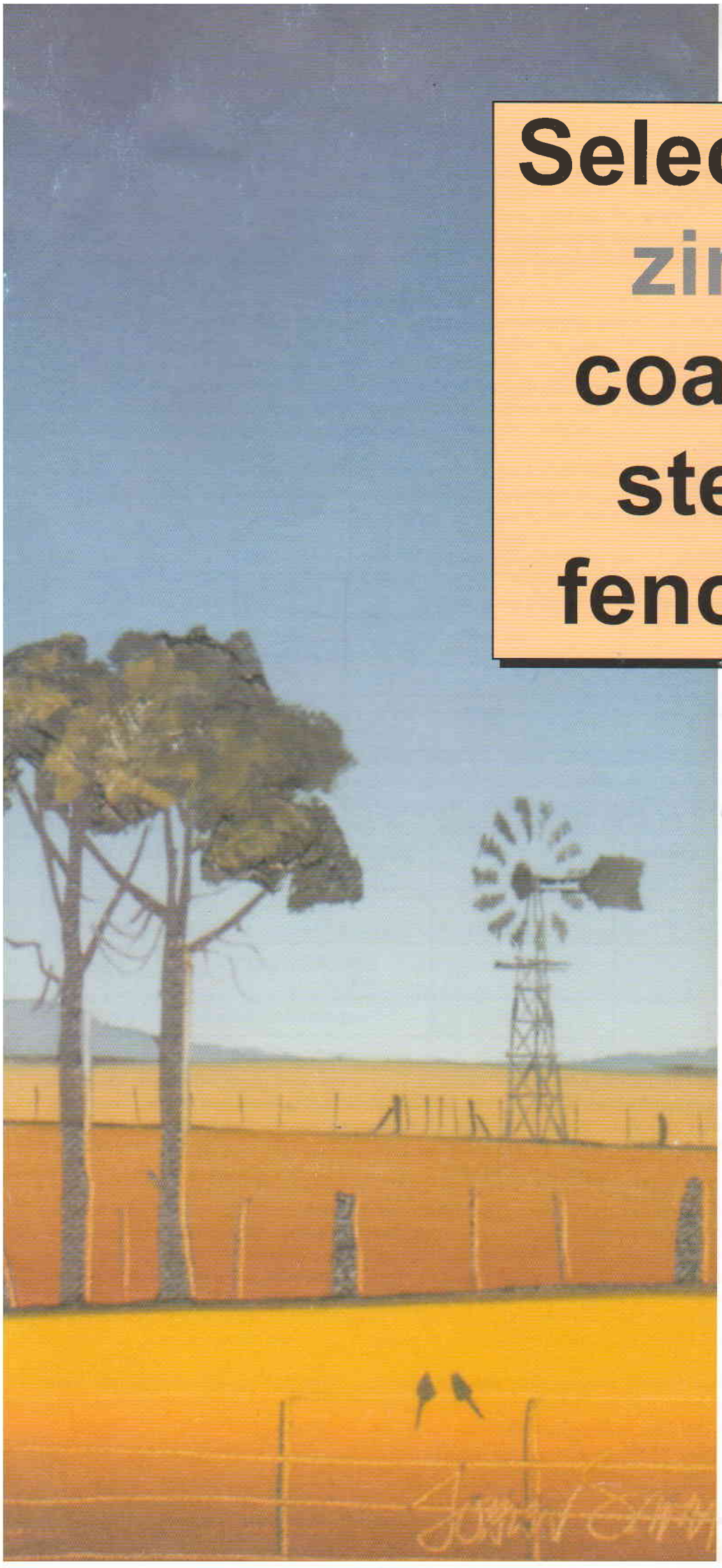

# Selecting zinc coated steel fencing

IZASA
INTERNATIONAL ZINC ASSOCIATION OF SOUTHERN AFRICA

SAWA
SOUTH AFRICAN WIRE ASSOCIATION

standards SouthAfrica
(a division of SABS)

ARC • LNR

## 1 Introduction on fencing in South Africa

The fencing of land contributes significantly to the input cost for farmers in South Africa and approximately 240 000 tons of galvanized wire is purchased annually at a cost in excess of R1 billion. This represents one-third of all galvanized wire produced within South Africa. It is therefore in the interest of the consumer to ensure they obtain the most durable wire for the applications they intend. Designing fences for specific applications instead of erecting multi-purpose fences can save money.

Choosing the correct type of fence and its material of construction will increase the expected life span of fences, resulting in substantial long-term savings. The life span of zinc coated steel wire is directly related to the thickness of the protective zinc coating.

