Wire and Strand
Construction Products
Introduction

Wire and Strand

The Scaw Metals Group operates two of the largest integrated wire, strand and rope manufacturing plants in the world. The factories were established in 1921 under the Haggie® name and are situated on the outskirts of Johannesburg, South Africa. A significant proportion of the output of the Wire and Strand operation is wire and strand for the construction industries. These products are marketed and sold in many countries of the world.

The Scaw’s Wire and Strand operation is equipped with modern low relaxation wire and strand lines, plastic extrusion lines for sheathing of tendons and cable stay strand. The wire product range consists of plain, indented and crimped PC wire in the stress relieved condition. Stranded products include low relaxation seven wire strand which may be bright, plastic sheathed, galvanized, compact or indented.
Product Range

N.B. See loose leaf inserts for details of products to national/international specifications.

7-WIRE PLAIN STRAND

<table>
<thead>
<tr>
<th>Size</th>
<th>Tensile Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>1770 MPa</td>
</tr>
<tr>
<td>9.3</td>
<td></td>
</tr>
<tr>
<td>9.53/9.6</td>
<td></td>
</tr>
<tr>
<td>11.0/11.1</td>
<td></td>
</tr>
<tr>
<td>11.3</td>
<td></td>
</tr>
<tr>
<td>12.5</td>
<td></td>
</tr>
<tr>
<td>12.7/12.9</td>
<td></td>
</tr>
<tr>
<td>15.2/15.24</td>
<td></td>
</tr>
<tr>
<td>15.7</td>
<td></td>
</tr>
<tr>
<td>16.0</td>
<td></td>
</tr>
<tr>
<td>18.0*</td>
<td>(1700)</td>
</tr>
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</table>

7-WIRE GALVANISED STRAND

<table>
<thead>
<tr>
<th>Size</th>
<th>Tensile Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>1770 MPa</td>
</tr>
<tr>
<td>12.7</td>
<td></td>
</tr>
<tr>
<td>12.9</td>
<td></td>
</tr>
<tr>
<td>15.2/15.24</td>
<td></td>
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<tr>
<td>15.7</td>
<td></td>
</tr>
<tr>
<td>16.0</td>
<td></td>
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</table>

SHEATHED & COATED STRAND

<table>
<thead>
<tr>
<th>Black</th>
<th>HDPE</th>
<th>HDPE + Grease</th>
<th>HDPE + Wax</th>
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</thead>
<tbody>
<tr>
<td></td>
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</table>

PRE-STRESSING WIRE

<table>
<thead>
<tr>
<th>Size</th>
<th>Tensile Grades (MPa)</th>
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</thead>
<tbody>
<tr>
<td>mm</td>
<td>1570</td>
</tr>
<tr>
<td>4.00</td>
<td></td>
</tr>
<tr>
<td>4.20/4.25</td>
<td></td>
</tr>
<tr>
<td>4.50</td>
<td></td>
</tr>
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<td>4.88</td>
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<td>4.98/6.00</td>
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<td>6.00</td>
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<td>6.35</td>
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</tr>
<tr>
<td>7.00/7.01</td>
<td></td>
</tr>
<tr>
<td>8.00</td>
<td></td>
</tr>
</tbody>
</table>

MPa = N/mm²  MPa x 145 = psi  The manufacture of special grades and sizes will be considered on request.
How to order

**List of Requirements**

When ordering PC products, or when making an enquiry, the following information should be made available to our Sales and Marketing Office:

1. Diameter of wire or strand.
2. Required specifications (BS, ASTM, AS, CSA, IS, JIS, EN, ISO, etc).
3. Tensile Grade or minimum required B/F.
4. Direction of Lay for strand.
5. Finish (plain, indented, crimped, compact, galvanized).
6. Special technical requirements (if different from the specification). Additional test requirements must be specified at the time of enquiry/order.
7. Packaging and labelling instructions (pack type, label specification).
8. Delivery instructions (address, transport or shipment method).
9. State if Test Certificates are required.

Declaration of the end application is often useful.

**Quality systems**

**Accreditations**

Scaw’s Wire and Strand operation has a comprehensive Quality Management System which satisfies the requirements of ISO 9001.

The operation is audited twice a year and is proud of the fact that the auditors (The South African Bureau of Standards, acting as an agent of ISO) commend the organisation for its well administered quality systems.

The Wire and Strand laboratory is SANAS (South African National Accreditation System), approved and through this association, is part of the mutual recognition agreement of ILAC, (International Laboratory Accreditation Cooperation), which covers twenty-six countries. Regular audits of the testing facility ensure that standards are maintained at the highest level.

In addition to this, Wire and Strand construction products are approved by UK CARES, (Certification Authority for Reinforcing Steels) and ACRS (Australian Certification Authority for Reinforcing Steels). Wire and Strand is also homologated in Germany for 7-wire strand and is an approved supplier to the Australian Queensland Department of Transport and Main Roads. Product and testing audits are carried out regularly by all organisations.

