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The International Magazine for the Wire & Cable Industries

INTERWIRE TRADE EXPOSITION

SPECIAL INTERWIRE ISSUE


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Rautomead Chairman, Sir Michael Nairn, will be presenting a technical paper at the Global Continuous Casting Forum which runs concurrently with the Interwire exhibition.
28 – 30 April 2015
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wire Russia
12 - 15 May, 2015
Moscow, Russia

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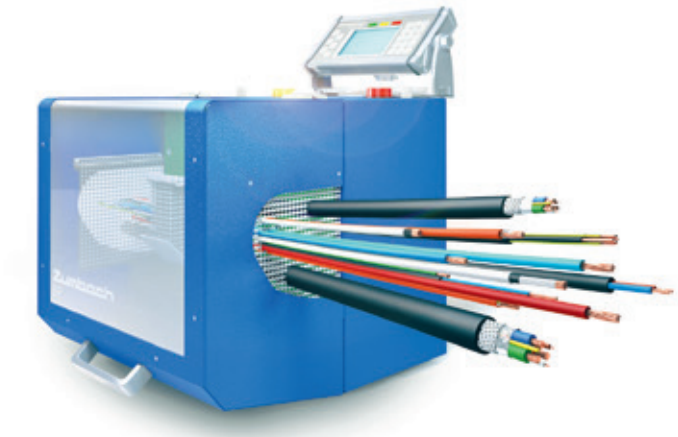

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DOUBLE TWIST

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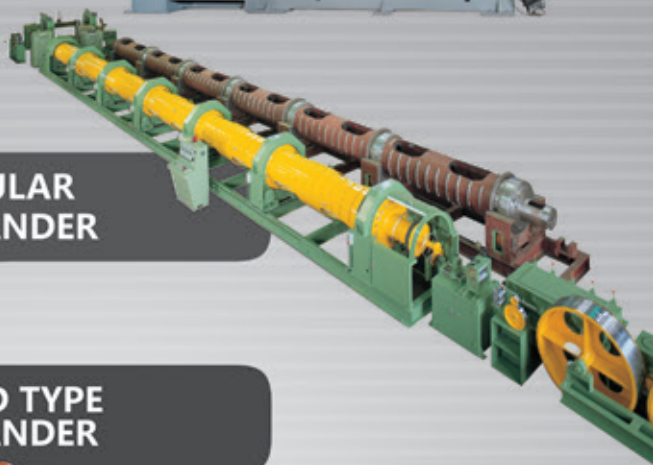
EXTRUDER

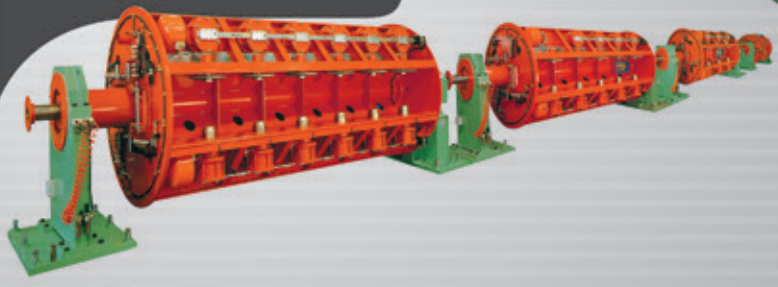


TUBULAR STRANDER

FINE WIRE DRAWING M/C WITH CONTINUOUS ANNEALING M/C

ROD BREAK DOWN M/C

RIGID TYPE STRANDER



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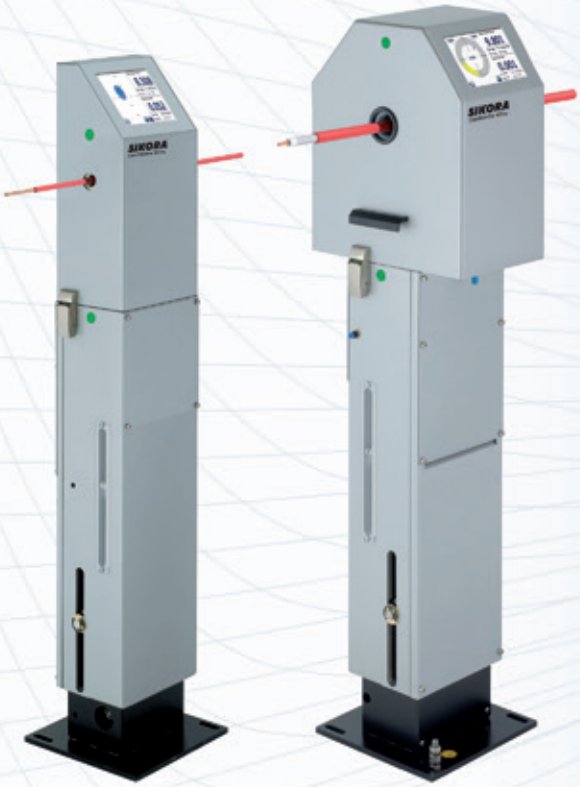
Sales Manager SIKORA International Corporation



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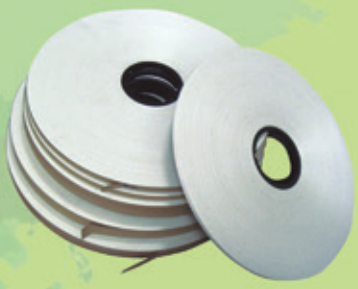
Fire-resistant synthetic mica tape



High temperature calcined mica tape

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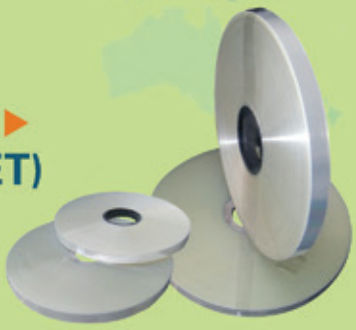

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See page 120 for further details

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Interwire is looming on the horizon

New plants, new jobs, new awards...it's all in the March issue of *EuroWire* – as well as a section on the wire and cable industry's largest American exhibition, Interwire.

Mario Frigerio has consolidated its operations in Molteno, Italy, with a new 30,000m^2 plant housing engineering, manufacturing, assembly, machinery sales, after sales and service and administration.

You can catch up with all the details of this on page 13.

UK lubricant manufacturer Metalube has another reason to be celebrating. The company, with plants in China, India and Brazil, has scooped its second Queen's Award for Enterprise, this time with an innovation award. Read all about it on page 14.

There are a number of new job appointments in this issue, and UK Steel – the trade body for the sector – has appointed Gareth Stace as its new director. The full story is on page 29.

Also worthy of mention is Sket manufacturing the world's largest machine for armouring of offshore power cables.

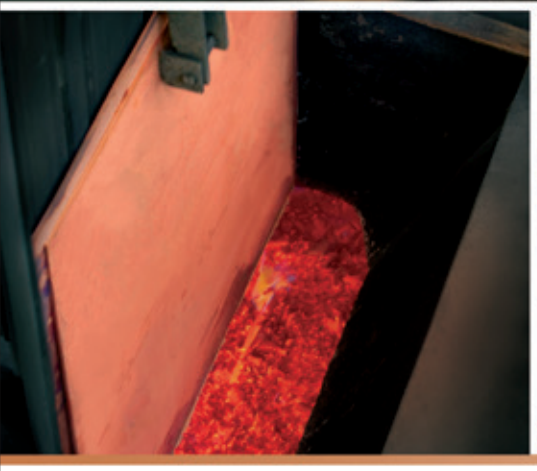
The machine – an impressive 150m long – has been delivered to a Scandinavian cable producer for the armouring of offshore power cables up to 350mm diameter. Turn to page 34.

Interwire is staged in Atlanta, USA, at the end of April and our coverage in this issue starts on page 60.

This well-respected exposition is a must-visit event that attracts both exhibitors and visitors alike from around the world.

If you are attending the show, please feel free to stop by Booth 132 to say hello and collect yout free copy of our magazine. See you there!

David Bell
Editor



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Technical Articles

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Next Issue

Getting Technical:

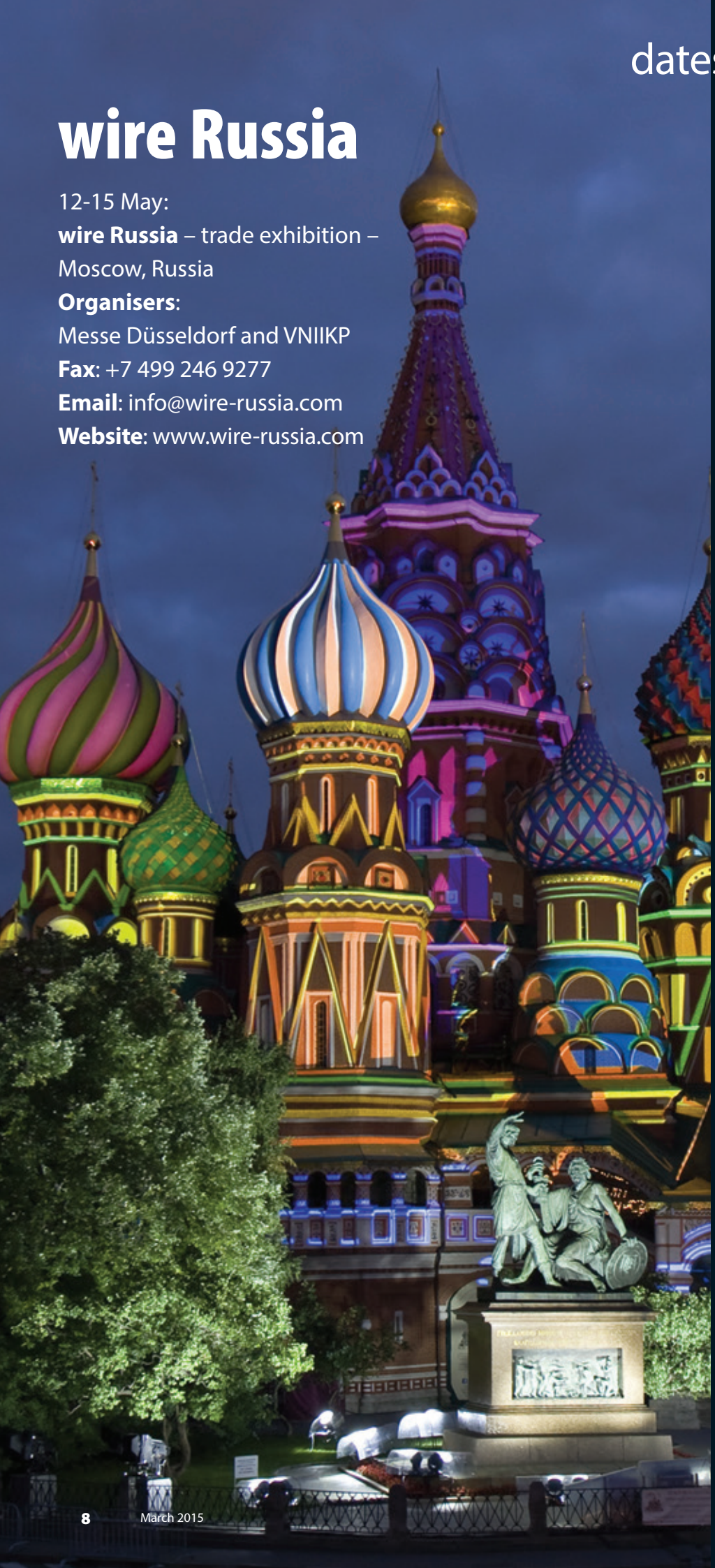
Measured and simulated DC powering of data cables for power over Ethernet

Feature

wire Russia

wire Russia

12-15 May:
wire Russia – trade exhibition – Moscow, Russia
Organisers:
Messe Düsseldorf and VNIIKP
Fax: +7 499 246 9277
Email: info@wire-russia.com
Website: www.wire-russia.com



www.bigstockphoto.com "St Basils Cathedral, Moscow, Russia" by Iva Afonskaya

2015

June

16-18 June:
16th Guangzhou Tube and Wire Fair – trade exhibition – Guangzhou, China
Organisers: Julang Exhibition Co Ltd
Fax: +86 203 862 0790
Email: meiwen@julang.com.cn
Website: www.julang.com.cn

September

15-17 September:
wire Southeast Asia – trade exhibition – Bangkok, Thailand
Organisers:
Messe Düsseldorf Asia Pte Ltd
Fax: +65 6337 4633
Email: wire@mda.com.sg
Website: www.wire-southeastasia.com

October

5-10 October:
EMO – trade exhibition – Milan, Italy
Organisers:
EFIM-ENTE Fiere Italiane Macchine
Fax: +39 226 255 882
Email: info@emo-milan.com
Website: www.emo-milano.com

5-8 October:
IWCS Technical Symposium – conference and exhibition – Atlanta, Georgia, USA
Organisers: IWCS
Tel: +1 717 993 9500
Email: phudak@iwcs.org
Website: www.iwcs.org

6-8 October:
wire South America – trade exhibition – São Paulo, Brazil
Organisers:
Messe Düsseldorf GmbH
Fax: +49 211 4560 668
Email: info@wire-south-america.com
Website:
www.wire-south-america.com

November

3 November:
Cabwire Conference – conference – Düsseldorf, Germany
Organisers:
IWMA, WAI, ACIMAF, CET IWCEA
Fax: +44 121 781 7404
Email: info@iwma.org
Website: www.cabwire.com

2016

April

4–8 April:
wire/Tube Düsseldorf – trade exhibition – Düsseldorf, Germany
Organisers: Messe Düsseldorf GmbH
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Website: www.wire.de

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▲ *Innovation and technology from Cortinovis Sictra*

The evolution of trolley wire manufacturing

AMONG wire and cable machinery suppliers, Cortinovis and Sictra are recognised for the advanced technology of their products and equipment reliability.

Many users with machinery from decades ago are still using their equipment, counting on the continuous supply of original spare parts from Cortinovis Sictra when they are needed.

It was at the beginning of the 1980s when Sictra developed its first integrated drawing line for shaped trolley wires, and the development of high-speed railways was still to come.

At that time, it was common practice to draw the shaped trolley wires utilising a single deck bull block, with which the rod was drawn down with several subsequent passages until the shaped wire final cross section was achieved.

The design and construction from Sictra of an integrated drawing line with four capstans represented a dramatic improvement. Productivity increased by a factor of ten while manpower requirement reduced. Not only that, but the scrap rate was also reduced significantly and the quality of the final product enhanced.

It soon became evident to the Industry that competing in the manufacture of trolley wires was no longer possible unless the equipment in use was up to date.

The product itself was subject to a significant evolution. The drives of this development have been environmental protection on one side and the increase of operation speed of the railways on the other side.

For a long time, copper was utilised for trolley wire alloyed with cadmium. The presence of cadmium gives to copper a much higher resistance to softening at elevated temperatures and also to arc erosion, as extremely heat resistant cadmium oxide forms on the surface of the wire during arcing and protects it from eroding.

Cadmium, however, is very toxic, even more than lead or mercury, therefore it has been replaced for this application by other metals to be alloyed with copper.

Nowadays the most utilised copper alloys for high-speed trains granting operating speed up to 400km/hour are copper and magnesium alloys; wear and tear is the lowest, while breaking load the highest. Silver copper and tin copper alloys are also used.

All of this implied a redesign of the Sictra trolley wire integrated drawing line.

A modern line capable of drawing Cu Mg 0.5 alloy is usually made of four capstans, the first two with 1,200mm diameter and the last two with 1,000mm diameter.

The AC motors provide adequate torque to the capstans to match the higher rod tensile strength of the new alloys and the increased breaking load of the final product.

More often the line is designed with five capstans (2 x 1,200mm and 3 x 1,000mm) to be able to draw down copper alloy rod with inlet diameter up to 30mm.

The process and the increased powers involved in it require an efficient capstan cooling system via inside chilled water circulation and rotating joints. Wire lubrication and additional cooling is provided with emulsion spray on the capstans' surface and most efficient lubrication of the round and shaped dies is achieved with specific oil circulation and die holders' chilled water cooling. All of this requires three separate cooling and circulating circuits.

Cortinovis Sictra – Italy
Website: www.trafcomachinery.com

Quality Products completes Fenn acquisition

QUALITY Products Inc (QPI), a manufacturer and distributor of aircraft ground support equipment, hydraulic press machine tools, press brakes, hydraulic presses and shears, has announced the acquisition of Fenn LLC.

Fenn president Paul Uccello said: "This is a great outcome for our customers and our companies, and we couldn't be more excited about our future together. With other businesses in capital equipment manufacturing, we believe QPI has the right combination of business experience and resources to allow Fenn to continue to develop and produce high quality machines."

Fenn will continue to produce custom engineered machinery to customer specifications, whether it be rolling mills, wire flattening and shaping, drawbench or turks head applications. In addition, Fenn will also continue to offer its industrial line of products including Torin spring coilers, swagers and impact cut-off machines. With all of its product lines, Fenn will also commit to a renewed focus on machine service and spare parts support.

QPI operates in two segments: machine tools and aircraft ground support equipment. QPI's machine tools segment consists of Multi-Press, Pacific Press and Fenn. With roots tracing back to the 1920s, Multi-Press is a provider of hi-tech hydraulic and electrical control presses including a full line of bench, floor model, and four-post configurations.

Pacific Press provides hydraulic press brakes, shears and presses in North America, manufacturing a broad range of metal forming equipment. In the aircraft ground support equipment category, Columbus Jack has served the aviation industry for decades, providing ground support equipment to commercial, military and civilian aircraft clientele.

Commenting on the transaction, Quality Products Inc president David Somers said: "This acquisition continues the expansion of our businesses in metal working machinery and equipment. We welcome Fenn into the Quality Products organisation, and we are excited about the ability to increase our product offerings and penetrate new markets."

Quality Products Inc – USA
Website: www.multipress.com

New Niehoff agency for France, Tunisia, Algeria and Morocco

Since January this year, Maschinenfabrik Niehoff has been collaborating with a new representative for France, Tunisia, Algeria and Morocco.

Sequem has taken over the support in the mentioned Niehoff sales areas from Sifem, a company with which Niehoff had worked together for more than 40 years.

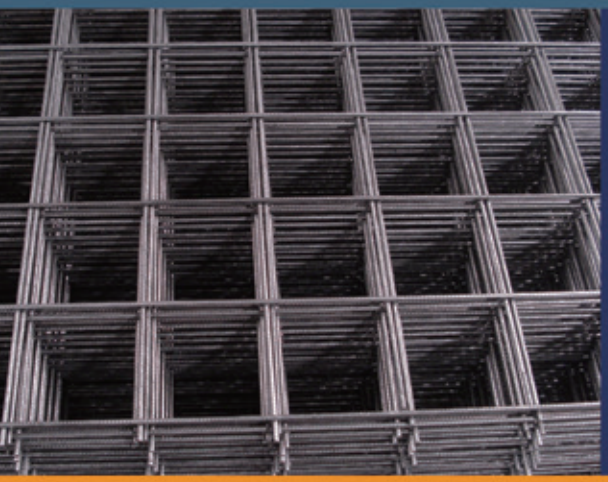
Sequem, based at Lezennes on the outskirts of Lille, France, has been representing Niehoff in Belgium and Luxembourg for ten years.

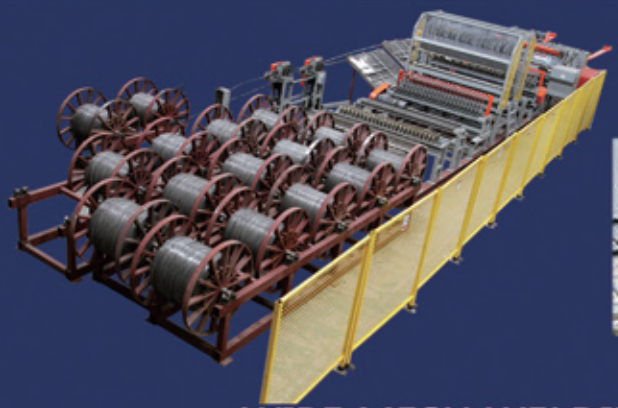
The family-run business cooperates with about 30 manufacturers of machinery for the wire, cable, wire processing and other sectors of the metal working industries.

Sequem – Services et Equipements Industriels sas – France
Website: www.sequem.fr

STIRRUP BENDER

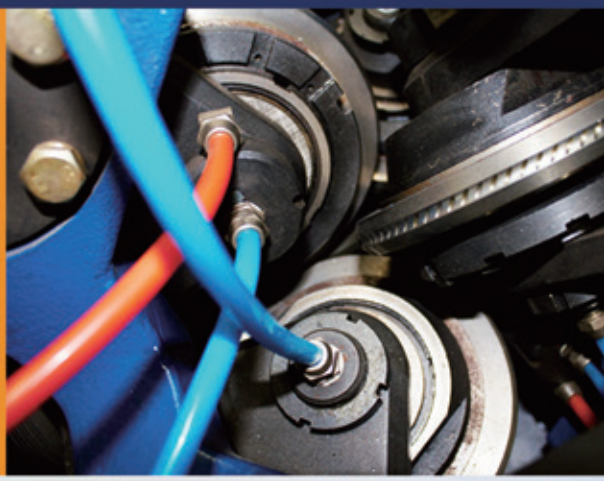
WIRE STRAIGHTENING AND CUTTING MACHINE





WIRE MESH WELDING MACHINE

WIRE COLD ROLLING MACHINE



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Fax: +86-22-86996265

Website: www.tjkmachinery.com

E-mail: tjk@tjkmachinery.com

New facility for Mario Frigerio

MFL Group provides its customers with complete innovative solutions, with products represented by two historic brands – Mario Frigerio steel wire and rope machinery and Frigeco machinery for the non-ferrous wire and cable industry.

Last year the company consolidated its operation in a new facility at Molteno, Italy. This new 320,000ft^2 (30,000m^2) facility houses engineering, manufacturing, assembly, machinery sales, after sales and service and administration.

Mario Frigerio was established in 1897. With more than 100 years' experience in the wire and cable industry, it has more than 400 employees, and customers located in over 100 countries around the world.

Throughout the years, it became clear there were synergies in the value chain of the MFL Group. Activities such as manufacturing, logistics, procurement, after sales and service, marketing and other administrative functions are centralised, while sales and the technical departments operate independently as technical know-how is highly specialised for each product and technology.

▲ *The new plant in Italy*

Now all these functions are located in a single corporate and manufacturing location.
The new Mario Frigerio facility also boasts a fully computerised manufacturing floor where all the parts used on Mario Frigerio and Frigeco machines are manufactured from raw material to finished parts.

All critical parts are statically and dynamically balanced on site. All parts are subjected to 100 per cent quality control.

Mario Frigerio SpA – Italy
Website: www.mflgroup.com

Second Queen's award for Metalube

CHRISTMAS came early for wire lubricating specialist firm Metalube Ltd.

The company, with offices in China, India and Brazil, received its second Queen's Award for Enterprise in December at its Manchester, UK, headquarters from Mrs Edith Conn, Her Majesty's Vice Lord-Lieutenant of Greater Manchester.

The innovation award was made to Metalube for inventing OCG 6000, a synthetic grease that protects over-head line electrical conductors.

The corrosion-preventing grease can operate at over 200ºC with an operational life exceeding 20 years.

OCG 6000 extends the lives of conductors and, ultimately, saves capital investments by delaying future renewal of pylon infrastructure.

This is the second successive year that the company has been bestowed a Queen's Award for Enterprise. Exporting to over 86 countries worldwide, the company won in the International Trade category in 2013.

Robert Brown, managing director, said: "It is a tremendously proud day for Metalube and I am particularly delighted for the company's many innovators, who work in our laboratory.

"It is their skills that set us apart, and for one of our ground-breaking products to be publicly recognised is a great compliment."

▲ *Managing director Robert Brown receives the Queen's Award from Mrs Edith Conn, Her Majesty's Vice Lord-Lieutenant of Greater Manchester*

The company manufactures a range of non-ferrous drawing oils and maintenance lubricants as well as a variety of corrosion protection and forming oils. This experienced exporter employs 34 people.

Metalube Ltd – UK **Website**: www.metalube.co.uk

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Cutting environmental impact – certified!

GMP SLOVAKIA is now certified to the ISO 14001:2004 standard for environmental management systems. This certification confirms the company's commitment to minimise the environmental impact in its day-to-day operations.

GMP has already been certified ISO 9001:2008 standard for quality management systems since 2010. This certification is essential for customers who need a supplier which can give them the assurance that all services and products supplied respect special specification during the realisation of the product.

Realisation of products is followed step by step, from the purchasing of raw material to manufacturing of the product, and all these steps can be coverable and verified. Both ISO 14001:2004 and ISO 9001:2008 are very important because they are synonymous with quality products respecting the environment.

GMP take-apart reels and handling are CE certified. The range of product includes the tilting unit model TU/M to turn coils and reels 90°. Loading capacity is up to five tons. The TU/M works by transmitting the movement from the motor to the tilting table by a chain.

▲ *Reel deal from GMP Slovakia*

It is set by a control panel outside the machine and is provided with safety barriers (hardware and optical). The equipment must be placed in the ground according to layout designed from GMP's technical team. The TU/M can be supplied with a rolling system, where the operator can place the reel in horizontal axis position for the strapping operation. Dimensions can be standard or customised according to the customer specification.

GMP Slovakia – Slovakia
Website: www.gmp-slovakia.com

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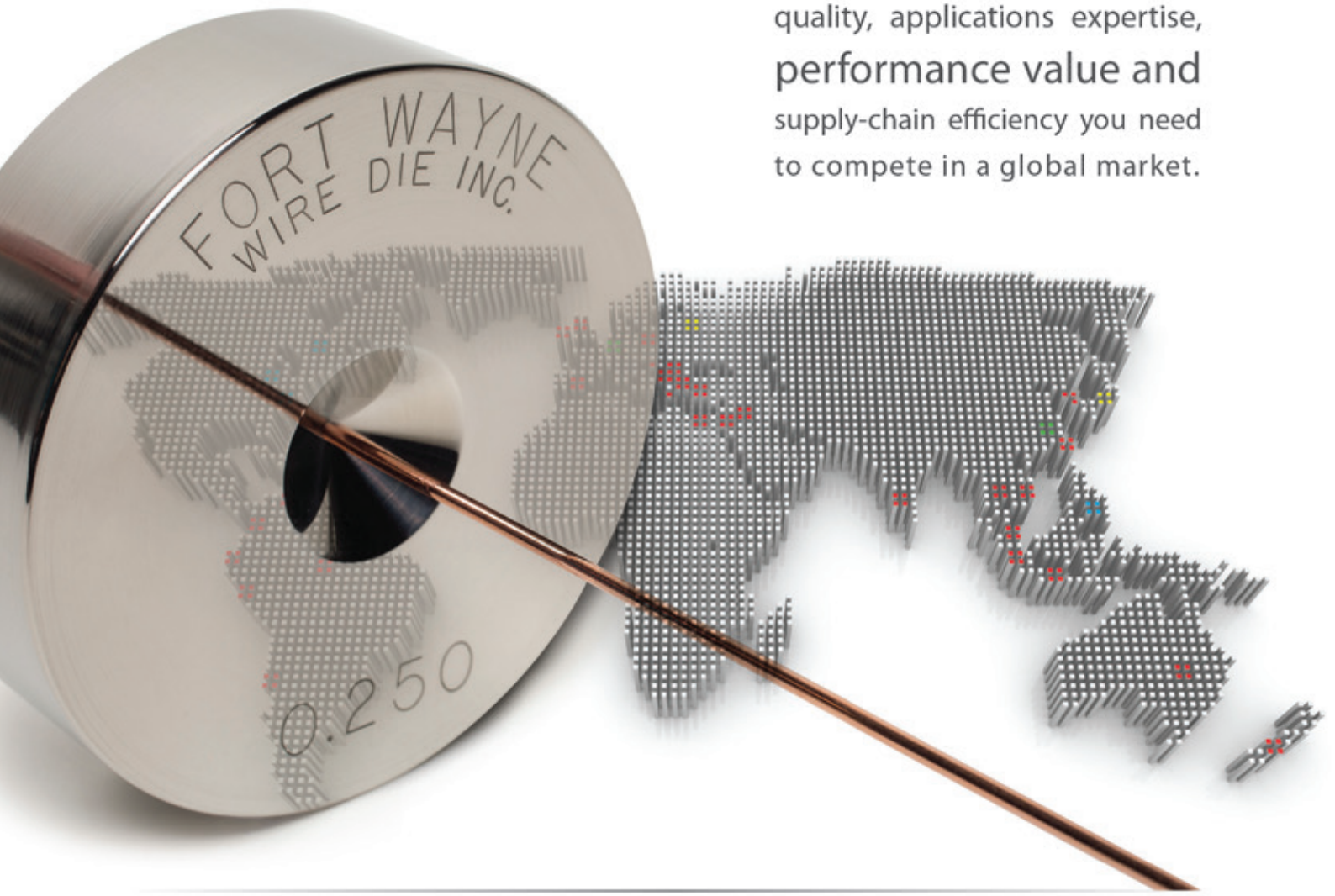

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New French distributor

ANICIA is the new distributor for Highvolt Prüftechnik Dresden GmbH in France.

"We are very pleased to welcome Anicia as the latest partner to strengthen our global distribution network," said Highvolt's senior sales engineer, Stefan Schierig.

"The contact person for all questions concerning our products and services is Christophe Buet, the managing director of Anicia."

Mr Buet lays claim to over 20 years' experience in the marketing of industrial test and measuring equipment, and – as a qualified engineer – possesses comprehensive technical knowledge. Highvolt sees the cooperation with Anicia as an opportunity to further expand its market presence in France.

For Mr Buet, customer relations and service are the most important concerns.

"We offer Highvolt customers competent advice right on their doorstep, irrespective of whether they are planning a new purchase of high-voltage testing systems with corresponding measuring devices, an upgrade of existing equipment, or maintenance measures."

▲ *Christophe Buet (centre), Highvolt's new representative in France, inspects the production facilities at Highvolt in Dresden with managing director Ralf Bergmann, left, and head of sales Alexander Kraetge*

Highvolt Prüftechnik Dresden GmbH – Germany
Website: www.highvolt.de

ITO-SIN (DEYANG) WIRE AND CABLE EQUIPMENT CO., LTD

Copper Aluminum rod breakdown machine, LHD-450

Application: the breakdown machine is used to draw copper wire or aluminum alloy wire. it consists of a host drawing machine, pay-off stand, continuous annealer, accumulator, dual-spooler take-up unit.

YQL-150 continuous Lead Extruder

This series of Lead Extruder is used to continuous coat lead layer for marine cable or rubber cable.

Copper rod continuous casting and rolling line, Aluminum rod continuous casting and rolling line

Copper CCR line is used to produce 8mm of copper rod from scrap copper and cathcode copper. it consists of a refrection furnace, five-wheel casting machine, front haul-off unit, straightener, continuous rolling machine and down coiler take-up unit. Users can choose different furnace system according to different raw material and output capacity.

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Guangzhou Office: Tel:+86-20-87376167 Fax:+86-20-85618049

New sales manager

▲ *New sales manager Richard Fichtner*

GEO-Reinigungstechnik, Germany, has appointed Richard Fichtner as sales manager and project development engineer.

Mr Fichtner has more than 20 years of sales and account management experience in surface treatment and welding wire material technology, most recently working as technical sales representative for an internationally active company with emphasis on the production of wire surface treatment systems, in whose development and marketing he played a key role.

He brings a wealth of knowledge and experience to GEO, and will focus on the development of new systems, cultivating existing customer relations and to convince new customers of GEO's ability to perform with multiple solutions in the field of wire cleaning.

Mr Fichtner will join the GEO team in the German pavilion at wire Russia 2015, and looks forward to meeting many business partners on this occasion.

GEO-Reinigungstechnik GmbH – Germany
Website: www.geo-reinigungstechnik.de

Strengthening sales team

▲ *Jessica Weiss*

Allied Wire and Cable has strengthened its sales team with the appointment of sales representative Jessica Weiss.

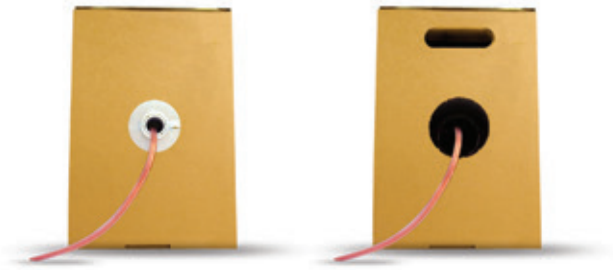
She is the first of several new staff for 2015, and leads the way for significant growth. Allied Wire & Cable's growth and development has caused the need for significant expansion of its sales team in 2015. Many of its locations will be adding new sales reps to the team, including at the headquarters in Pennsylvania, USA.

Prior to starting her sales career, Ms Weiss studied at Montgomery County Community College where she earned a Liberal Arts degree in 2004. Although new to the wire and cable industry, she is confident she will be able to bring her customer-based knowledge to her new position at Allied.

5th January 2015 was her official first day, and she is already enjoying her new role within the sales team, saying: "I am very excited to be part of the Allied team and to start this new chapter in my professional life."

Allied Wire and Cable – USA
Website: www.awcwire.com

Installing cable from a box like this?



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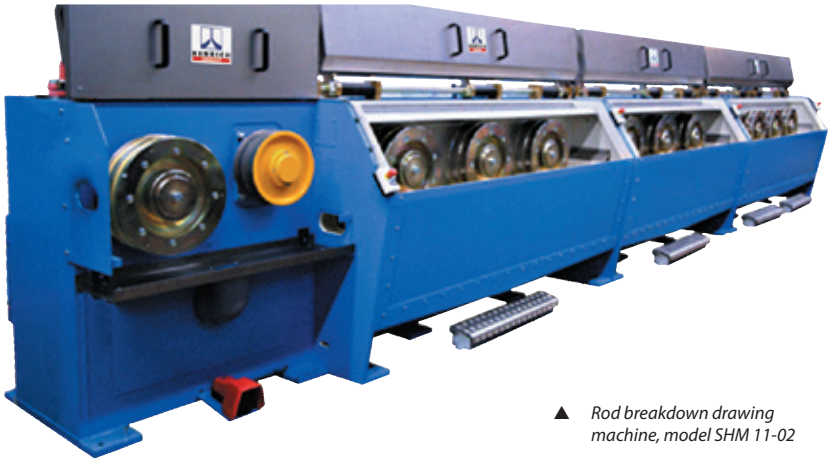

▲ *Rod breakdown drawing machine, model SHM 11-02*

Decades of work pays off

Experience and know-how, developed over decades, puts Henrich Maschinenfabrik among the major suppliers in the international cable and wire industry.

More than 3,000 wire drawing units are well established worldwide. Henrich's product range covers entire drawing lines and single-action machines for conductor cable, installation and special cable, telecommunication cable, trolley and enamelled wire. The production range is completed by cooling and cleaning devices for drawing and cooling solutions, drawing tools and pay-off devices.

Henrich Maschinenfabrik GmbH – Germany
Website: www.henrich.net

New plant manager

▲ *Jay Flahive*

ELECTRON Beam Technologies Inc has appointed Jay Flahive as its new plant manager. He has more than 17 years' experience in industrial management.

His strengths in the industry include a background in Lean Six Sigma manufacturing, quality control, operational organisation, scheduling and supply chain management.

These skills will be instrumental in implementing and improving Electron Beam's mission of providing customers with high quality products with reduced lead times.

Electron Beam Technologies is a worldwide OEM supplier of coaxial/ composite welding cables and Fast N' Easy® conduit systems for automation.

Electron Beam Technologies – USA
Website: www.electronbeam.com

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New system goes live

SUMITOMO Electric Lightwave (Sumitomo) has gone live with InnoVites CableERP, its comprehensive ERP solution for the wire and cable industry on Microsoft Dynamics AX.

The implementation project covered all business domains, including sales, logistics, production and planning. InnoVites successfully worked with Sumitomo and its local partner mcaConnect to complete the full project in just one year.

The comprehensive industry-specific functionality in CableERP results in a great fit and allows a short implementation time. Sumitomo is using the functionality of CableERP for the wire and cable industry, including specialised modules for optical fibre cable manufacturing.

The benefits include:

- Improved customer satisfaction by capturing full customer requirements like length break-down and tolerances, and drum type preferences. The integration with CableBuilder comes with a powerful search facility to find the design that meets customer requirements
- Reduced working capital and material losses. With the InnoVites length-based supply chain planning, materials are converted into finished cables in the shortest possible time and with the least possible material losses
- More effective and cost-efficient product data management with CableBuilder and CableERP. This integrated solution provides the latest product information across the company
- Streamlined and integrated processes across the company, including specific areas such as fibre import and fibre grading

Fred McDuffee, CEO at Sumitomo, said: "InnoVites, together with the mcaConnect team, provided excellent support during the project which allowed us to successfully go live in a very short period."

InnoVites BV – Netherlands
Website: www.innovites.com

Sumitomo Electric Lightwave – USA
Website: www.sumitomoelectric.com

New chief executive

Erik Boom has been named as the successor to Jos Holthaus as chief executive of Esteves Group. A member of the Diamond Tools Group, Netherlands, Esteves – with more than 100 years of history to its name – has manufacturing plants in Spain, Poland, USA, Mexico, Brazil and China.

Esteves Barcelona recently celebrated its 50th anniversary with a dinner and football match for guests at Barcelona's Camp Nou stadium, where the home side beat Sevilla 5-1.

Esteves Group – Netherlands **Website**: www.estevesgroup.com

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The NEW BETA LaserMike AccuScan 6012

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Learning from a proud history

ABOUT 40 years ago Sictra first designed a multi-wire line with the intention of increasing the output of single wire lines by simply raising the number of wires simultaneously drawn.

The company soon understood the essentials for multi-wire lines of concepts like productivity and efficiency. Its first priority was, and still is, to cut as much as possible any wire breakages, as the impact on the line productivity is much more harmful than in single wire drawing lines.

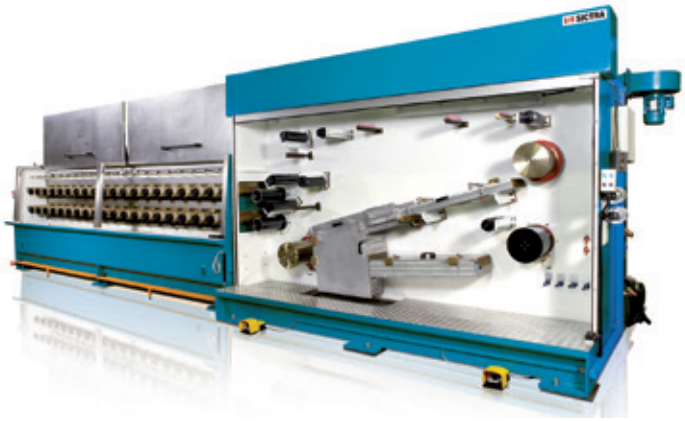
Therefore the drawing and annealing process has to be as smooth as possible, with any kinds of vibration needing to be avoided, not only as they are a source of noise, but also as they impact the frequency of wire breakages and subsequent losses of productivity.

Drawing capstans are located in very stiff modules, and access to the bearings for maintenance is from the back of the machine; the gears are helical, hardened and precision ground for the best meshing. The forced lubrication of gears and bearings utilises a sealing system that is intrinsically safe which makes the contamination of drawing emulsion with lubricant oil impossible.

Based on strict ergonomic concepts Trafco designed the drawing capstan area leaving ample room for the threading up of the line by the operator. For the same ergonomic reason it limited to 16 the number of wires which are drawn on a row. A higher number of wires would need a very long drawing shaft and would make it difficult and time consuming for the operator.

There is the same range of wire contact pulleys for the annealer. The advantage of this choice is a much longer life of the pulleys which last, based on customers' comparative tests, twice as long as the ones of other manufacturers, and also have a slower rotation speed, which has a positive impact on the life of the carbon brushes.

Annealers for the medium and large range of wires are available both in vertical and horizontal execution for those customers who prefer easier access to the machine and accept the greater overall dimension in plan.



▲ *Much longer life from Sictra*

Trafco Srl – Italy
Website:
www.trafcomachinery.com

stolberger

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Introduced at the beginning of nineties, the Frigeco multi-motor rod breakdown machine with minimised slippage has gone through continuous improvement in the last few years. The result of this effort provides the Frigeco rod breakdown machine with following advantages when compared with traditional machines:

- Excellent wire surface quality
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UK Steel's new director

UK STEEL, the trade body for the sector, has appointed Gareth Stace as its new director, replacing Ian Rodgers who retires on 31st March.

Mr Stace is currently head of climate and environment policy at EEF, the manufacturers' organisation where he leads EEF's work on a broad range of energy and environment policies, from compliance through to competitiveness.

He has more than 15 years' experience representing business interests and has had significant success in shaping and influencing policy at UK, European and regulatory level. In particular, he led EEF's representation in securing a compensation package for Energy Intensive Industries (EII) in the 2014 Budget.

He currently represents EEF on a number of government boards and panels, including the chair of the Manufacturers' Climate Change Group, Defra Business Contact Group and the Environment Agency Regulated Business Forum.

▲ *Gareth Stace*

He also represents the interests of the UK steel sector as chair of the BIS Green Economy Council EII Sub Group.

Prior to joining EEF, he was environmental manager at Dairy UK, the trade association for the UK milk processing sector.

"This is an important role, representing such a significant industry which feeds into almost all strategically important supply chains," said Mr Stace. "Yet steelmakers in the UK are facing huge challenges and, more than ever, need a strong united voice to ensure that the sector can compete and grow.

"It is vital that we continue to raise the profile of the sector to ensure its strategic importance to the UK economy is safeguarded and valued at the highest levels."

UK Steel – UK
Website: www.eef.org/uksteel

Agency role

Heinze & Streng is an international trading company with years of experience in the wire and cable industry. Its wide range of products includes various spare and used parts, equipment, complete solutions and new machines for bunching.

The company has recently become the agency for MicroWeld, a specialised manufacturer of butt welders for more than 80 years. The company also provides spare parts for a variety of machinery.

Heinze Streng GmbH – Germany
Website: www.heinze-streng-gmbh.de

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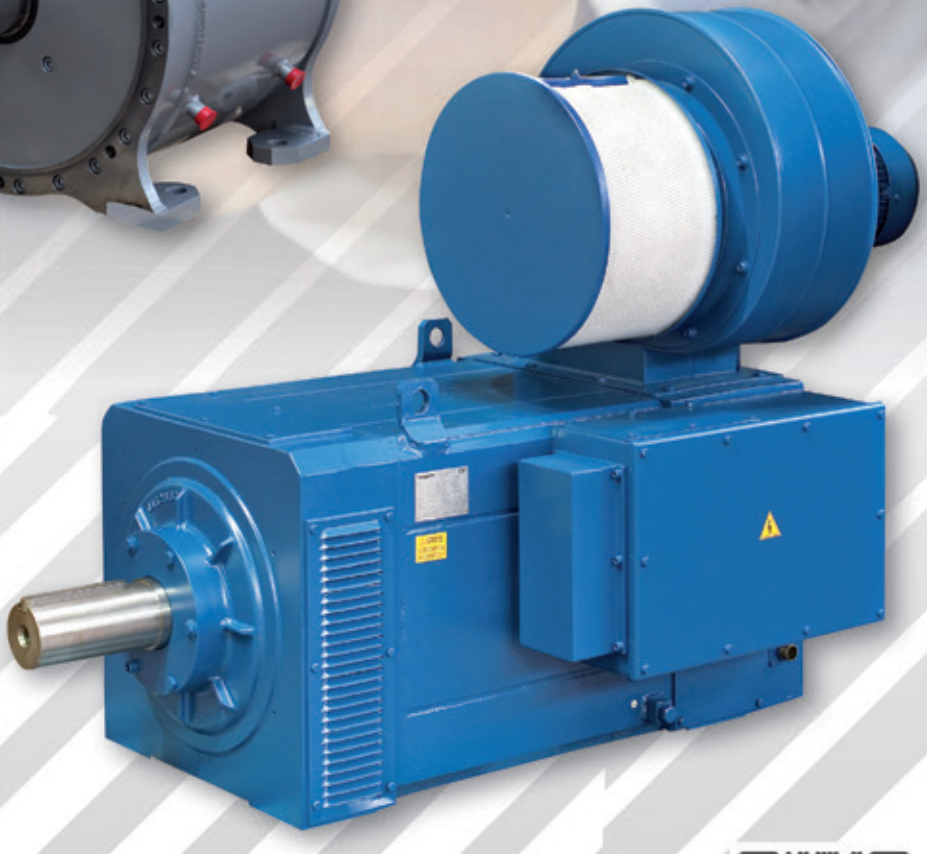

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Help available via download

MELOS is an experienced German manufacturer of cable compounds. Supported by the Dutch cooperation partner Inhol, Melos supplies cable manufacturers across the world, meeting individual requirements. Its new app for tablet and PC gives insight into its product range. It will help identify the most interesting compound solutions for specific cable requirements.