**Recommendations on coating thickness are given with reference to the recently completed 11-year atmospheric corrosion exposure programme.**

This programme involved the exposure of various wire-coating types at various locations countrywide. These locations were chosen to be representative of the range of atmospheric conditions typical of agricultural environments in South Africa.

## 2 Types of Wire

In South Africa two types of wire are sold. These are plain wires and barbed wires. Table 1 shows the basic properties of locally available plain wires. Table 2 shows the basic properties of locally available barbed wires.

### Table 1 - Availability of Plain Wires

| Wire type | Size range diameter, mm | Strength range UTS[1], MPa | Typical applications |
|---|---|---|---|
| Plain wires | 1- 6.00 | 400 - 600 | electrical fencing, property demarcation, vineyard trellises, binding wires |
| High strain wires | 2.00; 2.24;<br>2.00 x 2,60 oval | >1050 | Property demarcation, vineyard trellises |

1 Ultimate tensile strength

### Table 2 - Availability of Barbed Wires

| Wire type | Size range, diameter mm | Barb diameter, mm | Strength range UTS[1], MPa | Typical applications |
|---|---|---|---|---|
| Single strand oval | 2.80 x 1.90<br>3.15 x 2.50 | 1.60<br>1.80 | >1050<br>>1050 | boundary demarcation and security |
| Double strand round | 2.00<br>2.50 | 1.80<br>1.80 | 400 - 600<br>400 - 600 | |
| Double strand round | 1.57 | 1.49 | > 1050 | |

Double stranded barbed wires will give double the breaking strength of the single wires of the same diameter, however the single strand barbed wires are of a higher tensile strength The double twisted strand has only strength in one contact line on the animal. Although barbs are supposed to deter animals from leaning against fences, damage can occur to animal hides and sheep are prone to getting caught on the barbs. All barbs are 4 points. Barbed wires are generally used for boundary demarcation and anti-intrusion purposes.

Because of their high tensile strengths, thinner wires with the same breaking strength as thicker cold drawn wires may be used gaining longer wire strands for the mass of wire bought. High strength wires can cover larger distances and are therefore cheaper than the normal fence wires. The use of high strength and ultra high strength wires should be avoided in areas where high fire temperatures can occur (dry grass density above one kg per square metre). These wires can easily loose tension or break due to embrittlement through fire damage.

## 3 Wire coatings

Currently, metal-coated wires in South Africa are only manufactured with zinc coatings. Wires that can be imported from overseas are aluminium coated, and zinc/aluminium coated. These comprise two types; the zinc-5% aluminium-mischmetal alloy-coated steel wire and the aluminium-55% zinc alloy-coated steel wire.

Two standards cover wire galvanizing in South Africa. They are:

- *SANS 675:1993 "Zinc coated fencing wire (plain and barbed)."*
- *SANS 935:1993 "Hot-dip (galvanized) zinc coatings on steel wire."*

SANS 675 was amended in 1993 to include only one class of coating. The SANS 675 standard no longer includes the Class C (light) coating. This is shown in Table 3. The previous lighter coatings are no longer permitted. However, SANS 935 still contains different zinc coating thickness classes as shown in Table 4. Only the Class 1 is equivalent in coating thickness to SANS 675.

**From the results of the recent exposure programme, even in rural areas, only SANS 675 coating thicknesses should be used. The use of light galvanized wire cannot be recommended. It needs to be noted, that any extraneous effects such as fire or excessive humidity due to tall grass coming into contact with the wire, may compromise performance of light coatings. The use of imported wire not conforming to SANS 675 should be strongly discouraged. It is also recommended that should wire be specified to SANS 935 only Grade 1 (heavy) coating should be used for fencing. Under no circumstances should either Grade 2 (medium) or Grade 3 (light) be considered. Therefore, it is preferred that SANS 675 be used to specify all galvanized steel wire for fencing.**

### Table 3 - Mass per unit area of zinc coating (SANS 675:1993)

| Nominal diameter of zinc coated wire, mm | Minimum mass per unit area of zinc coating, g/m$^2$ | Approximate equivalent average thickness, µm |
|---|---|---|
| 1.20 - 1.50 | 215 | 30 |
| 1.51 - 1.80 | 230 | 32 |
| 1.81 - 2.20 | 245 | 34 |
| 2.21 - 2.50 | 260 | 36 |
| 2.51 - 3.50 | 275 | 38 |
| 3.51 - 5.00 | 290 | 40 |

The performance improvements available by using the more expensive imported coated wires instead of locally produced galvanized wires are such as to be only of real value at coastal locations. However, the cost of labour in replacing fencing could more than compensate the higher initial cost. This would have to be determined on a case-by-case basis. The zinc-5% aluminium-mischmetal alloy-coated steel wire should comply with ASTM A855:1998 "Standard Specification for Zinc-5% Aluminium-mischmetal Alloy-Coated Steel Wire".

