KAYA CONSTRUCTION

KAYAGRUBU.COM.TR

2015/ENG

CABLE STRUCTURES

# THE LIGHTNESS OF CONSTRUCTION

**SABRİ KAYA**
FOUNDING CHAIRMAN

**KEMAL KAYA**
CHAIRMAN

**GÜLSEN KAYA**
BOARD MEMBER

**ALİ KAYA**
BOARD MEMBER

# KAYA GROUP

KAYA WAS ESTABLISHED IN 1980 BY SABRİ KAYA IN KARAKÖY WHICH IS ONE OF ISTANBUL'S HISTORIC DISTRICTS. THE WORDS OF SABRİ KAYA "KARAKOY IS COMMERCIAL AND FINANCIAL CENTER OF DIFFERENT CIVILIZATIONS FOR CENTURIES, SO WE WILL BE A GLOBAL BRAND IN THE WORLD BY LOOKING AT WORLD FROM HERE." CLEARLY EXPLAIN THE PHILOSOPHY OF WHY THE BUSINESS IS ESTABLISHED IN KARAKÖY. THE STORY OF KAYA ROPE BEGINS WHEN OUR FOUNDER SABRI KAYA STARTED WORKING IN DISTRICT BAZAAR IN 1969 WITH A GREEK MASTER. ROPE USED TO BE MANUFACTURED AND TRADED SERIOUSLY IN BETWEEN 1969 AND 1980 .IN 1980, WHEN GREEK MASTER MOVED TO GREECE AND LEFT MR. SABRİ ALONE HE DECIDED TO FORM HIS OWN COMPANY.

AFTER YEARS, SABRİ KAYA TELLS ABOUT HIS STORY OF SUCCESS WHICH BEGAN WITH ROPE MANUFACTURING AS FOLLOW "IT IS THE FACT THAT SUCCESS ALWAYS COMES AFTER PERSEVERANCE. WHEN WE BEGIN THE WORK, WE CONSIDERED THE NEEDS OF THE PERIOD IN WHICH WE LIVE. IN THOSE YEARS, TURKISH ARMED FORCES USED TO IMPORT TECHNICAL AND TECHNOLOGICAL ROPES TO COVER THE NEEDS OF SEA, AIR AND LAND FORCES. AFTER KAYA TRADE WAS ESTABLISHED, WE STARTED MANUFACTURING TECHNICAL AND TECHNOLOGICAL ROPES FOR MARINE, PETROLEUM AS WELL AS CONSTRUCTION SECTOR AND SO WE HAVE BEEN SPECIALIZED IN THIS FIELD.

90S, AT THE SAME TIME, WAS THE YEARS IN WHICH NUMBER OF FATAL ACCIDENTS WAS INCREASED. IN THOSE YEARS, THERE WAS NO PRODUCTION OF SYSTEMS AND EQUIPMENT PROVIDING SAFE WORKING ENVIRONMENTS AT HEIGHTS.

ON THE OTHER HAND, AS THE POSITION OF KARAKÖY IN COMMERCIAL LIFE HAS CHANGED IN 90S IT WAS TIME FOR KAYA TRADE TO GROW AND MOVE OUT OF THE KARAKÖY. IN THE SAME PERIOD KEMAL KAYA, GÜLSEN KAYA AND ALİ KAYA WHO ARE THE SECOND GENERATION OF THE FAMILY HAVE COMPLETED THEIR HIGHER EDUCATION AND BEGAN WORKING FOR KAYA TRADE.

IN 1996, KAYA SAFETY WAS FORMED TO MANUFACTURER SYSTEMS AND EQUIPMENT PROVIDING SAFE WORKING ENVIRONMENTS AT HEIGHTS. IN THE SAME PERIOD, BRANDING OF 'KAYA ROPES' WAS COMPLETED TO OFFER TECHNICAL AND TECHNOLOGICAL ROPES TO WORLD MARKET.

TRAININGS FOR WORKING AT HEIGHTS SAFELY WERE GATHERED UNDER KAYA TRAINING IN 1996. TODAY KAYA TRAINING WHICH IS LOCATED IN GEBZE INDUSTRIAL ZONE HAS ONE OF THE LARGEST WORKING AT HEIGHT SIMULATION CENTERS OF EUROPE AND EACH YEAR CONTINUES TO PROVIDE TRAINING TO TENS OF THOUSANDS OF PEOPLE.

15 YEARS OF EXPERIENCE OF KAYA SAFETY AND KAYA TRAINING LED TO THE ESTABLISHMENT OF KAYA CONSULTING IN 2009. KAYA TRAINING AND KAYA CONSULTING HAVE WORLD-CLASS PHYSICAL TRAINING INFRASTRUCTURE WHERE MANY INDUSTRIES CAN BE SIMULATED ON SCENE. THESE TWO DIVISIONS HAVE BEEN A LEADER FOR A LONG TIME IN CONSULTING, TRAINING AND SUPERVISION ACTIVITIES WITH THE AIM OF TAKING NECESSARY PRECAUTIONS FOR SAFETY AND RESCUE WHILE WORKING AT HEIGHT. KAYA TRAINING AND KAYA CONSULTING CONTRIBUTE TO RAISING AWARENESS OF EMPLOYEES IN THE FIELD OF OCCUPATIONAL HEALTH AND SAFETY WITH PROFESSIONAL INTERNAL TRAININGS SPECIFIC TO THE MANY DANGERS GROUP IN WORKING LIFE.

**KAYAGRUBU.COM.TR**

# VISION

OUR VISION IS TO MAINTAIN THE SECTOR LEADERSHIP IN NATIONAL MARKET WHICH IS ACHIEVED THOROUGH CONSISTENT GROWTH SINCE THE FOUNDATION, WHILE EXPANDING GLOBALLY WITH A SUSTAINABLE STRUCTURE AND RANK AMONG THE STRONGEST BRANDS WITH A PERFECTIONIST APPROACH.

# MISSION

OUR MISSION IS TO ANALYSE THE NEEDS OF SECTORS IN WHICH WE PROVIDE SERVICE, CONDUCT R&D AND DEVELOP HIGH TECH PRODUCTS, CREATE SAFER, CLEANER AND LIVABLE LIFE AND ENVIRONMENT FOR POSTERITY, TRAIN EMPLOYEES AND MANAGERS THAT WILL CONTRIBUTE CREATING OCCUPATIONAL HEALTH AND SAFETY CULTURE ON ALL SECTORS, OFFER COMPLETE SOLUTIONS TO THE SECTOR BY INTEGRATED MANUFACTURING AND SERVICES.



## KAYAROPES

KAYA ROPES MANUFACTURERS ALL KINDS OF ROPES FOR EVERY FIELD, WHERE LIFE SAFETY AND PERFORMANS IS AIMED, THAT ARE MADE OF FROM VERIOUS TYPE OF RAW MATERIALS, AT DIFFERENT CONSTRUCTION WITH INTERNATIONALLY RECOGNIZED CERTIFICATIONS.

KAYA ROPES HAS BECOME A LADER OF INNOVATION IN TURKEY AND ONE OF WELL KNOWN AND REQUESTED BRANDS IN THE WORLD WITH ITS TECHNICAL AND TECHNOLOGICAL ROPES.

EQUIPPED WITH MOST DEVOLOPED MACHINARIES, KAYA ROPES MANUFACTURER ROPES FOR SAILING, YATHTING, MILITARY, OFF-ROAD, PLAYGROUND, MOUNTAINEERING, RESCUE, CIVIL DEFENCE, SAFETY, FISHING, ENERGY AND MINING AND SO ON.

**KAYAROPES.COM**

## KAYA SAFETY

KAYA SAFETY WAS ESTABLISHED IN 1996 TO DESIGN SYSTEMS AND EQUIPMENT FOR WORK AT HEIGHT ACTIVITIES TO BE PERFORMED PROPERLY AND SAFELY.

HAVING MOST ADVANCED FACILITY IN ITS FIELD, KAYA SAFETY DESIGNS, DEVELOPS AND MANUFACTURERS FALL ARREST SYSTEMS, RESCUE AND EVACUATION EQUIPMENT AND LIFTING EQUIPMENT IN TURKEY FOR INSTITUTIONS AND ORGANIZATIONS OPERATING IN SECTORS SUCH AS DEFENCE, FIRE FIGHTING, OIL & GAS, CONSTRUCTION AND TELECOMMUNICATION.

IN ADDITION TO OUR KNOWLEDGE AND EXPERIENCE GAINED FROM WORKING IN DIFFERENT FIELDS FOR OVER 18 YEARS, WE ARE AWARE OF THE ISSUE THAT EMPLOYEES AND MANAGERS NEED TO TAKE THE NECESSARY TRAINING FOR CORRECT USE OF SAFETY EQUIPMENT AND SYSTEMS. WE DO PROVIDE SECTOR BASED TRAININGS IN OUR TRAINING FACILITY WHICH IS ONE OF LARGEST WORKING AT HEIGHT SIMULATION CENTERS IN EUROPE. WE ALSO DO SUPPORT OUR USERS WITH TECHNICAL DOCUMENTS AND PRODUCT VIDEOS FOR EQUIPMENT TO BE USED CORRECTLY AND EFFICIENTLY.

**KAYAROPES.COM**

## KAYA ADVENTURE

KAYA ADVENTURE WAS FORMED THANKS TO THE KAYA SAFETY'S INTERNATIONAL EXPERIENCE ON WORKING AT HEIGHT SINCE 1996 AND KAYA ROPES'S INTERNATIONAL EXPERIENCE ON TECHNICAL AND TECHNOLOGICAL ROPES SINCE 1980.

KAYA ADVENTURE IS DEALING WITH DESIGNING, MANUFACTURING AND INSTALLATION OF SYSTEMS USED IN PLAYGROUND AND ADVENTURE PARKS.

KAYA ADVENTURE HAS DETERMINED ITS PRIMARY OBJECTIVE TO DESIGN SYSTEMS AND EQUIPMENT WHICH WILL ENTERTAIN BOTH KIDS AND ADULTS AS WELL AS TO CONTRIBUTE DEVELOPMENT OF THEIR PHYSICAL AND MENTAL HEALTH. ALL THE SYSTEMS AND EQUIPMENT THAT KAYA ADVENTURE MANUFACTURERS AND INSTALLS IN PLAYGROUND AND ADVENTURE PARKS ARE TESTED AND CERTIFICATE IN ACCORDANCE WITH EN 116-1 VE EN 1176-11 STANDARDS.

**KAYAADVENTURE.COM**


## KAYA TRAINING

## KAYA CONSULTING

COMBINING WITH 30 YEARS OF KNOWLEDGE OF KAYA GROUP IN OCCUPATIONAL HEALTH AND SAFETY; KAYA TRAINING AND KAYA CONSULTING PROVIDE SOLUTIONS IN STRATEGIC MANAGEMENT CONSULTING, OCCUPATIONAL HEALTH & SAFETY AND JOINT HEALTH SECURITY UNIT SERVICES SINCE 2001 TO A LARGE NUMBER OF MULTINATIONAL COMPANIES AND PROJECTS IN ALMOST ALL CITIES IN TURKEY AS WELL AS IN IRAQ, GABON, NIGERIA, RUSSIA, KAZAKHSTAN, TURKMENISTAN, LIBYA, ALGERIA, ALBANIA, KOSOVO, TUNISIA, SAUDI ARABIA, SYRIA, UKRAINE AND MOROCCO AND PLAYS AN IMPORTANT ROLE IN CREATING OCCUPATIONAL HEALTH AND SAFETY CULTURE WITH ITS OVER 40 PROFESSIONAL EMPLOYEES WHO HAVE INTERNATIONAL EXPERIENCE.

KAYA TRAINING AND KAYA CONSULTING; HAVE 1ST CLASS TRAINING FACILITIES AND INFRASTRUCTURE WHERE VARIOUS INDUSTRIES CAN BE SIMULATED. THE COMPANY ALSO MAINTAINS ITS LEADERSHIP IN TAKING PRECAUTIONS IN OCCUPATIONAL HEALTH AND SAFETY AND RESCUE ACTIVITIES AND PROVIDING TRAINING, INSPECTION AND SUPERVISION SERVICES WITH AIM OF CREATING SAFE WORKING ENVIRONMENT.

IN ADDITION TO THIS, COMPANY CONTRIBUTES RAISING AWARENESS OF OCCUPATIONAL HEALTH AND SAFETY ISSUES IN EMPLOYEES WITH ITS PROFESSIONAL INTERNAL TRAININGS.

KAYA TRAINING AND KAYA CONSULTING IS ALSO A PARTNER OF MANY WELL-KNOWN INTERNATIONAL ORGANIZATIONS IN TURKEY SUCH AS IOSH (INSTITUTION OF OCCUPATIONAL SAFETY & HEALTH), NSC (NATIONAL SAFETY COUNCIL) AND IRATA (INDUSTRIAL ROPE ACCESS TRADE ASSOCIATION) AND APART FROM THIS COMPANY IS ABLE TO PROVIDE THEIR TRAININGS WITH ITS OWN TRAINERS.

**KAYATRAINING.COM**

**KAYACONSULTING.COM**


## INTEGRATED MANAGEMENT SYSTEM POLICY

KAYA IS COMMITTED TO NOT ONLY FULFILLING OUR OBLIGATIONS, BUT ALSO ENSURING CONTINUAL IMPROVEMENT OF THE INTEGRATED MANAGEMENT SYSTEM POLICY BY;

- MEETING AND EXCEEDING CLIENT EXPECTATIONS BY CONTINUALLY IMPROVING THE QUALITY AND DELIVERY OF OUR SERVICES.
- USING ONLY RAW MATERIALS AND CHEMICALS WHICH DO NOT CAUSE TO MUCH DAMAGE TO THE ENVIRONMENTAL.
- OPTIMIZING OUR ENERGY USE, ENCOURAGING THE PURCHASE AND USE OF ENERGY-EFFICIENT PRODUCTS AND SERVICES, DESIGNING AND USING MORE SUSTAINABLE TECHNOLOGIES AND PRACTICES.
- ENSURING THAT OUR EMPLOYEES HAVE THE NECESSARY TRAINING, SKILLS AND RESOURCES TO MEET OUR SAFETY, HEALTH AND ENVIRONMENTAL PERFORMANCE.
- WORKING TOGETHER WITH EMPLOYEES WITH THE INTENTION OF CONTINUOUSLY IMPROVING WORKING CONDITIONS.
- ENSURING THE PHYSICAL HEALTH AND SAFETY OF ALL WORKERS IN KAYA GROUP, AND PREVENTING ANY DAMAGE OR IMPAIRMENT TO THE HEALTH OF OUR STAFF THROUGH ACTIONS WHICH, WHEN NECESSARY, EXCEED LEGALLY ESTABLISHED STANDARDS, AND BY COMPLYING WITH ALL THE OTHER REQUIREMENTS TO WHICH THE KAYA GROUP VOLUNTARILY SUBSCRIBES.
- KEEPING EVERYONE INVOLVED IN THE BUSINESS PROCESS INFORMED ABOUT THE OCCUPATIONAL HEALTH AND SAFETY POLICY.

### KAYA BRANDS

KAYA KAYA ROPES KAYA SPORT KAYA SAFETY KAYA DEFENCE KAYA TRAINING KAYA ADVENTURE KAYA CONSULTING KAYA SCAFFOLDING KAYA CONSTRUCTION


- KEEPING THE EMPLOYEES INFORMED ABOUT MANAGEMENT SYSTEM POLICY.
- WITHIN SCOPE OF COMPANY POLICY 'HIGH SAFETY AT WORK', COMPLYING WITH 89/686/EEC PERSONAL PROTECTIVE EQUIPMENT DIRECTIVE, ISO 9001, ISO 14001 AND OHSAS 18001 STANDARDS, ALL APPLICABLE LEGISLATION, REGULATIONS.
- CONDUCTING ACTIVITIES AND INVESTMENTS WHERE HEALTH AND SAFETY ISSUES ARE SERIOUSLY CONSIDERED. KAYA NEVER COMPROMISE FROM THESE VALUES TO SAVE TIME AND MINIMIZE THE COST, REQUESTS IT'S SUPPLIERS AND PARTNERS TO COMPLY WITH THE MANAGEMENT SYSTEM POLICY AND SHOWS MAXIMUM EFFORT TO WORK WITH COMPANIES WHO DO HAVE THE SAME COMMITMENT TO THE POLICY.
- CREATING A LIVING HEALTH AND SAFETY CULTURE WHERE ALL THE EMPLOYEES ADOPTS AND PARTICIPATES AS A VOLUNTEER.

COMPANY MANAGEMENT IS COMMITTED TO PROVIDING ALL THE REASONABLE HUMAN AND FINANCIAL RESOURCES NECESSARY TO IMPLEMENT AND GUARANTEE THAT THE QUALITY, ENVIRONMENTAL, ENERGY AND HEALTH & SAFETY MANAGEMENT SYSTEM WILL BE PERIODICALLY SUBJECTED TO THE REVISION NECESSARY TO OPTIMIZE RESULTS.

rock TURQUOISE ROPES | IGY WEST ROPES | HOOK RAIN ROPES | LION ROPES | ECO ROPES | TURK ROPES | GREENFISH ROPES

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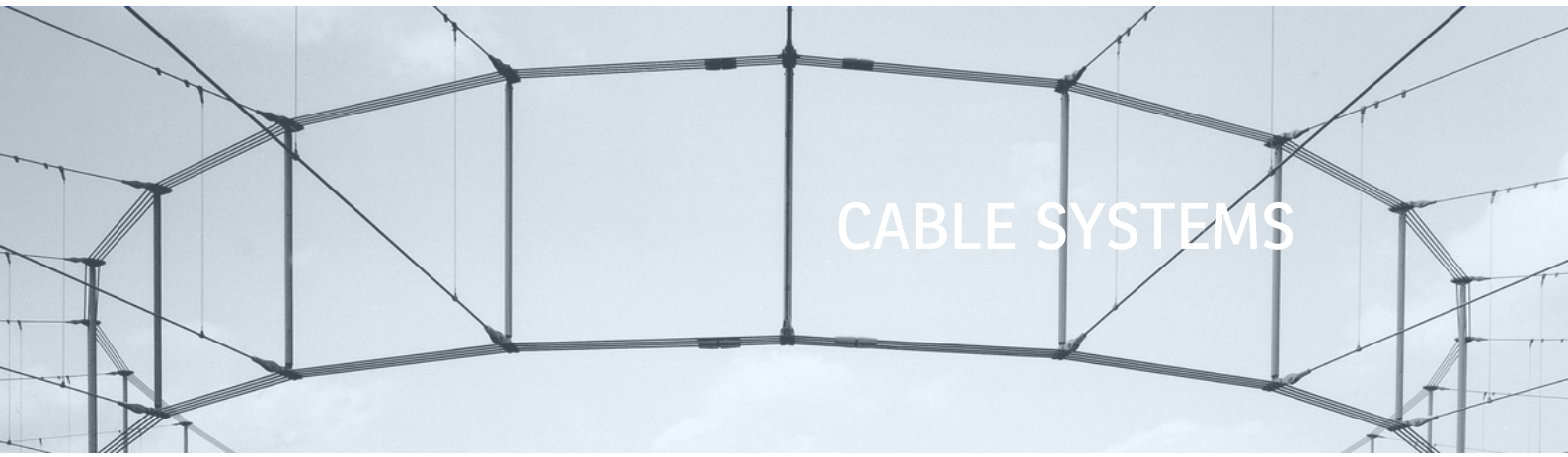

CABLE SYSTEMS

# Cable Systems

## The new PFEIFER-Product System for cable structures fulfils every requirement as to streamline-shaped elegance and capability – with planning and implementation kept simple and straightforward.

The new PFEIFER-Product System for cable structures consists of three cable systems which vary in terms of material used and possible use. During new conception of the systems, we consistently geared our efforts towards the planner's work method. The result: A highly capable product system consisting of high-quality materials, which is quickly and easily implemented during planning.
At the same time, PFEIFER-Cable Systems fulfil the strictest requirements with a view to corrosion protection and they are admitted for use by the construction supervising authority.

## Content


- Applications
- Engineering
- Data Sheets
- Technical Approvals

APPLICATION

Sports Facilities

Curtain Walls,
Roof Structures

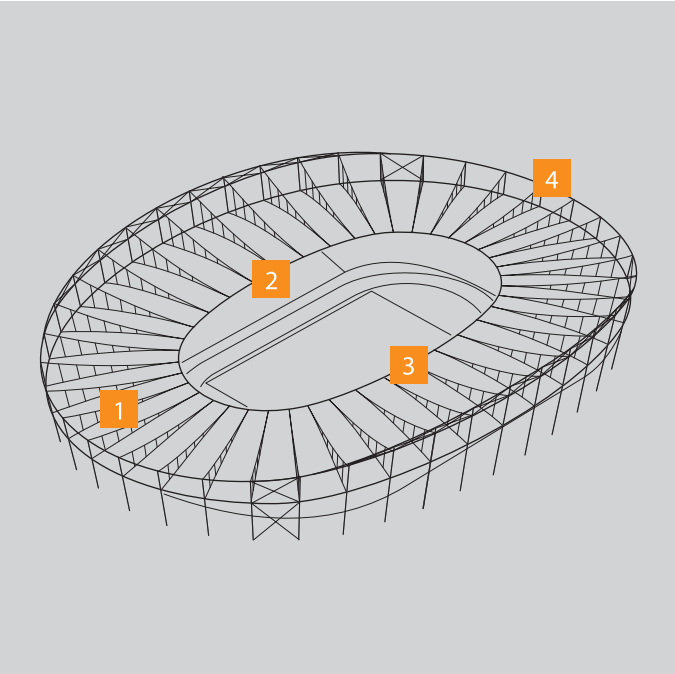
Bridges

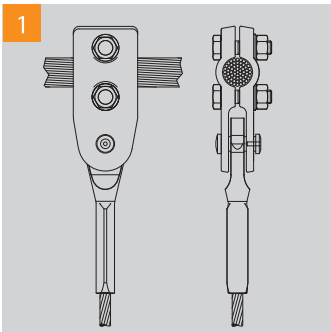
Wide Span Structures, Halls,
Exhibition Buildings

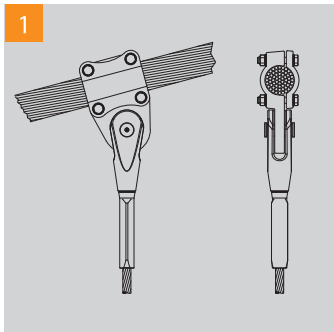
Zoological and Botanical
Gardens

Transmitter Masts

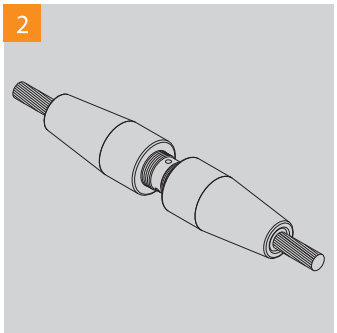
APPLICATION



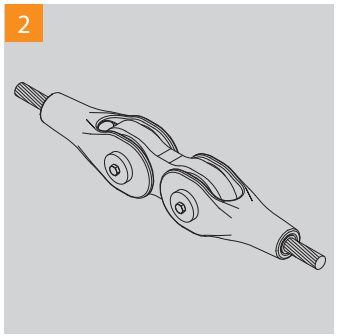




Connecting hanger cable
to suspension cable


Ring cable connection with
conical socket and
threaded rod




Ring cable connection with
open spelter socket and
connection plate

Gottlieb-Daimler-Stadium Stuttgart, Germany

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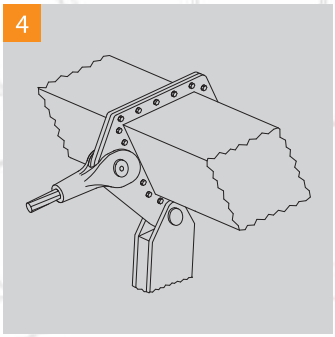

Connection suspension cable to steel structure

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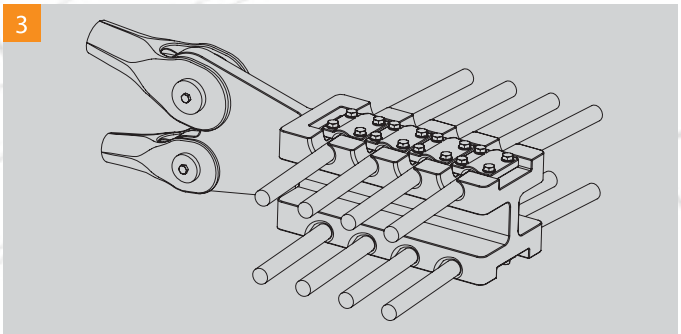

Connection cable truss to ring cable

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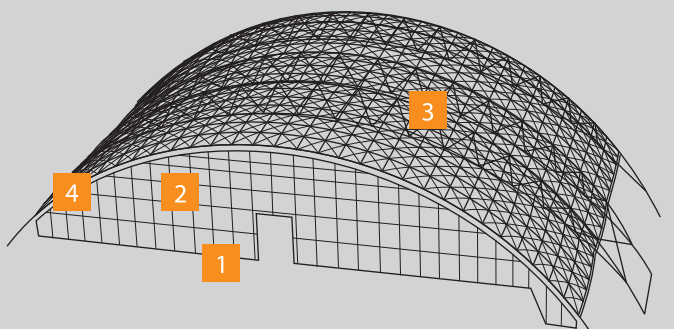
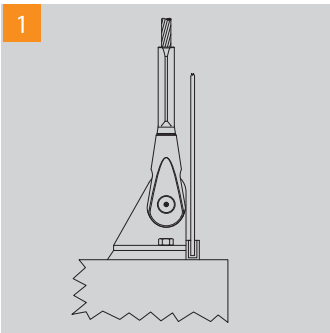
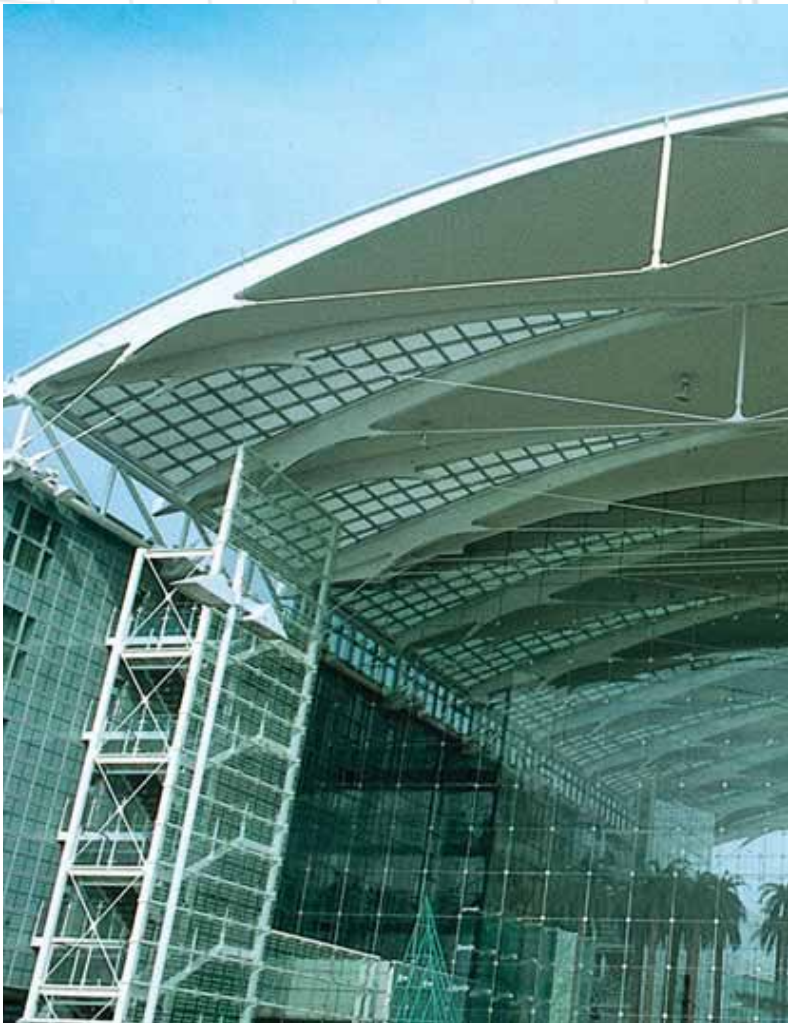
APPLICATION



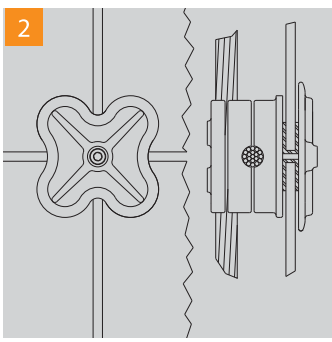



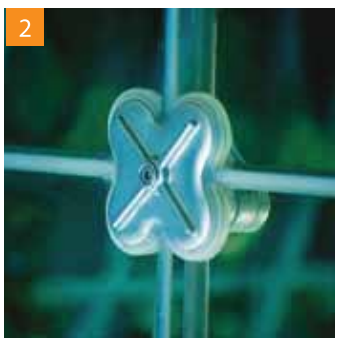

Anchorage cable net to foundation with glass fitting


Kempinski Hotel Airport Munich, Germany



Cable cross clamp with glass fitting



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Connection compression strut to parallel cabel net

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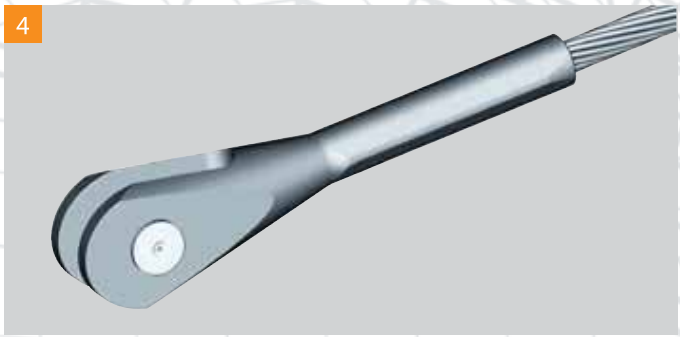

