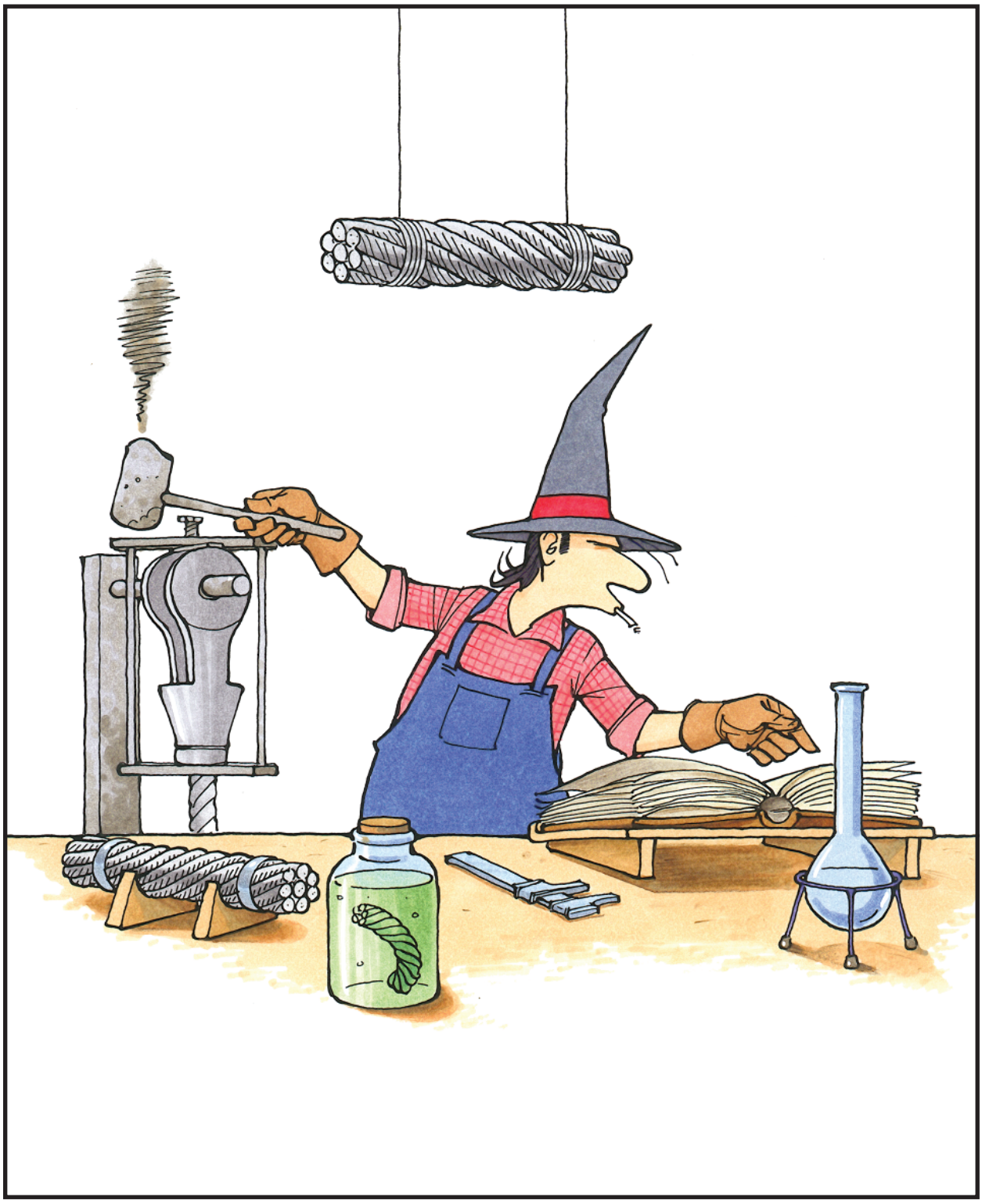
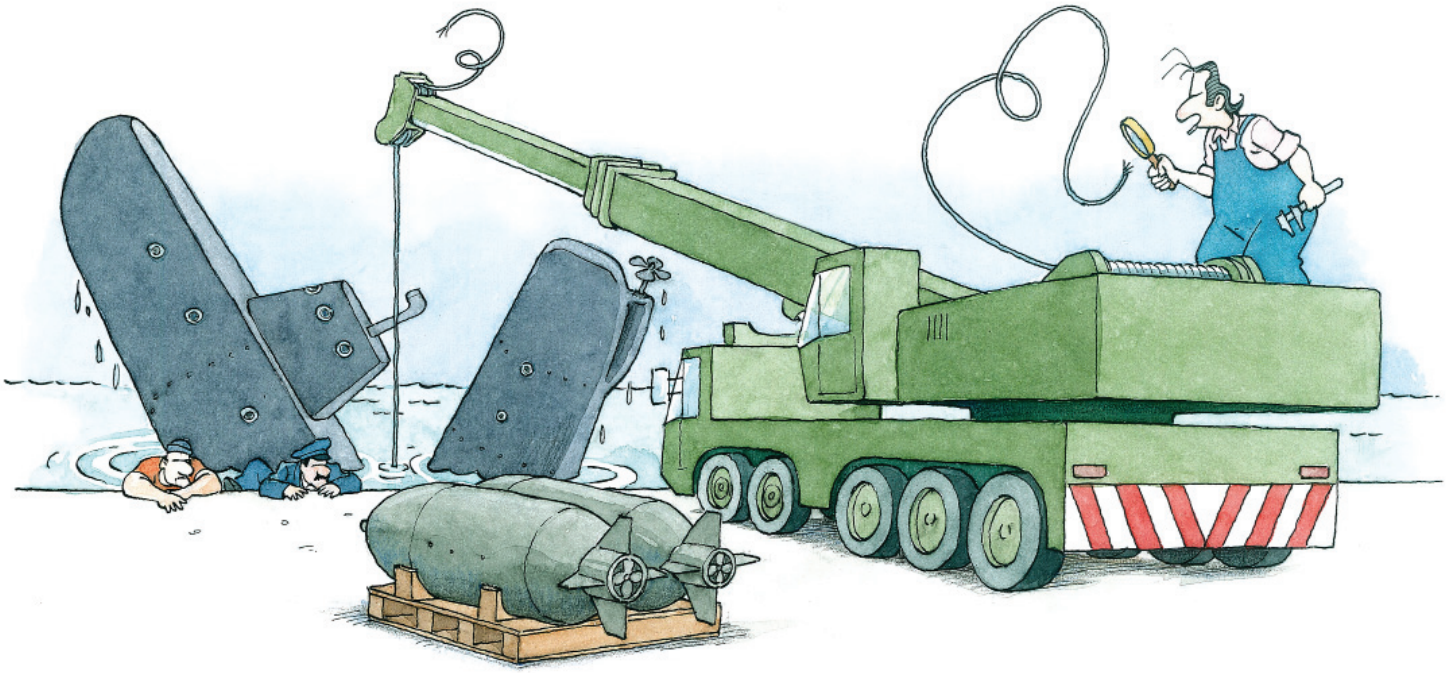
WIRE ROPE TECHNOLOGY AACHEN GMBH