## 4 Types of fences

Fences are typically of three types. These are smooth wire fences, smooth woven fences and barbed wire fences.

### Smooth wire fences

These use plain round or oval wires and are typically used in electrical fencing, property boundary fencing, vineyard trellises, etc.

### Smooth woven fences

These include diamond mesh, hexagonal mesh and hinge joint fencing. Typical uses include enclosures for domestic animals, livestock, game, poultry, birds and property. Tables 5 to 7 provide typical local availability.

### Barbed wire fences

These can be either single or double strand fences and typically are used as enclosures for property and livestock.

Fences for large stock will inevitably require stronger fences than those used for small stock. A fence's strength is determined primarily by the strength of the wire and thereafter by the number of wires stretched per fence height and the spacing of droppers, fence posts and straining posts.

## Table 4 - Mass per unit area of zinc coating (SANS 935:1993)

| Nominal diameter of zinc coated wire, mm | | Minimum mass of zinc coating per unit area, $g/m^2$ | | |
|---|---|---|---|---|
| From | Up to but excluding | Grade 1 | Grade 2 | Grade 3 |
| 0.20 | 0.30 | 45 | 20 | - |
| 0.30 | 0.40 | 60 | 25 | - |
| 0.40 | 0.50 | 80 | 30 | - |
| 0.50 | 0.60 | 100 | 35 | 20 |
| 0.60 | 0.70 | 110 | 40 | 20 |
| 0.70 | 0.80 | 120 | 40 | 20 |
| 0.80 | 0.90 | 140 | 45 | 20 |
| 0.90 | 1.00 | 170 | 45 | 20 |
| 1.00 | 1.20 | 200 | 50 | 25 |
| 1.20 | 1.50 | 215 | 55 | 25 |
| 1.50 | 1.80 | 230 | 65 | 30 |
| 1.80 | 2.20 | 245 | 70 | 40 |
| 2.20 | 2.50 | 260 | 80 | 40 |
| 2.50 | 3.50 | 275 | 90 | 45 |
| 3.50 | 5.00 | 290 | 105 | 60 |

## Table 5 - Size range for hexagonal netting[1]

| Roll heights, mm | Wire diameter, mm | Mesh size, mm | Typical applications |
|---|---|---|---|
| 300, 600, 1200, 1500, 1800 | 0.71 | 13 | Jackal and rabbit proofing, aviary, chicken, animal and poultry enclosures |
| | 0.90 | 25 | |
| | 1.00 | 50 | |
| | 1.80 | 75 | |
| | 1.80 | 90 | |

1 Often used in combination with high strain and / or barbed wires

## Table 6 - Size range for diamond mesh

| Roll heights, mm | Wire diameter, mm | Mesh size, mm | Typical applications |
|---|---|---|---|
| 300, 600, 1200, 1500, 1800 | 0.71 | 13 | Jackal and rabbit proofing, aviary, chicken, animal and poultry enclosures |
| | 0.90 | 25 | |
| | 1.00 | 50 | |
| | 1.80 | 75 | |
| | 1.80 | 90 | |

## 5 Fence erection

**Tips:**

- Fences should be straight, with droppers and posts (Standards) in alignment
- Corners and gate posts should be sturdy and anchored
- All standards and droppers should stand erect and at the correct height
- The closer standards and droppers are placed, the more sturdy the fence
- Wires should be parallel to each other and well secured to standards and droppers
- Divide space between standards with droppers equally - secure droppers and standards at the same height
- NOTE: a good fence cannot be erected with inferior materials

Fence height is determined by the application. Typical values are given in Table 8.

on the standards, so that they cannot shift up or down. Twisted galvanized wire droppers are sometimes used. However, as wire droppers bend easily, the fence soon appears battered and maintenance of such a fence will be high.

The closer the standards are together and the more droppers there are between them the more sturdy and efficient the fence. The purpose of the fence, circumstances and soil conditions will dictate what the best Standards spacing will be for an efficient fence. Some practical guidelines are provided in Table 9.