Customers can choose between bedding, sheathing and insulation materials, and filters can then be set in five to six categories which will determine the search results. The portfolio contains thermoplastic and cross-linkable compounds for more than eight different applications: Installation, shipboard, green energy, offshore, aerospace, marine, defence, rolling stock, rapid transit, railways, automotive and general applications.

Customers can define the standards they are looking for: BS, CEI, DIN VDE, EN, IEC, NEK, NFC, TÜV, ISO, LV, SAE, IEEE, UL or MIL. Additional filters have been added for specific product features such as 'halogen-free', 'oil resistant' and 'flexible'.

▲ *New app for tablet and PC from Melos*

After setting the filters, a list of products will appear in the table, including the most relevant technical data.

This new app will enable customers to directly download the technical data sheets of the selected products. It can also put the selected products on the inquiry list and send requests to Melos's dedicated support team.

If the right product is not found in its portfolio, clients can easily configure their own compound with the tool 'Create your compound', simply by adjusting the values of the features that are relevant.

Decades of experience and know-how in the formulation and manufacturing of speciality cable compounds makes Melos the right partner.

Melos GmbH – Germany
Website: www.melos-gmbh.com

Partnership expertise

KRAUSSMAFFEI is reinforcing its system expertise for reaction process machinery in the area of interior trim and has plans to work together with 3CON Anlagenbau GmbH as a partner in the future.

The company was founded in 1998 and is headquartered in Ebbs, Austria. It is a provider of laminating, edgefolding and thermoforming technologies for the automotive industry and its suppliers.

In the area of interior trim, KraussMaffei's reaction process machinery implements production systems for foamed or back-foamed parts for vehicle manufacturing with surfaces with especially high aesthetic quality. This includes parts such as instrument panels, door coverings, door panels and window trim.

KraussMaffei provides customised system solutions from a single source, starting with the moulds, including the mixing and metering systems, and spanning all the way to equipment for cutting and punching finished components.

Through the partnership with 3CON, KraussMaffei is now expanding its system expertise.

Nicolas Beyl, president of the reaction process machinery segment of the KraussMaffei Group, said: "3CON is a valued partner to have at our side; together with them, we can also offer our customers technologies for laminating, edgefolding and thermoforming."

Hannes Auer, founder and CEO of 3CON, added: "We are very glad to have KraussMaffei, a company with global standing, at our side."

KraussMaffei – Austria
Website: www.kraussmaffei.com

Renewables in Scotland

Following a nine-month procurement process, Schneider Electric has been awarded a two-year framework contract with Scottish Power Renewables for the design, manufacture, supply, installation, test and commissioning of technology for the delivery of over 215MW of renewable energy.

"The success of renewable energy projects is vital. The UK government is facing challenging targets to cut greenhouse gas emissions, as well as aiming to reduce dependency on volatile foreign markets," said John Patton, northern UK operations manager at Schneider Electric.

"With our help, Scottish Power Renewables are reshaping the British energy sector to build a new generation of clean and secure power supplies.

"By engaging local suppliers where possible, we've been able to deliver a competitive deal to Scottish Power and reduce the carbon footprint involved in such a mammoth project."

The deal follows a busy period for Schneider Electric in the renewable energy sector, including the official opening of the 136MW Harestanes Windfarm in southern Scotland.

Scottish Power Renewables – UK
Website: www.scottishpowerrenewables.com

Good results and high productivity

VIOLI Srl offers a wide range of drawing machines developed for the processing of metal profiles that ensures results and high productivity.

Top of the products is the TRI series, a full range of hydraulic equipment for the drawing of tubes and rods with circular cross section or complex profile, fully PLC controlled for both working phases and safety protection.

The speed of the traction is adjustable and the use of the bench is extremely simple by the use of a joystick placed on the control panel which allows the operator to easily manage all steps.

The TR series is a line of chain draw benches designed for the processing of bars and tubes.

The anchorage pliers, with adjustable jaws, are provided with a locking system manually managed by the operator, and the return of the draw lift is electrically controlled. The working speed can be fixed to one or two levels, or adjustable by inverter.

▲ *High productivity on offer from Violi*

Violi's range of drawing machines is completed by subsidiary equipment such as APT series tapering machines for pipes and bars and AP series for wires, manual or automatic unlocking systems and the KTF10 compact kit for drawing for the production of half-processed pipes and rods ready to be finished. Violi machines comply with the applicable international standards.

Violi Srl – Italy
Website: www.violimacchine.it

World's largest machine for armouring of offshore power cable

SKET Verseilmaschinenbau has scaled new heights related to the output of the company and the size of the machines it has designed and delivered.

The company supplied the largest tandem cage-type stranding machine in the world to a Scandinavian cable producer for the armouring of offshore power cable with a diameter up to 350mm.

The machine, a type MKVD 96x800+112x800, is 150m long, not including the turntables at the input and the take-up ends. It consists in the main of two stranding cages arranged to accommodate 96 and 112 bobbins, respectively. The bobbins have a flange diameter of 800mm and are suitable for up to 7mm diameter steel wire.

The stranding cages can be operated either with 100 per cent or with zero per cent back twist in single or tandem mode. The machine is suitable for the stranding of galvanised or plastic insulated round or flat steel wire and copper and aluminium alloy wire.

A technical feature of the machine is that each of the cages is fitted with a single cradle which can accommodate bobbins with a flange diameter of 1,000mm, suitable for fibre optic conductors. These bobbins are arranged to operate with a single reverse twist.

▲ *The MKVD 96x800+112x800 from Sket*

The stranding system is completed by tape wrapping heads suitable for the application of four tapes, jute applicators for up to 72 copses, special die boxes and pre-form heads and a number of band haul-offs. Semi-automatic portal cranes are provided for the loading and unloading of the machine bobbins.

Sket has fulfilled major contracts with leading wire rope and cable producers worldwide, including General Cable, NKT, Bridon, Kiswire and Brunton Shaw.

Sket Verseilmaschinenbau GmbH – Germany
Website: www.sketvmb.de

Investing in its people for a bright 2015

Hayakawa, a developer of wire harness and cabling solutions, has welcomed 2015 by investing in its people to drive future growth. The company's UK operation, which was established in 1993 as part of the global Hayakawa group, has worked closely with Skills Growth Wales to create a sustainable organisational structure.

As part of a Skills Growth Wales programme and with investment from Welsh Government funding, all employees attended comprehensive training to help their personal and professional development. A strategic business model has been developed and implemented, supported by training modules that focused on organisational effectiveness.

The foundations for growth were implemented throughout 2014, and at the end of November 2014 the company's investment in people saw an organic growth of 54 per cent. This growing workforce will be supported by the restructuring of the organisation and the appointment of a quality engineer and a business operations manager.

These both have extensive engineering capabilities and a strong vision to safeguard the company's position in wire and cable manufacturing across a number of sectors, including automotive and rail.

As well as senior roles, Hayakawa actively promotes career growth amongst graduates and new starters, and is sponsoring a graduate employee's MBA at Glyndwr University.

It is also set to install 3D CAD to further expand its service capabilities.

Hayakawa UK – UK
Website: www.hayakawa.co.uk

▲ *Hayakawa staff at the company's site in Wales*

Unique measurement from Aesa

COBALT is AESA's high precision balunless measurement system for LAN cables.

Its unique single-ended way of measuring makes full dynamic range available and works over the full frequency range (>4 GHz), avoiding additional losses due to balun.

A high-tech switching with at least two million cycles secures stable, repeatable and highly accurate measurements. Easy to operate, the highly modular Cobalt is now a well-known partner for LAN cable measurements.

Aesa has added a technical innovation with a recently developed feature: patchcord adapters that allow using the benefits of a balunless system combined with the ability of patchcord testing.

Single ended and mixed mode parameters are accessible to deliver more information about the patchcord.

The new adapters use an easy interface and can be mounted or removed in a few seconds from the Cobalt cable interface. The measurement can be performed automatically from both sides according to customer specification or standard values.

If requested, many additional parameters can easily be taken into account, for example insertion loss, TCL or in pair skew.

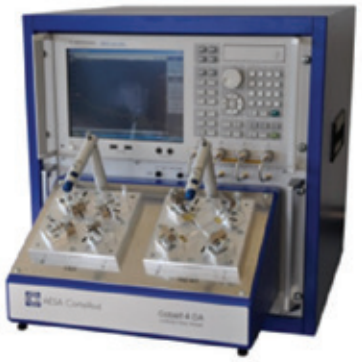
As AESA is an ISO 17025 certified company, the highest accuracy can be expected for patchcord testing. Including de-embedding method allows removal of the adapters mathematically and provides the opportunity to use any other connector if required.

Cable manufacturers produce not only wires, but also stranded, flexible, sector-shaped and insulated conductors, among others.

Measuring them requires additional skills and constraints, otherwise results are not repeatable or even incorrect. Using integrated equipment allows mastering of the uncertainties related to the connecting device, then ensuring the overall measurement, on the line or in the laboratory.

The ResTest family (linear resistance bridges) now consists of four integrated pieces of equipment developed in this perspective.

Aesa Cortaillod – Switzerland
Website : www.aesa-cortaillod.com



▲ *LAN cable and patchcord testing from Aesa*

HEADING TO INTERWIRE? SEE OUR SHOW PREVIEW STARTING ON PAGE 60

Innovation and design from QED

QED specialises in equipment for heat-treating, cleaning and coating of steel wire. Custom designed and built, its high-speed lines are for galvanising, Galfan®, patenting, annealing, and oil tempering processes. Combining innovative design concepts with 30 years' practical experience, QED has developed a range of products and equipment that is both technologically advanced and ruggedly dependable.

With a view to improved efficiency and to minimise environmental impact, QED developed the dual loop pressure control combustion system. This system maintains a steady output with precise air-gas ratio. This patented combustion control system is now used on all its multiple burner furnaces.

QED has recently upgraded its proven fluidbed technology with proportional, closed-loop feedback and mass flow controls. The Siemens PLC-based system provides much higher thermal efficiency and lower fuel costs than previous systems. Its fluidbeds operate from DV=120 to DV=240 and from 1.5t/h to 8.0t/h production, with satisfied customers on six continents.

The latest development in galvanising furnaces is the advanced recuperative technology Mark 4 immersion burner. This burner offers dramatically higher combustion efficiency from a double pass pre-heat design with extended heat-transfer area. Constructed of stainless and high nickel alloy steels, the modularly constructed burner offers an extended operating lifespan and reduced maintenance.

In addition to the fuel savings, the new burner runs with a cooler skin temperature, providing a more pleasant working and maintenance environment.

The company also supplies the latest development in HighTurbulence® pickling and galvanising technology. The multiple stage cleaning systems have high turbulence acid that greatly accelerates the pickling process.

▲ *Mark 4 immersion burners on a high carbon line*

Computer control, nitrogen wiping in galvanising and Galfan offer significant savings and accurate coating weights.

QED Wire Lines Inc – Canada
Website: www.qedwire.com

New high-performance lubricants

Lubricants manufacturer Metalube has launched Rope-Tek™ WRD, a new range of biodegradable, high-performance lubricants, specifically designed to protect steel wire ropes.

Each product is formulated from high-performance base oils and thickeners, and contains an advanced additive system that minimises friction and wear, delivering outstanding corrosion protection.

Commenting on the new range, Douglas Hunt, commercial director, said: "Steel wire ropes are complex in construction and are often subject to arduous operating conditions.

▲ *The new range from Metalube*

"Movement, such as loading and unloading of the rope, bending and flexing over sheaves and pulleys, creates high load points where wires and strands cross over each other. This can result in fretting wear and corrosion – reducing the life of the rope. The high load carrying solids contained in Rope-Tek™ form a low friction barrier between the metal surfaces, minimising frictional contact and wear."

Due to the vastly different environments that wire ropes operate in, Metalube has a comprehensive range of wire rope lubricants to provide the right product for every condition and situation.

The company manufactures a range of non-ferrous drawing oils and maintenance lubricants as well as a variety of corrosion protection and forming oils.

Metalube Ltd – UK
Website: www.metalube.co.uk

Moorings producer roped in

Bridon Holdings Ltd has acquired the ScanRope moorings business and deep-water moorings assets from the Parker Hannifin Corporation.

With the addition of ScanRope, the Bridon Group will have over 1,700 employees worldwide producing wire and fibre ropes. Bridon operates across many sectors including oil and gas, mining, construction, fishing and marine, and crane and industrial, and was originally formed in 1924 from an amalgamation of wire rope producers.

Bridon Group – UK **Website**: www.bridon.com

UK/Norway energy plan

NATIONAL Grid and Statnett, currently developing a 1,400MW, ±525kV HVDC electricity interconnector between the UK and Norway, are reported to be close to agreement on the €2billion investment, which would create a 700km undersea interconnector, the longest anywhere in the world, between Blyth in Northumberland, UK, and Kvilldal in southern Norway.

It would allow the UK to import hydroelectric power, and could be a major factor as it attempts to meet its national and EU renewables targets while boosting its generating capacity.

Auke Lont, chief executive of Statnett, said that he hoped that a firm decision to build would be made early this year. "The plan is to take a decision on investing in the first quarter, with the hope that it could be in operation by 2020," he said.

The project still requires official sanction from Ofgem, the UK's energy regulator. Ofgem launched a consultation in early January aimed at agreeing an acceptable 'cap and floor' regulatory regime for the project, an arrangement that would in effect have UK taxpayers underwriting the project – the government would offer National Grid and Statnett a guaranteed minimum return on the interconnector. However, the government would be able to claw back any excess profits if returns from the trading of renewable energy across the North Sea are higher than expected.

Ed Davey, the UK energy secretary, has already signalled his backing for the scheme.

National Grid – UK
Website: www.nationalgrid.com.uk

Statnett – Norway
Website: www.statnett.no

£300,000 investment in Scottish armouring line

Aberdeen energy service firm Hydro Group has invested £300,000 in an advanced cable armouring line at its Bridge of Don facility.

Hydro Group, which designs and manufactures cables and connectors for subsea and onshore use, said its custom-designed single- and multi-layered steel armoured cables will withstand higher stresses in subsea and defence operations.

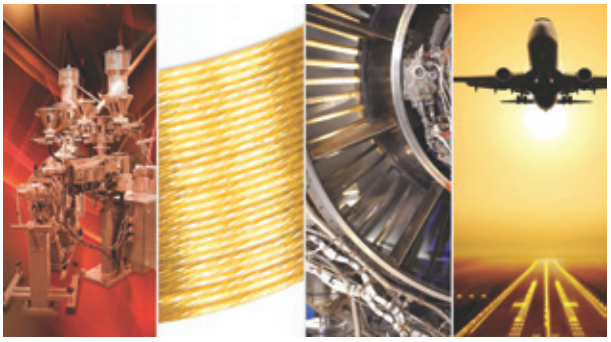
Hydro managing director Doug Whyte added: "The new machinery is a significant addition to our current capabilities, as well as enhancing the quality of work we produce.

"The installation is the first of two armouring lines, with the second, which will have greater capacity in size and overall lengths, being installed after completion of our facility extension later in the year."

Hydro Group, comprising Hydro Bond Engineering and Hydro Cable Systems, employs about 100 people and was founded by Mr Whyte as Hydro Bond Engineering in 1982.

The group now serves the energy and defence industries, with projects including work on submarine platforms and acoustic ranges for navies around the world.

Hydro Group – UK
Website: www.hydrogroupplc.com



▲ *Rosendahl – suitable for the production of special cables*

High-performance X-ETFE extrusion

WHEN it comes to the production of special cables with special properties, the desired machine performance rises to a high level. The demand of sensitive production processes made Rosendahl boost and fine-tune its manufacturing solutions for aerospace and automotive cable manufacturers.

High-quality extrusion, combined with economic production, plays a pivotal role for every cable manufacturer. This is why Rosendahl has developed first-class process technology for X-ETFE extrusion under economical production conditions.

Rosendahl has put its extensive material and process know-how into special equipment features. The results are process security and high productivity. Its high performance extrusion line can be set up in either a single or dual layer insulation design in a tandem process.

Features include:

- Extruder and screw design: Achieve outstanding product quality due to low shear of sensitive materials
- Crosshead design: Expect perfect material flow. A minimum residence time maintains the material's properties and supports smooth production. The design's uniform melt flow leads to perfect concentricity
- Line configuration: Benefit from a quick process start-up with a helper capstan. Optimise production with a cooling trough close to the crosshead

Line demonstrations can be seen at the installed laboratory line at Rosendahl's new technology centre in Austria.

Rosendahl Nextrom GmbH – Austria
Website: www.rosendahlnextrom.com

New data record?

Alcatel-Lucent and the Africa Coast to Europe (ACE) consortium have successfully completed a field trial on the existing ACE system between France and the west coast of Africa, based on 300Gbit/s and 400Gbit/s technology. Transmission rates were achieved of 12.6Tbit/s of data per fibre pair.

Alcatel-Lucent – France
Website: www.alcatel-lucent.com

Big switch on for Advaris

AS part of its cross-group switchover to SAP's ERP system, USA cable manufacturer Southwire is installing Advaris Cable MES. In August the manufacturing execution system by Advaris Informationssysteme GmbH went live in the first Southwire cable factory in Mineral Wells, Texas, USA.

Here, Southwire produces industrial cables for a wide range of applications. Advaris MES is a core component of 'Advaris Cable', the integrated operations management system for length-based manufacturers. The installation of Advaris Cable MES is a pilot project for the subsequent installation in all the North American company's cable plants. Installation was preceded by an exhaustive evaluation of relevant MES systems.

Guy Brassard, company CIO in Carollton, Georgia, USA, outlined the objectives of the system changeover: "We needed more transparency on production processes across all our sites, and we wanted to be able to trace back every product through the whole production process. Two other aspects that mattered a lot to us were keeping a close watch on the stocks in our factories, and possibilities for quality monitoring and control."

One decisive factor in favour of the system developer from Bruchsal, Germany, was its specific orientation to the cable and wire industry over more than 15 years of company history. As a result, Southwire's IT specialists found at Advaris every feature that a state-of-the-art, sector-specific MES solution for cable manufacturers should provide – including the planning and control of complex multistage stranding operations, tracing of individual lengths and the management of manufacturing variants.

▲ *Southwire's plant in Mineral Wells, Texas*

Speaking of the initial installation, Advaris managing director Dr Manfred Moser said: "We are proud that another enterprise in the world's "Top Ten" cable manufacturers has decided in favour of our system. Southwire is getting a state-of-the-art MES which integrates seamlessly into the new SAP system."

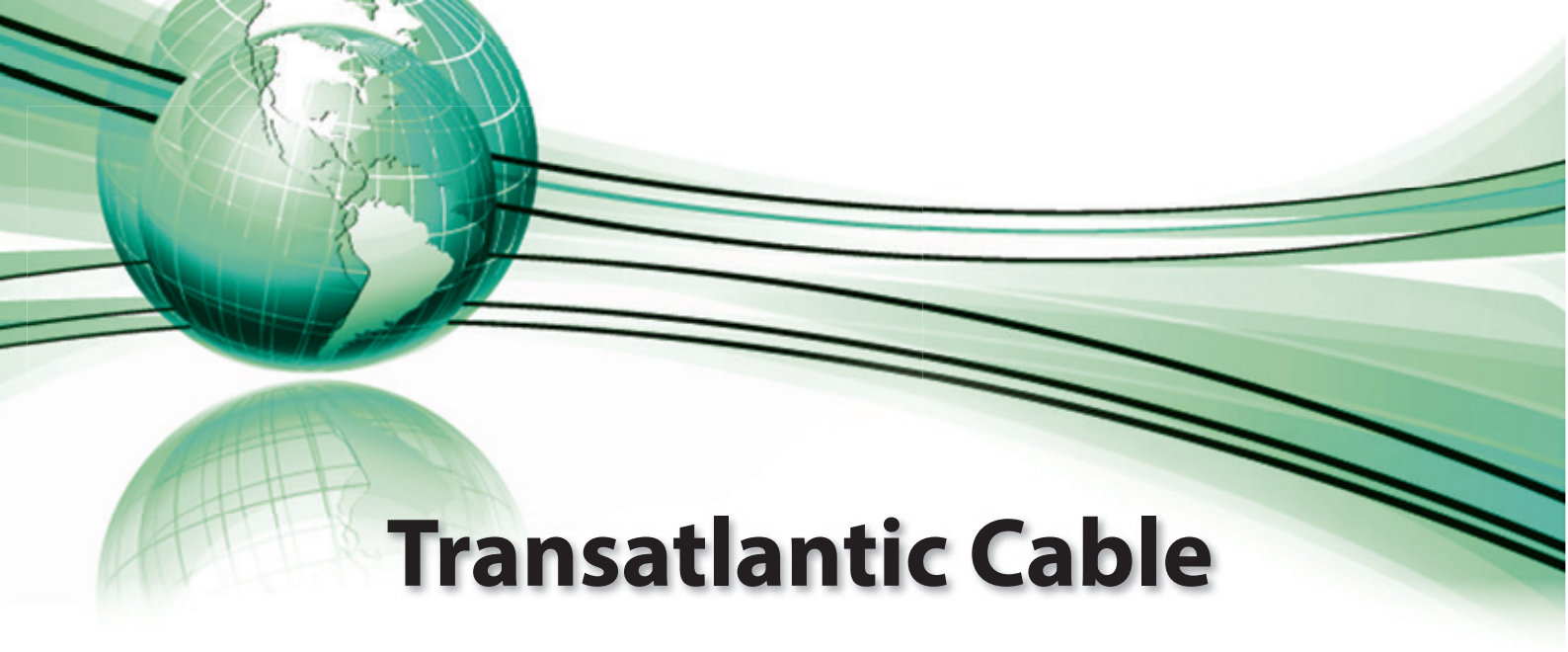
The range of functions covered by Advaris Cable MES at Southwire includes detailed production scheduling, with the target criteria of meeting deadlines and minimising setup times. The production assignments to be carried out are displayed on the touch-screen terminals in production.

Recorded production data includes barcode scanning of every individual drum with actual length, machine setup times and material consumption. Process data such as production speeds, lengths produced and quality data measurements are directly recorded via interfaces from the PLC machine controls.

If divergences from planning are recognised, such as delays in completing an order, machine stoppages, consumption of materials in excess of planning, occurrence of defective goods, etc, an alarm is automatically activated and immediately transmitted to the relevant group of employees by SMS, email or pop-up screen.

Advaris Informationssysteme GmbH – Germany
Website: www.advaris.de

Southwire – USA
Website: www.southwire.com



Transatlantic Cable

Energy

With Copenhagen, Denmark, in the lead, cities across the globe explore the potential of LED technology to enhance the quality of urban life

"Cities worldwide are expected to replace 50 million aging fixtures with LEDs over the next three years, with roughly half of those in Europe. Some are mainly interested in switching from outmoded technologies to one that uses less energy and can last for decades."

From Copenhagen, Diane Cardwell of the *New York Times* reported on a growing network of LED (light-emitting diode) installations that officials hope will help the city of roughly 1.2 million meet its goal of becoming the world's first carbon-neutral capital by 2025. LEDs perform only when activated, brightening and dimming streetlamps as dictated by traffic patterns. Their use in the Danish capital is intended to ease mobility, cut the use of fossil fuels, and save money. ("Copenhagen Lighting the Way to Greener, More Efficient Cities," 8th December)

But Ms Cardwell noted that many other cities only want to take full advantage of the electronics of the LED, which are more conducive to wireless communication than other types of lighting. Los Angeles has almost completed the switch to outdoor LED lighting and is using sensors embedded in the pavement to detect traffic congestion and synchronise signals. Ms Cardwell was told by Munish Khetrapal, who helps lead so-called smart city efforts at Cisco Systems (San Jose, California), that the company is working with more than 100 cities. In October, Cisco entered into a partnership with another California firm, Sensity Systems, which makes advanced networks to help connect and coordinate agencies in cities as disparate as Chicago; Bangalore, India; and Barcelona, Spain.

The American companies IBM and Philips are also aggressively pursuing smart city projects, together with lesser-known companies like California-based Silver Spring Networks, which provides utilities and cities with networking platforms, software, and services for critical infrastructure. Ms Cardwell reported that Silver Spring helped with the design and operation of the traffic and street lighting project in Copenhagen.

- Other cities are also pushing ahead, and hundreds of pilot programmes and dozens of larger-scale installations involving LEDs with network control are going forward. Seeing the demand, technology and software companies are mobilising to serve the market.

Despite all the activity, Hugh Martin, Sensity's chief executive, told Ms Cardwell that no one has yet created a fully integrated network. But signs are strong that it is on the way. "The cities are in a race to deploy smart technology," Mr Martin said. "And in the business of building a platform [the lights and sensors capable of connecting to a larger network] it's all about how many nodes are out there. It's a land grab."

Telecom

The repair of the Cuba-USA rupture is under way. But are the opportunities for American tech companies more apparent than real?

"People love the image of Cuba with its vintage 1950s cars, but unfortunately its tech infrastructure is not much newer. And that's why US tech companies are eyeing eased trade regulations with interest." Barb Darrow, who covers technology and high-tech companies for *Gigaom*, was writing on 15th January, the day on which the US Departments of Treasury and Commerce issued orders that should make it easier for American tech companies to enter the Cuban market. The moves came only about a month after President Barack Obama signalled his intention to open up Cuba-USA relations.

While the new regulations will pave the way for individuals travelling from the USA to Cuba, Ms Darrow confined herself largely to consideration of the prospects there for American tech companies. ("Just How Big Is the Cuban Market for US Tech?", 15th January). A pertinent estimate was published in December by the Peterson Institute of International Economics (Washington, DC), which said that exports of US goods to Cuba could reach $4.3 billion a year eventually – up from $360 million in 2013. Cuban exports going the opposite way could reach $5.8 billion at some point – up from zero now.

The American telecom sector would seem poised to figure in that trade. The USA has pledged to ease the "establishment of commercial telecommunications facilities linking third countries and Cuba and in Cuba." According to a Commerce Dept fact sheet, a new general licence by the Office of Foreign Assets Control (OFAC), a Treasury Dept unit, should ease the sales of "certain consumer devices, related software applications, hardware and services for communications-related systems."

There is no question that the demand is there. Ms Darrow sees "pent-up need" for communications and other tech services in Cuba where personal ownership of cell phones or computers was prohibited until 2009.

At that time, according to Felice Gorordo, CEO of the Miami-based non-profit Roots of Hope, which aims to build trade with Cuba, "the [Cuban] government had a couple of hundred thousand mobile phones. There are now more than two million in Cuba – all 2G."

No undersea cable to the USA

Ms Darrow noted that, "needless to say," Mr Gorordo – who is also a White House Fellow in the US Office of Public Engagement and Intergovernmental Affairs – is happy about the thaw in USA-Cuba relations. But he doubts that an accurate estimate can be made of the size of the potential telecom market in Cuba, and sees no guarantee that the still-authoritarian Cuban government will allow an incursion of USA technology interests. A potential obstacle is ETECSA, the state-run entity that controls telecommunications in Cuba. ETECSA is "not only the operator but also controls the cellular phone company and the cybercafes," Mr Gorordo told Ms Darrow. "It is a monopoly at each end – retail and wholesale." Connectivity is another challenge. As *Gigaom* pointed out in December, Cuba – only 228 nautical miles from Florida – has no submarine cable connections to the USA. Its sole undersea fibre optic cable has two branches: to nearby Jamaica and Venezuela.

- By way of comparison to Cuba, the Dominican Republic – a country of similar size but with one million fewer people – has five fibre optic cables linking it to the rest of the world. "So the need is there, presuming Cuba wants to be part of the larger world," wrote Ms Darrow. But the cash is not, she was told by an executive with a large USA computer and networking company. Making another comparison, this observer equated the economy of Cuba with that of West Virginia – the third-poorest state in America.
- With tourism leading the way, the Cuban economy will likely improve, creating more of a monetary incentive for American vendors. But another *Gigaom* source – Robert Muse, a Washington, DC-based specialist in the laws governing USA-Cuba relations – pointed out that the Cuban government still views control of media and information as necessary to state security. In December Mr Muse told *Scientific American*: "It seems unlikely that Cuba is going to welcome US telecom infrastructure providers or direct, unmediated broadcasts between the US and the island – at least for now."

> Mobile phones gain ground – quite a bit of it – in the highest echelons of the USA civil service

According to a report from the management consulting firm ICF International (Fairfax, Virginia), some 93 per cent of senior employees of the USA federal government embrace digital technology in the workplace, with nearly three-quarters using an agency-issued smartphone and about half using a personal device for business purposes. As reviewed in *FierceMobileGovernment* (28th January), the ICF report, commissioned by the National Academy of Public Administration, surveyed responses from more than 500 randomly selected senior civil servants GS-13 and above in the federal system of 15 pay-grades. In a major finding by ICF – which also examined issues of IT investment and technology procurement – 82 per cent of the federal employees said they believe job-related online information and services should be available at any time and on any device.

Transatlantic cable

And nearly three-quarters would expect to be more productive if their agency were to provide technology that improves data access. When asked to name the three tools that would have the 'greatest impact to improve workplace performance,' nearly 67 per cent of the respondents put remote access to work systems in first place. That was followed by an agency-issued smartphone, which got the vote of about 65 per cent of the respondents. And about 39 per cent said agency-provided online sharing tools would help improve collaboration.

Additionally, about 20 per cent of respondents said that personally owned smartphones and agency-issued tablets would help improve their work efficiency. Among recommendations regarding workforce training, recruiting and retention, the ICF report said that a blended approach to technology-related training should mix classroom with online courses, mobile learning, and on-the-job training. The survey was conducted between 28th August and 26th September 2014. Out of the nearly 9,000 federal workers who received the survey, 510 responded for a response rate of 5.7 per cent. The overall margin of error was ±4.2 percentage points.

Automotive

American Millennials deliver a surprise: they may be keener on car ownership and driving than automakers tend to believe

"Our main point is that Baby Boomers have the financial power to drive more sales, but there is a tremendous opportunity to work with Millennials and the industry needs to do better at reaching them." Berj Kazanjian, vice president for ad sales research at *MTV*, was responding to the results of a survey conducted by the New York-based cable and satellite network in the spring of 2014 and published this January. The responses collected from 3,600 Millennials [aged 18-34], about 400 Generation Xers [aged 35-49], and 400 Baby Boomers [aged 50-68] challenge some entrenched convictions about the preferences of the youngest cohort of the American spending public.

In findings that would puzzle Traditionals [those born before 1946] but are dense with meaning in the year 2015, *MTV* reported that – rather than relinquish their cars – 75 per cent of Millennials would give up social media for a day and 72 per cent would give up texting for a week. In an interview with *Detroit Free Press* business writer Greg Gardner at the annual convention of the National Automobile Dealers Association (San Francisco, 22nd-25th January), Mr Kazanjian cited this as proof that Millennials are more interested in driving and buying cars than much other research has led automakers to believe. And he believes that the auto industry ignores the *MTV* results at its peril.

"This is the first generation in history that can literally kill a brand with the push of a button," said Mr Kazanjian. His message to automakers, dealers and advertisers: they need to speak to the Millennials' transportation needs and respect their easy access to comparative pricing information. ("MTV: Millennials Want Their Cars, SUVs, Pickup Trucks," 26th January)

- Mr Gardner of the *Free Press* noted that the contrary view of Millennials – that they can take cars or leave them – is held by a great many respected analysts and observers. Only in October the US Public Interest Research Group released a study showing that the generation born after 1980 is less focused than older Americans on owning cars and trucks.

  Mr Kazanjian explained the variance between the *MTV* findings and those of other recent studies in terms of the age spread within the Millennials. The youngest of them may indeed have to content themselves with bicycles rather than cars. But the oldest are now in their early 30s and, as the American economy improves, they are earning more than they did in the immediate wake of the recent recession.

- Mr Kazanjian believes that the spending choices of these Millennials should be of intense concern to the automobile industry. "This generation is almost 100 million strong," he told Mr Gardner. "They have close to a trillion dollars in buying power. It's not something to sneeze at. [And] there are significantly more of them than Gen Xers."

Elsewhere in automotive . . .

- CEO Mark Fields of Ford Motor Co told the *Detroit Free Press* (29th January) that his company had overcome most of the obstacles to the launch of its 2015 F-150.

  Analysts estimate that the F-Series line accounts for as much as 90 per cent of Ford's automotive profits, explaining the company's decision to shut down its Dearborn (Michigan) and Kansas City (Missouri) plants for 13 weeks last year in preparation for building the new-model F-150. As noted by auto/business reporter Alisa Priddle, the production intermission "cost the automaker 90,000 pickups."

  In his *Free Press* interview Mr Fields also took issue with *Edmunds.com* over its report of having received a high repair estimate on an F-150 purchased for purposes of comparison with a steel-bodied truck. The Ford CEO said the shop chosen by the automotive website was not among the 750 dealerships certified by the company for work on the 2015 model, and that the repair time estimate was double what it ought to be.

- Nissan said on 26th January that it would sponsor about 1,000 high-speed charging stations for electric vehicles in the USA by April 2016. High-speed chargers can fill up a vehicle's battery in roughly 20 to 30 minutes. The Japanese automaker already has charging stations in 13 metro areas including San Francisco, Dallas and Washington, and plans to expand that coverage to 25 cities by the end of the year. The construction and operation of many of the new locations will be assigned to third-party networks like NRG eVgo. Days earlier, German automakers BMW and Volkswagen had announced that they would be teaming up with ChargePoint to develop an American network of fast-charging stations for electric and plug-in hybrid vehicles. By the end of 2015, the trio of companies plans to have opened almost 100 ChargePoint ports along heavily trafficked corridors on the East and West Coasts.

  Only about 120,000 vehicles that require a plug-in electric charge were sold in the United States last year, an increase of 20 per cent over 2013 but a tiny fraction of the 16.5 million vehicles sold overall. Analysts say the sudden urgency to install high-speed charging stations across the USA reflects an acknowledgment by the makers of electric-powered vehicles of a mistake they made five years ago. When mass-marketing commenced, American consumers were expected to charge their cars at home for use over typically modest distances. But it has become apparent that the constraint on mobility is strongly resented, irrespective of driving habits. The phenomenon is known as 'range anxiety.' If it can be eased by the new charging stations, this might mean the breakthrough for electric cars that has proved elusive to this point.

Transatlantic cable

Steel and aluminium

- Three months in, some 10 to 15 per cent of the steel made at the Faircrest plant of TimkenSteel Corp (Canton, Ohio) is running through the company's new continuous jumbo bloom caster, unique in its being completely vertical. As described by manufacturing reporter Rachel Abbey McCafferty in *Crain's Cleveland Business* (29th January), the 270-foot caster – 180 feet above ground and 90 below – "does create a striking image."

  TimkenSteel invested about $200 million in the caster, believed to be the largest of its kind in the world. It is certainly the sole example of the design in North America. The poured molten steel is extracted slowly from the tundish at the top and split into three strands. When the steel reaches the bottom it is cut into blooms. According to the company, the process yields cleaner, higher quality steel.

  The caster is still in the hot commissioning phase but it is expected to handle about 60 per cent of the plant's melt by the end of the year. By 2017, TimkenSteel plans to be running 85 per cent of the melt through the caster, the rest through an ingot pour. At full capacity the vertical caster has potential to raise shippable capacity at Faircrest by 25 per cent, or 165,000 tons per year.

- According to Alcoa, global sales of aluminium wheels are expected to increase from 30 per cent of the total market in 2010 to 50 per cent in 2018. Positioning itself to meet anticipated European demand for its lightweight aluminium truck wheels, the New York-based aluminium manufacturer on 30th January announced the completion of a $13 million expansion that doubles capacity at its wheels manufacturing plant in Hungary.

  Demonstrating support for the project, the Hungarian government agreed to contribute $4.4 million through its Regional Operative Program, a government-led economic development initiative. Under a pilot programme, a number of buses in the regional Székesfehérvár city transportation system are to be outfitted with Alcoa wheels.

  Alcoa Wheel and Transportation Products (AWTP), headquartered in Cleveland, Ohio, is part of Alcoa's downstream business, serving the commercial vehicle, automotive and defence markets. The company projects its own revenues from wheel products to rise to $1 billion in 2016 from $700 million in 2013.

The USA economy

A strong dollar helps consumers but hurts American corporations doing business overseas

While the American public enjoys the benefits of a swiftly growing domestic economy – lower oil prices, rock-bottom interest rates, a greatly improved employment picture, a strong dollar – big US-based companies with business abroad are experiencing the bad effects. The strong dollar, in particular, is hitting a wide swathe of corporate America, slicing sales and profits and reviving a concern for cost-cutting. On 27th January, the machinery maker Caterpillar, which exports many of its products, cited a too-strong dollar as contributing to its disappointing earnings for fourth-quarter 2014. A day earlier, the multinational computer software giant Microsoft had also blamed its lacklustre results on the robust dollar.

While the United States is not an export-driven economy, many of its largest companies rely heavily on overseas sales. Because these multinationals will inevitably suffer from the combination of a stronger dollar and a sluggish global market, analysts say they expect many other firms to see a weaker bottom line this year.

The disparity of outlook between American consumers and multinationals was underscored by a report from the Conference Board, a private research group, that its index of consumer confidence jumped to 102.9 in January from a revised 93.1 in December (originally reported as 92.6). Economists surveyed by the *Wall Street Journal* had forecast a rise in the latest index to a more modest reading of 95.1.

Transatlantic cable

The widely consulted barometer of customer morale is at its highest since August 2007, the Conference Board said.

- In January, on a year-to-date basis, the US dollar was up 8.8 per cent versus the Euro, 3.2 per cent against the British pound, and 2.4 per cent against the Yen, with almost all of the gains coming since midyear 2014. While recognising a significant performance, David Kelly, chief global strategist for J P Morgan Funds, observed that currency movements have always been complicated in both their causes and consequences.

  Writing in *Barron's* (31st January), Dr Kelly also suggested that the strength of the greenback is encouraging for future capital investment. While a higher dollar presents challenges for American corporations, he said: "At this time it appears to be a positive force in the global economy and, in the long run, for global investors."

> President Barack Obama seeks to close a tax loophole that allows American firms to avoid paying taxes on overseas profits

The USA fiscal budget for 2016, presented 2nd February, contained some additional bad news for big American multinationals. It includes a proposal for a one-off 14 per cent tax on US profits stashed overseas, as well as a 19 per cent tax on future profits as they are earned.

Currently no tax is due on foreign profits so long as they are not brought into the USA. A company may postpone the payment of taxes indefinitely by simply leaving its profits in the low-tax jurisdictions in which they were generated.

BBC News (2nd February) cited a calculation by research firm Audit Analytics that, as of April 2014, American companies had $2.1 trillion in profits stashed abroad. The conglomerate General Electric was found to have the most profit ($110 billion) stored overseas. Tech giants Microsoft and Apple also avail themselves of the tax loophole.

The White House said the immediate 14 per cent tax would raise $238 billion, which would help fund a $478bn public works programme of road, bridge and transport upgrades.

President Obama told broadcaster *NBC* that, despite several years of economic improvement, wages and incomes for middle-class American families were 'just now ticking up.'

While the projected 19 per cent permanent tax on overseas profits is far lower than the current USA top corporate tax rate of 35 per cent, the expectation is that its implementation would encourage multinationals to create jobs at home.

- A device enabling companies to put off, essentially forever, the payment of taxes on trillions in profits may seem indefensible. But its elimination faces long odds in a Republican Congress united in fierce opposition to all things Obama. Even so, the scrutiny attracted to it by the presidential push has to be very unwelcome in the executive suites of some of the world's most successful companies.

Dorothy Fabian
USA Editor

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▲ *The SPH 1001 automatic single portal spooler*

Optimum process technology

IN 2014 Maschinenfabrik Niehoff introduced its completely new developed MSM 86 type rod breakdown machine at its factory in Schwabach, Germany. Designed for copper wires, the machine can also be used for wires made of aluminium, alminium alloys, copper alloys and special materials.

Being of modular design, the MSM 86 offers users more options in terms of process technology. The latest generation of controls allows drawing/annealing with minimal slip, resulting in high quality wire surfaces. The optimised wire path, innovative drawing die holders with high-pressure cooling of the drawing dies and an optimised wire cooling/lubrication due to the fully submerged drawing basin contribute to a high wire quality.

Capstans which are not in use are switched off. In addition, design changes have been made to reduce maintenance work requirements and make the access to the relevant areas easier. A quick drawing die change system reduces downtime when changing the machine setup for different dimensions, and enhances productivity.

Other features are an ergonomic and user-friendly design and a highly reliable separation of drawing emulsion and gear oil by mechanical sealing enabling easy maintenance and long maintenance intervals. The total energy consumption of MSM machines is up to 20 per cent lower than that of rod breakdown machines with conventional drives.

The MSM 86 is designed to be combined with the new R 502 continuous resistance annealer. With an annealing power of 600kW it is the most powerful annealer made by Niehoff so far and is suitable for combining with MSM 85 or MM 85 rod breakdown machines. Power consumption is reduced by 20 per cent compared to state-of-the art DC annealers due to the newly developed voltage control system NAC (Niehoff Annealing Controller) and the AC annealing principle.

The rod break down line – a 13-draft two-wire MSM 86 + R 502 + SND 801 + SPH 1001 rod breakdown line – can produce, for example, two wires with a diameter of 2.6mm at a production speed of 24m/s resulting in an output of eight tons per hour.

The SND 801 automatic double spooler is designed for a larger wire range (diameters of 0.8 to 4.5mm for copper wire and 1 to 6mm for wire made of EC grade aluminium and aluminium alloys) and can transfer the wire automatically from full to empty spool with very high transfer safety. The operator-friendly spooler also enables easier foundations.

The SPH 1001 automatic single portal spooler features automatic spool changing for increased productivity of the overall line. The SPH 1001 spoolers are built in two versions. Both versions are suitable for spools with 1,000mm flange diameter or less down to 630mm flange diameter. In this case a lifting table is necessary. The difference between both spoolers is the degree of automation: While the fully automatic version works with automatic wire and spool handling, the semi-automatic version is characterised by manual wire handling on the one hand, and automatic spool handling on the other. The electrical system, with independent PLC, enables flexible integration of the spooler in any kind of new or existing drawing lines.

The MSM 86 rod breakdown line is operated by means of the new NMI (Niehoff Machine Interface) 15" colour touch-screen display with user interface and simplified navigation structure.

Maschinenfabrik Niehoff GmbH – Germany
Website: www.niehoff-gmbh.info

One tag, start to finish

INFOSIGHT addresses many marking challenges for the wire, pipe, tube and steel industries – helping manufacturers reduce costs, increase product traceability and eliminate errors.

It is now possible to track the entire wire production process with one barcoded tag – from start to finish – without re-attachment and without re-identification after the pickling and/or annealing process.

Barcoding provides:

- Improved traceability of each piece back to the parent material
- Automatic data collection during processing
- Error proofing and error tracking
- Inventory accuracy and improved efficiency in taking inventory
- Improved shipping accuracy
- Field identification

Plastic and paper tags used in the past had the potential to make the inventory process easier with their ability to hold barcoded information, virtually eliminating human error. These tags were able to survive the process of pickling for periods of up to 90 minutes.