The Wire and Strand operation is fully committed to ensuring a safe and healthy working environment for employees. As part of an extensive SHE programme, the factory has achieved ISO18001 status as well.

Scaw’s Wire and Strand Operation has the following accreditations, represented by these logos.
Product development and testing

Modern Technology

The Wire and Strand operation has a long history of being at the forefront of PC wire and strand technology. A well equipped laboratory, with a staff of dedicated metallurgists, is situated within the confines of the factory.

This facility carries out development project work for the operation enabling it to offer superior quality products. Specialised products, such as a range of coated strands, have also come out of this effort. The demands and requirements of our customers are the ultimate driving force for these development programmes.

Product properties

Elongation Properties

Scaw’s strand elongation exceeds ASTM and BS specifications minimum requirements of 3.5% over a gauge length of 600mm.

Relaxation Properties

Scaw’s wire and strand is routinely tested in a temperature controlled stress relaxation laboratory. Typical relaxation values of our strand products after 1000 hours at an initial load of 70% of minimum breaking load are 1.0 to 1.5%. Both ASTM and BS specify 2.5% maximum for low relaxation strand. Results for an initial load of 80% of minimum breaking load are typically between 2.0 – 2.5%. The maximum permissible is 3.5%.

Bond Strength & Transmission Length

Through the years our PC wire and strand has been tested for bond strength and transmission length by various independent bodies. Regular bond strength tests are conducted internally as well.

Multi-axial Stressing Properties

Pre-stressing strand is routinely tested for conformance with both the FIP and the PTI versions of the deflected tensile test, also known as “the one pin test”. The test assesses the strand for tensile strength when stressed around a pin. Results well in excess of 80% of the uni-axial breaking force are routinely obtained (equivalent to a D value of less than 0.2 when reported as required by the FIP). These results indicate that the strand is suitable for multi-axial stressing applications.
**Stress Corrosion Resistance**

Scaw’s wire and strand is tested in a purpose built laboratory for conformance to the FIP test, now incorporated into the latest draft version of Euronorm 10138. Both products easily pass the minimum requirements of the test.

**Fatigue Endurance**

Scaw’s strand has been tested by two independent laboratories for conformance to the tension-tension fatigue test requirements of BS, EURONORM, and other standard bodies, including the PTI for stay cables.

The requirements is for the strand to endure 2 million cycles at specified maximum loads of up to 70% of the actual breaking force, with specified load ranges. The product’s tendons pass easily, with results in excess of 5 million cycles being recorded.

**Cryogenic Properties**

For use in the prestressing of concrete vessels for liquid gas, or other applications where very low temperatures are experienced, Scaw’s Wire and Strand regularly tests its PC strand cryogenic properties. Typically the tensile strength of strand increases by about 12% at 165°C, while elongation is reduced from approximately 5.5% to 3.7%. Relaxation losses are minimal below -100°C. Young’s Modulus is slightly increased.

**Tensile Testing of PC Wire and Strand**

The applied stress versus the strain, or elongation, of the test piece shows the initial elastic response of the material, followed by yielding plastic (permanent) deformation, necking and fracture. Several readings are taken during the duration of the test as an important indication of the strength of the material, and its ability to withstand premature yielding. These readings are:

- Modulus of Elasticity (Young’s Modulus) – E
- 0.1% and 0.2% Proof Load – Rp0.1 & Rp0.2
- Load at 1% Extension – F(1%)
- Ultimate Tensile Strength – Fm
- Maximum Breaking Load or Stress – Rm
- Total Elongation at Fracture – At
- Ductility – reported as Total Elongation at Fracture At

In addition to these readings, the following information is recorded on the stress-strain diagram provided by Scaw Wire and Strand:

- A unique test number, which ensures traceability back to the original test
- A unique number identifying the person performing the test
- The identity number of the machine on which the test was performed
- The diameter of the strand or wire being tested
- The cross sectional area of the strand
- The cast number and analysis of the steel used to produce the product

![Typical load / extension curve for 12.7mm 250 low relaxation strand](image)

**Normal Relaxation**

- Test temperature: 20°C
- Initial Load: 70% of nominal load

**Low Relaxation**

- 6 weeks
- 1 year
- 10 year
- 50 year
Plastic Sheathed Strand for Post-Tensioning

Strand of all sizes and grades may be plastic sheathed in order to conform to the recommendations of the Fédération Internationale de la Précontrainte (F.I.P.) and the US Post Tensioning Institute (P.T.I.), or to any other standard.

This served to protect all seven wires, including the king wire. Corrosion resistant high temperature grease, or low slump paraffin wax, is then applied to fill all the voids between wires, and to coat the strand with a protective layer, usually 0.38mm at the outer wire crowns. High density polyethylene or polypropylene, is then extruded over the greased strand with thickness to specification or customer requirements.

