CORROSION CONTROL MATERIALS

Anodes, Zinc

1. SCOPE

This specification covers zinc ribbon and zinc package anodes for grounding purposes of buried steel piping and tracer wire. These anodes are used for mitigative purposes when hazardous AC voltages are present on the piping system or when interference from foreign DC sources is detected on buried metallic structures. The zinc anodes may be bare ribbon or packaged in backfill.

2. APPLICABLE DOCUMENTS

2.1 ASTM International (ASTM) B-418 Type I or II, "Specification for Cast and Wrought Galvanic Zinc Anodes."

2.2 ASTM International (ASTM) F1182-07, "Standard Specification for Anodes, Sacrificial Zinc Alloy."

2.3 MIL-A-18001(Military Specification) "Sacrificial Zinc Alloy"

2.4 United States Department of Transportation (DOT), Code of Federal Regulations, Title 49, Part 192, "Transportation of Natural and Other Gas by Pipelines Minimum Safety Standards."

NOTE: Unless otherwise specified, the editions of the above documents incorporated by DOT 49 CFR 192 are applicable. Documents not incorporated by DOT 49 CFR 192 will be the most recent edition.

3. TERMINOLOGY

3.1 General

3.1.1 "Southwest Gas," "Southwest" or "SWG" wherever used in this specification and other related documents will refer exclusively to Southwest Gas Corporation.

3.1.2 The terms "approved," "as approved," "satisfactory," "as directed," "or equal" or other similar terms wherever used in this specification and other related documents will mean "as determined by Southwest Gas," unless specifically stated otherwise.

3.1.3 "Product Information Package" or "PIP" wherever used in this specification and other related documents will mean the required technical product information that a manufacturer must submit to Southwest to determine if the product is suitable for use by Southwest, unless specifically stated otherwise.

3. TERMINOLOGY (Cont'd)

General (Cont'd)

3.2 "Anode Weight" is the minimum physical poundage of the active anode material only. The total anode assembly may actually weigh more.

4. MATERIALS AND MANUFACTURING

4.1 The active anode material shall be free of foreign metal inclusions. The alloy composition shall conform to Table L-23.1 by percent weight.

ELEMENT	TYPE I	TYPE II
Lead-%	0.005	0.003
Iron-%	0.005	0.0014
Cadmium-%	0.025-0.07	0.003
Copper-%	0.005	0.002
Aluminum-%	0.1-0.5	0.005
Others-Total %	0.1	-
Zinc-%	Remainder	Remainder

TABLE L-23.1

4. MATERIALS AND MANUFACTURING (Cont'd)

4.2 Bare zinc ribbon anodes shall be sized in accordance with Table L-23.2

PRODUCT SIZE	PLUS	STANDARD
Cross Section (Inches)	5/8" x 7/8"	½" x 9/16"
Weight/Foot (Pounds)	1.2	0.6
Diameter of Wire Core (Inches)	0.135	0.130
Standard Coil Length (Feet)	200	500
Standard Coil I.D. (Inches)	36	12
Packaging	Steel-Banded Random-Wound Open Coils	Wood Reels

TABLE L-23.2

4.3 Pre-packaged zinc anodes shall be sized in accordance with Table L-23.3

BARE WEIGHT	BARE DIMENSIONS	PACKAGED WEIGHT	PACKAGED DIMENSIONS
48 LBS.	2" X 2" X 48 "	100 LBS.	6" X 58"
60LBS.	2" X 2" X 60"	120 LBS.	6" X 65"

TABLE L-23.3

4. MATERIALS AND MANUFACTURING (Cont'd)

4.4 The anode shall be centered in a water-permeable cloth sack. The sack opening shall be securely fastened closed. The backfill shall be dry, finely powered and uniformly mixed. A plastic or paper outer bag shall be used for protection during shipping.

4.5 The backfill material composition by volume shall be:

- Hydrated Gypsum, 75% +/- 3%
- Bentonite Clay, 20% +/-, and
- Sodium Sulfate, 5% +/- 1%

4.6 Each pre-packaged anode shall contain a core of steel wire extending at least three-quarters into the anode's length. The core shall be galvanized or otherwise metallurgic ally bonded to the cast zinc alloy.

4.7 The core at any cross section shall not lie closer to the outer surface of the anode that 25% of the width of the cross section of the anode. The core shall terminate in a recess in the top of the anode.

4.8 A 25-foot long No. 12 AWG stranded copper wire with type TW or THWN insulation shall be attached to the anode. The free end of the wire shall have the insulation removed for a length of ¾ inch. The wire shall extend through the top of the bag of the backfill-packaged anodes.

4.9 The copper wire shall be wrapped around and soldered to the core of the anode. The recess shall be even with the anode top with a potting compound.

5. PERFORMANCE REQUIREMENTS

5.1 The anodes should meet the requirements shown in Table L-23.4 at a minimum.

ELECTROCHEMICAL PROPERTIES OF ZINC ANODES		
	TYPE I	**TYPE II**
Open Circuit Potential (-V)	1.05 Min.	1.10 Min.
Closed Circuit Potential (-V)	1.00 Min.	1.05 Min.
Current Capacity (amp-hrs/lb.)	372	372
Galvanic Efficiency (%)	95	90
Consumption-Actual (lb/amp*yr)	24.8	26.2

TABLE L-23.4

6. INSPECTION

6.1 Successful review of the Product Information Package (PIP), as well as any future reference by SWG to the Seller's part number or internal code number in any future contract or purchase, will mean only that no conflict with the specification was found, and will not relieve the seller from meeting all the requirements of this specification.