However, when it came to the process of annealing, at temperatures of 1,400ºF (760ºC) or greater, these tags would vanish in a puff of smoke. Applying tags after the annealing process meant a wait of several days until the coils cooled. This opened the door to more potential for human error.

Early metal tags survived through the annealing process, but in some cases would not withstand the pickling. They required noisy stamping machines that were difficult and expensive to maintain.

Barcoding systems for metal tags were not suitable for all industrial applications. This meant the use of manual inventory control, which again meant the risk of human error.

InfoSight created the first non-contact, laser-markable tag system in 1995. The next step in the process was developing tags that would survive the myriad of different annealing and pickling processes utilised by the world's wire manufacturers. InfoSight developed the Pic-Anneal® laser printable tag.

▲ *An example of one of the InfoSight tags*

The Pic-Anneal® tag has a two-hour resistance to acid baths of 20% H_2SO_4 at 180ºF (82ºC) and 24% HCL at 100ºF (38ºC). It also withstands 1,400ºF heat for 48 hours and 1,800ºF (1,000ºC) for two hours.

The Pic-Anneal® laser-marked tags measure 3" wide and a slot or hole is punched near the top for easy attaching to wire coils.

The tags are marked with a CO_2 laser, resulting in black print across the white surface. The barcodes printed on the tags are readable by standard barcode readers.

A full selection of metal tags is available from InfoSight – all designed to withstand harsh manufacturing environments. Tags can be custom sized and pre-printed tags to most customer specifications.

The company also offers a line of laser printers which allow customers to print their own metal tags and to change their layout and barcodes, as needed.

InfoSight – USA
Website: www.infosight.com

HEADING TO INTERWIRE? OUR SHOW COVERAGE STARTS ON PAGE 60

New range of unattended automatic lines

I.LE.S. Industrial Furnaces in Pianengo, Italy, has introduced a new range of unattended automatic lines for stabilisation, tempering, structural hardening, ageing, pre-heating, and stress-relieving heat treatments.

These lines are composed of the following main system components:

- Horizontal chamber electric furnace, with forced air circulation and 700°C maximum working temperature, with high thermal efficiency obtained by insulation with the more advanced ecological ceramic fibres, assembled in several layers with differentiated density, without thermal bridges; heating with massless wire elements, placed directly into the air circuit; using a patented system of vitrification of the surfaces which are in contact with the air; assembling specially shaped baffle and fan for the air circulation. All of these elements allow a temperature uniformity obtained spatially in the treatment chamber, according to AMS 2750 E and CQI9 standards requirements
- Storage system with two, four, six or eight positions

Main characteristics include:

- Useful load for each position of the storage system from 500 to 3,000kg
- Specific software for managing the line with no operator
- Saving of up to 60 different thermal cycles
- Supervisor system with advanced diagnostics, for monitoring of the production as well as for detecting anomalies
- SMS telecommunication system, to send diagnostic messages to different users, according to the occurred event
- Paperless recorder for product certification, arranged to be linked to the company's network
- Air cleaner for smoke and smells

I.LE.S. Srl – Italy
Website: www.iles.it

▼ *Part of the range on offer from I.LE.S.*

Innovative OTA technology for quality wires

MEDICAL technology, power engineering, or mobility – quality wire plays an important roll in all progressive industries.

The OTA technology that has been developed by system supplier Koch achieves the top qualities that are demanded.

The drawing system enables non-diverted, straight-line drawing under a constant and reproducible counter tension. From pay-off to spooler – thanks to the linear wire drawing, especially accurate wire dimensions and high surface qualities are achieved.

▲ *As a system supplier, Koch designs, builds, and installs complete machine lines*

Depending on wire quality, dimension, and requirements of the end product, different machines with OTA technology from Koch are employed.

For the production of pre-stressing steel wire and spring steel wire using capstans with diameters of up to 1,200mm, the KGT 47 OTA sets benchmarks.

The machine's size is compact and despite its tractions of up to 90,000 N, it generates very little noise. Also part of the OTA family is the KGT 25. It is especially suitable for low- and high-carbon steel wires as well as stainless steel wires. The KGT 12 produces fine wires and rope wires with diameters of less than 0.8mm. Here, a dynamically regulated process optimisation ensures the required accuracy. The OTA technology puts Koch in a leading position on the global market as it offers economical production with the utmost accuracy, reproducibility and product quality.

As a system supplier, Koch designs, builds and installs complete machine lines according to customer specifications. The company, which has been established for more than 90 years, has always made drawing machines in-house. Coilers and spoolers, which are also produced in-house, ensure that the wire is collected efficiently and carefully, even on heavy coils.

Peripheral modules made by partner companies complete the machine lines, for instance, fulfilling functions such as cleaning the wire surface or treating it with copper, aluminium or zinc. Customers in more than 60 countries value Koch's technical know-how in the areas of engineering, drive technology, programming and control.

Ernst Koch GmbH & Co KG – Germany
Website: www.koch-ihmert.de

Smooth from Applied

A line of Teflon®-coated forming mandrels for catheter fuse welding and tipping operations that are designed to optimise ID quality and production speed are available from Applied Plastics.

▲ *The Teflon-coated mandrels from Applied Plastics*

Applied Plastics' PTFE Natural® forming mandrels feature a smooth surface that provides a 0.5 dynamic coefficient of friction to prevent sticking, block tubing from shrinking, and simplify catheter removal. Allowing over 25 per cent elongation without flaking or failure, these extrusion mandrels are chemically inert and can operate up to 315°C (600°F) continuously.

Offered in stainless steel or nitinol, the mandrels can be supplied pre-cut in 0.127mm to 25.4mm diameter sizes with ±.003mm to ±.013mm tolerance, depending upon size. PTFE Natural® grey is available with zero PFOA. A proprietary surface preparation process before applying the coating assures the coating will not flake or crack.

Applied Plastics Co Inc – USA **Website**: www.appliedplasticsinc.com

Techna's components

FOR almost 20 years, Techna International has represented Naber & Wissmann in the UK market, by providing an extensive range of replacement machinery components and ancillary products.

Replacement ceramic, ceramic-composite and hardened-steel drawing rings, cones and capstans are available for virtually all models from drawing machine manufacturers including Henrich, Herborn, Niehoff, Samp and Syncro.

Components can be provided in a variety of materials and grades including hardened steel (to 65 HRC), ceramic oxide coated, carbide coated, solid ceramic, ceramic coated and tungsten-carbide coated, with roughness between <0.05µm Ra and <0.15µm Ra, depending on applications, life expectancy and regrinding requirements for non-ferrous metals, steel cord wire, copper, copper-plated and fine wires, steel wire and for soft aluminium and jewellery wire.

Also available is a large range of pulleys, rollers and wire guides in ceramic,

▲ *Just some of the components from Techna*

ceramic-groove and ceramic-coatings, (with or without bearings) enabling efficient and smooth routing of wires and cables through manufacturing processes.

This range is extended with a comprehensive selection of ceramic wire guides including eyelets, rings, bars, tubes, bushings, guides, rods, rolls and jets, in high-purity alumina and zirconia ceramics.

Techna International – UK
Website: www.techna.co.uk

Cable expertise

Red Sea Cables company KSA has many years' experience in manufacturing irrigation cable required by the Saudi Arabian market.

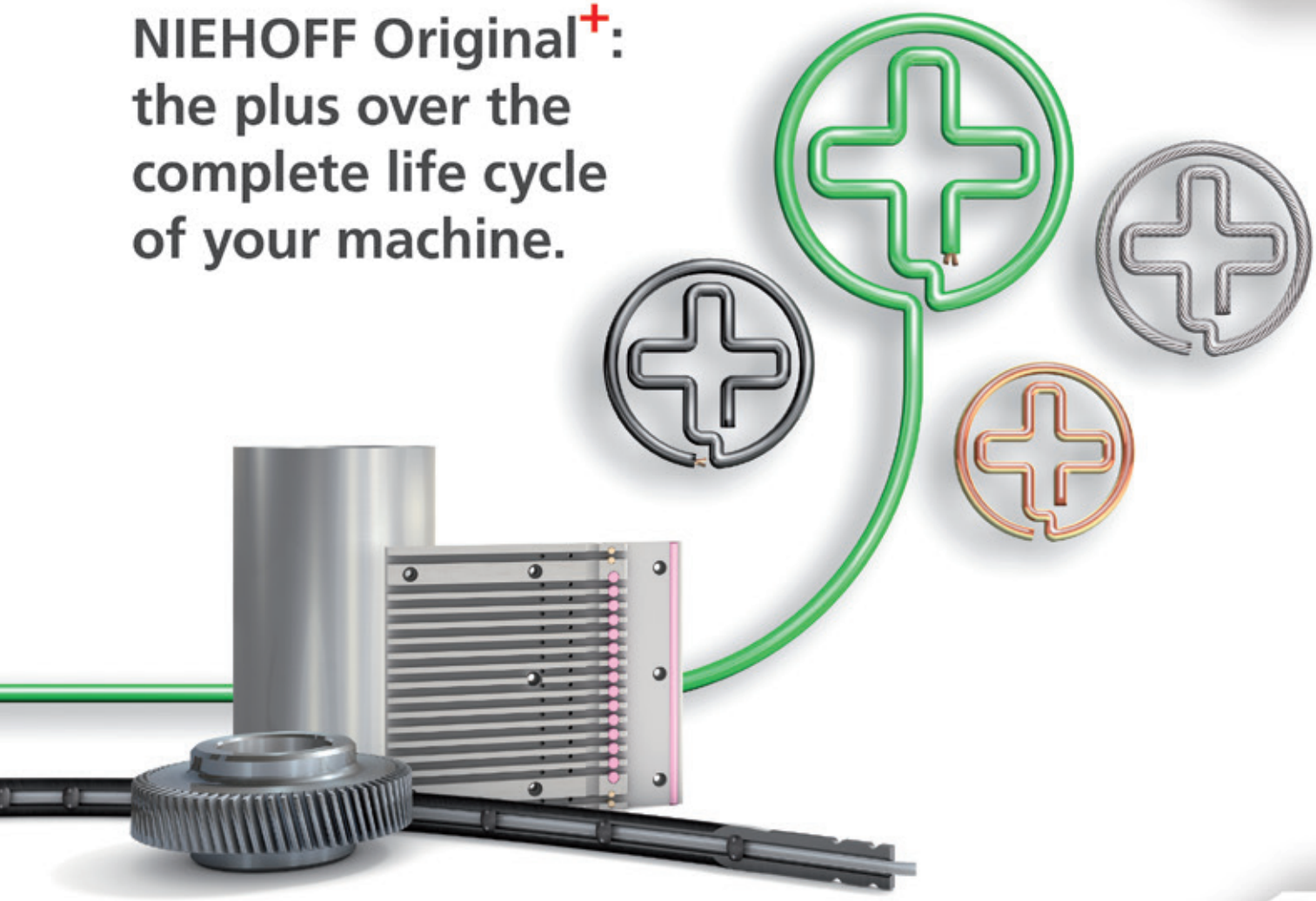
This cable is commercially called Irrigation cable with multiple coloured cores according to UL 83. Each cable core is nylon jacketed, and assembled cores jacketed with double PVC layers.

The unique cable construction, material and high manufacturing technology provided by Red Sea Cables ensures the following cable performance:

- Continuous use at 90º dry and 75º wet location
- Meets requirements of UL83
- Designed for voltage rating 600V
- High colour identified cores
- Oil resistance
- Resistance to flame propagation
- Resistance to water and moisture
- Mechanical and electrical properties
- High abrasion resistance

Red Sea Cables Company – Saudi Arabia
Website: www.rescab.com

NIEHOFF Original+: the plus over the complete life cycle of your machine.



Only NIEHOFF, the global partner for the wire and cable industry, offers a comprehensive aftersales portfolio. A portfolio that gives you a decisive plus over the complete life cycle of your machine investment. That is why we call it NIEHOFF Original+.

Our plus stands for fair cost-benefit ratio, top quality, customized solutions, latest technology trends, utilizing resources optimally, possibility to upgrade your machine, competent service engineers, and a contact person near to you who speaks your language.

When it comes to real understanding just trust our NIEHOFF Original+ experts. We offer you NIEHOFF Original+ Wear Parts, NIEHOFF Original+ Spare Parts, NIEHOFF Original+ Service, and NIEHOFF Original+ Modernization.

Just contact us to learn more about NIEHOFF Original+ or visit our home page.

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Phone +49 9122 977-283 / Fax +49 9122 977-155
service@niehoff.de

www.niehoff.de

NIEHOFF
GRUPPE

Versatile heat and surface treatment process

PLASMA proves itself in a range of continuous applications from mainstream stainless steel annealing to precision alloy wire cleaning and heat-treating.

The past two years have been an exciting and productive time for the Plasmait team. The company sold a range of plasma machines in the ferrous and non-ferrous markets, and it is proving its performance in an increasingly wide range of materials, from mainstream copper alloy and aluminium wire to specialist medical tubes and ropes, jewellery strands, aerospace materials, electronics and semiconductor wire and strip.

Most significant is Plasmait's success in the stainless steel and nickel alloy wire and tube markets with new deployments in fine, medium and large cross-section materials. Deployments included annealing of various forms, ie wire, tube, strip, strand and ropes.

For example, Plasmait's most recent annealer for large and intermediate stainless steel wire boasts a single line output of 130kg/h (250lb/h). Stainless steel wires from 1mm-6mm can now be produced scratch-free and pile-free at high speed.

Furthermore, superior surface and homogeneous recrystallisation with small grain improves subsequent drawing by reducing the number of wire breaks on the drawing machine. Die wear is also reduced.

The Plasma annealer can cold start production in a few minutes and can be stopped immediately. This avoids the lengthy heating-up and cooling-down times and associated energy costs that are symptomatic of a conventional tube furnace.

Equally important was the introduction of a new fine wire annealing line, allowing recrystallisation annealing at up to 25m/s (5,000ft/min) on a range of fine stainless steel and nickel alloy wires. It is now possible to anneal fine stainless wires in-line with the drawing machine.

The annealer features compact design, high-energy conversion efficiency and low gas consumption. Annealing fine wire at up to 20 times the speed of a traditional strand furnace means fewer take-ups and payoffs and hence lower cost of total capital investment.

▲ *Plasmait is proving its performance in an increasingly wide range of materials*

With the introduction of high-output annealers Plasmait also became competitive in the mainstream stainless steel markets in the fine, small and large diameter ranges. A single line of a high output plasma annealer can replace five to 20 annealing lines of a conventional annealing furnace.

This means a considerably lower investment in transport and winding equipment, which often bears the brunt of the cost of annealing equipment. The savings are even more pronounced on fine sizes where a plasma annealer runs in-line with a drawing machine.

The first plasma annealer for taped copper conductors has been in operation now for more than a decade. The latest one was installed in 2014 with another one scheduled for delivery in early 2015.

Taped conductors have traditionally been annealed in bell furnaces, which may result in uneven recrystallisation and surface quality issues like sticking of flat products.

Round or rectangular conductors can now be plasma annealed and cleaned continuously in-line with a conventional taping line.

Plasma annealed conductors feature better accuracy in mechanical properties. Better surface finish also results in superior tape adhesion.

The latest deployment of PlasmaCleaner features plasma surface activation for improvement of lubricant pickup in a rod drawing line. Plasma surface treatment ensures good lubricant adhesion during drawing of stainless steel or titanium rods.

Surface activation is achieved at low temperatures, which makes the process particularly economical compared to expensive-to-run traditional processes such as brushing, acid treatment or sand blasting.

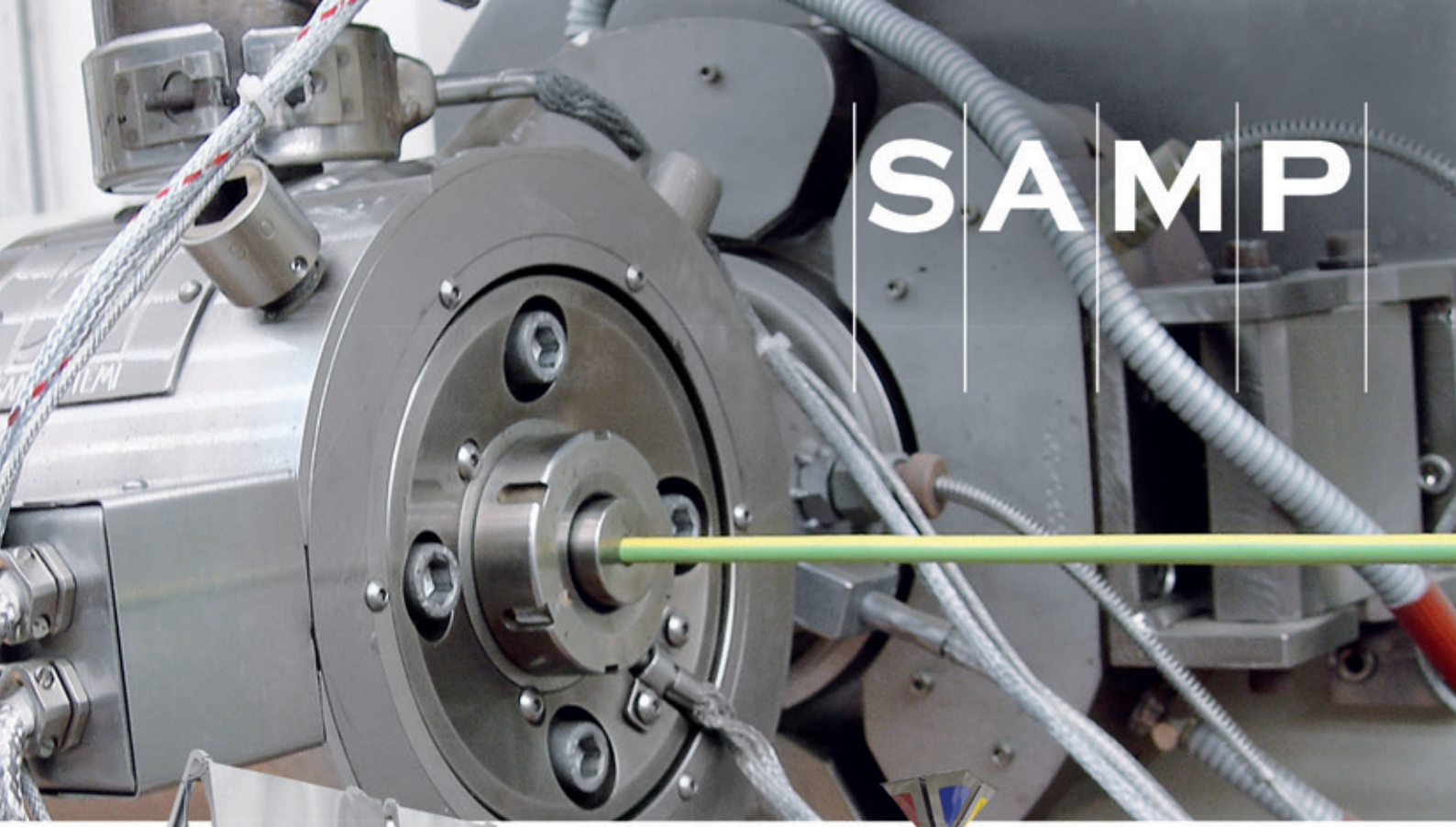
Among the latest deployments is a plasma annealer for stranded conductors and ropes.

The annealer was designed to allow for rapid heat penetration through the cross-section of the stranded construction so that individual wires in a strand/rope can be heat-treated to an equal temper.

Accurate control of heat transfer and thereby resulting mechanical properties can be achieved on a wide range of stranded constructions and materials from copper, aluminium, stainless steel and alloys.

Plasmait GmbH – Austria
Website: www.plasmait.com

OUR COVERAGE OF INTERWIRE STARTS ON PAGE 60



RB 450
Rod break-down machine

SAMP 120-25
Extruder for
insulation and
sheathing lines

BM 630
Double-twist bunching machine

DM 80
Multi-wire drawing machine

Founded in 1936 in Bologna (Italy), SAMP is the only company worldwide able to provide customers with the complete wire and cable process chain.

All machines and lines by SAMP guarantee high productivity, incredible flexibility and great savings in terms of energy and material consumption.

Contact us today for more information.

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wire Russia
wire & cable springmaking fastener

CONVENTION: APRIL 27-30, 2015 EXPOSITION: APRIL 28-30, 2015

INTERWIRE
TRADE EXPOSITION

A meeting this productive shows up every other year.

Georgia World Congress Center | Atlanta, Georgia, USA

Industry leaders are following ***www.wirenet.org*** for details on the largest wire and cable meeting place and marketplace in the Americas. Decidedly the most valuable use of your time...until 2017.

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Higher accuracy with new AccuScan launch

NDC Technologies has launched the highly anticipated Beta LaserMike AccuScan 6012 four-axis diameter and ovality gauge.

Built on the proven and widely deployed AccuScan series platform, the new AccuScan 6012 is claimed to be the industry's first four-axis gauge for measuring products up to 12mm.

This advancement enables communication cable manufacturers to measure product diameter and ovality with higher accuracy than two- and three axis gauges for added quality assurance and bottom-line savings.

Over the years, manufacturers of high-performance communication cables have relied on two- and three-axis diameter and ovality gauges for their on-line and off-line measurement applications. Increasing production line speeds and uncontrollable rotation and vibration of products still pose measurement challenges.

The need to precisely measure the diameter and ovality of cylindrical round products to ensure they meet tight design and quality specifications is of paramount importance to cable manufacturers. Any error in the diameter or roundness of the conductor or insulation in coaxial and twisted-pair LAN products directly impacts the cable's performance characteristics – rendering it useless for the designed application. This unusable product winds up being scrapped, increasing manufacturing costs.

The new Beta LaserMike AccuScan 6012 four-axis gauge solves this problem by providing a more comprehensive measurement coverage than two- and three-axis gauges and an ultra-fast scan rate. This combination of advantages now makes it possible to achieve a more accurate average outer diameter and ovality measurement at higher line speeds and for off-line applications.

Highlights include:

- More accurate average diameter – the AccuScan 6012 performs ultra-fast measurements at 2,400 scans per second per axis (totalling 9,600 measurements per second) and has single-scan repeatability to one micron. This means with each and every scan you get a true and more accurate average diameter measurement
- Significant improvement in ovality accuracy – the AccuScan 6012 offers a 42 per cent improvement in detecting true ovality over three-axis gauges and delivers 100 per cent ovality accuracy when the product is aligned with the measurement axes
- Highest flaw detection accuracy – the AccuScan 6012 provides the highest flaw detection accuracy with 25 per cent improvement over three-axis gauges. The ultra-fast scan rate and higher accuracy coupled with the high-speed tolerance checking option permits the early, accurate and dependable detection of product flaws such as lumps and neckdowns. This enables manufacturers to better control product quality, reduce scrap, and realise manufacturing savings
- High-accuracy off-line part/sample inspection – using the Beta LaserMike PC-based AccuNet display system, the AccuScan 6012 can be easily and quickly set up as an off-line part measurement system to check samples and track, manage and analyse critical product data. This eliminates the need to set up two dual-axis gauges to perform four-axis measurements
- The AccuScan 6012 gauge offers flexible communications capabilities, allowing for easy connection to PCs, PLCs, or processes with leading protocols. This gauge can also be equipped with an optional ultra-bright display and human interface to easily configure and view measurement data. The AccuScan 6012 allows for top or side mounting of the display.

▲ *The new AccuScan 6012*

NDC Technologies – USA
Website: www.ndc.com

Upward casting copper rod – simple and reliable

SINCE 1968 many new developments have taken place to the concept of upward casting copper rod, and systematically the technology has been further developed to meet the current requirements of customers and markets.

Today´s Upcast process is simple and reliable with easy operation through an advanced control system resulting in a low lifecycle cost.

With the consistent and systematic research and development work, the capacity of the lines has become bigger, more rod diameter sizes are possible and the lines operate safely and reliably for many years. The invention of Upcast SGTube casting process took place a few years ago – small grains, bigger gains – and the Cu tube upward casting technology reached new levels.

As new applications for copper alloys are being developed, the utilisation of Upcast technology within the copper alloys field is rapidly increasing, too.

There are a few things, however, that have always driven the research and development, and the implementation of the new features brings cost savings and guarantees cost efficiency to the customers; the quality of rod has to remain at the level received or rather become better with every development; the process has to remain environmentally friendly – always greener.

With this work the original continuous casting technology has again been taken to the next level: with the new coolers and the latest furnace, inductor, automation and control system designs Upcast can now offer even more efficient, consistent and reliable Cu rod production process. Higher speed means more capacity with less cost and results in improved cast rod quality.

▲ *Research and development plays a large part in Upcast's future*

The possibility of using clean and dry Cu recycled material in the process has become more important, and Upcast has accepted the challenge and can now design a solution for different needs. All this is available for existing customers due to the upgradability of casting lines.

Rod production lines are of modular design. Both single- and double-furnace configurations are possible. With a double-furnace configuration – having separate melting and casting furnaces – it is possible to reach 40,000 tpa output, while 12,000 tpa is possible for a single-furnace configuration.

A wide capacity range both in single- and double-furnace configurations is available with a possibility for upgrade.

The majority of delivered Upcast lines are for Cu-OF rod and mainly with most common cast rod diameter of 8mm.

Rods with bigger diameters are used for manufacturing a variety of finished products, eg bus bars, shaped profiles, trolley wires, electroplating anodes, etc. Cu-OF rod with its excellent formability is well suited for all electrical applications.

Cast and form process combines Upcast Cu rod casting with Asmag´s ASCON continuous rotary extrusion ending with the drawing, stretching, cutting and packing. This reduces the investment costs and offers a reliable full-process solution with low operational costs.

Upcast hybrid technology is based on using the same equipment for casting both Cu rod and Cu tube. This has been achieved by modifying certain product-specific parts of the SGTube casting machine and coilers to facilitate easy changeover. The flexibility of the product mix makes the hybrid system a cost-effective solution for companies with a diverse product portfolio and a certain capacity requirement for both products.

There is no need to have two separate lines and, in the worst case scenario, neither one being fully utilised all year round.

Upcast OY – Finland
Website: www.upcast.com

2,000°F gas-heated box furnace

The No 871 is a 2000°F(~1093.3°C) gas-heated box furnace from Grieve, and is currently used for heat treating and high temperature testing. 650,000 BTU/HR are installed in three modulating natural gas burners with a floor mounted combustion air blower. Workspace dimensions are 30" wide x 48" deep x 30" high.

The unit has 7" insulated walls comprised of 5" of 2,300°F ceramic fibre and 2" of 1,700°F block insulation. The 6½" floor insulation is made of 4½" of 2,300°F firebrick and 2" of 1,900°F block insulation. The plate hearth is made of firebrick and supported by firebrick piers. Controls on board the furnace include a Partlow MRC 7000 recording and programming temperature controller and an electrically operated vertical lift door.

▲ *The 871 box furnace from Grieve*

Grieve Corporation – USA **Website**: www.grievecorp.com

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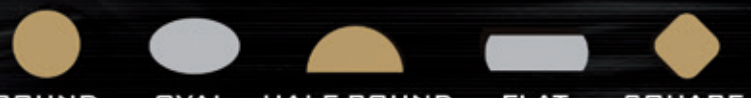
Wire multi-stand mill suitable for cold rolling of wires, bars and profiles.

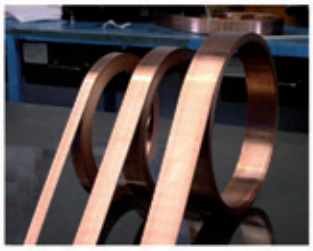
EFFE 2015 single-drive
Opening Stand option

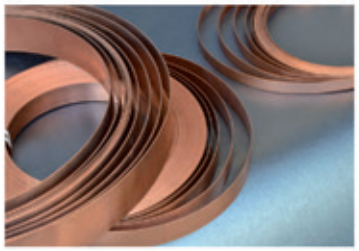
WIRE



ENNE 150i single-drive

STRIP & FLAT Single and Tandem Rolling Mills





APPLICATIONS:

Electrical Contacts - Medical - Superconductor - Watch Making - Wire Reduction - Flattening

MATERIALS:

- Precious Metals
- Brazing Alloys
- Welding Wires
- Bi and Trimetallic
- Special Alloys

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www.invimec.com

Totally flexible with Zumbach

THE production of offshore flexibles involves complex processes requiring varying individual performances for quality control.

Any deviations from the required standards can risk severe consequences if failure occurs, depending on the application scenarios.

In order that the risks for future product failure are eliminated during the manufacturing processes, such as wire drawing, profile rolling/extruding, stranding and sheathing, Zumbach provides reliable solutions for the measurement of all critical parameters.

Zumbach has measurement solutions for nearly all wires, cables, tubes and profiles.

From the first seconds of extrusion, ultrasonic measurement systems (UMAC®) with up to eight real measurement points allow the eccentricity, independently of the material temperature, to be measured.

Once the eccentricity of the cable is optimised, it comes down to the next stage of maintaining the required average wall thickness and then further to derive the minimum wall thickness limitation.

These measurements are typically performed before and after the extruder by ODAC® and UMAC®. An additional measurement of the outside diameter at the end of the line allows the integration of the measured cold diameter value.

This allows the determination of the shrinkage, which can be fed back within the process to realise optimum configuration.

In the extrusion of cables or pipe jackets, UMAC ultrasonic measurement ensures early notification of product centralisation and achieved wall thickness. UMAC measures and controls parameters such as eccentricity and wall thickness for up to five layers of material at a maximum of eight individual measuring points around the circumference.

Additional installed ODAC or MSD® diameter measuring heads benefit by checking the diameter and ovality. Using these technologies, the manufacturer can closely monitor the extrusion processes and thus continuously maintain the quality requirements.

Control solutions such as Zumbach's dual-loop method, as an example, take into account the product properties in both the hot and cold conditions. The resultant reported data is determined

▲ *3-axis ODAC 550 system, measuring an offshore cable of 500mm OD*

from a combination of the diameter measurement using ODAC laser measuring heads and UMAC ultrasonic eccentricity and wall thickness scanners.

Wherever several Zumbach systems are used in combination, success can be achieved in DLP measurement and control.

Considerable thought should always be given to investing in several high-precision and reliable control technologies within the extrusion line. Global material costs are rising just as fast as quality requirements.

Whether it is quality improvement for very precise cables or further material savings for commodity tubing, with the Zumbach hot end dual loop control strategy, the extrusion can be monitored and controlled even more precisely and quickly.

The unique and cost-effective process exploits the benefits of ultrasonic measurement and perfects it in combination with laser scanner technologies.

The intelligent solution offered by the Zumbach control strategy makes allowance for the product's properties at the hot and cold ends of the line. It utilises data from the diameter measurement, determined from the ultrasonic eccentricity and wall thickness scanner UMAC.

These data measurements are automatically adjusted based on the data from the ODAC laser diameter scanner at the end of the line and evaluated.

This creates a very fast control feedback loop (due to the short distance from the point of change to the point of measurement) while still basing the control decisions on the final diameter measurements.

Using this dual loop, transient deviations can be minimised, in turn leading to a significant reduction in standard deviation and ultimately an increase in the process capability index (CPK).

Zumbach Electronic AG – Switzerland
Website: www.zumbach.com

...and top service is the aim

It is not just the technology that is aimed at complete customer satisfaction for Zumbach's clients; it is also customer service.

In addition to classical service, Zumbach offers customer training, calibration and maintenance services if required. With its worldwide service support, customers can choose from a variety of possibilities – no matter in which part of the world the devices are operating.

For customers requiring monitoring of measurement equipment to ISO 9001 and other norms, Zumbach offers a calibration service.

This allows the accuracy verification of the measuring device and provides its corresponding certification and documentation.

Usually, the calibration of a device is required once per year. This can be realised by use of Zumbach's own supplied certified calibration standards, or if they do not wish to buy and maintain the calibration equipment themselves, the company can offer an on-site or return-to-base service from any of the company branches worldwide.

Zumbach trained engineers are located around the globe and customers can be supported by service specialists in Switzerland or by one of the worldwide offices in their own native language.

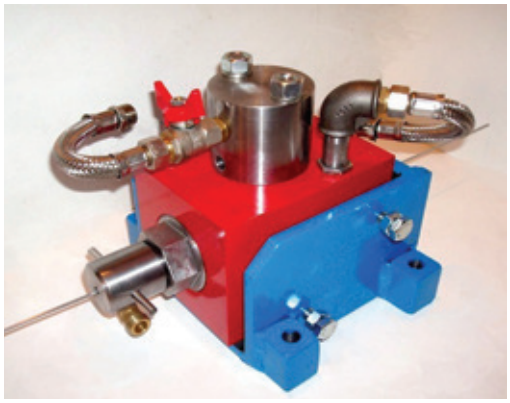
Zumbach Electronic AG – Switzerland
Website: www.zumbach.com

Advertorial on behalf of Decalub

Wire cleaning provides glossy finish

THE PWC-S system simultaneously performs drawn wire cleaning and polishing, in-line with wire drawing machines at up to 12m/s (2,400ft/min), in a totally green application.

Exceptional cleanliness obtained permits wire direct brass coating, copper coating, galvanising and wire cleaning prior to heat treatment and coating applications including patenting, annealing, painting, plastic coating, etc.



▲ *Wire cleaning by PWC-S system*

The PWC-S cleaning system incorporates new technology which enables normal plant cold water to be converted into a unique multi-action cleaner including wetting/extreme pressure extrusion/ contaminants displace and flushing out used to clean drawn wire at high-speed, providing wire glossy finish in plating quality.

For a clean mirror reflective wire finish, for decorative applications, the system can be used with emulsion including a new rust preventive additive diluted at 3-5% concentration.

The PWC-S system effectively loosens and removes lubricant residue from base material and is particularly recommended for cleaning applications with wires drawn upon severe conditions resulting in increased heat and burned lubricant tightly bound to the wire surface and embedded in micro-cavities.

These are further smoothly polished under high pressure separating lubricant residue from base material, washing away dispersed contaminants, enabling wire exiting the unit to be very clean of white-metal appearance with a reflective finish and totally dry.

The PWC-S system provides the ultimate combination of simplicity and effectiveness: acid-free, caustic-free, without ultrasonic, without chemicals, hermetically sealed zero-emission system, no fumes, no foam.

Economical and environmentally friendly, the system provides significant process savings in production of clean wire. The PWC-S unit is compact and can be easily installed on the finishing/ last block of a wire dry drawing machine.

Decalub – France
Email: info@decalub.com
Website: www.decalub.com

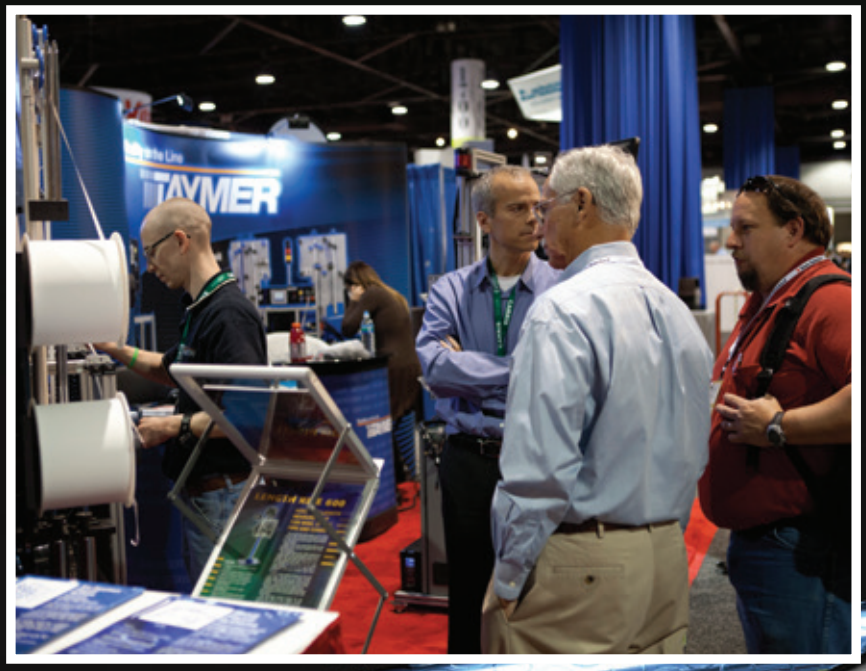
Advantages of the new Inotec™ generation

Ask Chemicals has succeeded in further enhancing its inorganic Inotec™ technology through its new TC 5000 and HS 3000 products. The new developments lead, in particular, to improved shakeout and higher moisture stability of the cores.

The newly developed promoter TC 5000 complements the positive qualities of the previous generation in regard to penetration-free and sand-adhesion-free casting surfaces, and in terms of improved collapsibility properties in light metal casting, improved immediate strength levels, as well as increased storage life of the cores.

Likewise, the storage life of cores manufactured using inorganic binders previously posed a challenge, especially on hot summer days with high humidity and a high ambient temperature. The new binder HS 3000 significantly improves the moisture stability of the inorganically bound cores. This, in turn, makes it possible to manufacture stable cores coated with a water-based coating, which also makes the binder system interesting for iron casting.

Ask Chemicals GmbH – Germany **Website**: www.ask-chemicals.com



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www.wirenet.org

2015 INTERWIRE TRADE EXPOSITION

April 27-30

Four day show

THE largest wire and cable exhibition in North America is now just weeks away.

The Georgia World Congress Center in Atlanta, Georgia, USA, will throw open its doors to the Wire Association International's biennial event for four days from 27th April.

Suppliers to the industry and manufacturers of wire, cable, and fasteners, formed and fabricated wire products will be on hand to welcome visitors from around the world. The show crosses dozens of industries, including automotive, construction, aerospace, transportation and communications.

Exhibitors, speakers and visitors from more than 50 countries will descend on Interwire – a benchmark show for the industry in North America.

Time
27 April at 08:00 am - 30 April at 03:00 pm (UTC -05:00)
Eastern Time (USA & Canada)
Location
Georgia World Congress Center, Atlanta GA

Alphabetical list of Exhibitors

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AIM Inc
Booth 1014

AIM offers 2D and 3D CNC wire bending solutions with models ranging from 2.5mm to 25mm. Its automated work cell solutions take wire from straight and cut or coil and will form, weld and systematically arrange the finished parts.

▲ *The AFM-3D8Sd will be on show in Atlanta*

During the past few years, AIM has developed new benders and accessories that it will unveil at the show.

AIM will exhibit robotic integrations with its patented AFM-3D8Sd capable of versatility, fast output and low-cost maintenance.

The Synchro is AIM's hybrid forming solution that provides the user with the technology needed in today's ever-changing marketplace.

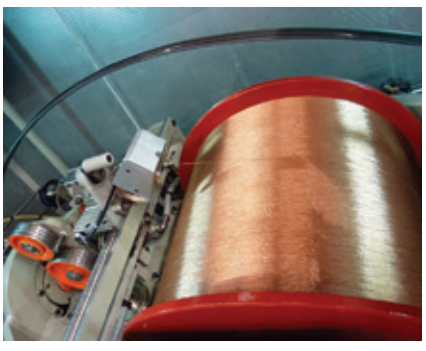
AIM Inc – USA
Website: www.aimmachines.com

Bow Technology
Booth 424

Bow Technology is the answer to cable makers concerned by quality and long-life reliable bows for all brands of double twist machines from 560mm to 2,500mm.

With a comprehensive range of over 500 sizes, designs including the new generation multi-use 'GreenBow2' (one bow fibre, three wire paths, 30 per cent energy saving), the division offers a global service from conception to production.

▼ *The GreenBow from Bow Technology*



Bow Technology – USA
Website: www.bowtechnology.com

Caballé SA
Booth 312

With over 70 years of experience in the design and manufacture of rotating machinery for the production of power and telecommunication cables as well as steel ropes, Spanish company CM Caballé provides the cable industry with a wide array of stranding, twinning, bunching and cabling machinery.

The firm is constantly developing new, high quality equipment to meet the ever-changing needs of the wire and cable industry.

▲ *Rigid strander for DIN 800 bobbins*

The company's portfolio includes the following equipment for:

- Power cables: double twist stranders, rigid stranders, drum twisters, single twist stranders, bow skip stranders, tubular stranders, planetary stranders and SZ stranders
- Telecom and LAN cables: double twist pairing-quadding machines, single twist cabling lines, group twinners, drum twisters, shielding-jelly filling-sheathing lines, and SZ stranders
- Steel ropes: double twist stranders, tubular stranders, planetary stranders, and bow skip stranders
- Ancillary equipment: pay-offs, take-ups, capstans, caterpillars, taping machines, and binders

At Interwire 2015, Caballé will show its new developments, highlighting the following products:

- Upgraded rigid stranders and drum twisters for HV energy cables (Milliken conductors, overhead conductors with trapezoidal wires
- Complete range of double twist stranders to manufacture compacted conductors of Cu and Al up to 400mm^2
- Complete range of stranders and closers for steel ropes
- Latest improvements in existing stranders for all types of cable

Construcciones Mecánicas Caballé SA – Spain
Website: www.cmcaballe.com

Cable Services & Systems
Booth 424

With a long successful experience in North America, the Gauder Group takes care of all wire and cable production lines, acting as an overall efficiency booster to restore machine productivity and product quality.

▲ *Service maintenance from Cable Services & Systems*

The newly rebranded 'C2S' division is being assigned spare parts, upgrades and maintenance projects for all brands of rotating equipment, recently reinforcing the engineering and commissioning team with ex-Lesmo and ex-Cortinovis engineers.

The global services division turnover has been rising by 350 per cent for ten years.

Cable Services & Systems – USA
Website:
www.cable-services-systems.com

Cimteq Ltd
Booth 2019

Cimteq, the company behind CableBuilder, will be showcasing two of its revolutionary software products: the flagship product CableBuilder, and a new innovation called CableMES, a manufacturing execution system specific to cable manufacturing based on the Wonderware platform.

CableBuilder has multiple applications. It enables companies to design wire and cable more quickly and efficiently, allows quotations to be raised faster and, perhaps most importantly, avoids costly mistakes that lead to excessive waste which impacts profitability.

CableBuilder is applicable to all types of cables, and can be fully integrated into a company's existing ERP system. It permits a company to fully embrace the concept of length-based costing and to produce accurate, unique datasheets quickly and effectively, further facilitating the quotation process.

CableMES is a natural fit to CableBuilder, continuing the benefits that CableBuilder brings to the design and quotation process through to the manufacturing process.

Based on one of the leading automation platforms from Wonderware, CableMES controls the process of cable production by electronically relaying manufacturing instructions to the operators on the shop floor and collecting order progress, as well as process information from machine sensors, process controllers and manual operator input.

It also collects quality data from test equipment and ensures traceability of materials used in every batch.

The software improves communication with the shop-floor in order to maximise throughput, improve schedule adherence, improve process efficiency, and reduce waste. Amanda Shehab, principal of Cimteq, said: "CableMES is a new product to the market and the benefits that it offers are vast so we expect to see a lot of interest in it at Interwire this year."

Cimteq is extremely enthusiastic to see how its two innovative software products will be received by the delegates attending Interwire and also to experience the buzz of the event itself.

Mrs Shehab went on to say: "We are really looking forward to Interwire 2015 and are particularly excited to see many of our North American and other international customers at the show in addition to meeting some new ones.

"As the chairman of the IWMA, I am also looking forward to meeting the IWMA members that are in attendance. The exhibition centre in Atlanta is such a great venue; it is a very accessible and convenient location, so I anticipate that it will be a very busy few days."

Cimteq Ltd – UK
Website: www.cimteq.com

Clifford Welding Systems Booth 1723

Clifford Welding Systems recently opened a new dedicated sales and service office in the USA.

The office will handle the North and South American market, and Interwire 2015 is the perfect time and place to let customers know about the changes ahead this year.

▲ *One of the many lines on offer from Clifford Welding Systems*

Clifford is known worldwide for its reinforcing mesh welders, offcoil fencing welders, fine mesh welders, grating welders and high speed wire straightening machines.

