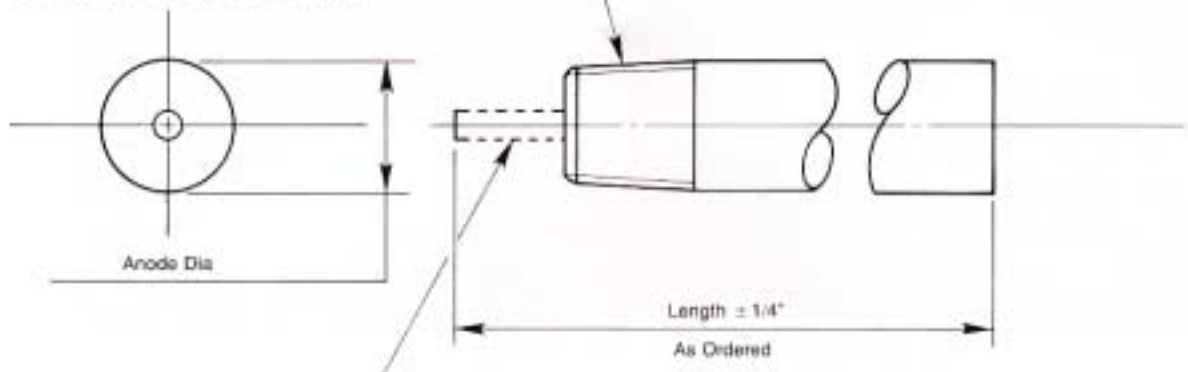
GALVOLINE™: Exact number of coils ordered.

Bare (banded) coils. Special packaging requires a quotation from the Aurora Customer Service Center or Haley Customer Service Center.

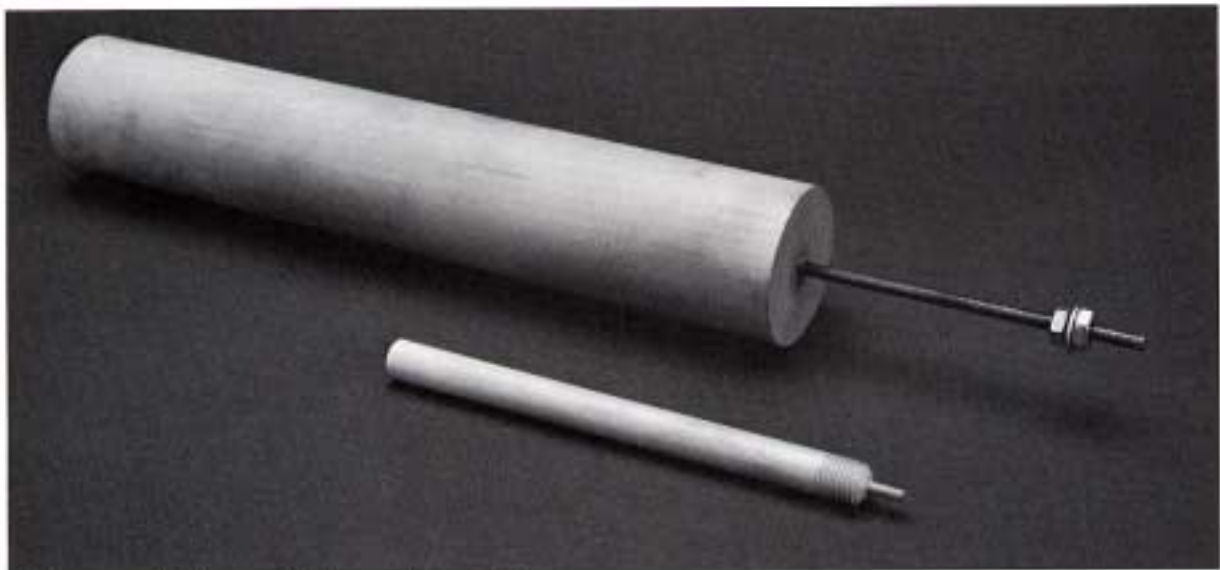
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THREADED OR EXPOSED CORE WIRE