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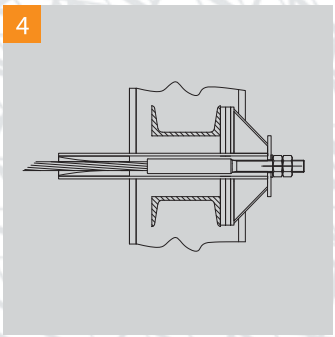

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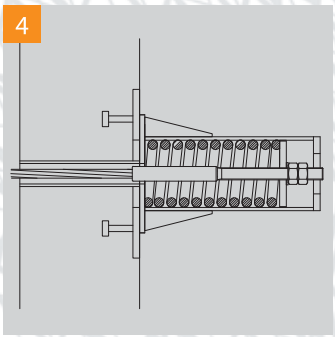

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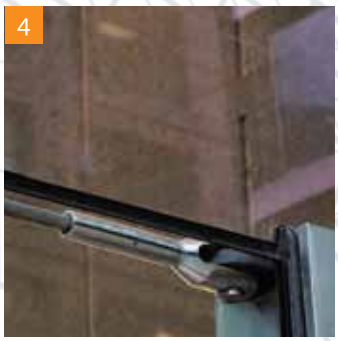

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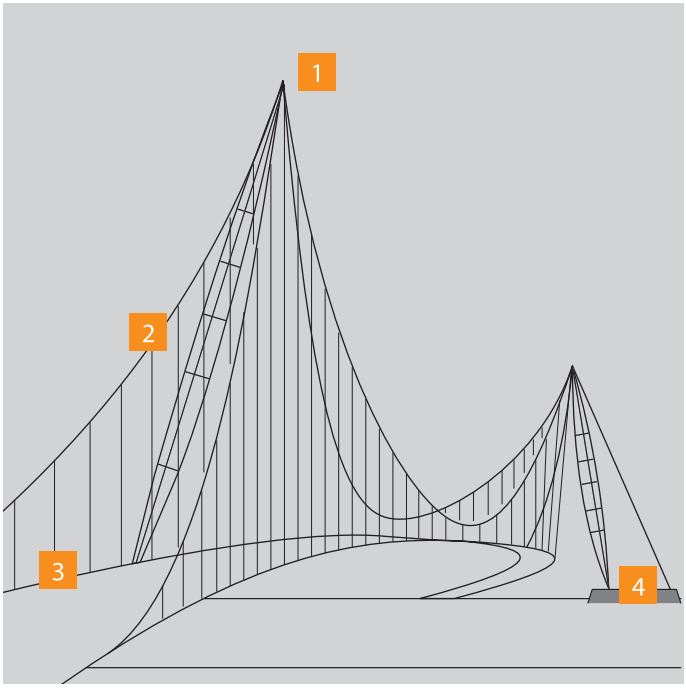
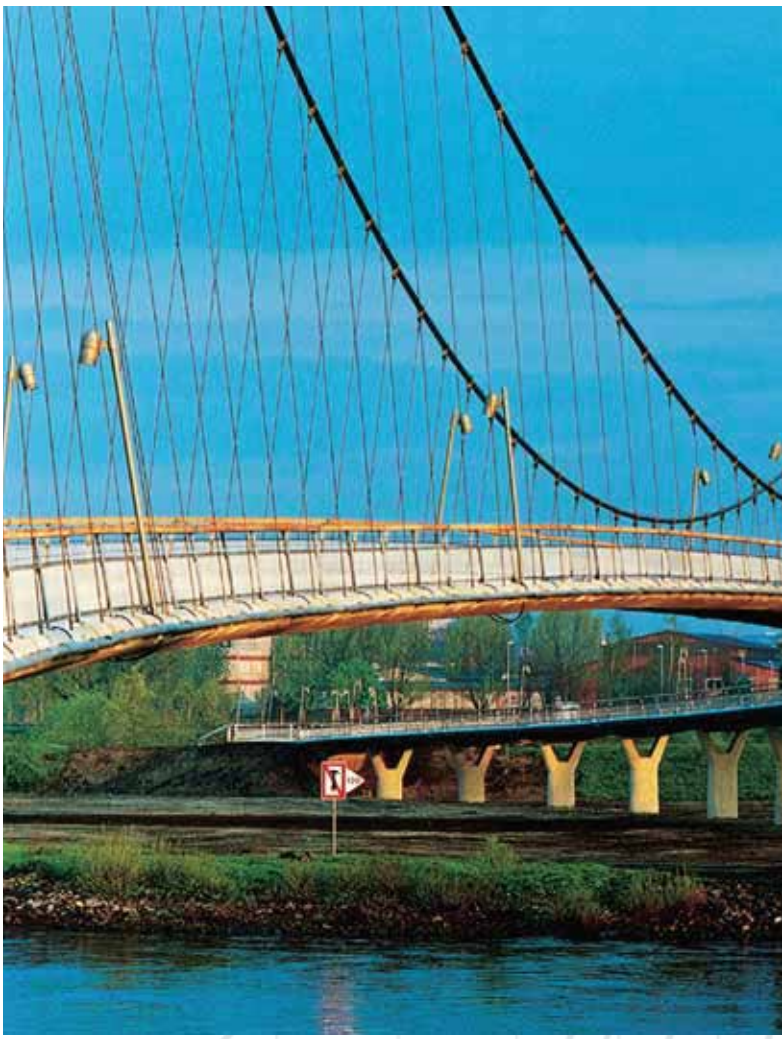
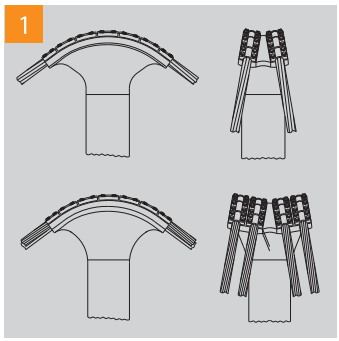
Connection stabilizing cable to frame

APPLICATION

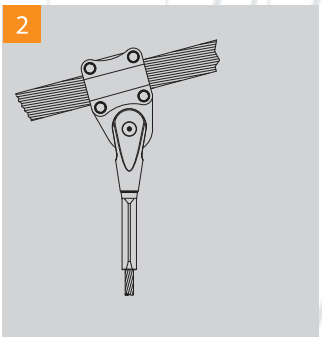


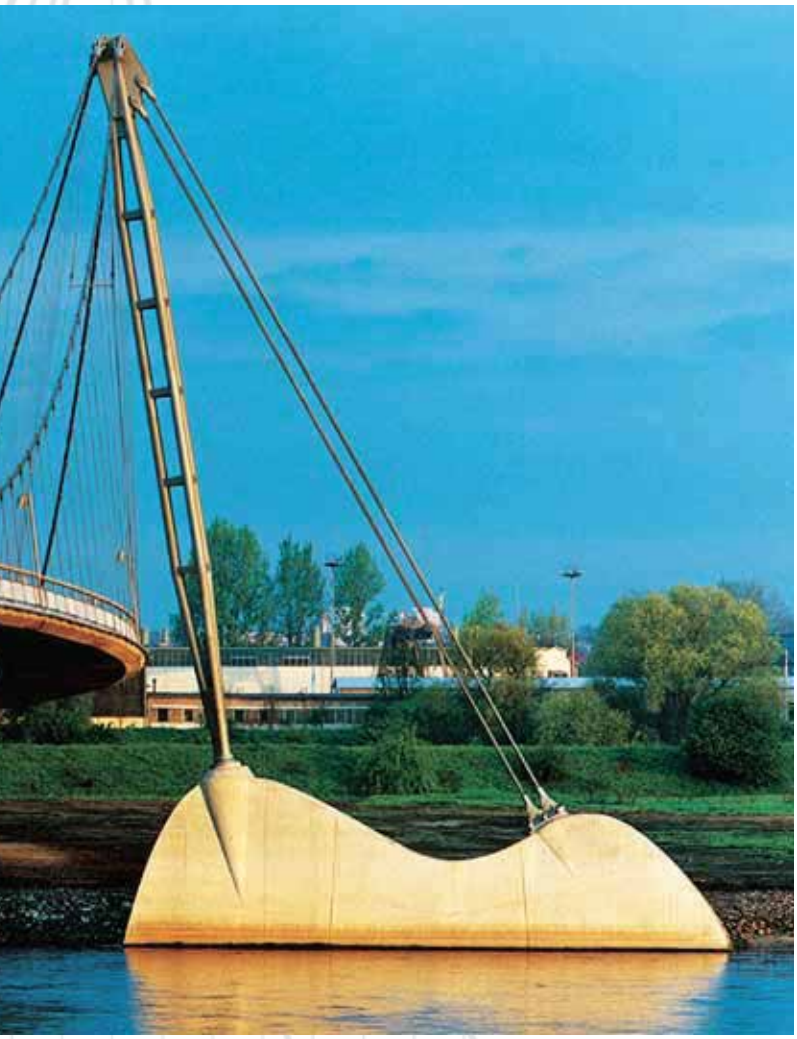

Connection suspension cable to pylon head with open spelter socket




Suspension cable at saddle


Connection hanger cable to suspension cable



Elbsteg Herrenkrug Magdeburg, Germany

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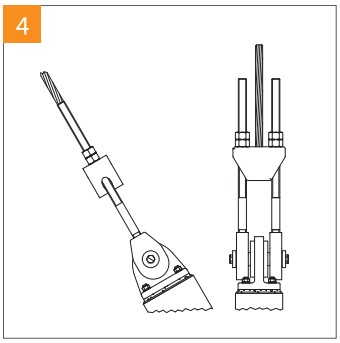

Connection stay cable to foundation with open bridge socket

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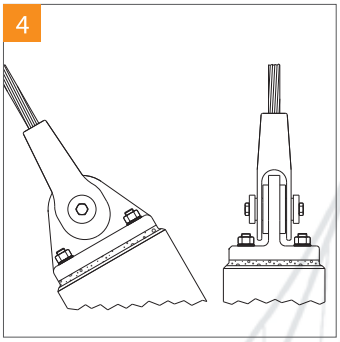

Connection stay cable to foundation with open spelter socket

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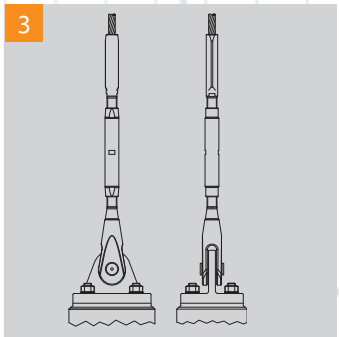

Connection hanger cable to bridge deck

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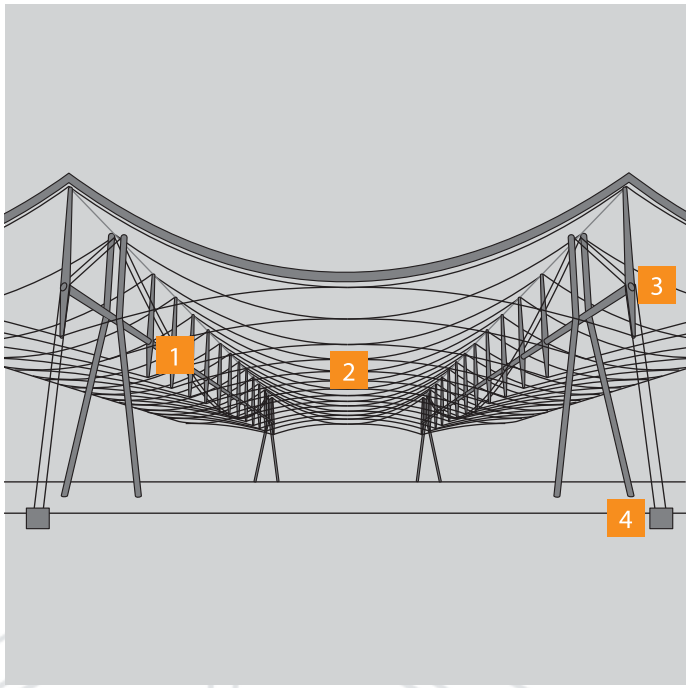
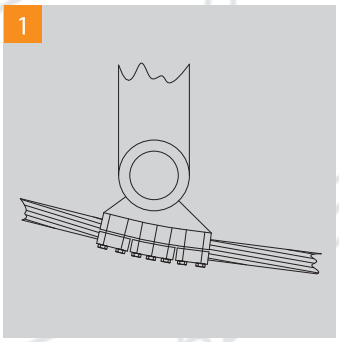
# WIDE SPAN STRUCTURES, HALLS, EXHIBITION BUILDINGS

APPLICATION




Compression strut of main girder with girder with



Exhibition Hall 9 Hannover, Germany

Inside view of main and secondary girders

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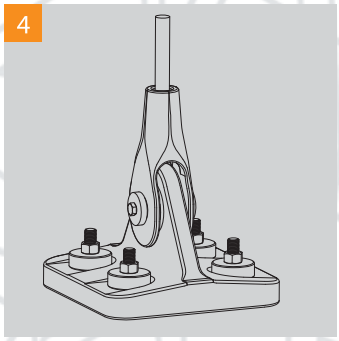

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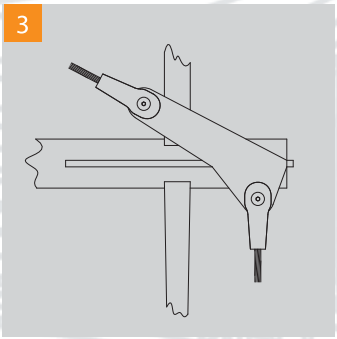
Connection stay cable to foundation



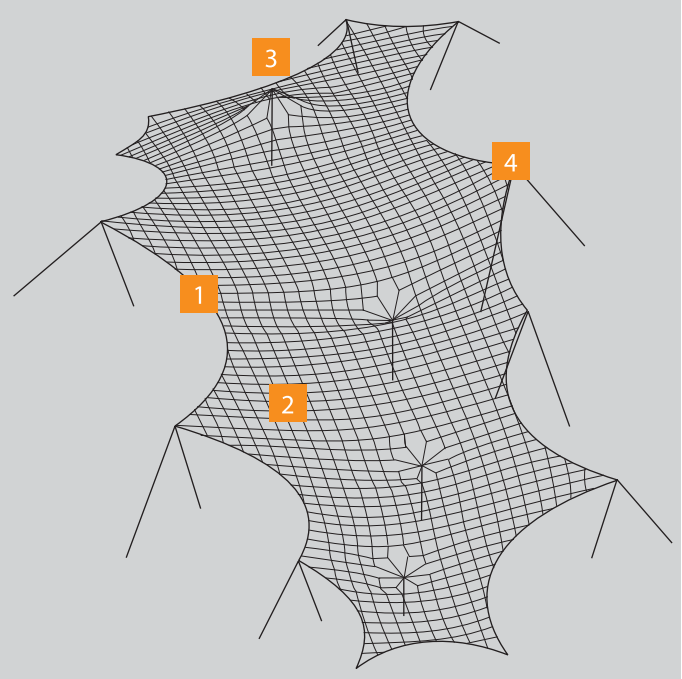
3

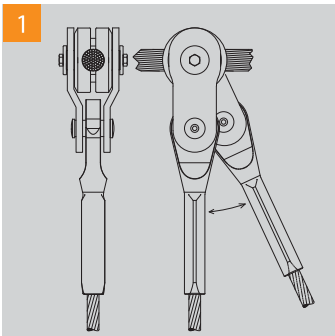
3

Connection of cables outside the building

# ZOOLOGICAL AND BOTANICAL GARDEN

APPLICATION



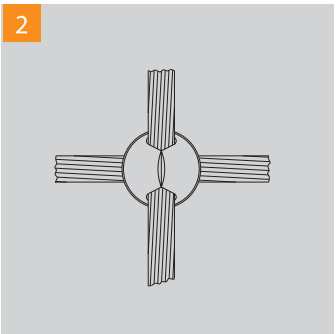



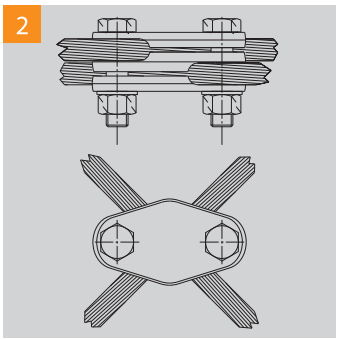


Connection cable net to edge cable

Aviary Wilhelma Stuttgart, Germany

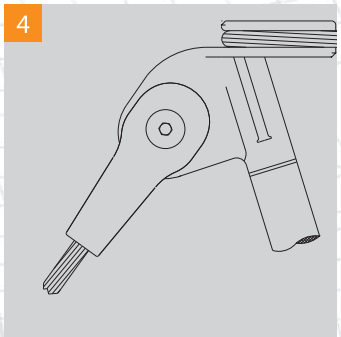
Cable cross clamp swaged / screwed




Border cable with outer post

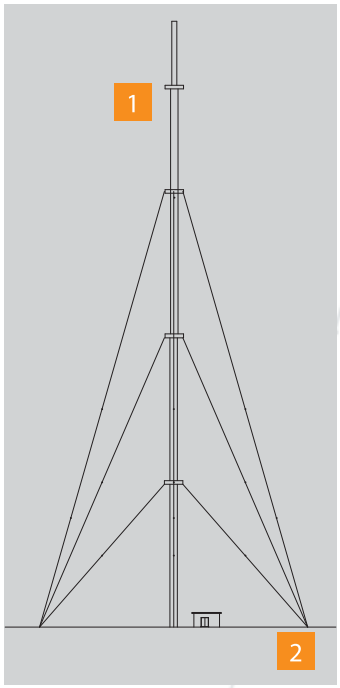

Girder Pylon with loop cables

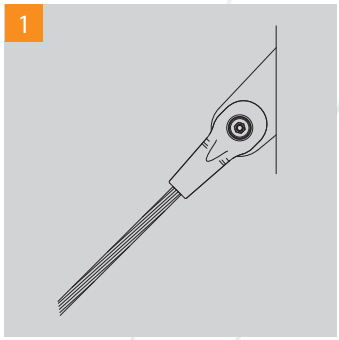




Connecting edge cable
to pylon stay cable

# TRANSMITTER MASTS

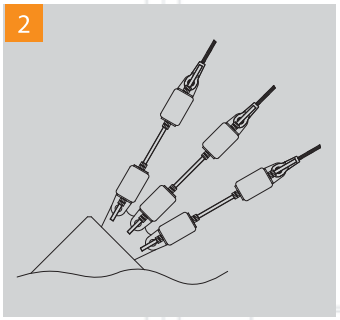
APPLICATION




Connection stay cable at transmitter mast


Stay cable at foundation anchoring



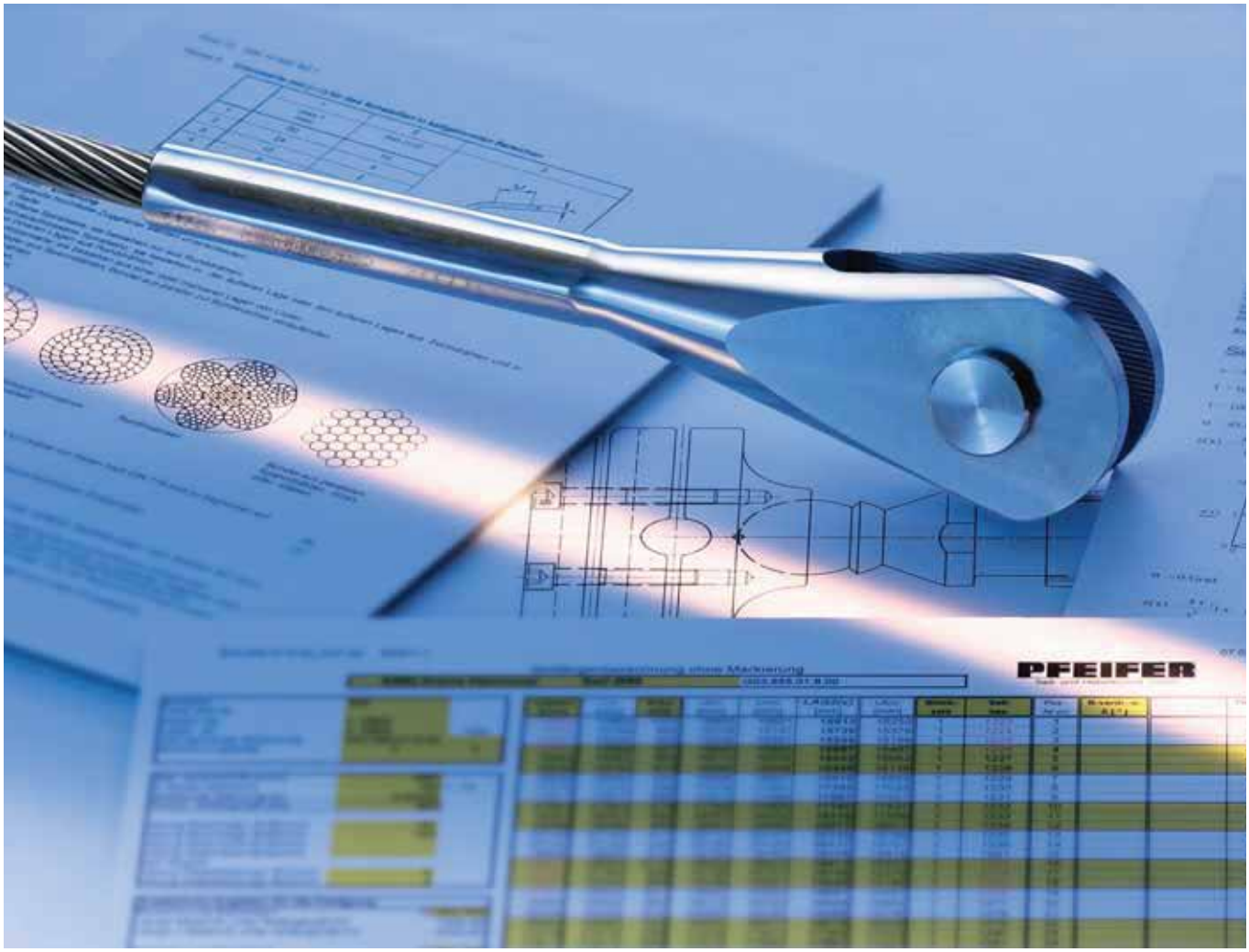


Transmitter Mast

CE 1771 ETA

ETA-11/0160






# Make use of our experience!

All components of our programm are developed and designed to fulfil the needs of the structures up to the last detail. Our technical team of experienced structural and mechanical engineers provides a large knowledge in all aspects of cable structures.

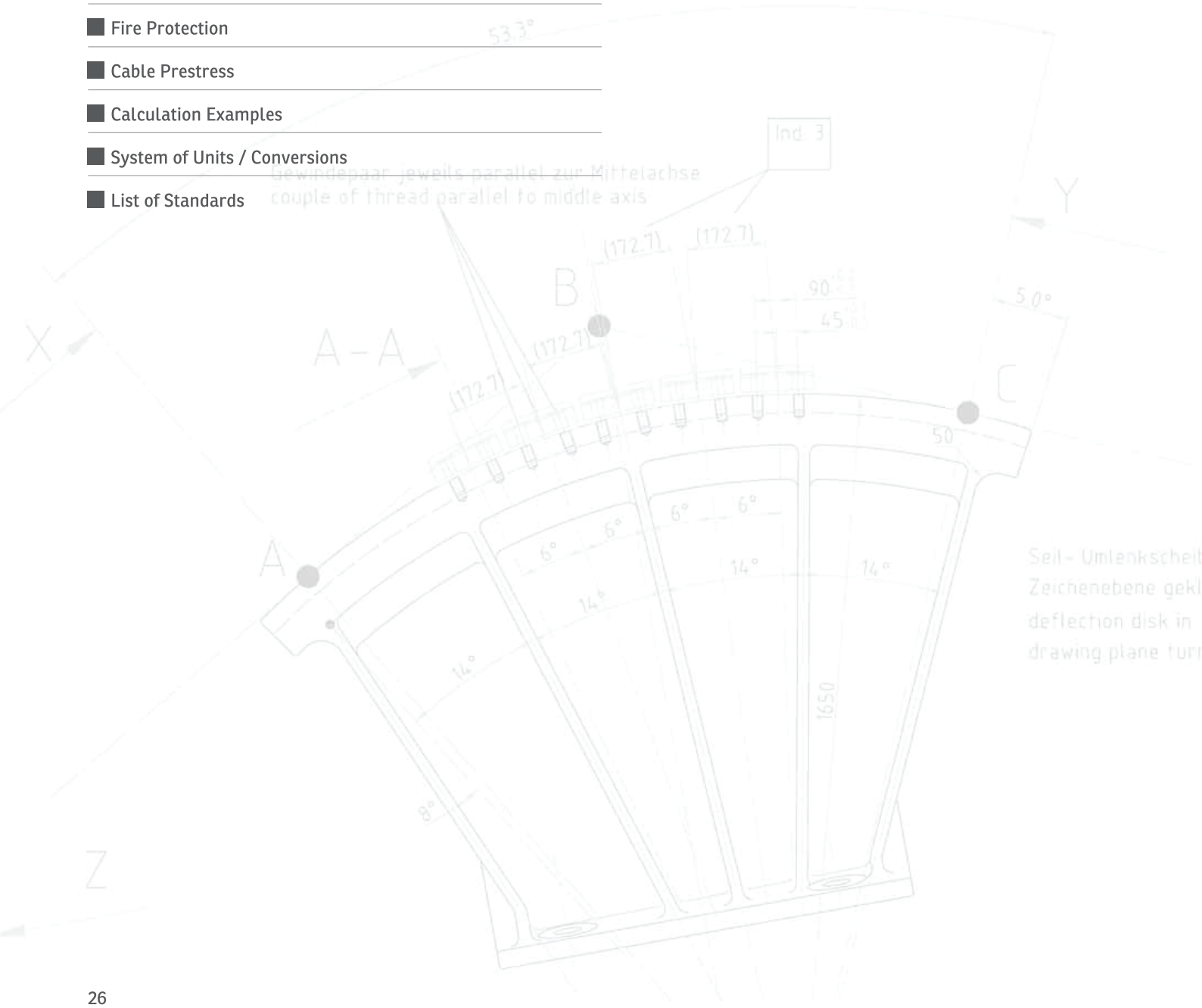
# MAKE USE OF OUR EXPERIENCE

ENGINEERING

In our engineering office we handle all the tasks of sophisticated cable construction. Apart from the implementation of cable touching parts and special building components, we focus on the development of special installation methods.

**Content**


- Cable Types
- Cable End Terminations
- Cable Characteristics
- Dimensional Accuracy / Tolerances
- Corrosion Protection
- Fire Protection
- Cable Prestress
- Calculation Examples
- System of Units / Conversions
- List of Standards

Stranding of a cable

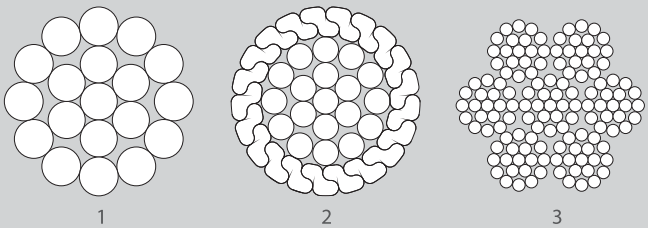
According to DIN Standard 18 800 all cables are rated as high tensile tension members.

Cables consist of many individual wires, i.e. individual cross sections.
This reduces the defect rate per cross section as compared to monofilament individual cross sections (e.g. solid rods) to a minimum or even to zero.

Preferably the following constructions are used in construction:
- spiral strands (Picture 1)
- full locked cables (Picture 2)

For specific cases of a secondary nature
- structural wire ropes (Picture 3)

Picture 1




## Spiral Strands

Applications of spiral strands:

| | |
|---|---|
| stay cables | for transmitter masts, smoke stacks |
| suspension cables - border cables | for lightweight structures |
| hanger cables | for suspension bridges |
| stabilizing cables | for wooden trusses or steel trusses |
| suspension cables-stabilizing cables | for cable nets |
| railing cables | for stairs balconies bridges and pedestrian ways |

# CABLE TYPES



## Full Locked Cables

Applications of full locked cables:

- suspension cables – hanger cables for bridge construction
- suspension cables – stabilizing cables in cables trusses
- border cables for cable nets
- stay cables for pylons, masts and
- stabilizing cables

transmitter masts
for wooden trusses and
steel trusses

Main advantages of full locked cables are:

- high modulus of elasticity
- high resistance against surface pressure
- consistently closed surface therefore good cable core protection against corrosion

The core of this cable consists of several layers of round wire, the outer layers are formed by Z-shaped wires. These interlocking wire profiles form a smooth, consistently closed surface which prevents unwanted foreign media from entering into the cable's interior.

## Strand Ropes

Strand ropes only play a tangential role in construction. They are mainly used as "running ropes" (hoisting ropes, elevator ropes) and sling ropes (suspension tackles, cable slings) i.e. everywhere where flexible ropes are required. Because of a lower modulus of elasticity, a more damageable rope surface and lower corrosion resistance, these ropes are used only for specific requirements in architecture.

- border cables — for textile membranes
- railing cables — for stairs, balconies, bridges and pedestrian ways
- installation cables — for temporary installation purpose

If required, our respective technical department will be pleased to provide you with more detailed information on strand ropes.

For high-tensile tension members the following end terminations are approved according DIN Standard 18 800:

- Poured anchorings, acc. to DIN EN 13411-4
- Ferrules acc. to DIN EN 13411-3
- Steel ferrules

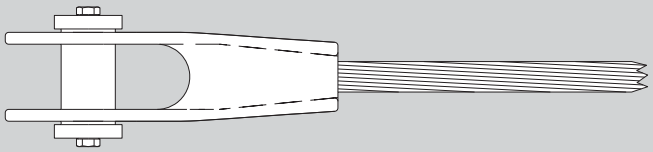
All cable end termination calculations are based on the characteristic breaking load of the cable system.