Clifford Welding Systems (Pty) Ltd – South Africa
Website: www.cliffeng.com

Clinton Instrument Company Booth 901

Clinton Instrument Company has introduced the model HF-15B series of high frequency AC spark testers. This series replaces the highly successful HF-15A, which was first shown at Interwire in 2001. Since then more than 10,000 HF-15A units have been shipped worldwide.

In addition to the reliability of Clinton Instrument spark testers, the HF-15B offers customers the ability to utilise many new technologies.

New features provide more information, easier integration, and flexible solutions in response to difficult applications.

The HF-15B series features a large adjustable alphanumeric display with multiple view options. Customers can monitor total fault count, specific types of fault conditions, and per cent load. The front panel also offers optional password security.

PLC integration is effortless when connecting with Modbus RTU via RS-485 full duplex. Optional Ethernet/IP, profinet, profibus, modbus TCP, and analogue communications are also offered with the new series.

New features of the HF-15B series also include:

- Continuous output voltage monitoring at the electrode
- DSP-based voltage regulation and fault detection
- Four relay outputs with selectable functions – high voltage on indicator, fault alarm, voltage watchdog, and gross bare wire alarm, with others available
- Several electrode options for testing a wide range of products

➤➤➤

In addition to these abilities the HF-15B series features a fully automatic calibration of voltage and sensitivity to EN50356, IEC/CEI 62230 and NEMA standards when using the STCAL system.

Clinton Instrument Company – USA
Website: www.cicsparkers.com

Commission Brokers Booth 212

Commission Brokers will be displaying photographs and brochures of available used equipment, as well as information relating to the company's appraisal, liquidation and consignment capabilities.

Martin Kenner, president of Commission Brokers, with over 41 years' service to the wire industry, specialises in non-ferrous wire and cable equipment, wire harness/assembly/processing equipment, and braiding machinery, from individual components to complete plants.

Commission Brokers Inc – USA
Website: www.commissionbrokers.com

Condat Booth 1650

Condat will present its latest developments in lubricants and products for the wire drawing industries, including:

Vicafil®: Claimed to be the industry's most complete range of wire drawing lubricants

Steelskin®: Speciality lubricants for the most demanding applications

Condat continues to develop advanced solutions to meet the increasingly stringent requirements for environmental and health and safety regulations, including:

- Reduction of dust in workshops (OSHA Directive)
- Impending SDS updates (GHS system – June 2015)

▼ *Vicafil wire drawing soaps from Condat*

The show will be the opportunity for the company to promote several recently developed products, including:

Vicafil TF 1869: A new and very versatile mixed-basis soap for high speed drawing of galvanised high carbon steels or phosphated steels. It may be used throughout all passes, or in conjunction with another high performance sodium-based soap, for the fastest draw speeds.

Vicafil Sumac 5 T: A new addition to the Sumac family. A low-borax soap, offering exceptional performance on the most demanding high carbon steel wire applications, such as tyre cord and tyre bead wires, but versatile for a wide range of uses and materials, without leaving an excessive or dusty residue.

Condat – France
Website: www.condat-lubricants.com

Daloo Booth 424

As a member of the Gauder Group, Daloo provides an option for cable producers wanting simple and reliable machines at an affordable price.

▲ *Stranding line from Daloo*

The design, as well as the manufacturing in Changzhou, China, is based on European experience following strict quality criteria. Its complete stranding lines and accessories for the production of power and communication cables are delivered worldwide: rigid cage stranders, taping lines, rewinding lines, take-ups and pay-offs, pulling caterpillars and now tubular stranders.

Daloo – USA
Website: www.daloo-machines.com

DEM Costruzioni Speciali Srl Booth 1824

DEM wire rolling technology provides cutting-edge solutions for the cold rolling industry, for ferrous and non-ferrous metals, on a worldwide scale.

▲ *Double coiler from DEM*

Its range of products includes:

- Profile wire rolling lines
- Rolling lines for flat wire
- High speed rolling lines for the production of concrete reinforcing wire in coils and bars
- Rolling cassettes for wire rolling and rope compacting
- Micro-cassettes to replace traditional dies in drawing lines
- Tube forming technology for flux cored wire (welding wire)
- Auxiliary solutions

One of the newest machines to be delivered to the USA is a special collapsible coiler (1-3 ton coils) that will complement an existing rolling line.

The machine has automatic opening/closing front door, and automatic coil height pre-set adjustment to make all operations fast and easy to increase uptime.

The coiler is provided with precision laying software that controls the side-ways positioning movements with the rotation, to obtain a perfect traverse oscillated coiling of the wire.

The machine can coil flats, squares or round wires with speed synchronised with that of the line. A heavy-duty structure, rational design and the use of high quality components ensure reduced, fast and easy maintenance and long machine life.

The machine is also equipped with coil ejection and tilting unit for fast coil removal. Double configuration is possible to achieve ceaseless rolling.

DEM, in the last eight years, has enjoyed a constant and double-digit turnover increase. As a result, its team is also growing in number and specialisation to reach and honour the next business targets. This includes service all along the operational lifetime of equipment.

DEM's expansion calls for new offices and the doubling of the shop floor, to be inaugurated this spring.

DEM Costruzioni Speciali Srl – Italy
Website: www.demgroup.com

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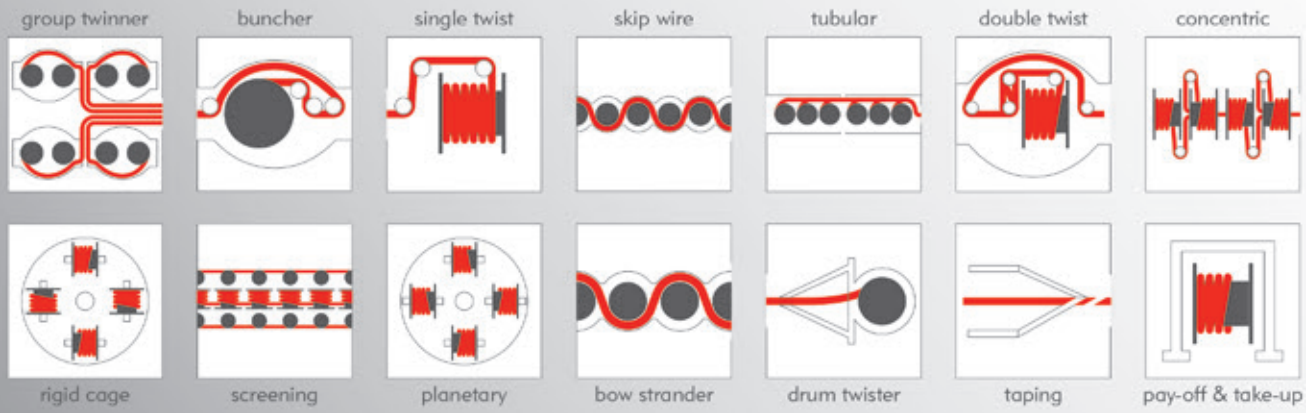

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Booth 424

wire Russia
May 12 - 15
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Die Quip
Booth 1003

Die Quip will feature several of its cutters for wire, cable and chain solutions to eliminate manual, hazardous and abrasive operations. Its cutting line includes Knipex pliers and hand tools, Krenn triangle blade bolt cutters, and air-powered, battery, electro-hydraulic and fully hydraulic cutters.

How much are your dies costing you? Chances are much more than you realise. Many factories take a disposal approach to their dies, looking for a way to reduce cost. High overnight freight and two-way freight fees are regularly absorbed from rush orders when dies are needed quickly or customer requests demand changes to stock. Large inventories, hidden labour and disposal of good dies from short runs are common areas where production costs are increased but not controlled.

▲ *The MGF-200 die saver machine for grinding and polishing tungsten carbide dies*

An internal die shop can easily eliminate these expensive problems. Die Quip provides a variety of die finishing machines and work cells that are designed to quickly and easily produce dies for any size facility. The right training and machinery allows each die to be cut quickly to handle any production variation.

Die Quip – USA
Website: www.diequip.com

Dynamex Corporation
Booth 1911

Dynamex will be exhibiting the newest version of its patented automatic tape-splicer for high-speed taping at the extruder. This is a low-cost, small footprint, longitudinal taping system with fully automatic on-the-fly tape splicing at full line-speed.

This process enables taping continuously with unattended automatic splices at constant tension. Payoff is PLC controlled, with digital AC drives, and runs up to 1,500 FPM.

▲ *The TPX-36-3-EU from Dynamex*

The machine operates with AL/PE, PE, Mylar, Kraft, tissue, water-swellable, etc. The tape leaves the payoff and is redirected to the wire-line and enters the tape-folder that folds it around the core prior to entering the extruder. Models are now available for flat pads, traversed pads, or universal for both styles, up to 3" wide tape.

For taping in a cabling line, Dynamex offers non-driven two-position tape payoffs, for flat pads, traverse pads, both styles, for single- or two-tape operation. These units operate best with "dial-in-angle" tape redirection units, delivering the tape to the cable at the correct angle.

Dynamex offers newly designed rugged single-twist cablers and bunchers:

- New CU & AL bunchers offered for 36", 48", 1,000mm or 1,250mm. The same size machines available as cablers for insulated products
- New high speed 36" cabler running 15 per cent faster for small size cables

Multi-position or single-position shaftless driven reel payoffs are available, as well as driven tension control payoffs for feeding a cabler out of stempaks, neutralising payoffs and more.

Dynamex Corporation – USA
Website: www.dynamexcorp.com

Gabarró SA
Booth 732

Founded in 1920, Gabarró is fully consolidated internationally and involved in the production of wire drawn from medium and low carbon steel.

With two modern production plants, one in Barcelona and another in Brandenburg, the company offers its clients logistic flexibility, high quality and competitive prices. ➢➢➢

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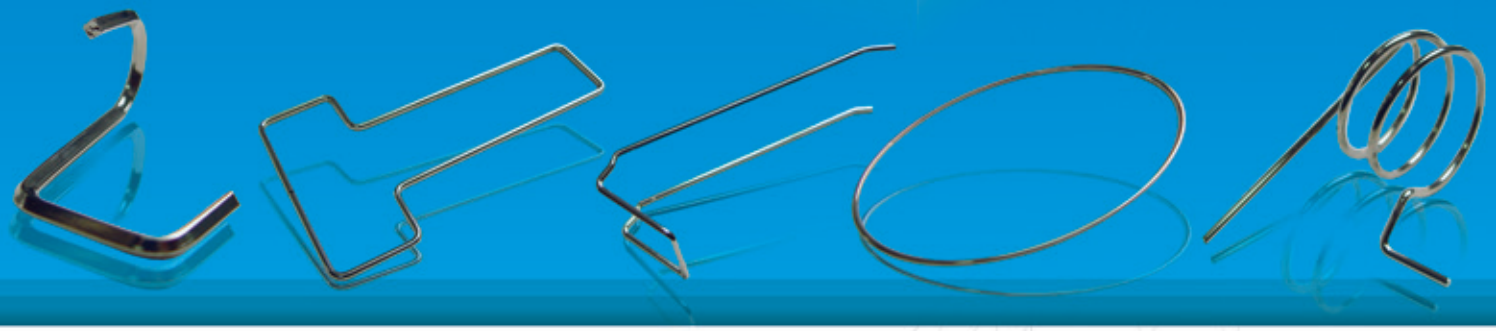

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The bright, grey and annealed wire produced by Gabarró, under scrupulous quality control certifications, guarantees absolute compatibility with the most demanding applications.

The product range includes wire diameters ranging from 0.094" to 0.551" and in units between 1,100 and 6,600lb, according to the client's technical requirements. Gabarró collaborates with its customers to ensure an optimal match between product and application.

▲ *The company's plant*

The company has grown, but the philosophy of the family firm remains pertinent in the day-to-day business. Partnering with customers and suppliers and enabling transparent and efficient internal operations delivers benefits for all and ensures that the company is proud to be approaching its 100th anniversary.

Gabarró SA – Spain
Website: www.gabarro.eu

Gauder Group Inc Booth 424

For more than two decades, Gauder Group Inc, the North American representative of the Gauder Group based in Greensboro, North Carolina, has been serving the wire and cable industry to locally support the machine and services range of the group.

All companies within the Gauder Group occupy the same booth for easy customer access and to enable the exhibition of multi-purpose single twist machines for the production of special and power cables.

Gauder Group – USA
Website: www.gaudergroup.com

Gauder Booth 424

The Gauder member of the Gauder Group earned its position providing reliable and economical solutions ready to manufacture non-ferrous and ferrous products like rods, wires, conductors, cables, strands, ropes, bars and meshes.

▲ *The Gauder factory*

The Belgium-based supplier has in stock more than 1,000 machines ready to manufacture wires, conductors, cables, ropes or steel products. New Mapré extruders ranging from 38 to 150mm are also available, along with accessories.

Gauder – Belgium
Website: www.gauderonline.com

Gavlick Machinery Corporation Booth 1053

Gavlick Machinery was established in 1957. The company is a supplier of used machinery for the ferrous and non-ferrous industry internationally, with appraisals, liquidations, buying and selling single machines and complete plants in the following categories: Bar, rod and wire processing; wire drawing; multi-pass; bullblocks; wire flattening mills; stranders; cablers; straight and cut; fence; nails; rope; spring coiling; shaped and flat; weaving; and welded mesh, etc.

Gavlick Machinery Corporation – USA
Website: www.gavlick.com

Guill Tool & Engineering Co Inc Booth 211

Guill Tool, a West Warwick, Rhode Island, USA, designer and builder of extrusion tooling, offers an assortment of literature for machine builders and extruders.

Individual brochures are offered, depicting the wide array of tooling possibilities: straight inline heads, rotary heads and crosshead dies, available to suit any extrusion machine built anywhere in the world, running all types of compounds.

Guill provides tooling for plastic, rubber, TPE and other material extrusions, with end products ranging from extremely thin-walled, multi-lumen medical tubing and catheter balloon tubings up to multi-layer wire and cable jacketing

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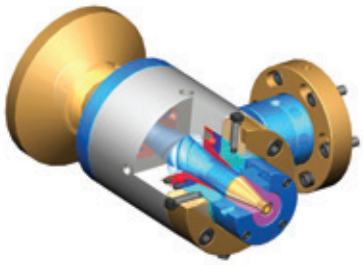

▲ *Guill extrusion tooling is available for all popular materials and applications*

and 20" diameter pipe for industrial applications and agricultural drip lines. Guill also provides tooling for film, sheet and profile extrusions.

The company designs, engineers, machines, assembles, tests and delivers all tooling to its worldwide customer base in all the consuming industries for extrusions. The company also offers tooling carts and disassembly/cleaning stations for easier line integration.

According to company sources, the utilisation of properly designed and engineered tooling can result in substantial material savings for extruders of all types.

Guill Tool & Engineering Co Inc – USA
Website: www.guill.com

IBA Group Booth 569

Ionising energy, as provided by an accelerated electron beam (EB), is an efficient means of crosslinking polymers used for wire and cable jacketing. In this process, chemical bonds are formed between polymer molecules chains in order to produce a three-dimensional insoluble network.

This can be done without heat. In most instances, ionisation causes the abstraction of an atom of hydrogen from a polymer to produce active sites along a polymer chain that can bind to similar sites on adjacent chains without the use of crosslinking agents.

EB processing is faster, more controllable and more economical than thermal and/or chemical crosslinking when used in the production of insulated wires and cables.

EB crosslinked wire and cable insulation entails several favourable properties. It will not melt and flow at elevated ambient temperatures, nor melt and flow should the conductor become heated due to an electrical short circuit. EB crosslinking reduces the risk of flame propagation should a fire occur in electrical equipment. Tensile strength, especially at elevated temperatures, is increased, as are abrasion resistance, stress crack resistance and solvent resistance.

IBA's solution for electron beam crosslinking, called Easy-e-Beam®, is based on the proven industrial reliability of the Dynamitron® accelerator.

It is easy in the sense that the solution is self-shielded, allowing an easy installation in an existing facility. Additionally, Easy-e-Beam® integrates in one system the E-beam accelerator and the wire handling system, both of them being managed by a single PLC-based control system.

Wires and cables that are wound on reels are fed into the Easy-e-Beam® and then, after electron beam treatment, are rewound onto take-up reels. Easy-e-Beam® can handle cross-sections up to 30mm² (60kcmil) and, for small wires, reach a line speed of up to 1,000m/min.

▲ *IBA's Easy-e-Beam®: An integrated crosslinking solution including a self-shielded E-beam accelerator, pay-off, take-up and the overall control system*

IBA can also provide complete and fully integrated crosslinking lines, including pay-off, take-up and quality control equipment.

The company has made progress in bringing advantages to the self-shielded solutions for systems ranging up to 1.0 MeV.

Full factory pre-assembly, pre-wiring and performance testing, minimised site preparation and installation are the major assets of those solutions.

IBA Group – Belgium
Website: www.iba-cables.com

Innovites Booth 1920

InnoVites will present its comprehensive CableERP solution. The complexity of cable manufacturing and distribution puts special requirements on the applications that companies use to run the business. InnoVites leverages a long history within the industry to come up with the comprehensive CableERP solution on Microsoft Dynamics AX. It combines specialised functionality for the industry with the user-friendly screens of Microsoft Dynamics.

Cable manufacturers typically have large product portfolios with hundreds of different constructions. Only a limited set of these products are sold in a year. The sales teams need help to navigate quickly to the products that meet the customer requirements. InnoVites for cable introduces powerful search capabilities, based on the cable specifications, to respond to the customer requirement immediately.

In addition to this, the cable industry has a special type of calculus. In this cable calculus 200 plus 100 doesn't equal 300. A telecom network installer will not accept two drums with lengths of 200m and 100m when the order was for one 300m cable.

Also, customers are specific about the length tolerances that they accept: the customer can reject the cable if the actual length of the cable is outside this range.

Another customer-specific information is the drum type that should be used to deliver the cable. The right drum type depends on customer preferences and the capacity of the drum, based on weight, length and bending radius of the cable.

This means that the customer requirements concerning length information, and the length tolerances need to be captured in the system accurately and complete.

InnoVites for Cable provides the solution that conveys these customer requirements into the supply chain right away. The customer cable requirements are continuously validated against the actual deliveries from production or external suppliers.

InnoVites – Netherlands
Website: www.innovites.com

Inosym Booth 1731

Inosym will display a range of steel and plastic reels to showcase its production capabilities and quality.

The team welcomes the opportunity to talk to customers about some of the new technology it has introduced into

Beyond Bending...

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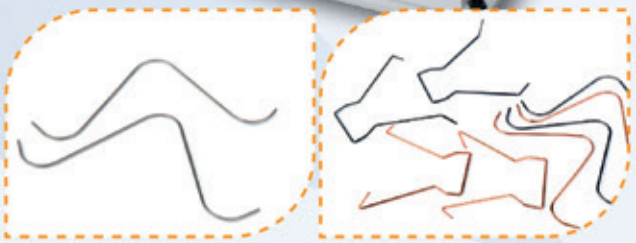

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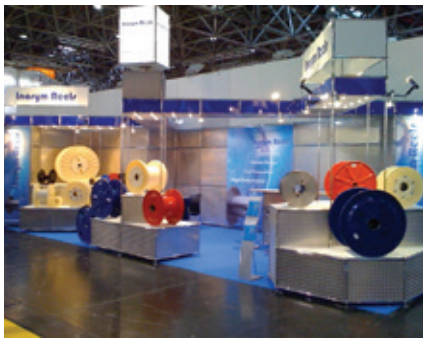

▲ *Some of the reels on offer from Inosym*

its manufacturing plant and how this can benefit the wire and cable manufacturer. This includes robotic welding and automated painting.

Inosym Ltd – New Zealand
Website: www.inosym.com

Keir Manufacturing Booth 703

Keir Manufacturing is USA-based manufacturer of high-purity 99.8 per cent alumina ceramic guides, the Frontiersman™ line of air wipes, and composite flyer bows serving the global wire and cable industry. The company is dedicated to making products that enable manufacturing processes to run more efficiently and productively through the application of leading-edge materials. Its solutions are focused on continuous process improvement, energy savings and longer operating life.

Keir's patented SureShot and SplitShot air wipes provide a more effective drying method that does not depend on high-volume air consumption. The efficient design yields effective drying using a very low volume of compressed air and lasts longer than other brands due to the rugged ceramic insert lining the wire path. This equates to over 25 per cent reduction in compressed air usage and an operating life of years versus months.

The company's triaxially braided composite standard and BackBone™ flyer bow constructions are claimed to have greater durability than layered/laminated designs, allowing them to take more hits and endure higher stress, yielding increased operating life and less machine downtime. The more aerodynamic BackBone™ design functions at lower power consumption and higher TPM with improved wire quality and a further reduction in bow breakage. Up to 40 per cent less energy is used along with a decrease in wire scrapped.

Keir Manufacturing Inc – USA
Website: www.keirmfg.com

LaserLinc Inc Booth 1503

LaserLinc is a supplier of non-contact devices for diameter, ovality, wall thickness, concentricity and inside diameter measurement systems for wire, cable, fibre and other industries.

In-process solutions deliver material savings, scrap reduction, production efficiencies, process improvement and product quality documentation.

Offline solutions deliver detailed inspection results, statistics and reporting. Both offer a unique HMI/MMI so operators can see and do exactly what they need, in a way that is optimised for simplicity and effectiveness while providing engineers and managers the real-time tools and reporting they require.

For PLC-based line control systems and those using their own HMI tool, SmartLinc-based solutions deliver secure data directly over an industrial network of the user's choice, such as EtherNet/IP.

Unlimited technical support is included with all systems and a four-year warranty covers most LaserLinc products.

LaserLinc Inc – USA
Website: www.laserlinc.com

Maillefer Extrusion OY Booth 932

With Maillefer, you do not need to be fixed within the limits of your current business. The company offers an extensive portfolio of production solutions for the global wire and cable market. Its roots lie in the extrusion technology, on which nearly 20 applications are based. Its portfolio includes over 50 technologies.

▲ *A pilot-scale vertical extrusion group for medium and high voltage cable production in Maillefer's R&D centre in Finland*

To better answer the diverse needs of wire and cable manufacturers worldwide, the portfolio is organised into three different levels of production solutions: / Enter, //Extend and ///Explore.

These solutions vary in capacity, cost, automation, flexibility, product range, space requirements and maintenance needs.

From the widest services in the industry, you can always find the ideal match to your lifecycle needs. Maillefer delivers versatile maintenance, performance and upgrade solutions, as well as continuous service level agreements and 24/7 support to its clients.

The wire and cable production solutions are available for building and automotive wires, dry or jelly filled fibre optic cables, low, medium, high and extra high voltage cables, rubber cables, telecom, LAN and coaxial cables.

For energy applications, expect to see new technology and innovations for material savings and perfect cable roundness. The new high-end manufacturing solutions for every stage of the fibre optic cable process will also be exhibited – the future is here with the new ultra-high speed secondary coating line OEL 40///Explore with production speeds up to 1,000m/min. The company's new aviation cable production line and the 1,500m^2 research and development centre at its headquarters in Finland are also both well worth mentioning. The centre aims at providing a solid platform for strengthened customer partnerships, where visiting customers develop customised solutions and receive training on full-scale equipment.

Maillefer Extrusion OY – Finland
Website: www.maillefer.net

MFL Group Booth 1739

The MFL Group will display the following equipment and will have technical and commercial personnel on hand to present the entire scope of its machinery:

MFL Group – Mario Frigerio – WS2 – "Draweasy" Sander. This machine, which uses one or two heads depending on inlet speed, has increased the efficiency of the entire line producing from low carbon to a mechanical descaling process for the rod preparation to draw PC wire with carbon contents up to 1,080c. The 50 units sold in the last year have seen energy savings, higher operating speeds, less maintenance costs, and easier use by the operator.

MFL Group – Frigeco Extruder – 60mm + 35mm Dual Extrusion. The Frigeco Extruder re-design was initiated to provide a more accurate temperature

The Wire Drawing Standard

Paramount Die is the leading designer and manufacturer of wire drawing inserts and tooling systems for the wire drawing industry. For more than 45 years we have been delivering the global wire drawing market with dies and wire drawing solutions that optimize wire drawing operations.

Why Use Paramount Die?

Productivity - Maximize die performance by increasing machine utilization and decreasing production cost.

Speed - Achieve drawing speeds up to 45% faster than conventional cased dies.

Efficiency - Dramatically lower material and shipping costs.

Consistency - Highly efficient and automated production equipment allows us to provide premium quality solutions at a competitive price.

Visit us at Interwire

Booth #340

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DRAWING SYSTEMS FOR THE WIRE INDUSTRY

paradie.com

▲ *MFL Group will present its range of machinery at Interwire*

control system for the extrusion process. The result of this study is increased output without degrading the material. In some cases there is the option of going down one size of extruder, decreasing capital cost and the amount of energy required. MFL will display a 60mm 25:1 L/D extruder with volumetric dosing system used for colour or master batch plus a 35mm 25:1 L/D extruder with volumetric dosing system for colour concentrate, dual cross head and operator interface.

MFL Group-Frigeco – Italy
Website: www.frigeco.com

Nano Diamond America Inc Booth 1806

Nano Diamond America Inc supplies Nano-Dies® to the industrial world in the cable, wire and tube manufacturing industries.

Cable manufacturers all over the world know the benefits of operating at +0 tolerance. Now they do this all the time using Nano-dies – and at 2-10 times less than previous-generation diamond dies.

Nano-dies still lead the way in diamond coating technology, giving them their tremendously strong surface. Nano Diamond America claims to provide the lowest-friction working surface on the die market. This unparalleled smoothness leads to raw material savings due to less damage being done to the stranded material.

The configuration of the nanocrystalline diamond is strong and hard, composed of particles sticking perpendicular to the surface, not composed in random directions. The advancements in CVD technology for this field have allowed

▲ *Range of dies from Nano Diamond America*

Nano-dies a favourable advantage as a new way of producing a bright product at minimal cost.

Nano Diamond America Inc – USA
Website: www.nano-die.com

NDC Technologies Booth 631

NDC Technologies debuts the latest Beta LaserMike products for in-process dimensional monitoring and automated quality cable testing at this year's Interwire. The new lineup delivers higher accuracies, production efficiencies, and savings for profit-minded wire and cable manufacturers.

The new four-axis AccuScan 6012 gauge provides a comprehensive measurement coverage around the product's circumference to instantly detect changes in product diameter. It performs ultra-fast diameter and ovality measurements at 9,600 scans per second on products up to 12mm, and offers high single-scan accuracy with single-scan repeatability down to one micron.

AccuScan 6012 also improves ovality accuracy up to 100 per cent and provides high flaw detection accuracy with 25 per cent improvement over three-axis measurement methods.

The new DCM SCS-700 efficiently tests Cat 5e/6/6a cables to 700MHz and offers a low-frequency option to test cables down to 100Hz. Dual-frequency testing is performed with a single connection to significantly reduce set-up and testing time. Automated four-pair switching platform enables operators to perform cable testing in less than three minutes. Easy-to-use testing software offers complete test management and reporting capabilities.

In addition, the next generation of Beta LaserMike process controllers will be debuted along with the existing family of DataPro process controllers.

▲ *The new AS6012*

Other products on display include:

- Latest high-speed AccuScan 5000 series two-axis diameter and ovality gauges
- New LN series three-axis lump and neckdown detectors
- Innovative LayScan lay length measurement system
- CenterScan eccentricity measurement system
- LaserSpeed® length and speed measurement system
- Preheaters and spark testers
- CapScan capacitance measurement system
- SRL pro structural return loss prediction software

NDC Technologies – USA
Website: www.ndc.com

Maschinenfabrik Niehoff Booth 740

Maschinenfabrik Niehoff and its subsidiary Niehoff Endex (NENA) will present the following equipment:

- MMH 121.E2.1.A.16.2622 + RM 201.1.S.16.5000 multiwire drawing line
- D 632.2.A double twist bunching machine with NBAT and pay-off ARH 800.1.3.R
- BMV 16 / BAS 800 rotary braiding machine
- ECC 42.S.RTT (no pusher)

The multiwire drawing machine MMH121 is designed to simultaneously draw 16 wires with a final diameter of up to 0.2mm (32 AWG) which can be processed to intermediate multiwire bundles.

➢➢➢

Based on a modular principle, customer-specific MMH machines suitable for copper wires, aluminium wires, wires made from their alloys and from non-ferrous metals can be built. The wires drawn on such lines have homogeneous physical properties along their whole length and exceed the highest processing requirements. Meanwhile, more than 1,100 MMH lines are working worldwide.

The D632 type double-twist bunching machine is foreseen to produce strands with 0.09 to 6mm^2 cross section and a steplessly variable lay length of 6 to 100mm. The maximum number of twists is 6,500 twists/min, the maximum speed 300m/min. A special feature is the patented opto-electronic NBAT system (Niehoff Bunching Automatic Traverse), which allows spools to be perfectly spooled.

Spooled wire can then be paid-off tangle-free at extremely high speeds with no damage. Other features include the service proven energy-saving single bow (ECO-Bow) design, the contactless transmission of machine data within the machine and the NMI touch-screen display with colour user interface and simplified navigation structure.

▲ *The BMV 16 rotary braiding machine*

The 16-carrier lever arm rotary braiding machine BMV 16 can process bare or coated copper wire, aluminium wire and stainless steel wire with a single-wire diameter ranging from 0.05 to 0.3mm (40-28 AWG) as well as artificial yarn and fibres.

The machine features an infinitely variable electronic control of line speed and braiding pitch as well as an automatic central lubrication system.

With an integrated central taping device, the braiding and the subsequent taping processes are completed in one step. By means of integrated and optionally available quality assurance systems, BMV braiders can work for a long time unattended and without operator intervention.

The machine that will be on display is equipped with a BAS 800 take-up and pay-off unit for spools with a flange diameter of up to 800mm.

The ECC 42 continuous down coiler developed and manufactured by Niehoff Endex (NENA) is designed for inline operation with extrusion, tinning or drawing lines and suitable for bare and plated copper, aluminium wire as well as insulated solid and stranded cable.

It is designed for coiling of soft and hard solid copper wire with 0.8-4.1mm diameter (20-6 AWG) and insulated stranded conductor with 0.8-5.2mm diameter (20-4 AWG). The maximum production speed is 43m/s (8,500fpm). The ECC type coilers are suitable for use with cardboard barrels, stems or baskets.

The Endex coiling system guarantees a high barrel filling weight and a safe pay-off of up to 8m/s (1,600fpm) of coiled cables, even after long transport distances.

Maschinenfabrik Niehoff GmbH & Co KG – Germany
Website: www.niehoff.de

Niehoff Endex North America Inc – USA
Website: www.niehoff-usa.com

Numalliance Booth 732

While mechanical slide machines revolutionised wire bending in the last century, Numalliance has the solution for the 21st century.

Mechanical slide machines started dwindling with the rise of CNC bending equipment a few decades ago, while large production of simple parts has been relocated to lower cost countries.

In a resuming worldwide economy, a flexible solution for high volume production is a necessity.

Designed to host hard tools like multiple slide mechanical machines, capable of similar cycle time and identical quality with reduced set-up time and minimal adjustment, the Numaslide 05 is the answer.

▲ *The Numaslide 5 from Numalliance*

"Since re-shoring is a reality in North America and since Europe suffered the same decline in mechanical machinery, the Numaslide will bring an answer for the manufacturer looking for speed, flexibility and quality," said Manuel Uriarte, general manager of Numalliance de Mexico.

Numalliance – France
Website: www.numalliance.com

Pourtier of America Booth 424

Pourtier of America is the name chosen by the Gauder Group to promote the sales of the Pourtier product range.

▲ *Rigid strander from Pourtier*

The line of equipment includes the company's successful rigid and planetary stranders, single twist cablers and drum twisters for producing of all types of power cable (low, medium, high and extra high voltage underground, overhead conductors and submarine/umbilical), as well as signal/instrumentation and large communication cables. Pourtier is also extending its existing range of tubular stranders, skip stranders and bow cablers.

Pourtier of America – USA
Website: www.pourtier-setic.com

PWM Ltd Booth 1355

British company PWM will present its best-selling EP500 rod welder, plus a range of powerful portable cold welders and manual machines. The PWM products will be featured by Joe Snee Associates, exclusive distributor of PWM

▲ *The PWM EP500*

cold welding equipment, spares and dies in the US and Canada.

PWM's electro/pneumatic EP500 cold welder provides a cost-effective method of welding large non-ferrous rod sections. The machine is designed for wire sizes 5mm to 12.5mm (0.197" to 0.492") copper and 5mm to 15mm (0.59") aluminium, and is quiet, clean and energy efficient to operate.

The smaller air/hydraulic HP100 cold welder, for welding wire and strip 1mm to 5mm (0.039" to 0.197") is mounted on a trolley, so it can be wheeled quickly to the work area.

Manual cold welders on show include the manually operated M101 cold welder, for copper wire and strip 1mm to 3.6mm (0.04" to 0.141") and aluminium 1mm to 5mm (0.197"). The M101 can be used on a workbench or supplied with a trolley.

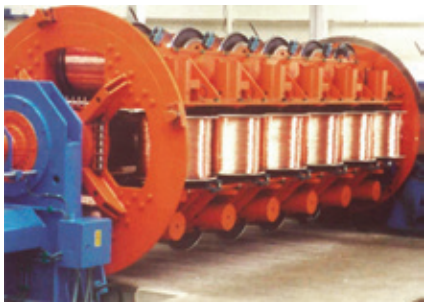
Suitable for joining fine wire in confined spaces, PWM's M10, M25 and M30 hand-held machines are suitable for wire and strip 0.1mm to 1.8mm (0.0039" to 0.071"). The BM10 and BM30 models, for similar wire sizes, can be used on a workbench or trolley.

PWM machines and dies, standard or custom made to suit round or profile wire and rod, are designed and made in the company's own UK workshops.

PWM Ltd – UK
Website: www.pwmltd.co.uk

Queins Machines GmbH
Booth 1506

Queins will show large-sized pictures of machines on display, as well as a movie showing the machines in operation. Since the 1970s the company has supplied new and reconditioned machinery to customers of the cable and rope industry worldwide. By consulting with customers, Queins is continuously updating its range.



▲ *A rigid strander from Queins*

Besides the standard machines for the production of cables and ropes, it also supplies huge production lines for special industries such as the offshore or the transformer industry.

Queins offers a wide range of modern rigid, planetary, skip-type and tubular stranders, single- or double-twist bunchers/stranders, machines for the production of off-shore and umbilical cables, continuously transposed conductors (CTC) as well as disc- and belt-capstans, taping machines and all types of pay-offs and take-ups. ➢➢➢

It also offers used and reconditioned cable-making machines which have been modernised and finished with new components according to the customer's specification.

Queins Machines GmbH – Germany
Website: www.queins.com

Refractron Booth 302

Refractron's speciality is manufacturing Izory® rolls and rings for breaking down rod and drawing non-ferrous wire. Its proprietary magnesia stabilised zirconia material, Izory®, has a history of excellent performance with wire manufacturers in the industry. Refractron is the official certified supplier of drawing rolls for SAMP.

The company has experience making Izory® for rod mills, intermediates and multiwires made by all major OEMs.

▲ *Izory rolls from Refractron*

Refractron has material scientists who measure the key material properties on every lot based on ASTM methods. Every part is checked with calibrated equipment and laser marked to ensure traceability.

Refrectron's team makes communication the top priority from quote to delivery. Its applications engineers understand the key role Izory® plays in wire drawing and can offer solutions to "keep you running".

Additional products manufactured include:
- Drawing rolls and assemblies
- Annealer pins
- Spooler guides
- Eyelets
- Air wipes
- Wire reeds
- Idler rollers

Refractron is able to accommodate dimensions certified to 0.005mm (0.0002"), and polished to 0.05µm (2 micro inch). A comprehensive material lab, a full machine shop to create metal assemblies and an ISO 9001/ITAR certified quality department round out the manufacturing capabilities.

Refractron – USA
Website: www.refractron.com

Setic of America Booth 424

Setic's product line includes double twist bunchers/cablers for low- and medium-voltage power cable and the automotive industry, as well as a complete range of machines for the production of all types of data and special cable with enhanced performance.

▲ *Single twist cabler from Setic*

Setic is now extending its existing range of small single twist cablers/stranders and large double twist stranders/cablers.

Setic, combined with Pourtier, offers a wide range of twisting/stranding solutions to cable makers.

Setic of America – USA
Website: www.gaudergroup.com

Shanghai Jiajie Technology Co Ltd Booth 1919

Shanghai Jiajie Technology Co Ltd is not only a manufacturer of steel wire drawing machines, patenting lines, brassing lines, bead wire lines, galvanised lines, etc, but has experience for turnkey projects.

Equipment includes:
- Bead wire line: DV 500, wire number: 10-48
- Patenting line: DV 140, wire up to 40
- Electro galvanising line: DV 140; zinc coating deviation: ±1%, wire up to 60

Characteristics:
- The acid (HCl) consumption is ≤9kg/t; the consumption of rinsing water is ≤0.1m3/t
- Auto control on solution composition, temperature, water level, self-diagnosis and alarm
- Control system: digitisation, networked and intelligence; remote diagnosis

Shanghai Jiajie Technology Co Ltd – China
Website: www.shjiajie.cn

Sikora Booth 812

Sikora will be showcasing measuring, control, inspection and sorting technology for continuous online quality control in the wire, cable and plastic industry.

The Purity Scanner is a system for the online inspection and sorting of plastic pellets used for the insulation of medium-, high- and extra-high voltage cables where 100 per cent purity is required.

Contaminated pellets are detected and sorted out, assuring that only pure pellets get into the extrusion process. The pellet inspection allows for the detection of organic and metallic contamination inside the pellet as well as on the pellet surface, using a special combination of X-ray technology and an optical system. The smallest detectable particle size is 50 µm.

The Fiber Series 6000 is sophisticated equipment for continuous online quality control of optical fibres in the drawing tower.

The Fiber Laser 6003 measures the diameter of uncoated and coated fibres. Depending on its point of installation, it provides information on the position, vibration frequency, tension and spinning. The measuring principle ensures an accuracy of ±0.05µm. For the detection of airlines Sikora offers the Fiber Laser 6003 Airline. In addition, further gauge heads provide information on concentricity and temperature of the optical fibre.

The newly developed Fiber Lump 6003 Micro detects lumps and neckdowns on the optical fibre surface to 100 per cent. This is the result of the integration of six measuring axes. Shadow areas are eliminated and even the smallest faults from 5µm height and 50µm length are reliably detected.

For online quality control, optimisation of material usage and increased productivity during wire and cable production, Sikora offers the X-Ray 6000.

There are two X-Ray models available, the X-Ray 6000 for quality assurance of single layer products and the X-Ray 6000 Pro for the measurement of single and multi-layer products.

The systems are designed for continuous measurement of the outer diameter, wall thickness, eccentricity and ovality of cables.

▲ *The Fiber Laser 6003 Airline reliably detects airlines in the fibre*

In combination with the processor system Ecocontrol 600/1000/6000 an automatic control of the line speed and extruder rpm under consideration of the minimum values is possible.

The Laser Series 2000 is for classic diameter measurement in two or three planes, covering product diameters from 0.05 to 500mm. Furthermore, the high-end Laser Series 6000 will be displayed. These diameter-measuring devices meet the current high-end requirements in the wire and cable industry.

The gauges fulfil all needs regarding high accuracy, a variety of interface connection options and utmost reliability for a quality control at its best during wire and cable production. The high accuracy allows in addition for the detection of lumps and neckdowns. Three high-end gauges are available for product diameters from 0.2 to 78mm.

Also on display will be the Centerview 8000, which measures eccentricity, diameter and ovality of coaxial cables, LAN cables as well as automotive and installation cables. Optionally integrated in the Centerview 8000e is a 7" TFT monitor, which displays production data.

A special feature is the so-called scatter plot, which shows the distribution of short-term variations of the eccentricity. The scatter plot is an alternative style visual view of the measurements being made at the processor system Ecocontrol or the integrated TFT monitor. The operation is intuitive and menu-driven via touch screen.

For quality control during the production of MV-, HV- and EHV-cables in CCV-, VCV- and MDCV-lines Sikora provides the X-Ray 8000 NXT. It is used for precise measurement of the wall thickness of all three layers (concentricity, diameter and ovality). Measuring values for centring and control are therefore available immediately after starting up the line.

Additionally, the two or three-axis lump detectors Lump 2000 XY/T will be exhibited. The heart of the Lump 2000 device is the advanced double sensor technology, which detects punctual non-conformities on the cable surface even at high line speeds.

Sikora AG – Germany
Website: www.sikora.net

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Sirio Wire Srl
Booth 1358

A provider of technology, know-how and services, Sirio Wire designs, builds and installs equipment for the chemical and electrochemical treatment of wire.

▲ *Ultrasonic and electrolytic cleaning from Sirio*

It will display pictures and film of its technology. In particular: ultrasonic and electrolytic cleaning, fumeless HCl pickling, electrolytic pickling, bronze coating line for bead wires, electroplating lines, and coating baths as well as batch pickling and phosphating lines.

Sirio Wire Srl – Italy
Website: www.siriowire.it

Ultimate Automation Ltd
Booth 458

Ultimat has been designing and manufacturing innovative CNC wire forming and welding machines, used for the manufacture of a wide range of wire products from POP displays to automotive components, since 1991.

The range includes the well-established Ultimat UMW series of 2D wire forming and welding machines, which feature a robust, modern, modular design, and user-friendly Windows-based software.

All Ultimat models feature a "closed die" forming and cutting system, giving a high quality square, burr-free cut and butt weld. Options available include secondary bend heads, press tools, drilling, threading and chamfering stations, and automatic part unloading systems.

The company will be displaying the latest version of the Ultimat UMW-100 2D wire forming and welding machine, suitable for a range of 3-10mm (0.12"-0.395"), which incorporates faster drives and new software and control systems.

▲ *The UMW-65*

The UMW can be combined with the innovative UCW series of machines, to create a fully integrated forming and welding cell, with rectangular butt-welded frames being produced directly from coil, on the UMW-100 wire forming and welding machine, and then the completed frame being transferred into the UCW-100 where the frames support/brace wire is fed direct from coil, straightened, cut to length and welded into the butt welded frame.

Ultimat has a machine to suit everyone's requirement from the manufacture of point of purchase displays, to lampshades, supermarket shelving and automotive components.

Ultimate Automation Ltd – UK
Website: www.ultimat.com

Windak Group
Booth 1940

Windak provides intelligent material handling and packaging solutions with almost 20 years of experience in wire, cable and automotive industries and has offices in Sweden, USA, Australia and Estonia.

Windak packaging equipment includes automatic coilers and spoolers, payoffs and take-ups, rewind lines, palletising and pallet handling systems.

The company is a large supplier of automatic packaging equipment for the cable industry in North America. It has delivered its products to 30 countries worldwide.

Windak will introduce the SW6-14, a dual head spooler developed for fully automatic packaging of cable and wire products onto spools between 165mm (6.5") and 360mm (14") in overall diameter. It can be run both in line applications and offline applications. Full line integration can include an automatic palletiser, film unit, pallet conveyor, reel labeller, test equipment and meter marking on the cable.

▲ *The SW6-14 dual head spooler from Windak*

The SW6-14 loads and unloads the spools automatically. The cut ends are secured with stretch wrap. The SW6-14 uses the same reliable catch cut mechanism as the high-speed SW6 spoolers.

This proven design allows for a stop time of approximately one second. The short stop time increase the line output up to 30-40 per cent against traditional spoolers.

The SW6-14 offers maximum flexibility and high output.

Windak Group – Estonia
Website: www.windakgroup.com

Zumbach Electronic AG
Booth 1540

Zumbach will showcase its broad range of dimensional measurement and inspection systems for rod and bar mills, and wire drawing, wire insulating and cable jacketing processes.

Existing technology to be featured includes ODAC® laser scanning diameter gauges with new three-axis models for diameters down to 0.0024" (0.06mm); DVO 2 and DVW 1 oscillating devices for ODAC® gauges; MSD diameter and ovality gauges with novel linear sensor technology; ODEX® non-contact diameter and

eccentricity system; CAPAC® for in-line dielectric testing and FFT/SRL analysis; Wallmaster in-line ultrasonic wall thickness and concentricity systems; Rayex® for diameter, wall thickness and concentricity for CV power cable applications; WST and AUTAC preheating and conductor temperature sensors; and novel AC and DC spark tester solutions.