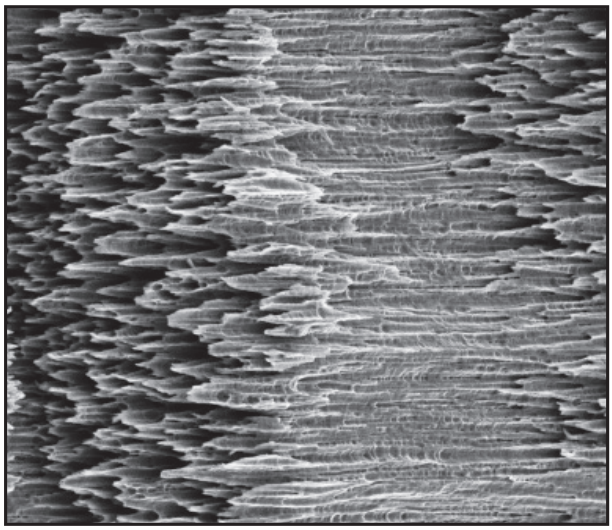
WHAT WE CAN DO FOR YOU

WIRE ROPE FAILURE ANALYSIS



A steel wire rope has failed and has caused severe damage. You have to know why, for legal purposes or simply in order to prevent such an accident from happening again. Talk to us at Wire Rope Technology Aachen. Over the years we have analysed many hundreds of wire rope accidents. We can help you too!

This wire suffered from a certain amount of fatigue (lower section) when it broke due to an overload. Scanning electron microscope (SEM) photograph.



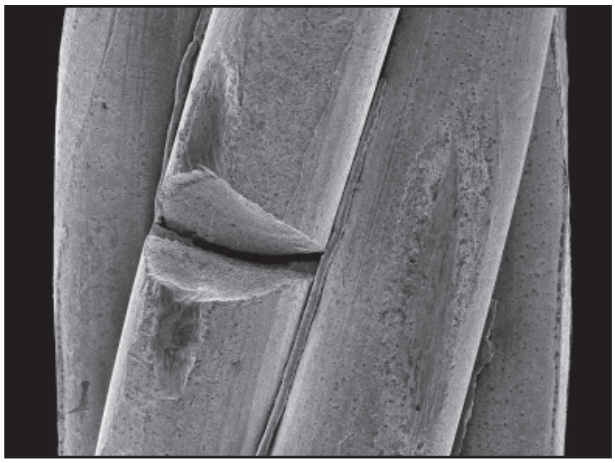
Corrosion in hidden areas is a frequent cause for wire and wire rope failure. Under a scanning electron microscope, however, corrosion looks like art....

WIRE ROPE FAILURE ANALYSIS

Whatever your rope damage looks like, we will be able tell you how to avoid it. A tilted block caused this damage.

Wire breaks on the IWRC of a steel wire rope at the contact points with the outer strands. This work was done for CERN, Geneva.

„Double“ wire break in a tension-torsion application. This is a digital microscope multi-focus photograph with colour information.



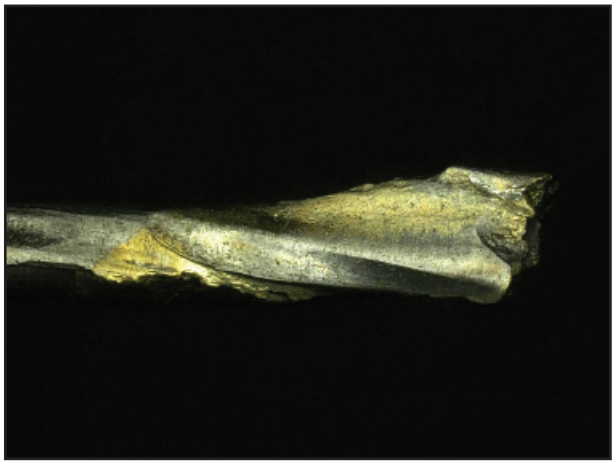
„Double“ wire break in a tension-torsion application. Scanning electron microscope image for comparison.

This wire was broken in a torsion test. The shiny break surface is perpendicular to the wire‘s axis.

Five people lost their lives in the far east when a hoist rope failed. The rope had been damaged by a lightning strike the day before. Wire diameter 0,3mm.

WIRE ANALYSIS

This steel wire has a surface defect (often referred to as Crow‘s Feet). The defect was caused during the drawing process. If such a defect is not detected by the quality control engineers of the rope manufacturer it might lead to premature wire breaks. Multifocus digital microscope photograph.



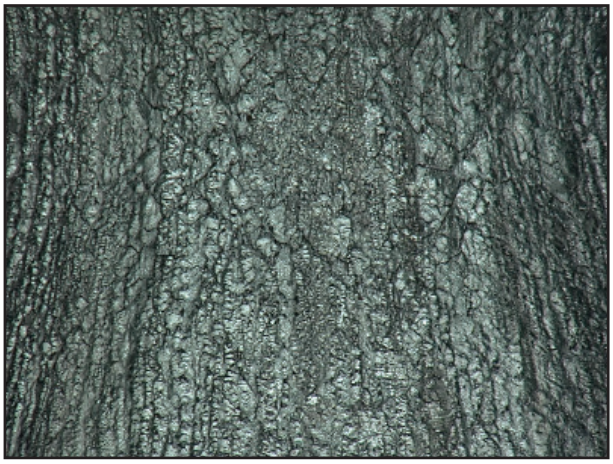
Poor soldering during the stranding process has caused this premature wire break. Unlike the scanning electron microscope the digital microscope offers colour information.

Fatigue break surface (digital microscope 900x). These orders of magnification are not possible with ordinary optical microscopes.

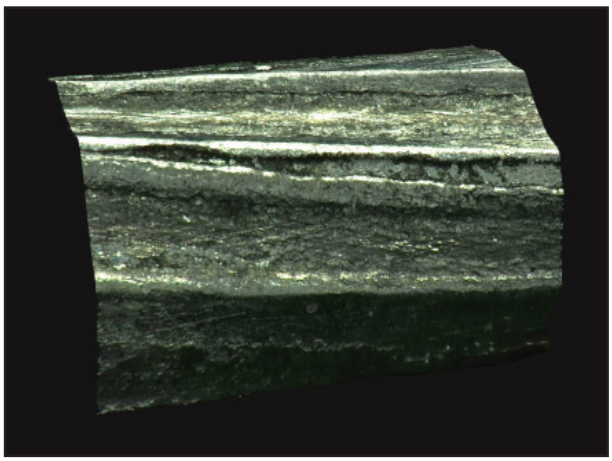
DIGITAL SURFACE ANALYSIS

We analyze wires with two digital microscopes with multifocal capabilities and magnifications ranging from 5x to 1000x.

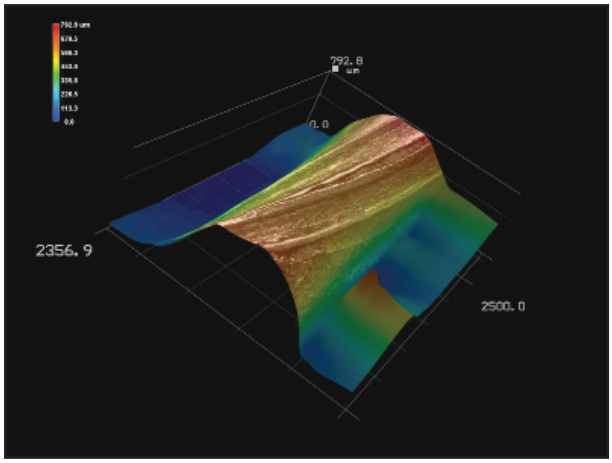
Damage caused by lightning on a steel wire rope. 3D photograph. This 3D photograph was made for NASA.