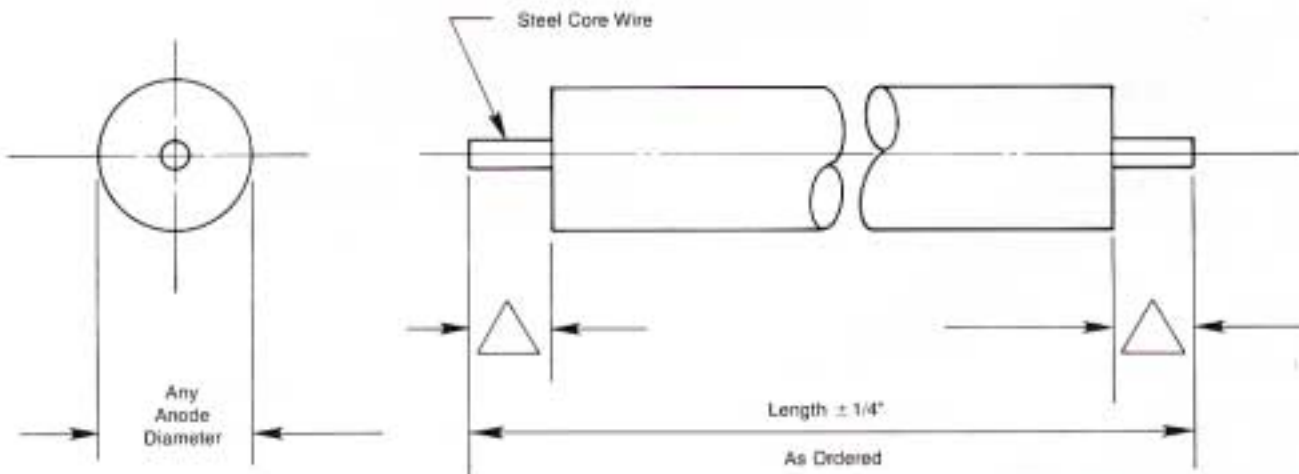
Commercial pipe thread tolerances apply



When rod is being prepared for weld screw-on cap a suitable length of core wire is left exposed.



Anode, one end plain, one end with core wire exposed.



As ordered, on one or both ends. Up to 1 inch exposed, tolerance is $\pm 1/16$ \"

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Water Tanks

The use of extruded anodes for cathodic protection of residential and commercial glass-lined water heaters is a universal practice. A 3/4" half-coupling welded into the top head of the water heater is typically used for anode installation. Caps DS-1W, DS-2W, and DS-3W (Page 6) can be screwed into the 3/4" half-coupling. DS-4W requires a 1" half-coupling.

Heater manufacturers with in-house capping capability may purchase anodes with both ends plain (saw cut) or one end plain and one end threaded.

Structures in High Resistivity Electrolytes

The conventional GALVOMAG™ magnesium cast anode is an economical and dependable source of current in soils and waters of comparatively low electrolytic resistivity. However, at higher resistivities, the problem becomes supplying enough current for protection without installing an excessive weight of anodes.

The solution? The magnesium ribbon anode called GALVOLINE™.

A considerable departure from traditional sacrificial anodes, GALVOLINE™ ribbon anode offers the following advantages.

- **Minimum resistance to earth per unit weight of anode installed.** The GALVOLINE™ anode supplies from three to seven times as much current per pound of magnesium installed as does the conventional cast anode, so you will obtain more milliamperes per pound for any weight of anode installed.
- **Efficient current distribution along a pipeline reduces current requirements to a minimum.** Whereas individual anode installations provide an uneven current distribution along a pipeline, the continuous ribbon anode provides uniform current along the pipeline.

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THREADED ANODE STANDARDS

Shape Identification Number	Anode Diameter (inches)	Commercial Pipe Thread
DC-4400	0.500	1/4-18 NPT
DC-6066	0.675	3/8-18 NPT
DC-6836	0.700	3/8-18 NPT
DC-1070	0.750	3/8-18 NPT
DC-983	0.840	1/2-14 NPT
DC-6826	0.900	1/2-14 NPT
DC-982	1.050	3/4-14 NPT
DC-980	1.315	1-11 1/2 NPT

- **Fewer electrical connections.** The number of electrical connections between the anode and the structure being protected is reduced to a minimum. Since the core wire is in contact with each incremental length of anode, the ribbon serves as its own collector wire, eliminating much of the wiring normal to the conventional anode installation. Given reasonably uniform corrosion of the anode ribbon and relatively light current drains (1-3 ma, per running foot), connections made at intervals of 500 to 1000 feet are adequate. No chemical backfill is necessary.
- **Mechanical installation.** The ribbon is formable enough to permit storage in coils or on reels. If the reel is mounted on a tractor or truck, the ribbon anode can be fed from the reel to a wire-laying plow for continuous mechanical installation. The ribbon can also be placed in special configurations such as helical, pancake, or hairpin coils, where interior surfaces of tanks, large pipes, or condensers are to be protected.