New developments to be introduced include the modular USYS IPCe line of processors and controllers; Steelmaster Rotation (SMR) for in-line hot and cold rod and bar mills; SIMAC® 63 for in-line surface faults and defects; KW Trio for lump and neckdown detection for fine dimension applications; and Profilemaster® PMM 30 for in-line profile measurement of non-round products for fine dimensions.

Zumbach Electronic AG – Switzerland
Website: www.zumbach.com

Come say hello and get your free copy

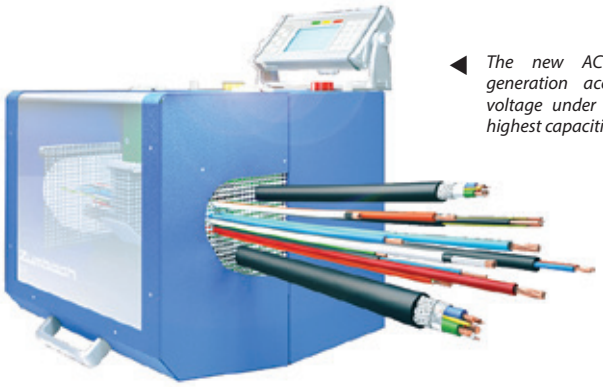
Staff from *EuroWire* and sister publications *Wire & Cable ASIA* and *wiredInUSA* will be at Interwire in Atlanta on Booth 132 during the three-day exposition.

▲ *The EuroWire booth at Interwire in 2013*

Please feel free to stop by the booth to discuss your editorial and advertising needs.

You will also be able to pick up a free copy of our publication for you to take away with you.

▲ *Sunrise over Atlanta*



◀ *The new AC and DC Sparktester generation accurately maintains test voltage under any condition including highest capacitive loads*

Long-term cable reliability design criteria

By David Mazzarese, Mike Kinard and Kariofilis (Phil) Konstadinidis, OFS, Norcross, Georgia, USA

Abstract

This paper investigates the current requirements for allowable axial load on optical cables. It is shown that the current criterion found in many optical cable standards – that the allowable long-term load should be less than 20 per cent of the proof test stress – may be optimistic in some cases. Instead, a new criterion – that the long-term load be standardised as 0.14 GPa (20 kpsi) – is recommended.

1 Introduction

In overhead cables, there is a set of conflicting design requirements that must be optimised. One objective is to minimise the strain on the optical fibres. A second objective is to minimise the cable diameter to reduce wind and ice loading. A third is to minimise the sag in each span.

Aramid yarn added to the cable minimises strain and sag, but the added material increases the diameter of the cable, which in turn increases the wind and ice loading.

One key variable in the optimisation of these parameters is the allowable strain on the optical fibre. A common rule of thumb, which has been used for years, is to allow a maximum of 20 per cent of the proof test stress as a long-term strain on the optical fibres in the cable.

This criterion appears in many of the current standards documents and has proven to be reasonable for the current generation of cables manufactured with 0.69 GPa (100 kpsi) proof-tested fibre.

The criterion, which was developed to provide 30-year mechanical reliability and is based on the excellent overall reliability performance of deployed overhead cables, appears sound.

With cables being developed closer to their design limits, it is worth exploring these limits and the rules of thumb that are used in cable design to ensure that, in the future, deployed optical cables will provide similar or better reliability performance than their predecessors.

2 Impact of modified cable designs on reliability

2.1 General observations

The traditional design boundaries for the manufacture of optical cables have changed in the past ten years. Some of these changes include:

1 Deployment of higher fibre count cables
2 Deployment of low macro bend loss fibres (G.657) and micro bend-resistant coatings
3 Cutting costs by minimising material in the cable and reducing design margins
4 Higher proof-tested fibres (1.38 GPa [200 kpsi])

These changes in cable design trends can impact the overall reliability of optical cables.

Each will be discussed separately to show that, when combined, they could have a dramatic impact on long-term reliability if not managed correctly.

2.2 Deployment of higher fibre counts

Many overhead cables fall into the drop cable category. These small cables tie the access network to an individual dwelling.

These are typically low fibre-count cables. Excluding these drop cables, however, there is a general trend to deployment of higher fibre-count cables. This is driven by the high cost of rights of way and installation.

In many higher fibre-count cables, half the weight of optical cables comes from the optical fibres. The higher weight requires higher tension on the cable to minimise cable sag. Aramid yarns and fibreglass composites (FRP) are used to carry the bulk of this load, with the residual load being taken up by the optical fibres.

Further, the more fibres in an optical cable, the larger its diameter becomes. Larger diameter cables have greater wind- and ice-loading, making the situation more difficult. As a result, higher fibre-count cables have the potential for more strain on the optical fibres.

2.3 Deployment of G.657 fibres and micro bend-resistant coatings

It is no surprise that we are seeing greater deployment of G.657 fibres in the optical network. Recent data from CRU has shown that more than six per cent of optical fibre being deployed today falls into this category. [Private communications Patrick Faye of CRU.] The G.657 fibres are being deployed because of their superior macro bend performance. One further benefit of G.657 fibres is the improved micro bend performance, making them less sensitive to cabling conditions.

Another key development in optical fibres is the deployment of micro bend-resistant coatings[1]. This new generation of optical coatings show two to four times improvement in loss due to micro bending, as compared to those deployed five to ten years ago. Together, these two improvements to the optical fibre have a huge impact in observed cable attenuation, even under aggressive conditions. The superior fibre and coating properties can 'mask' the impact of a poor cable design or installation.

When optical cables using traditional G.652 fibres are deployed with high residual strain on the fibre, higher attenuation is often observed. By default, the cable manufacturer is required to control the strain on the fibre to ensure the cable can meet the qualification requirements.

When G.657 fibres with micro bend-resistant coatings are used for the same cable design, then the measured attenuation will improve and the same cable design may pass this optical requirement. The net result of using G.657 fibres is that the cable will pass this qualification test. However, after deployment, higher fibre strain could pose a long-term reliability risk.

In short, if the cable is designed properly, G.657 fibres and micro bend coatings are a huge benefit to the optical performance of the deployed cable. But if the cable is designed poorly, the improved optical fibres can mask the strain issue from the end user, which could pose a long-term mechanical reliability risk.

2.4 *Cutting costs by minimising material in the cable and reducing design margins*

Many overhead cables are designed with zero per cent strain on the optical fibre. With increased cost pressure, design engineers are challenged to reduce material costs. As strength elements around the optical fibre are removed, the optical fibre starts to take some of the axial strain traditionally taken by the strength members in the cable. The design engineer can look to the various cabling standards and see that the maximum allowable long-term strain is 20 per cent of the proof test level.

In effect, for these cables, the industry is progressing from a common design practice where no strain was carried by the optical fibres after installation to one where a strain of up to 20 per cent of the proof test level is allowed. The long history of reliable cable performance at this strain level makes it seem a reasonable decision.

2.5 *Higher proof-tested fibres 1.38 GPa (200 kpsi) are now available*

In the previous section it was shown that material costs can be reduced by allowing strain on optical fibre. For traditional optical fibre that is proof tested at 0.69 GPa (100 kpsi), the maximum allowable strain on the fibre at the 20 per cent limit is 0.14 GPa. A design engineer could choose to use higher proof-tested fibre, such as 1.38 GPa (200 kpsi) fibre, at the 20 per cent limit, and the allowable strain on the fibre after installation would increase to 0.28 GPa. This would allow further material reductions in the optical cable by allowing greater cable strain to impart twice the strain on the optical fibre. The net result could be a lower cost optical cable.

2.6 *Combined impact of modified optical cable design criteria*

Taken together, all these trends can result in a scenario that may not be optimal to the service provider. The strain on the fibres allowed by the usual criteria is higher, but the strain is not impacting the attenuation because of the use of G.657 fibres. The net result could be an optical cable that is deployed with up to 0.28 GPa long-term strain on the optical fibres. Meanwhile, there remains an expectation that the fibres will survive 30+ years without breaking. This situation tests the limits of reliability theory and should be looked at more closely before it is implemented.

3 Origin of the current allowable strain criterion

The current rule of thumb used for cable design is a maximum allowable strain of 20 per cent of the proof test level. This criterion comes from the reliability work done in the 1990s[2,3]. In those studies, the authors show that long-term performance can be related to the proof test stress, but this assumes a certain proof test failure probability. They, then, look at various stress corrosion parameters and at 50 kpsi and 100 kpsi proof-tested fibre to show that their approximation is a reasonable, conservative method to ensure long-term reliability. This work was an important step forward for the fibre industry and supported the move for proof-testing fibre at the current levels.

Unfortunately, there is a key assumption about the flaw distribution of the optical fibre – specifically the chance of a fibre breaking when proof-tested. This probability is not constant and can vary for fibres manufactured under different conditions or using different raw materials.

Figure 1 shows a failure probability curve for silica fibre generated by one of the authors' facilities using 10m gauge length to illustrate the range of flaws found in optical fibres.

The figure shows two regions: region I (intrinsic strength) and region II (extrinsic strength). The curve illustrates the main regions that need to be characterised to predict long-term fibre reliability. Region I is the high strength intrinsic region.

The fibre investigated showed the inherent strength of the glass at ~4.6 GPa, which is significantly above the limit of 3.1 GPa recommended in Telcordia GR-20. Short gauge-length strength testing in this region can be used to determine the n value, which is greater than 20 for the fibre investigated. The intrinsic strength and n values are typically specified by end users to ensure long-term reliability of the cable.

Unfortunately, the extrinsic portion, shown as region II, plays an important role in characterising the long-term reliability of an optical cable. This region contains flaws closer to the proof-test level that are spaced at a frequency which may be several kilometres apart.

Over time, these can become fibre breaks if the cable is left in tension. Understanding this region requires information that can only be gathered by measuring many kilometres of fibre. Higher proof test levels will eliminate some of the larger flaws in the fibre.

However, the exact impact to optical fibre reliability in a deployed cable is hard to determine without more information on the overall flaw distribution in the fibre.

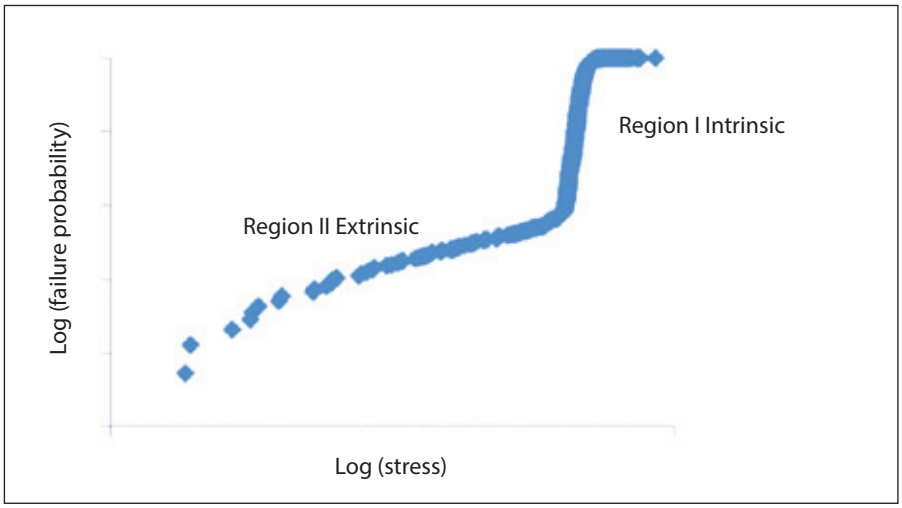
One way to illustrate this would be to proof-test an optical cable at a level just shy of the intrinsic strength of the fibre, or about 3.8 GPa (550 kpsi). If a 1,000m fibre sample generated from that experiment were left at a constant stress of 110 kpsi, the fibre would likely break in less than a day, or well in advance of the 40-year expected life time. This example is an extreme case, but highlights the importance of understanding the complex equations that govern reliability.

4 Guidance from IEC technical report on reliability

One of the currently accepted reliability models has been published by the IEC[4]. One of the equations found in that report is used to predict fibre lifetime – the lifetime equation for optical fibre after proof testing. This can be shown as the following expression:

$$t_f = t_p \left(\frac{\sigma_p}{\sigma_a}\right)^n \left\{\left[1 - \frac{\ln(1-F)}{N_p L}\right]^{\frac{n+1}{n_d}} - 1\right\} \quad (1)$$

Figure 1: *Failure probability for over 100km of fibre tested at 10m gauge lengths*



Where:
t_f is time to failure (lifetime)
t_p is proof test time
σ_p is proof test stress
σ_a is applied stress
F is failure probability
N_p is the proof test break rate
L is the length under tension
m_d is the Weibull m parameter from dynamic fatigue
n is the stress corrosion parameter

The expression is complex, but we can make a few observations.

Figure 1 shows that the greater the applied stress, the greater the failure probability. Thus, the failure probability term in the equation, F, is directly related to the applied stress term, σ_a. The traditional rule of thumb that has been used to derive 20 per cent of the proof stress as a long-term maximum allowable load assumes these two variables are independent, which is not consistent with *Figure 1*. Hundreds of kilometres of fibre must be tested to fully understand the relationship between the failure rate and the applied stress.

Table 1 gives the results comparing three scenarios. The first is 0.69 GPa proof-tested fibre with a long-term load of 20 per cent of the proof-test load. Generating the data we used following values substituted into *Equation 1*:
n_d =20
m_d = 2.5
t_p = 0.05 seconds
N_p = 1 break every 250km

The table shows that an optical fibre meeting the conservative criteria above would exhibit reasonable mechanical performance for the 0.69 GPa at 20 per cent of the proof test level. The second case shows that the same fibre was maintained at 40 per cent of the proof test level. In this case, the 1ppm failure rate would be reached in less than a year. The third case is 1.38 GPa proof-tested fibre with a long-term load of 20 per cent of the proof test level.

For this set of conditions, 1ppm failure probability is met in less than six years. Note that data in *Table 1* is representative of fibre in a non-aggressive environment. Terms such as zero stress ageing, macro bends, abrasion and other factors can greatly reduce the fibre lifetime.

5 Discussion

Fibre lifetime is the sum of the intrinsic and extrinsic failure probability. This paper focuses on long lengths of fibre under axial load in a regime where failure is dominated by extrinsic failures. The results shown in *Table 1* highlight the error in the common requirement for optical cables, which holds that the long-term load on the optical fibres is simply 20 per cent of the proof-test level. If the fibre break rate was the same for the 0.69 GPa and 1.38 GPa proof tested fibre, then both fibres would have the same 1ppm life-time. We know this is not the case from the data of *Figure 1*. When this knowledge is included in the analysis, the results change dramatically.

Failure probability of 1km of optical fibre	0.069 GPa proof tested fibre 20 per cent long-term load	0.069 GPa proof tested fibre 40 per cent long-term load	1.38 GPa proof tested fibre 20 per cent long-term load
1.0ppm per km	1,600 years	0.0 years	530 years*
1.0ppm per 100km	16 years	0.0 years	5.3 years*

** The failure rate varies greatly, with the change in proof-test going from 0.69 GPa to 1.38 GPa*

▲ **Table 1**: *Comparison of failure probabilities (1ppm lifetime)*

Typically, long-term reliability expectation for optical cables is that the fibre failure probability should be less than 1ppm in 30 years. Using this criterion, the example given in *Table 1* can be simplified as follows:

- 0.69 GPa fibre at 20 per cent long-term load will provide reliable performance
- 0.69 GPa fibre at 40 per cent long-term load will not provide reliable performance
- 1.38 GPa fibre at 20 per cent long-term load will not provide reliable performance

Though it is apparent that proof-testing at higher levels greatly improves the performance of the cables, the value commonly used in cabling standards – 20 per cent of the proof test level – can lead to false expectations about the long-term reliability of the optical cables.

6 Recommendations

The information described in this document indicates that, though 20 per cent of the proof-test load for a long-term load on optical fibre may be a reasonable criterion for optical fibre proof-tested at 0.69 GPa or less, it may produce optimistic estimations for optical fibre proof-tested at higher levels.

Currently, most major optical fibre standards, including those in ITU-T, IEC, and TIA, require the fibre to be proof-tested at 0.69 GPa. Cable standards in IEC, ICEA and IEEE should align with this criterion. It is thus recommended that the documents be modified to simply require maximum long-term load of 0.14 GPa (20 kpsi) on the cabled optical fibre after deployment, regardless of the proof-test level. A note could be added to the requirement stating that when optical fibre with proof-test levels higher than 0.69 GPa is deployed, higher strains on the optical fibre will affect reliability and should be agreed to by the cable supplier and end user, and that more precise fibre reliability models should be considered.

7 Conclusions

This paper has shown that modern cable designs are pushing the design limits for allowable long-term strain in optical cables. Under these new boundary conditions, the old rule of thumb allowing up to 20 per cent of the proof-test level as a long-term strain may no longer be appropriate. A new recommendation requiring the long-term load be limited to 0.14 GPa is proposed as an alternative criterion. This new criterion should be included in upcoming revisions of fibre cable standards. Particularly critical designs are high-strain cable types such as drop cable, and overhead cables including OPGW and ADSS cables. ■

8 Acknowledgments

Special thanks to Peter Hasløv (OFS), Hiroshi Nakamura (Furukawa) and Peter Pondillo (Corning) for their helpful discussions on fibre lifetime.

9 References

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Erwerb von Fenn

Quality Products Inc, ein Hersteller und Vertreiber von Luftfahrt-Bodengeräten, Werkzeugmaschinen für hydraulische Pressen, Abkantpressen, hydraulische Pressen und Scheren, hat den Erwerb von Fenn LLC bekanntgegeben.

Paul Uccello, Präsident von Fenn sagte: "Das ist ein großartiges Ergebnis für unsere Kunden und unsere Unternehmen, und wir freuen uns auf unsere gemeinsame Zukunft. Mit weiteren Geschäftsfeldern in der Investitionsgüterherstellung, glauben wir, dass QPI die richtige Kombination von unternehmerischer Erfahrung und Ressourcen besitzt, damit Fenn weiterhin hochwertige Maschinen entwickelt und herstellt."

Fenn wird weiter maßgeschneidete Maschinen entsprechend der Kundenspezifikationen herstellen, seien es Walzwerke, Anlagen für die Abflachung und Formung von Draht, Ziehbänke oder Türkenkopf-Anwendungen. Darüber hinaus wird Fenn auch weiterhin stolz seine industriellen Produktlinien einschließlich Torin-Wickelmaschinen, Hämmern und Trennmaschinen Schlag-Typ, anbieten.

Mit allen seinen Produktlinien, wird sich Fenn auch für eine erneute Fokussierung auf den Maschinenkundendienst und die Ersatzteilbetreuung engagieren.

QPI ist in zwei Geschäftsbereichen tätig: Werkzeugmaschinen und Luftfahrt-Bodengeräte. Der Geschäftsbereich der Werkzeugmaschinen von QPI besteht aus Multi-Press, Pacific Press und Fenn. Aufgrund seiner jahrzehntelangen Erfahrung, die bis in die zwanziger Jahre zurückreichen, ist Multi-Press ein kompetenter Lieferant von hochtechnologischen hydraulisch und elektrisch gesteuerten Pressen, einschließlich einer kompletten Linie von Tisch- und Standmodellen sowie Vier-Säulen-Konfigurationen.

Pacific Press bietet hydraulische Abkantpressen, Scheren und Pressen in Nordamerika an und stellt eine große Auswahl an Ausrüstungen für die Metallumformung her. In der Kategorie Luftfahrt-Bodengeräte, ist Columbus Jack seit Jahrzehnten in der Luftfahrtindustrie tätig und beliefert die Klientel des kommerziellen, militärischen und zivilen Luftverkehrs mit Bodengeräten.

Quality Products Inc – USA **Website**: www.multipress.com

Innovative OTA-Technologie für hochwertige Drähte

MEDIZINISCHE Technologie, Energietechnik oder Mobilität – hochwertiger Draht spielt in allen fortschrittlichen Industrien eine wichtige Rolle. Die OTA-Technologie, die vom Systemlieferant Koch entwickelt wurde, erreicht die geforderte Spitzenqualität.

Das Ziehsystem ermöglicht ein nicht umgeleitetes, gradliniges Ziehen unter einer gleichbleibenden und reproduzierbaren Gegenspannung. Vom Abwickler bis zum Aufwickler – dank des linearen Drahtziehens können besonders genaue Drahtabmessungen und hochwertige Oberflächengüte erzielt werden.

Abhängig von der Drahtqualität und -abmessung sowie von den Anforderungen des Endprodukts werden unterschiedliche Maschinen mit der OTA-Technologie von Koch eingesetzt.

Für die Herstellung von Spannstahl- und Federstahldraht mit Ziehscheiben von bis zu 1200mm Durchmesser, setzt die KGT 47 OTA Maßstäbe.

Die Maschinengröße ist kompakt und trotz einer Zugkraft von bis zu 90.000N, ist diese Maschine sehr geräuscharm. Zu der OTA-Familie gehört auch die KGT 25, die sich besonders für niedrig- und hochgekohlte Stahldrähte sowie

▲ *Nach Kundenvorgaben: als Systemlieferant entwirft, fertigt und installiert Koch komplette Maschinenlinien*

Edelstahldrähte eignet. Dünne Drähte und Seile, deren Durchmesser kleiner als 0,8mm ist, produziert die KGT 12.

Hier gewährleistet eine dynamisch geregelte Prozessoptimierung die geforderte Genauigkeit. Die OTA-Technologie bringt Koch in eine führende Position am Weltmarkt, denn damit wird eine kostengünstige Produktion mit der höchsten Genauigkeit, Reproduzierbarkeit und bester Produktqualität geboten.

Als Systemlieferant entwirft, fertigt und installiert Koch komplette Maschinenlinien nach Kundenvorgaben. Das Unternehmen, das vor über 90 Jahren gegründet wurde, hat schon immer werksintern Ziehmaschinen hergestellt. Wickler und Spuler, die ebenfalls werksintern gefertigt werden, gewährleisten, dass der Draht effizient und schonend, auch bei hohen Bundgewichten, aufgenommen wird.

Von Partnerunternehmen gefertigte Peripheriemodule vervollständigen die Maschinenlinien, etwa um Funktionen zu erfüllen, wie z. B. zum Reinigen der Drahtoberflächen oder zum Veredeln mit Kupfer, Aluminium oder Zink.

Kunden in über 60 Ländern schätzen das technologische Know-How von Koch in den Sektoren Engineering, Antriebstechnik, Programmierung und Steuerung.

Ernst Koch GmbH & Co KG – Deutschland
Website: www.koch-ihmert.de

Höhere Genauigkeit mit der neuen Einführung von AccuScan

NDC Technologies hat den mit Spannung erwarteten Beta LaserMike AccuScan 6012 vierachsigen Durchmesser- und Ovalitätsmessgerät auf dem Markt gebracht. Auf Basis der bewährten und weit verbreiteten AccuScan-Serien entwickelt, behauptet das neue AccuScan 6012 das erste industrielle vierachsige Messgerät zu sein, das bis 12mm große Produkte misst.

Dank dieser Weitentwicklung können die Hersteller von Kommunikationskabeln den Durchmesser sowie die Ovalität der Produkte, im Vergleich zu den zwei- oder dreiachsigen Messgeräten, mit höherer Genauigkeit messen und somit eine erhöhte Qualitätssicherung und effektive Kosteneinsparungen sichern.

Jahrelang haben die Hersteller von Hochleistungs-Kommunikationskabeln auf zwei- und dreiachsige Durchmesser- und Ovalitätsmessgeräte für diese On- und Offline-Messanwendungen vertraut. Die höheren Produktionsgeschwindigkeiten und die unkontrollierbare Drehung und Vibration der Produkte stellen weiterhin Herausforderungen beim Messen dar.

Die Notwendigkeit den Durchmesser und die Ovalität zylindrischer runder Produkte genau zu messen, um sicherzustellen, dass sie den strengen Entwurfs- und Qualitätsspezifikationen gerecht werden, ist für die Kabelhersteller von höchster Bedeutung. Jeder Fehler im Durchmesser oder in der Rundheit des Leiters oder der Isolierung koaxialer und paarverseilter LAN-Produkte hat einen direkten Einfluss

▲ *Das Messgerät AccuScan 6012 von Beta LaserMike*

auf die Leistungsmerkmale des Kabels, das somit für die vorgesehenen Anwendungen nicht einsetzbar ist. Dieses unbrauchbare Produkt wird daher verschrottet, mit steigenden Produktionskosten.

Das neue Beta LaserMike AccuScan 6012 vierachsige Messgerät löst dieses Problem durch eine umfassendere Messwerterfassung gegenüber den zwei- oder dreiachsigen Messgeräten und durch eine extrem schnelle Scanrate. Dank dieser Kombination von Vorteilen kann nun eine extrem genaue Messung des durchschnittlichen Außendurchmessers sowie der Ovalität bei höheren Liniengeschwindigkeiten und für Offline-Anwendungen erzielt werden.

Die Highlights umfassen:

- Extrem genaue Messung des durchschnittlichen Durchmessers – AccuScan 6012 führt extreme schnelle Messungen bei 2.400 Scan pro Sekunde pro Achse durch (insgesamt 9.600 Messungen pro Sekunde) und weist eine Einzel-Scan-Wiederholbarkeit von einem Mikron auf. Das bedeutet, dass mit jedem einzelnen Scan eine effektive und genauere Messung des durchschnittlichen Durchmessers erzielt wird.
- Erhebliche Verbesserung der Ovalitätsgenauigkeit – AccuScan 6012 bietet eine Verbesserung um 42 Prozent bei der Erfassung der effektiven Ovalität im Vergleich zu dreiachsigen Messgeräten und erbringt eine 100-prozentige Ovalitätsgenauigkeit, wenn das Produkt an den Messachsen ausgerichtet ist.
- Höchste Präzision bei der Fehlererkennung – AccuScan 6012 bietet die höchste Präzision bei der Fehlererkennung mit einer Verbesserung von 25 Prozent im Vergleich zu dreiachsigen Messgeräten. Die extreme schnelle Scanrate und die höhere Genauigkeit zusammen mit der Hochgeschwindigkeits-Toleranzprüfungsoption unterstützt die frühzeitige, genaue und zuverlässige Erkennung von Produktfehlern wie z. B. Knoten und Einschnürungen. Somit können die Hersteller die Produktqualität besser kontrollieren, Ausschuss reduzieren und Einsparungen bei der Produktion realisieren.
- Hohe Genauigkeit bei der Offline-Teilen-/Probeinspektion – mit Einsatz des PC-basierten AccuNet-Anzeigesystems von Beta LaserMike kann der AccuScan 6012 unkompliziert und rasch eingerichtet werden, wie ein Offline-Teilemesssystem, mit dem Stichproben geprüft und kritische Produktdaten nachverfolgt, verwaltet und analysiert werden können. Dadurch entfällt, zwei zweiachsige Messgeräte einzurichten, um vierachsige Messungen durchzuführen.
- Das AccuScan 6012 Messgerät bietet flexible Kommunikationsoptionen, was einen leichten Anschluss an PC, SPS oder Verfahren mit führenden Protokollen ermöglicht. Dieses Messgerät kann auch mit einem optionalen superhellen Display sowie einer Benutzerschnittstelle ausgestattet werden, zur leichten Konfiguration und Anzeige von Messdaten. Der Einbau des Display vom AccuScan 6012 ist oben oder seitlich möglich.

NDC Technologies – USA
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Neue Formdorne von Applied Plastics

Eine Reihe von teflonbeschichteten Formdornen für das Schmelzschweißen und Spitzenpolieren von Kathetern, welche die ID-Güte und Fertigungsgeschwindigkeit optimieren, sind von Applied Plastics erhältlich.

PTFE Natural® Formdorne von Applied Plastics verfügen über eine glatte Oberfläche mit einem dynamischen Reibungskoeffizienten von 0,5 und verhinderten dadurch ein Anhaften oder Schrumpfen des Rohrs, so dass die Katheerentfernung erleichtert werde. Mit über 25% Dehnung – ohne Gefahr von Abblättern oder Ausfallen – sind diese Extrusionsformdorne chemisch inert und können bei bis zu 315°C (600°F) dauerhaft eingesetzt werden.

Die Dorne werden aus Edelstahl oder Nitinol angeboten und sind in vorgeschnitten in Durchmessern von 0,127 bis 25,4mm mit ±0,003 bis ±0,013mm Toleranz, je nach Größe, lieferbar.

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Kriterien für die Langzeitzuverlässigkeit von Kabelaufbauten

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Übersicht

In diesem Artikel werden die aktuellen Anforderungen für die zulässige Achslast an Lichtleitkabeln untersucht. Bewiesen wird, dass das in vielen Normen von Lichtleitkabeln angegebene aktuelle Kriterium – bzw. dass die zulässige Langzeitlast unter 20 Prozent der geprüften Spannung *(Proof-Test)* sein sollte – in einigen Fällen optimistisch zu betrachten wäre. Empfohlen wird dagegen ein neues Kriterium, bzw. dass die Langzeitlast bei 0,14GPa (20kpsi) standardisiert wird.

1 Einleitung

Bei Freileitungskabeln gibt es eine Reihe von widersprüchlichen Anforderungen beim Aufbau, die optimiert werden müssen. Eine Zielsetzung besteht darin, die Verformung in den Lichtwellenleitern zu minimieren.

Eine zweite Zielsetzung liegt in der Minimierung des Kabeldurchmessers, um die Wind- und Eislast zu reduzieren. Eine dritte besteht darin, den Durchhang je Mastabstand zu minimieren. Dem Kabel hinzugefügtes Aramid-Garn minimiert die Verformung und den Durchhang, jedoch erhöht sich durch das hinzugefügte Material der Kabeldurchmesser, das wiederum die Wind- und Eislast steigert.

Eine Schlüsselvariable bei der Optimierung dieser Parameter ist die zulässige Verformung im Lichtwellenleiter. Eine verbreitete Faustregel, die jahrelang eingesetzt wurde, liegt darin, höchstens 20 Prozent der geprüften Spannung (Proof-Test) als Langzeitverformung in den Lichtwellenleitern im Kabel zuzulassen.

Dieses Kriterium erscheint in vielen der aktuellen Normungsunterlagen und hat sich als angemessen erwiesen für die aktuelle Generation von Kabeln, die mit einer bei 0,69GPa (100kpsi) geprüften Faser hergestellt werden.

Dieses Kriterium, das entwickelt wurde um eine 30-jährige mechanische Zuverlässigkeit zu bieten und auf der ausgezeichneten allgemeinen Zuverlässigkeitsleistung der verlegten Freileitungskabel basiert, erweist sich als aussagekräftig.

Bei Kabeln, die fast bei deren Grenzen im Aufbau entwickelt wurden, ist es beachtenswert diese Grenzen sowie die Faustregeln, die im Kabelaufbau eingesetzt werden, zu erforschen, um somit sicherzustellen, dass zukünftig die verlegten Lichtleitkabel eine ähnliche oder bessere Zuverlässigkeit im Vergleich zu deren Vorgängern bieten.

2 Wirkung der geänderten Kabelaufbauten auf die Zuverlässigkeit

2.1 Allgemeine Beobachtungen

Die Grenzen traditioneller Aufbauten für die Herstellung von Lichtleitkabeln haben sich in den letzten zehn Jahren verändert. Einige dieser Änderungen umfassen:

1 Verlegung von Kabeln mit höheren Faserzahlen
2 Verlegung von Fasern mit niedrigem Makrobiegeverlust (G.657) und Mikrobiegung unempfindliche Beschichtungen
3 Sinken der Kosten durch eine Minimierung des Kabel-Materials und Reduzierung der Grenzen beim Aufbau
4 Mit höheren Werten geprüfte Fasern (1,38GPa [200kpsi])

Diese Änderungen bei den Kabelaufbautrends können einen Einfluss auf die gesamte Zuverlässigkeit der Lichtleitkabel haben.

Jede Änderung wird gesondert betrachtet. Somit wird gezeigt, dass im Falle einer Kombination dieser Änderungen, ein erheblicher Einfluss auf die Langzeitzuverlässigkeit entstehen könnte, wenn diese nicht richtig durchgeführt werden.

2.2 Verlegung von Kabeln mit höheren Faserzahlen

Viele Freileitungskabel fallen unter die Drop-Kabel-Kategorie. Diese kleinen Kabel binden das Zugangsnetz an den individuellen Wohnstätten. In der Regel handelt es sich dabei um Kabel mit niedriger Faserzahl.

Mit Ausnahme dieser Drop-Kabel, besteht dennoch eine allgemeine Tendenz der Verlegung von Kabeln mit höherer Faserzahl. Das ergibt sich durch die hohen Kosten der Wegerechte und bei der Installation.

Bei zahlreichen Kabeln mit höherer Faserzahl, kommt die Hälfte des Gewichts des Lichtleitkabels aus den Lichtwellenleitern. Ein höheres Gewicht fordert eine höhere Spannung im Kabel, um den Kabeldurchhang zu minimieren. Aramid-Garne und Glasfaserverbundstoffe (FRP - Faserverstärktes Polymer) werden eingesetzt, um den Großteil dieser Last zu tragen, während die restliche Last von den Lichtwellenleitern aufgenommen wird.

Darüber hinaus, je mehr Fasern sich in einem Lichtleitkabel befinden, desto größer wird dessen Durchmesser. Kabel mit größerem Durchmesser weisen eine höhere Wind- und Eislast auf, was diese Lage noch weiter erschwert. Infolgedessen haben Kabel mit höherer Faserzahl das Potential für eine höhere Verformung der Lichtwellenleiter.

2.3 Verlegung von G.657-Fasern und Mikrobiegung unempfindliche Beschichtungen

Es ist keine Überraschung, dass zahlreicher Verlegungen von G.657-Faser im optischen Netzwerk gesehen werden. Die aktuelle Daten von CRU zeigten, dass über sechs Prozent der heute verlegten Lichtwellenleiter in diese Kategorie fällt.

[Private communications Patrick Faye of CRU.] G.657-Faser werden wegen deren überlegenen Makrobiegeleistung verlegt. Ein weiterer Vorteil der G.657-Faser ist die verbesserte Leistung der Mikrobiegung, dank welcher die Fasern den Verkabelungsbedingungen gegenüber weniger empfindlich sind.

Eine andere Schlüsselentwicklung im Bereich Lichtwellenleiter ist die Verlegung von Mikrobiegung unempfindliche Beschichtungen[1]. Diese neue Generation der Beschichtungen des Lichtwellenleiters zeigt eine zwei- bis vierfache Verlust-Minimierung dank der Mikrobiegung, im Vergleich zu denen, die fünf bis zehn Jahren zuvor verlegt wurden.

Diese zwei Verbesserungen gegenüber dem Lichtwellenleiter haben gemeinsam einen großen Einfluss auf die beobachtete Kabeldämpfung, auch unter aggressiven Bedingungen. Die überlegenen Faser- und Beschichtungseigenschaften können den Einfluss eines schwachen Kabelaufbaus bzw. Verlegung „verbergen".

Wenn Lichtleitkabel mit Einsatz traditioneller G.652-Faser bei hoher Restverformung an der Faser verlegt werden, kann oft eine höhere Dämpfung beobachtet werden. Daher wird der Kabelhersteller aufgefordert, die Verformung in der Faser zu prüfen, um zuzusichern, dass das Kabel die Qualifizierungsanforderungen erfüllen kann.

Werden G.657-Fasern mit Mikrobiegung-unempfindlichen Beschichtungen für den gleichen Kabelaufbau eingesetzt, so wird sich die gemessene Dämpfung verbessern und derselbe Kabelaufbau könnte diese optischen Anforderungen bestehen. Das Endresultat nach dem Einsatz von G.657-Fasern besteht darin, dass das Kabel diese Qualifizierungsprüfung bestehen wird. Dennoch könnte nach der Verlegung die höhere Faserverformung ein Risiko für die Langzeitzuverlässigkeit darstellen.

Kurzgefasst, bei einem passenden Kabelaufbau sind G.657-Fasern und Mikrobiegungsbeschichtungen ein beträchtlicher Vorteil für die optischen Leistungen des verlegten Kabels. Bei einem nicht passenden Kabelaufbau können dagegen die verbesserten Lichtwellenleiter die Aspekte der Verformung dem Endbenutzer verbergen, was wiederum ein Risiko für die mechanische Langzeitzuverlässigkeit darstellen könnte.

2.4 *Kostensenkung durch Material-Minimierung im Kabel und Reduzierung der Aufbaugrenzen*

Viele Freileitungskabel werden mit Null-Prozent-Verformung im Lichtwellenleiter entworfen. Durch einen erhöhten Kostendruck werden Konstrukteure gefordert die Materialkosten zu senken.

Wenn die Verstärkungselemente um den Lichtwellenleiter beseitigt werden, beginnt der Lichtwellenleiter ein Teil der axialen Verformung aufzunehmen, die traditionell von den Verstärkungselementen des Kabels aufgenommen wird. Der Konstrukteur kann die verschiedenen Verkabelungsnormen berücksichtigen und sehen, dass die höchste zulässige Langzeitverformung 20 Prozent des geprüften Niveaus entspricht.

Faktisch ist hier die Kabelindustrie von einer weit verbreiteten Aufbaupraxis, in der vom Lichtwellenleiter nach der Installation keine Verformung getragen wurde, auf eine Aufbaupraxis übergegangen, in der eine Verformung bis zu 20 Prozent des geprüften Niveaus zugelassen wird. Die lange Geschichte der zuverlässigen Kabelleistung mit diesem Verformungsniveau scheint sich als richtige Entscheidung zu bestätigen.

2.5 *Mit höheren Werten als 1,38GPa (200kpsi) geprüfte Faser sind nun erhältlich*

Im vorherigen Abschnitt wurde gezeigt, dass die Materialkosten reduziert werden können, indem die Verformung im Lichtwellenleiter zugelassen wird. Für traditionelle Lichtwellenleiter, die bei 0,69GPa (100kpsi) geprüft werden, beträgt die höchste zugelassene Verformung in der Faser bei der 20-Prozentgrenze 0,14GPa. Ein Konstrukteur könnte den Einsatz einer Faser auswählen, die mit höheren Werten getestet wurde, wie z. B. eine bei 1,38GPa (200kpsi) geprüfte Faser, bei der 20-Prozentgrenze, und die zugelassene Verformung in der Faser nach der Installation würde sich hier auf 0,28GPa erhöhen.

Das würde weitere Materialreduzierungen im Lichtleitkabel ermöglichen, indem eine höhere Kabelverformung zugelassen werden würde, bis ein doppelter Verformungswert im Lichtwellenleiter erzielt wird. Das Endresultat könnte ein Lichtleitkabel mit niedrigeren Kosten sein.

2.6 *Kombinierter Einfluss der geänderten Aufbaukriterien bei Lichtleitkabel*

Zusammengefasst kann sich aus all diesen Trends ein Szenario ergeben, das für den Service-Provider nicht optimal sein könnte. Die Verformung in den Fasern, die mit den üblichen Kriterien zugelassen wird, ist höher, jedoch hat diese Verformung keinen Einfluss auf die Dämpfung dank dem Einsatz der G.657-Faser. Das Endresultat könnte ein Lichtleitkabel sein, das mit einer bis zu 0,28GPa Langzeitverformung am Lichtwellenleiter verlegt wird.

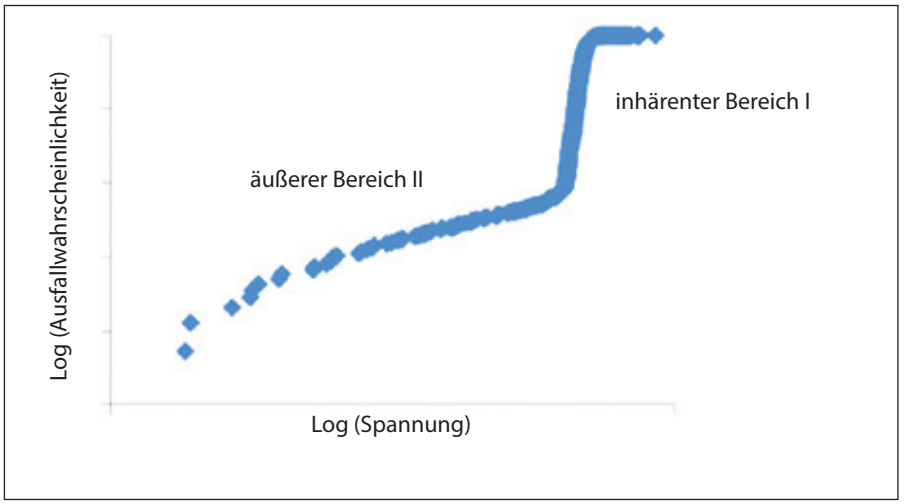
Inzwischen bleibt die Erwartung, dass Fasern über 30 Jahre lang ohne zu brechen fortbestehen werden. Diese Situation testet die Grenzen der Zuverlässigkeitstheorie und sollte näher betrachtet werden, bevor sie umgesetzt wird.

3 Ursprung des aktuellen zugelassenen Verform-ungskriteriums

Die derzeitige Faustregel die beim Kabelaufbau berücksichtigt wird, ist eine maximale zugelassene Verformung von 20 Prozent des geprüften Niveaus. Dieses Kriterium stammt aus der Studie über die Zuverlässigkeit, die in den 90iger Jahre durchgeführt wurde[2,3].

In dieser Studie zeigen die Autoren, dass die Langzeitleistungen mit der geprüften

▼ **Abbildung 1**: *Ausfallwahrscheinlichkeit für über 100km Faser, bei 10m Messlängen geprüft*



Spannung (proof test) in Verbindungen stehen können, jedoch wird somit eine bestimmte Ausfallwahrscheinlichkeit in derselben Prüfung angenommen.

Dann wurden verschiedene Spannungskorrosionsparameter berücksichtigt sowie bei 50kpsi und 100kpsi geprüfte Faser, um zu zeigen, dass deren Approximation eine angemessene, zurückhaltende Methode war, um die Langzeitzuverlässigkeit zu sichern.

Dieser Artikel war ein wichtiger Schritt nach vorne für die Faserindustrie und unterstützte die Tendenz die Faser einzusetzen, die entsprechend den aktuellen Niveaus geprüft wird.

Leider besteht eine Grundsatzannahme zu der Fehlerverteilung des Lichtwellenleiters, d. h. die Möglichkeit eines Faserbruchs während des Proof-Tests. Diese Wahrscheinlichkeit ist nicht konstant und kann variieren für Fasern, die unter verschiedenen Bedienungen oder mit Einsatz unterschiedlicher Rohstoffe hergestellt werden. *Abbildung 1* zeigt eine Kurve der Ausfallwahrscheinlichkeit für Silizium-Fasern, die von einer Einrichtung des Autors hervorgerufen wurde, mit Einsatz einer 10m Messlänge, um die Auswahl an festgestellten Fehlern in den Lichtwellenleiter darzustellen.

Die Abbildung zeigt zwei Bereiche: Bereich I (inhärente Festigkeit) und Bereich II (äußere Festigkeit). Die Kurve verdeutlicht die Hauptbereiche, die gekennzeichnet werden müssen, um die Langzeitzuverlässigkeit der Faser vorauszusagen.

Bereich I ist der Bereich der hohen inhärenten Festigkeit. Die erforschte Faser zeigte die inhärente Festigkeit des Glases bei ~4,6GPa, die wesentlich über die in Telcordia GR-20 empfohlene Grenze von 3,1GPa liegt.

Die Festigkeitsprüfung bei kurzer Messlänge in diesem Bereich kann eingesetzt werden, um den n-Wert festzulegen, der größer als 20 für die erforschte Faser ist.

Die inhärente Festigkeit und die n-Werte werden in der Regel von den Endbenutzern spezifiziert, um die Langzeitzuverlässigkeit des Kabels zu sichern.