Free cable length between fittings shall be at least fifty times the cable diameter for construction 1 x 19 and 1 x 37. For all other constructions free cable length shall be at least seventy times the cable diameter (see picture 3 page 3/20).

Poured anchorings (picture 1) acc. to DIN EN 13411-4 for

- spiral strand
- full locked cables
- strand ropes

Picture 1



Aluminium-wrought alloy ferrules (picture 2) acc. to DIN EN 13411-3 for

- spiral strands
- strand ropes

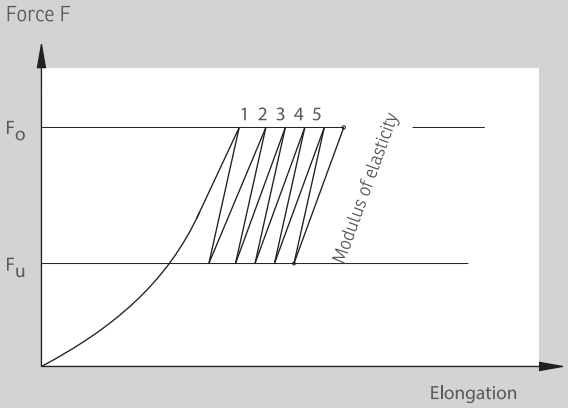
Picture 2

Steel ferrules (picture 3) for

- spiral strands
- strand ropes

Picture 3

Picture 1




Preparation of prestretching for a cable

Measuring of cable elongation

Unloaded cables show a non-linear load/elongation behaviour. Even cables of the same design and diameter have to be exposed to a defined load before their lengths can be compared. Elongation can be predicted for a pre-stretched cable only. Therefore the cables are prestretched and respective length measured under preload.

Required geometry and preloads are already taken into account during confectioning of cables in the plant.

First the modulus of elasticity for each cable type and diameter is measured as secant for load increase after cables have been cyclically loaded five times to between $F_u$ up to $F_o$. Multiple burdening and unburdening causes the cable's individual wires to align themselves in such a way that elongation characteristics are achieved which are reproducible to the greatest possible extend (see picture 1).

## Cutting to length

Accurate cutting to length requires measured elongation properties as well as the following criteria to be considered:

- ambient temperature when cutting to length relative to temperature adopted in static calculation
- settling of the pouring cone after cooling of molten metal and after initial load is applied
- additional elongation of cable after installation of cable clamps
- cable creep

In general the tension members of a cable structure do not provide any means for later adjustment for the compensation of fabrication tolerances and measuring errors.

To reduce manufacturing tolerances, the following measures are taken:

### Prestretching

To determine their elastic elongation behaviour, the cables are burdened and unburdened five times to $F_0$ (see page 3/18).
Under a defined preload – generally actual load applied plus dead weight in the building structure – total length and all measuring points for the attachment of saddles and clamps are marked. Additional control markings allow for a later check of exact position after parts have been installed.

### Temperature

The confection of the cables is carried out in controlled conditions and at constant temperatures. Since the confectioning temperature can deviate from the rated temperature – which forms the basis for static calculations – this difference must be considered.

### Settling of the pouring cone

Settling of the pouring cone only occurs above a certain load level. This level, as a rule, is achieved during installation by prestressing. Above mentioned settlement is considered in the calculations, so that the cables are usually delivered with unsettled pouring cones to the construction site (cables are shortened).

### Elongation through clamping

If additional clamps are mounted on a cable, the transverse compression causes a local cable elongation within the clamp. Especially if a large number of clamps are used, this elongation must be considered.

Providing measuring points of the cable

## Cable Creep

Because of the cable creep all cables will be produced at $E_K$ =0,35 ‰ shorter, if no other agreements are made. It is assumed, that cable creeping will take place after a certain time and load in the building.

Therefore higher loads may be needed during erection as the cable creep has not finished yet.

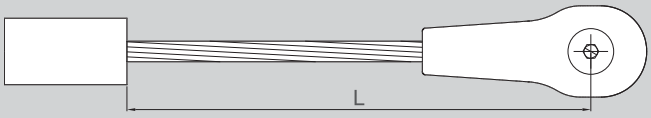
Time until the end of cable creeping depends on different factors. The level of loading, the number of loads and the temperature influences the cable creep.

The estimated value of the cable creep about $E_K$ = 0,35 ‰ is a value which correspond with our experience. Therefore this values could be slightly more or less.

For this reason constructions which are sensitive in a geometric way, should be tested for actual cable creep value $E_K$ or should be planned with adjusting possibilities.

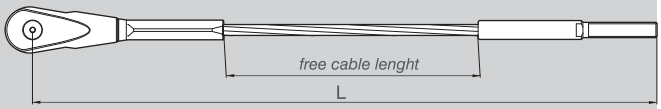
Careful planning and manufacture allow for the following fabrication tolerances Δ L for prestretched cables marked under preload as shown in pictures 2 and 3.

Picture 2 - End termination acc. to DIN EN 13411-4, poured




$\Delta L = \pm ( \sqrt{L\,[m]} + 5\ mm)$

Picture 3 - End termination for spiral strand, swaged




$\Delta L = \pm ( \sqrt{L\,[m]} + 5\ mm)$

Corrosion protection is an essential component of safety engineering. Materials and substances used in corrosion protection must be environmentally safe and must offer a long-term effect.

Corrosion Protection of cables can essentially be subdivided into four areas:

- Corrosion protection via constructive measures on the structure
- Corrosion protection of the individual wire
- Corrosion protection of the cable's interior (inner filling)
- Corrosion protection of the cable surface inclusive end terminations

## Corrosion protection via constructive measures on the structure

Rainwater running down the cables must quickly run off in areas such as end anchorage and clamps. If required, appropriate drilling or grooves for the water to run off have to be applied so that no water remains trapped in these areas. All connection plates on the structure must be designed in such a way that appropriate ventilation of the cables is guaranteed and humidity can dry quickly. Furthermore, it is essential that cables and cable connections are not in areas where they are directly sprayed with road salt.

## Corrosion protection of individual wires

### galvanized wires

For static applications, round wires and profile wires are usually manufactured according to DIN EN 10264-3 Class B und Class A. Depending on wire diameter respectively section height of the profile wires, the following minimum values have been set for the area mass (grams per square meter) of the zinc coating according to DIN EN 10264-3.

| | |
|---|---|
| Round wires | 0,8 mm – 4 mm: |
| Class B: | 70g/m$^2$ – 135g/m$^2$ |
| Class A: | 145g/m$^2$ – 275g/m$^2$ |
| Section height of profile wires | 2 mm – 8 mm: |
| Class B: | 115g/m$^2$ – 150g/m$^2$ |
| Class A: | 215g/m$^2$ – 290g/m$^2$ |

### GALFAN coated wires

GALFAN currently offers the most effective corrosion protection for wires made of non-alloyed steel. In a hot-dip process similar to galvanizing, the GALFAN coating is applied to the individual wire. Thus the wires receive a consistent protective layer of zinc (95 %) and aluminium (5 %).

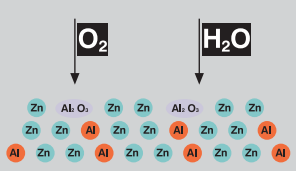
GALFAN's mode of action combines the passive protective properties of aluminium with the active protective properties of zinc in an optimal way. In a first phase, the aluminium in the protective layer reacts with oxygen and water taken from the atmosphere to form aluminium oxide (picture 1).

At the same time, as is usual in conventional galvanizing, zinc is washed out of the upper molecule layers resulting in vacancies (picture 2).

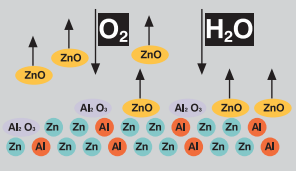
This creates a pathway for new aluminium, which also reacts to aluminium oxide (picture 3).

Thus a consistent layer of aluminium oxide develops gradually (picture 4).

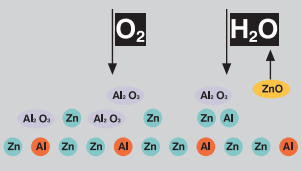
Picture 1



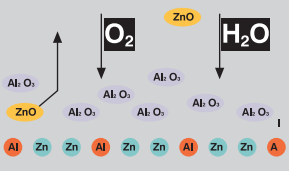

Picture 2




Picture 3




Picture 4



Contrary to a 100 % zinc layer, the aluminium-oxide layer is stable and thus prevents further washing out of zinc.

Round wires and profile wires can be manufactured with a GALFAN area weight of ca. 300 g/m$^2$

The GALFAN coating (Zn/Al) is regulated in DIN EN 10264-3.

■ Stainless steel wires

Round wires up to about 3 mm diameter can also be manufactured from non-corrosive stainless steel.

■ Corrosion protection of the interior of the cable

■ Full Locked Cables

Cavities existing in the cable's interior between heavy galvanized round wires and profile wires are filled with an active inner filling: PU-oil-based zinc dust paint, alternatively low-solvent, highly pigmented single-component zinc paste. The outer GALFAN coated profile-wire layer, in case of thicker cables two GALFAN coated layers, does not receive an inner filling. Thus escape of the inner filling to the cable's surface is reduced to a minimum.

Take notice! When selecting an inner filling, compatibility of the material with a corrosion protection coating, which is possibly applied later on, is essential.

Inner filling which is brought into the cables during stranding of the wires can escape to the surface when load has been handed over to the cable.

■ Open Spiral Strand

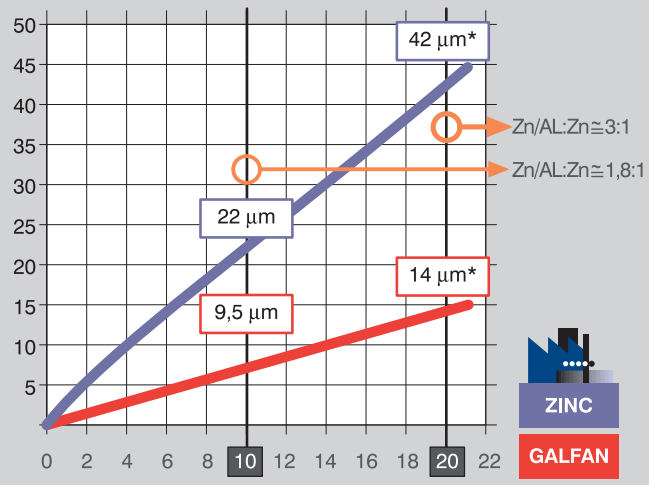
These cables consist only of GALFAN coated round wires or wires in stainless steel and don't receive an inner filling.

■ Corrosion protection of the cables surface inclusive of end terminations

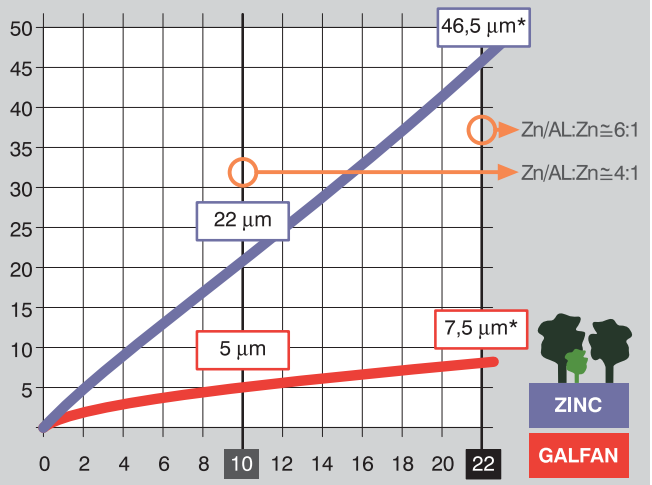
■ Cables GALFAN coated without additional coating:

GALFAN currently offers the most effective corrosion protection if used for the external wires made of non-alloyed steel.

Picture 5 Erosion of the corrosion-protection layer in industrial atmosphere over time:




Picture 6 Erosion of the corrosion-protection layer in rural atmosphere over time:



In practice, depending on the atmosphere, this results in a three to six times lower erosion rate of the corrosion-protection layer compared to conventional heavy galvanizing. (Picture 5 and 6)

In general there is therefore no need for additional coating of cables with GALFAN-coated external wires.

The following applies to Germany: for 95 % of the area of land corrosiveness categories C2 and C3 apply. Average zinc abrasion rate is ca 1µm per year. Within corrosion stresses C1 ... C3 (long lasting protection) hot-dip galvanizing alone is therefore not sufficient to provide corrosion protection for several decades.

■ Cables with additional coating

We will be glad to provide you with further information about an appropriate coating and paint system for full locked cables. If required, we are also able to accommodate desires as to coloration on the part of the project owner or architect.

■ End terminations

Sockets of cables are usually hot-dip galvanized, cable fittings are delivered zinc-sprayed.

Contingently existing threads at the end terminations are delivered bare (only temporary corrosion protection).

We are able to offer zinc/nickel-coating for certain parts as threaded fittings. Due to the fact of the excellent corrosion protection is also on the external threads it may not be necessary to apply additional painting under certain circumstances.

Through so-called Duplex-Systems (hot-dip galvanizing or zinc spraying plus coating system) longerlasting protection and coloration requirements can be realized.

Bare threads must be degreased, cleaned and coated after installation.

Corrosion stress, abrasion rates of zinc as well as allocation of atmospheric conditions can be determined according to DIN EN ISO 12944-2.

■ Stainless steel cables and end terminations made of non-corrosive steels

Stainless steel cables are usually made of materials no. 1.4401 or 1.4436.

Stainless steel cables made of 1.4401 are allocated to corrosion resistance class II/moderate (technical approval non-corrosive steels Z-30.3-6 table 1) according to our technical approval ETA-11/0160. These cables can be employed in accessible structures without noteworthy chloride or sulphur dioxide stress.

Stainless steel cables made of 1.4436 and end terminations made of 1.4462 are allocated to corrosion resistance class III/medium (technical approval non-corrosive steels Z-30.3-6 table 1) according to our technical approval ETA-11/0160. These cables can be employed in accessible structures, end terminations; also for inaccessible structures subject to moderate chloride or sulphur dioxide stress from industry, traffic or caused by maritime atmosphere.

All external-layer wires of our stainless steel cables are subsequently polished to guarantee a shiny surface.

# FIRE PROTECTION



In most cases appropriate constructive measures render fire protection systems on the cable and its components unnecessary, as cables don't add fire load. They are usually located far away from possible fire. In doubtable cases the fire authority report will specify the required fire protection system.

In Germany building regulations of the federal states have to be adhered to as far as fire protection is concerned.

If fire protection for the cables becomes necessary in individual specific cases, the following points must be strictly borne in mind:

■ Critical temperatures of cable and components, which must not be surpassed to preserve load-bearing capabilities:

| | |
|---|---|
| Socketing material: | max. 120 °C |
| Cold-drawn wires: | 350...450 °C |
| Cable sockets (cast steel): | max. 450 °C |
| Fittings (construction steel): | max. 450 °C |

To make sure that these temperatures are not surpassed in fire conditions for the prescribed time (dependant on fire resistance class), an appropriate fire protection system must be applied where required.

■ Minimum cable diameter

According to DIN 4102-4 paragraph 6.1.3 the following limit value must be adhered to: Circumference C / Cross-sectional area A ≤ 300 $m^{-1}$
According to this requirement, spiral strand from cable diameter d = 18 mm can be employed in fire protection relevant tension elements.

■ Building regulation aspects

For high-performance tension elements subject to fire protection requirements, approval has to be applied for in Germany for individual cases. For other countries the regulations prevailing have to be adhered to.

We will be glad to provide you with more detailed information about an appropriate fire protection system at the cable and its components for your specific case.

3D-design with CAD system and technical advice

In general, cables in cable structures are tensioned during or after installation.

Cable-tensioning forces are mainly applied by means of appropriate hydraulic tensioning systems.

If possible, the tensioning forces must be chosen such that even in case of adverse load distribution no slack cables occur.

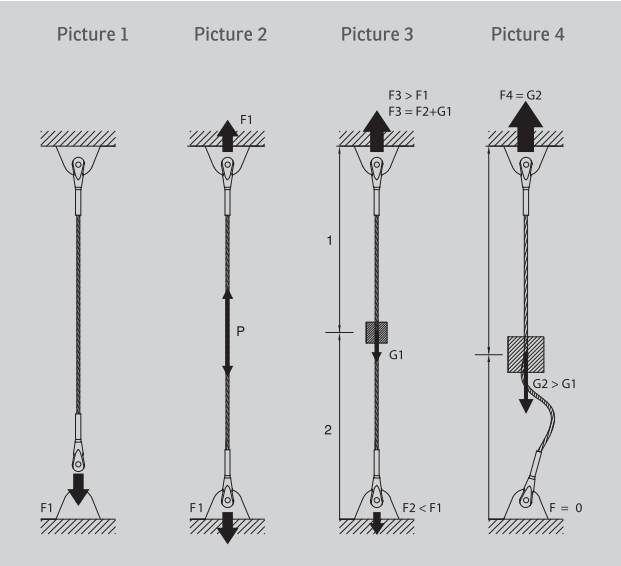
Picture 1:
The length of the unloaded cable is shorter than the distance between the two hook-in points.
The cable is attached to the upper hook-in point and expanded by application of the ten-sioning force F1 until it can be fastened to the lower hook-in point.

Picture 2:
The cable extended by the force F1 and connected at both ends is now subject to a cable force, which is also referred to as prestress P (P = F1).

Picture 3:
An additional external force G1 is now applied to the free cable length (e.g. by means of a cable clamp).
The cable can be thought of as a cable system in which the cable in Section 1 acts as a suspension cable while the cable in Section 2 acts as a stay cable. Suspension cable and stay cable now bear and stabilize the additional external force G1, respectively. Consequently, Section 1 is extended further and the force F1 in this Section increases (F3 > F1). In Section 2 the force F1, and thus prestress, decreases (F2 < F1).

Picture 4:
The force G1 applied according to Picture 3 is increased (G2 > G1). Consequently, Section 1 is tensioned further. Section 2 is slackened fully and thus it does not take on any more forces. The suspension cable only bears the external force G2. Given that the stabilizing force ceases to exist, the system becomes unstable (G2 can swing freely).

Note:
More detailed information about this topic can be found in our information leaflet “PFEIFER Infoschrift 02/2010”.




Pretensioning of a cable with hydraulic tensioning system

# CALCULATION EXAMPLES

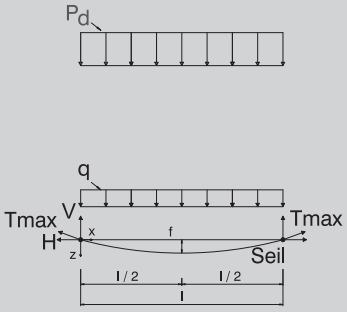
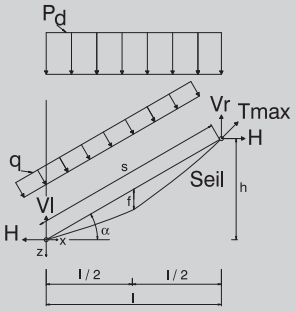
Cable subject to evenly spread uniform load for which case a) "level anchorage points" and case b) "anchorage points at different heights" is set.

■ The following values are given:

| | |
|---|---|
| ■ Evenly spread uniform load (assumption) | q = 3.5 kN/m |
| ■ Partial safety factor (DIN 18800) | $\gamma_F$ = 1,35 |
| ■ approx. cable weight (assumption) | g < 10 kg/m<br>~ 0,1 kN/m |
| ■ uniform load (horizontally lying) | Pd1= (q+g)*$\gamma_F$ ~ 5 kN/m |
| ■ horizontal distance of anchorage points l | 10 m |
| ■ sag of the cable | f = 1 m<br>(guiding value for practical application: f = s/10 to s/20 ) |
| ■ Difference in height case b | h = 10 m |

■ Note:

The approximation formulae stated here only apply for small cable sag (f <= s/10; with s = chord length)
Cable end terminations are not considered in this example.

| | case a | case b |
|---|---|---|
| angle $\alpha$ | 0° | 45° |
| **cable curve**<br>$z(x) = -\tan(\alpha)\cdot x + \left[\frac{4\cdot f}{l^2}\cdot(l\cdot x - x^2)\right]$ |  |  |
| **cable sag in middle of the cable** | f = 1 m assumed | f = 1 m assumed |
| **cable length**<br>$L = l\left(1+\frac{8}{3\cdot\theta^4}\cdot n^2\right)\cdot\theta$<br>$\theta = \frac{1}{\cos(\alpha)}$ $n = \frac{f}{l}$ | L = 10,267 m | L = 14,236 m |
| **calculated distributed load**<br>$p_d = p_{d1}{}^* s/l$<br>**in vertical direction** | ~ 5 kN/m | ~ 7 kN/m |
| **horizontal force**<br>$H = \frac{p_d\cdot l^2}{8\cdot f}$ | H = 62,5 kN | H = 87,5 kN |
| **vertical force** | $V = \frac{p_d\cdot l}{2}$<br>V = 25 kN | $V_l = \frac{p_d\cdot l}{2} - \frac{H\cdot h}{l}$<br>$V_r = \frac{p_d\cdot l}{2} + \frac{H\cdot h}{l}$<br>$V_l$ = -52,5 kN $V_r$ = 122,5 kN |

| | case a | case b |
|---|---|---|
| maximum cable force | | |
| $T_{max} = \sqrt{(H^2 + V^2)}$ | $T_{max} =$ 67,3 kN | $T_{max} =$ 150,5 kN |
| selection cable size | PG 15 | PG 25 |
| In this case the loading was calculated for the limit conditions of ultimate limit state according DIN 18 800 ( $\gamma_F$ = 1.35). This determination of the cabe size happened therefore by $Z_{R,d}$ See page 3 – 34 (Selecting a cable) | | |
| Change cable length due to force | | |
| $\Delta L \cong \frac{T_{max} \cdot L}{A_m \cdot E}$ | $\Delta L \cong$ 50 mm | $\Delta L \cong$ 80 mm |
| $A_m$ =metallic cross section | $A_m$ = 87 mm $^2$ | $A_m$ = 168 mm $^2$ |
| E =Modulus of elasticity | E = 160 KN/mm $^2$ | E = 160 KN/ mm$^2$ |
| change cable length due to temperature | | |
| $\Delta L = \Delta t \cdot \alpha_t \cdot l \cdot ( 1 + \frac{8}{3 \cdot \theta} 4 \cdot n^2) \cdot \theta$ | $\Delta L \cong$ 3,7 mm | $\Delta L \cong$ 5,1 mm |
| $\alpha_t$ =temperature coefficient | $\alpha_t = 12.10^{-6}$ 1/K | $\alpha_t = 12.10^{-6}$ 1/K |
| $\Delta$ =temperature difference | $\Delta t$ = 30 K | $\Delta t$ = 30 K |

# System of Units / Conversions

| German – American | | | American – German | | |
|---|---|---|---|---|---|
| 1 kN | = | 0,22472 KIPS | 1 KIPS | = | 4,45 kN |
| 1 mm | = | 0,03937 inch | 1 inch | = | 25,4 mm |
| 1 mm$^2$ | = | 0,00155 square inch | 1 square inch | = | 645,16 mm$^2$ |
| 1 N | = | 0,22473 pounds | 1 pound | = | 4,45 N |
| 1 N/mm$^2$ | = | 145 psi | 1 psi | = | 0,00690 N/mm$^2$ |
| 1 kN/mm$^2$ | = | 145 ksi | 1 ksi | = | 0,0069 kN/mm$^2$ |
| 1 N/mm$^2$ | = | 1 MPa | 1 MPa | = | 1 N/mm$^2$ |
| 1 kg | = | 2,20462 pounds | 1 pound | = | 0,45359 kg |
| 1 m | = | 39.37 inches | 1 inch | = | 0,02540 m |
| 1 kg/m | = | 0,056 pounds per inch | 1 pound per inch | = | 17,857 kg/m |

# COMPARISION OF STANDARDS

The construction of cable structures in Germany currently is still for the most part based on DIN 18800. In future, Eurocode 3 is to be predominantly used all over Europe.

Since our products are employed globally, we have also added the American ASCE Standard 19-96 for comparison purposes.

In the following table, the various designations for the minimum breaking load, the characteristic value of breaking load and the limit tension within the individual standards are listed in parallel for comparison.

| | DIN 18800 Teil1 1990 | EC 3 (pr EN 1993) | ASCE Standard 19-96 |
|---|---|---|---|
| Minimum breaking load | – | $F_{min}$ | $S_n$ |
| Characteristic breaking load | $Z_{B,k} \geq A_m \cdot f_{u,k} \cdot k_s \cdot k_e$<br>$A_m$ =met. cross section<br>$f_{u,k}$ =char. tensile strength<br>$k_s$ =stranding factor<br>$k_e$=loss factor | $F_{u,k} \geq F_{min} \cdot k_e$ | $S_d \geq S_n \cdot \phi_f$<br>$\phi_f$ = Verlustfaktor/loss factor |
| limit tension | $Z_{R,d} \geq \frac{Z_{B,k}}{1,5 \cdot \gamma_M}$<br>$\gamma_M$ =safety factor | $F_{R,d} \geq \frac{F_{u,k}}{1,5 \cdot \gamma_R}$<br>$\gamma_R$ =safety factor | |

In our cable data sheets we have allocated a “characteristic value of breaking load” and a “limit tension” to every size.

The “characteristic breaking load” of a cable tension element, in DIN 18800 a.k.a. $Z_{B,k}$ states the minimum force that has to be reached in a tensile test. The loss factor for the cable end terminations is considered in this force. This value is regulated in all three mentioned standards and can be obtained directly from our catalogue for all sizes.

The “limit tension” of a cable tension element is regulated only in DIN 18800 and in Eurocode 3. It states the limit value up until which the building component still behaves elastically under $\gamma_F$-fold burden and thus no load transfers to other parts of the structure occur. “Limit tension” may only be used if the statics for the cable structure have been calculated according to DIN 18800 or Eurocode 3. The ASCE Standard 19-96 does not cover this term.

“Minimum breaking load” is a value that only applies to the cable itself (without end terminations), it does not consider the loss factor of the end terminations. This value is only covered by Eurocode 3 and ASCE Standard 19-96.

Since in cable structures always the complete cable tension element is used (with end termination), we only state the characteristic “breaking load”, which is the essential standard for the whole tension element, in the catalogue.

