No.	Aggressiveness	Soil Condition	Resistivity in ohm	Method of protection
1	low	dry	>100	Hot dip galvanizing > 200µm
2	low	moist	>450	Hot dip galvanizing > 200µm
3	moderate	dry	<100	Hot dip galvanizing > 200µm plus a rust allowance on the basis material of 0.5mm on each side.
4	moderate	moist	150-450	Same as for 3
5	high	moist	50-150	Hot dip galvanizing > 200µm and rust allowance of 1mm on each side.
6	very high	moist (In certain cases H_2SO_4 can form)	<50-100	Same as for 5 but rust allowance of 1.5mm on each side

Table 25. Soil aggressiveness at different resistivity levels with hot dip galvanized coatings.

Soil type	Aggressiveness
Lime, calcareous marl, moraine, sand marl	Low
Sand, gravel	Moderate
Clay, peat, bog, humus-rich soils	High

Table 26. Corrosivity of different soil types.

mended that hot dip galvanized systems not be used above 65°C.

The electricity supply commission (Eskom), advise that with proper pipe insulation, the maximum temperature for hot water cylinders be 60°C. For practical purposes therefore, hot dip galvanized piping is acceptable for use in both hot and cold water systems.

In domestic systems copper should only be used downstream of hot dip galvanized piping. This will avoid the possibility of pitting corrosion.

Effect of sea water

Hot dip galvanized coatings perform relatively well in submerged seawater conditions which are severely corrosive to most protective systems. Dissolved salts present in seawater react with zinc to form a protective layer minimizing corrosive action. The pH of seawater tends to be constant worldwide as a result of the buffering action of the hydrogen-carbonate salts present. The presence of pollutants is equally not detrimental provided that levels are within internationally acceptable norms.

A simple nomogram *(table 27)* has been produced to allow the specifier to determine the suitability of hot dip galvanizing for the protection of steel piping in water. This provides guidance based upon the water quality and general operating conditions likely to be encountered. More detailed information is contained in **ARP 060:** *Guidance on the use and application of hot dip galvanized steel piping for the transportation of potable water in South Africa.*

12.6 CORROSION RESISTANCE OF HOT DIP GALVANIZED COATINGS IN SOIL CONDITIONS

Soil can contain weathered products, free or bound salts, acids and alkalis, mixtures of organic substances, oxidizing or reducing fungi, micro-organisms, etc.. Depending on its structure, soil has different degrees of permeability to air and moisture. Normally, the oxygen content is less than in the air, while the carbon dioxide content is higher. The corrosion conditions in soil are therefore very complicated and variations can be great between different locations, even those in close proximity to each other.

Southern African soils vary from highly corrosive in some regions to moderately corrosive in others.

One method of determining the corrosivity of a soil is to measure its resistivity. Recommendations are given in *table 25.*

If the resistivity of the soil cannot be determined, the rule-of-thumb method listed in *table 26* can give a measure of guidance. Where the exposure of metals to soil is concerned, it is advisable to seek expert advice from suitably qualified sources.

See also "Guidelines for Buried Hot Dip Galvanized Conveyance Piping" – available from the Association.

12.7 HOT DIP GALVANIZED STEEL IN CONTACT WITH BUILDING MATERIALS

Mortar, Plaster and Wood

Damp mortar and plaster attack zinc. The attack ceases when the material dries out. Dry or moderately damp wood, both impregnated and unimpregnated, can be nailed with hot dip galvanized nails to good effect. However, in the case of nails or threaded unions that are constantly exposed to water an acid-resistant material is preferred. Other dry building materials, such as mineral wool, do not attack zinc.

Wood with acidic properties should not come into contact with galvanized steel.

VALUE	PARAMETER	UNIT	RATING
CONDITION OF WATER			
A	Flowing		2
	Standing		1
	Anaerobic		-5
CORROSIVITY INDEX *			
B	<1		0
	≥1, <2		-1
	≥2, <5		-2
	≥5		-4
TOTAL ALKALINITY			
C	<50	ppm as (CaCo3)	-1
	≥50, <200		1
	≥200, ≤300		0
	>300		-1
CALCIUM HARDNESS			
D	<50	ppm as (CaCo3)	-1
	≥50, <200		2
	≥200		3
pH			
E	<5.5		-6
	≥5.5, <6.5		-4
	≥6.5, ≤7		-1
	>7		1
CALCIUM CARBONATE PRECIPITATION INDEX			
F	<-2		-2
	≥-2, <0		-1
	0		0
	>0, ≤6		1
	>6		0
Probability = Sum (A to F)			
Result		Performance	
Greater than 1		Satisfactory (+25 years)	
1 to -1		Fair	
-3 to -5		Unsatisfactory	
* Corrosivity index (B) can be calculated by - (Cl x 0,03) + (SO_4 x 0,04)			

Table 27. Probability of performance.

Concrete

Unprotected reinforcement can corrode in certain environments when moisture penetrates the concrete through cracks and pores. Since rust has a greater volume than the steel from which it was formed, the covering layer over the reinforcement can crack and spall *(figure 99).*

Steel components such as bolts and edge guards that have been partly grouted in are often poorly protected against rust. Apart from crack formation and scaling, a problem occurs with unsightly rust staining on the concrete surfaces below.