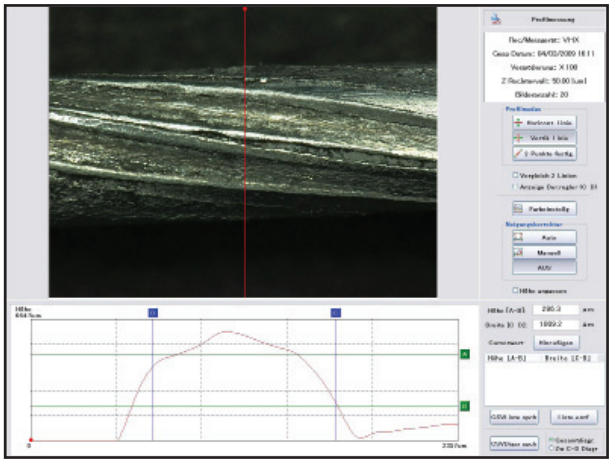
Wire surface near an overload break. The once-smooth surface has wrinkled because of the reduction in the wire´s diameter. Lab test.



A 3D photograph of a centre (king) wire of a steel wire rope. The rope was subjected to tension-tension loading.

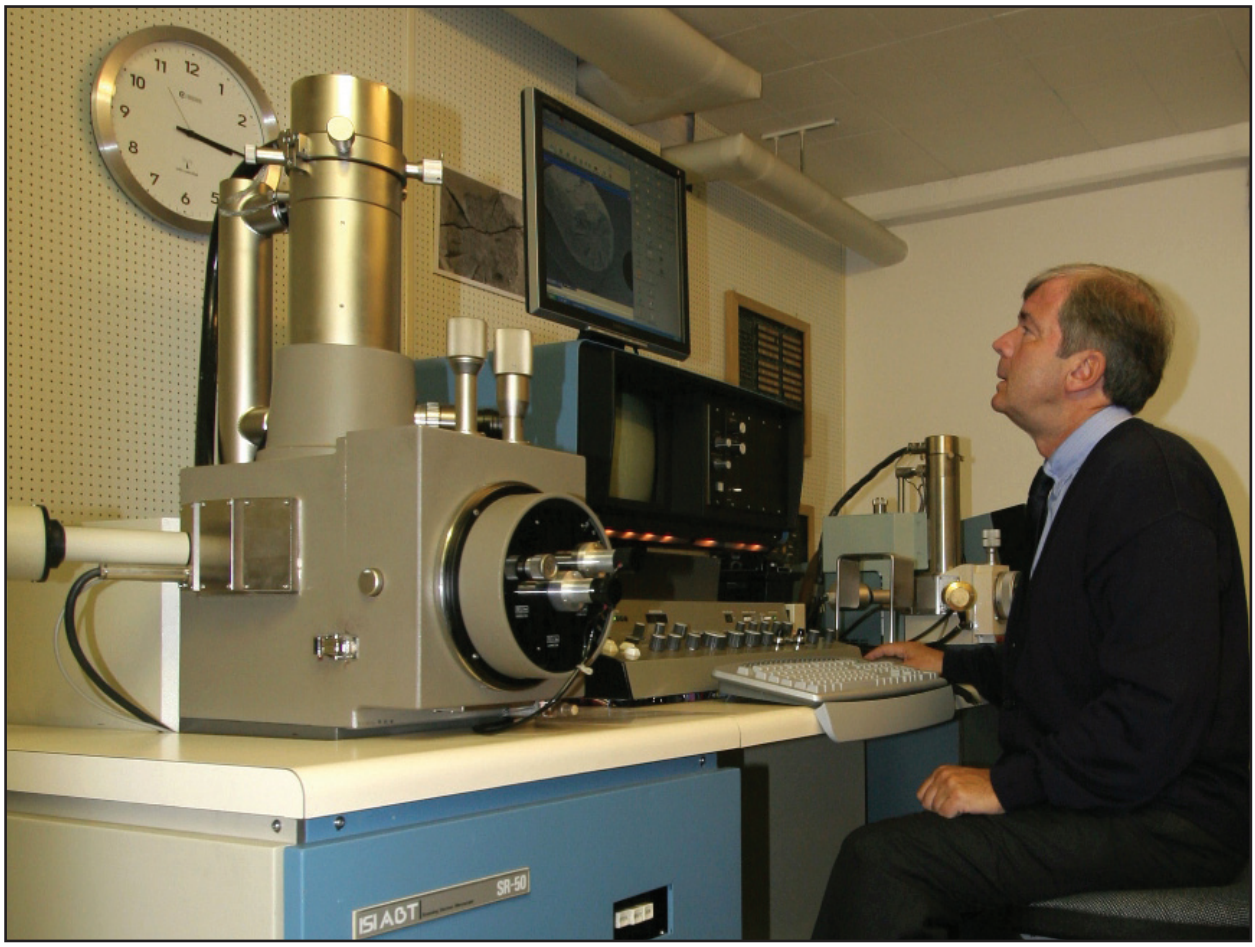


The same centre wire as in the previous image, with colour coding.

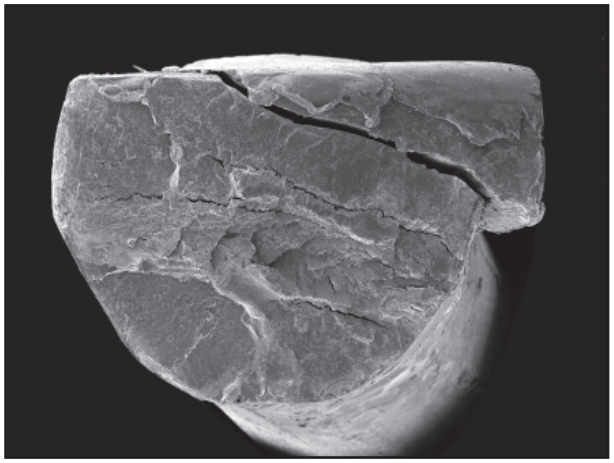


The 3D imaging technology enables us to analyse the cross sections of individual wires and to take measurements.

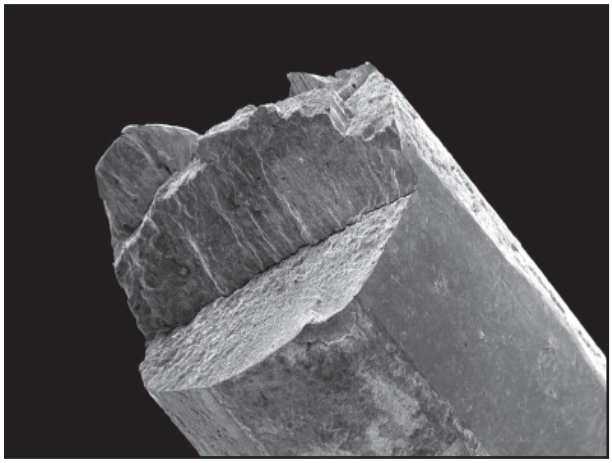
SEM FRACTURE ANALYSIS



Our laboratory is equipped with two scanning electron microscopes that are used for failure analysis. We have a lot of experience in wire, strand and rope failures. Above you can see Roland Verreet in his favourite working environment. The large specimen chamber in the foreground enables us to analyse complete strands or even entire sections of steel wire ropes.