## Fabrication and delivery of wires

| | |
|---|---|
| DIN 1653 | Surface Condition of Commercial Steel Wires; Denominations and Abbreviations thereof |
| DIN EN 10016-1 | Non-alloy steel rod for drawing or cold rolling – Part 1: General requirements |
| DIN EN 10016-2 | Non-alloy steel rod for drawing or cold rolling – Part 2: Specific requirements for general purpose rod |
| DIN EN 10016-4 | Non-alloy steel rod for drawing and/or cold rolling – Part 4: Specific requirements for rod for special applications; |
| DIN EN 10088-2 | Stainless steels – Part 2: Technical delivery conditions for sheet/plate and strip for general purposes; |
| DIN EN 10088-3 | Stainless steels – Part 3: Technical delivery conditions for semi-finished products, bars, rods and sections for general purposes; |
| DIN EN 10244-2 | Steel wire and wire products – Non-ferrous metallic coatings on steel wire – Part 2: Zinc or zinc alloy coatings; |
| DIN EN 10264-1 | Steel wire and wire products – Steel wire for ropes – Part 1: General requirements; |
| DIN EN 10264-2 | Steel wire and wire products – Steel wire for ropes – Part 2: Cold drawn non alloyed steel wire for ropes for general applications; |
| DIN EN 10264-3 | Steel wire and wire products – Steel wire for ropes – Part 3: Round and shaped non alloyed steel wire for high duty applications; |
| DIN EN 10264-4 | Steel wire and wire products – Steel wire for ropes – Part 4: Stainless steel wire; |
| DIN 17440 | Stainless steels – Technical delivery conditions for drawn wire |

## Fabrication and delivery of wire ropes

| | |
|---|---|
| DIN 3052 | Steel wire ropes; spiral rope 1 x 7 |
| DIN 3053 | Steel wire ropes; spiral rope 1 x 19 |
| DIN 3054 | Steel wire ropes; spiral rope 1 x 37 |
| DIN 3094 | Reel for wire ropes |
| DIN EN 12385-1 | Steel wire ropes-Safety – Part 1: General requirements; |
| DIN EN 12385-2 | Steel wire ropes-Safety – Part 2: Definitions, designation and classification; |
| DIN EN 12385-4 | Steel wire ropes-Safety – Part 4: Stranded ropes for general lifting applications; |
| DIN EN 12385-10 | Steel wire ropes-Safety – Part 10: Spiral ropes for general structural applications; |

# LIST OF STANDARDS



## Fabrication and delivery of components

| | |
|---|---|
| DIN EN 13411-1 | Terminations for steel wire ropes-Safety – Part 1: Thimbles for steel wire rope slings; |
| DIN EN 13411-3 | Terminations for steel wire ropes-Safety – Part 3: Ferrules and ferrule-securing; |
| DIN EN 13411-4 | Terminations for steel wire ropes-Safety – Part 4: Metal and resin socketing; |
| DIN EN 13411-5 | Terminations for steel wire ropes-Safety – Part 5: U-bolt wire grips; |

## Testing and inspection of wires

| | |
|---|---|
| DIN EN 10002-1 | Metallic materials – Tensile testing – Part 1: Method of testing at ambient temperature; |
| DIN EN 10204 | Metallic products – Types of inspection documents; |
| DIN EN 10244-2 | Steel wire and wire products – Non-ferrous metallic coatings on steel wire – Part 2: Zinc or zinc alloy coatings; |
| DIN EN 10244-4 | Steel wire and wire products – Non-ferrous metallic coatings on steel wire – Part 4: Tin coatings |
| DIN 51211 | Testing of Metallic Materials; Reverse Bend Test of Wires |
| DIN 51212 | Testing of Metallic Materials; Torsion Test of Wires |
| DIN 51215 | Testing of Metallic Materials; Wrapping Test for Wires; General Information |

## Testing and inspection of wire ropes

| | |
|---|---|
| DIN EN 12385-1 | Steel wire ropes-Safety – Part 1: General requirements; |

## Application of wire ropes in building construction

| | |
|---|---|
| DIN 4131 | Steel radio towers and masts |
| DIN 4133 | Steel stacks |
| DIN 18800-1 | Structural steelwork; design and construction |
| DIN 18800-7 | Steel structures – Part 7: Execution and constructor's qualification |
| DIN 18809 | Steel road bridges and foot bridges; design and construction |
| DIN 1076 | Engineering structures in connection with roads - inspection and test |

## Components - materials

| | |
|---|---|
| DIN 1681 | Cast steels for general engineering purposes; technical delivery conditions |
| DIN 1683-1 | Rough steel castings – General tolerances, machining allowances; inactive for new design |
| DIN EN 10025-1 | Hot rolled products of structural steels – Part 1: General technical delivery conditions; |

| | |
|---|---|
| DIN EN 10025-2 | Hot rolled products of structural steels – Part 2: Technical delivery conditions for non-alloy structural steels; |
| DIN EN 10025-3 | Hot rolled products of structural steels – Part 3: Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels; |
| DIN EN 10025-6 | Hot rolled products of structural steels – Part 6: Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition; |
| DIN EN 10083-1 | Quenched and tempered steels – Part 1: Technical delivery conditions for special steels; |
| DIN EN 10088-1 | Stainless steels – Part 1: List of stainless steels; |
| DIN EN 10088-2 | Stainless steels – Part 2: Technical delivery conditions for sheet/plate and strip for general purposes; |
| DIN EN 10088-3 | Stainless steels – Part 3: Technical delivery conditions for semi-finished products, bars, rods and sections for general purposes; |
| DIN 17182 | General-purpose steel castings with enhanced weldability and higher toughness; technical delivery conditions; |
| DIN 17205 | Quenched and tempered steel castings for general applications; technical delivery conditions |
| DIN 17440 | Stainless steels – Technical delivery conditions for drawn wire; |

SEW 400 Stainless rolled and forget steels;

SEW 520 High-tensile casted steel especially suited for welding technical delivery conditions;

SEW 550 Steels for larger forgings; quality regulations;

**Testing and inspection of material - components**

| | | |
|---|---|---|
| DIN EN | 444 | Non-destructive testing; general principles for the radiographic examination of metallic materials using X-rays and gamma-rays; |
| DIN EN | 583-1 | Non-destructive testing – Ultrasonic examination – Part 1: General principles; |
| DIN EN | 1369 | Founding – Magnetic particle inspection; |
| DIN EN | 1559-1 | Founding – Technical conditions of delivery – Part 1: General; |
| DIN EN | 1559-2 | Founding – Technical conditions of delivery – Part 2: Additional requirements for steel castings; |
| DIN EN | 10002-1 | Metallic materials – Tensile testing – Part 1: Method of testing at ambient temperature; |
| DIN EN | 10045-1 | Charpy impact test on metallic materials; Part 1: test method; |

DIN EN 10204 Metallic products – Types of inspection documents;

SEP 1390 Bead bend test;

# LIST OF STANDARDS



## Corrosion protection

| | |
|---|---|
| DIN EN ISO 1461 | Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods (ISO 1461:1999); |
| DIN EN ISO 12944-2 | Paints and varnishes - Corrosion protection of steel structures by protective paint systems – Part 2: Classification of environments (ISO 12944-2:1998); |
| DIN EN ISO 12944-3 | Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 3: Design considerations (ISO 12944-3:1998); |
| DIN EN ISO 12944-4 | Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 4: Types of surface and surface preparation (ISO 12944-4:1998); |
| DIN EN ISO 12944-5 | Paints and varnishes - Corrosion protection of steel structures by protective paint systems – Part 5: Protective paint systems (ISO 12944-5:1998); |
| DIN EN ISO 12944-6 | Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 6: Laboratory performance test (ISO 12944-6:1998); |
| DIN EN ISO 12944-7 | Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 7: Execution and supervision of paint work (ISO 12944-7:1998); |
| DIN EN ISO 12944-8 | Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 8: Development of specifications for new work and maintenance (ISO 12944-8:1998); |
| DIN EN 22063 | Metallic and other inorganic coatings – Thermal spraying – Zinc, aluminium and their alloys (ISO 2063:1991); |
| DIN 50979 | Metallic coatings of zinc and zinc alloys on iron with supplementary Cr (VI) – free treatment; |
| DIN 55928-8 | Protection of steel structures from corrosion by organic and metallic coatings; Part 8: protection of supporting thin-walled building components from corrosion; |
| RKS- Seile | Guide lines for the corrosion protection of wire ropes and cables in building construction; |

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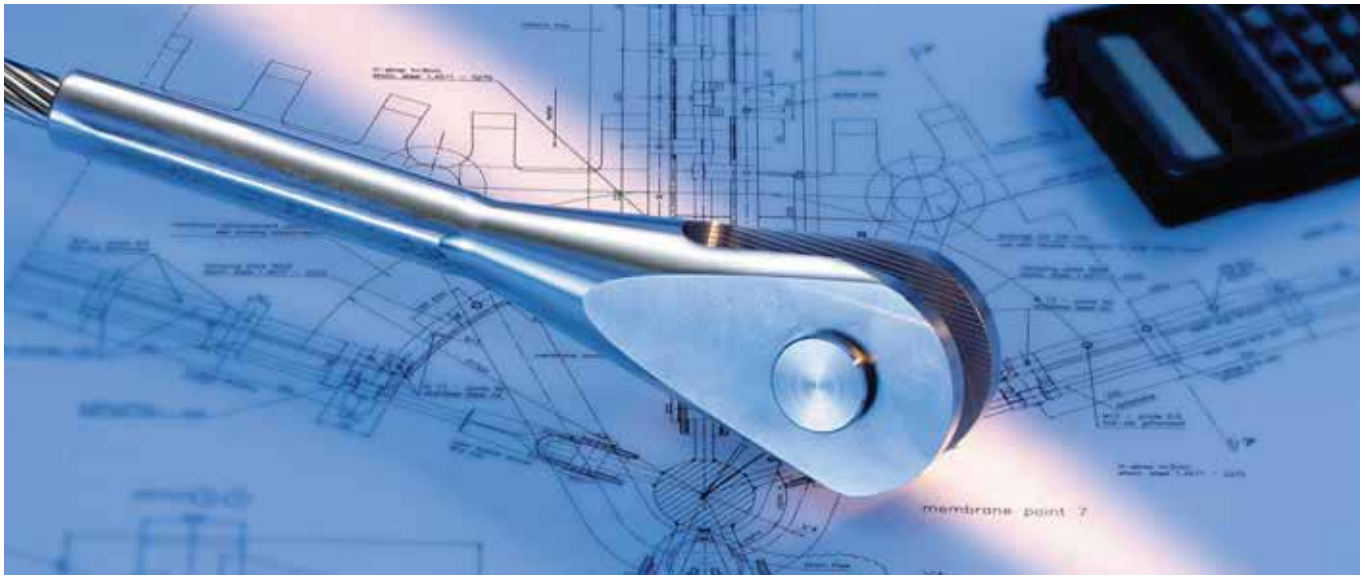



# The new PFEIFER Product System:

## simple

- Adjusted to the planner's method: load-bearing capability is decisive!
- The latest standards and assessment concepts are considered
- Clear depiction, helpful colour coding, systematic product designation

## capable

- High-performance PFEIFER cable systems are dimensioned to the characteristic value of breaking load $Z_{B,k}$
- Sensibly adjusted graduation in performance
- High force transmission achieved with small cross sections

## quick

- Consistently colour-coded product overview
- No time consuming search, find the right PFEIFER Cable System directly

## Four steps to the right PFEIFER Cable System:

## 1 Selecting a Cable

Selecting a cable via:

Required load range $(Z)_{B,k}$
Place of use
Aesthetics

Load range

**PE** Open Spiral strand – Stainless Steel

26 kN $Z_{B,k}$ 945 kN

**PG** Open Spiral strand – GALFAN

56 kN $Z_{B,k}$ 1189 kN

**PV** Full locked cable – GALFAN

405 kN $Z_{B,k}$ 20000 kN

Teil Technik (Seite 3/21) zu finden oder bei uns auf corrosion protection in the technology chapter (page 3/21) or enquire directly at PFEIFER.

Corrosiveness at place of use

gering / low interior areas) —— exterior areas ) hoch / high

PE
PV
PG
heavy galvanized
galvanized

Äesthetics of cable surface:

- Cable with GALFAN coated wires: silver-grey
- Cable with stainless steel wires: shining/polished

## 2 Cable Data Sheet

The colour-coded, fold-out cable data sheets make it easy to select the required cable type.

The new PFEIFER Product System helps the planner to find the fitting cable size via the characteristic breaking load. Reduction factors have already been considered here. Further reduction is not necessary.

The appropriate limit tension can be obtained directly from the tables or via country specific standards (see page 3/28.)

Example:

Decision-making parameters:

1. Required load range taken from cable structural analysis:

$Z_{B,K}$ = 330 kN

2. Corrosion protection high

3. Silver-grey surface

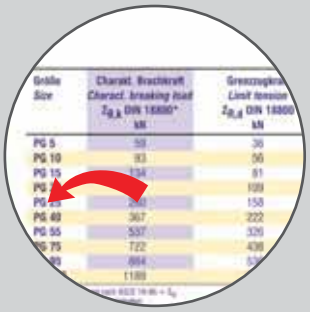
↓

PG


$Z_{B,k}$ = 330 kN

↓

PG 40



according to DIN 18800 T.1 (903): limit tension:

$$Z_{R,d} = \frac{Z_{B,k}}{1{,}5 \cdot \gamma_M} \qquad \gamma_M = 1{,}1$$

→ $Z_{R,d}$ = 220 kN

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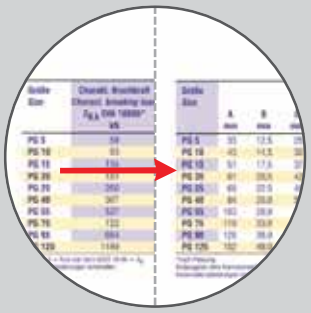
## 3 End Termination

Via the defined size and the given connection conditions for the cable system, the end terminations can be selected according to type in the subsequently also colour-coded data sheets.

Here the fold-out cable data sheets offer further support in allocating the appropriate cable system.

All reduction factors have already been considered in the cable data sheets. Further reduction is not necessary.

## 4 Cable System

Get the required cable system (example):

| | | | | | |
|---|---|---|---|---|---|
| PG | 40 | Typ | 980 | / | 984 |
| Cable Size | | End | and End | | |
| termination 1 | | | termination 2 | | |

System length

Can be easily taken into our tender text for PFEIFER Cable Systems, which you find under www.pfeifer.de

Example Text:

Pos. 1.1
Open spiral cable GALFAN-coated
PG 40 Type 980 / 984
Round wires GALFAN-coated according to DIN 10264
Elasticity module: 160kN/mm$^2$±10kN/mm$^2$
Characteristic value of breaking load $Z_{B,k}$ : 367 kN
Limit tension $Z_{R,d}$ : 220 kN (optional)
1 end open swaged socket PG 40 type 980
1 end turnbuckle with open socket PG 40 Typ 984

999 pieces length 999.000 mm Euro/piece _ EUR/total _

Connection 1 to steel construction:
- single-shear connection plate

→ Typ 980 Gabelfitting Open swaged socket

Connection 2 to steel construction:
- single-shear connection plate
- adjustable cable system

→ Typ 984 Turnbuckle with open socket

↓

PG 40 Typ 980/984

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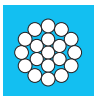
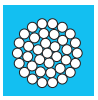
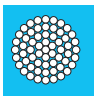
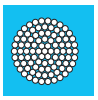
# PE

1 x 19  1 x 37  1 x 61  1 x 91 

## Technical Data

Material :
according Technical Approval ETA-11/0160

Modulus of Elasticity:
130 ± 10 kN/mm $^2$

Tolerance d $_S$ :
+ 3%

| size | charact. breaking load $Z_{B,k}$ DIN 18800* kN | limit tension $Z_{R,d}$ DIN 18800 kN | metallic cross section ca./approx. mm$^2$ | weight ca./ approx. kg/m | construction | nomin. strand dia. $d_S$ mm |
|---|---|---|---|---|---|---|
| PE 3 | 26 | 16 | 22 | 0,2 | 1 x 19 | 6,1 |
| PE 5 | 47 | 28 | 38 | 0,3 | 1 x 19 | 8,1 |
| PE 7 | 73 | 44 | 60 | 0,5 | 1 x 19 | 10,1 |
| PE 10 | 101 | 61 | 83 | 0,7 | 1 x 19 | 11,9 |
| PE 15 | 141 | 86 | 117 | 0,9 | 1 x 37 | 14,1 |
| PE 20 | 195 | 118 | 161 | 1,3 | 1 x 37 | 16,6 |
| PE 30 | 298 | 180 | 246 | 1,9 | 1 x 37 | 20,5 |
| PE 45 | 409 | 248 | 338 | 2,7 | 1 x 61 | 24,1 |
| PE 60 | 578 | 350 | 477 | 3,7 | 1 x 61 | 28,6 |
| PE 75 | 730 | 442 | 602 | 4,7 | 1 x 91 | 32,1 |
| PE 100 | 945 | 573 | 780 | 6,1 | 1 x 91 | 36,6 |

*according EC 3 = $F_{u,k}$ and according ASCE 19-96 = $S_d$
Subject to technical modification
Bigger dimensions and intermediate dimensions upon request

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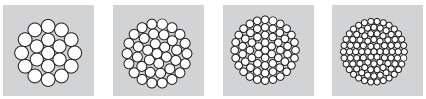
# PE Typ Type 981

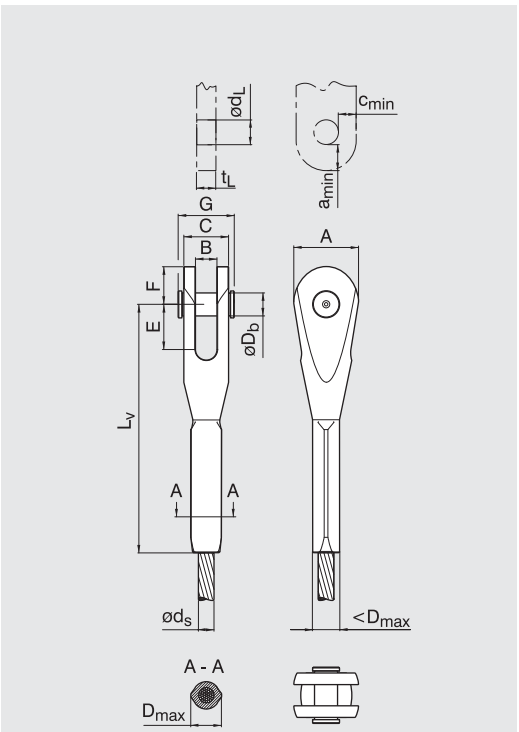


Technical Data

Material :
according Technical Approval ETA-11/0160

Field of Application

Spiral strands




| size | | | | | | | | | | connnecting plate Material : S 355 | | | | tot.-weight* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | A mm | B mm | C mm | $D_{max}$* mm | $D_b$ mm | E mm | F mm | G mm | ~$L_v$* mm | $d_L$ mm | $t_L$ mm | $a_{min}$ mm | $c_{min}$ mm | kg | $d_s$ mm |
| PE 3 | 25 | 10,5 | 18 | 13 | 9 | 18 | 15 | 27 | 99 | 10 | 8 | 11 | 9 | 0,1 | 6,1 |
| PE 5 | 32 | 12,5 | 23 | 15 | 12 | 24 | 20 | 32 | 127 | 13 | 10 | 14 | 10 | 0,2 | 8,1 |
| PE 7 | 40 | 14,5 | 27 | 20 | 15 | 29 | 24 | 36 | 153 | 16 | 12 | 17 | 12 | 0,4 | 10,1 |
| PE 10 | 50 | 17,5 | 33 | 22 | 19 | 35 | 30 | 43 | 187 | 20 | 15 | 22 | 15 | 0,7 | 11,9 |
| PE 15 | 57 | 20,5 | 38 | 26 | 22 | 41 | 35 | 50 | 218 | 23 | 18 | 25 | 17 | 1,2 | 14,1 |
| PE 20 | 67 | 22,5 | 43 | 30 | 25 | 48 | 41 | 55 | 253 | 27 | 20 | 29 | 20 | 1,9 | 16,6 |
| PE 30 | 80 | 28,0 | 52 | 39 | 30 | 59 | 48 | 64 | 303 | 32 | 25 | 34 | 24 | 3,3 | 20,5 |
| PE 45 | 96 | 28,0 | 58 | 44 | 33 | 66 | 57 | 73 | 375 | 35 | 25 | 41 | 30 | 5,6 | 24,1 |
| PE 60 | 110 | 33,0 | 68 | 50 | 40 | 77 | 67 | 83 | 415 | 42 | 30 | 48 | 34 | 8,0 | 28,6 |
| PE 75 | 117 | 38,0 | 76 | 59 | 45 | 84 | 71 | 95 | 458 | 47 | 35 | 51 | 36 | 10,9 | 32,1 |
| PE 100 | 142 | 49,0 | 92 | 65 | 55 | 102 | 86 | 111 | 535 | 57 | 45 | 63 | 44 | 17,4 | 36,6 |

*after swaging
Subject to technical modification

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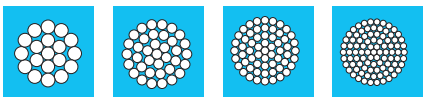
DATA SHEETS

# PE Typ Type 985

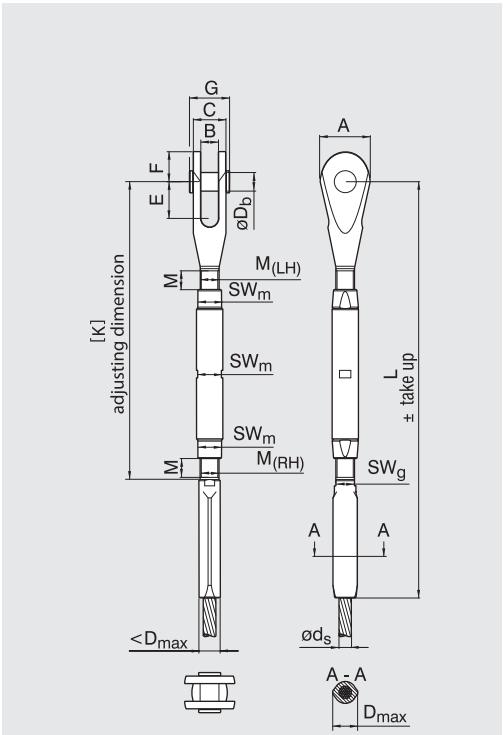


## Technical Data

Material :
according Technical Approval ETA-11/0160

## Field of Application

Spiral strands




| Size | A mm | B mm | C mm | $D_{max}$* mm | $D_b$ mm | E mm | F mm | G mm | ~L* mm | take up ± mm | M mm | $SW_m$ mm | $SW_g$ mm | tot.-weight kg | $d_s$ mm | K mm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PE 3 | 25 | 10,5 | 18 | 13 | 9 | 18 | 15 | 27 | 225 | 20 | 10 | 12 | 9 | 0,3 | 6,1 | 165 |
| PE 5 | 32 | 12,5 | 23 | 15 | 12 | 24 | 20 | 32 | 294 | 28 | 14 | 16 | 12 | 0,5 | 8,1 | 216 |
| PE 7 | 40 | 14,5 | 27 | 20 | 15 | 29 | 24 | 36 | 353 | 32 | 16 | 20 | 15 | 0,9 | 10,1 | 255 |
| PE 10 | 50 | 17,5 | 33 | 22 | 19 | 35 | 30 | 43 | 427 | 40 | 20 | 24 | 17 | 1,6 | 11,9 | 310 |
| PE 15 | 57 | 20,5 | 38 | 26 | 22 | 41 | 35 | 50 | 503 | 48 | 24 | 29 | 20 | 2,6 | 14,1 | 367 |
| PE 20 | 67 | 22,5 | 43 | 30 | 25 | 48 | 41 | 55 | 575 | 54 | 27 | 34 | 24 | 4,0 | 16,6 | 420 |
| PE 30 | 80 | 28,0 | 52 | 39 | 30 | 59 | 48 | 64 | 680 | 60 | 30 | 38 | 30 | 6,5 | 20,5 | 484 |
| PE 45 | 96 | 28,0 | 58 | 44 | 33 | 66 | 57 | 73 | 816 | 72 | 36 | 44 | 32 | 10,8 | 24,1 | 583 |
| PE 60 | 110 | 33,0 | 68 | 50 | 40 | 77 | 67 | 83 | 927 | 84 | 42 | 54 | 36 | 16,6 | 28,6 | 656 |
| PE 75 | 117 | 38,0 | 76 | 59 | 45 | 84 | 71 | 95 | 1047 | 96 | 48 | 58 | 45 | 22,7 | 32,1 | 736 |
| PE 100 | 142 | 49,0 | 92 | 65 | 55 | 102 | 86 | 111 | 1215 | 112 | 56 | 68 | 50 | 35,6 | 36,6 | 868 |

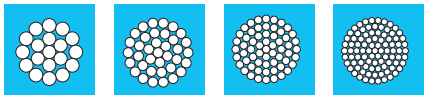
*after swaging
Subject to technical modification

CE 1771 ETA

ETA-11/0160



# PE Typ Type 989

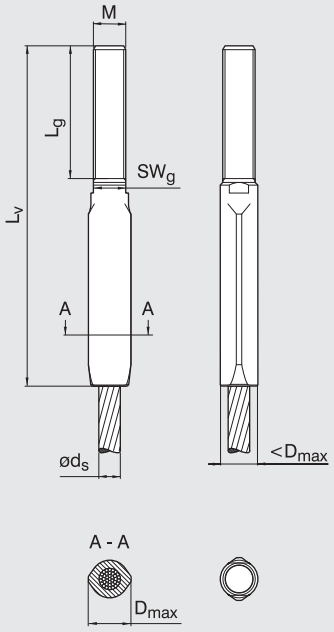


Technical Data

Material :
according Technical Approval ETA-11/0160

Field of Application

Spiral strands




| size | M mm | $L_g$ mm | ~$L_v$* mm | $D_{max}$* mm | $SW_g$ mm | weight kg | $d_s$ mm |
|---|---|---|---|---|---|---|---|
| PE 3 | 10 | 40 | 103 | 13 | 9 | 0,1 | 6,1 |
| PE 5 | 14 | 56 | 138 | 15 | 12 | 0,1 | 8,1 |
| PE 7 | 16 | 64 | 166 | 20 | 15 | 0,3 | 10,1 |
| PE 10 | 20 | 80 | 202 | 22 | 17 | 0,4 | 11,9 |
| PE 15 | 24 | 96 | 238 | 26 | 20 | 0,7 | 14,1 |
| PE 20 | 27 | 108 | 269 | 30 | 24 | 1,0 | 16,6 |
| PE 30 | 30 | 120 | 323 | 39 | 30 | 1,8 | 20,5 |
| PE 45 | 36 | 144 | 385 | 44 | 32 | 2,7 | 24,1 |
| PE 60 | 42 | 168 | 448 | 50 | 36 | 4,2 | 28,6 |
| PE 75 | 48 | 192 | 513 | 59 | 45 | 6,8 | 32,1 |
| PE 100 | 56 | 224 | 582 | 65 | 50 | 9,7 | 36,6 |

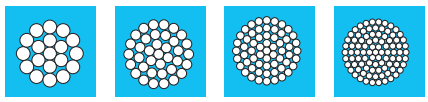
*after swaging
Subject to technical modification

CE 1771 ETA

ETA-11/0160

DATA SHEETS

# PE Typ Type 983

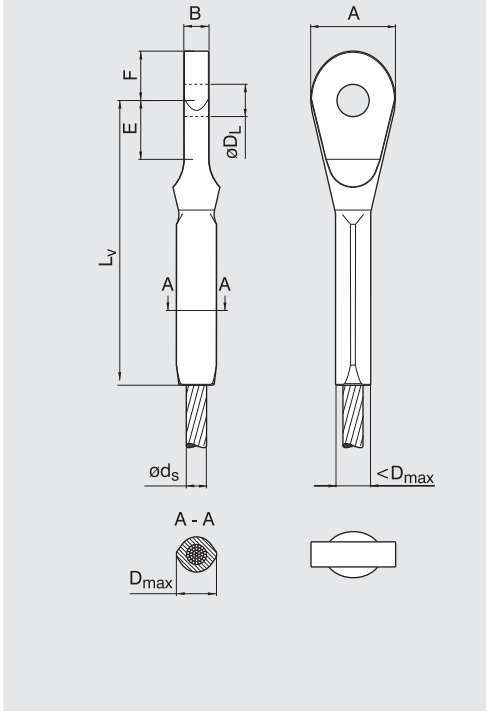


## Technical Data

Material :
according Technical Approval ETA-11/0160

## Field of Application

Spiral strands




| Size | A mm | B mm | $D_{max}$* mm | $D_L$ mm | E mm | F mm | ~$L_v$* mm | Weight kg | $d_s$ mm |
|---|---|---|---|---|---|---|---|---|---|
| PE 3 | 25 | 8 | 13 | 10 | 18 | 15 | 85 | 0,1 | 6,1 |
| PE 5 | 32 | 10 | 15 | 13 | 24 | 20 | 118 | 0,2 | 8,1 |
| PE 7 | 40 | 12 | 20 | 16 | 29 | 24 | 140 | 0,4 | 10,1 |
| PE 10 | 50 | 15 | 22 | 20 | 35 | 30 | 178 | 0,6 | 11,9 |
| PE 15 | 57 | 18 | 26 | 23 | 41 | 35 | 203 | 1,0 | 14,1 |
| PE 20 | 67 | 20 | 30 | 27 | 48 | 41 | 230 | 1,4 | 16,6 |
| PE 30 | 80 | 25 | 39 | 32 | 59 | 48 | 283 | 2,7 | 20,5 |
| PE 45 | 96 | 25 | 44 | 35 | 66 | 57 | 337 | 4,1 | 24,1 |
| PE 60 | 110 | 30 | 50 | 42 | 77 | 67 | 391 | 6,0 | 28,6 |
| PE 75 | 117 | 35 | 59 | 47 | 84 | 71 | 437 | 8,9 | 32,1 |
| PE 100 | 142 | 45 | 65 | 57 | 102 | 86 | 508 | 14,6 | 36,6 |

*after swaging
Subject to technical modification

PE

PG

PV

CE 1771 ETA

ETA-11/0160



# PG

1 x 19  1 x 37  1 x 61 

## Technical Data

Material :
unalloyed quality steel

Modulus of Elasticity:
160 ± 10 kN/mm $^2$

Tolerance $d_S$ :
+ 3%

Corrosion Protection:
GALFAN coated without inner filling

| size | charact. breaking load $Z_{B,k}$ DIN 18800* kN | limit tension $Z_{R,d}$ DIN 18800 kN | metallic cross section ca./approx. mm² | weight ca./approx. kg/m | construction | nomin. strand dia. $d_S$ mm |
|---|---|---|---|---|---|---|
| PG 5 | 59 | 36 | 39 | 0,3 | 1 x 19 | 8,1 |
| PG 10 | 93 | 56 | 60 | 0,5 | 1 x 19 | 10,1 |
| PG 15 | 134 | 81 | 87 | 0,7 | 1 x 19 | 12,2 |
| PG 20 | 181 | 109 | 117 | 0,9 | 1 x 37 | 14,1 |
| PG 25 | 260 | 158 | 168 | 1,3 | 1 x 37 | 17,0 |
| PG 40 | 367 | 222 | 237 | 1,9 | 1 x 37 | 20,1 |
| PG 55 | 537 | 326 | 347 | 2,7 | 1 x 37 | 24,4 |
| PG 75 | 722 | 438 | 467 | 3,7 | 1 x 37 | 28,3 |
| PG 90 | 884 | 536 | 572 | 4,5 | 1 x 61 | 31,3 |
| PG 125 | 1189 | 721 | 769 | 6,1 | 1 x 61 | 36,3 |

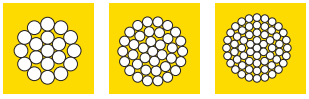
*according EC 3 = $F_{u,k}$ and according ASCE 19-96 = $S_d$
Subject to technical modification
Bigger dimensions and intermediate dimensions upon request

CE 1771 ETA

ETA-11/0160



# PG Typ Type 980



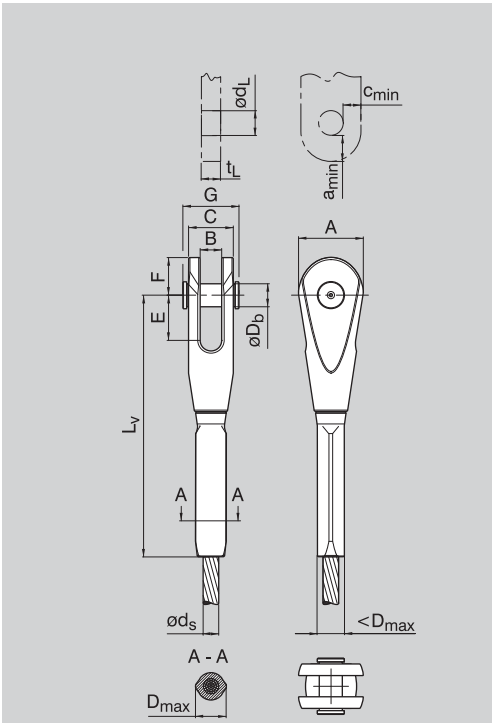
## Technical Data

Material:
according Technical Approval ETA-11/0160

Corrosion Protection:
hot dip galvanized 80 µm DIN EN ISO 1461/
spraying galvanized