6.2 SWG retains the option to inspect the manufacture and testing of all materials sold to SWG.

6.3 SWG will make appropriate inspections and test of any and all materials, products or systems supplied to this specification. SWG will have the right, at their option, to reject any material, which fails to conform to this specification. Any such rejection may take place at the manufacture's facility; the supplier's warehouse or any subsequent delivery location, before or after SWG assumes possession. Notice of the rejection will be made promptly to the supplier by SWG. The defective product will be replaced or returned for credit at the manufacturer's expense.

6.4 Any changes in the manufacturing of previously approved materials, products or systems described in this material specification for sale to SWG must be approved by SWG's Engineering Staff. **Failure to obtain SWG's approval may be cause for rejection and disqualification as an approved supplier.**

7. CERTIFICATION

The manufacturer's or supplier's certification will be furnished to SWG. This certification will state that samples representing each lot have been manufactured, tested and inspected in accordance with this specification and that all requirements have been met. When specified in the purchase order or contract, a report of results will be provided.

Upon the request of Southwest, the certification of an independent third party indicating conformance to the specification may be considered at Southwest's expense.

8. SAFETY DATA SHEETS

In accordance with law, the seller will supply Safety Data Sheets for all applicable items supplied under this specification to the following:

1) The Receiving Location
2) Engineering Staff
3) Southwest Gas Corporation
   Corporate Safety
   Mail Station LVA-120
   P.O. Box 98510
   Las Vegas, NV 89193-8510

9. PACKAGING AND PACKAGE MARKING

9.1 Non-drivable anodes shall be shipped in a sealed, reinforced water-resistant bag or container to provide protection against damage to the backfill sack. The maximum bag or container weight as shipped shall be 90 lbs. If stored on a pallet, the shipping bags must be protected as to prevent damage if moved by forklift.

9.2 Drivable anodes shall be shipped in a box or container. No more than a quantity of fifty (50) 1 Lb. anodes or twenty (20) 2.5 Lb. anodes shall be packaged in the same container.

9.3 The shipping bag or container shall be marked with the manufacturer's name and/or trademark, type of anode (Zinc), weight of anode (i.e., 32 lbs.) and number of units.

9.4 All products covered in this specification will be packaged in a manner to prevent damage during transportation and storage.

10. STOCK CLASS DESCRIPTION

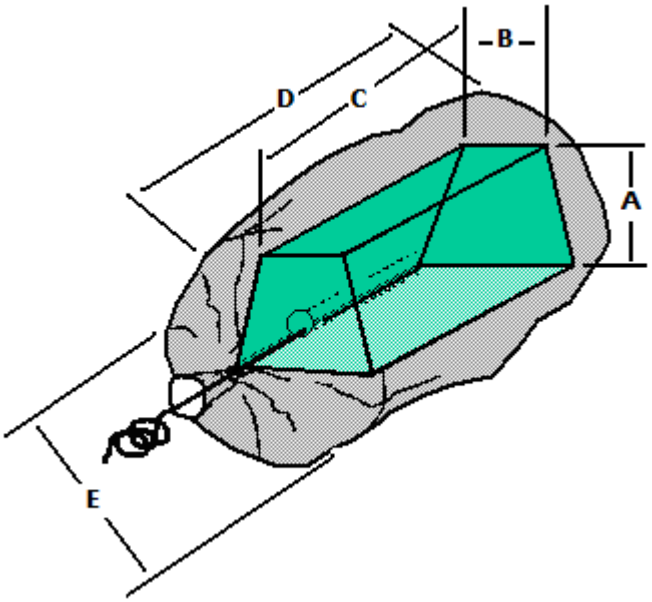
ANODE, ZINC RIBBON, ½ INCH X 9/16 INCH, WITH 0.130 INCH DIAMETER GALVANIZED STEEL CORE.

ANODE, ZINC RIBBON, 5/8 INCH X 7/8 INCH, WITH 0.135 INCH DIAMETER GALVANIZED STEEL CORE, 200 FEET PER COIL.

ANODE, 48 POUND, ZINC, ¼ INCH GALVANIZED MILD STEEL CORE, WITH 25 FEET OF NO. 12 AWG COPPER WIRE WITH TW OR THWN INSULATION, WITH GYPSUM AND BENTONITE BACKFILL MIXTURE, PACKAGED WEIGHT 100-105 POUNDS.

ANODE, 60 POUND, ZINC, ¼ INCH GALVANIZED MILD STEEL CORE, WITH 25 FEET OF NO. 12 AWG COPPER WIRE WITH TW OR THWN INSULATION, WITH GYPSUM AND BENTONITE BACKFILL MIXTURE, PACKAGED WEIGHT 120-130 POUNDS.

APPENDIX A



TYPICAL DRAWING-ANODE

(Non-Drivable Prepackaged Anode Shown)

ANODE NOMINAL WT. (Lbs. Bare)	TYPICAL DIMENSION (Inches)				
	A	B	C	D	E
1	1.3 Φ	Round	12	N/A	N/A
2.5	1.3 Φ	Round	30	N/A	N/A
5	3	3	3	11	6
9	3	3	13.5	15.5	6
17	4	4	17	21	6.5
20	2	2	60	64	5
32	5	5	20	26	8
50	8 Φ	Round	16	N/A	N/A
Φ = Diameter					

APPENDIX B

TYPICAL RIBBON-ANODE

ELECTROCHEMICAL PROPERTIES OF ZINC RIBBON ANODES		
	TYPE I	**TYPE II**
Open Circuit Potential (-V)	1.05 min.	1.10 min.
Closed Circuit Potential (-V)	1.00 min.	1.05 min.
Current Capacity (amp-hrs/lb)	372	372
Galvanic Efficiency (%)	95	90
Consumption-Actual (lb/amp*yr)	24.8	26.2