Leider spielt der äußere Teil, der als Bereich II dargestellt wird, eine wichtige Rolle bei der Kennzeichnung der Langzeitzuverlässigkeit eines Lichtleitkabels. Dieser Bereich enthält die dem Proof-Test-Niveau näherstehende Fehler und zwar im Abstand, der mehrere Kilometer entfernt sein könnte.

Ausfallwahrscheinlichkeit von 1km Lichtwellenleiter	Bei 0,69GPa geprüfte Faser bei 20 Prozent Langzeitlast	Bei 0,69GPa geprüfte Faser bei 40 Prozent Langzeitlast	Bei 1,38GPa geprüfte Faser bei 20 Prozent Langzeitlast
1,0ppm pro km	1,600 Jahre	0.0 Jahre	530 Jahre*
1,0ppm pro 100km	16 Jahre	0.0 Jahre	5.3 Jahre*

* Die Ausfallrate variiert stark mit der Änderung der geprüften Werte (Proof-Test), indem man von 0,69GPa auf 1,38GPa übergeht

▲ **Tabelle 1**: *Vergleich zwischen den Ausfallwahrscheinlichkeiten (1ppm Lebensdauer)*

Mit der Zeit kann dies zu Faserbrüchen führen, wenn das Kabel gespannt bleibt. Zum Verständnis dieses Bereichs werden Informationen gefordert, die nur durch das Messen vieler Kilometer Fasern gesammelt werden können. Höhere Niveaus des Proof-Tests werden einige der größeren Fehler in der Faser beseitigen.

Dennoch ist der genaue Einfluss auf die Zuverlässigkeit der Lichtwellenleiter in einem verlegten Kabel schwer zu bestimmen, ohne über weitere Informationen der gesamten Fehlerverteilung in der Faser zu verfügen. Eine Möglichkeit zur entsprechenden Darstellung könnte darin liegen, ein Lichtleitkabel dem Proof-Test zu unterziehen bei einem Niveau knapp bei der inhärenten Festigkeit der Faser oder um 3,8GPa (550kpsi).

Würde ein von diesem Versuch erzeugtes 1.000m Fasermuster einer Dauerspannung von 110kpsi unterzogen, würde die Faser wahrscheinlich in weniger als einem Tag brechen, bzw. wesentlich früher als die erwartete Lebensdauer von 40 Jahren.

Dieses Beispiel ist ein extremer Fall, hebt aber die Bedeutung des Verständnisses der komplexen Gleichungen hervor, die die Zuverlässigkeit bestimmen.

4 Anleitung aus dem technischen IEC-Bericht über die Zuverlässigkeit

Einer der derzeit angenommenen Zuverlässigkeitsmodelle wurde von IEC veröffentlicht[4].

Eine der im diesem Bericht angegebenen Gleichungen wird benutzt, um die Lebensdauer der Faser vorauszusagen – die Lebensdauergleichung für Lichtwellenleiter nach dem sie geprüft wurden (Proof-Test). Dargestellt wird dies mit nachfolgendem Ausdruck:

$$t_f = t_p \left(\frac{\sigma_p}{\sigma_a}\right)^n \left\{\left[1 - \frac{ln(1-F)}{N_p L}\right]^{\frac{n+1}{m_d}} - 1\right\} \qquad (1)$$

Wo:
t_f die Zeit vor dem Fehler (Lebensdauer) ist
t_p die Zeit des Proof-Tests ist
σ_p die Spannung des Proof-Tests ist
σ_a die angelegte Spannung ist
F die Ausfallwahrscheinlichkeit ist
N_p die Bruchrate während des Proof-Tests ist
L die Länge unter Spannung ist
m_d das Weibull m-Parameter von der dynamischen Ermüdung ist
n der Spannungskorrosionsparameter ist

Der Ausdruck ist komplex, jedoch können einige Beobachtungen erwähnt werden.

Abbildung 1 zeigt, je größer die angelegte Spannung, desto größer die Ausfallwahrscheinlichkeit. Demzufolge ist der Term der Ausfallwahrscheinlichkeit in der Gleichung, F, direkt mit dem Term der angelegten Spannung, σ_a, verbunden Die traditionelle Faustregel, die benutzt wurde um 20 Prozent der Probespannung als langzeitige maximale zugelassene Spannung abzuleiten, nimmt an, dass diese zwei Variablen unabhängig sind, was aber nicht mit der *Abbildung 1* übereinstimmt.

Hunderte Kilometer Fasern müssen geprüft werden, um die Beziehung zwischen der Ausfallrate und der angelegten Spannung vollkommen zu ergreifen.

Tabelle 1 liefert die Ergebnisse aus dem Vergleich von drei Szenarien. Das erste ist die mit 0,69GPa geprüfte Faser mit einer Langzeitlast von 20 Prozent der geprüfte Last (Proof-Test).

Bei der Erzeugung der Daten wurden nachfolgende in der *Gleichung 1* ausgetauschte Werte benutzt:
n_d =20
m_d = 2,5
t_p = 0,05/sec
N_p = 1 Bruch alle 250km

Die Tabelle zeigt, dass ein Lichtwellenleiter, der den obengenannten konservativen Kriterien entspricht, angemessene mechanische Leistungen für 0,69GPa bei 20 Prozent des Proof-Test-Niveaus zeigen würde.

Der zweite Fall zeigt, dass dieselbe Faser bei 40 Prozent des Proof-Test-Niveaus gehalten wurde. In diesem Fall, würde die 1ppm Ausfallrate in weniger als einem Jahr erreicht werden. Der dritte Fall ist eine bei 1,38GPa geprüfte Faser mit einer Langzeitlast von 20 Prozent des Proof-Test-Niveaus.

Für diese Reihe von Bedingungen, wird die 1ppm Ausfallwahrscheinlichkeit in weniger als sechs Jahren eintreten. Zu beachten ist, dass die Angaben in der *Tabelle 1* typisch für Fasern in einer nichtaggressiven Umgebung sind.

Terme wie z. B. Alterung ohne Spannung, Makrobiegungen, Abrieb und weitere Faktoren, können die Lebensdauer der Faser wesentlich reduzieren.

5 Debatte

Die Lebensdauer der Faser ist die Summe der inhärenten und äußeren Ausfallwahrscheinlichkeit. Dieser Artikel befasst sich mit großen Faserlängen unter Achslast in einem System, in dem der Fehler von äußeren Fehlern beherrscht wird.

Die in der *Tabelle 1* gezeigten Ergebnisse heben den Fehler bei gängigen Anforderungen für Lichtleitkabel hervor, entsprechend welcher die Langzeitlast in den Lichtwellenleitern einfach 20 Prozent des Proof-Test-Niveaus ist. Wäre die Faserbruchrate für die geprüfte Faser bei 0,69GPa und bei 1,38GPa gleich, so würden beide Fasern dieselbe Lebensdauer von 1ppm aufweisen.

Wir wissen, dass dies nicht der Fall ist, wie aus den Angaben in den Abbildung 1 ersichtlich ist. Wenn diese Erkenntnis in der Analyse eingeschlossen wird, ändern sich die Ergebnisse drastisch.

In der Regel liegt die Erwartung der Langzeitzuverlässigkeit für Lichtleitkabel darin, dass die Ausfallwahrscheinlichkeit der Faser 30 Jahre lang unter 1ppm sein sollte. Unter Verwendung dieses Kriteriums, kann das in der *Tabelle 1* angegebene Beispiel wie nachfolgend beschrieben, vereinfacht werden:

- eine bei 0,69GPa geprüfte Faser bei 20 Prozent Langzeitlast wird zuverlässige Leistungen bieten
- eine bei 0,69GPa geprüfte Faser bei 40 Prozent Langzeitlast wird keine zuverlässige Leistung bieten
- eine bei 1,38GPa-geprüfte Faser bei 20 Prozent Langzeitlast wird keine zuverlässige Leistung bieten

Obwohl es offensichtlich ist, dass durch den Proof-Test bei höheren Niveaus die Leistungen der Kabel wesentlich erhöht werden, kann der üblicherweise bei Verkabelungsstandards eingesetzte Wert, bzw. 20 Prozent des Proof-Test-Niveaus, zu falschen Erwartungen führen, was die Langzeitzuverlässigkeit der Lichtleitkabel betrifft.

6 Empfehlungen

Die in diesem Artikel beschriebenen Informationen zeigen, dass obwohl 20 Prozent der geprüften Last (Proof-Test) für eine Langzeitlast im Lichtwellenleiter ein angemessenes Kriterium für die Lichtwellenleiter bieten könnte, die bei 0,69GPa oder bei einem niedrigeren Wert geprüft werden, dieses Kriterium jedoch eine optimistische Einschätzung für Lichtwellenleiter sein könnte, die bei höheren Niveaus geprüft werden.

Derzeit fordern die meisten wichtigsten Lichtwellenleiter-Standards, einschließlich jene in ITU-T, IEC und TIA, dass die Faser bei 0,69GPa geprüft wird. Kabelstandards in IEC, ICEA und IEEE sollten sich diesem Kriterium angleichen.

Es wird daher empfohlen, dass die Unterlagen geändert werden, um einfach die höchste Langzeitlast von 0,14GPa (20kpsi) am verkabelten Lichtwellenleiter nach der Verlegung zu fordern, unabhängig vom Proof-Test-Niveau.

Eine Anmerkung könnte der Voraussetzung hinzugefügt werden, in der steht, dass wenn ein Lichtwellenleiter mit Proof-Test-Niveaus über 0,69GPa verlegt wird, höhere Verformungen im Lichtwellenleiter die Zuverlässigkeit beeinflussen werden und zwischen dem Kabellieferant und dem Endbenutzer abgestimmt werden sollten, und dass präzisere Faserzuverlässigkeitsmodelle zu berücksichtigen wären.

7 Schlussfolgerungen

Dieser Artikel hat gezeigt, dass die modernen Kabelaufbauten die Aufbaugrenzen für eine zugelassene Langzeitverformung in Lichtleitkabel weiter hinausschieben. Mit diesen neuen Grenzbedingungen, könnte die alte Faustregel - entsprechend welcher bis zu 20 Prozent des Proof-Test-Niveaus als eine Langzeitverformung zugelassen wurde - nicht mehr angemessen sein. Eine neue Empfehlung, entsprechend welcher gefordert wird die Langzeitlast auf 0,14GPa (20kpsi) einzuschränken, wird als alternatives Kriterium vorgeschlagen. Dieses neue Kriterium sollte in demnächst stattfindenden Revisionen der Lichtleitkabelstandards einschlossen werden.

Besonders kritische Aufbauten sind Kabeltypen mit hoher Verformung, wie z. Drop-Kabel und Freileitungskabel, einschließlich Erdungsseile (OPGW) und Luftkabel (ADSS). ■

8 Danksagungen

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«Pacific Press» поставляет гидравлические кромкозагибочные прессы, ножницы и прессы в Северной Америке, производя большой диапазон оборудования для формования. В категории оборудования для наземного обслуживания воздушных судов «Columbus Jack» работает в авиационной сфере десятилетиями, предоставляя оборудование для наземного обслуживания владельцам судов коммерческой, военной и гражданской авиации.

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Инновационная технология OTA для высококачественной проволоки

Медицинская техника, энергетика или мобильная связь – качественная проволока играет важную роль во всех прогрессивных сферах промышленности. Технология OTA, которая была разработана системным поставщиком «Koch», предоставляет лучшее требуемое качество.

▲ *В соответствии с техническими требованиями заказчика: Как поставщик системы «Koch» разрабатывает, производит и устанавливает полные линейки оборудования*

Система волочения предусматривает непрерывное прямолинейное волочение при постоянном и повторяемом обратном напряжении. С отдатчика и до катушки достигаются особо четкие размеры проволоки и высочайшее качество поверхности благодаря линейному волочению проволоки. В зависимости от качества проволоки, размера и требований к окончательной продукции применяются различные устройства с технологией OTA от «Koch». Для производства предварительно растянутой стальной проволоки и пружинной стальной проволоки, используя тяговые шайбы с диаметром до 1200 мм KGT 47 OTA устанавливает контрольные задачи.

Размер устройства компактный и несмотря на силу волочения до 90000 Н, оно работает практически бесшумно. Еще одно устройство с технологией OTA – KGT 25. Оно применимо в особенности для проволоки из низко- и высокоуглеродистой стали, а также для проволоки из нержавеющей стали. KGT 12 производит тонкую проволоку и канатную проволоку с диаметрами менее 0,8 мм.

При этом динамически регулируемый процесс оптимизации обеспечивает необходимую точность. Технология OTA выводит «Koch» на лидирующую позицию на мировом рынке, так как она предоставляет экономичное производство с высочайшей точностью, воспроизводимостью и качеством продукции.

Как поставщик системы «Koch» разрабатывает, производит и устанавливает полные линейки оборудования в соответствии с техническими требованиями заказчика. Компания, существующая более 90 лет, всегда являлась производителем собственных волочильных машин. Намоточные устройства и мотальные машины, которые также производятся компанией обеспечивают надежный и аккуратный сбор проволоки особенно на больших катушках.

Внешние устройства, изготавливаемые компаниями-партнерами, дополняют линейки оборудования, к примеру, выполняя такие функции, как очистка поверхности проволоки или ее обработка медью, алюминием или цинком. Клиенты в более 60 странах высоко ценят технологическое ноу-хау «Koch» в сфере инжиниринга, приводной техники, программирования и управления.

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Более высокая точность благодаря выпуску нового устройства AccuScan

«NDC Technologies» выпустили давно ожидаемый четырехосевой прибор Beta LaserMike AccuScan 6012 для измерения диаметра и овальности. Созданный на основе проверенной и широко используемой серийной платформе AccuScan, новый AccuScan 6012 является первым промышленным четырехосевым прибором для измерения продукции до 12 мм.

Данное усовершенствование делает возможным измерение производителями диаметра и овальности продукции кабелей связи с большей точностью, чем при использовании трехосевых приборов, что в результате предоставляет преимущества в системе обеспечения качества и в итоговой экономичности.

На протяжении долгих лет производители высокопараметричных кабелей связи полагались на двух- и трехосевые приборы измерения овальности и диаметра при использовании для измерения во время производства и после него.

Необходимость обеспечения точного измерения диаметра и овальности цилиндрической круглой продукции обуславливает ее строгое соответствие техническим требованиям к качеству и расчету и имеет первостепенное значение для производителей кабеля. Любая ошибка в диаметре или округленности проводника

▲ *AccuScan 6012 Beta LaserMike*

или изоляции в коаксиальной и двухжильной продукции для передачи данных напрямую влияет на рабочие характеристики кабеля, делая его бесполезным для предназначенного применения. Новое четырехосевое устройство Beta LaserMike AccuScan 6012 решает данную проблему благодаря предусмотренному более комплексному диапазону измерения, что двух- и трехосевые устройства и сверхбыстрой скорости сканирования.

Преимущества включают:

- Более точный средний диаметр - AccuScan 6012 выполняет сверхскоростные измерения при 2400 сканирований в секунду по оси (что в итоге составляет 9600 измерений в секунду) и имеет воспроизводимость сканирования до одного микрона. Это означает, что с каждым сканированием вы получите более точное и четкое измерение среднего диаметра.
- Существенно повышенная точность измерения овальности - AccuScan 6012 предполагает 42% улучшение обнаружения правильной овальности по сравнению с трехосевыми датчиками и предоставляет 100% точность в измерении овальности, когда продукция центрирована по осям измерения.
- Более высокая точность обнаружения дефектов - AccuScan 6012 предусматривает высочайшую точность обнаружения дефектов при 25-процентном преимуществе по сравнению с трехосевыми устройствами. Сверхбыстрая скорость сканирования и более высокая точность в сочетании с возможностью высокоскоростной проверки допусков позволяет точно и надежно обнаружить дефекты продукции, такие как выступы и сужение материала на ранней стадии. Это дает возможность производителям лучше контролировать качество продукции, уменьшить объем брака и снизить производственные расходы.
- Высокая автономная точность инспекции части/образца при использовании компьютеризированной системы отображения AccuNet Beta LaserMike AccuScan 6012 может легко и быстро производить настройку для работы в качестве автономной системы измерения для измерения образцов и контроля, а также коррекции и анализа критических данных продукции. Это устраняет необходимость настройки двух двухосевых приборов для выполнения четырехосевых измерений.
- Прибор AccuScan 6012 обладает гибкими характеристиками связи, которые предполагают легкое соединение с ПК или ПЛК, либо с протоколами контроля технологий. Данное устройство может также быть оснащено опциональным сверхъярким дисплеем и интерфейсом пользователя для легкой конфигурации и просмотра данных измерения. AccuScan 6012 предусматривает верхнюю или боковую установку дисплея.

«NDC Technologies» – США
Вебсайт: www.ndc.com

Идеально гладкая поверхность от «Applied»

Линейка оправок с покрытием Teflon® для сварки плавлением при применении катетера и процедур кантования, которая разработана для оптимизации качества внутреннего диаметра и скорости производства, появилась в наличии от «Applied Plastics».

Формующие оправки с фторопластовым покрытием PTFE Natural® от «Applied Plastics» имеют гладкую поверхность, которая предусматривает динамический коэффициент трения 0,5 для предотвращения налипания, застревания внутри вследствие сокращения и упрощает удаление катетера. Данные экструзионные оправки предусматривают 25-процентное удлинение без расслаивания или брака, они химически неактивны и могут функционировать непрерывно до 315°C (600°F). Предлагаемые оправки из нержавеющей стали или нитинола могут поставляться предварительно разрезанными по размерам диаметра от 0,127 мм до 25,4 мм с допуском от ±.003 мм до ±.013 мм в зависимости от размера. Фторопластовое серое покрытие PTFE Natural® также в наличии без ПФОК. Благодаря запатентованной технологии подготовки поверхности перед нанесением покрытия, покрытие не осыпается и не трескается.

«Applied Plastics Co Inc» – США
Вебсайт: www.appliedplasticsinc.com

Критерии расчёта для обеспечения долговечности эксплуатации кабеля

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Аннотация

В данной работе подробно рассмотрены современные требования к допустимой осевой нагрузке оптических кабелей. Показано, что современный критерий, содержащийся в ряде стандартов оптических кабелей, согласно которому постоянная нагрузка должна быть менее 20 процентов от нагрузки при контрольных испытаниях, может быть оптимистичным в некоторых случаях. Вместо этого рекомендуется применять другой критерий, в соответствии с которым постоянная нагрузка должна быть стандартизирована до 0,14 ГПа (кфунт/дюйм^2).

1 Введение

В подвесных кабелях существует ряд противоречивых требований к проектированию, которые должны быть оптимизированы. Одной целью является минимизация нагрузки на оптические волокна. Второй целью служит минимизация кабельного диаметра, что уменьшит ветровую и ледяную нагрузку. Третья задача – минимизация провисания на каждом пролёте. Арамидная пряжа, добавляемая к кабелю минимизирует нагрузку и провисание, но добавление материала увеличивает диаметр кабеля, что, в свою очередь, увеличивает ветровую и ледяную нагрузку.

Одной ключевой переменной в оптимизации данных параметров является допустимая нагрузка на оптическое волокно. Стандартное правило, которое применялось годами, заключается в предусмотрении максимум 20 процентов от нагрузки, применявшейся в контрольных испытаниях в качестве постоянной нагрузки на оптическое волокно кабеля. Данный критерий фигурирует во многих современных документальных стандартах и является проверенным и приемлемым для современного поколения кабелей, изготавливаемых с волокном, прошедшим испытание при 0,69 ГПа (100 кфунтов/дюйм^2). Критерий, который был разработан, чтобы предусмотреть 30-летнюю механическую работоспособность, основан на превосходном показателе общей надёжности установленных подвесных кабелей, считается приемлемым.

С кабелями, которые разрабатываются ближе к пределам проектирования, стоит рассмотреть данные ограничения и стандартные правила, используемые при разработке кабеля для обеспечения применения оптических кабелей в будущем, которые будут предусматривать те же или лучшие показатели надёжности по сравнению с их предшественниками.

2 Влияние изменённой конструкции кабеля на надёжность

2.1 Общие замечания

Традиционные пределы проектирования для производства оптических кабелей изменились за последние десять лет. Некоторые из данных изменений включают:

1. Применение кабелей с большим числом волокон
2. Применение кабелей с низкими потерями на макроизгибах (G.657) и покрытия, устойчивые к микроизгибам
3. Уменьшение стоимости путём минимизации материала кабеля и сокращения расчётных запасов
4. Волокно, прошедшее испытание при более высоких нагрузках (1.38 ГПа [200 кфунтов/дюйм^2])

Данные изменения в тенденциях конструкции кабелей могут повлиять на общую надёжность оптических кабелей. Каждый фактор будет рассмотрен отдельно, чтобы доказать в результате, что при суммировании их всех можно сильно изменить долгосрочность при надлежащем применении.

2.2 Применение кабелей с большим числом волокон

Многие подвесные кабели попадают в категорию абонентских кабелей. Данные небольшие кабели соединяют сеть доступа с частным жильём. Такими кабелями являются обычно кабели с небольшим числом волокон. За исключением данных абонентских кабелей, однако, существует общая тенденция в применении кабелей с большим числом оптических волокон. Это связано с высокой стоимостью на права прокладки и установки.

Во многих кабелях с большим количеством волокон половину веса оптических кабелей составляют оптические волокна. При большем весе требуется большее натяжение на кабель для минимизации провисания кабеля. Арамидная пряжа и стеклопластиковые материалы используются для восприятия большей части данной нагрузки, при этом оптическое волокно несёт остальную нагрузку.

Кроме того, чем больше волокон в оптическом кабеле, тем больше становится его диаметр. Больший диаметр кабелей имеет большую ветровую и ледяную нагрузку, тем самым усложняя ситуацию. В результате, применение кабелей с большим количеством оптических волокон несёт риск увеличения нагрузки на оптические кабели.

2.3 Применение волокон G.657 и покрытий, устойчивых к микроизгибам

Неудивительно, что волокна G.657 получают всё большее распространение в оптических сетях. Согласно последним данным, полученным от «CRU», оптическое волокно, применяемое сегодня, попадает в данную категорию. [Private communications Patrick Faye of CRU.] Волокна G.657 применяются из-за своих великолепных характеристик макроизгиба. Одним из дополнительных преимуществ волокон G.657 являются характеристики микроизгиба, что делает их менее чувствительными к условиям эксплуатации кабеля. Ещё одной ключевой разработкой в оптических волокнах является применение покрытий, устойчивых к микроизгибам[1]. Данное новое поколение оптических покрытий показывают уменьшение потери при микроизгибах в два и до четырёх раз по сравнению с теми, которые были применены от пяти до десяти лет назад.

В совокупности два данных усовершенствования оптического волокна имеют огромное влияние на затухание кабеля, даже в агрессивных условиях эксплуатации. Лучшие характеристики волокна и покрытия могут «скрыть» влияние плохой конструкции кабеля или его прокладки. Более высокое затухание часто наблюдается при применении традиционных оптических кабелей с волокнами G.652 при высокой остаточной нагрузке на волокно. По умолчанию производителям кабеля необходимо контролировать нагрузку на волокно для обеспечения соответствия кабеля требованиям к качеству. При использовании волокон G.657 с покрытием, устойчивым к микроизгибам для той же кабельной конструкции, измеренное затухание улучшится, и тот же самый кабель сможет пройти испытания на соответствие техническим условиям. Окончательный результат использования волокон G.657 заключается в способности данного кабеля пройти испытания на соответствие техническим условиям. Однако после применения более высокая нагрузка на волокно может вызвать риск в долговечности эксплуатации. Иными словами, если кабель сконструирован надлежащим образом, волокна G.657 и покрытия, устойчивые к микроизгибам являются большим преимуществом с точки зрения оптических характеристик используемого кабеля. Но если конструкция кабеля плохая, усовершенствованные оптические волокна могут скрыть проблему нагрузки от конечного потребителя, чтобы может привести к риску в долговечности эксплуатации.

2.4 Снижение стоимости путём минимизации кабельного материала и сокращения расчётных предельных параметров

Многие подвесные кабели рассчитываются с нулевой нагрузкой на оптическое волокно. Со стеснёнными ценовыми рамками инженерам по проектированию приходится уменьшать материальные расходы. Так как силовые элементы вокруг оптического волокна убраны, оптическое волокно принимает часть осевой нагрузки, которую обычно несут силовые компоненты кабеля. Инженер проектировщик может рассмотреть различные кабельные стандарты и убедиться, что максимально допустимая постоянная нагрузка составляет 20 процентов от той, что была использована в контрольных испытаниях. На практике с данными кабелями промышленность прогрессирует от общепринятой практики проектирования, при которой оптическое волокно не несёт никакой нагрузки после установки до варианта, когда нагрузка составляет до 20 процентов от допустимой нагрузки при испытаниях. Продолжительный опыт надёжного функционирования кабелей с данным уровнем нагрузки показывает, что данное решение является вполне рациональным.

2.5 Волокна, проходящие испытания при большей нагрузке 1,38 ГПа (200 кфунтов/дюйм^2) теперь доступны

В предыдущем разделе было показано, что материальные расходы могут быть сокращены путём предусмотрения нагрузки на оптическое волокно. Для стандартного оптического волокна, которое проходит испытание при 0,69 ГПа (100 кфунтов/дюйм^2), максимальная допустимая нагрузка на волокно при 20-процентном ограничении – 0,14 ГПа. Проектировщик мог бы использовать волокна, проходящие испытания при большей нагрузку, такой как волокно, тестируемое при 1,38 ГПа (200 кфунтов/дюйм^2) с 20-процентным ограничением, и допустимая нагрузка на волокно после установки увеличивалась бы до 0,28 ГПа. Это бы обеспечило дальнейшее сокращение материала оптического кабеля благодаря большей кабельной нагрузке, передаваемой вдвойне оптическому волокну. Окончательным результатом могла бы быть более низкая стоимость оптического кабеля.

2.6 Суммарное влияние изменённых критериев проектирования оптического кабеля

В совокупности все данные тенденции могут привести к сценарию, который может оказаться не оптимальным для поставщика услуг. Нагрузка, допустимая на волокна при обычных критериях выше, но нагрузка при этом не влияет на затухание благодаря использованию волокон G.657. Конечный результат может заключаться в применении постоянной нагрузки до 0,28 ГПа на оптические волокна. В то же время, сохраняются ожидания долговечности в функционировании оптических волокон в течение 30+ лет без выходов из строя. Данная ситуация ставит под вопрос пределы долговечности и требует тщательного изучения до практического применения.

3 Происхождение современного критерия допустимой нагрузки

Современное стандартное правило, применяемое для расчёта – это максимальная допустимая нагрузка в 20 процентов от нагрузки эксплуатационных испытаний. Данный критерий обоснован изучением вопроса надёжности, проведённым в 1990-х[2,3]. В данных работах, авторы показывают, что долговечность может зависеть от нагрузки при эксплуатационных испытаниях, но это подразумевает вероятность отказа при испытаниях. Затем они рассматривают различные параметры механической коррозии и волокно, проходящее испытание при нагрузке 50 кфунтов/дюйм^2 и 100 кфунтов/дюйм^2, чтобы показать, что их приближенное значение является рациональным и стабильным способом предусмотреть долговечность функционирования. Данная работа являлась важным шагом вперёд для оптической промышленности и поддержала движение за сохранение нагрузки волокна при эксплуатационных испытаниях на текущем уровне.

К сожалению, существует предположение о распределении трещин оптического волокна, а именно, возможность выхода из строя волокна при эксплуатационных испытаниях. Данная вероятность не постоянна и может варьироваться для волокон, произведённых при специальных условиях или при использовании сырьевых материалов. На рисунке 1 показана кривая вероятности выхода из строя волокна для кварцевого волокна, произведённого на одном из заводов автора при использовании образца 10 м длины для иллюстрации трещин, обнаруженных в оптических волокнах.

На рисунке показаны 2 области: Область I (внутренняя прочность) и Область II (внешняя прочность). Кривая демонстрирует основные области, которые должны быть охарактеризованы для предусмотрения долговечности волокна. Область I – это область с большой внутренней прочности. Рассматриваемое волокно показало результаты прочности, присущие стеклу при ~4,6 ГПа, что значительно выше предела в 3,1 ГПа, рекомендуемого Telcordia GR-20. Испытание прочности на небольшой длине в данной области может быть использовано для определения значения n, которое больше 20 для рассматриваемого волокна. Внутренняя нагрузка и значения n обычно указываются конечными потребителями для обеспечения долговечности эксплуатации кабеля.

К сожалению, внешняя часть, показанная как Область II, играет важную роль в определении долговечности эксплуатации оптического кабеля. Данная область содержит трещины ближе к уровню эксплуатационных испытаний, расстояние между которыми может составлять до нескольких километров.

Со временем это может привести к разрушению волокна, если кабель находится под напряжением. Понимание данной области требует наличия информации, которая может быть получена только путём измерения многих километров волокна. Большая нагрузка при эксплуатационных испытаниях устранит некоторые недостатки волокна.

Однако, точное влияние на долговечность оптического волокна в установленном кабеле трудно определить без более подробной информации по общему распространению трещин на волокне. Одним из способов продемонстрировать это было бы провести эксплуатационные испытания оптического кабеля на почти уровне внутренней прочности волокна или около 3,8 ГПа (550 кфунтов/дюйм^2). Если образец волокна длиной 1,000 м, полученный в ходе данного эксперимента, оставить под постоянной нагрузкой 110 кфунтов/дюйм^2, волокно вероятно будет повреждено меньше, чем за день, или задолго до 40-летнего ожидаемого срока эксплуатации. Данный пример является экстремальным случаем, но он подчеркивает важность понимания сложных зависимостей, которые влияют на долговечность.

4 Руководства из технического отчёта по долговечности Международной электротехнической комиссии

Одна из приемлемых в настоящее время моделей была опубликована Международной электротехнической комиссией[4]. Одно из уравнений, предоставленных в данном отчёте, используется для расчёта долговечности – уравнение срока эксплуатации оптического волокна после эксплуатационных испытаний. Это можно продемонстрировать следующим образом:

Где:

$$t_f = t_p \left(\frac{\sigma_p}{\sigma_a}\right)^n \left\{\left[1 - \frac{ln(1-F)}{N_p L}\right]^{\frac{n+1}{n_d}} - 1\right\} \quad (1)$$

t_f время до поломки (срок эксплуатации)
t_p время эксплуатационных испытаний
σ_p нагрузка эксплуатационных испытаний
σ_a применённая нагрузка
F вероятность выхода из строя
N_p коэффициент поломок во время эксплуатационных испытаний
L длина под напряжением
m_d параметр Вейбулла от динамической усталости
n параметр механической коррозии

Соотношение сложное, но можно сделать несколько наблюдений.

На рисунке 1 показано, что, чем больше применяемая нагрузка, тем меньше вероятность выхода из строя. Таким образом, срок выхода из строя в уравнении F напрямую зависит от срока применяемой нагрузки σ_a. Стандартное правило, которое использовалось для расчёта 20 процентов от нагрузки испытаний в качестве постоянной максимальной допустимой нагрузки подразумевает, что две данные переменные независимы, что не соответствует рисунку 1. Сотни километров волокна необходимо подвергнуть испытаниям для полного понимания зависимости между частотой поломок и применённой нагрузкой.

В таблице 1 показаны результаты сравнения трёх сценариев. Первый – это волокно, проходящее испытание при 0,69 ГПа с постоянной нагрузкой 20 процентов от нагрузки эксплуатационных испытаний.

Получая данные, мы использовали следующие показатели, заменённые в Уравнении 1:

n_d =20
m_d = 2,5
t_p = 0,05 секунд
N_p = 1 трещина через каждые 250 км

В таблице показано, что оптическое волокно, соответствующее стандартным вышеуказанным критериям показывает надлежащие механические характеристики для 0,69 ГПа при 20 процентах нагрузки от эксплуатационных испытаний. Во втором случае показано, что то же самое волокно было получено при 40 процентах эксплуатационных испытаний. В данном случае частота выхода из строя 1 ч/млн будет достигнута менее, чем через год. Третий класс – волокно, проходящее испытания при 1,38 ГПа с постоянной нагрузкой 20 процентов от эксплуатационных испытаний. Для данного ряда условий, вероятность выхода из строя 1 ч/млн наступает менее, чем за шесть лет. Следует отметить, что данные в Таблице 1 представлены для волокна в неагрессивной среде. Такие термины, как старение при нулевом напряжении, макроизгибы, трение и другие факторы

▼ **Рисунок 1:** *Вероятность трещин на более 100 км волокна, прошедшего испытание на 10 м расчётной длины*

могут значительно сократить срок эксплуатации волокна.

5 Исследование

Срок службы волокна – это сумма вероятностей внутреннего и наружного выхода из строя. Данная работа сфокусирована на больших длинах волокна при осевой нагрузке в режиме, когда выход из строя обусловлен внешними разрывами. Результаты, показанные в таблице 1 подчёркивают ошибку в общепринятом требовании для оптических кабелей, которое представляет собой 20-процентную постоянную нагрузку от той, что использовалась на эксплуатационных испытаниях на оптические кабели. Если частота выхода из строя волокна была одинакова для 0,69 ГПа и 1,38 ГПа волокна, проходившего испытания, следовательно, оба волокна имели бы одинаковый срок эксплуатации с разрывом 1 ч/млн. Мы знаем, что это не верно в случае с данными на рисунке 1. Когда данное знание включено в анализ, результаты меняются радикально.

Обычно ожидаемый срок эксплуатации оптического кабеля – это вероятность разрыва волокна, которая должна быть менее чем 1 ч/млн за 30 лет. Используя данный критерий, пример в таблице 1 может быть упрощен следующим образом:

- 0,69 ГПа волокно при 20-процентной постоянной нагрузке будет долговечным
- 0,69 ГПа волокно при 40-процентной постоянной нагрузке не будет долговечным
- 1,38 ГПа волокно при 20-процентной постоянной нагрузке не будет долговечным

Хотя очевидно, что испытания при большем нагрузки намного улучшает характеристики кабелей, показатели, обычно используемые в кабельных стандартах – 20 процентов от рекомендуемого уровня нагрузки при испытаниях – могут привести к напрасным ожиданиям долговечности оптических кабелей.

6 Рекомендации

Информация, изложенная в данном документе указывает, что хотя 20 процентов от нагрузки при испытаниях на оптическое волокно могут быть рациональным критерием для оптического волокна, проходящего испытания при 0,69 ГПа или менее, результат может быть оптимистичным

Вероятность повреждения 1 км оптического волокна	волокно, проходящее испытание при 0,69 ГПа 20 процентов от постоянной нагрузки	волокно, проходящее испытание при 0,69 ГПа 40 процентов от постоянной нагрузки	волокно, проходящее испытание при 1,38 ГПа 20 процентов от постоянной нагрузки
1,0 ч/млн на км	1600 годы	0.0 годы	530 годы*
1,0 ч/млн на 100 км	16 годы	0.0 годы	5.3 годы*

**Частота трещин сильно отличается с изменением при эксплуатационных испытаниях от 0,69 ГПа до 1,38 ГПа*

▲ **Таблица 1:** *Сравнение вероятности трещин (1 ч/млн срока эксплуатации)*

и для оптических волокон, проходящих эксплуатационные испытания при больших нагрузках.

В настоящее время большинство стандартов по оптическому волокну, включая ITU-T, IEC и TIA, требуют проведения испытаний волокна при 0,69 ГПа. Кабельные стандарты в IEC, ICEA и IEEE должны соответствовать данному критерию.

Таким образом, рекомендуется изменить документы для требования максимальной постоянной нагрузки 0,14 ГПа (20 кфунтов/дюйм^2) на оптическое волокно кабеля после установки, вне зависимости от нагрузки при испытаниях. Можно было бы добавить замечание к требованию о том, что при установке оптического волокна с применённой во время испытаний нагрузкой выше 0,69 ГПа, более высокая нагрузка на оптическое волокно отрицательно повлияет на долговечность, что должно быть согласовано кабельным поставщиком и конечным пользователем, и должны быть предусмотрены более точные сроки долговечности моделей.

7 Выводы

Данная работа продемонстрировала, что современные расчёты кабельной конструкции выходят за пределы проектирования по допустимым постоянным нагрузкам на оптические кабели. При данных пограничных условиях, стандартное старое правило, допускающее до 20 процентов нагрузки при испытаниях для постоянной нагрузки уже не приемлемо. Новая рекомендация заключается в ограничении постоянной нагрузки до 0,14 ГПа в качестве альтернативного критерия. Данный новый критерий должен быть включён в последующие ревизии стандартов по кабельному волокну. Особенно важными являются расчёты кабелей с большими нагрузками, такие как абонентские кабели и подвесные кабели, включая оптико-волоконные и самоподдерживающиеся диэлектрические кабели. ■

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Acquisition de Fenn

Quality Products Inc (QPI), producteur et distributeur de matériel de piste pour avions, de machines-outils pour presses hydrauliques, de presses plieuses ainsi que de presses et de cisailles hydrauliques, a annoncé l'acquisition de Fenn LLC.

Le président de Fenn, Paul Uccello, a déclaré: "Il s'agit d'un résultat important pour nos clients et pour les entreprises, et comment ne pas être aussi enthousiastes quant à notre futur ensemble. Avec d'autres activités dans le secteur de la fabrication de biens d'investissement, nous estimons que QPI dispose de la combinaison parfaite d'expérience professionnelle et de ressources pour consentir à Fenn de continuer à développer et à produire des équipements de haute qualité."

Fenn continuera à produire des machines personnalisées conçues en fonction des exigences spécifiques des clients, soit qu'il s'agisse d'installations de laminage, d'aplatissement ou de façonnage du fil, de bancs de tréfilage ou d'applications pour le laminage des bords (tête de turc). En outre, Fenn continuera à offrir avec orgueil sa propre ligne industrielle de produits comprenant des enrouleurs de ressorts Torin, des presses à estamper et des tronçonneuses du type à impact. Avec toutes ses lignes de produits, Fenn se penchera également sur le service d'entretien et sur la fourniture de parties de rechange.

QPI est spécialisée en deux secteurs : les secteurs des machines-outils et le secteur du matériel de piste pour avions. Le secteur des machines-outils de QPI comprend les sociétés Multi-Press, Pacific Press et Fenn. Multi-Press, dont l'origine remonte aux années 20, est spécialisée dans la fourniture de presses électriques et hydrauliques de pointe incluant une ligne complète de modèles d'établi, de plancher et à quatre colonnes.

Pacific Press fournit des plieuses hydrauliques, des cisailles et des presses en Amérique du Nord et produit une ample gamme d'équipement pour le façonnage des métaux. Dans la catégorie des matériels de piste pour les avions, la société Columbus Jack a fourni pendant des décennies l'industrie de l'aviation en offrant des matériels de piste aux clients du secteur de l'aviation commerciale, civil et militaire.

Quality Products Inc – États-Unis
Website: www.multipress.com

Technologie innovante OTA pour fils de qualité

QU'IL s'agisse de technologie du secteur médical, du génie électrique ou de mobilité, le fil de qualité joue un rôle essentiel dans la totalité des secteurs industriels avancés. La technologie OTA, développée par le fournisseur de systèmes Koch, permet d'obtenir les meilleures qualités requises.

Le système de tréfilage permet d'effectuer un tréfilage en ligne droite, sans déviations, à une contre-tension constante et reproductible. À partir du dévidoir à l'enrouleur, grâce au tréfilage linéaire du fil, il est possible d'obtenir des dimensions du fil très précises et de qualité de surface élevée.

Différentes machines produites par Koch et équipées de la technologie OTA sont utilisée en fonction de la qualité et des dimensions du fil ainsi que des spécifications du produit final. Pour la production de fil en acier précontraint et de fil d'acier pour ressorts en utilisant des cabestans avec des diamètres arrivant jusqu'à 1200mm, l'équipement KGT 47 OTA fixe des paramètres de référence.

Les dimensions de la machine sont compactes et, bien qu'elle soit sujette à des tractions jusqu'à 90 000N, le bruit produit est négligeable. La famille OTA comprend également le KGT 25.

▲ *Suivant les exigences du client: en tant que fournisseur de systèmes, Koch s'occupe de la conception, de la fabrication et de l'installation de lignes de machines complètes*

Cet équipement est tout particulièrement indiqué pour les fils d'acier à faible et haute teneur en carbone et pour les fils d'acier inoxydable. Le KGT 12 produit du fil fin et du fil pour câbles de diamètres inférieurs à 0,8mm.

Dans cet équipement, l'optimisation du processus réglé dynamiquement assure la précision requise. La technologie OTA situe Koch en première ligne dans le marché global, puisqu'elle offre une production économique avec la meilleure précision, reproductibilité et qualité de produit.

En tant que fournisseur de systèmes, la société Koch est spécialisée dans la conception, la fabrication et l'installation de machines complètes en fonction des exigences spécifiques du client. Créée il y a plus de 90 ans, la société a toujours produit ses tréfileuses en entreprise. Les enrouleurs et les bobinoirs, également produits en entreprise, garantissent l'enroulement du fil de façon efficace et précise, même dans le cas de bobines lourdes.

Les modules périphériques réalisés par les sociétés associées, complètent les lignes des machines en effectuant, par exemple, des fonctions telles que le nettoyage de la surface du fil ou son traitement avec le cuivre, l'aluminium ou le zinc.

Ernst Koch GmbH & Co KG – Allemagne
Website: www.koch-ihmert.de

Une meilleure précision avec le lancement du nouveau AccuScan

NDC Technologies a lancé AccuScan 6012 de Beta LaserMike, le mesureur de diamètre et de l'ovalité à quatre axes attendu depuis longtemps. Le nouveau mesureur, fabriqué à partir de la plateforme de la série testée et amplement utilisée AccuScan, se confirme comme le premier mesureur à quatre axes du secteur conçu pour la mesure de produits jusqu'à 12mm.

Cette innovation permet aux fabricants de câbles de télécommunications de mesurer le diamètre et l'ovalité des produits avec une majeure précision par rapport aux mesureurs à deux ou trois axes, en garantissant ainsi une meilleure qualité et des économies plus importantes comme résultat final.

Au fil des ans, les fabricants de télécommunications hautes performances ont compté sur les mesureurs de diamètre et ovalité à deux et à trois axes pour réaliser leurs mesures en ligne ou hors ligne. Toutefois, l'augmentation de la vitesse des lignes de production, de la rotation incontrôlable et de la vibration des produits représentent encore un défi en ce qui concerne la mesure.

La nécessité de mesurer avec précision le diamètre et l'ovalité des produits ronds cylindriques pour garantir le respect des exigences sévères en matière de conception et de qualité revêt une importance fondamentale pour les fabricants de câbles. Toute erreur dans le diamètre ou dans la rondeur du conducteur ou encore dans l'isolement d'un produit LAN coaxial et avec paires torsadées influence directement les performances du câble, en le rendant inutilisable pour les applications prévues. Ce produit inutilisable finit par être mis au rebut d'où une augmentation des coûts de fabrication.

▲ *Mesureur AccuScan 6012 de Beta LaserMike*

Le nouveau mesureur à quatre axes AccuScan 6012 de Beta LaserMike résout ce problème en offrant une couverture plus complète par rapport aux mesureurs à deux ou trois axes et à une vitesse de balayage ultra-rapide. La combinaison de ces avantages permet actuellement d'effectuer une mesure plus précise de l'ovalité et du diamètre extérieur moyen à des vitesses plus élevées et pour les applications hors ligne.