## Field of Application

Spiral strands




| size | A mm | B mm | C mm | $D_{max}$* mm | $D_b$ mm | E mm | F mm | G mm | ~$L_v$* mm | connnecting plate Material/material : S 355 $d_L$ mm | $t_L$ mm | $a_{min}$ mm | $c_{min}$ mm | tot.-weight* kg | $d_s$ mm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PG 5 | 33 | 12,5 | 25 | 16 | 12 | 24 | 20 | 37 | 135 | 13 | 10 | 14 | 10 | 0,4 | 8,1 |
| PG 10 | 42 | 14,5 | 30 | 20 | 15 | 29 | 25 | 41 | 167 | 16 | 12 | 17 | 12 | 0,6 | 10,1 |
| PG 15 | 51 | 17,5 | 37 | 25 | 19 | 35 | 30 | 48 | 200 | 20 | 15 | 22 | 15 | 1,2 | 12,2 |
| PG 20 | 60 | 20,5 | 42 | 30 | 22 | 41 | 35 | 55 | 234 | 23 | 18 | 25 | 17 | 1,8 | 14,1 |
| PG 25 | 70 | 22,5 | 49 | 34 | 25 | 48 | 40 | 62 | 276 | 27 | 20 | 29 | 20 | 2,9 | 17,0 |
| PG 40 | 84 | 28,0 | 59 | 40 | 30 | 59 | 49 | 74 | 335 | 32 | 25 | 34 | 24 | 4,8 | 20,1 |
| PG 55 | 102 | 28,0 | 70 | 49 | 33 | 66 | 60 | 86 | 403 | 35 | 25 | 41 | 30 | 9,1 | 24,4 |
| PG 75 | 118 | 33,0 | 82 | 57 | 40 | 77 | 69 | 98 | 471 | 42 | 30 | 48 | 34 | 14,1 | 28,3 |
| PG 90 | 127 | 38,0 | 87 | 64 | 45 | 84 | 74 | 107 | 514 | 47 | 35 | 51 | 36 | 18,0 | 31,3 |
| PG 125 | 150 | 49,0 | 105 | 71 | 55 | 102 | 89 | 125 | 604 | 57 | 45 | 63 | 44 | 28,2 | 36,3 |

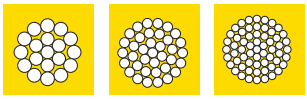
*after swaging
Dimensions without corrosion protection
Subject to technical modification

CE 1771 ETA

ETA-11/0160

DATA SHEETS

# PG Typ Type 984



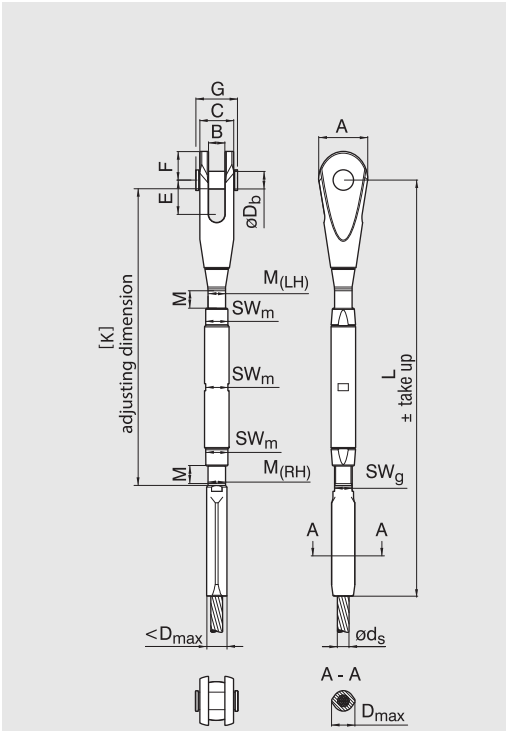
## Technical Data

Material:
according Technical Approval ETA-11/0160

Corrosion Protection:
hot dip galvanized 80 µm DIN EN ISO 1461
spraying galvanized, thread bare

## Field of Application

Spiral strands




| size | A mm | B mm | C mm | $D_{max}$* mm | $D_b$ mm | E mm | F mm | G mm | ~L* mm | take up ± mm | M mm | $SW_m$ mm | $SW_g$ mm | tot.-weight kg | $d_s$ mm | K mm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PG 5 | 33 | 12,5 | 25 | 16 | 12 | 24 | 20 | 37 | 310 | 28 | 14 | 16 | 13 | 0,6 | 8,1 | 230 |
| PG 10 | 42 | 14,5 | 30 | 20 | 15 | 29 | 25 | 41 | 369 | 32 | 16 | 20 | 16 | 1,0 | 10,1 | 270 |
| PG 15 | 51 | 17,5 | 37 | 25 | 19 | 35 | 30 | 48 | 455 | 40 | 20 | 24 | 19 | 2,0 | 12,2 | 335 |
| PG 20 | 60 | 20,5 | 42 | 30 | 22 | 41 | 35 | 55 | 537 | 48 | 24 | 30 | 24 | 3,2 | 14,1 | 397 |
| PG 25 | 70 | 22,5 | 49 | 34 | 25 | 48 | 40 | 62 | 619 | 54 | 27 | 34 | 27 | 5,0 | 17,0 | 450 |
| PG 40 | 84 | 28,0 | 59 | 40 | 30 | 59 | 49 | 74 | 723 | 60 | 30 | 38 | 30 | 7,9 | 20,1 | 525 |
| PG 55 | 102 | 28,0 | 70 | 49 | 33 | 66 | 60 | 86 | 875 | 72 | 36 | 46 | 36 | 14,5 | 24,4 | 635 |
| PG 75 | 118 | 33,0 | 82 | 57 | 40 | 77 | 69 | 98 | 1017 | 84 | 42 | 55 | 41 | 23,0 | 28,3 | 738 |
| PG 90 | 127 | 38,0 | 87 | 64 | 45 | 84 | 74 | 107 | 1133 | 96 | 48 | 60 | 48 | 30,0 | 31,3 | 824 |
| PG 125 | 150 | 49,0 | 105 | 71 | 55 | 102 | 89 | 125 | 1313 | 112 | 56 | 70 | 55 | 47,0 | 36,3 | 956 |

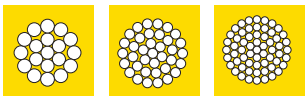
*after swaging
Dimensions without corrosion protection
Subject to technical modification

CE 1771 ETA

ETA-11/0160



# PG Typ Type 988



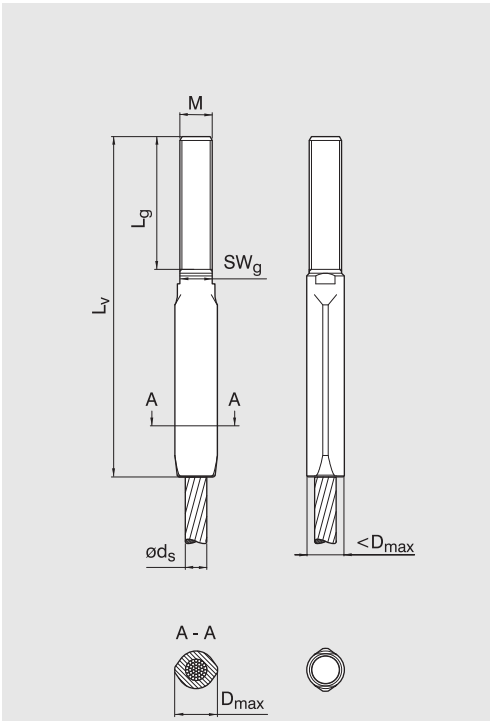
## Technical Data

Material :
according Technical Approval ETA-11/0160

Corrosion Protection:
spraying galvanized, thread bare

## Field of Application

Spiral strands




| size | M mm | $L_g$ mm | ~$L_v$* mm | $D_{max}$* mm | $SW_g$ mm | weight kg | $d_s$ mm |
|---|---|---|---|---|---|---|---|
| PG 5 | 14 | 56 | 140 | 16 | 13 | 0,2 | 8,1 |
| PG 10 | 16 | 64 | 167 | 20 | 16 | 0,3 | 10,1 |
| PG 15 | 20 | 80 | 205 | 25 | 19 | 0,5 | 12,2 |
| PG 20 | 24 | 96 | 242 | 30 | 24 | 0,8 | 14,1 |
| PG 25 | 27 | 108 | 283 | 34 | 27 | 1,3 | 17,0 |
| PG 40 | 30 | 120 | 325 | 40 | 30 | 1,9 | 20,1 |
| PG 55 | 36 | 144 | 392 | 49 | 36 | 3,5 | 24,4 |
| PG 75 | 42 | 168 | 456 | 57 | 41 | 5,4 | 28,3 |
| PG 90 | 48 | 192 | 511 | 64 | 48 | 7,7 | 31,3 |
| PG 125 | 56 | 224 | 592 | 71 | 55 | 11,3 | 36,3 |

*after swaging
Dimensions without corrosion protection
Subject to technical modification

CE 1771 ETA

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DATA SHEETS

# PG Typ Type 982

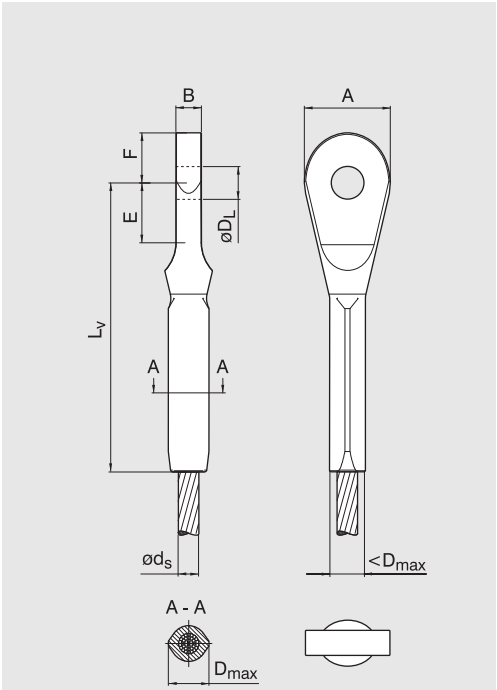
## Technical Data

Material:
according Technical Approval ETA-11/0160

Corrosion Protection:
spraying galvanized
altern. Zinc/Nickel-cotated DIN 50979

## Field of Application

Spiral strands




| size | A mm | B mm | $D_{max}$* mm | $D_L$ mm | E mm | F mm | ~$L_v$* mm | weight kg | $d_s$ mm |
|---|---|---|---|---|---|---|---|---|---|
| PG 5 | 32 | 10 | 16 | 13 | 24 | 20 | 120 | 0,2 | 8,1 |
| PG 10 | 40 | 12 | 20 | 16 | 29 | 25 | 145 | 0,4 | 10,1 |
| PG 15 | 50 | 15 | 25 | 20 | 35 | 30 | 175 | 0,7 | 12,2 |
| PG 20 | 57 | 18 | 30 | 23 | 41 | 35 | 204 | 1,1 | 14,1 |
| PG 25 | 67 | 20 | 34 | 27 | 48 | 41 | 245 | 1,7 | 17,0 |
| PG 40 | 80 | 25 | 40 | 32 | 59 | 48 | 286 | 2,8 | 20,1 |
| PG 55 | 96 | 25 | 49 | 35 | 66 | 57 | 338 | 4,6 | 24,4 |
| PG 75 | 110 | 30 | 57 | 42 | 77 | 67 | 392 | 7,1 | 28,3 |
| PG 90 | 117 | 35 | 64 | 47 | 84 | 71 | 437 | 9,9 | 31,3 |
| PG 125 | 142 | 45 | 71 | 57 | 102 | 86 | 515 | 16,1 | 36,3 |

*after swaging
Dimensions without corrosion protection
Subject to technical modification

DATA SHEETS

PE

PG

PV

CE 1771 ETA

ETA-11/0160

DATA SHEETS

# PV

VVS-1 VVS-2 VVS-3

Technical Data

Material:
unalloyed quality steel

Modulus of Elasticity:
160 ± 10 kN/mm $^2$

Tolerance d $_S$:
+ 3%

Corrosion Protection:
inner layers: hot dip galvanized

outer layers: GALFAN coated
without inner filling

| size | charact. breaking load $Z_{B,k}$ DIN 18800* kN | limit tension $Z_{R,d}$ DIN 18800 kN | metallic cross section ca./approx. mm² | weight ca./approx. kg/m | construction ** | nomin. strand dia. $d_S$ mm |
|---|---|---|---|---|---|---|
| PV 40 | 405 | 245 | 281 | 2,4 | VVS-1 | 21 |
| PV 60 | 621 | 376 | 430 | 3,6 | VVS-1 | 26 |
| PV 90 | 916 | 555 | 634 | 5,3 | VVS-2 | 31 |
| PV 115 | 1170 | 709 | 808 | 6,8 | VVS-2 | 35 |
| PV 150 | 1520 | 921 | 1060 | 8,9 | VVS-2 | 40 |
| PV 195 | 1930 | 1170 | 1340 | 11,2 | VVS-2 | 45 |
| PV 240 | 2380 | 1442 | 1650 | 13,8 | VVS-2 | 50 |
| PV 300 | 3020 | 1830 | 2090 | 17,2 | VVS-3 | 55 |
| PV 360 | 3590 | 2176 | 2490 | 20,5 | VVS-3 | 60 |
| PV 420 | 4220 | 2558 | 2920 | 24,1 | VVS-3 | 65 |
| PV 490 | 4890 | 2964 | 3390 | 27,9 | VVS-3 | 70 |
| PV 560 | 5620 | 3406 | 3890 | 32,1 | VVS-3 | 75 |
| PV 640 | 6390 | 3873 | 4420 | 36,4 | VVS-3 | 80 |
| PV 720 | 7210 | 4370 | 4990 | 41,1 | VVS-3 | 85 |
| PV 810 | 8090 | 4903 | 5600 | 46,2 | VVS-3 | 90 |
| PV 910 | 9110 | 5521 | 6310 | 52,0 | VVS-3 | 95 |
| PV 1010 | 10100 | 6121 | 6990 | 57,6 | VVS-3 | 100 |
| PV 1110 | 11100 | 6727 | 7710 | 63,5 | VVS-3 | 105 |
| PV 1220 | 12200 | 7394 | 8460 | 69,7 | VVS-3 | 110 |
| PV 1340 | 13400 | 8121 | 9240 | 76,2 | VVS-3 | 115 |
| PV 1450 | 14500 | 8788 | 10100 | 83,2 | VVS-3 | 120 |
| PV 1580 | 15800 | 9576 | 10900 | 89,8 | VVS-3 | 125 |
| PV 1730 | 17300 | 10485 | 11900 | 96,7 | VVS-3 | 130 |
| PV 1860 | 18600 | 11273 | 12900 | 104,8 | VVS-3 | 135 |
| PV 2000 | 20000 | 12121 | 13900 | 112,9 | VVS-3 | 140 |

**VVS-1 = 1, VVS-2 = 2, VVS-3 = 3 and more layers z-profiled wires
*according EC 3 = $F_{u,k}$ and according ASCE 19-96 = $S_d$
Due to prestressing and / or differing weather conditions inner filling may escape to the surface.
Subject to technical modifications
Bigger dimensions and intermediate dimensions upon request

CE 1771 ETA

ETA-11/0160



# PV Typ Type 802

## Technical Data

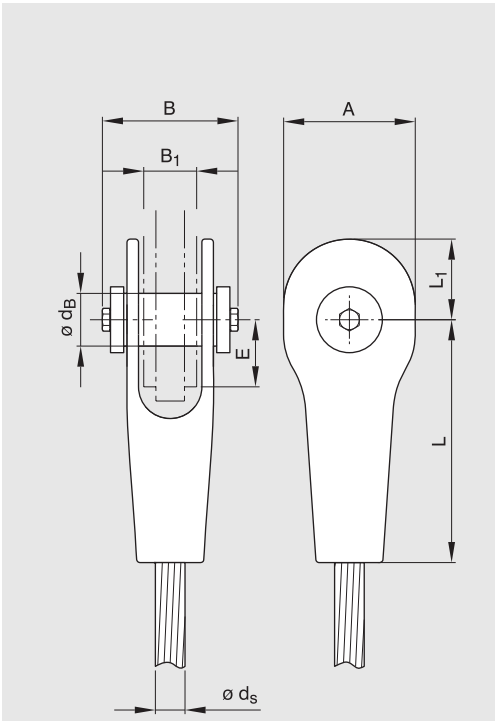
Material:
according Technical Approval ETA-11/0160

Corrosion Protection:
hot dip galvanized 80 µm DIN EN ISO 1461
altern. spraying galvanized

Socketing:
According Technical Approval ETA-11/0160

## Field of Application

Full locked cables, spiral strands




| size | A mm | B mm | min. B1 mm | max. B1 mm | dB mm | max. E mm | L1 mm | L mm | tot.-weight* kg | max. ds mm |
|---|---|---|---|---|---|---|---|---|---|---|
| PV 40 | 90 | 103 | 40 | 42 | 39 | 48 | 55 | 170 | 3 | 21 |
| PV 60 | 110 | 120 | 50 | 53 | 44 | 58 | 68 | 210 | 5 | 26 |
| PV 90 | 135 | 146 | 60 | 64 | 54 | 72 | 83 | 255 | 9 | 31 |
| PV 115 | 160 | 165 | 70 | 74 | 64 | 82 | 98 | 295 | 15 | 35 |
| PV 150 | 160 | 165 | 70 | 74 | 64 | 82 | 98 | 295 | 15 | 40 |
| PV 195 | 180 | 190 | 80 | 85 | 73 | 96 | 110 | 340 | 23 | 45 |
| PV 240 | 200 | 210 | 90 | 96 | 83 | 106 | 123 | 380 | 31 | 50 |
| PV 300 | 230 | 235 | 100 | 107 | 88 | 120 | 140 | 425 | 44 | 55 |
| PV 360 | 250 | 251 | 110 | 118 | 98 | 130 | 153 | 465 | 58 | 60 |
| PV 420 | 270 | 281 | 120 | 129 | 108 | 144 | 165 | 510 | 76 | 65 |
| PV 490 | 290 | 296 | 130 | 139 | 118 | 154 | 178 | 550 | 95 | 70 |
| PV 560 | 320 | 335 | 140 | 150 | 128 | 168 | 195 | 595 | 149 | 75 |
| PV 640 | 340 | 359 | 150 | 161 | 138 | 178 | 208 | 635 | 183 | 80 |
| PV 720 | 360 | 374 | 160 | 172 | 142 | 192 | 220 | 680 | 215 | 85 |
| PV 810 | 380 | 401 | 170 | 183 | 153 | 202 | 233 | 720 | 262 | 90 |
| PV 910 | 410 | 434 | 180 | 194 | 162 | 231 | 260 | 780 | 324 | 95 |
| PV 1010 | 430 | 451 | 190 | 205 | 172 | 226 | 263 | 805 | 369 | 100 |
| PV 1110 | 450 | 466 | 200 | 216 | 182 | 240 | 275 | 850 | 424 | 105 |
| PV 1220 | 480 | 498 | 205 | 222 | 187 | 262 | 295 | 900 | 527 | 110 |
| PV 1340 | 503 | 520 | 218 | 237 | 202 | 264 | 317 | 935 | 625 | 115 |
| PV 1450 | 530 | 544 | 230 | 251 | 207 | 302 | 335 | 1015 | 749 | 120 |
| PV 1580 | 550 | 555 | 238 | 259 | 217 | 288 | 350 | 1020 | 808 | 125 |
| PV 1730 | 570 | 590 | 247 | 269 | 227 | 300 | 365 | 1063 | 913 | 130 |
| PV 1860 | 590 | 605 | 256 | 280 | 237 | 315 | 380 | 1105 | 1015 | 135 |
| PV 2000 | 620 | 622 | 267 | 290 | 247 | 324 | 395 | 1148 | 1132 | 140 |

* Without molten zinc
Dimensions without corrosion protection
Subject to technical modifications
Bigger dimensions upon request

for predominantly static loads only

CE 1771 ETA

ETA-11/0160

DATA SHEETS

# PV Typ Type 700

## Technical Data

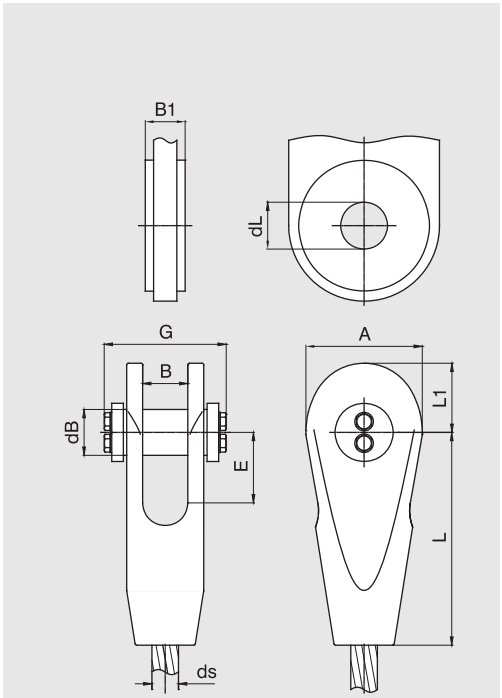
Material:
according to technical approval ETA-11/0160

Corrosion Protection:
Hot dip galvanized 80 µm
DIN EN ISO 1461

Socketing:
according to technical approval ETA-11/0160

## Field of Application

Full locked cables, spiral strands




| size | A mm | B mm | min. $B_1$ mm | max. $B_1$ mm | $d_B$ mm | $d_L$ mm | max. E mm | G mm | $L_1$ mm | L mm | tot.-weight* max. kg | $d_s$ mm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PV 40 | 93 | 35 | 29 | 31 | 39 | 42 | 57 | 108 | 55 | 168 | 4 | 21 |
| PV 60 | 116 | 43 | 36 | 39 | 44 | 47 | 70 | 128 | 68 | 208 | 7 | 26 |
| PV 90 | 137 | 52 | 45 | 48 | 54 | 57 | 83 | 152 | 86 | 248 | 12 | 31 |
| PV 115 | 153 | 60 | 52 | 55 | 59 | 62 | 93 | 168 | 91 | 280 | 17 | 35 |
| PV 150 | 176 | 68 | 60 | 63 | 64 | 67 | 106 | 183 | 98 | 320 | 24 | 40 |
| PV 195 | 197 | 77 | 69 | 72 | 73 | 76 | 120 | 213 | 110 | 360 | 34 | 45 |
| PV 240 | 220 | 85 | 76 | 79 | 83 | 86 | 133 | 227 | 123 | 400 | 47 | 50 |
| PV 300 | 241 | 94 | 85 | 88 | 88 | 91 | 146 | 257 | 140 | 440 | 63 | 55 |
| PV 360 | 263 | 102 | 92 | 96 | 98 | 101 | 159 | 273 | 153 | 480 | 81 | 60 |
| PV 420 | 285 | 111 | 100 | 105 | 108 | 111 | 173 | 306 | 165 | 520 | 104 | 65 |
| PV 490 | 308 | 119 | 107 | 112 | 118 | 121 | 186 | 321 | 178 | 560 | 131 | 70 |
| PV 560 | 329 | 128 | 114 | 121 | 128 | 131 | 199 | 346 | 195 | 600 | 163 | 75 |
| PV 640 | 351 | 136 | 121 | 128 | 138 | 141 | 212 | 368 | 208 | 640 | 197 | 80 |
| PV 720 | 372 | 145 | 129 | 137 | 142 | 145 | 226 | 382 | 220 | 680 | 232 | 85 |
| PV 810 | 395 | 153 | 136 | 145 | 153 | 156 | 239 | 406 | 233 | 720 | 280 | 90 |
| PV 910 | 416 | 162 | 144 | 153 | 162 | 165 | 252 | 432 | 253 | 760 | 330 | 95 |
| PV 1010 | 438 | 170 | 151 | 161 | 172 | 175 | 265 | 457 | 263 | 800 | 386 | 100 |

* Without molten zinc
Open spelter socket 700 PV is not subject to the approval ETA-11/0160
Dimensions without corrosion protection, Subject to technical modifications!
Bigger dimensions upon request

This open spelter sockets are designed for dynamic loaded cable tension members with the following characteristics:

- Full locked cables and strands with metal socketing
- Detail category of cables according to EN 1993-1-11: $\Delta\sigma_c = 150$ N/mm² at $\gamma_{Mf} = 1{,}0$; $\sigma_o = 0{,}45 \times \sigma_{uk}$; $n = 2 \times 10^6$ number of cycles
- The open spelter sockets type 700 fulfill the exposure classes 1 to 5 according EN 1993-1-11

CE 1771 ETA

ETA-11/0160



# PV Typ Type 811

## Technical Data

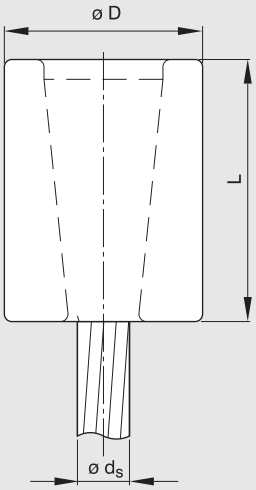
Material :
according Technical Approval ETA-11/0160

Corrosion Protection:
hot dip galvanized 80 µm DIN EN ISO 1461
alternate spraying galvanized

Socketing:
according Technical Approval ETA-11/0160

## Field of Application

Full locked cables , spiral strands




| size | L mm | D mm | weight* kg | max. $d_s$ mm |
|---|---|---|---|---|
| PV 40 | 108 | 80 | 3 | 21 |
| PV 60 | 133 | 95 | 5 | 26 |
| PV 90 | 158 | 110 | 8 | 31 |
| PV 115 | 183 | 125 | 12 | 35 |
| PV 150 | 183 | 125 | 12 | 40 |
| PV 195 | 208 | 140 | 17 | 45 |
| PV 240 | 237 | 155 | 24 | 50 |
| PV 300 | 262 | 170 | 31 | 55 |
| PV 360 | 287 | 185 | 40 | 60 |
| PV 420 | 312 | 205 | 55 | 65 |
| PV 490 | 337 | 220 | 67 | 70 |
| PV 560 | 362 | 235 | 82 | 75 |
| PV 640 | 387 | 250 | 99 | 80 |
| PV 720 | 412 | 265 | 117 | 85 |
| PV 810 | 441 | 280 | 139 | 90 |
| PV 910 | 466 | 295 | 162 | 95 |
| PV 1010 | 491 | 310 | 188 | 100 |
| PV 1110 | 516 | 330 | 227 | 105 |
| PV 1220 | 541 | 345 | 260 | 110 |
| PV 1340 | 566 | 360 | 295 | 115 |
| PV 1450 | 591 | 380 | 348 | 120 |
| PV 1580 | 616 | 395 | 391 | 125 |
| PV 1730 | 645 | 410 | 439 | 130 |
| PV 1860 | 670 | 425 | 488 | 135 |
| PV 2000 | 695 | 440 | 541 | 140 |

* without molten zinc
Dimensions without corrosion protection
Subject to technical modifications
Bigger dimensions upon request

CE 1771 ETA

ETA-11/0160

DATA SHEETS

# PV Typ Type 800

## Technical Data

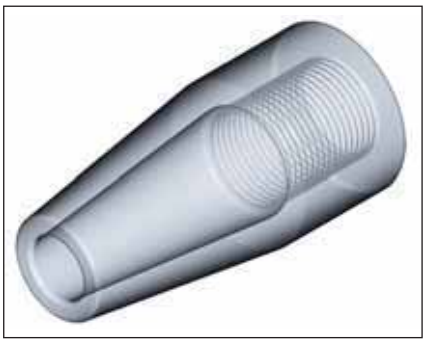
Material:
according Technical Approval ETA-11/0160

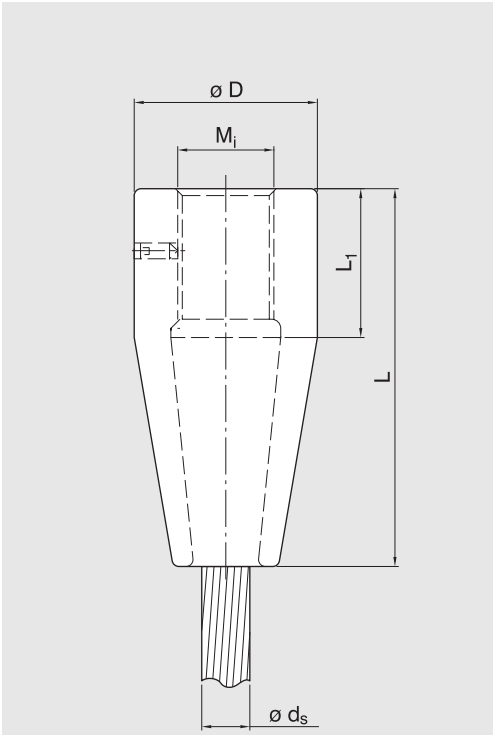
Corrosion Protection:
hot dip galvanized 80 µm DIN EN ISO 1461
alternate spraying galvanized, thread bare

Socketing:
according Technical Approval ETA-11/0160

## Field of Application

Full locked cables , spiral strands






| size | D mm | L mm | $L_1$ mm | $M_i$ | weight* kg | max. $d_s$ mm |
|---|---|---|---|---|---|---|
| PV 40 | 80 | 165 | 65 | 42 x 3 | 4 | 21 |
| PV 60 | 95 | 200 | 75 | 52 x 3 | 6 | 26 |
| PV 90 | 110 | 235 | 85 | 64 x 4 | 9 | 31 |
| PV 115 | 125 | 270 | 95 | 75 x 4 | 13 | 35 |
| PV 150 | 125 | 270 | 95 | 75 x 4 | 13 | 40 |
| PV 195 | 140 | 305 | 105 | 85 x 4 | 18 | 45 |
| PV 240 | 155 | 350 | 125 | 95 x 4 | 25 | 50 |
| PV 300 | 170 | 385 | 135 | 108 x 4 | 32 | 55 |
| PV 360 | 185 | 420 | 145 | 118 x 4 | 42 | 60 |
| PV 420 | 205 | 460 | 160 | 128 x 4 | 56 | 65 |
| PV 490 | 220 | 495 | 170 | 140 x 4 | 69 | 70 |
| PV 560 | 235 | 530 | 180 | 150 x 4 | 90 | 75 |
| PV 640 | 250 | 565 | 190 | 160 x 4 | 109 | 80 |
| PV 720 | 265 | 600 | 200 | 172 x 4 | 128 | 85 |
| PV 810 | 280 | 645 | 220 | 185 x 6 | 154 | 90 |
| PV 910 | 295 | 680 | 230 | 195 x 6 | 184 | 95 |
| PV 1010 | 310 | 715 | 240 | 205 x 6 | 208 | 100 |
| PV 1110 | 330 | 760 | 260 | 215 x 6 | 253 | 105 |
| PV 1220 | 345 | 800 | 275 | 225 x 6 | 295 | 110 |
| PV 1340 | 360 | 840 | 290 | 235 x 6 | 337 | 115 |
| PV 1450 | 380 | 880 | 305 | 245 x 6 | 395 | 120 |
| PV 1580 | 395 | 920 | 320 | 260 x 6 | 441 | 125 |
| PV 1730 | 410 | 960 | 335 | 270 x 6 | 495 | 130 |
| PV 1860 | 425 | 1000 | 350 | 280 x 6 | 552 | 135 |
| PV 2000 | 440 | 1040 | 365 | 290 x 6 | 615 | 140 |