### Table 9 - Typical post and dropper configuration for stock fences

| Application | Post (Standards) separation, m | Number of droppers |
|---|---|---|
| Intensive stock farming where fences are subject to continuous pressure | 12 | 2 (3[1]) |
| Average conditions | 16 | 3 (4[1]) |
| Extensive farming where animals only occasionally make contact with the fence | 20 | 4 (5[1]) |
| 1 Where mixed stock is kept | | |

If required, reference should be made to Farm Fences published by the Department of Agriculture (DOA).

## 6 Binding wire, fence posts and droppers

It was noticed in the wire exposure study that some binding wires used to fasten droppers lost their metal coating within the first 18 months of exposure. This is easily ascribed to incorrect choice of wire.

**Binding wire used to fasten wire strand to posts or droppers should also comply with SANS 675. As a rule galvanized binding wire should not be thinner than 2.50mm.**

Steel posts that are concreted into the ground must always have the concrete forming an elevated cone around the posts to allow drainage of water away from the posts. Any water retained in the area where the post meets the concrete, will increase the corrosion rate of the post and will cause earlier failure which could be prevented.

The steel post can cause steel coatings of wires touching it to sacrificially try to protect the steel post from corroding and eventually leaves the wire, which it is supposed to protect, bare in the contact area. Once a large enough bare area occurs on a metal-coated steel wire, rusting along the wire accelerates, causing premature failure of the fence.

**Dropper effect on the corrosion rates of wires was found to be negligibly small in the study. As a result no material system needs to be preferred over another.**

However, any measure taken to prevent direct contact between metal coated wires and bare metal posts and droppers will significantly retard corrosion rates. Painting or metal coating the metal posts and droppers with appropriate coatings prior to wrapping the wire around the poles and droppers, will ensure a significant improvement of wire life.

Wooden posts and droppers retain moisture longer than steel posts and droppers. Moisture is an essential requirement for corrosion. Using creosoted and copper chromium arsenate (CCA) impregnated wooden posts and droppers do not significantly affect the corrosion rate of wires at the contact interfaces. Modern environmental controls are beginning to limit the use of creosote and CCA treatments. In the USA and Europe, these treatments are being replaced by copper based treatments such as Alkaline Copper Quat (ACQ) and copper azoles (CABA-A and CA-B). Although initial indications are that these treatments are more corrosive than the previous treatments, studies are underway to identify less corrosive, more environmentally benign alternatives. Sealing areas where wires are in contact with wooden posts and droppers to prevent moisture retention will also increase the life span of fences.

## 7 Fence maintenance

Good fence maintenance should include keeping fence areas as clear from tall grass as is possible.

**If the dry grass density around zinc coated steel wire fences is below 0,5 kg per square metre no damage to the wires is likely to occur if this grass is set alight.**

**Extensive damage to these wires will occur however when dry grass with a density of 1 kg per square metre is set alight and allowed to burn through the fence.**

High strength steel wire, being generally thinner than soft wire, will require less heat to raise its temperature to reduce the tensioning strength of the wire. Thicker, softer wire is generally tensioned lower than thinner high strength wire and, as a result, tension failures in the softer wire would be expected to be less than those occurring in high strength wires.

**The effects of fire will be more on high strength wires.**

Periodic checking and re-tensioning of the wires, especially after veld fires, will ensure the continued functionality of fences and will extend the life of the fence.

No significant differences in corrosion rates of top and bottom wires were found in the exposure study. Therefore, a single material type would be suitable for all the installed wire strands at a particular site. Good fence maintenance would include reasonable effort to keep undergrowth away from the lower fence areas where a continuously wet poultice would accelerate corrosion.

Poor fence maintenance

## 8 Fence performance

The recently completed eleven-year fencing wire exposure study has shown the longevity likely for different regions within South Africa. To enable a more regional use of this brochure, Table 10 shows the likely life expectancy of fencing wires in the general exposure regions used for the corrosion performance study.

**Barbs do not significantly affect the corrosion rate of the metal coatings on the wires.**

The effect will probably only become significant once all the zinc coating is removed from the barbs. If this happens, the wire coating will also sacrificially protect the barb thus causing increased rates of attack to occur. None of the barbs on the wires in the test study lost all the coating during the exposure period. Thus, the longevity of barbed versus smooth wire fences would be expected to be equivalent.

Finally, an estimate of life performance throughout South Africa is provided via the map shown in Figure 1. However, it should be remembered that this map cannot take into account either bad fence erection practice or poor fence maintenance, both of which may adversely affect overall fence performance. Also, local micro-climates may exist in various areas which cannot be accounted for. Nevertheless, the map provides a good basis for estimating life performance of fencing wires.