Principales caractéristiques:

- Une meilleure précision de la mesure du diamètre moyen: AccuScan 6012 effectue des mesures ultrarapides à 2400 balayages par seconde par axe (9600 mesures par seconde au total) et présente une répétabilité de chaque balayage à un micron. Cela signifie qu'avec chaque balayage il est possible d'obtenir une mesure réelle et plus précise du diamètre moyen.
- Une amélioration significative dans la précision de l'ovalité: AccuScan 6012 a amélioré de 42% l'enregistrement de l'ovalité réelle par rapport aux mesureurs à trois axes et offre une précision de 100% lorsque le produit est aligné avec les axes de mesure.
- Une précision très élevée dans la détection des défauts: AccuScan 6012 offre la meilleure précision de détection des défauts avec une amélioration de 25% par rapport aux mesureurs à trois axes. La vitesse de balayage ultrarapide et la meilleure précision, combinées avec l'option de contrôle de la tolérance à haute vitesse, permet de détecter les défauts des produits, tels que nœuds et étranglements. Cela permet aux fabricants de mieux contrôler la qualité de leurs produits, de réduire les quantités de ferrailles et de réaliser des économies dans le processus de production.
- Une précision élevée dans l'inspection de parts/échantillons hors ligne: avec le système de visualisation AccuNet basé sur ordinateur de Beta LaserMike, AccuScan 6012 peut être configuré de façon simple et rapide comme un système de mesure des parties hors ligne pour contrôler les échantillons et identifier, gérer et analyser les données critiques des produits. Ce qui permet d'éliminer la nécessité de configurer deux mesureurs à deux axes pour effectuer les mesures à quatre axes.
- AccuScan 6012 offre des fonctions de communication flexibles permettant de le connecter aisément aux micro-ordinateurs, API ou à des processus avec des protocoles avancés. Ce mesureur peut également être équipé d'un écran d'affichage ultra-lumineux optionnel et d'une interface humaine pour une configuration et un affichage des données conviviaux. Enfin, AccuScan 6012 permet l'installation de l'écran d'affichage sur la partie supérieure et sur le côté.

NDC Technologies – États-Unis
Website: www.ndc.com

Nouvelle ligne de mandrins de façonnage de Applied Plastics

Applied Plastics a lancé une nouvelle ligne de mandrins de façonnage revêtus de Teflon® pour effectuer des opérations de soudage par fusion et meulage de pointes de cathéter, projetés pour optimiser la qualité du diamètre interne et la vitesse de production.

Les mandrins de façonnage Natural® de PTFE de Applied Plastics présentent une surface lisse avec un coefficient de friction dynamique de 0,5 permettant d'en éviter l'adhésion, la contraction du tube e de faciliter l'enlèvement du cathéter. Ces mandrins d'extrusion permettant un allongement d'outre 25% sans générer d'écaillage ni de défauts, sont chimiquement inertes et peuvent fonctionner en continu jusqu'à une température de 315ºC (600ºF).

Les mandrins, disponibles en acier inoxydable ou en nitinol, peuvent être fournis coupés à longueur en diamètres de 0,127mm à 25,4mm avec une tolérance de ±0,003mm à ±0,013mm, en fonction de la dimension.

Applied Plastics Co Inc – États-Unis
Website: www.appliedplasticsinc.com

Critères de conception pour la fiabilité à long terme des câbles

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Résumé

Le présent article analyse les spécifications actuelles de la charge axiale admissible sur les câbles optiques. Il est démontré que le critère courant rencontré dans de nombreuses normes pour les câbles optiques, à savoir que la charge admissible à long terme devrait être inférieure à 20 pour cent de la charge d'essai, peut être, dans certains cas, optimiste. Au contraire, il est ici recommandé d'utiliser un nouveau critère, à savoir une charge à long terme standardisée à 0,14GPa (20kpsi).

1 Introduction

Pour les câbles aériens, il existe une série de spécifications contradictoires qui doivent être optimisées. L'un des objectifs consiste à réduire au minimum la déformation dans les fibres optiques.

Un deuxième objectif consiste à réduire au minimum le diamètre du câble pour diminuer la charge due au vent et à la glace. Un troisième objectif consiste à réduire au minimum la flèche pour chaque distance entre les pylônes. L'addition de fil d'aramide au câble réduit au minimum la déformation et la flèche, mais le matériau supplémentaire augmente le diamètre du câble lequel, à son tour, augmente la charge due au vent et à la glace.

Une variable clé pour l'optimisation de ces paramètres est représentée par la déformation admissible dans la fibre optique. Un procédé empirique commun, utilisé pendant plusieurs années, consiste à permettre un maximum de 20% de la tension d'essai (*proof-test)* comme déformation à long terme dans les fibres optiques du câble.

Ce critère apparaît dans plusieurs documents de normes en vigueur et s'est démontré raisonnable pour la génération actuelle de câbles fabriqués avec la fibre essayée à 0,69GPa (100kpsi).

Ce critère, qui a été développé pour assurer une fiabilité mécanique de 30 ans et qui est basé sur les performances excellentes de fiabilité générale des câbles aériens installés, semble valable.

Avec les câbles développés presque aux limites de conception, il vaut la peine d'explorer ces limites ainsi que les règles empiriques que l'on utilise dans la conception des câbles pour garantir que, dans le futur, les câbles optiques puissent offrir une fiabilité similaire ou supérieure à celle de leurs prédécesseurs.

2 Effets des modifications de conception des câbles sur la fiabilité

2.1 Remarques générales

Les limites de conception traditionnelles en ce qui concerne la fabrication des câbles optiques ont changé au cours de ces dix dernières années. Certains de ces changements concernent:

1 L'installation de câbles avec un nombre de fibres supérieur
2 L'installation de fibres à basse perte par macrocourbures (G.657) et de revêtements résistant à la microcourbure
3 La réduction des coûts en limitant au maximum le matériau du câble et en réduisant les limites de conception
4 Fibres testées à des valeurs supérieures (1,38GPa [200kpsi])

Ces modifications des tendances de conception des câbles peuvent influencer la fiabilité générale des câbles optiques.

Chaque modification sera examinée séparément pour démontrer que, lorsqu'elles sont combinées, elles peuvent influencer radicalement la fiabilité à long terme si elles ne sont pas gérées correctement.

2.2 Installation de câbles avec un nombre supérieur de fibres

De nombreux câbles aériens sont inclus dans la catégorie des câbles de dérivation (*drop cables*). Ces petits câbles connectent le réseau d'accès aux logements individuels. Normalement, il s'agit de câbles ayant un nombre de fibres réduit. Toutefois, en excluant ces câbles de dérivation, il y a une tendance générale à installer les câbles avec un nombre de fibres majeur. Cela est dû aux coûts élevés des droits de passage et d'installation.

Dans de nombreux câbles avec un nombre de fibres élevé, les fibres optiques représentent la moitié du poids des câbles. Plus le poids est élevé et majeure est la tension requise dans le câble pour réduire au minimum la flèche. Les fils d'aramide et les composés de fibres de verre (*FRP*) sont utilisés pour supporter la plupart de ce poids, alors que la charge résiduelle est supportée par les fibres optiques.

En outre, plus le nombre de fibres et élevé, plus le diamètre est grand. Les câbles de diamètre supérieur supportent une charge due au vent et à la glace majeure, ce qui complique la situation. Par conséquent, les câbles avec un nombre de fibres supérieur sont potentiellement sujets à une déformation majeure des fibres optiques.

2.3 Déploiement de fibres G.657 et revêtements résistant à la microcourbure

Il n'est donc pas surprenant de constater une augmentation des installations de fibres G.657 dans le réseau optique. Des données récentes provenant du CRU ont démontré que plus de six pour cent de la fibre optique installée actuellement appartient à cette catégorie. [*Private communications Patrick Faye of CRU*.] Les fibres G.657 sont installées grâce à leurs excellentes performances de macrocourbure. Un avantage supplémentaire des fibres G.657 est représenté par leur majeure résistance à la microcourbure qui les rend moins sensibles aux conditions de câblage.

Un autre développement clé des fibres optiques est représenté par l'installation de revêtements résistant à la microcourbure[1]. Cette nouvelle génération de revêtements de la fibre optique montre de deux à quatre fois moins de pertes dues à la microcourbure par rapport à celles installées il y a cinq, dix ans.

Ensemble, ces deux perfectionnements de la fibre optique influencent considérablement l'atténuation des câbles observés, même dans des conditions agressives. Les excellentes propriétés de la fibre et du revêtement peuvent «dissimuler» l'effet d'une conception ou d'une installation du câble inappropriée.

Lors de l'installation de câbles optiques utilisant les fibres G.652 traditionnelles avec une ample déformation résiduelle dans la fibre, l'on remarque souvent une atténuation supérieure. Par conséquent, le fabricant de câbles doit contrôler la déformation dans la fibre pour s'assurer que le câble répondra aux exigences de qualification. Lorsque l'on utilise les fibres G.657 avec des revêtements résistant à la microcourbure pour la même structure de câble, l'atténuation mesurée s'améliore et la même structure du câble pourrait répondre à cette spécification optique.

Le résultat final dérivant de l'utilisation des fibres G.657 est que le câble passera cet essai de qualification. Toutefois, après l'installation, la majeure déformation de la fibre peut présenter un risque de fiabilité à long terme.

En résumant, si le câble est conçu correctement, les fibres G.657 et les revêtements résistant à la microcourbure sont très avantageux pour les performances optiques du câble installé.

Toutefois, si le câble n'est pas bien conçu, les fibres optiques améliorées peuvent cacher le problème de la déformation à l'utilisateur final, et cela peut entraîner un risque de fiabilité mécanique à long terme.

2.4 Réduction des coûts en limitant au maximum le matériau du câble et en réduisant les limites de conception

Plusieurs câbles aériens sont conçus avec une déformation à zéro pour cent dans la fibre optique. Avec une pression sur les coûts plus forte, les concepteurs sont appelés à réduire les coûts des matériaux.

Lorsque l'on élimine les éléments autour de la fibre optique, cette dernière commence à supporter une partie de la déformation axiale qui est normalement supportée par les éléments de renfort dans le câble. Le concepteur de câbles peut faire référence aux diverses normes concernant l'installation des câbles et voir que la déformation maximale admissible à long terme correspond à 20 pour cent du niveau de l'essai. En fait, pour ces câbles, l'industrie est en train de passer d'une pratique de conception commune où les fibres optiques ne devaient supporter aucune déformation après l'installation à une autre permettant une déformation jusqu'à 20 pour cent du niveau d'essai.

Du fait de la longue histoire de la performance fiable du câble à ce niveau de déformation, il semble bien qu'il s'agisse d'une décision raisonnable.

2.5 Fibres essayées à plus de 1,38GPa (200kpsi) maintenant disponibles

Dans le chapitre précédent, il a été démontré que les coûts des matériaux peuvent être réduits en permettant la déformation dans la fibre optique. Pour la fibre optique traditionnelle qui est soumise à un test de 0,69GPa (100kpsi), la déformation maximale consentie dans la fibre à la limite de 20 pour cent est de 0,14GPa.

Un concepteur peut décider d'utiliser une fibre testée aux valeurs les plus élevées, telles que la fibre essayée à 1,38GPa (200kpsi), à la limite de 20 pour cent; dans ce cas, la déformation consentie dans la fibre après l'installation augmenterait à 0,28GPa. Cela permettrait de réduire davantage le matériau du câble optique en permettant une majeure déformation du câble jusqu'à doubler la valeur de déformation admissible dans la fibre optique. Le résultat final pourrait être un câble à fibre optique d'un coût inférieur.

2.6 Effet combiné des critères de conception des câbles optiques modifiés

Considérés dans leur ensemble, toutes ces tendances peuvent aboutir à un scénario guère optimal pour les fournisseurs de services. La déformation consentie dans les fibres en appliquant les critères usuels est majeure; toutefois cette déformation n'influence pas l'atténuation grâce à l'utilisation des fibres G.657. Le résultat final pourrait être un câble optique installé pour supporter une déformation à long terme jusqu'à 0,28GPa dans les fibres optiques. Entretemps, l'on espère que les fibres survivent plus de 30 ans sans ruptures. Cette situation teste en fait les limites de la théorie de la fiabilité et devrait être analysée plus en détail avant d'être appliquée.

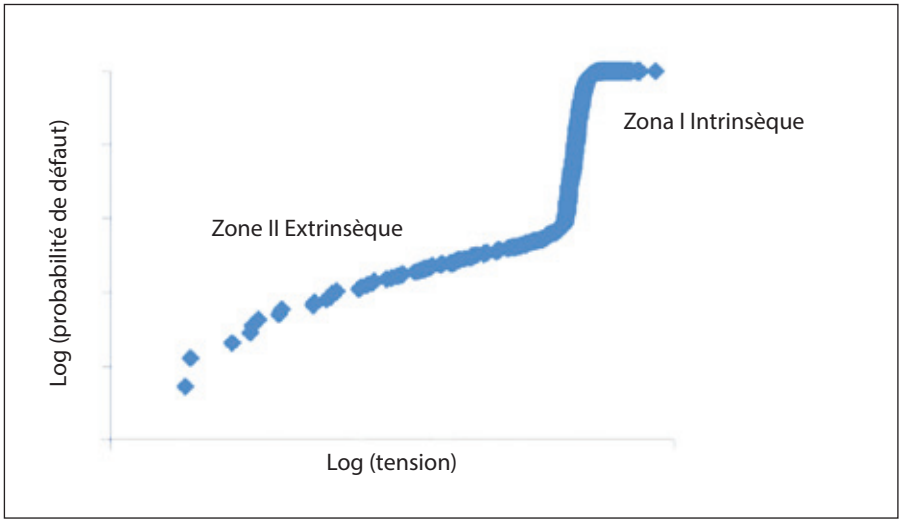
3 Origine du critère actuel de déformation admissible

Le procédé empirique courant utilisé dans la conception des câbles prend en considération une déformation maximale admissible égale à 20 pour cent du niveau de l'essai. Ce critère dérive d'une étude concernant la fiabilité, menée dans les années 90[2,3].

Dans cette étude, les auteurs montrent que les performances à long terme peuvent être mises en relation avec la tension d'essai (*proof test*), mais cela entraîne une certaine probabilité d'échec de l'essai même. Ensuite, les auteurs ont pris en considération différents paramètres de corrosion sous tension dans des fibres essayées à 50kpsi et 100kpsi pour démontrer que leur approximation était une méthode rationnelle et prudente pour assurer la fiabilité à long terme. Ce travail a représenté une avancée importante pour l'industrie de la fibre et a supporté la tendance à utiliser la fibre essayée aux niveaux courants.

Malheureusement, il existe une hypothèse fondamentale en ce qui concerne la distribution des défauts de la fibre

▼ **Figure 1**: *Probabilité de défaut pour plus de 100km de fibre testée à des longueurs de référence de 10m*



optique, c'est-à-dire la probabilité d'une rupture de la fibre pendant les essais. Cette probabilité n'est pas constante et peut varier dans les fibres fabriquées dans différentes conditions ou en utilisant les matières premières.

La *Figure 1* montre une courbe de probabilité d'erreur pour une fibre de silice générée par un équipement de l'auteur en utilisant une longueur de référence de 10m pour illustrer une gamme de défauts rencontrés dans les fibres optiques.

La figure montre deux zones: la zone I (résistance intrinsèque) et la zone II (résistance extrinsèque). La courbe illustre les principales zones exigeant d'être caractérisées pour prédire la fiabilité à long terme de la fibre.

La zone I est la zone de haute résistance intrinsèque. La fibre étudiée montrait la résistance intrinsèque du verre à ~4,6GPa, qui est considérablement supérieure à la limite de 3,1GPa recommandée par la norme Telecordia Gr-20. L'essai de résistance avec une longueur de référence courte dans cette zone peut être utilisé pour déterminer la valeur n, qui est supérieure à 20 pour la fibre examinée.

La résistance intrinsèque et les valeurs n sont typiquement spécifiées par les utilisateurs finals pour garantir la fiabilité à long terme du câble.

Malheureusement, la portion extrinsèque indiquée comme zone II, joue un rôle important dans la caractérisation de la fiabilité à long terme du câble optique. Cette zone contient des défauts plus proches du niveau d'essai et ces derniers sont espacés à une distance pouvant être également de plusieurs kilomètres.

Au fil du temps, ces défauts peuvent amener à des ruptures de la fibre si le câble est laissé sous tension. La compréhension de cette zone exige des informations qui ne peuvent être obtenues qu'en mesurant plusieurs kilomètres de fibre. Des niveaux d'essai plus élevés permettront d'éliminer certains des défauts plus importants de la fibre.

Toutefois, il est difficile de déterminer avec précision l'effet sur la fiabilité de la fibre optique dans un câble installé sans plus d'informations concernant la distribution générale des défauts dans la fibre. Une façon pour expliquer cela pourrait consister à soumettre le câble de fibre optique à un essai à un niveau proche de la résistance intrinsèque de la fibre ou à environ 3,8GPa (550kpsi). Si l'on soumet un échantillon de fibre de 1 000m générée par cette expérience à un effort constant de 110kpsi, on aurait probablement la rupture de la fibre en l'espace d'un jour ou bien avant les 40 ans de durée prévue.

Probabilité de défaut de 1km de fibre optique	Fibre testée à 0,69GPa à 20 pour cent de charge à long terme	Fibre testée à 0,69GPa à 40 pour cent de charge à long terme	Fibre testée à 1,38GPa à 20 pour cent de charge à long terme
1,0ppm par km	1,600 années	0.0 années	530 années*
1,0ppm per 100km	16 années	0.0 années	5.3 années*

* La fréquence de défaut varie considérablement en modifiant les valeurs d'essai (*proof-test*) de 0,69GPa à 1,38GPa

▲ **Tableau 1**: *Comparaison entre probabilité de défaut (durée de 1 ppm)*

Cet exemple représente un cas extrême, mais souligne également qu'il est important de comprendre les équations complexes qui règlent la fiabilité.

4 Instructions dérivées du rapport technique IEC concernant la fiabilité

L'un des modèles de fiabilité accepté actuellement a été publié par IEC[4]. Une des équations indiquées dans ce rapport est utilisée pour prévoir la durée de la fibre - l'équation de la durée pour la fibre optique après l'avoir essayée (*proof-test*)) et peut être représentée par l'expression suivante:

$$t_f = t_p \left(\frac{\sigma_p}{\sigma_a}\right)^n \left\{\left[1 - \frac{ln(1-F)}{N_p L}\right]^{\frac{n-1}{m_d n}} - 1\right\} \quad (1)$$

Où:
t_f est le temps qui précède le défaut (durée)
t_p est le temps d'essai (*proof-test*)
σ_p est la tension d'essai (*proof-test*)
σ_a est la tension appliquée
F est la probabilité du défaut
N_p est le taux de rupture durant l'essai
L est la longueur sous tension
m_d est le paramètre m Weibull de la fatigue dynamique
n est le paramètre de la corrosion sous tension

L'expression est complexe, mais il est toutefois possible de faire quelques remarques.

La *Figure 1* montre que plus l'effort appliqué est grand, plus la probabilité de défaut est fréquente. Il s'ensuit que le terme de probabilité de défaut dans l'équation, F, est en relation directe avec le terme d'effort appliqué, σ_a. Le procédé empirique traditionnel utilisé pour obtenir 20 pour cent de la contrainte d'essai comme charge maximale admissible à long terme présuppose que les deux variables sont indépendantes, ce qui n'est pas cohérent avec la *Figure 1*. Il est nécessaire d'essayer des centaines de kilomètres de fibre pour une connaissance approfondie de la relation entre la fréquence de défaut et l'effort appliqué.

Le *Tableau 1* présente les résultats comparatifs de trois scénarios. Le premier est constitué d'une fibre testée à 0,69GPa avec une charge à long terme de 20 pour cent de la charge d'essai (*proof-test*).

Pour générer les données, les valeurs suivantes ont été remplacées dans *l'Équation 1*:
n_d =20
m_d = 2,5
t_p = 0,05 secondes
N_p = 1 rupture tous les 250km

Le tableau montre qu'une fibre optique qui répond aux critères conservatifs cités plus haut, présenterait des performances mécaniques raisonnables pour l'essai à 0,69GPa à 20 pour cent du niveau d'essai.

Le deuxième cas montre que la même fibre a été maintenue à 40 pour cent du niveau d'essai. Dans ce cas, la fréquence de défaut de 1ppm serait atteinte en moins d'un an. Dans le troisième cas, il s'agit d'une fibre essayée à 1,38GPa avec une charge à long terme de 20 pour cent du niveau d'essai. Dans ces conditions spécifiques, la probabilité de défaut de 1ppm se manifeste en moins de six ans.

Il faut remarquer que les données du *Tableau 1* sont représentatives de la fibre dans un environnement non agressif. Les termes tels que le vieillissement en l'absence de tension, les macrocourbures, l'abrasion et d'autres facteurs peuvent réduire considérablement la durée de la fibre.

5 Discussion

La durée de la fibre est la somme de la probabilité du défaut intrinsèque et extrinsèque. Le présent article se concentre en particulier sur les longs traits de la fibre soumise à la charge axiale dans un régime où le défaut est dominé par les défauts extrinsèques.

Les résultats illustrés dans le *Tableau 1* soulignent le défaut dans la spécification commune pour les câbles optiques, selon lequel la charge à long terme dans les

fibres optiques est simplement égale à 20 pour cent du niveau d'essai. Si le taux de rupture des fibres était le même pour les fibres testées à 0,69GPa et 1,38GPa, les deux fibres auraient alors la même durée de 1ppm.

Les données de la *Figure 1* indiquent que cela n'est pas le cas. À la lumière de cette connaissance, les résultats de l'analyse changent radicalement.

Normalement, l'espérance de fiabilité à long terme pour les câbles à fibre optique est que la probabilité de défaut de la fibre soit inférieure à 1ppm dans 30 ans.

En utilisant ce critère, l'exemple donné au *Tableau 1*, peut être simplifié comme suit:

- une fibre testée à 0,69GPa à 20 pour cent de la charge à long terme, donnera des performances fiables
- une fibre testée à 0,69GPa à 40 pour cent de la charge à long terme ne donnera pas de performances fiables
- une fibre testée à 1,38GPa à 20 pour cent de la charge à long terme ne donnera pas de performances fiables

Bien qu'il ne soit pas clair qu'effectuer l'essai des câbles (*proof-test*) à des niveaux supérieurs améliore significativement les performances des ces derniers, la valeur utilisée ordinairement dans les normes de câblage (20 pour cent du niveau d'essai) peut entraîner de fausses espérances en ce qui concerne la fiabilité à long terme des câbles optiques.

6 Recommandations

Les informations fournies dans le présent document indiquent que, malgré 20 pour cent de la charge d'essai (*proof test*) pour une charge à long terme dans la fibre optique puisse constituer un critère raisonnable pour les fibres optiques testées à 0,69GPa ou à des valeurs inférieures, ce critère peut donner lieu à des évaluations optimistes pour les fibres optiques testées à des niveaux supérieurs.

Actuellement, la majorité des principales normes relatives aux fibres optiques, y compris les normes ITU-T, IEC, et TIA exigent que la fibre optique soit testée à 0,69GPa. Les normes concernant les câbles IEC, ICEA et IEEE devraient s'aligner avec ce critère.

Par conséquent, il est recommandé de modifier les documents simplement pour demander une charge maximale à long terme de 0,14GPa (20kpsi) dans la fibre optique câblée après l'installation, indépendamment du niveau d'essai.

On pourrait ajouter une note à la spécification selon laquelle, lorsqu'une fibre optique est installée avec des niveaux d'essai supérieurs à 0,69GPa, des valeurs de déformation supérieures dans la fibre optique influenceront la fiabilité; ces valeurs devraient être établies d'un commun accord par les fournisseurs des câbles et l'utilisateur final; en outre, des modèles de fiabilité plus précis devraient être pris en considération.

7 Conclusions

Le présent article a démontré que les conceptions des câbles modernes repoussent les limites de conception pour la déformation admissible à long terme dans les câbles optiques.

Dans ces nouvelles conditions limites, la règle empirique permettant jusqu'à 20 pour cent du niveau d'essai comme déformation à long terme, pourrait ne plus être appropriée.

Comme critère alternatif, on propose une nouvelle recommandation qui prévoit une charge à long terme limitée à 0,14GPa.

Ce nouveau critère devrait être inclus dans les révisions futures des normes concernant les fibres optiques.

Des formes constructives particulièrement critiques sont constituées de types de câbles sujets à des niveaux élevés de déformation tels que les câbles de dérivation et les câbles aériens y compris les câbles OPGW et ADSS. ■

8 Remerciements

Remerciements particuliers à Peter Hasløv (OFS), Hiroshi Nakamura (Furukawa) et Peter Pondillo (Corning) pour les précieuses discussions concernant la durée de la fibre.

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Acquisizione di Fenn

Quality Products Inc (QPI), produttore e distributore di attrezzature di supporto a terra per aerei, macchine utensili per presse idrauliche, presse piegatrici, presse e cesoie idrauliche, ha annunciato l'acquisizione di Fenn LLC.

Il presidente di Fenn, Paul Uccello, ha dichiarato: "É un gran risultato per i nostri clienti e per le imprese, e non potevamo essere più entusiasti del nostro futuro assieme. Con altre attività nel settore della fabbricazione di beni d'investimento, riteniamo che QPI disponga della combinazione perfetta di esperienza professionale e risorse per consentire a Fenn di continuare a sviluppare e produrre macchine di alta qualità."

Fenn continuerà a produrre macchinari progettati su misura in base alle specifiche dei clienti, che si tratti di impianti di laminazione, impianti di appiattimento o di formatura del filo, o banchi di trafilatura o di applicazioni per la laminazione dei bordi (testa di turco). Inoltre, Fenn continuerà ad offrire con orgoglio la propria linea industriale di prodotti che comprende avvolgitori di molle Torin, presse stampatrici e troncatrici del tipo a impatto. Con tutte le sue linee di prodotto, Fenn si concentrerà inoltre sul servizio di manutenzione e sulla fornitura di parti di ricambio.

QPI è specializzata in due settori: il settore delle macchine utensili e il settore delle attrezzature di supporto a terra per aerei. Il settore delle macchine utensili di QPI include le società Multi-Press, Pacific Press e Fenn. Multi-Press, la cui origine risale agli anni '20, è specializzata nella fornitura di presse elettriche e idrauliche di tecnologia avanzata che comprendono una linea completa di modelli da banco, da terra e a quattro colonne.

Pacific Press fornisce piegatrici idrauliche, cesoie e presse nel Nord America e produce un'ampia gamma di equipaggiamenti per la formatura dei metalli. Nella categoria delle attrezzature di supporto a terra per gli aerei, la società Columbus Jack ha fornito per decenni l'industria dell'aviazione offrendo attrezzature di supporto a terra a clienti del settore dell'aviazione commerciale, civile e militare.

Commentando la transazione, il presidente di Quality Products Inc, David Somers, ha dichiarato: "Questa acquisizione contribuirà all'espansione delle nostre attività nel settore dei macchinari e degli equipaggiamenti per la lavorazione dei metalli. "

Quality Products Inc – Stati Uniti
Website: www.multipress.com

Tecnologia innovativa OTA per fili di qualità

CHE si tratti di tecnologia del settore medicale, dell'alimentazione elettrica o della mobilità, il filo di qualità gioca un ruolo importante in tutte i settori industriali avanzati. La tecnologia OTA, sviluppata dal fornitore di sistemi Koch, consente di ottenere le migliori qualità richieste.

Il sistema di trafilatura permette di effettuare una trafilatura in linea retta, senza deviazioni, ad una controtensione constante e riproducibile. A partire dal bobinatore all'avvolgitore, grazie alla trafilatura lineare del filo, è possibile ottenere dimensioni di filo molto precise ed elevata qualità superficiale.

A seconda della qualità e delle dimensioni del filo e dei requisiti del prodotto finale, vengono utilizzate diverse macchine prodotte da Koch dotate di tecnologia OTA. Per la produzione di filo di acciaio precompresso e filo di acciaio per molle utilizzando cabestani con diametri fino a 1200mm, l'equipaggiamento KGT 47 con tecnologia OTA fissa dei parametri di riferimento.

Le dimensioni della macchina sono compatte e, nonostante sia soggetta a trazioni fino a 90.000N, produce pochissimo rumore. Della famiglia OTA fa parte anche il KGT 25. Questo equipaggiamento è particolarmente indicato per fili di acciaio a ridotto ed elevato tenore di carbonio e per fili di acciaio inossidabile. Il KGT 12 produce filo fino e filo per cavi di diametri inferiori a 0,8mm.

▲ *Secondo le specifiche del cliente: quale fornitore di sistemi, Koch progetta, fabbrica e installa linee di macchine complete*

In questo equipaggiamento, un'ottimizzazione del processo regolato dinamicamente assicura la precisione richiesta. La tecnologia OTA pone Koch ai vertici del mercato globale, poiché offre una produzione economica con la maggiore precisione, riproducibilità e qualità del prodotto.

Come fornitore di sistemi, Koch progetta, fabbrica e installa linee di macchine complete secondo le specifiche del cliente. La società, che è stata fondata da oltre 90 anni, ha sempre prodotto le proprie trafile internamente. Gli avvolgitori e le bobinatrici, anch'essi prodotti internamente, garantiscono la raccolta del filo in modo efficiente e attento, anche nel caso di bobine pesanti.

I moduli periferici realizzati dalle consociate completano le linee di macchine realizzando, ad esempio, funzioni quali la pulizia della superficie del filo o la sua raffinazione con il rame, l'alluminio o lo zinco. I clienti di oltre 60 paesi apprezzano il know-how tecnologico di Koch nei settori dell'ingegneria, della tecnologia degli azionamenti, della programmazione e del controllo.

Ernst Koch GmbH & Co KG – Germania
Website: www.koch-ihmert.de

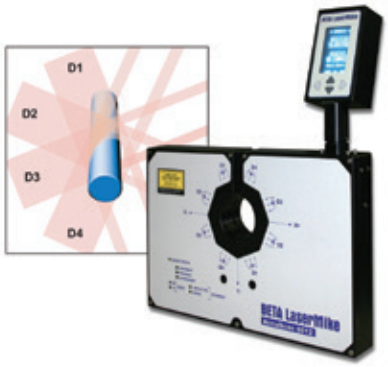
Maggiore precisione con il lancio del nuovo AccuScan

NDC Technologies ha lanciato il tanto atteso misuratore di diametro e ovalità a quattro assi AccuScan 6012 di Beta LaserMike. Il nuovo AccuScan 6012, fabbricato a partire dalla piattaforma della serie collaudata e ampiamente utilizzata AccuScan, si conferma come il primo misuratore a quattro assi del settore industriale progettato per la misurazione di prodotti fino a 12mm.

Questa innovazione consente ai fabbricanti di cavi di telecomunicazioni di misurare il diametro e l'ovalità dei prodotti con maggiore precisione rispetto ai misuratori a due o tre assi, garantendo così una maggiore qualità e risparmio finali.

Nel corso degli anni, i fabbricanti di cavi di telecomunicazione ad elevate prestazioni hanno contato sui misuratori di diametro e ovalità a due o tre assi per realizzare le proprie misurazioni in linea o fuori linea. Tuttavia, l'aumento di velocità delle linee di produzione e l'incontrollabile rotazione e vibrazione dei prodotti rappresentano tuttora una sfida per quanto riguarda la misurazione.

La necessità di misurare con precisione il diametro e l'ovalità dei prodotti tondi cilindrici per garantire il rispetto di rigorose specifiche di progettazione e di qualità è di importanza fondamentale per i fabbricanti di cavi. Qualsiasi errore nel diametro o nella rotondità del conduttore



▲ *Misuratore AccuScan 6012 di Beta LaserMike*

o ancora nell'isolamento di un prodotto LAN coassiale e con doppino intrecciato influenza direttamente le prestazioni del cavo, rendendolo inutilizzabile per le applicazioni previste. Questo prodotto inutilizzabile finisce con l'essere rottamato, aumentando così i costi di fabbricazione.

Il nuovo misuratore a quattro assi AccuScan 6012 di Beta LaserMike risolve questo problema offrendo una copertura più completa rispetto ai misuratori a due e tre assi e ad una velocità di scansione ultra rapida.

La combinazione di questi vantaggi rende ora possibile una misurazione più precisa dell'ovalità e del diametro esterno medio a velocità di linea più elevate e per applicazioni fuori linea.

Caratteristiche principali:

- Maggiore precisione nella misurazione del diametro medio: AccuScan 6012 esegue misurazioni ultra rapide a 2400 scansioni al secondo per asse (in totale 9600 misurazioni al secondo) e presenta una ripetibilità della singola scansione a un micron. Ciò significa che con ciascuna scansione è possibile ottenere una misurazione reale e più precisa del diametro medio.
- Miglioramento significativo nella precisione dell'ovalità: AccuScan 6012 ha migliorato del 42% il rilevamento dell'ovalità reale rispetto ai misuratori a tre assi e offre una precisione del 100% quando il prodotto è allineato con gli assi di misurazione.
- Elevatissima precisione nel rilevamento dei difetti: AccuScan 6012 offre la migliore precisione nel rilevamento di difetti con un miglioramento del 25% rispetto ai misuratori a tre assi. La velocità di scansione ultra rapida e la maggiore precisione, combinate con l'opzione di controllo della tolleranza ad alta velocità, consente di rilevare i difetti dei prodotti, come nodi e strozzature, con rapidità, precisione e affidabilità. Ciò permette ai fabbricanti di controllare meglio la qualità dei loro prodotti, di ridurre la quantità di scarti e di realizzare risparmi nella produzione.
- Elevata precisione nell'ispezione di parti/campioni fuori linea: con il sistema di visualizzazione basato su PC di Beta LaserMike, AccuScan 6012 può essere configurato in modo semplice e rapido come un sistema di misurazione di parti fuori linea per controllare campioni e rintracciare, gestire e analizzare i dati critici dei prodotti. Ciò evita la necessità di configurare due misuratori a due assi per eseguire misurazioni a quattro assi.
- AccuScan 6012 offre funzioni di comunicazioni flessibili che consentono di collegarlo facilmente a PC, PLC o processi con protocolli avanzati. Questo misuratore può inoltre essere equipaggiato con un display ultra-luminoso opzionale e un'interfaccia umana per una facile configurazione e visualizzazione dei dati. Infine, AccuScan 6012 permette l'installazione del display sia nella parte superiore che lateralmente.

NDC Technologies – Stati Uniti
Website: www.ndc.com

Nuova linea di mandrini di formatura di Applied Plastics

Applied Plastics ha lanciato una linea di mandrini di formatura rivestiti di Teflon® per effettuare operazioni di saldatura per fusione e molatura di punte di cateteri, progettati per ottimizzare la qualità del diametro interno e la velocità di produzione.

I mandrini di formatura Natural® di PTFE di Applied Plastics presentano una superficie liscia con un coefficiente di attrito dinamico dello 0,5 che consente di evitarne l'adesione, la contrazione del tubo e facilitare la rimozione del catetere. Questi mandrini estrusori che permettono un allungamento di oltre il 25% senza provocare scagliature né difetti, sono chimicamente inerti e possono funzionare in continuo fino a una temperatura di 315ºC (600ºF).

I mandrini, disponibili in acciaio inossidabile o nitinolo, possono essere forniti tagliati a misura in diametri da 0,127mm a 25,4mm con una tolleranza da ±0,003mm a ±0,013mm, a seconda della dimensione.

Applied Plastics Co Inc – Stati Uniti
Website: www.appliedplasticsinc.com

Criteri di progettazione per l'affidabilità a lungo termine dei cavi

A cura di David Mazzarese, Mike Kinard e Kariofilis (Phil) Konstadinidis, OFS, Norcross, Georgia, Stati Uniti

Riassunto

Il presente articolo esamina i requisiti attuali del carico assiale ammissibile sui cavi ottici. Si dimostra che il criterio corrente riscontrato in numerose norme per cavi ottici, ovvero che il carico ammissibile a lungo termine dovrebbe essere inferiore al 20 per cento della tensione di prova (*proof-test*), in alcuni casi può essere considerato ottimistico. Al contrario, in questa sede si raccomanda un nuovo criterio e cioè che il carico a lungo termine sia standardizzato a 0,14GPa (20kpsi).

1 Introduzione

Per i cavi aerei, esiste una serie di requisiti di progettazione contradditori che devono essere ottimizzati. Uno degli obiettivi consiste nel ridurre al minimo la deformazione nelle fibre ottiche. Un secondo obiettivo consiste nel ridurre al minimo il diametro del cavo per diminuire il carico dovuto al vento e al ghiaccio.

Un terzo obiettivo consiste nel ridurre al minimo la freccia per ciascuna distanza tra i tralicci. L'aggiunta del filo di aramide al cavo riduce al minimo la deformazione e la freccia, ma il materiale aggiunto aumenta il diametro del cavo che a sua volta aumenta il carico dovuto al vento e al ghiaccio.

Una variabile chiave per l'ottimizzazione di questi parametri è rappresentata dalla deformazione ammissibile nella fibra ottica. Una regola empirica comune, utilizzata per anni, consiste nel permettere un massimo del 20% della tensione di prova (*proof-test*) come deformazione a lungo termine nelle fibre ottiche del cavo.

Questo criterio compare in numerosi documenti di norme correnti e si è dimostrato ragionevole per la generazione attuale di cavi fabbricati con fibra testata a 0,69GPa (100kpsi).

Questo criterio, che è stato sviluppato per assicurare un'affidabilità meccanica di 30 anni e che si basa sulle eccellenti prestazioni di affidabilità generale dei cavi aerei installati, appare valido. Con cavi sviluppati quasi ai limiti di progettazione, vale la pena di esplorare tali limiti e le regole empiriche che si utilizzano nella progettazione dei cavi per assicurare che, in futuro, i cavi ottici installati possano fornire un'affidabilità simile o superiore a quella dei loro predecessori.

2 Effetti delle modifiche di progetto dei cavi sull'affidabilità

2.1 Osservazioni generali

I limiti di progetto tradizionali per la fabbricazione di cavi ottici sono cambiati negli ultimi dieci anni. Alcuni di questi cambiamenti riguardano:

1 L'installazione di cavi con un maggiore numero di fibre
2 L'installazione di fibre a bassa perdita per macrocurvatura (G.657) e di rivestimenti resistenti alla microcurvatura
3 Il taglio dei costi riducendo al minimo il materiale del cavo e riducendo i limiti di progettazione
4 Il test delle fibre a valori più elevati (1,38GPa [200kpsi])

Queste modifiche nelle tendenze di progettazione dei cavi possono influenzare l'affidabilità generale dei cavi ottici. Ciascuna modifica sarà esaminata separatamente per dimostrare che, quando combinate, possono influenzare radicalmente l'affidabilità a lungo termine se non gestite correttamente.

2.2 Installazione di cavi con un maggior numero di fibre

Numerosi cavi aerei sono inclusi nella categoria dei cavi di derivazione (*drop cables*). Questi piccoli cavi collegano la rete di accesso alle singole abitazioni.

Normalmente, si tratta di cavi con un ridotto numero di fibre. Tuttavia, escludendo questi cavi di derivazione, vi è una tendenza generale ad installare cavi con un maggiore numero di fibre. Ciò è dovuto agli elevati costi dei diritti di passaggio e di installazione.

In numerosi cavi con un elevato numero di fibre, la metà del peso dei cavi ottici è costituito dalle fibre ottiche. Maggiore è il peso, maggiore è la tensione richiesta nel cavo per ridurre al minimo la freccia.

I fili di aramide e i composti di fibra di vetro (*FRP*) vengono utilizzati per sostenere la maggior parte di questo carico, mentre il carico residuo viene supportato dalle fibre ottiche.

Inoltre, quanto più elevato è il numero di fibre in un cavo ottico, tanto più grande è il suo diametro. I cavi di diametro maggiore sopportano un maggiore carico dovuto al vento e al ghiaccio, rendendo la situazione più complessa.

Di conseguenza, i cavi con un numero maggiore di fibre sono potenzialmente soggetti a una maggiore deformazione delle fibre ottiche.

2.3 Installazione di fibre G.657 e rivestimenti resistenti alla microcurvatura

Non è sorprendente che assistiamo ad una maggiore installazione di fibre G.657 nella rete ottica. Dati recenti provenienti dal CRU hanno dimostrato che oltre il sei per cento della fibra ottica installata attualmente appartiene a questa categoria [*Private communications Patrick Faye of CRU.*] Le fibre G.657 vengono installate grazie alle loro ottime prestazioni di macrocurvatura. Un ulteriore vantaggio delle fibre G.657 è dato dalla loro maggiore resistenza alla microcurvatura che le rende meno sensibili alle condizioni di cablaggio. Un altro sviluppo chiave delle fibre ottiche è rappresentato dall'installazione di rivestimenti resistenti alla microcurvatura[1].

Questa nuova generazione di rivestimenti della fibra ottica mostra da due a quattro volte perdite in meno dovute alla microcurvatura rispetto a quelle installate cinque, dieci anni fa.

Assieme, questi due miglioramenti della fibra ottica influiscono notevolmente sull'attenuazione dei cavi osservati, persino in condizioni aggressive. Le eccellenti proprietà della fibra e del rivestimento possono "dissimulare" l'effetto di una progettazione o di un'installazione del cavo inadeguati.

Quando vengono installati cavi ottici utilizzando fibre G.652 tradizionali con un'elevata deformazione residua nella fibra, si osserva sovente una maggiore attenuazione. Pertanto, il fabbricante di cavi deve controllare la deformazione nella fibra per assicurarsi che il cavo soddisfi i requisiti di qualificazione.

Quando si utilizzano fibre G.657 con rivestimenti resistenti alla microcurvatura per la stessa struttura di cavo, migliora l'attenuazione misurata e la stessa struttura di cavo potrebbe soddisfare tali requisiti ottici. Il risultato finale derivante dall'utilizzo di fibre G.657 è che il cavo supererà questa prova di qualificazione. Tuttavia, dopo l'installazione, la maggiore deformazione della fibra può presentare un rischio di affidabilità a lungo termine.

Riassumendo, se il cavo è progettato correttamente, le fibre G.657 e i rivestimenti resistenti alla microcurvatura sono di grande vantaggio per le prestazioni ottiche del cavo installato.

Tuttavia, se il cavo non è ben progettato, le fibre ottiche migliorate possono mascherare il problema della deformazione all'utente finale, e ciò può comportare un rischio di affidabilità meccanica a lungo termine.

2.4 Taglio dei costi riducendo al minimo il materiale del cavo e riducendo i limiti di progettazione

Molti cavi aerei sono progettati con una deformazione allo zero per cento nella fibra ottica. Con un maggiore pressione sui costi, i progettisti sono chiamati a ridurre i costi dei materiali. Quando si eliminano gli elementi di rinforzo attorno alla fibra ottica, questa deve sopportare parte della deformazione assiale che normalmente è sopportata dagli elementi di rinforzo del cavo. Il progettista di cavi può fare riferimento alle varie norme sull'installazione dei cavi e vedere che la deformazione massima ammissibile a lungo termine corrisponde al 20 per cento del livello di prova.

Effettivamente, per questi cavi, l'industria sta passando da una prassi di progettazione comune in cui le fibre ottiche non dovevano sopportare alcuna deformazione dopo l'installazione a un'altra in cui è consentita una deformazione fino al 20 per cento del livello di prova. La lunga storia del rendimento affidabile del cavo a questo livello di deformazione la fa apparire una decisione ragionevole.

2.5 Fibre testate a oltre 1,38GPa (200kpsi) ora disponibili

Nel capitolo precedente è stato dimostrato che i costi del materiale possono essere ridotti consentendo una certa deformazione nella fibra ottica. Per la fibra ottica tradizionale che viene testata a 0,69GPa (100kpsi), la deformazione massima consentita nella fibra al limite del 20 per cento è di 0,14GPa. Un progettista può decidere di utilizzare una fibra testata a valori più alti, come la fibra testata a 1,38GPa (200kpsi), al limite del 20 per cento; in questo caso la deformazione consentita nella fibra dopo l'installazione aumenterebbe a 0,28GPa.

Ciò consentirebbe ulteriori riduzioni di materiale del cavo ottico permettendo una maggiore deformazione nel cavo fino a raddoppiare il valore ammissibile di deformazione nella fibra ottica. Il risultato finale potrebbe essere un cavo a fibra ottica di costo inferiore.