* without molten zinc
Dimensions without corrosion protection
Subject to technical modifications
Bigger dimensions upon request

CE 1771 ETA

ETA-11/0160



# PV Typ Type 801

Technical Data

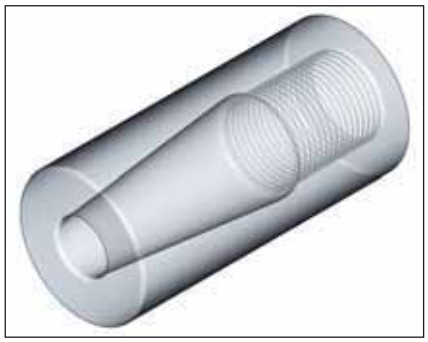
Material :
according Technical Approval ETA-11/0160

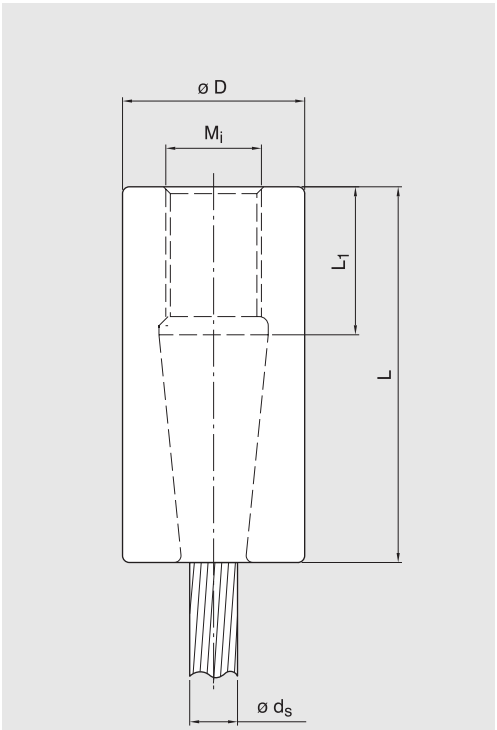
Corrosion Protection:
hot dip galvanized 80 µm DIN EN ISO 1461
alternate spraying galvanized, thread bare

Socketing:
according Technical Approval ETA-11/0160

Field of Application

spiral strands, Full locked cables






| size | D mm | L mm | $L_1$ mm | $M_i$ | weight* kg | max. $d_s$ mm |
|---|---|---|---|---|---|---|
| PV 40 | 80 | 165 | 65 | 42 x 3 | 5 | 21 |
| PV 60 | 95 | 200 | 75 | 52 x 3 | 8 | 26 |
| PV 90 | 110 | 235 | 85 | 64 x 4 | 13 | 31 |
| PV 115 | 125 | 270 | 95 | 75 x 4 | 18 | 35 |
| PV 150 | 125 | 270 | 95 | 75 x 4 | 18 | 40 |
| PV 195 | 140 | 305 | 105 | 85 x 4 | 25 | 45 |
| PV 240 | 155 | 350 | 125 | 95 x 4 | 35 | 50 |
| PV 300 | 170 | 385 | 135 | 108 x 4 | 45 | 55 |
| PV 360 | 185 | 420 | 145 | 118 x 4 | 58 | 60 |
| PV 420 | 205 | 460 | 160 | 128 x 4 | 79 | 65 |
| PV 490 | 220 | 495 | 170 | 140 x 4 | 97 | 70 |
| PV 560 | 235 | 530 | 180 | 150 x 4 | 117 | 75 |
| PV 640 | 250 | 565 | 190 | 160 x 4 | 141 | 80 |
| PV 720 | 265 | 600 | 200 | 172 x 4 | 166 | 85 |
| PV 810 | 280 | 645 | 220 | 185 x 6 | 198 | 90 |
| PV 910 | 295 | 680 | 230 | 195 x 6 | 230 | 95 |
| PV 1010 | 310 | 715 | 240 | 205 x 6 | 266 | 100 |
| PV 1110 | 330 | 760 | 260 | 215 x 6 | 326 | 105 |
| PV 1220 | 345 | 800 | 275 | 225 x 6 | 373 | 110 |
| PV 1340 | 360 | 840 | 290 | 235 x 6 | 425 | 115 |
| PV 1450 | 380 | 880 | 305 | 245 x 6 | 502 | 120 |
| PV 1580 | 395 | 920 | 320 | 260 x 6 | 561 | 125 |
| PV 1730 | 410 | 960 | 335 | 270 x 6 | 628 | 130 |
| PV 1860 | 425 | 1000 | 350 | 280 x 6 | 701 | 135 |
| PV 2000 | 440 | 1040 | 365 | 290 x 6 | 779 | 140 |

* without molten zinc
Dimensions without corrosion protection
Subject to technical modifications
Bigger dimensions upon request

CE 1771 ETA

ETA-11/0160



# PV Typ Type 812

## Technical Data

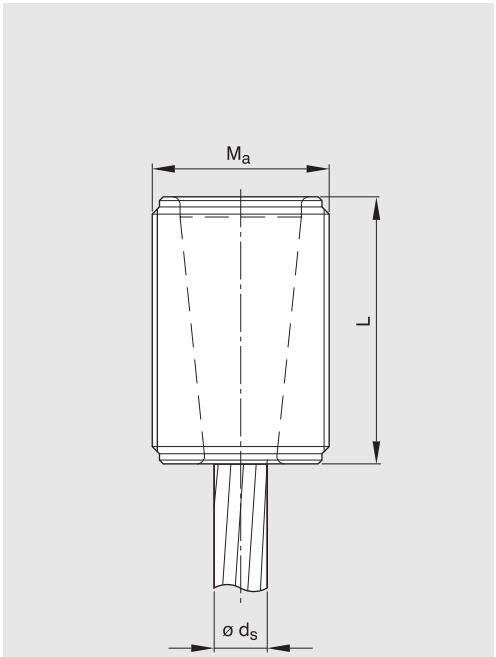
Material:
according Technical Approval ETA-11/0160

Corrosion Protection:
hot dip galvanized 80 µm DIN EN ISO 1461
alternate spraying galvanized, thread bare

Socketing:
according Technical Approval ETA-11/0160

## Field of Application

Full locked cables, spiral strands




| size | $M_a$ mm | L mm | weight* kg | max. $d_s$ mm |
|---|---|---|---|---|
| PV 40 | 70 x 4 | 108 | 2 | 21 |
| PV 60 | 85 x 4 | 133 | 4 | 26 |
| PV 90 | 100 x 4 | 158 | 6 | 31 |
| PV 115 | 115 x 6 | 183 | 10 | 35 |
| PV 150 | 115 x 6 | 183 | 10 | 40 |
| PV 195 | 130 x 6 | 208 | 14 | 45 |
| PV 240 | 145 x 6 | 237 | 19 | 50 |
| PV 300 | 160 x 6 | 262 | 26 | 55 |
| PV 360 | 175 x 6 | 287 | 34 | 60 |
| PV 420 | 195 x 6 | 312 | 47 | 65 |
| PV 490 | 210 x 8 | 337 | 58 | 70 |
| PV 560 | 225 x 8 | 362 | 71 | 75 |
| PV 640 | 240 x 8 | 387 | 86 | 80 |
| PV 720 | 255 x 8 | 412 | 103 | 85 |
| PV 810 | 270 x 8 | 441 | 123 | 90 |
| PV 910 | 285 x 8 | 466 | 145 | 95 |
| PV 1010 | 300 x 8 | 491 | 169 | 100 |
| PV 1110 | 320 x 8 | 516 | 206 | 105 |
| PV 1220 | 335 x 8 | 541 | 236 | 110 |
| PV 1340 | 350 x 8 | 566 | 269 | 115 |
| PV 1450 | 370 x 8 | 591 | 318 | 120 |
| PV 1580 | 385 x 10 | 616 | 357 | 125 |
| PV 1730 | 400 x 10 | 645 | 402 | 130 |
| PV 1860 | 415 x 10 | 670 | 449 | 135 |
| PV 2000 | 430 x 10 | 695 | 499 | 140 |

* without molten zinc
Dimensions without corrosion protection
Subject to technical modifications
Bigger dimensions upon request

CE 1771 ETA

ETA-11/0160



# PV Typ Type 810

## Technical Data

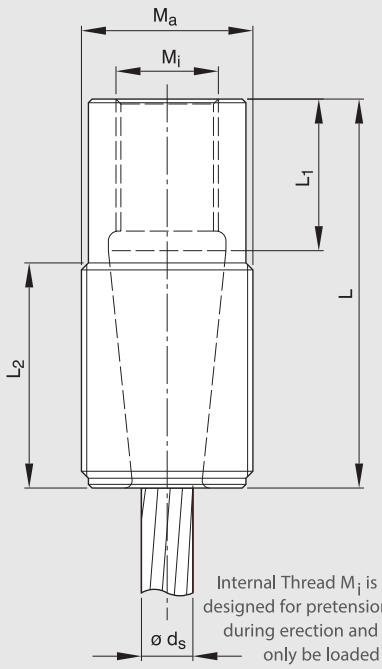
Material :
according Technical Approval ETA-11/0160

Corrosion Protection:
hot dip galvanized 80 µm DIN EN ISO 1461
altern. spraying galvanized, thread bare

Socketing:
according Technical Approval ETA-11/0160

## Field of Application

Full locked cables, spiral strands




Internal Thread $M_i$ is only designed for pretensioning during erection and may only be loaded with 60 % of the limit tension in accordance with DIN 18 800 (cable data sheets)!

| size | $M_a$ | $M_i$ | L mm | $L_1$ mm | $L_2$ mm | weight* kg | max. $d_s$ mm |
|---|---|---|---|---|---|---|---|
| PV 40 | 70 x 4 | 42 x 3 | 165 | 65 | 95 | 3 | 21 |
| PV 60 | 85 x 4 | 52 x 3 | 200 | 75 | 120 | 6 | 26 |
| PV 90 | 100 x 4 | 64 x 4 | 235 | 85 | 145 | 9 | 31 |
| PV 115 | 115 x 6 | 75 x 4 | 270 | 95 | 168 | 13 | 35 |
| PV 150 | 115 x 6 | 75 x 4 | 270 | 95 | 168 | 13 | 40 |
| PV 195 | 130 x 6 | 85 x 4 | 305 | 105 | 193 | 19 | 45 |
| PV 240 | 145 x 6 | 95 x 4 | 350 | 125 | 218 | 26 | 50 |
| PV 300 | 160 x 6 | 108 x 4 | 385 | 135 | 243 | 35 | 55 |
| PV 360 | 175 x 6 | 118 x 4 | 420 | 145 | 268 | 46 | 60 |
| PV 420 | 195 x 6 | 128 x 4 | 460 | 160 | 293 | 64 | 65 |
| PV 490 | 210 x 8 | 140 x 4 | 495 | 170 | 318 | 78 | 70 |
| PV 560 | 225 x 8 | 150 x 4 | 530 | 180 | 343 | 96 | 75 |
| PV 640 | 240 x 8 | 160 x 4 | 565 | 190 | 365 | 117 | 80 |
| PV 720 | 255 x 8 | 172 x 4 | 600 | 200 | 390 | 139 | 85 |
| PV 810 | 270 x 8 | 185 x 6 | 645 | 220 | 415 | 167 | 90 |
| PV 910 | 285 x 8 | 195 x 6 | 680 | 230 | 440 | 197 | 95 |
| PV 1010 | 300 x 8 | 205 x 6 | 715 | 240 | 465 | 229 | 100 |
| PV 1110 | 320 x 8 | 215 x 6 | 760 | 260 | 490 | 283 | 105 |
| PV 1220 | 335 x 8 | 225 x 6 | 800 | 275 | 515 | 326 | 110 |
| PV 1340 | 350 x 8 | 235 x 6 | 840 | 290 | 538 | 373 | 115 |
| PV 1450 | 370 x 8 | 245 x 6 | 880 | 305 | 563 | 444 | 120 |
| PV 1580 | 385 x 10 | 260 x 6 | 920 | 320 | 588 | 493 | 125 |
| PV 1730 | 400 x 10 | 270 x 6 | 960 | 335 | 613 | 555 | 130 |
| PV 1860 | 415 x 10 | 280 x 6 | 1000 | 350 | 638 | 621 | 135 |
| PV 2000 | 430 x 10 | 290 x 6 | 1040 | 365 | 663 | 693 | 140 |

* without molten zinc
Dimensions without corrosion protection
Subject to technical modifications
Bigger dimensions upon request

CE 1771 ETA

ETA-11/0160



# PV Typ Type 813/814

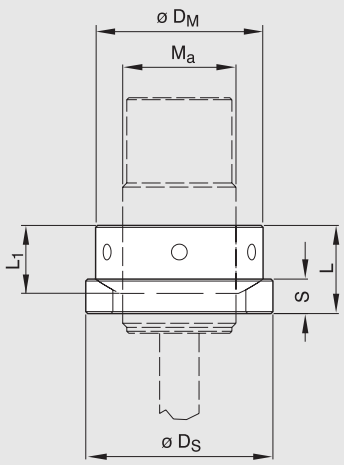
## Technical Data

Material:
S355J2+N, DIN EN 10025

Corrosion Protection:
hot dip galvanized 80 µm DIN EN ISO 1461
alternate spraying galvanized, thread bare

## Field of Application

Sockets type 810 PV and 812 PV




| size | $D_S$ mm | $D_M$ mm | $M_a$ mm | S mm | L mm | $L_1$ mm | weight nut kg | weight disc kg |
|---|---|---|---|---|---|---|---|---|
| PV 40 | 120 | 105 | 70 x 4 | 25 | 58 | 42 | 2 | 1 |
| PV 60 | 140 | 125 | 85 x 4 | 25 | 66 | 52 | 3 | 1 |
| PV 90 | 165 | 150 | 100 x 4 | 35 | 82 | 60 | 4 | 3 |
| PV 115 | 190 | 170 | 115 x 6 | 35 | 89 | 69 | 6 | 4 |
| PV 150 | 190 | 170 | 115 x 6 | 35 | 89 | 69 | 6 | 4 |
| PV 195 | 215 | 195 | 130 x 6 | 45 | 106 | 79 | 10 | 6 |
| PV 240 | 235 | 215 | 145 x 6 | 45 | 113 | 87 | 13 | 7 |
| PV 300 | 260 | 240 | 160 x 6 | 55 | 130 | 97 | 18 | 10 |
| PV 360 | 280 | 260 | 175 x 6 | 55 | 137 | 105 | 22 | 11 |
| PV 420 | 310 | 290 | 195 x 6 | 65 | 156 | 117 | 31 | 16 |
| PV 490 | 335 | 315 | 210 x 8 | 65 | 163 | 126 | 41 | 18 |
| PV 560 | 355 | 335 | 225 x 8 | 75 | 180 | 135 | 48 | 24 |
| PV 640 | 380 | 360 | 240 x 8 | 75 | 187 | 144 | 60 | 26 |
| PV 720 | 405 | 380 | 255 x 8 | 85 | 204 | 153 | 70 | 36 |
| PV 810 | 430 | 405 | 270 x 8 | 85 | 211 | 162 | 86 | 39 |
| PV 910 | 450 | 425 | 285 x 8 | 95 | 228 | 171 | 98 | 48 |
| PV 1010 | 475 | 450 | 300 x 8 | 95 | 235 | 180 | 115 | 54 |
| PV 1110 | 505 | 480 | 320 x 8 | 105 | 253 | 192 | 141 | 67 |
| PV 1220 | 525 | 500 | 335 x 8 | 105 | 264 | 201 | 160 | 71 |
| PV 1340 | 550 | 525 | 350 x 8 | 115 | 278 | 210 | 183 | 85 |
| PV 1450 | 580 | 555 | 370 x 8 | 115 | 286 | 222 | 215 | 92 |
| PV 1580 | 600 | 575 | 385 x 10 | 125 | 306 | 231 | 244 | 108 |
| PV 1730 | 630 | 600 | 400 x 10 | 125 | 312 | 240 | 276 | 122 |
| PV 1860 | 650 | 620 | 415 x 10 | 135 | 329 | 249 | 304 | 138 |
| PV 2000 | 675 | 645 | 430 x 10 | 135 | 334 | 258 | 340 | 150 |

Dimensions without corrosion protection
Subject to technical modifications
Bigger dimensions upon request

CE 1771 ETA

ETA-11/0160



# PV Typ Type 864

## Technical Data

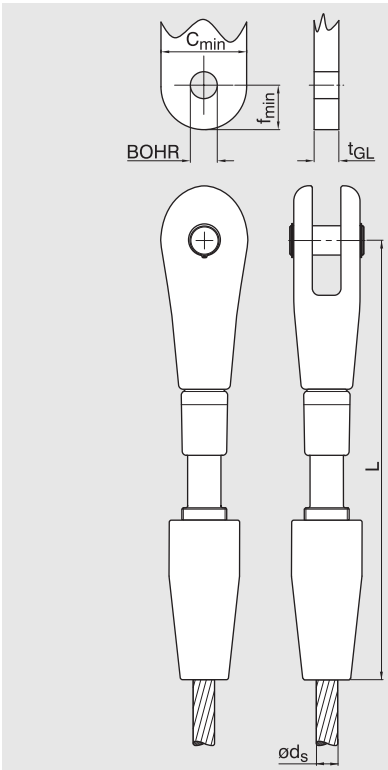
Material:
acc.Techn. Approval ETA-11/0160 and
ETA-04/0039

Corrosion Protection:
hot dip galvanized 80 µm DIN EN ISO 1461
altern. spraying galvanized, thread bare
altern. Zinc/Nickel-coated DIN 50979 (incl. external thread)

Socketing:
according Technical Approval ETA-11/0160

## Field of Application

Full locked cables, spiral strands




Fork dimensions like type 864

| size | Typ 860 fork connector type 860 | Typ 800 PV socket type 800 PV | L mm | take up ± mm | tot.-weight * kg | max. $d_S$ mm | $t_{GL}$ mm | $f_{min}$ mm | $c_{min}$ mm | BOHR mm |
|---|---|---|---|---|---|---|---|---|---|---|
| PV 40 | 36 | PV 40 | 480 | 35 | 12 | 21 | 25 | 53 | 90 | 34 |
| PV 60 | 42 | PV 60 | 560 | 42 | 19 | 26 | 30 | 59 | 104 | 38 |
| PV 90 | 48 | PV 90 | 630 | 41 | 27 | 31 | 35 | 66 | 120 | 42 |
| PV 115 | 56 | PV 115 | 740 | 47 | 44 | 35 | 40 | 81 | 148 | 52 |
| PV 150 | 64 | PV 150 | 790 | 50 | 56 | 40 | 50 | 90 | 170 | 58 |
| PV 195 | 70 | PV 195 | 870 | 55 | 73 | 45 | 55 | 98 | 185 | 63 |
| PV 240 | 80 | PV 240 | 1000 | 67 | 107 | 50 | 65 | 114 | 210 | 73 |
| PV 300 | 90 | PV 300 | 1090 | 70 | 150 | 55 | 75 | 128 | 240 | 82 |
| PV 360 | 100 | PV 360 | 1210 | 75 | 204 | 60 | 80 | 144 | 265 | 92 |

*without molten zinc
Subject to technical modification
Dimensions without corrosion protection

for predominantly static loads only

CE 1771 ETA

ETA-11/0160

DATA SHEETS

# PV Typ Type 710

## Technical Data

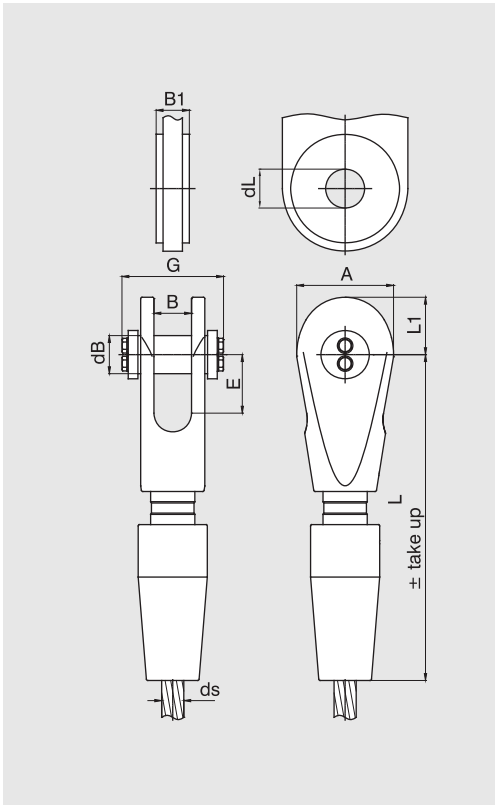
Material
according to technical approval ETA-11/0160

Corrosion Protection:
Hot dip galvanized 80 µm
DIN EN ISO 1461

Socketing:
according to technical approval ETA-11/0160

## Field of Application

Full locked cables, Spiral strands




| size | A mm | B mm | min. $B_1$ mm | max. $B_1$ mm | $d_B$ mm | $d_L$ mm | max. E mm | G mm | $L_1$ mm | L mm | take up ± mm | tot.-weight* kg | max. $d_s$ mm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PV 40 | 93 | 35 | 29 | 31 | 39 | 42 | 57 | 108 | 57 | 359 | ±32 | 9 | 21 |
| PV 60 | 116 | 43 | 36 | 39 | 44 | 47 | 70 | 128 | 68 | 429 | ±36 | 15 | 26 |
| PV 90 | 137 | 52 | 45 | 48 | 54 | 57 | 83 | 152 | 86 | 497 | ±38 | 25 | 31 |
| PV 115 | 153 | 60 | 52 | 55 | 59 | 62 | 93 | 168 | 91 | 559 | ±42 | 35 | 35 |
| PV 150 | 176 | 68 | 60 | 63 | 64 | 67 | 106 | 183 | 98 | 590 | ±42 | 42 | 40 |
| PV 195 | 197 | 73 | 69 | 72 | 73 | 76 | 120 | 213 | 110 | 660 | ±46 | 60 | 45 |
| PV 240 | 220 | 85 | 76 | 79 | 83 | 86 | 133 | 227 | 123 | 746 | ±56 | 84 | 50 |
| PV 300 | 241 | 94 | 85 | 88 | 88 | 91 | 146 | 257 | 140 | 824 | ±58 | 111 | 55 |
| PV 360 | 263 | 102 | 92 | 96 | 98 | 101 | 159 | 273 | 153 | 894 | ±62 | 144 | 60 |
| PV 420 | 285 | 111 | 100 | 105 | 108 | 111 | 173 | 306 | 165 | 973 | ±70 | 188 | 65 |
| PV 490 | 308 | 119 | 107 | 112 | 118 | 121 | 186 | 321 | 178 | 1041 | ±72 | 233 | 70 |
| PV 560 | 329 | 128 | 114 | 121 | 128 | 131 | 199 | 346 | 195 | 1111 | ±76 | 294 | 75 |
| PV 640 | 351 | 136 | 121 | 128 | 138 | 141 | 212 | 367 | 208 | 1181 | ±80 | 354 | 80 |
| PV 720 | 372 | 145 | 129 | 137 | 142 | 145 | 226 | 382 | 220 | 1261 | ±84 | 420 | 85 |
| PV 810 | 395 | 153 | 136 | 145 | 153 | 156 | 239 | 406 | 233 | 1345 | ±92 | 507 | 90 |
| PV 910 | 416 | 162 | 144 | 153 | 162 | 165 | 252 | 432 | 253 | 1415 | ±96 | 599 | 95 |
| PV 1010 | 438 | 170 | 151 | 161 | 172 | 175 | 265 | 457 | 263 | 1483 | ±98 | 692 | 100 |

* Without molten zinc
Open spelter socket 710 PV is not subject to the approval ETA-11/0160
Dimensions without corrosion protection, Subject to technical modificat
Bigger dimensions upon request

This open spelter sockets are designed for dynamic loaded cable tension members with the following characteristics:

- Full locked cables and strands with metal socketing
- Detail category of cables according to EN 1993-1-11: $\Delta\sigma_c = 150$ N/mm² at $\gamma_{Mf} = 1{,}0$; $\sigma_o = 0{,}45 \times \sigma_{uk}$; $n = 2 \times 10^6$ number of cycles
- The open spelter sockets type 710 fulfill the exposure classes 1 to 4 according EN 1993-1-11

CE 1771 ETA

ETA-11/0160



# PV Typ Type 804

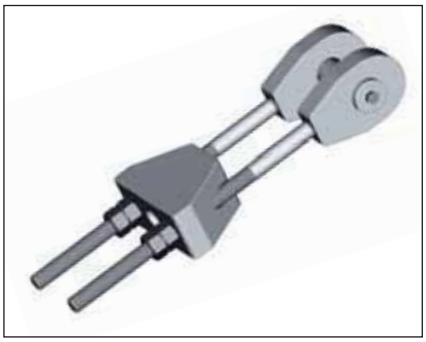
## Technical Data

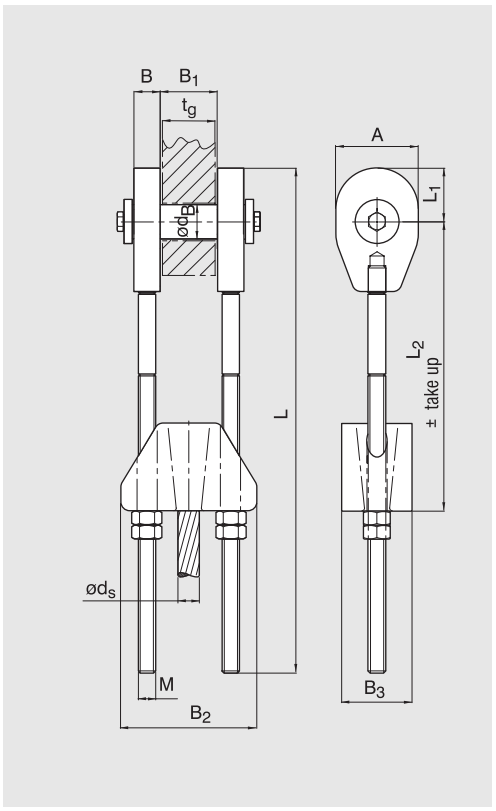
Material :
Anchor block: S355J2+N DIN EN 10025
Eye bar: S355J2+N DIN EN 10025
pin, threaded rod: 34 CrNiMo 6 V
DIN EN 10083

Corrosion Protection:
hot dip galvanized 80 µm DIN EN ISO 1461
altern. spraying galvanized, thread bare
altern. Zinc/Nickel-coated DIN 50979 (incl. external thread)

## Field of Application

Full locked cables, Spiral strands






| size | $d_B$ mm | A mm | $B_1$ mm | B mm | $B_2$ mm | $B_3$ mm | M mm | L mm | $L_1$ mm | $L_2$ mm | min. $t_g$ mm | max. $t_g$ mm | take up mm | tot.-weight* kg | max. $d_s$ mm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PV 40 | 39 | 94 | 65 | 30 | 155 | 80 | 20 | 576 | 61 | 330 | 60 | 65 | ±150 | 17 | 21 |
| PV 60 | 44 | 110 | 75 | 40 | 190 | 90 | 27 | 646 | 71 | 375 | 70 | 75 | ±150 | 30 | 26 |
| PV 90 | 54 | 127 | 85 | 50 | 220 | 110 | 30 | 704 | 84 | 415 | 80 | 85 | ±150 | 48 | 31 |
| PV 115 | 64 | 148 | 95 | 70 | 260 | 130 | 42 | 813 | 96 | 495 | 90 | 95 | ±150 | 92 | 35 |
| PV 150 | 64 | 148 | 95 | 70 | 260 | 130 | 42 | 813 | 96 | 495 | 90 | 95 | ±150 | 92 | 40 |
| PV 195 | 73 | 165 | 120 | 70 | 290 | 150 | 48 | 881 | 108 | 540 | 110 | 120 | ±150 | 126 | 45 |
| PV 240 | 83 | 200 | 130 | 80 | 325 | 160 | 52 | 945 | 128 | 575 | 120 | 130 | ±150 | 176 | 50 |
| PV 300 | 88 | 215 | 150 | 80 | 350 | 180 | 56 | 1108 | 137 | 670 | 140 | 150 | ±200 | 224 | 55 |
| PV 360 | 98 | 230 | 160 | 90 | 380 | 200 | 60 | 1172 | 147 | 715 | 150 | 160 | ±200 | 293 | 60 |
| PV 420 | 108 | 250 | 175 | 100 | 420 | 220 | 68 | 1243 | 160 | 760 | 165 | 175 | ±200 | 388 | 65 |
| PV 490 | 118 | 270 | 180 | 110 | 450 | 240 | 72 x 6 | 1310 | 173 | 805 | 175 | 180 | ±200 | 493 | 70 |
| PV 560 | 128 | 290 | 210 | 110 | 480 | 250 | 76 x 6 | 1364 | 187 | 845 | 205 | 210 | ±200 | 573 | 75 |
| PV 640 | 138 | 310 | 230 | 120 | 510 | 280 | 80 x 6 | 1531 | 201 | 940 | 225 | 230 | ±250 | 732 | 80 |
| PV 720 | 142 | 330 | 255 | 120 | 550 | 300 | 85 x 6 | 1592 | 215 | 980 | 250 | 255 | ±250 | 862 | 85 |
| PV 810 | 153 | 350 | 270 | 130 | 580 | 320 | 90 x 6 | 1654 | 229 | 1020 | 265 | 270 | ±250 | 1037 | 90 |
| PV 910 | 162 | 370 | 285 | 140 | 630 | 340 | 100 x 6 | 1743 | 243 | 1075 | 280 | 285 | ± 250 | 1309 | 95 |
| PV 1010 | 172 | 390 | 290 | 150 | 650 | 350 | 105 x 6 | 1809 | 257 | 1120 | 285 | 290 | ± 250 | 1463 | 100 |