### Table 10 - Estimated life expectancies for coated steel wire in the regions used in the 11 year atmospheric corrosion exposure programme

| Exposure region | SANS 675 | SANS 935 Grade 2 | 95/5[1] Coated wire ASTM A 855 |
|---|---|---|---|
| Northern inland Western Cape | > 50 years | 10 years[2] | > 50 years |
| South Western Cape | > 25 years | 6 years | > 50 years |
| Coastal Eastern Cape | > 10 years | 4 years | Not determined |
| Eastern Gauteng | > 50 years | 30 years[2] | > 50 years |
| Southern Mpumalanga | > 50 years | 30 years[2] | Not determined |
| Northern inland KZN | > 50 years | 30 years[2] | > 50 years |
| KZN Midlands | > 20 years | Not determined | > 50 years |
| Inland Eastern Cape | > 25 years | Not determined | > 50 years |

1 Zinc-5% aluminium-mischmetal alloy-coated steel wire
2 Assuming no mechanical damage or attack at droppers

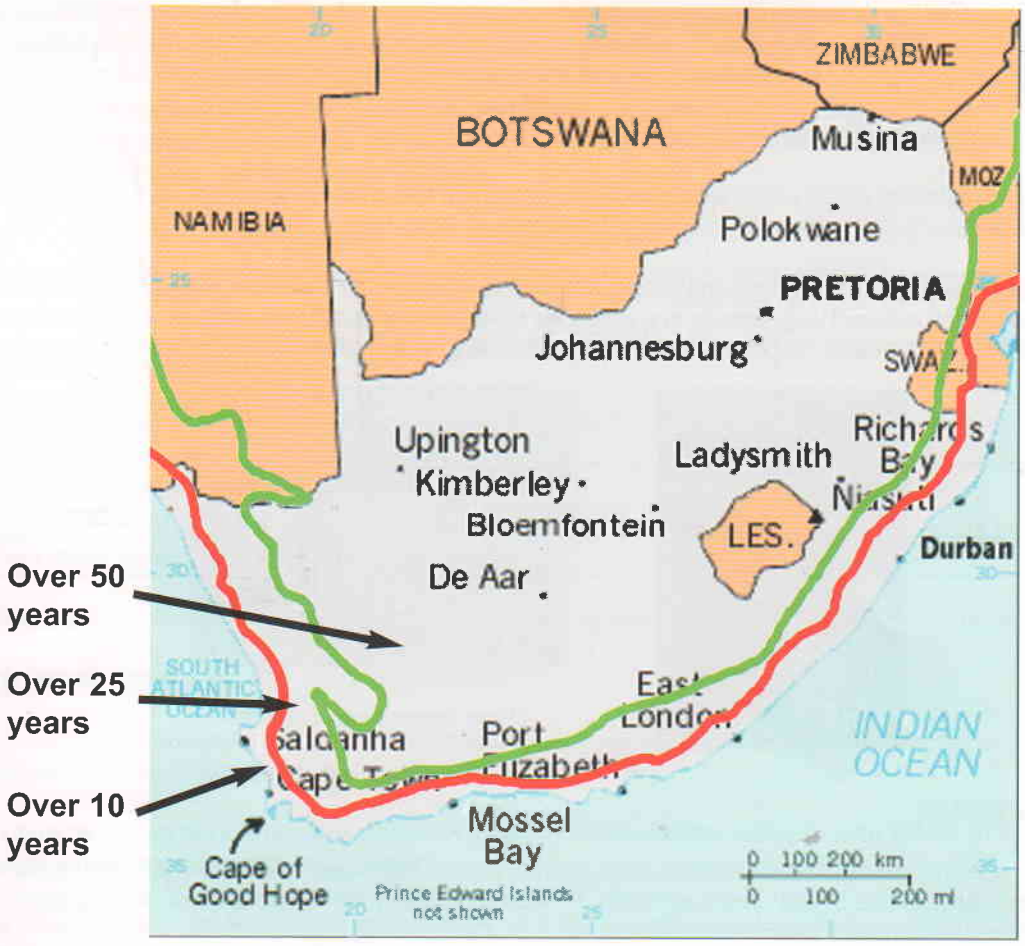


**Figure 1 - Estimated life expectancies for galvanized steel wire complying to SANS 675:1993.**


## Acknowledgement:

The authors are indebted to the following organisations for assisting with input and editing of the final document.

International Zinc Association of Southern Africa
The South African Wire Association - Tel: (011) 453-0921
The Research and Development Department of Standards South Africa
(a Division of the South African Bureau of Standards)
The Institute for Agricultural Engineering of the Agricultural Research Council.

July 2004