The nomograph on page 9 can be used in pipeline applications to determine current output per foot of GALVOLINE™ and anode life.

Gas Service Entrance Piping

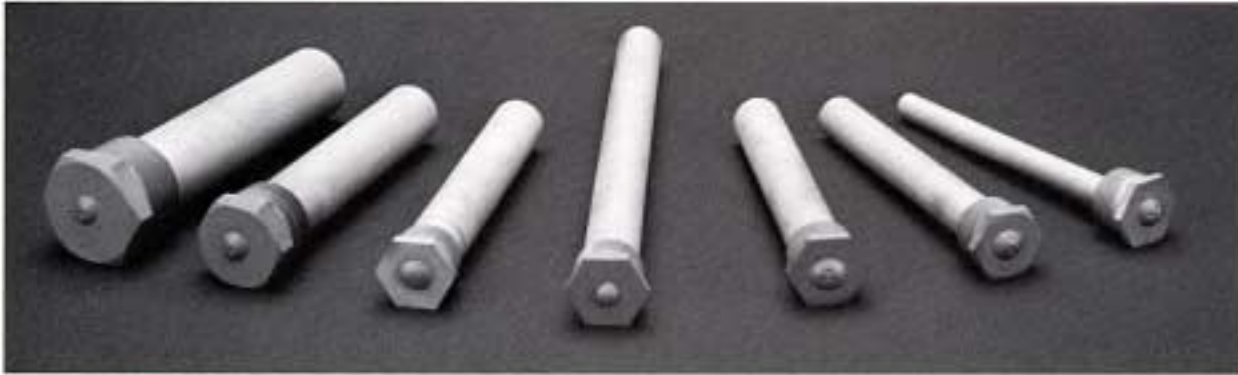
A gas company's need to protect the pipe located between a gas main and a customer's gas meter can be easily and inexpensively met by a small diameter extruded magnesium anode. The amount of current required in this application is typically only a few milliamperes, easily supplied by a small extruded anode. Installation is a simple matter of driving the anode into the ground with a hammer. Both capped anodes (facing page) and counter bored anodes (page 7) have been used successfully in this application.

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GALVOLINE™ ribbon anodes offer minimum resistance to earth per unit weight of anode installed. GALVOLINE™ ribbon anode is extruded as a 3/8" x 3/4" ribbon. Each anode has a steel core running lengthwise through its center.