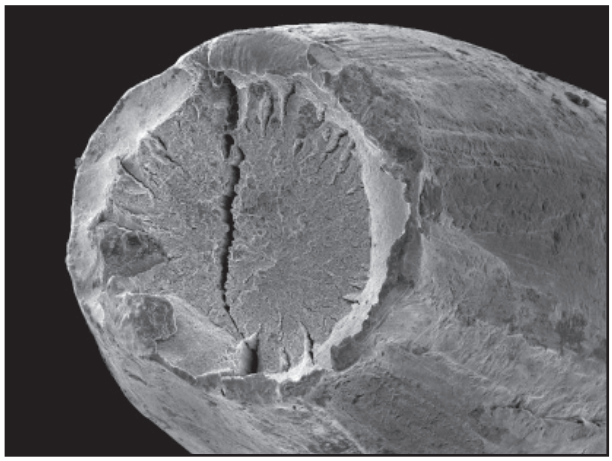


Outer wire of a deep-shaft mining rope that was destroyed in a South African mine by high impact forces caused during multi-layer spooling.

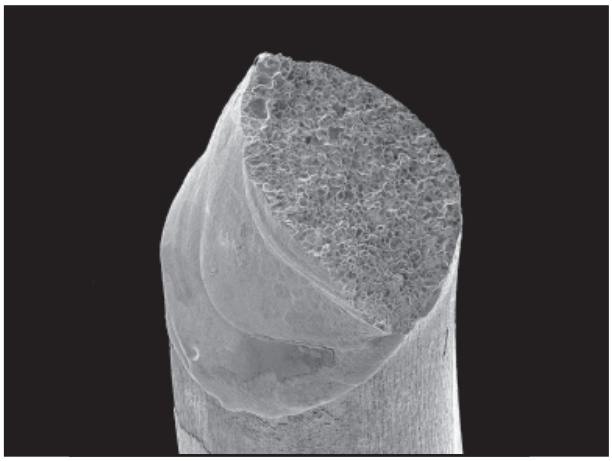


This outer wire of a steel wire rope was weakened by 50% by a fatigue crack before it failed completely.

SEM FRACTURE ANALYSIS

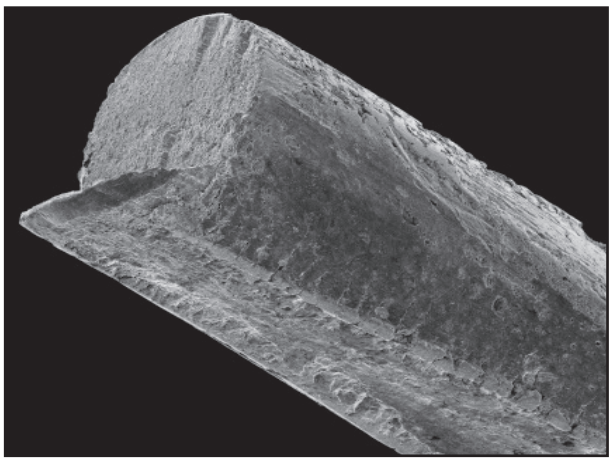


Overload break of a wire. The rope had jumped over a sheave, and many wires broke in this cup and cone configuration. Client: Shell.

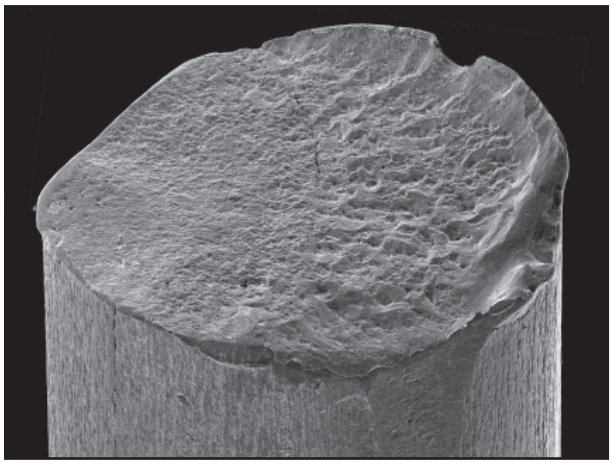


An outer wire of a rope struck by artificial lightning. The structure has recrystallized. Work for NASA.

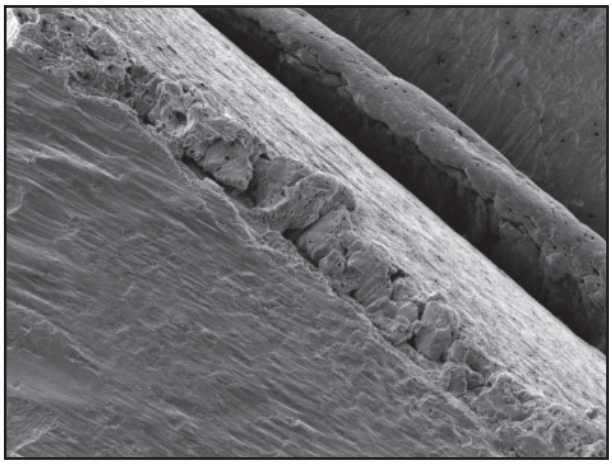
Mechanical damage to a wire. The rope had jumped a sheave (same rope as above). The center of the wire failed as a shear break.



Fatigue break (valley break) at the contact point between two outer wires of neighbouring strands. Failure on Russian drilling rig.