*without molten zinc
Dimensions without corrosion protection
Subject to technical modifications
Bigger dimensions upon request

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# PV Typ Type 840

## Technical Data

Material:
S355J2+N, DIN EN 10025

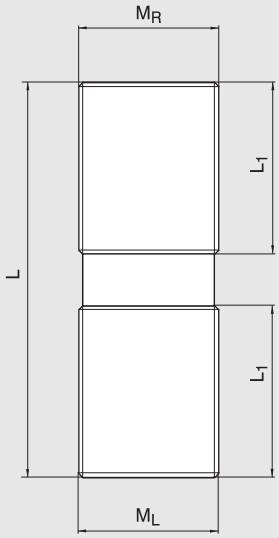
Corrosion Protection:
bare

(incl. external thread)

## Field of Application

Sockets type 800 PV and 801 PV

Installation by strapwrench/chain pipe wrench




| size | $M_R$ mm | $M_L$ mm | L mm | $L_1$ mm | weight kg |
|---|---|---|---|---|---|
| PV 40 | 42 x 3 | 42 x 3 | 160 | 65 | 2 |
| PV 60 | 52 x 3 | 52 x 3 | 180 | 75 | 3 |
| PV 90 | 64 x 4 | 64 x 4 | 200 | 85 | 5 |
| PV 115 | 75 x 4 | 75 x 4 | 220 | 95 | 7 |
| PV 150 | 75 x 4 | 75 x 4 | 220 | 95 | 7 |
| PV 195 | 85 x 4 | 85 x 4 | 240 | 105 | 11 |
| PV 240 | 95 x 4 | 95 x 4 | 280 | 125 | 15 |
| PV 300 | 108 x 4 | 108 x 4 | 310 | 135 | 22 |
| PV 360 | 118 x 4 | 118 x 4 | 330 | 145 | 28 |
| PV 420 | 128 x 4 | 128 x 4 | 360 | 160 | 36 |
| PV 490 | 140 x 4 | 140 x 4 | 380 | 170 | 45 |
| PV 560 | 150 x 4 | 150 x 4 | 400 | 180 | 55 |
| PV 640 | 160 x 4 | 160 x 4 | 420 | 190 | 66 |
| PV 720 | 172 x 4 | 172 x 4 | 450 | 200 | 81 |
| PV 810 | 185 x 6 | 185 x 6 | 490 | 220 | 102 |
| PV 910 | 195 x 6 | 195 x 6 | 510 | 230 | 118 |
| PV 1010 | 205 x 6 | 205 x 6 | 530 | 240 | 136 |
| PV 1110 | 215 x 6 | 215 x 6 | 570 | 260 | 163 |
| PV 1220 | 225 x 6 | 225 x 6 | 600 | 275 | 188 |
| PV 1340 | 235 x 6 | 235 x 6 | 640 | 290 | 216 |
| PV 1450 | 245 x 6 | 245 x 6 | 670 | 305 | 246 |
| PV 1580 | 260 x 6 | 260 x 6 | 700 | 320 | 290 |
| PV 1730 | 270 x 6 | 270 x 6 | 730 | 335 | 326 |
| PV 1860 | 280 x 6 | 280 x 6 | 760 | 350 | 365 |
| PV 2000 | 290 x 6 | 290 x 6 | 790 | 365 | 407 |

Subject to technical modifications
Bigger dimensions upon request

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# PV Typ Type 842

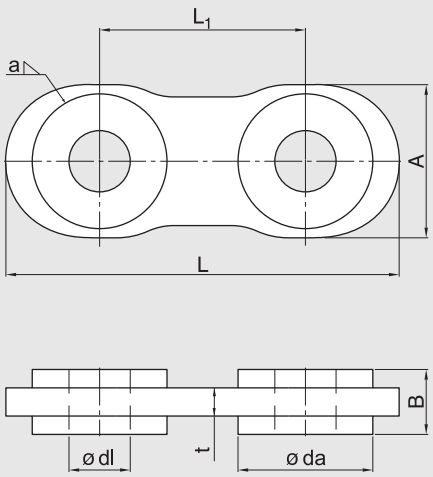
## Technical Data

Material :
S355J2+N, DIN EN 10025

Corrosion Protection:
hot dip galvanized 80 µm DIN EN ISO 1461
alternate spraying galvanized

## Field of Application

Sockets type 802 PV




| size | dl mm | L mm | $L_1$ mm | A mm | B mm | t mm | da mm | a mm | weight kg |
|---|---|---|---|---|---|---|---|---|---|
| PV 40 | 42 | 262 | 140 | 90 | 40 | 20 | 80 | 3 | 4 |
| PV 60 | 47 | 306 | 166 | 110 | 51 | 25 | 90 | 4 | 7 |
| PV 90 | 57 | 365 | 196 | 135 | 62 | 30 | 115 | 4 | 13 |
| PV 115 | 67 | 435 | 226 | 160 | 71 | 40 | 140 | 5 | 23 |
| PV 150 | 67 | 435 | 226 | 160 | 71 | 40 | 140 | 5 | 23 |
| PV 195 | 76 | 488 | 250 | 180 | 82 | 40 | 160 | 6 | 32 |
| PV 240 | 86 | 540 | 276 | 200 | 93 | 50 | 180 | 6 | 46 |
| PV 300 | 91 | 596 | 310 | 230 | 104 | 50 | 205 | 8 | 64 |
| PV 360 | 101 | 650 | 336 | 250 | 115 | 50 | 225 | 9 | 82 |
| PV 420 | 111 | 705 | 360 | 270 | 126 | 60 | 245 | 9 | 108 |
| PV 490 | 121 | 772 | 396 | 290 | 136 | 60 | 260 | 10 | 131 |
| PV 560 | 131 | 835 | 430 | 320 | 147 | 70 | 290 | 10 | 177 |
| PV 640 | 141 | 890 | 456 | 340 | 158 | 70 | 310 | 11 | 211 |
| PV 720 | 145 | 930 | 480 | 360 | 168 | 80 | 330 | 11 | 260 |
| PV 810 | 156 | 990 | 506 | 380 | 179 | 80 | 340 | 13 | 294 |
| PV 910 | 165 | 1080 | 560 | 410 | 190 | 90 | 370 | 14 | 379 |
| PV 1010 | 175 | 1110 | 566 | 430 | 201 | 90 | 390 | 14 | 428 |
| PV 1110 | 185 | 1160 | 590 | 450 | 210 | 100 | 405 | 14 | 493 |
| PV 1220 | 190 | 1220 | 630 | 480 | 218 | 100 | 435 | 15 | 580 |
| PV 1340 | 205 | 1318 | 684 | 503 | 230 | 100 | 453 | 16 | 665 |
| PV 1450 | 210 | 1390 | 720 | 530 | 240 | 110 | 480 | 18 | 796 |
| PV 1580 | 220 | 1450 | 750 | 550 | 250 | 110 | 495 | 18 | 877 |
| PV 1730 | 230 | 1510 | 780 | 570 | 260 | 110 | 515 | 20 | 971 |
| PV 1860 | 240 | 1570 | 810 | 590 | 270 | 120 | 530 | 22 | 1090 |
| PV 2000 | 250 | 1630 | 840 | 620 | 280 | 120 | 560 | 22 | 1235 |

Dimensions without corrosion protection
Subject to technical modifications
Bigger dimensions upon request

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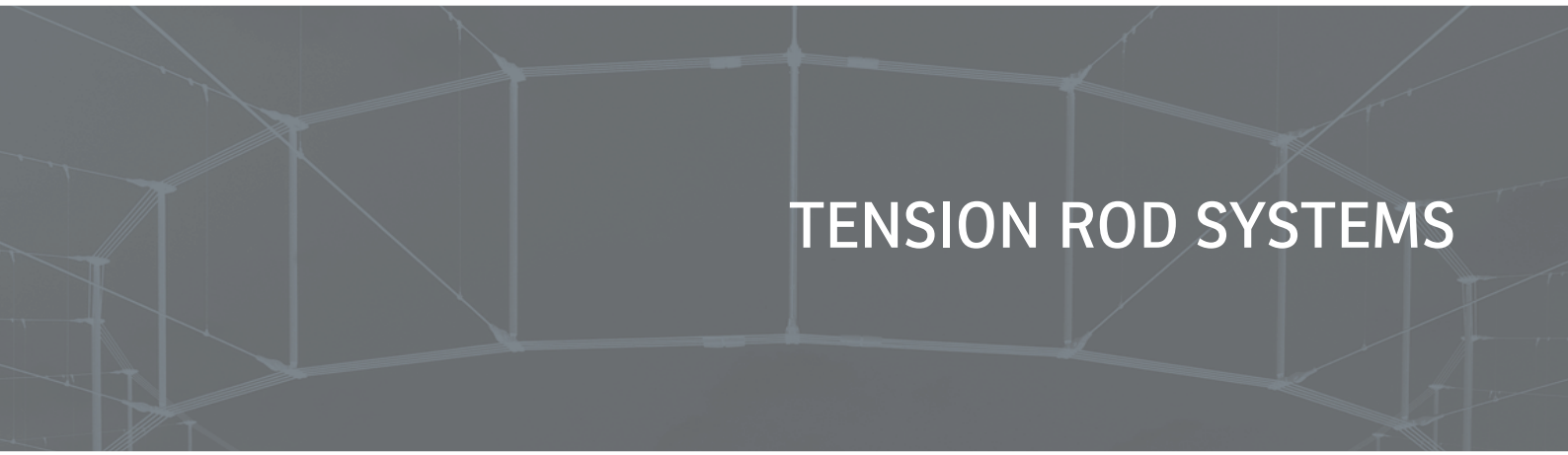
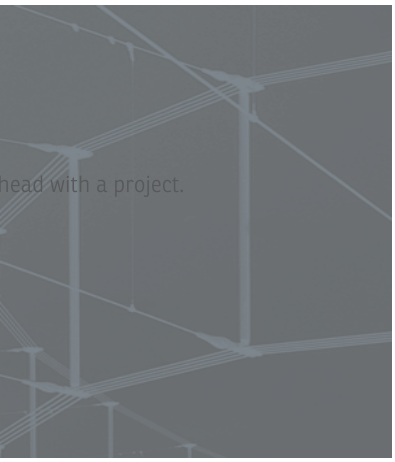
Because of our European Technical Approval ETA-11/0160, our products may be used in buildings and structures. Our products are examined at regular intervals by independent quality inspectors. Thus we create the amount of implementation safety that owners, designers and engineers need to go ahead with a project.



# TENSION ROD SYSTEMS

## Cable Systems




### PFEIFER'S elegant high-performance tension rod system type 860 is a complete system of highest quality and aesthe-tics, which also offers a high degree of economy.

PFEIFER'S tension rod system type 860 can be used profitably in many areas of structural engineering. It makes slender and aesthetically attractive structures possible and can be combined with a host of materials. The tension rod system is technically approved by the European Association for Technical Approvals (ETA-04/0039), furthermore it is building regulations approved by the German authority Deutsches Institut für Bautechnik. This makes it possible to install tension elements without having to go through lengthy and costly approval procedures.

## Content


- Applications
- Engineering
- Data Sheets
- Technical Approvals

Economical use of PFEIFER-Tension Members is possible in a variety of engineering areas, for example for:

- Header ties
- Facade suspensions
- Pylon bracings
- Canopy guying
- Truss systems

PFEIFER-Tension Members allow for slender and aesthetically appealing design and function and they can be easilly combined with the entire range of materials used in modern architecture, such as steel, wood and glass.

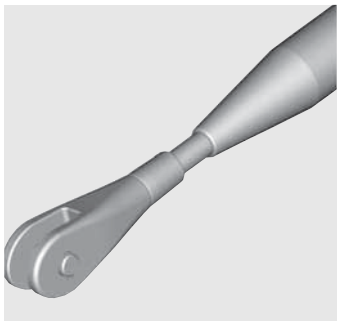
When designing a construction, the planner of load-bearing structures can profit from the principle of load diversion via tension an compression elements, and at the same time, clear and interesting architectural forms are created.


Bracings in the
AWD Arena Hannover

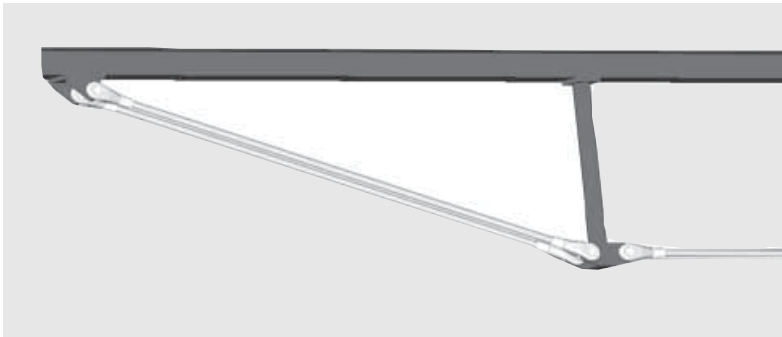

Guyings in the Stadium Coimbra

Ties in timber frame works

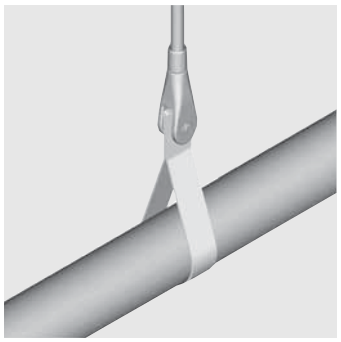
Approved compression rod connector

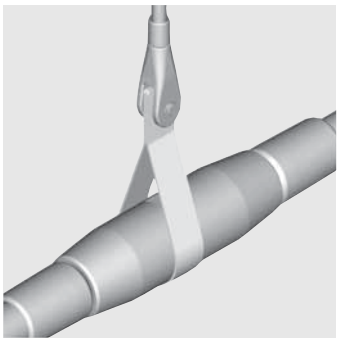


Pylon bracing

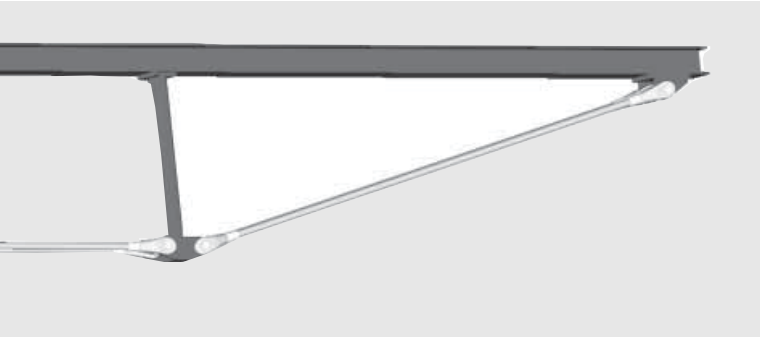


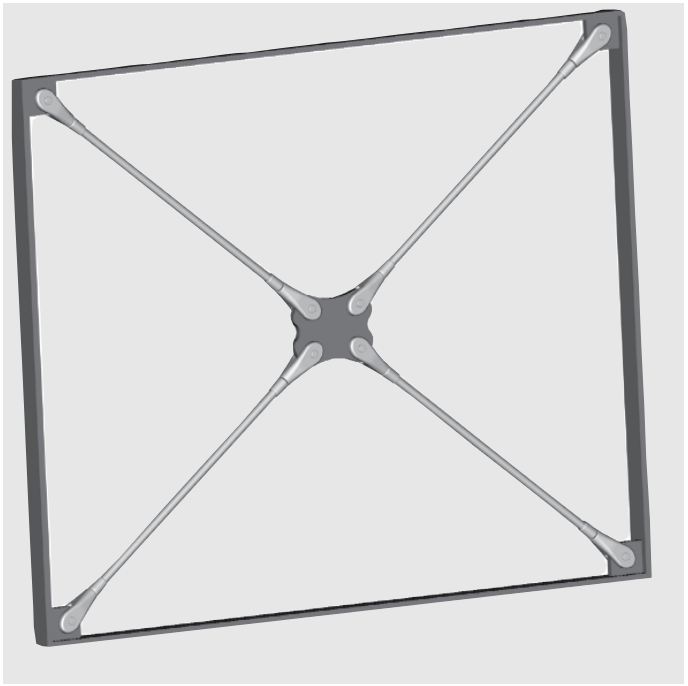
Truss system





Suspension at the bar / at the coupler





Wind bracing with intersection plate

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# Take advantage of our know-how!

If you are the number one in cables, you will also want to set standards when it comes to tension rods. Utilize our hands-on experience during every phase of your project. No matter if it is a question of planning, tensioning or maintenance, we will be glad to advise and assist.

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Engineering

The PFEIFER-Tension Rod System Type 860 consists of a tension rod, the fork connector and the components of the latter; furthermore special components are available.

The PFEIFER-Tension Rod System Type 860 was statically designed pursuant to German standard DIN 18800 Part 1/11.90. Said design was confirmed by an expertise.

## Tension Rod

The tension rod is made of the material S460N with a yield strength of at least 460 N/mm², thus approximately 30 % higher than that of the conventional material S355. Consequently, the same loads can be taken up with a smaller rod diameter. The Tension Rod has a slender design and economic efficiency is increased.

The limit tension loads resulting from design can be seen from the product tables below. For calculation they have to be at least as high as the design values of impacts ($F_d$). Intersection plates and connecting plates made of the material S355 are used as connecting points. Their geometrical design guarantees full load-bearing capacity as regards the limit tension loads $(N)_{R,d}$ listed in the product tables below. If intersection plates and connecting plates are made of S235, the reduced limit tension loads ($N_{R,d,red}$) can also be given.

## Components

The tension rod is the weakest link in the Tension Rod System. Thus, fork connectors, pins and couplers are designed to withstand higher loads so as to preclude failure of these components. Locking nuts that safely lock fork connector and tension rod as well as tension rod and coupler, respectively, are supplied. Furthermore, the locking nut protects the thread of the tension rod and provides for flush contours between fork connector and tension rod and between tension rod and coupler, respectively.

## Special Components

Adapters, compression rods and cable tension members are also available as special components.

## Adjustment Options

The left-hand and right-hand threads of the fork connectors enable exact adjustment of length, which is done by turning the rod. No turnbuckle is required. The take-up range can be comfortably adjusted by approximately 1.4 times the thread diameter for all sizes per system length. System length is the distance between the centres of the pins.

## Corrosion Protection

All elements of PFEIFER-Tension Rod System Type 860 are protected from corrosion either by hot-dip galvanisation pursuant to German standard DIN EN ISO 1461 or by metal spraying of zinc pursuant to German standard DIN EN 22063. All threads are brushed after galvanisation.

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The following construction aids for the PFEIFER-Tension Rod System Type 860 shall illustrate the formation of connecting points and the structural alignment of the Tension Rod System.

## Connecting Points

In the case of connecting points attention must be paid to the orientation of the system axes of all abutting components. The axes of load diversion and load transmission have to intersect in exactly one point. The connecting plates have to be designed and manufactured in keeping with the diameter of bore, the minimum distance $f_{min}$ between the centre of bore and the apex of the connecting plate, the minimum width $c_{min}$ as listed in the table "Fork Connector", a connection edge that is parallel to the fork base and the necessary material quality (see Fig. 1).
An estimate of the connecting-plate dimensions can be made on the basis of the connection angle and via the geometric proportions of the diameter of bore (see Fig. 2).

Fig. 1 right wrong

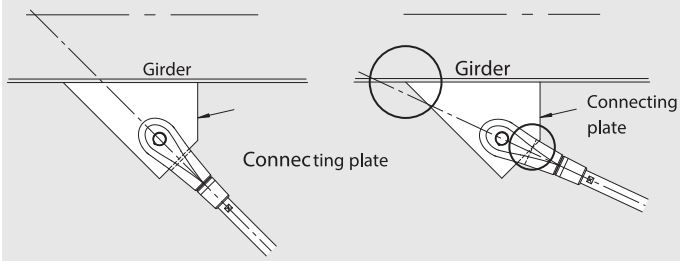
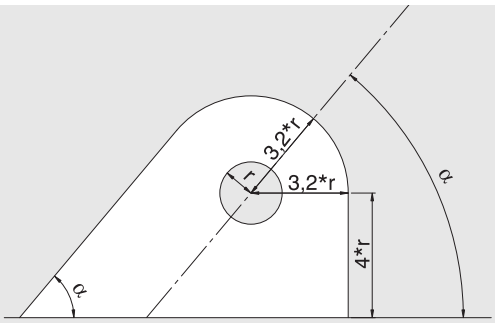



Fig. 2




## Structural Alignment

During installation of the Tension Rod System, care must be taken to ensure that any misalignment is avoided. Alignment of the entire system must not deviate from its plane by more than 0.5°. Otherwise, non permissible bending tensions are introduced into both the fork connectors and the connecting plates (see Fig. 3). Especially during installation of a tension rod with connections that are offset towards each other, precise structural orientation (alignment) must be ensured (see Fig. 4 and Fig. 5).

Fig. 3 Bending

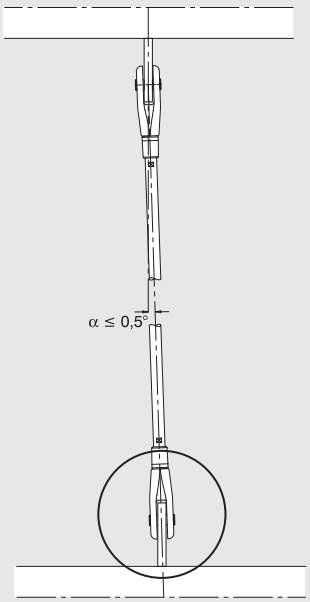



Fig. 4 Misaligned (i.e. offset) connecting plates – NOT recommended!

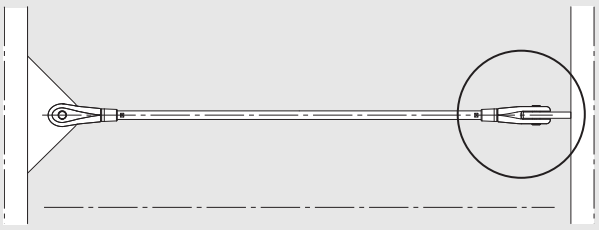
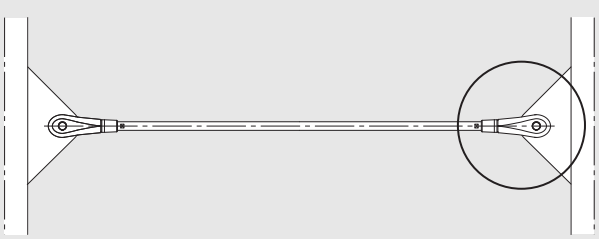


Fig. 5 Correctly aligned connecting plates – recommended



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## Delivery and Installation

The PFEIFER-Tension Rod System Type 860 is pre-assembled so as to facilitate installation (see Fig. 6).

For installation the length of the Tension Rod System has to be adjusted to the system length by turning the tension rod and by aligning it such that the pin can be inserted without bending (see Fig. 7). Driving in the pin with a hammer is forbidden since it can cause damage to the fork connector!

The Tension Rod System is adjusted with a spanner. If used correctly, adjustable spanners and screw wrenches (monkey wrenches) can also be practical. Special-design spanners are available on request. The locking nuts are then screwed back towards the fork connector until they are locked. A strap wrench can be used to tighten the locking nut so as to avoid damaging the surface (see Fig. 8).

In the scope of building supervision the minimal thread reach has to be checked for each fixing insert by appropriate measures.
Checks have to be documented and recorded by the responsible head of installation or chief erector. The minimal thread reach is achieved when the rod thread is completely covered by the locking nut. If threads with a special length are used, appropriate measures have to be taken to ensure that the minimal thread reach is achieved.

If the galvanized surface is damaged during tightening, the damaged spots have to be repaired professionally so as to guarantee the necessary corrosion protection.

If the system length exceeds 10 m, the Tension Rod System has to be supported and stabilized with at least two round slings since otherwise the entire system is susceptible to buckling.

Fig. 6

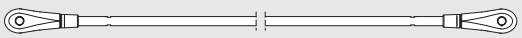


Fig. 7

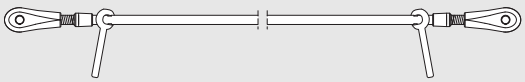


Fig. 8

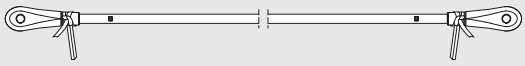


Fig. 9

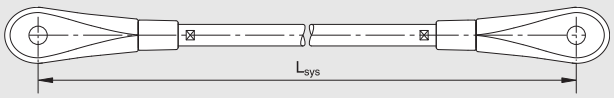



Fig. 10

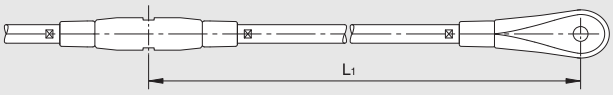
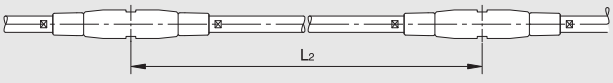



Fig. 11




## Information about Inquiry or Ordering

The diameter of the tension members has to be taken from the table of tension rod parameters or the table of tension-cable parameters in dependence on the limit tension ($N_{R,d}$). The required limit tension results from structural calculation.

When indicating the system length ($L_{sys}$), the minimum length, that is the shortest producible length, of the respective tension member has to be considered (see Fig. 9).

Additional specifications, such as partial lengths $L_1$ and $L_2$ that have to be taken into consideration have to be entered into the field "Comments" on the order form (see Fig. 10 and Fig. 11).