2.6 Impatto combinato dei criteri di progettazione dei cavi ottici modificati

Considerate nel loro insieme, tutte queste tendenze possono condurre ad uno scenario non ottimale per i fornitori di servizi. La deformazione consentita nelle fibre applicando i criteri consueti è maggiore; tuttavia, tale deformazione non influenza l'attenuazione grazie all'utilizzo delle fibre G.657. Il risultato finale potrebbe essere un cavo ottico installato per sopportare una deformazione a lungo termine fino a 0,28GPa nelle fibre ottiche. Nel frattempo, si spera che le fibre sopravvivano oltre 30 anni senza rompersi.

Questa situazione mette alla prova i limiti della teoria di affidabilità e dovrebbe essere analizzata più attentamente prima di essere applicata.

3 Origine dell'attuale criterio di deformazione ammissibile

La regola empirica corrente utilizzata nella progettazione dei cavi prende in considerazione una deformazione massima ammissibile pari al 20 per cento del livello di prova. Questo criterio deriva da uno studio sull'affidabilità realizzato negli anni 90[2,3]. In questo studio gli autori mostrano che le prestazioni a lungo termine possono essere poste in relazione con la tensione di prova (*proof-test*), ma ciò comporta una certa probabilità di errore della prova stessa.

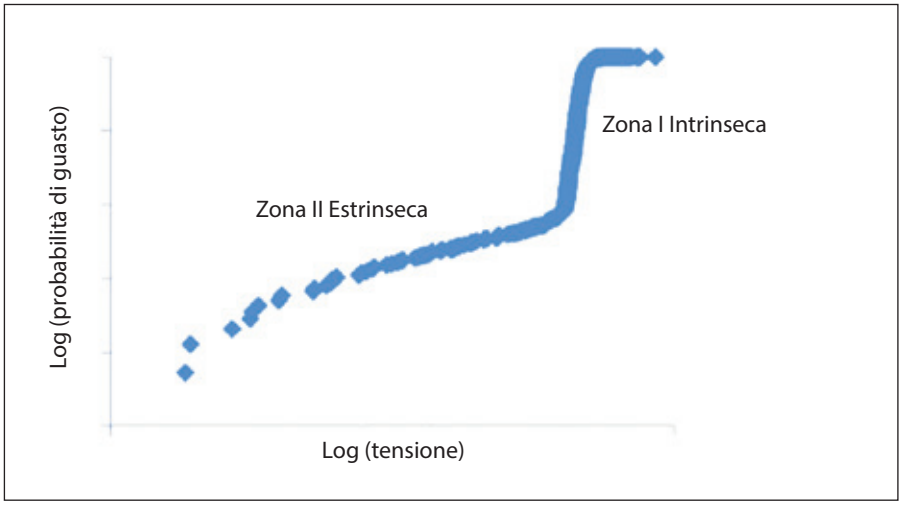
Allora, gli autori presero in considerazione vari parametri di tensocorrosione e fibre testate a 50kpsi e 100kpsi per dimostrare che la loro approssimazione era un metodo razionale e prudente per assicurare l'affidabilità a lungo termine. Questo lavoro rappresentò un importante passo in avanti per l'industria della fibra sostenendo la tendenza ad utilizzare la fibra testata ai livelli correnti.

Sfortunatamente, esiste un presupposto fondamentale circa la distribuzione dei difetti della fibra ottica, ovvero la probabilità di una rottura della fibra durante le prove.

Questa probabilità non è costante e può variare nelle fibre fabbricate in diverse condizioni o utilizzando materie prime.

La *Figura 1* mostra una curva di probabilità di errore per una fibra di silicio generata da

▼ **Figura 1**: *Probabilità di guasto per oltre 100km di fibra testata a lunghezze di riferimento di 10m*



un'apparecchiatura dell'autore utilizzando una lunghezza di riferimento di 10m per illustrare una gamma di difetti incontrati nelle fibre ottiche.

La figura mostra due zone: la zona I (resistenza intrinseca) e la zona II (resistenza estrinseca). La curva illustra le zone principali che richiedono di essere caratterizzate per predire l'affidabilità a lungo termine della fibra. La zona I è la zona di alta resistenza intrinseca. La fibra studiata mostrava la resistenza intrinseca del vetro a ~4,6GPa, che è notevolmente superiore al limite di 3,1GPa raccomandato dalla norma Telecordia Gr-20.

La prova di resistenza con una lunghezza di riferimento breve in questa zona può essere utilizzata per determinare il valore n, che è maggiore di 20 per la fibra esaminata.

La resistenza intrinseca e i valori n sono tipicamente specificati dagli utilizzatori finali per garantire l'affidabilità a lungo termine del cavo.

Sfortunatamente, la porzione estrinseca indicata come zona II, gioca un ruolo importante nella caratterizzazione dell'affidabilità a lungo termine del cavo ottico. Questa zona contiene difetti più prossimi al livello di prova e sono spaziati ad una distanza che può essere anche di parecchi chilometri.

Con il tempo, questi difetti possono sfociare in rotture della fibra se il cavo viene tenuto sotto tensione.

La comprensione di questa zona richiede informazioni che si possono ottenere solamente misurando molti chilometri di fibra. Livelli di prova più alti consentiranno di eliminare alcuni dei difetti più importanti della fibra.

Tuttavia, è difficile determinare con precisione l'effetto sull'affidabilità della fibra ottica in un cavo installato senza maggiori informazioni sulla distribuzione generale dei difetti nella fibra.

Un modo per spiegare questo potrebbe essere sottoporre un cavo di fibra ottica ad una prova a un livello prossimo alla resistenza intrinseca della fibra o a circa 3,8GPa (550kpsi).

Se si sottoponesse un campione di fibra di 1.000m prodotta da questo esperimento ad uno sforzo constante di 110kpsi, probabilmente la fibra si romperebbe in meno di un giorno, o molto prima dei 40 anni di durata prevista.

Questo esempio rappresenta un caso estremo, ma evidenzia l'importanza di capire le complesse equazioni che governano l'affidabilità.

Probabilità di guasto di 1km di fibra ottica	Fibra testata a 0,69GPa al 20 per cento di carico a lungo termine	Fibra testata a 0,69GPa al 40 per cento di carico a lungo termine	Fibra testata a 1,38GPa al 20 per cento del carico a lungo termine
1,0ppm per km	1,600 anni	0.0 anni	530 anni*
1,0ppm per 100km	16 anni	0.0 anni	5.3 anni*

* La frequenza del guasto varia notevolmente modificando i valori di prova (*proof-test*) da 0,69GPa a 1,38GPa

▲ **Tabella 1**: *Comparazione fra probabilità di guasto (durata di 1 ppm)*

4 Istruzioni del rapporto tecnico IEC sull'affidabilità

Uno dei modelli di affidabilità accettato correntemente è stato pubblicato dalla IEC[4]. Una delle equazioni indicate in questo rapporto viene utilizzata per predire la durata della fibra - l'equazione della durata per la fibra ottica dopo averla testata (*proof-test*). Questa può essere rappresentata dalla seguente espressione:

$$t_f = t_p \left(\frac{\sigma_p}{\sigma_a}\right)^n \left\{\left[1 - \frac{ln(1-F)}{N_p L}\right]^{\frac{m_d+1}{n_d}} - 1\right\} \quad (1)$$

Dove:
t_f è il tempo che precede il guasto (durata)
t_p è il tempo di prova (*proof-test*)
σ_p è la tensione di prova (*proof-test*)
σ_a è la tensione applicata
F è la probabilità di guasto
N_p è l'indice di rottura durante la prova
L è la lunghezza sotto tensione
m_d è il parametro m Weibull della fatica dinamica
n è il parametro di tensocorrosione

L'espressione è complessa, tuttavia si possono fare alcune osservazioni.

La *Figura 1* mostra che quanto maggiore è la tensione applicata, tanto maggiore è la probabilità di guasto. Ne consegue che il termine di probabilità di guasto nell'equazione, F, è in rapporto diretto con il termine di sforzo applicato, σ_a.

La regola empirica tradizionale utilizzata per ottenere il 20 per cento della tensione di prova come carico massimo ammissibile a lungo termine presuppone che queste due variabili siano indipendenti, il che non è coerente con la *Figura 1*.

È necessario sottoporre a prova centinaia di chilometri di fibra per una conoscenza approfondita della relazione fra la frequenza di guasto e la tensione applicata.

La *Tabella 1* presenta i risultati comparativi di tre scenari. Il primo è costituito da una fibra testata a 0,69GPa con un carico a lungo termine del 20 per cento del carico di prova (*proof-test*).

Per generare i dati, sono stati sostituiti i seguenti valori nell'*Equazione 1*:
n_d =20
m_d = 2,5
t_p = 0,05 secondi
N_p = 1 rottura ogni 250km

La tabella mostra che una fibra ottica che soddisfa i criteri conservativi di cui sopra presenterebbe prestazioni meccaniche ragionevoli per il test a 0,69GPa al 20 per cento del livello di prova. Il secondo caso mostra che la stessa fibra è stata mantenuta a un 40 per cento del livello di prova.

In questo caso, la frequenza di guasto di 1ppm verrebbe raggiunta in meno di un anno. Il terzo caso è costituito da una fibra testata a 1,38GPa con carico a lungo termine del 20 per cento del livello di prova. In queste specifiche condizioni, la probabilità di guasto di 1ppm si verifica in meno di sei anni.

Va notato che i dati della *Tabella 1* sono rappresentativi della fibra in un ambiente non aggressivo. I termini quali l'invecchiamento in assenza di tensione, le macrocurvature, l'abrasione e altri fattori possono ridurre notevolmente la durata della fibra.

5 Discussione

La durata della fibra è la somma della probabilità di guasto intrinseco ed estrinseco. Il presente articolo esamina in particolare lunghi tratti di fibra sottoposti a carico assiale in un regime in cui il guasto è dominato da guasti estrinseci.

I risultati illustrati nella *Tabella 1* evidenziano l'errore nel requisito comune per i cavi ottici, in base al quale il carico a lungo termine nelle fibre ottiche è semplicemente pari al 20 per cento del livello di prova.

Se l'indice di rottura della fibra fosse lo stesso per le fibre provate a 0,69GPa e 1,38GPa, allora entrambe le fibre avrebbero la medesima durata di 1ppm. I dati della *Figura 1* indicano che non è questo il caso. Alla luce di questa conoscenza, i risultati dell'analisi cambiano radicalmente.

Normalmente, l'aspettativa di affidabilità a lungo termine per i cavi a fibra ottica è che la probabilità di guasto della fibra sia inferiore a 1ppm in 30 anni.

Utilizzando questo criterio, l'esempio dato nella *Tabella 1* può essere semplificato come segue:

- una fibra testata a 0,69GPa al 20 per cento del carico a lungo termine darà prestazioni affidabili
- una fibra testata a 0,69GPa al 40 per cento del carico a lungo termine non darà prestazioni affidabili
- una fibra testata a 1,38GPa al 20 per cento del carico a lungo termine non darà prestazioni affidabili

Nonostante sia chiaro che effettuare la prova dei cavi (*proof-test*) a livelli superiori migliori significativamente le prestazioni degli stessi, il valore utilizzato comunemente nelle norme di cablaggio (20 per cento del livello di prova) può condurre a false aspettative circa l'affidabilità a lungo termine dei cavi ottici.

6 Raccomandazioni

Le informazioni fornite nel presente documento indicano che, nonostante il 20 per cento del carico di prova (proof test) per un carico a lungo termine nella fibra ottica possa costituire un criterio ragionevole per le fibre ottiche testate a 0,69GPa o a valori inferiori, tale criterio può dar luogo a stime ottimistiche per le fibre ottiche testate a livelli superiori. Attualmente, la maggioranza delle norme più importanti relative alle fibre ottiche, incluse le norme ITU-T, IEC, e TIA richiedono che la fibra ottica sia collaudata a 0,69GPa.

Le norme sui cavi IEC, ICEA e IEEE dovrebbero allinearsi con questo criterio. Pertanto, si raccomanda di modificare i documenti semplicemente per richiedere un carico massimo a lungo termine di 0,14GPa (20kpsi) nella fibra ottica cablata dopo l'installazione, indipendentemente dal livello di prova. Si potrebbe aggiungere una nota al requisito che afferma che quando si installa una fibra ottica con livelli di prova superiori a 0,69GPa, valori di deformazione maggiori nella fibra ottica influenzeranno l'affidabilità, i quali dovrebbero essere concordati fra il fornitore di cavi e l'utilizzatore finale, e inoltre si dovrebbero prendere in considerazione modelli di affidabilità della fibra più precisi.

7 Conclusioni

Il presente articolo ha dimostrato che i progetti dei cavi moderni stanno spingendo i limiti di progettazione per la deformazione ammissibile a lungo termine nei cavi ottici.

In queste nuove condizioni limite, la regola empirica che consente fino al 20 per cento del livello di prova come deformazione a lungo termine potrebbe non essere più appropriata. Come criterio alternativo, viene proposta una nuova raccomandazione che prevede un carico a lungo termine limitato a 0,14GPa.

Questo nuovo criterio dovrebbe essere incluso nelle revisioni future delle norme per i cavi di fibre ottiche. Forme costruttive particolarmente critiche sono costituite da tipi di cavi sottoposti ad alti livelli di deformazione come i cavi di derivazione e i cavi aerei inclusi i cavi OPGW e ADSS. ■

8 Ringraziamenti

Un particolare ringraziamento va a Peter Hasløv (OFS), Hiroshi Nakamura (Furukawa) e Peter Pondillo (Corning) per le utili discussioni sulla durata della fibra.

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Adquisición de Fenn

Quality Products Inc (QPI), fabricante y distribuidor de equipos de apoyo en tierra para aviones, máquinas-herramienta de prensa hidráulica, prensas dobladoras, prensas y cizallas hidráulicas, ha anunciado su intención de adquirir Fenn LLC.

El presidente de Fenn, Paul Uccello, declaró: "Es un magnífico paso para nuestros clientes y empresas, y estamos muy ilusionados con nuestro futuro juntos. Con otras empresas en el campo de la fabricación de bienes de equipo, creemos que QPI dispone de la combinación perfecta de experiencia y recursos empresariales para permitirle a Fenn seguir desarrollando y produciendo máquinas de alta calidad."

Fenn seguirá fabricando maquinaria de diseño personalizado según las especificaciones de los clientes, ya se trate de plantas de laminación, aplanado y modelado de alambrón que de bancos de trefilado o aplicaciones con cabezas de turco. Además, Fenn continuará ofreciendo con orgullo su línea industrial de productos, que comprende enrolladoras de resortes Torin, estampadoras y cortadoras por impacto. Con todas sus líneas de productos, Fenn también dará un nuevo enfoque al servicio de mantenimiento de máquinas y suministro de piezas de repuesto.

QPI se dedica a dos sectores, el de las máquinas-herramienta y el de los equipos de soporte en tierra para aviones. El sector de las máquinas-herramienta de QPI abarca las empresas Multi-Press, Pacific Press y Fenn. Multi-Press, cuyo origen se remota a los años '20, es proveedor de prensas eléctricas e hidráulicas de alta tecnología que comprenden una línea completa de modelos de banco, de pie y sobre cuatro patas.

Pacific Press suministra dobladoras hidráulicas, cizallas y prensas en Norteamérica y fabrica una vasta gama de equipos de conformación de metales. En la categoría de los equipos de apoyo en tierra para aviones, Columbus Jack ha ofrecido sus servicios al sector de la aviación durante décadas suministrando equipos de apoyo en tierra para aviones a su clientela de la aviación comercial, civil y militar.

Quality Products Inc – EE UU
Website: www.multipress.com

Tecnología innovadora OTA para alambres de calidad

YA se trate de tecnología médica, ingeniería de suministro eléctrico o movilidad, un alambre de calidad juega un papel importante en todos los sectores industriales crecientes. La tecnología OTA, desarrollada por el proveedor de sistemas Koch, permite obtener las mejores calidades requeridas.

El sistema de enderezado permite efectuar un enderezado en línea recta, sin desvíos, a una contratensión constante y reproducible.

Desde el desenrollador hasta la bobinadora, gracias al enderezado lineal del alambre, es posible conseguir un alambre de dimensiones muy precisas y de alta calidad superficial.

Dependiendo de la calidad, de las dimensiones del alambre y de los requisitos del producto final, se emplean distintas máquinas con tecnología OTA producidas por Koch.

Para la producción de alambre de acero pretensado y alambre de acero para resortes usando cabrestantes de diámetros de hasta 1200mm, el equipo KGT 47 con tecnología OTA marca estándares de referencia.

El tamaño de la máquina es compacto y, a pesar de estar sujeta a tracciones de hasta 90.000N, produce poquísimo ruido. Como parte de la familia OTA también tenemos al KGT 25. Este equipo es indicado especialmente para alambre de acero de bajo y alto carbono, así como para alambre de acero inoxidable. El KGT 12 produce alambre fino y alambre para cables de diámetros inferiores a 0,8mm.

▲ *Según las especificaciones del cliente: como proveedor de sistemas, Koch diseña, fabrica e instala líneas de máquinas completas*

En este equipo una optimización del proceso regulado de modo dinámico garantiza la precisión requerida. La tecnología OTA sitúa a Koch en primera línea en el mercado global, ya que ofrece producción económica con la mayor precisión, reproducibilidad y calidad del producto.

Como proveedor de sistemas, Koch diseña, fabrica e instala líneas de máquinas completas según las especificaciones del cliente. La empresa, que fue fundada hace más de 90 años, siempre ha fabricado sus enderezadoras internamente. Las enrolladoras y encarretadoras, fabricadas también internamente, garantizan la recogida del alambre con eficiencia y cuidado, incluso en el caso de bobinas pesadas.

Los módulos periféricos fabricados por empresas asociadas completan las líneas de máquinas realizando, por ejemplo, funciones como la limpieza de la superficie del alambre o su tratamiento con cobre, aluminio, zinc.

Los clientes de más de 60 países aprecian el know-how técnico de Koch en los sectores de la ingeniería, tecnología de accionamientos, programación y control.

Ernst Koch GmbH & Co KG – Alemania
Website: www.koch-ihmert.de

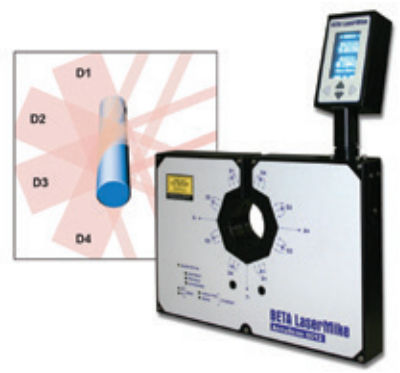
Mayor precisión con el nuevo AccuScan

NDC Technologies ha lanzado el tan esperado medidor de diámetro y ovalidad de cuatro ejes AccuScan 6012 de Beta LaserMike. El nuevo AccuScan 6012, fabricado a partir de la plataforma de la serie probada y de uso generalizado AccuScan, se confirma como el primer medidor de cuatro ejes del sector industrial capaz de medir productos de hasta 12mm.

Este innovador medidor les permite a los fabricantes de cables de comunicaciones medir el diámetro y la ovalidad de los productos con mayor precisión que los medidores de dos o tres ejes, garantizando así mayor calidad y ahorro final.

Hasta ahora, los fabricantes de cables de comunicaciones de alto rendimiento han venido utilizando medidores de diámetro y ovalidad de dos o tres ejes para realizar sus medidas en línea y fuera de línea. Pero el aumento de las velocidades de producción y la incontrolable rotación y vibración de los productos representan todo un desafío a la hora de medir.

La necesidad de medir con precisión el diámetro y la ovalidad de los productos cilíndricos redondos para poder ajustarse exactamente al diseño y cumplir especificaciones de calidad es de suma importancia para los fabricantes de



▲ *Medidor AccuScan 6012 de Beta LaserMike*

cables. Cualquier error en el diámetro o redondez del conductor o del aislamiento de un producto LAN coaxial y de par trenzado afecta directamente al rendimiento del cable, dejándolo inservible para la aplicación prevista. Este producto inservible acaba siendo troceado como chatarra, aumentando así los costes de fabricación.

El nuevo medidor de cuatro ejes AccuScan 6012 de Beta LaserMike elimina este problema ofreciendo un campo de medida más extenso que los medidores de dos y tres ejes y una velocidad de barrido ultra rápida. Con estas ventajas ahora es posible realizar una medida de la ovalidad y del diámetro medio externo de mayor precisión a velocidades de línea más elevadas y para aplicaciones fuera de línea.

Características destacadas:

- Mayor precisión en la medida del diámetro medio: AccuScan 6012 realiza medidas ultra rápidas a razón de 2400 barridos/s por eje (en total 9600 medidas/s) y ofrece repetibilidad de barrido individual de hasta una micra. Esto significa que con cada barrido se puede obtener una medida de diámetro medio real y de mayor precisión.
- Significativa mejora en la precisión de ovalidad: AccuScan 6012 ha mejorado en un 42% la medida de ovalidad real respecto a los medidores de tres ejes y ofrece una precisión de ovalidad del 100% cuando el producto está alineado con los ejes de medida.
- Elevadísima precisión en la detección de defectos: AccuScan 6012 ofrece la mejor precisión en la detección de defectos con una mejora del 25% respecto a los medidores de tres ejes. La velocidad de medida ultra rápida y la mayor precisión, combinadas con el control de tolerancia a alta velocidad, permite detectar los defectos de los productos, tales como bultos y estrechamientos, con prontitud, precisión y fiabilidad. Esto les permite a los fabricantes controlar mejor la calidad de los productos, reducir la cantidad de chatarra y ahorrar en el proceso productivo.
- Elevada precisión en la inspección de piezas/muestras fuera de línea: con el sistema de visualización en PC de Beta LaserMike, AccuScan 6012 puede ser configurado de manera fácil y rápida como un sistema de medida de piezas fuera de línea para comprobar muestras y rastrear, administrar y analizar los datos críticos de los productos. Esto evita tener que configurar dos medidores de dos ejes para tomar medidas en cuatro ejes.
- AccuScan 6012 ofrece funciones de comunicación flexibles que permiten conectarlo fácilmente a PCs, PLCs o procesos con protocolos de vanguardia. Este medidor también puede ser equipado con una pantalla ultra brillante opcional y una interfaz humana que permita configurar y ver las medidas fácilmente. En AccuScan 6012 la pantalla puede ser montada en la parte superior o lateralmente.

NDC Technologies – EE UU
Website: www.ndc.com

Nuevos mandriles lisos de Applied Plastics

Applied Plastics lanza una línea de mandriles revestidos de Teflon® para biselar la punta y soldar por fusión catéteres, diseñados para optimizar la calidad del diámetro interno y la velocidad de producción.

▲ *Mandriles revestidos de Teflón de Applied Plastics*

Los mandriles conformadores Natural® de PTFE de Applied Plastics tienen una superficie lisa con un coeficiente de rozamiento dinámico de 0,5 que evita que se claven, que se obstruya el tubo por contracción y facilita la retirada del catéter. Estos mandriles extrusores, que admiten un alargamiento de más del 25% sin descascarillado ni fallos, son inertes químicamente y pueden funcionar de manera continua a temperaturas de hasta 315ºC (600ºF).

Los mandriles, disponibles de acero inoxidable o nitinol, pueden ser suministrados previamente cortados en diámetros de 0,127mm a 25,4mm con una tolerancia de ±0,003mm a ±0,013mm, dependiendo del tamaño.

La versión Natural® de PTFE gris no contiene ácido perfluorooctanoico (PFOA). El uso de un proceso de preparación de la superficie patentado antes de aplicar el revestimiento garantiza la persistencia del revestimiento al descascarillado o al agrietamiento.

Applied Plastics Co Inc – EE UU **Website**: www.appliedplasticsinc.com

Criterios de diseño para la fiabilidad de los cables a largo plazo

Por David Mazzarese, Mike Kinard Y Kariofilis (Phil) Konstadinidis, OFS, Norcross, Georgia, Estados Unidos

Resumen

En este artículo se examinan los requisitos actuales de carga axial permitida en los cables ópticos. Se demuestra que el criterio corriente encontrado en muchas normas para cable óptico, es decir, que la carga permitida a largo plazo debería ser inferior al 20 por ciento de la tensión de prueba (*proof test*), puede ser un valor optimista en algunos casos. En cambio, ahora se recomienda un nuevo criterio, es decir que la carga a largo plazo sea normalizada a 0,14GPa (20kpsi).

1 Introducción

Para los cables aéreos, hay una serie de requisitos de diseño contradictorios que deben ser optimizados. Uno de los objetivos es reducir al mínimo la deformación de las fibras ópticas.

Un segundo objetivo es reducir al mínimo el diámetro del cable para reducir la carga debida a viento e hielo. Un tercer objetivo es reducir al mínimo la flecha de cada tramo. El hilo de aramida añadido al cable reduce al mínimo la deformación y la flecha, pero el material añadido aumenta el diámetro del cable, que a su vez aumenta la carga debida a viento e hielo. Una variable clave para la optimización de estos parámetros es la deformación permitida en la fibra óptica.

Una regla empírica común, que se ha usado durante años, es permitir un 20% como máximo de la tensión de prueba (*proof test*) como deformación a largo plazo en las fibras ópticas del cable. Este criterio aparece en muchos documentos de normas actuales y ha demostrado que es razonable para la generación corriente de cables fabricados con fibra probada a 0,69GPa (100kpsi).

Este criterio, que fue desarrollado para asegurar una fiabilidad mecánica de 30 años y que se basa en las excelentes prestaciones de fiabilidad generales de los cables aéreos instalados, parece valido.

Con cables desarrollados más cerca de sus límites de diseño, merece la pena explorar estos límites y las reglas empíricas que se usan en el diseño de cables para asegurar que, en el futuro, los cables ópticos instalados puedan proveer una fiabilidad igual o superior a la de sus antecesores.

2 Como influye la modificación de los diseños de cable en la fiabilidad

2.1 Observaciones generales

Los límites de diseño convencionales para la fabricación de cables ópticos han cambiado durante los últimos diez años. Algunos de estos cambios incluyen:

1 Instalación de cables con mayor número de fibras
2 Instalación de fibras con bajas pérdidas por macrocurvatura (G.657) y de revestimientos resistentes a la microcurvatura
3 Recorte de los costes reduciendo al mínimo el material del cable y reduciendo los límites de diseño
4 Fibras probadas a valores más altos (1,38GPa [200kpsi])

Estos cambios en las tendencias de diseño de los cables pueden influir en la fiabilidad general de los cables ópticos. Cada cambio será examinado separadamente para demostrar que, cuando se combinan, pueden tener una influencia importante en la fiabilidad a largo plazo si no se gestionan de manera correcta.

2.2 Instalación de cables con mayor número de fibras

Muchos cables aéreos son incluidos en la categoría de cables de bajada (*drop cables*). Esto cables pequeños conectan la red de acceso a los hogares.

Normalmente, se trata de cables de pocas fibras. Sin embargo, excluyendo estos cables de bajada, hay una tendencia general a instalar cables con mayor número de fibras. Esto se debe al alto coste de los derechos de paso e instalación.

En muchos cables con número de fibras elevado, la mitad del peso de los cables ópticos depende de las fibras ópticas. Un peso mayor requiere también mayor tensión en el cable para reducir al mínimo la flecha.

Los hilos de aramida y los compuestos de fibra de vidrio (*FRP*) se usan para soportar la mayor parte de esta carga, mientras que la carga residual es soportada por las fibras ópticas.

Además, cuanto más fibras hay en un cable óptico, más grande es su diámetro. Los cables de diámetro más grande tienen que soportar mayor carga por viento e hielo, complicando la situación. Por consiguiente, los cables con mayor número de fibras son potencialmente sujetos a una mayor deformación de las fibras ópticas.

2.3 Instalación de fibras G.657 y revestimientos resistentes a la microcurvatura

No es de sorprender que haya un incremento en la instalación de fibras G.657 en la red óptica. Datos recientes del CRU han mostrado que más del seis por ciento de la fibra óptica instalada hoy en día pertenece a esta categoría. [Private communications Patrick Faye of CRU.]

Se están instalando las fibras G.657 por sus excelentes prestaciones frente a la macrocurvatura. Otra ventaja de las fibras G.657 es su mayor resistencia a la microcurvatura, que las hacen menos sensibles a las condiciones de cableado.

Otro desarrollo clave de las fibras ópticas es la instalación de revestimientos resistentes a la microcurvatura[1]. Esta nueva generación de revestimientos para fibra óptica muestra de dos a cuatro veces menos pérdidas debidas a microcurvatura respecto a las instaladas de cinco a diez años atrás.

Juntas, estas dos mejoras de la fibra óptica influyen en gran medida en la atenuación del cable, incluso en condiciones adversas. Las excelentes propiedades de la fibra y del revestimiento pueden "disimular" la influencia que tiene un diseño o una instalación inadecuados.

Cuando se instalan cables ópticos usando fibras G.652 convencionales con alta deformación residual en la fibra, a menudo se observa mayor atenuación. Por consiguiente, el fabricante de cable debe controlar la deformación en la fibra para asegurarse de que el cable cumpla los requisitos de calificación. Cuando se usan fibras G.657 con revestimientos resistentes a la microcurvatura, para el mismo diseño de cable, la atenuación medida mejora y el mismo diseño de cable podría cumplir dichos requisitos ópticos.

El resultado final de usar fibras G.657 es que el cable superará este ensayo de calificación. Sin embargo, después de la instalación, la mayor deformación de la fibra puede suponer un riesgo de fiabilidad a largo plazo.

Resumiendo, si el cable está diseñado correctamente, las fibras G.657 y los revestimientos resistentes a micro-curvatura son elementos muy beneficiosos para las prestaciones ópticas del cable instalado. Pero si el cable no está bien diseñado, las fibras ópticas mejoradas pueden encubrir el problema de la deformación al usuario final y esto puede suponer un riesgo de fiabilidad mecánica a largo plazo.

2.4 Recorte de los costes reduciendo al mínimo el material del cable y reduciendo los márgenes de diseño

Muchos cables aéreos están diseñados con cero por ciento de deformación en la fibra óptica. Ante una mayor presión para recortar costes, los ingenieros de diseño se ven obligados a reducir el coste de los materiales. Cuando se eliminan los elementos de refuerzo alrededor de la fibra óptica, esta debe soportar parte de la tensión axial que normalmente es soportada por los elementos de refuerzo del cable.

El diseñador de cables puede hacer referencia a las distintas normas de cables y ver que la deformación máxima permitida a largo plazo corresponda al 20% del nivel de prueba.

Efectivamente, para estos cables, la industria está pasando de un diseño común donde las fibras ópticas no tienen que soportar ninguna tensión después de la instalación a otro que permite una tensión de hasta un 20 por ciento del nivel de prueba.

La larga historia del rendimiento fiable del cable a este nivel de deformación la hace aparecer como una decisión razonable.

2.5 Fibras probadas a más de 1,38GPa (200kpsi) ahora disponibles

En la sección anterior se ha mostrado que los costes del material pueden ser reducidos permitiendo una cierta deformación en la fibra óptica. Para la fibra óptica convencional que es probada a 0,69GPa (100kpsi), la deformación máxima permitida en la fibra al límite del 20 por ciento es 0,14GPa.

Un ingeniero de diseño puede decidir usar una fibra probada a valores más altos, como la fibra probada a 1,38GPa (200kpsi), al límite del 20 por ciento, y en este caso la deformación permitida en la fibra después de la instalación aumentaría a 0,28GPa.

Esto permitiría reducir aun mas el material del cable de fibra óptica permitiendo una mayor deformación en el cable hasta redoblar el valor permitido de deformación en la fibra óptica. El resultado final podría ser un cable de fibra óptica de coste inferior.

2.6 Impacto combinado de los criterios de diseño de cables ópticos modificados

Aplicadas juntas, todas estas tendencias pueden no ser lo más indicado para el proveedor de servicios.

La deformación permitida en las fibras aplicando el criterio de siempre es más alta, pero esta deformación no afecta a la atenuación gracias al uso de fibras G.657.

El resultado final puede ser un cable óptico que es instalado para soportar una deformación a largo plazo de hasta 0,28GPa en las fibras ópticas. Entretanto, se espera que las fibras sobrevivan más de 30 años sin romperse. Esta situación prueba los límites la teoría de fiabilidad, que debería ser analizada más atentamente antes de ser implementada.

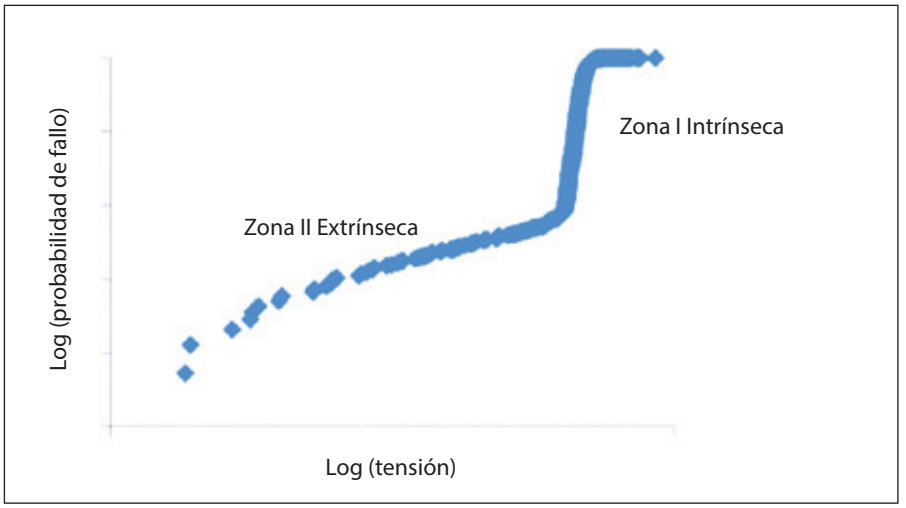
3 Origen del criterio de deformación permitida corriente

La regla empírica corriente que se usa para el diseño de cables toma en consideración una deformación permitida máxima de un 20 por ciento del nivel de prueba. Este criterio deriva de un trabajo sobre fiabilidad realizado en los años 90'[2,3].

En estos estudios, los autores muestran que las prestaciones a largo plazo pueden ser relacionadas con la tensión de prueba (*proof test*), pero esto supone una cierta probabilidad de fallo en la prueba. Entonces, los autores consideraron varios parámetros de corrosión por esfuerzo y fibras probadas a 50kpsi y 100kpsi para demostrar que su aproximación era un método razonable y conservador para asegurar fiabilidad a largo plazo. Este trabajo representó un importante paso adelante para la industria de la fibra soportando la tendencia a utilizar fibra probada a los niveles corrientes.

Desafortunadamente, existe un supuesto clave sobre la distribución de los fallos de la fibra óptica, en concreto, la probabilidad de una rotura de la fibra durante las pruebas.

▼ **Figura 1**: *Probabilidad de fallo para más de 100km de fibra probada a longitudes de ensayo de 10m*



Esta probabilidad no es constante y puede variar en fibra fabricadas en diferentes condiciones o usando diferentes materias primas.

La *Figura 1* muestra una curva de probabilidad de fallo para una fibra de silicio generada por uno de los equipos del autor usando una longitud de ensayo de 10m para ilustrar la gama de fallos encontrados en las fibras ópticas.

La figura muestra dos zonas: la zona I (resistencia intrínseca) y la zona II (resistencia extrínseca). La curva ilustra las zonas principales que necesitan ser caracterizadas para predecir la fiabilidad a largo plazo de la fibra. La zona I es la zona de alta resistencia intrínseca.

La fibra estudiada mostraba la resistencia inherente del vidrio a ~4,6GPa, que está significativamente por encima del límite de 3,1GPa recomendado en Telecordia Gr-20. La prueba de resistencia en una longitud de ensayo corta en esta zona puede ser usada para determinar el valor n, que es mayor de 20 para la fibra estudiada. La resistencia intrínseca y los valores n son típicamente especificados por usuarios finales para asegurar la fiabilidad a largo plazo del cable.

Desafortunadamente, la porción extrínseca mostrada como zona II juega un papel importante en la caracterización de la fiabilidad a largo plazo del cable óptico. Esta zona contiene fallos más cercanos al nivel de prueba que son espaciados a una frecuencia que puede tener kilómetros de distancia.

Con el tiempo, pueden dar lugar a roturas de la fibra si se queda el cable bajo tensión. Para comprender esta zona se requiere información que se puede obtener solamente midiendo muchos kilómetros de fibra. Con niveles de prueba más altos se eliminarán algunos de los fallos más importantes en la fibra.

Sin embargo, el efecto en la fiabilidad de la fibra óptica de un cable instalado es difícil de determinar con precisión sin más información sobre la distribución general de los fallos en la fibra. Un modo para ilustrar esto podría ser probar un cable de fibra óptica a un nivel cercano al de la resistencia intrínseca de la fibra o a aproximadamente 3,8GPa (550kpsi).

Si se dejara una muestra de fibra de 1.000m generada en dicho experimento sometida a un esfuerzo constante de 110kpsi, la fibra probablemente se rompería en menos de un día, o mucho antes de los 40 años de vida esperados. Este ejemplo es un caso extremo, pero reasalta la importancia de comprender las complejas ecuaciones que gobiernan la fiabilidad.

Probabilidad de fallo de 1km de fibra óptica	Fibra probada a 0,69GPa al 20 por ciento de carga a largo plazo	Fibra probada a 0,69GPa al 40 por ciento de carga a largo plazo	Fibra probada a 1,38GPa al 20 por ciento de carga a largo plazo
1,0ppm por km	1,600 años	0.0años	530 años*
1,0ppm por 100km	16 años	0.0 años	5.3 años*

* La frecuencia de fallo varía mucho con el cambio de los valores de prueba (*proof test*) cuando se pasa de 0,69GPa a 1,38GPa

▲ **Tabla 1**: *Comparación entre probabilidades de fallo (vida útil 1ppm)*

4 Instrucciones del informe técnico de la IEC sobre fiabilidad

Uno de los modelos de fiabilidad aceptado corrientemente ha sido publicado por la IEC[4].

Una de las ecuaciones encontradas en este informe es usada para predecir la vida útil de la fibra - la ecuación de la vida útil para la fibra óptica después de probarla (*proof test*) - puede ser representada por la expresión siguiente:

$$t_f = t_p \left(\frac{\sigma_p}{\sigma_a}\right)^n \left\{\left[1 - \frac{\ln(1-F)}{N_p L}\right]^{\frac{m_d+1}{n_d}} - 1\right\} \qquad (1)$$

Donde:
t_f es el tiempo antes de fallar (vida útil)
t_p es el tiempo de prueba (*proof test*)
σ_p es la tensión de prueba (*proof test*)
σ_a es la tensión aplicada
F es la probabilidad de fallo
N_p es el índice de rotura de la prueba
L es la longitud bajo tensión
m_d es el parámetro m Weibull de la fatiga dinámica
n es el parámetro de corrosión por esfuerzo

La ecuación es compleja, pero se pueden hacer algunas observaciones.

La *Figura 1* muestra que cuanto mayor es la tensión aplicada, mayor es la probabilidad de fallo. Por lo tanto, el término de probabilidad de fallo en la ecuación, F, está directamente relacionado con el término de tensión aplicada, σ_a.

La regla empírica convencional que se ha usado para obtener el 20 por ciento de la tensión de prueba como carga máxima permitida a largo plazo supone que estas dos variables son independientes, lo que no es coherente con la *Figura 1*.

Es necesario probar cientos de kilómetros de fibra para comprender plenamente la relación entre frecuencia de fallo y tensión aplicada.

La *Tabla 1* compara los resultados de los tres escenarios. En el primero se prueba una fibra a 0,69GPa con carga a largo plazo del 20 por ciento de la carga de la prueba (*proof test*).

Para generar los datos se sustituyeron los valores siguientes en la *Ecuación 1*:
$n_d = 20$
$m_d = 2,5$
$t_p = 0,05$ segundos
$N_p = 1$ rotura cada 250km

La tabla muestra que una fibra óptica que cumple con los criterios conservativos anteriores tendría un rendimiento mecánico razonable para los 0,69GPa al 20 por ciento del nivel de prueba. El segundo caso muestra que la misma fibra fue mantenida a un 40 por ciento del nivel del nivel de prueba.

En este caso, la frecuencia de fallo de 1ppm sería alcanzado en menos de un año. El tercer caso es una fibra probada a 1,38GPa con carga a largo plazo del 20 por ciento del nivel del nivel de prueba.

En estas condiciones, la probabilidad de fallo de 1ppm se alcanza en menos de seis años. Nótese que los datos de la *Tabla 1* se refieren a la fibra en un ambiente no agresivo.

Los términos como envejecimiento en ausencia de tensión, macrocurvaturas, abrasión y otros factores pueden reducir en mucho la vida útil de la fibra.

5 Consideraciones

La vida útil de la fibra es la suma de la probabilidad de fallo intrínseco y extrínseco. Este artículo se centra en tramos largos de fibra bajo carga axial en un régimen donde el fallo es dominado por fallos extrínsecos.

Los resultados ilustrados en la *Tabla 1* resaltan el error del requisito común para cables ópticos, que afirma que la carga a largo plazo en fibras ópticas es simplemente igual a un 20 por ciento del nivel de prueba.

Si el índice de rotura de la fibra fuera el mismo para las fibras probadas a 0,69GPa y 1,38GPa, entonces ambas fibras tendrían la misma vida útil de 1ppm.

Los datos de la *Figura 1* indican que no es este el caso. Cuando se incluye este conocimiento en el análisis, los resultados cambian drásticamente.

Normalmente, la expectativa de fiabilidad a largo plazo para cables de fibra óptica es que la probabilidad de fallo de la fibra sea menos de 1ppm en 30 años.

Usando este criterio, el ejemplo dado en la *Tabla 1* puede ser simplificado como sigue:

- una fibra probada a 0,69GPa al 20 por ciento de la carga a largo plazo tendrá un rendimiento fiable
- una fibra probada a 0,69GPa al 40 por ciento de la carga a largo plazo no tendrá un rendimiento fiable
- una fibra probada a 1,38GPa al 20 por ciento de la carga a largo plazo no tendrá un rendimiento fiable

Aunque esté claro que efectuar la prueba de los cable (*proof test*) a niveles más altos mejora mucho las sus prestaciones, el valor usado normalmente en las normas de cableados - 20 por ciento del nivel de prueba - puede dar origen a falsas expectativas sobre la fiabilidad a largo plazo de los cables ópticos.

6 Recomendaciones

La información dada en este documento indica que, aunque el 20 por ciento de la carga de prueba (*proof test*) para una carga a largo plazo en la fibra óptica pueda ser un criterio razonable para fibras ópticas probadas a 0,69GPa o valores inferiores, dicho criterio puede dar lugar a estimas optimistas en el caso de fibra óptica probada a niveles más altos.

Actualmente, la mayoría de las normas más importantes para fibra óptica, incluidas las ITU-T, IEC, y TIA establecen que la fibra óptica sea probada a 0,69GPa. Las normas de cables de IEC, ICEA e IEEE se deberían alinear con este criterio.

Por lo tanto, se recomienda modificar los documentos simplemente para requerir una carga máxima de 0,14GPa (20kpsi) a aplicar a largo plazo en la fibra óptica cableada después de la instalación, sin tener en cuenta el nivel de prueba.

Se puede añadir una nota al requisito que diga que cuando se instala fibra óptica con niveles de prueba superiores a 0,69GPa se tendrán valores de deformación mayores en la fibra óptica que afectarán a la fiabilidad y deberían ser acordados entre el proveedor de cable y el usuario final, y que se deberían estudiar modelos de fiabilidad de la fibra de mayor precisión.

7 Conclusiones

Este artículo ha mostrado que los diseños de cables modernos están apretando los límites de diseño para la deformación permitida a largo plazo en los cables ópticos. En estas nuevas condiciones límite, la regla empírica que permite hasta un 20 por ciento del nivel de prueba como deformación a largo plazo puede no ser ya apropiada. Se propone una nueva recomendación que requiere una carga a largo plazo limitada a 0,14GPa como criterio alternativo.

Este nuevo criterio debería ser incluido en las revisiones futuras de las normas para fibra óptica. Los diseños que requieren especial atención son los de cables sometidos a altos niveles de deformación como el cable de bajada, y los cables aéreos, incluidos los OPGW y ADSS. ■

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9 Referencias

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