The polymer grade is selected for:
• high impact resistance
• high rigidity
• chemical stability
• good resistance to creep
• high abrasion resistance
• high stability at elevated temperatures

Galvanised PC Strand

For some applications, such as maritime environments, particularly corrosive conditions may be encountered. Scaw’s galvanised PC strand provides the additional protection required, and can be manufactured to customer requirements. Strand manufactured for drawn-galvanised wire is offered with the same mechanical and physical properties as bright strand, with no reduction in strength. The fatigue requirements of all national and international specifications have been met. Strand manufactured from hot dip galvanised wire is also available. A range of zinc coating weights to suit customer requirements can be supplied.

Strand for Stay Cable Bridges

Scaw’s PC strand is suitable for stay cables and conforms to the requirements of the F.I.B and P.T.I recommendations for Stay Cables. The routine control of process parameters during manufacture, particularly with regard to diameter, allows for bridge designers to bundle Scaw strand with confidence. Where individual strand sheathing is required, the Scaw plastication line is capable of applying polymer sheathing in any profile at close thickness tolerances, with prior application of a high temperature low slump grease or other corrosion inhibitors, such as paraffin wax. Fatigue endurance exceeds 2 million cycles at the special test conditions required for strand stay cables.

PC Wire

Scaw produce PC wire on three modern low relaxation production lines. Finishes available are plain and indented. In addition to the wire sizes and grades listed in the loose leaf inserts, other special grades are available on request. Specifications to which wire can be manufactured apart from BS 5896 and EN 10138, include:

ASTM A648
Steel Wire, Hard Drawn for Prestressing Concrete Pipe.

ASTM A821
Steel Wire, Hard Drawn for Prestressing Concrete Tanks by Redrawing.

ASTM A884
Steel Wire, Deformed, for Prestressed Concrete Railroad ties.

ASTM A881
Steel Wire, Deformed, Stress Relieved or Low-Relaxation for Prestressed Concrete Railroad Ties.

CSA G279
Steel for Prestressed Concrete Tendons.

JIS G3538
Hard Drawn Steel Wire for Prestressed Concrete.
Packaging Specifications

In the despatch area both wire and strand products are packaged according to destination and to customer requirements. Strand may be palletised or mounted eye-to-the-side. An additional corrosion protecting treatment may be applied if requested. Test lengths may be packaged outside the strapping for easy access, or may be cut off and wrapped separately with individual pack identity labels and then shipped inside the eye of the pack.

Users are requested to turn to the separate loose leaf page headed PACKAGING SPECIFICATIONS showing details of pack dimensions for our range of products.

Users are also advised that PC products should be stored under cover and that handling procedures, which minimise mechanical damage, should be employed.

Quality Plan

As part of our commitment to quality, we have formulated a comprehensive quality plan in an effort to provide our customers with the assurance that they are receiving a top quality product. The following areas are covered in detail by the plan:

Checking of incoming Steel Wire Rod. This involves comprehensive checking of the physical condition of the material as well as the metallurgical and chemical properties.

Rod Surface Preparation. Quality and process checks include ensuring that all cleaning and coating process variables are properly controlled and that all coating are of a specified quality.

Wire Drawing. Regular audits of wire drawing machines are specified to ensure that all variables during wire drawing are within the prescribed limits. This will ensure optimal quality of the finished product.

Proofing (Wire). Control of the process is ensured with continuous monitoring with suitable instrumentation. Interpretation of these results forms part of the plan to ensure 24 hour control of product quality.

Proofing (Strand). Like the proofing of wire, the process is monitored continuously and readings are checked by suitably qualified personnel.

Die Quality. As an integral part of the drawing process, the quality of our wire drawing dies is monitored on a regular basis in line with the quality plan.

Plastic Sheathing. State of the art measuring and control equipment has been installed on the extrusion line to ensure consistent quality of the extrusion line to ensure consistent quality of the plastic sheath. SPC results from this line are monitored and interpreted by suitably qualified personnel.

Weld Control. An important part of the manufacturing process for PC products includes ensuring that welds are removed, where applicable, or that those made in the base rod, which are allowed to remain in the product, are of the required standard.

Final product Testing. All products are comprehensively tested and meet the requirements of the specified international standards as requested by the customer.
PC Wire applications - precast products

PC Strand applications

Concrete Pipes

Precast hollow core floor slabs factory in the UK

Precast hollow core floor slabs

Railway Sleepers

Lake Terrace

Dubai Healthcare City Hospital, United Arab Emirates

Jumeirah Emirates Towers
PC Strand applications

- Completed Peace Building, Azriely Centre - Israel
- Princes Hotel - Israel
- DFC Plaza - Dubai
- Diagonal Street - Johannesburg, South Africa

Asriele Mega Mall under construction - Beton Daruch, Israel
Sydney Olympic Stadium, Australia
Kendah House - Dubai, UAE
Applications - Bridges

The Light Horse Interchange - Australia

Bridge under construction in Israel

DR1 Extension, Sheikh Zayed Road (31/2 Interchange) close up view

Mall of Emirates Bridge

DR1 Extension, Sheikh Zayed Road (31/2 Interchange)

R859 Interchange N 05 - Palm Jumeirah

R800/2 Ras Al Khor Crossing (3D View)
Scaw Metals Group

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