Membrane Properties
(Best Cover 21 oz.)

Material Construction

BASE FABRIC	Weft Inserted	Weft Inserted
FILAMENT SIZE	1000 Denier	1000 Denier
CONSTRUCTION	7 f/cm X 7 f/cm	18 f/m X 18 f/m
BASE FABRIC WEIGHT	200 g/m Squared	5.8 oz/yd Squared
FINISHED WEIGHT	720 g/m Squared	25 oz/yd squared
WIDTH	250 cm	98.5 in

Physical Properties*

Grab Tensile (Method 5100)	1998 X 2131 N	450 X 480 lb
Strip Tensile (Method 5102)	1243 X 1110 N	280 X 250 lb
Tongue Tear (Method 5134	Exceeds 444 N	Exceeds 100 lb
Trapezoid Tear (Method 5136)	222 X 200 N	50 X 45 lb
Adhesion In-House (force/2cm)**	67 N	15 lb
Cold Crack (Method 5874 @ -67°F	No Cracking or Flaking	
Flame Resistance**	Meets NFPA 701 Small and Large Scale Tests	

* Properties analysis performed according to Federal Test Method 191A except those labeled with "**"

Flame Resistance

Best cover's flame resistance has been evaluated using the following flame retardant test standards.

- NFPA 701 – 1996 Edition Test Method 1
- NFPA 702 – 1996 Edition Test Method 2
- NFPA 701 – 1989 Edition Small Scale Test
- NFPA 701 – 1989 Edition Large Scale Test
- CAN/ULC – S109 – M87 Small Flame Test
- CAN/ULC – S109 – M87 Large Flame Test
- CPAI – 84 Section 6 (Horizontal Test) and Section 7 (Vertical Test)
- California Fire Marshall Small Scale Test (Paragraph 1237.1)

The Average Melting Point of all coated fabrics using the Fisher-Johns Melting point apparatus is:

- 160°C (320°F)

Fungal & Microbial Resistance

Best cover's fungal and microbial resistance has been evaluated using the following test standards.

- Fungal Chamber Test: U.S. MIL STD-810E Method 508.4 (1989)
- A.A.T.C.C. Test Method 147-1993 – Staphylococcus Aureus (ATCC # 6538)
- A.A.T.C.C. Test Method 30-1993 – Aspergillus Niger (ATCC # 6275)

HOT DIP GALVANIZING LIFETIME CORROSION PROTECTION

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The economic cost of corrosion is staggering. A National Bureau of Standards study in the late 1970s estimated annual corrosion costs in the United States to be 4.2% of the Gross National Product. Based on this estimate, current corrosion costs in North America in 1988 were over $200 billion. Hot dip galvanizing is a cost effective, readily available technology which can be used to protect exposed steel structures and articles against corrosion.

Corrosion Of Steel

Rust, the corrosion product of iron, is the result of an electrochemical process. The reaction takes place because of elecnopoiential differences which exist between areas on the steel surface. These microscopic areas are called anodes and cathodes and occur because of variations in surface composition and structure, impurities in the steel. Internal stresses and\or a non-uniform environment. When an electrolyte (ie. moisture) is present, the anode and cathode are elecrochemically coupled. Ions are formed or consumed at the meial surface and electrons flow in the metal from the anode to the cathode. This generates positively charged iron ions at the anode which in turn combine with oxygen containing species in the electrolyte to form iron oxide or rust. In the vast majority of cases, corrosion of steel is prevented by applying a protective barrier to the steel surface. The coating does not allow the electrolyte (a required condition for corrosion) to contact the steel surface and prevents corrosion from occurring while the protective coating is intact.

How Zinc Prevents Steel From Corrosion

Zinc's ability to provide long term corrosion protection of steel is due to the two-fold nature of the coating. Zinc coatings provide excellent barrier protection and are also able to cathodically protect steel where damage or minor discontinuity occurs in the coating.

Barrier Protection

Some methods of applying zinc such as hot/dip galvanizing, result in a tightly bonded, continuous metallic coating which is highly abrasion resistant and impervious to gases and liquids. The excellent barrier protection of zinc coatings is maintained for long periods of time because of zinc's ability to protect itself with its corrosion product.

Zinc is a reactive metal and readily forms a protective corrosion product Film. When zinc is initially exposed to air, a very thin film of zinc oxide forms. During normal atmospheric exposure, this surface reacts with moisture to form zinc hydroxide. Then, during drying, the zinc hydroxide reacts with carbon dioxide to form zinc carbonate. The final corrosion product is a compact, tightly adherent, insoluble coating which provides excellent barrier protection to the underlying zinc.

The protective nature of this corrosion product can be seen in Table 1. Although zinc is more reactive than steel, because of the protective corrosion products which form. zinc will corrode, but at a rate many times slower than that of steel. This is especially true in more aggressive environments. Table 2 presents this information in a form that can be related more easily to coating life. If we know coating thickness and the environment in which it is exposed, we can make a rough prediction of coating life.

* A uniform coating is obtained on all surfaces, including those areas not normally accessible to mechanical applicators.

* The galvanized coating solidifies upon removal from the bath and the work piece requires no further processing.

* Galvanizing is a one step process where the full coating thickness is developed in one dip.

* Galvanizing quality is readily determined. An improperly prepared surface will not be galvanized and any bare spots will be clearly visible during inspection.

* Galvanizing is done inside a plant and is independent of prevailing weather conditions.

The nature of the coating itself imparts some significant advantages:

* The alloy structure is metallurgically bonded to the steel surface with good adhesion to underlying steel.