CAPPED ANODES

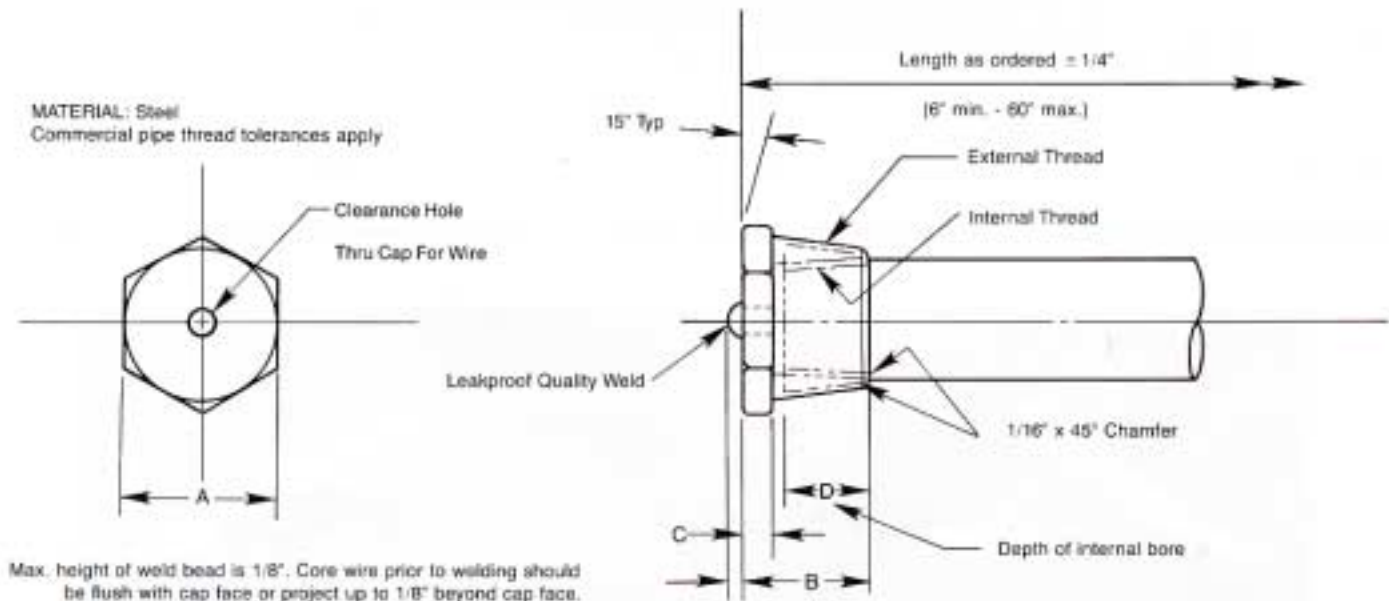


Anode, one end plain, one end capped.

WELDED SCREW ON CAP SPECIFICATIONS

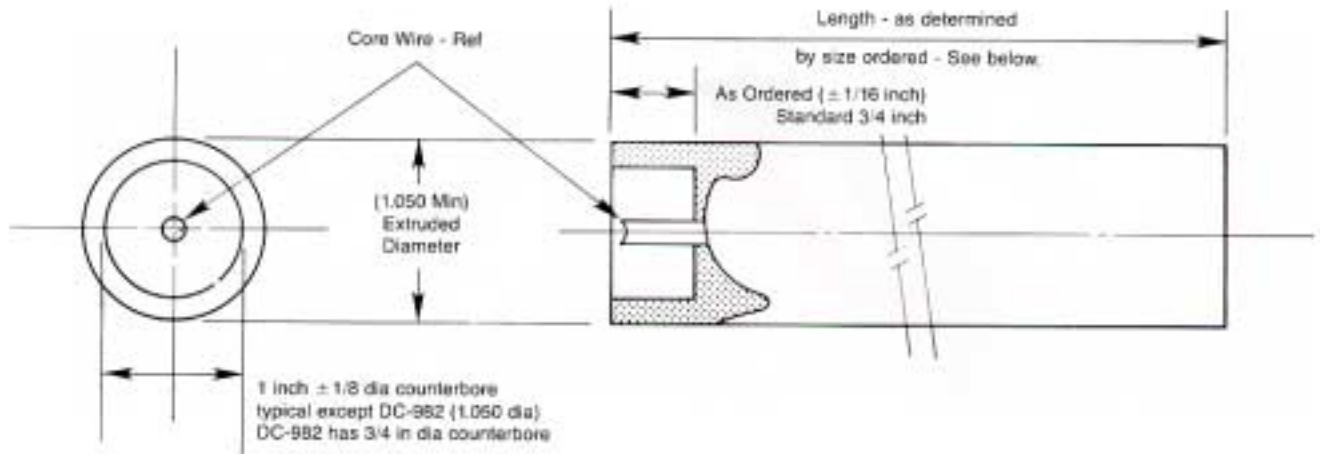
Cap Number	Used on Anode (Diameter)	Dimensions for Diagram Below				Cap Threads (See Page 4 for Rod Threads)	
		A	B	C	D	Internal	External
DS-1W	0.500	1.06	0.81	0.19	0.63	1/4-18 NPT	3/4-14 NPT
DS-2W	0.675, 0.700, 0.750	1.06	0.81	0.91	0.63	3/8-18 NPT	3/4-14 NPT
DS-3W	0.840, 0.900	1.06	0.81	0.19	0.63	1/2-14 NPT	3/4-14 NPT
DS-4W	1.050	1.31	1.19	0.44	1.00	3/4-14 NPT	1-11 1/2 NPT