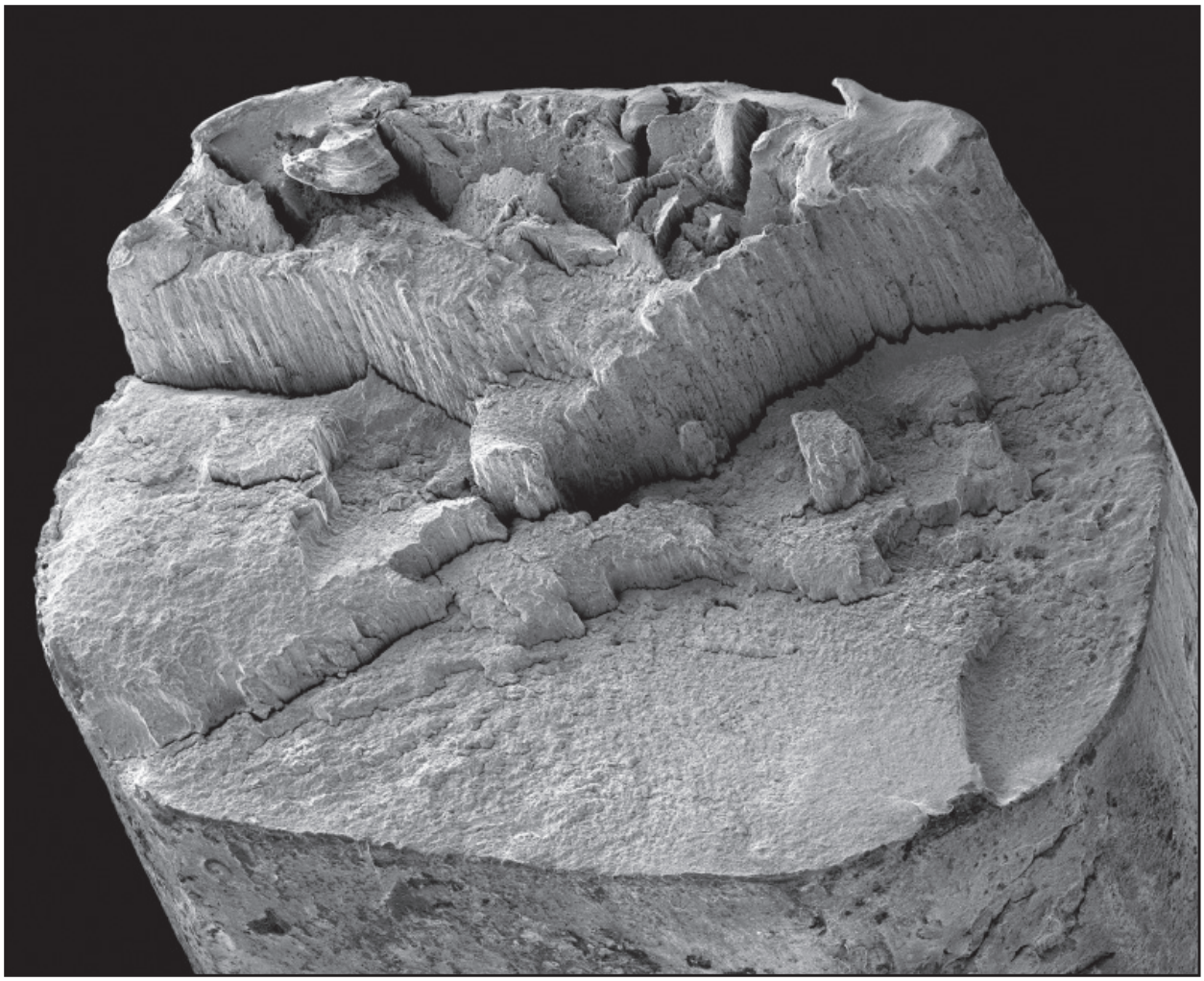


Fatigue break (Eiffel Tower elevators). After the wire had broken under compression, the two ends have polished each other off.



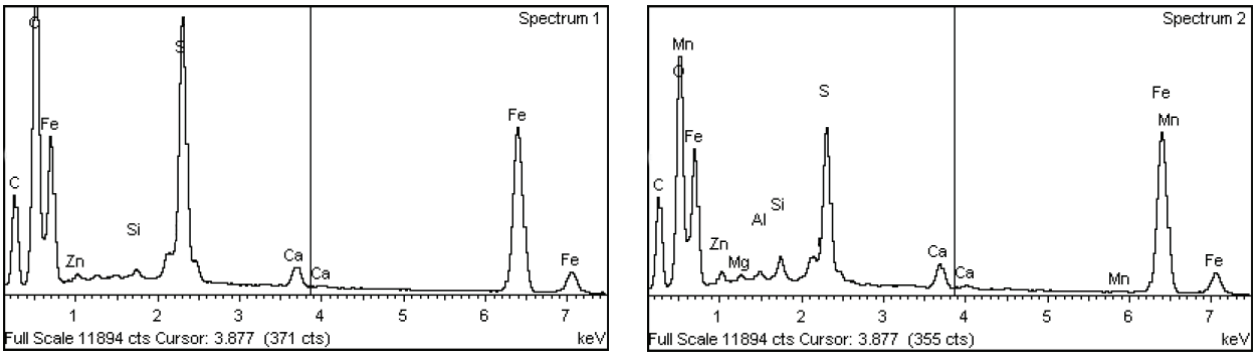
Crossover point between two wires. The zinc and delta layer on top of the wire have been ground off. Laboratory torsion-torsion test.

SEM FRACTURE ANALYSIS



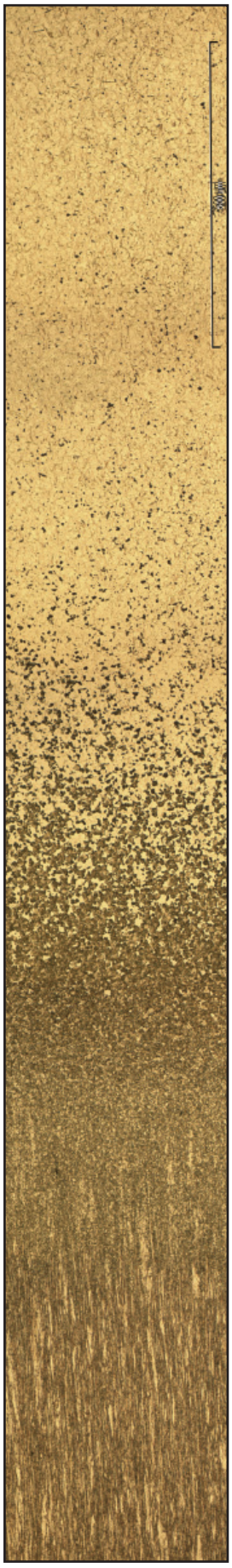
Fatigue wire break under high bearing pressure and under torsional stress. Triangular strand rope. Telfer Mine, Australia.

EDX ANALYSIS



Wire Rope Technology Aachen (WRTA) can perform EDX analyses in order to determine the chemical composition of materials such as small inclusions in rope wires. The process is based on the measurement of weak radioactive emissions in the scanning electron microscope.

METALLOGRAPHY



Wire Rope Technology Aachen (WRTA) can perform a metallographic analyses of steel wire microstructures.

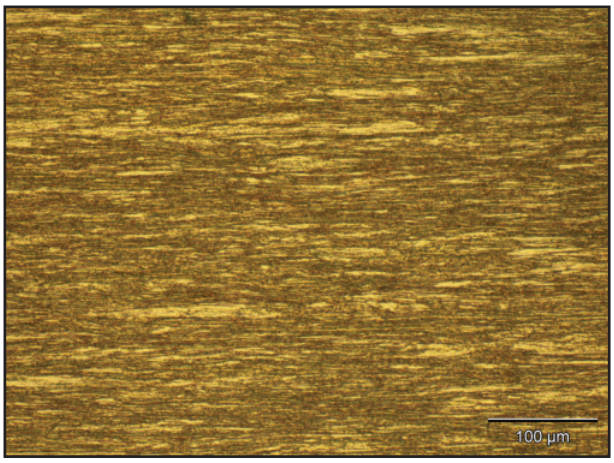
For this purpose, individual strands or rope wires (and sometimes even entire rope cross sections) are mounted in plastic and subsequently cut, ground and polished.

The photograph to the left is a section along the axis of a steel wire. It shows the continuous change in wire structure from typical elongated drawing structure (shown at the bottom) to the structure of recrystallized steel (shown at the top).

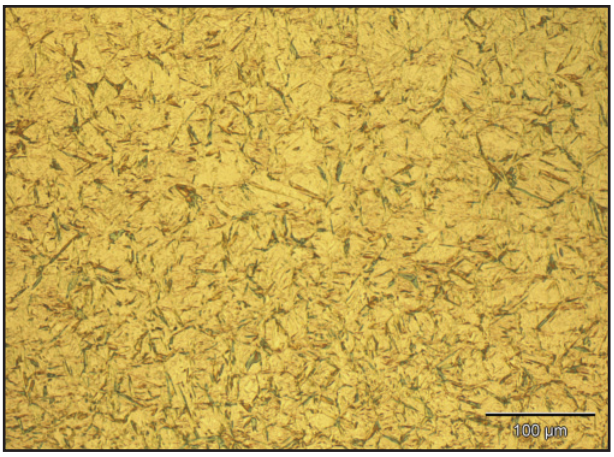
The steel wire has been subjected to excessive heat during welding at the crane boom structure. The rope later failed while in service.