* Two of the intermetallic alloys, the delta and zeta phases are harder than the underlying steel. Hence, a galvanized coating has good abrasion resistance.

* The formation of the alloy layers is not governed by surface tension as is paint. Hence coating thickness around corners and sharp edges is not diminished (ie. as thick or thicker than that on flat surfaces).

We have just reviewed some of the advantages of hot dipped galvanized steel coatings that make the coating unique, but let's not forget the two properties of all metallic zinc coatings that contribute to their long life.

1. Zinc forms a protective corrosion product layer.
2. Zinc is anodic to steel and will provide cathodic protection.

Economics

When judging the economics of a protective coating it is important to look at the coatings life-cycle costs. This includes initial coating costs plus the net present value (NPV) of all future maintenance costs associated with the coating over the life of the project.

Total Coating Cost = Initial Cost + NPV of all Maintenance Costs

Galvanizing's initial costs are generally proportional to the weight of the structure and increase only slightly as the surface area per ton of the work piece increases. In many cases initial galvanizing costs are competitive with that of high quality paint systems. In addition, galvanizing's long term corrosion protection ensures very low future maintenance costs.

These factors usually make hot dip galvanizing the most economic means of providing long term corrosion protection for steel.

Types Of Zinc Coatings

Table 3 lists the three ways in which zinc coatings can be applied to steel.

Table III
ZINC COATING TYPES

Liquid Applied
- Hot dip batch galvanized
- Hot dip continuous galvanized

Electrolytically Applied
- Electrogalvanizing
- Electroplating

Particulate Applied
- Zinc dust paint
- Mechanical plating
- Thermal spraying

Liquid

There are two immersion processes which are used to apply molten zinc to steel. Fabricated steel anicies can be individually dipped into a molten zinc bath. This is called batch galvanizing or hot dip galvanizing after fabrication. The process produces a metallurgically bonded zinc-alloy coating which typically ranges between 3-7 mils in thickness. We will cover this coating method in more detail in a moment. In the second process, steel strip or wire can be galvanized continuously by feeding the material through the zinc bath at high speeds, over 300 feet a minute for steel strip. This process is referred to as continuous galvanizing. The zinc coating is produced to close tolerances, anywhere between 0.5 and 2 mils, and the coated steel can be formed and painted after galvanizing.

Electrolytically

Zinc coatings can be applied to steel by electrodeposirion. Sheet and strip is fed continuously through a zinc salt solution (electrolyte) where zinc ions are reduced to zinc meial and deposited on the steel sheet which acts as a cathode. Electrogalvanizing produces relatively thin, smooth coatings up to a maximum of I mil. As with hot dipping, the electrogalvanizing technique can also be practiced as a batch process where small parts are charged into a perforated barrel or supported on racks and then immersed in a zinc electrolyte. This coating process is referred to as electroplating or zinc plating.

Particulate

Zinc dust can be applied in two ways. Zinc dust can be mechanically plated onto small pans by tumbling these pans in a barrel with zinc dust, promoter chemicals and glass beads. The tumbling action causes the glass beads to peen the zinc dust onto the pan. Zinc dust can also be incorporated into a paint film. The zinc loading is measured by the amount of metallic zinc in the dry film and zinc rich paint formulations are classified as organic or inorganic, depending on the binder used. Metallizing is another method of applying a zinc coating. Zinc wire or powder is fed into a thermal spray gun where the zinc is melted and sprayed onto the surface to produce a continuous, but porous, metallic coating between 3 and 10 mils. The metallized coating solidifies immediately upon contact. It does not implant any thermal distortion to the work piece and because metallizing equipment is ponable, the coating can be applied to any size work piece in the field or in the shop. Metallizing best matches the corrosion performance of hot dip batch galvanizing and is therefore an excellent touch-up material for galvanized steel. Each coating procedure produces a coating with unique mechanical properties and thicknesses.

Hot Dip Galvanizing

The formation of a galvanized coating in a hot dip after fabrication process is predicated on the fact that molten zinc reacts with steel to form iron-zinc alloys. The resultant coating has a composite structure in which distinct metallurgical phases of the iron-zinc system can be identified. The thickness of the alloy portion of this coating increases with immersion time in a parabolic manner. The outer pure zinc layer of the coating is mechanically carried out of the bath and its thickness is dependent on speed of withdrawal and other factors which affect drainage. There are many general advantages to the hot dip immersion process as compared to other coating processes.

Table I
Corrosion Rates Of Zinc And Steel

Environment	Weight Loss (g)		Steel/Zinc Loss Ratio
	Steel	Zinc	
Desert	2.2	.13	17
Rural	11.2	.51	22
Semi-Industrial	23.8	.84	28
Industrial	41.0	.79	52
Marine	71.0	.89	80

Table II
Corrosion Of Zinc
In Various Atmospheres

Environment	Years to Corrode 1 Mil
Semi-arid	100+
Rural	22
Southwestern Seacoast	14
Heavy Industrial Seacoast	4.6
Heavy Industrial	3.8

As Table II indicates, the degree of protection varies with the environment. The presence of chlorides and sulphur gases in the atmosphere will modify zinc's corrosion product, making it more soluble and therefore increasing zinc's corrosion rate.

Cathodic Protection

Zinc has a lower oxidation potential than iron or steel and when these two metals are physically joined, zinc will corrode preferentially and prevent the steel from rusting. This characteristic of zinc gives its coating a unique property. Any small discontinuity of the coating, exposing the underlying steel, will not promote rust because the iron is cathodically protected by the sacrificial corrosion of the zinc coating. Zinc coatings protect exposed steel and will therefore not be undercut or blistered by rusting steel.