Minimum backup torque to loosen cap from rod:
 DS-1W=5 ft•lb DS-2W and DS-3W=20 ft•lb DS-4W=50 ft•lb



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SERVICE ANODES, ONE END COUNTERBORED (Ready for Lead Wire)



SERVICE ANODE SPECIFICATIONS

Nominal Weight (lbs)	Nominal Length (inches)	Approximate Surface Area (square inches)	Nominal Diameter (inches)	DC References
1	17 1/2	59	1.040	982
1	11 1/2	50	1.305	980
1	4 3/4	37	2.024	2375
2	9 1/2	67	2.024	2375
2	6	59	2.562	6772
3	14 1/4	97	2.024	2375
3	9	83	2.562	6772
5	15	131	2.562	6772
7	21	179	2.562	6772
10	30	252	2.562	6772
15	45	372	2.562	6772
20	60	493	2.562	6772

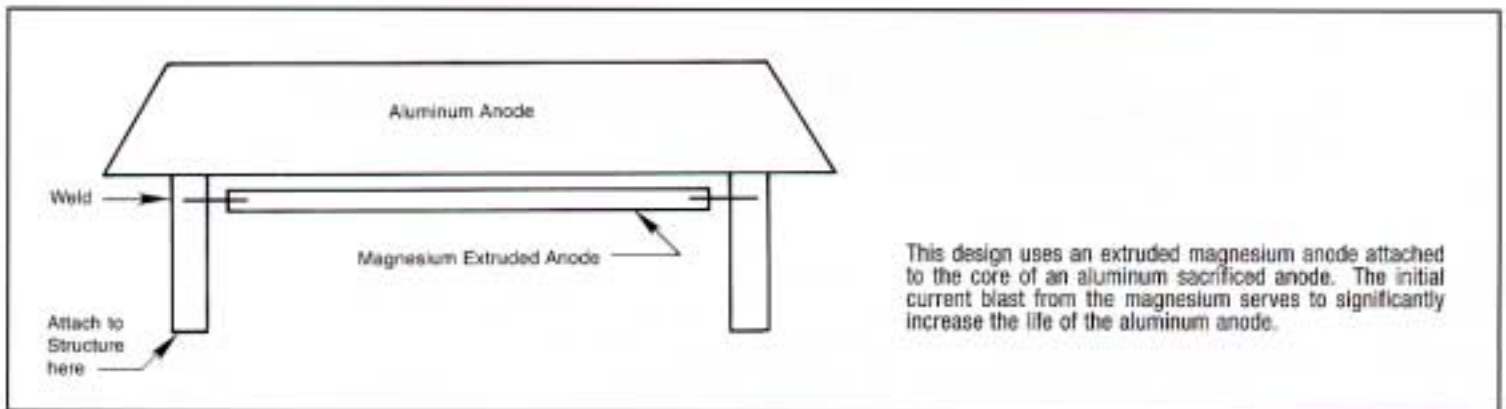


Link-type anode.