Wire Rope Technology Aachen can also perform measurements of the thickness or the weight of a wire‘s zinc coating. We can determine other characteristics such as breaking strength or micro hardness of steel wires.

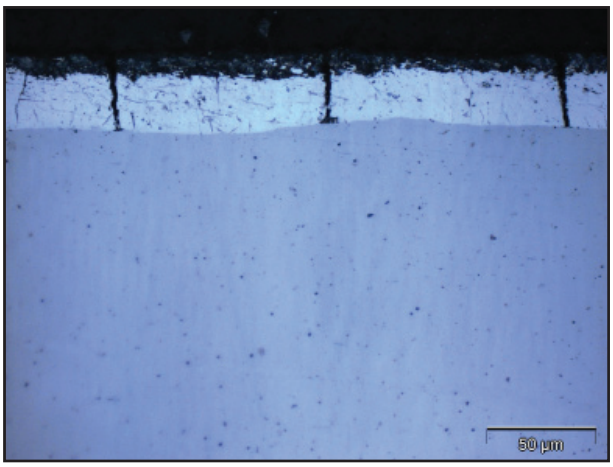
We also measurement the thickness of plastic coatings around steel wire ropes or IWRCs.



Typical fine lamellar drawing structure with Pearlite (dark) and Ferrite (bright).



The opposite wire end has been subjected to high temperatures. The structure has recrystallized and quenched. Martensite and Bainite have formed.



Crack formations in the zinc coating of a galvanized steel wire. Unetched sample.

DESIGN OF REEVING SYSTEMS

Over the last 25 years we have designed or helped improve a great number of spectacular reeving systems. One example, shown here, is the catapult of the Space Mountain ride at Eurodisney, Paris.
Almost every wire rope expert was convinced that, because of the high dynamic forces, such a catapult could never work using a wire rope. And yet we made it happen. The rope driven catapult has now shot more than 100 million people into the dome without a single rope-related incident.

We thank dep Grenoble for their permission.

Two of many other examples: We helped to improve the reeving system of the crane and the stinger for the Sapura 3000.....

We thank Huisman for their permission.

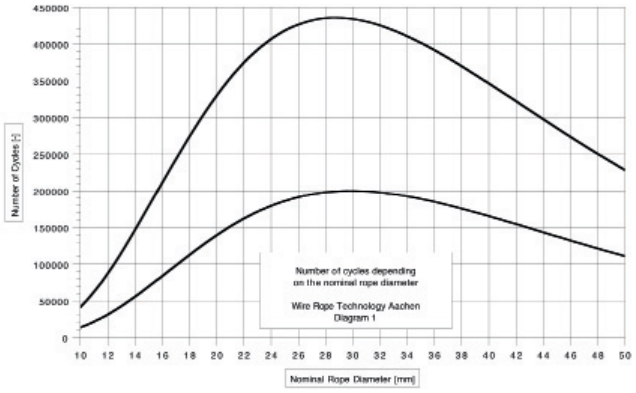
..... and the complex reeving system of the Terex Demag CC 8800 Twin, the world's largest land based crane.

We thank Terex Demag for their permission.

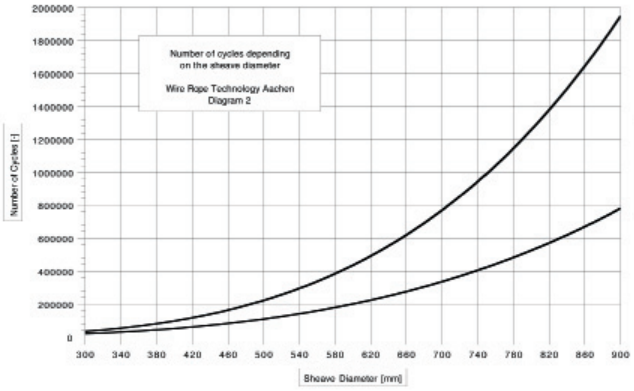
FATIGUE LIFE CALCULATIONS

Wire Rope Technology Aachen has developed its own sophisticated computer software that enables us to predict the fatigue life of steel wire rope. For a given set of conditions we can, for example, calculate the optimum rope diameter for your machine.

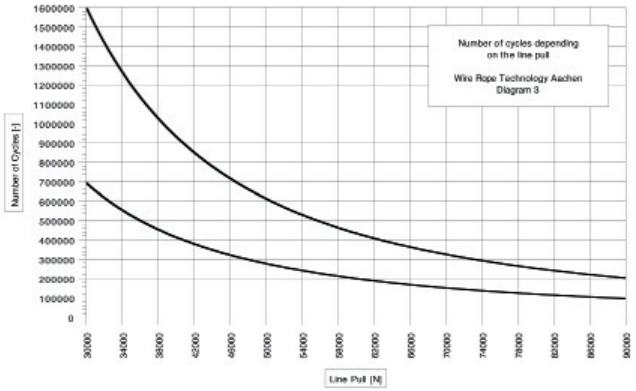
Rope diameters that are smaller than the optimum will have to be discarded prematurely because of the line pull (which is too high for the small rope). Likewise, ropes with a diameter larger than optimum will also have to be discarded prematurely due to the bending stresses (as a result of the smaller ratio D/d). Our software can also optimize your reeving system.



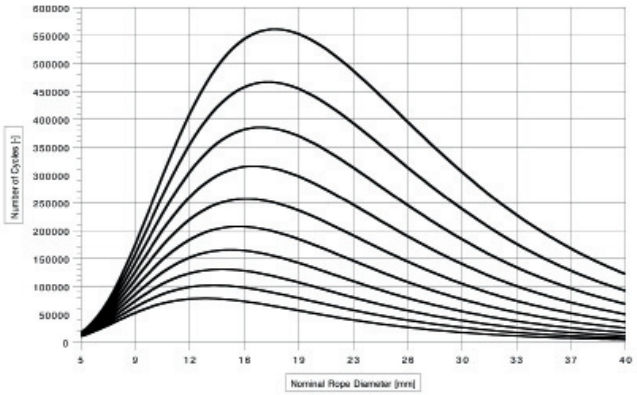
We can plot the rope life until discard (lower curve) and until break, as a function of the rope diameter. This will enable you to choose the optimum rope diameter for your system.



We can plot the rope life until discard (lower curve) and until break, as a function of the sheave diameter. This will enable you to achieve the fatigue life you require.

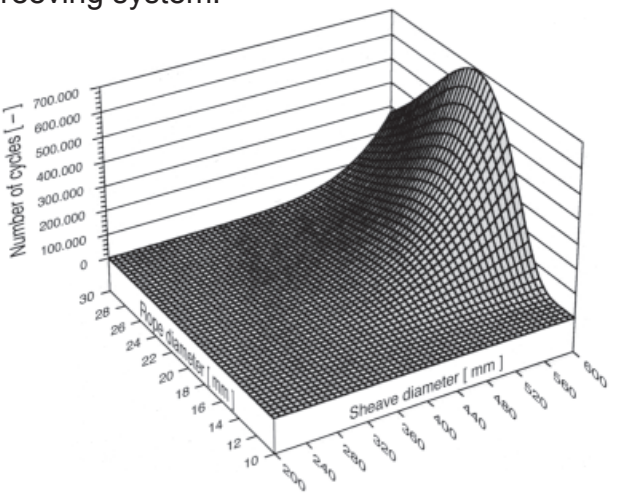


We can plot the rope life until discard (lower curve) and until break, as a function of the line pull. This will allow you to optimise your reeving system.