Prepolarization of Structures in Seawater

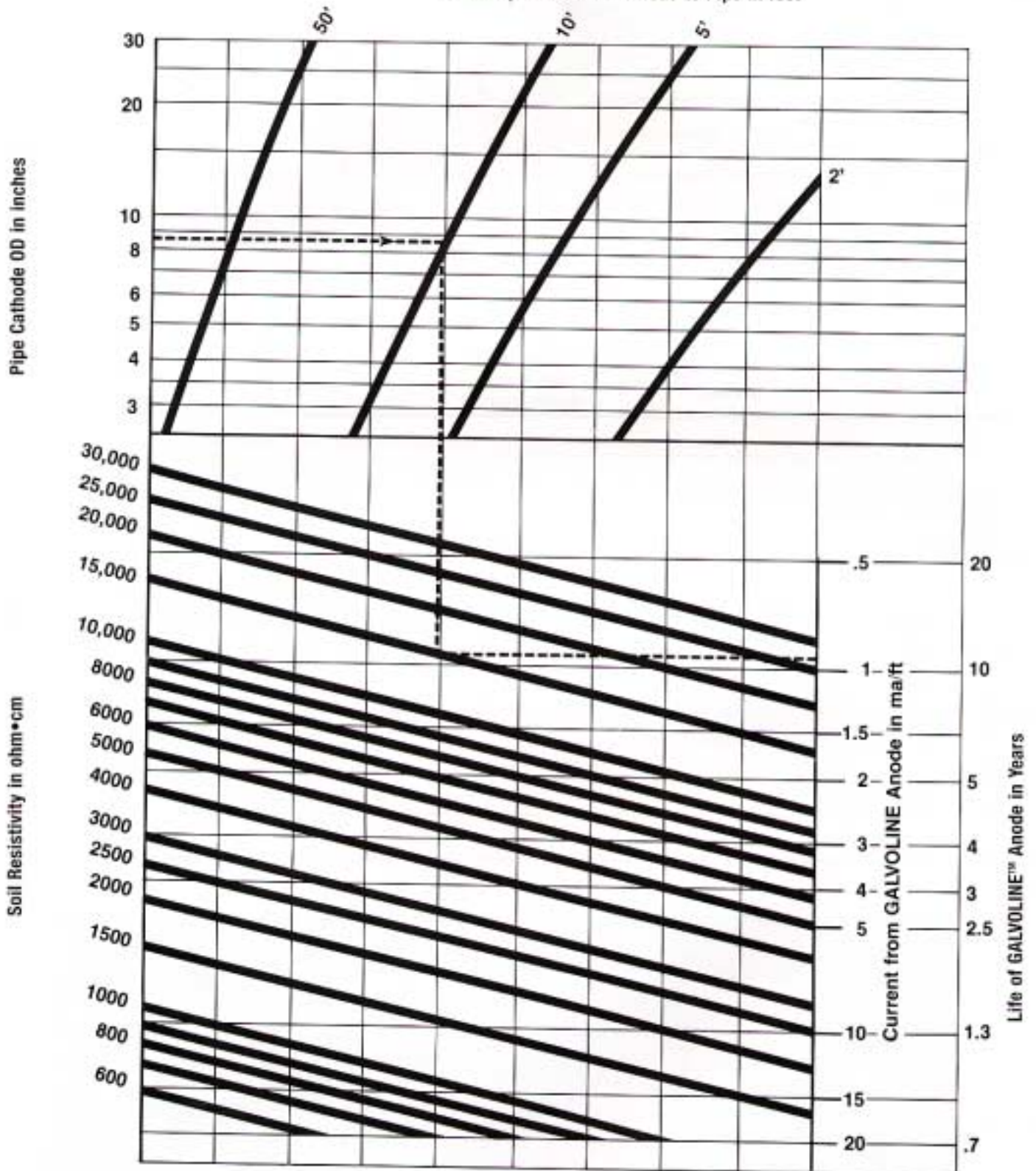
For cathodic protection of structures in seawater, it is best to first apply a high-current density (30-50 ma/ft²) for a short time (5 days or more). This immediately arrests steel corrosion and precipitates a calcareous coating (CaCO₃ plus Mg(OH)₂) from the seawater onto the steel surface. Once the calcareous coating has formed, the amount of current required to protect the steel is much less (2-3 ma/ft²) than before prepolarization (6-15 ma/ft²).

Extruded magnesium anodes supply a portable source of high current that can be used to prepolarize a corroding structure. The design shown below and on page 3 uses an extruded magnesium anode attached to the core of an aluminum sacrificial anode. The magnesium anode initially provides current at a rate of 1 to 2 amperes per foot of anode in seawater. By the time the magnesium has been consumed, the calcareous coating has been formed on the steel. The aluminum anode then begins to operate but at a lower current output than would have been required if the calcareous coating had not been formed. The initial current blast from the magnesium serves to significantly increase the life of the aluminum anode.



GALVOLINE™ Ribbon Anode Current and Life when Attached to Underground Pipe*

Distance, GALVOLINE™ Anode to Pipe in feet



Example - For 8.625" OD Pipe, 10' from GALVOLINE™ anodes, in 15,000 ohm • cm soil, I-0.9 ma/ft,
 Life of GALVOLINE™ anode = 11 years
 Pipe potential of .85 volts (copper-copper sulfate reference)