Different sheave diameters (see different curves) will result in different fatigue lives.

Also the optimum rope diameter will change as a function of the sheave diameter.

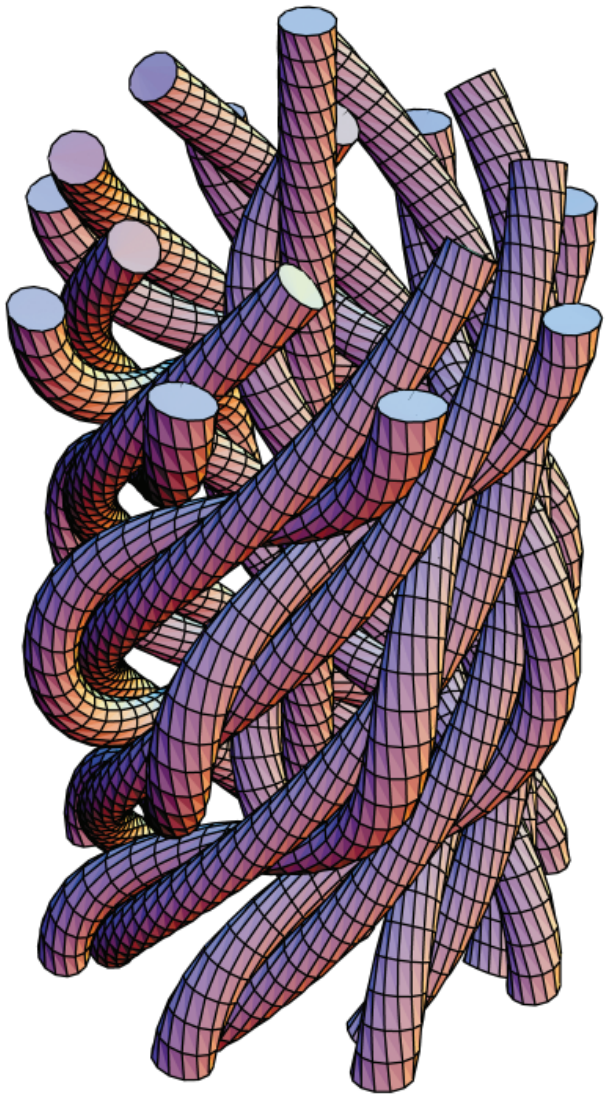


We can plot the fatigue life in 3D as a function of two different parameters in order to illustrate which parameters must be changed in order to achieve optimum performance.

ROPE GEOMETRY ANALYSIS

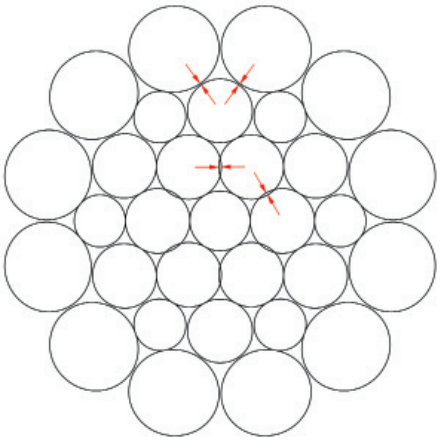
A steel wire rope performance problem or even a wire rope failure might have been caused by faulty rope geometry.

We have more than 35 years of experience in rope design. Over the years we have developed a sophisticated software that enables us to analyse individual rope designs.

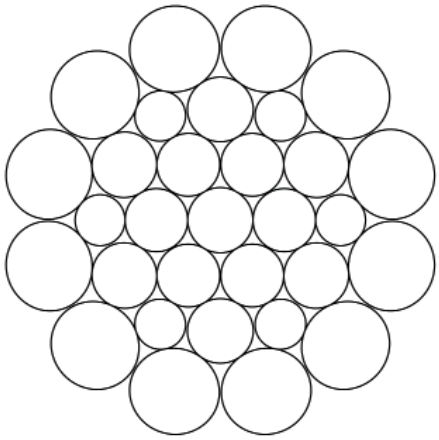


Our 2 D software (right) analyses the strand and rope cross- section as far as wire sizes and clearances are concerned.

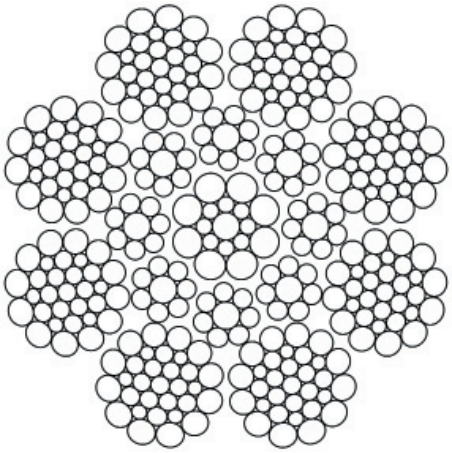
Our 3D software (above) is unique. It enables us to display the rope in three dimensions, to analyse the contact conditions and even to take a walk inside the wire rope.



Poorly designed or manufactured strand, with incorrect wire sizes and incorrect clearances.



Properly designed strand with correct wire sizes and correct clearances.

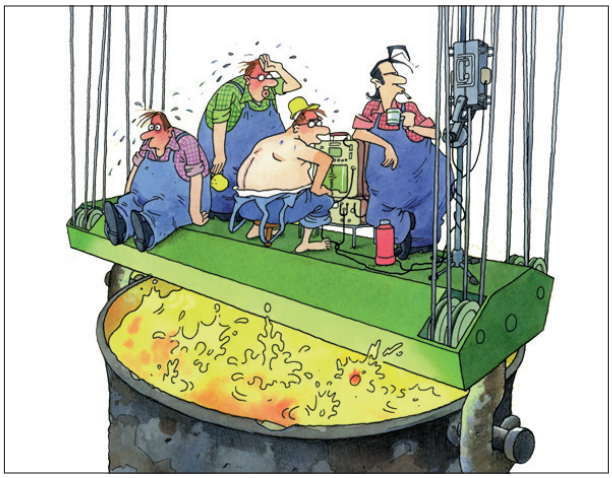


A cross section of a double- parallel steel wire rope that has the correct wire sizes and correct clearances.

WIRE ROPE INSPECTION

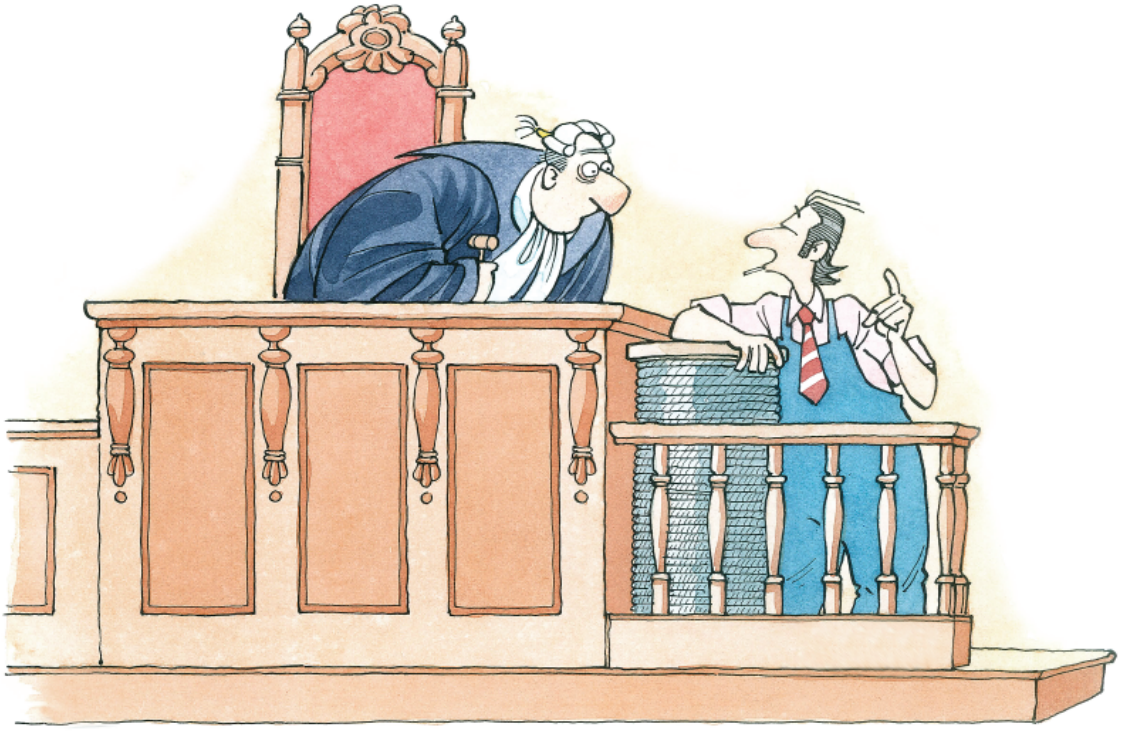
We can inspect your ropes wire ropes visually or using non destructive testing (NDT) equipment. We can also train you, your colleagues or your customers on how to do it. We can also analyse your reeving systems and tell you where your critical rope sections are located. We can even show you where your rope is most likely to fail. Roland‘s seminars on wire rope inspection are extremely popular.

Jean-Marc Teissier (photo) and Roland Verreet inspecting the elevator ropes on the Eiffel tower in Paris using NDT equipment.



Where possible, NDT should be carried out when the rope is under load. This can be a hot job in a steel mill!

EXPERT WITNESS IN COURT

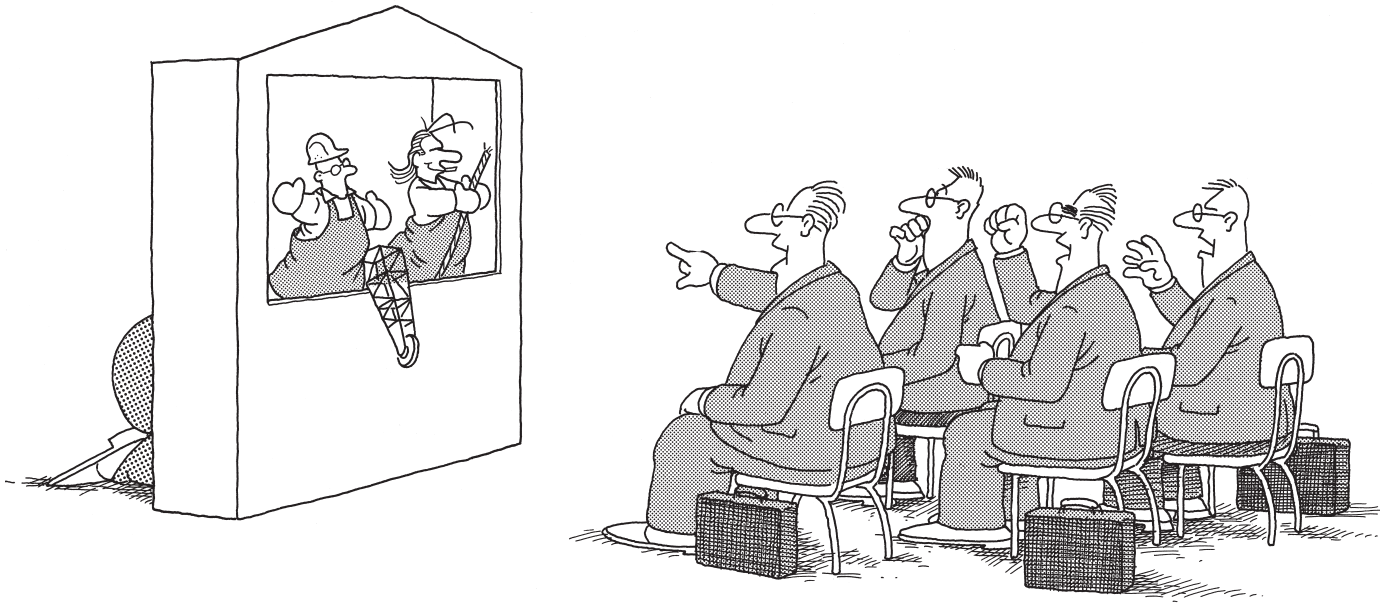


Are you involved in a court case because of a failed wire rope? Talk to us! We have worked as experts in court cases with damages ranging from 20 000 to about 1 billion dollars. We can help you too.

PROCESS OPTIMIZATION

Do you use the best techniques, and do you manufacture your products in the most cost-effective ways without sacrificing quality? Get an expert opinion from Wire Rope Technology Aachen!

SEMINARS



There is never a dull moment in Roland Verreet‘s celebrated wire rope seminars. These seminars are held all over the world, from Sidney to Stavanger, from Düsseldorf to Dubai, from London to Las Vegas, from Berlin to Buenos Aires.

We offer one- and two-day seminars on *Safe Ropes and Reeving Systems*. These seminars have achieved worldwide success. Customers include the world‘s leading crane manufacturers, offshore contractors, mining corporations and official bodies such as TÜV, DEKRA, LLoyds Register, Germanischer Lloyd or the NASA lifting engineers.

We also hold one- and two-day seminars on *Wire Rope Inspection*. We explain why, when, where and which way wire ropes must be inspected.

Our one day seminars on *Handling, Installation and Maintenance of Steel Wire Ropes*. are intended for riggers, but also for crane designers.

Over the years, many leading crane designers have attended our seminars on *How to design a Wire Rope Friendy Reeving System*.

No two seminars are ever the same. So even if you come for a second time you are guaranteed not to be bored.

PRODUCT DEVELOPMENT

Have your competitors stolen a march on you? Do you need new ideas? Why not talk to us? We can help you develop new ideas and products.

Creativity can be hired. Here:

Ingenieurbüro für Fördertechnik • Dipl.- Ing. Roland Verreet
Grünenthaler Str. 40a • D- 52072 Aachen, Germany

Ingenieurbüro für Drahtseiltechnik • Wire Rope Technology Aachen GmbH • Grünenthaler Str. 40a • D- 52072 Aachen, Germany

Tel. +49 241 17 31 47 • Fax +49 241 12982
www.seile.com • www.ropetechnology.com
email R.Verreet@t-online.de