# TENSION ROD TYPE 860

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DATA SHEETS

## Technical Data

Material:
S460N, DIN EN 10025

Modul of Elasticity:
210± 10 kN/mm $^2$

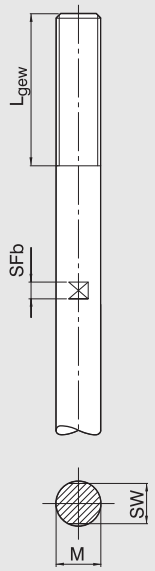
Corrosion Protection:
hot dip galvanised or bare

## Field of Application

Bracings for roofs, walls, girders

Stays for roof elements, pylons

In-line tensioning for steel-, wooden truss and steel structures, space frames




| size M mm | $N_{R,d}$* kN | $N_{R,d}$* kN | $L_{gew}$ mm | $S_{Fb}$ mm | $S_W$ mm | $L_{max}$ mm | weight kg/m |
|---|---|---|---|---|---|---|---|
| 10 | 26,3 | 26,1 | 33 | 19 | 9 | 6000 | 0,61 |
| 12 | 38,3 | 37,9 | 38 | 19 | 10 | 6000 | 0,88 |
| 16 | 71,2 | 70,5 | 54 | 19 | 14 | 12000 | 1,58 |
| 20 | 111,0 | 110,1 | 67 | 19 | 18 | 12000 | 2,47 |
| 24 | 160,0 | 158,5 | 80 | 19 | 22 | 15000 | 3,55 |
| 27 | 208,0 | 206,6 | 90 | 19 | 25 | 15000 | 4,50 |
| 30 | 254,0 | 252,1 | 100 | 19 | 28 | 15000 | 5,55 |
| 36 | 371,0 | 367,3 | 120 | 19 | 33 | 15000 | 8,00 |
| 42 | 509,0 | 504,2 | 140 | 19 | 39 | 15000 | 10,9 |
| 48 | 669,0 | 662,6 | 159 | 19 | 45 | 15000 | 14,2 |
| 52 | 798,0 | 790,6 | 172 | ** | ** | 15000 | 16,7 |
| 56 | 922,0 | 913,0 | 187 | ** | ** | 15000 | 19,3 |
| 60 | 1073,0 | 1062,4 | 199 | ** | ** | 15000 | 22,2 |
| 64 | 1215,0 | 1203,6 | 211 | ** | ** | 15000 | 25,3 |
| 70 | 1463,0 | 1463,7 | 233 | ** | ** | 15000 | 30,2 |
| 80 | 1910,0 | 1953,8 | 266 | ** | ** | 15000 | 39,5 |
| 90 | 2418,0 | 2514,6 | 297 | ** | ** | 15000 | 49,9 |
| 100 | 2985,0 | 3146,0 | 328 | ** | ** | 15000 | 61,7 |

Subject to technical modification
Connecting plate S355J2+N
We propose the use of a chain wrench

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Technical Data

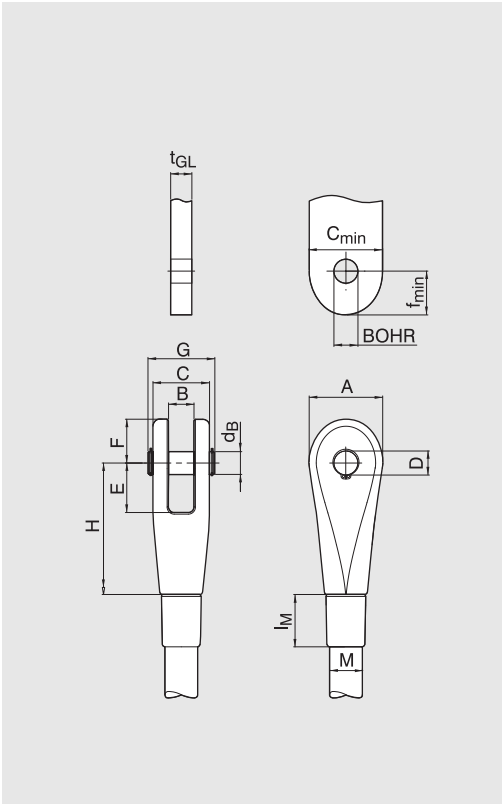
Material:
EN-GJS-400-18-LT DIN EN 1563

Pin:
34CrNiMo6V, W. Nr. 1.6582
DIN EN 10083-1

Locking Nut
S355J2+N, DIN EN 10025

Corrosion Protection:
hot dip galvanized, thread bright

Connecting Plate
S355J2+N

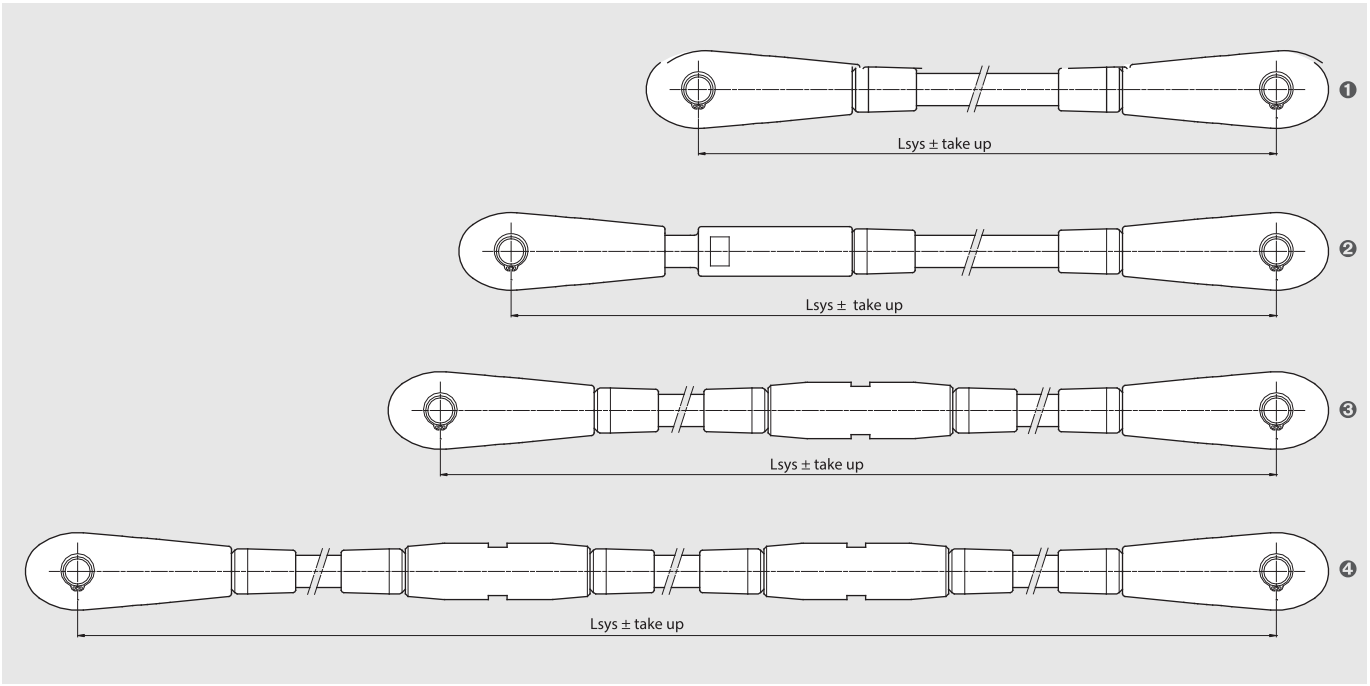



| size | fork connector | | | | | | | pin | | lock nut | connecting plate | | | | tot.weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M | A | B | C | D | E | F | H | $d_B$ | G | $l_M$ | $t_{GL}$ | $f_{min}$ | $c_{min}$ | BOHR | |
| mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | kg |
| 10 | 25 | 10 | 20 | 10 | 19 | 16 | 52 | 9 | 27,0 | 21 | 8 | 16 | 25 | 10 | 0,12 |
| 12 | 29 | 12 | 24 | 11 | 21 | 18 | 58 | 10 | 31,0 | 24 | 10 | 17 | 29 | 11 | 0,20 |
| 16 | 42 | 15 | 32 | 15 | 30 | 26 | 77 | 14 | 41,0 | 31 | 12 | 23 | 42 | 15 | 0,53 |
| 20 | 52 | 18 | 40 | 17 | 35 | 31 | 93 | 16 | 50,2 | 40 | 15 | 27 | 52 | 17 | 0,95 |
| 24 | 58 | 23 | 48 | 23 | 46 | 39 | 115 | 22 | 59,8 | 48 | 20 | 36 | 58 | 23 | 1,57 |
| 27 | 68 | 23 | 54 | 25 | 47 | 44 | 125 | 24 | 66,6 | 53 | 20 | 39 | 68 | 25 | 2,34 |
| 30 | 77 | 28 | 60 | 29 | 52 | 51 | 138 | 28 | 74,8 | 60 | 25 | 47 | 77 | 30 | 3,14 |
| 36 | 90 | 28 | 72 | 33 | 64 | 58 | 167 | 32 | 89,3 | 71 | 25 | 53 | 90 | 34 | 5,57 |
| 42 | 104 | 33 | 84 | 37 | 70 | 66 | 190 | 36 | 103,5 | 83 | 30 | 59 | 104 | 38 | 8,74 |
| 48 | 120 | 38 | 96 | 41 | 78 | 74 | 213 | 40 | 118,7 | 95 | 35 | 66 | 120 | 42 | 12,7 |
| 52 | 136 | 43 | 104 | 46 | 85 | 84 | 231 | 45 | 126,7 | 103 | 40 | 73 | 136 | 47 | 16,5 |
| 56 | 148 | 43 | 112 | 51 | 95 | 91 | 254 | 50 | 138,3 | 110 | 40 | 81 | 148 | 52 | 21,9 |
| 60 | 162 | 48 | 120 | 56 | 106 | 100 | 275 | 55 | 146,3 | 119 | 45 | 90 | 162 | 58 | 27,1 |
| 64 | 170 | 53 | 128 | 56 | 107 | 103 | 286 | 55 | 154,8 | 127 | 50 | 90 | 170 | 58 | 31,6 |
| 70 | 185 | 58 | 140 | 61 | 117 | 113 | 315 | 60 | 166,8 | 139 | 55 | 98 | 185 | 63 | 39,3 |
| 80 | 210 | 68 | 160 | 71 | 133 | 132 | 359 | 70 | 187,8 | 160 | 65 | 114 | 210 | 73 | 58,6 |
| 90 | 240 | 78 | 180 | 80 | 150 | 150 | 402 | 79 | 211,5 | 178 | 75 | 128 | 240 | 82 | 85,5 |
| 100 | 265 | 83 | 200 | 90 | 170 | 165 | 448 | 89 | 232,5 | 197 | 80 | 144 | 265 | 92 | 120,5 |

Subject to technical modification

CE 1771 ETA

ETA-11/0160




| | ❶ tension rod system with and without connector | | | ❷ tension rod system with one adapter | | | ❸ tension rod system with one coupler/intersection coupler | | | ❹ tension rod system with two couplers | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M mm | min ~L sys mm | max L sys mm | Verstellweg take up ±mm | min ~L sys mm | max L sys mm | Verstellweg take up ±mm | min ~L sys mm | max L sys mm | Verstellweg take up ±mm | min ~L sys mm | max L sys mm | Verstellweg take up ±mm |
| 10 | 196 | 6063 | 14 | 257 | 6124 | 21 | 347 | 12081 | 28 | 497 | 18098 | 42 |
| 12 | 226 | 6071 | 12 | 300 | 6145 | 18 | 399 | 12080 | 24 | 573 | 18109 | 36 |
| 16 | 294 | 12087 | 23 | 391 | 12184 | 35 | 528 | 24114 | 46 | 762 | 36141 | 69 |
| 20 | 359 | 12103 | 29 | 480 | 12224 | 44 | 645 | 24134 | 58 | 932 | 36165 | 87 |
| 24 | 436 | 15131 | 35 | 576 | 15271 | 53 | 777 | 30168 | 70 | 1119 | 45205 | 105 |
| 27 | 479 | 15139 | 40 | 636 | 15296 | 60 | 863 | 30182 | 80 | 1246 | 45226 | 120 |
| 30 | 530 | 15153 | 43 | 701 | 15324 | 65 | 955 | 30202 | 86 | 1381 | 45251 | 129 |
| 36 | 643 | 15186 | 52 | 849 | 15392 | 78 | 1160 | 30245 | 104 | 1676 | 45304 | 156 |
| 42 | 734 | 15207 | 61 | 971 | 15444 | 92 | 1329 | 30275 | 122 | 1923 | 45343 | 183 |
| 48 | 823 | 15228 | 68 | 1089 | 15494 | 102 | 1496 | 30306 | 136 | 2169 | 45384 | 204 |
| 52 | 895 | 15249 | 75 | 1185 | 15539 | 113 | 1624 | 30332 | 150 | 2353 | 45415 | 225 |
| 56 | 973 | 15276 | 82 | 1282 | 15585 | 123 | 1763 | 30369 | 164 | 2552 | 45461 | 246 |
| 60 | 1045 | 15305 | 85 | 1378 | 15638 | 128 | 1885 | 30405 | 170 | 2725 | 45505 | 255 |
| 64 | 1098 | 15311 | 89 | 1454 | 15667 | 134 | 1987 | 30414 | 178 | 2877 | 45518 | 267 |
| 70 | 1203 | 15343 | 101 | 1595 | 15735 | 152 | 2177 | 30458 | 202 | 3152 | 45573 | 303 |
| 80 | 1374 | 15390 | 116 | 1823 | 15839 | 174 | 2486 | 30518 | 232 | 3598 | 45646 | 348 |
| 90 | 1527 | 15436 | 128 | 2032 | 15941 | 192 | 2762 | 30580 | 256 | 3997 | 45724 | 384 |
| 100 | 1692 | 15489 | 141 | 2229 | 16026 | 212 | 3054 | 30648 | 282 | 4416 | 45807 | 423 |

Subject to technical modification

CE 1771 ETA

ETA-11/0160



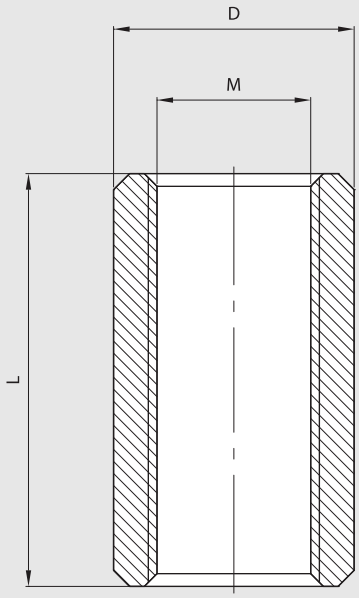
Technical Data

Material:
S460N, DIN EN 10025
34 CrNiMo 6 + QT, DIN EN 10083

Corrosion Protection:
hot dip galvanized, thread bright

Field of Application

For tension rod extension,




| size M mm | L mm | M mm | D mm | weight kg |
|---|---|---|---|---|
| 10 | 24 | 10 | 16 | 0,1 |
| 12 | 30 | 12 | 20 | 0,1 |
| 16 | 40 | 16 | 24 | 0,1 |
| 20 | 48 | 20 | 30 | 0,2 |
| 24 | 58 | 24 | 36 | 0,3 |
| 27 | 66 | 27 | 42 | 0,5 |
| 30 | 72 | 30 | 42 | 0,5 |
| 36 | 88 | 36 | 52 | 0,9 |
| 42 | 102 | 42 | 60 | 1,4 |
| 48 | 116 | 48 | 70 | 2,1 |
| 52 | 126 | 52 | 80 | 3,1 |
| 56 | 136 | 56 | 80 | 3,2 |
| 60 | 144 | 60 | 90 | 4,5 |
| 64 | 154 | 64 | 90 | 4,4 |
| 70 | 168 | 70 | 100 | 6,0 |
| 80 | 192 | 80 | 110 | 8,0 |
| 90 | 216 | 90 | 120 | 9,7 |
| 100 | 240 | 100 | 130 | 12,0 |

Subject to technical modification

# FORK CONNECTOR WITH ADAPTER

CE 1771 ETA

ETA-11/0160

DATA SHEETS

## Technical Data

Fork connector:
EN-GJS-400-18-LT DIN EN 1563

Pin:
34CrNiMo6V +QT, W. Nr. 1.6582
DIN EN 10083-3

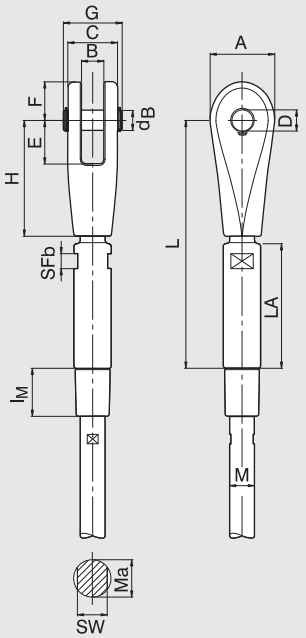
Locking Nut
S355J2+N, DIN EN 10025

Adapter:
S460N, DIN EN 10025
36CrNiMo6V+for ≥ M70

Corrosion Protection:
hot dip galvanized / hot spray galvanized,
thread bright

## Field of Application

Tension Rod




| size | fork connector | | | | | | | pin | | lock nut | adapter | | | | | tot.weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M | A | B | C | D | E | F | H | $d_B$ | G | $l_M$ | LA | L | Ma | SW | SFb | |
| mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | kg |
| 10 | 25 | 10 | 20 | 10 | 19 | 16 | 52 | 9 | 27,0 | 21 | 50 | 105 | 15 | 12 | 6 | 0,19 |
| 12 | 29 | 12 | 24 | 11 | 21 | 18 | 58 | 10 | 31,0 | 25 | 60 | 122 | 18 | 14 | 7 | 0,32 |
| 16 | 42 | 15 | 32 | 15 | 30 | 26 | 77 | 14 | 41,0 | 33 | 80 | 161 | 24 | 19 | 10 | 0,82 |
| 20 | 52 | 18 | 40 | 17 | 35 | 31 | 93 | 16 | 50,2 | 41 | 100 | 198 | 30 | 24 | 12 | 1,47 |
| 24 | 58 | 23 | 48 | 23 | 46 | 39 | 115 | 22 | 59,8 | 49 | 115 | 236 | 37 | 30 | 14 | 2,47 |
| 27 | 68 | 23 | 54 | 25 | 47 | 44 | 125 | 24 | 66,6 | 55 | 130 | 261 | 41 | 32 | 16 | 3,60 |
| 30 | 77 | 28 | 60 | 29 | 52 | 51 | 138 | 28 | 74,8 | 62 | 140 | 285 | 45 | 36 | 18 | 4,75 |
| 36 | 90 | 28 | 72 | 33 | 64 | 58 | 167 | 32 | 89,3 | 74 | 170 | 345 | 54 | 46 | 22 | 8,60 |
| 42 | 104 | 33 | 84 | 37 | 70 | 66 | 190 | 36 | 103,5 | 86 | 195 | 394 | 63 | 50 | 25 | 13,10 |
| 48 | 120 | 38 | 96 | 41 | 78 | 74 | 213 | 40 | 120,2 | 99 | 220 | 443 | 72 | 60 | 29 | 19,40 |
| 52 | 136 | 43 | 104 | 46 | 85 | 84 | 231 | 45 | 128,2 | 107 | 240 | 481 | 78 | 65 | 31 | 25,30 |
| 56 | 148 | 43 | 112 | 51 | 95 | 91 | 254 | 50 | 139,8 | 115 | 255 | 520 | 84 | 70 | 34 | 32,30 |
| 60 | 162 | 48 | 120 | 56 | 106 | 100 | 275 | 55 | 147,8 | 124 | 275 | 561 | 89 | 75 | 36 | 39,60 |
| 64 | 170 | 53 | 128 | 56 | 107 | 103 | 286 | 55 | 156,3 | 132 | 295 | 593 | 96 | 80 | 38 | 46,80 |
| 70 | 185 | 58 | 140 | 61 | 117 | 113 | 315 | 60 | 168,3 | 144 | 325 | 562 | 108 | 90 | 42 | 62,10 |
| 80 | 210 | 68 | 160 | 71 | 133 | 132 | 359 | 70 | 189,3 | 165 | 375 | 746 | 123 | 105 | 48 | 93,00 |
| 90 | 240 | 78 | 180 | 80 | 150 | 150 | 402 | 79 | 213,0 | 185 | 425 | 839 | 139 | 115 | 54 | 134,00 |
| 100 | 265 | 83 | 200 | 90 | 170 | 165 | 448 | 89 | 234,0 | 205 | 450 | 910 | 154 | 130 | 60 | 179,00 |

Subject to technical modification

CE 1771 ETA

ETA-11/0160



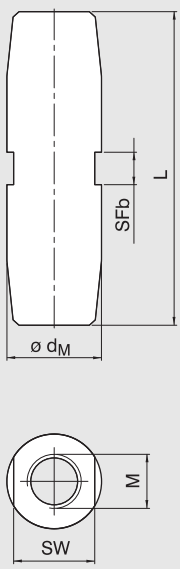
Technical Data

Material:
S355J2+N

Corrosion Protection:
hot dip galvanized, thread bright

Field of Application

Tension Rod




| size M mm | L mm | $d_M$ mm | SFb mm | SW mm | take up ±mm | weight kg |
|---|---|---|---|---|---|---|
| 10 | 58 | 17 | 7 | 15 | 14 | 0,07 |
| 12 | 72 | 19 | 7 | 17 | 12 | 0,10 |
| 16 | 94 | 28 | 11 | 24 | 23 | 0,31 |
| 20 | 116 | 35 | 12 | 30 | 29 | 0,60 |
| 24 | 138 | 42 | 14 | 36 | 35 | 1,04 |
| 27 | 156 | 48 | 15 | 41 | 40 | 1,51 |
| 30 | 172 | 51 | 16 | 46 | 43 | 1,88 |
| 36 | 207 | 65 | 17 | 55 | 52 | 3,69 |
| 42 | 242 | 75 | 19 | 65 | 61 | 5,74 |
| 48 | 273 | 88 | 21 | 75 | 68 | 8,80 |
| 52 | 295 | 92 | 22 | 80 | 75 | 10,4 |
| 56 | 321 | 98 | 24 | 85 | 82 | 12,8 |
| 60 | 341 | 105 | 25 | 90 | 85 | 15,5 |
| 64 | 362 | 110 | 27 | 95 | 89 | 17,9 |
| 70 | 400 | 128 | 27 | 110 | 101 | 27,7 |
| 80 | 456 | 144 | 30 | 125 | 116 | 39,1 |
| 90 | 508 | 163 | 36 | 140 | 128 | 55,5 |
| 100 | 560 | 174 | 39 | 155 | 141 | 69,0 |

Subject to technical modification

# INTERSECTION COUPLER

CE 1771 ETA

ETA-11/0160

DATA SHEETS

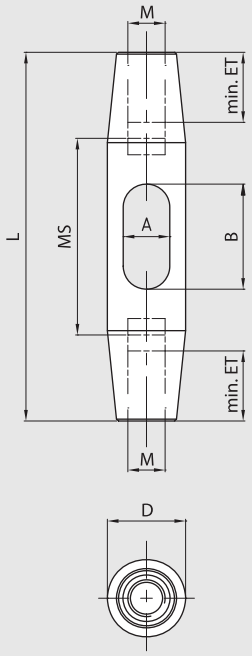
Technical Data

Material:
S460N, DIN EN 10025

Corrosion Protection:
hot dip galvanized, thread bright

Field of Application

Tension Rod




| size M mm | L mm | D mm | MS mm | min. ET mm | A mm | B mm | take up ± mm | weight kg |
|---|---|---|---|---|---|---|---|---|
| 12 | 121 | 27 | 77 | 16 | 16,5 | 39,0 | 12 | 0,3 |
| 16 | 165 | 36 | 97 | 22 | 20,5 | 48,5 | 24 | 0,7 |
| 20 | 200 | 42 | 114 | 28 | 25 | 57 | 30 | 1,3 |
| 24 | 238 | 48 | 137 | 32 | 28,5 | 70,5 | 36 | 1,9 |
| 27 | 262 | 52 | 148 | 37 | 32 | 77 | 40 | 2,5 |
| 30 | 285 | 60 | 162 | 39 | 35 | 84 | 44 | 3,7 |
| 36 | 329 | 70 | 180 | 48 | 41 | 97 | 52 | 5,7 |

Other sizes and designes on request
Subject to technical modification

# INTERSECTION PLATE WITH CONNECTION ANGLE

CE 1771 ETA

ETA-11/0160

## Technical Data

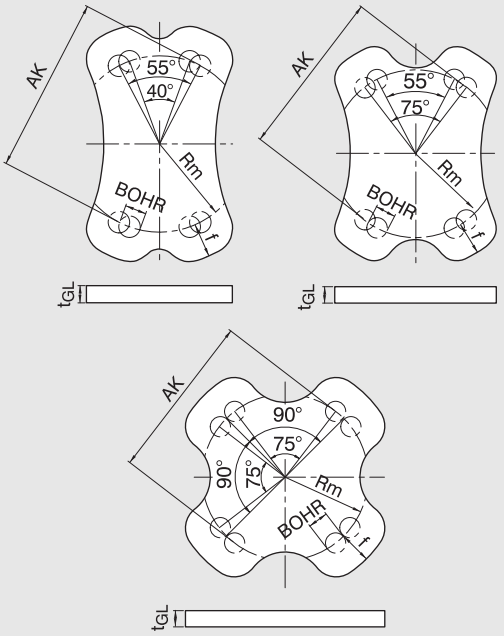
Material:
S355J2+N

Corrosion Protection:

hot dip galvanized, thread bright

## Field of Application

Tension Rod




| size M mm | $t_{GL}$ mm | BOHR mm | Rm mm | f mm | Ak mm | weight 40°-55° kg | weight 55°-75° kg | weight 75°-90° kg |
|---|---|---|---|---|---|---|---|---|
| 10 | 8 | 10 | 41 | 16 | 82 | 0,37 | 0,41 | 0,46 |
| 12 | 10 | 11 | 53 | 17 | 106 | 0,67 | 0,79 | 0,92 |
| 16 | 12 | 15 | 71 | 23 | 142 | 1,54 | 1,76 | 1,78 |
| 20 | 15 | 17 | 86 | 27 | 172 | 2,77 | 3,19 | 3,31 |
| 24 | 20 | 23 | 99 | 36 | 198 | 5,13 | 5,85 | 6,03 |
| 27 | 20 | 25 | 114 | 39 | 228 | 6,86 | 7,64 | 7,91 |
| 30 | 25 | 30 | 131 | 47 | 262 | 11,4 | 12,8 | 13,3 |
| 36 | 25 | 34 | 153 | 53 | 306 | 15,1 | 17,3 | 18,0 |
| 42 | 30 | 38 | 171 | 59 | 342 | 22,9 | 26,5 | 27,2 |
| 48 | 35 | 42 | 194 | 66 | 388 | 34,7 | 39,7 | 41,1 |
| 52 | 40 | 47 | 219 | 73 | 438 | 49,8 | 57,0 | 58,8 |
| 56 | 40 | 52 | 236 | 81 | 472 | 57,9 | 66,7 | 69,0 |
| 60 | 45 | 58 | 260 | 90 | 520 | 80,2 | 92,5 | 95,0 |
| 64 | 50 | 58 | 283 | 90 | 566 | 101,5 | 114,9 | 119,9 |
| 70 | 55 | 63 | 313 | 98 | 626 | 131,8 | 152,7 | 159,0 |
| 80 | 65 | 73 | 352 | 114 | 704 | 200,9 | 233,2 | 240,5 |
| 90 | 75 | 82 | 390 | 128 | 780 | 291,2 | 334,3 | 346,8 |
| 100 | 80 | 92 | 425 | 144 | 850 | 373,2 | 432,8 | 446,5 |

Subject to technical modification

# FORK CONNECTOR WITH THREADED FITTING TYPE 861

CE 1771 ETA
ETA-11/0160



## Technical Data

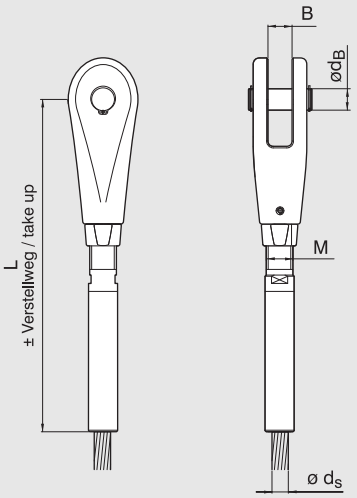
Forked end see data sheet 860
Swaged fitting see data sheet 988 PG

## Field of Application

Bracings for roofs, walls, girders

Stays for roof elements, pylons

In-line tensioning for steel-, wooden truss and steel structures, space frames




| type | size | limit tension | | take up | | | |
|---|---|---|---|---|---|---|---|
| | $M_{(LH/RH)}$ | $Z_{R,d}$ DIN 18800 kN | L mm | ± mm | B mm | $d_B$ mm | $d_S$ mm |
| 861-10 | 16 | 56 | 210 | 11,5 | 15 | 14 | 10,1 |
| 861-15 | 20 | 81 | 256 | 14,5 | 18 | 16 | 12,2 |
| 861-20 | 24 | 109 | 307 | 17,5 | 23 | 22 | 14,1 |
| 861-25 | 27 | 158 | 352 | 20,0 | 23 | 24 | 17,0 |
| 861-40 | 30 | 222 | 401 | 21,5 | 28 | 28 | 20,1 |
| 861-55 | 36 | 326 | 485 | 26,0 | 28 | 32 | 24,4 |
| 861-75 | 42 | 438 | 559 | 30,5 | 33 | 36 | 28,3 |
| 861-90 | 48 | 536 | 625 | 34,0 | 38 | 40 | 31,3 |
| 861-125 | 56 | 721 | 730 | 41,0 | 43 | 50 | 36,3 |

Subject to technical modification
Dimensions without corrosion protection!

# FORK CONNECTOR WITH ADAPTER AND THREADED FITTING TYPE 865

CE 1771 ETA

ETA-11/0160



## Technical Data

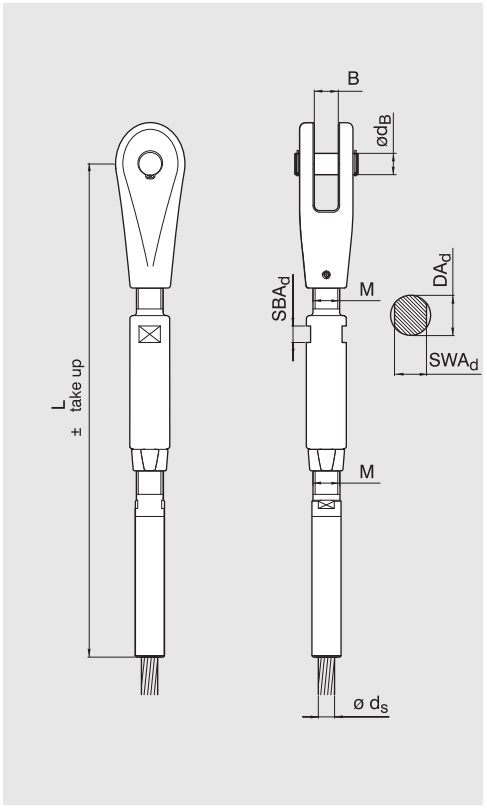
Forked end see data sheet 860
Adapter see data sheet 860
Swaged fitting see data sheet 988 PG

## Field of Application

Bracings for roofs, walls, girders

Stays for roof elements, pylons

In-line tensioning for steel-, wooden truss and steel structures, space frames




| Type | size | limit tension | | | | | take up | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $M_{(LH/RH)}$ | $Z_{R,d}$ DIN 18800 kN | $D_{Ad}$ mm | $SW_{Ad}$ mm | $SB_{Ad}$ mm | L mm | ± mm | B mm | $d_B$ mm | $d_s$ mm |
| 865-10 | 16 | 56 | 24 | 19 | 10 | 305 | 23 | 15 | 14 | 10,1 |
| 865-15 | 20 | 81 | 30 | 24 | 12 | 374 | 29 | 18 | 16 | 12,2 |
| 865-20 | 24 | 109 | 37 | 30 | 14 | 447 | 35 | 23 | 22 | 14,1 |
| 865-25 | 27 | 158 | 41 | 32 | 16 | 511 | 40 | 23 | 24 | 17,0 |
| 865-40 | 30 | 222 | 45 | 36 | 18 | 573 | 43 | 28 | 28 | 20,1 |
| 865-55 | 36 | 326 | 54 | 46 | 22 | 693 | 52 | 28 | 32 | 24,4 |
| 865-75 | 42 | 438 | 63 | 50 | 25 | 797 | 61 | 33 | 36 | 28,3 |
| 865-90 | 48 | 536 | 72 | 60 | 29 | 896 | 68 | 38 | 40 | 31,3 |
| 865-125 | 56 | 721 | 84 | 70 | 34 | 1043 | 82 | 43 | 50 | 36,3 |

Subject to technical modification
Dimensions without corrosion protection!

CE 1771 ETA

ETA-11/0160

TECHNICAL APPROVALS


The following approval belong to our products:

- ETA-04/0039 of the European Organisation for Technical Approvals

They are subject to inspections by independent inspectors at prescribed intervals.

# INSTALLATION AND HANDLING

## Together with our highly-capable installation team we reliably implement cable structure projects around the globe. Even the most trying installation projects are safely and reliably handled by our experienced specialists.

Even during design of the load-bearing system and the individual components, we bear in mind the requirements of safe installation that remains on schedule later on. Hands-on experience, which we have gained over decades, as well as our acquired competence in dealing with cables guarantee both expert handling and the greatest possible safety during installation. Via a high degree of pre-manufacturing we achieve short installation periods according to schedule.

## Content


- **Installation in general**
- **Shipping, Storage, Handling**
- **Maintenance**
- **Assembly instructions**

INSTALLATION IN GENERAL

Installation of cables is often carried out in precipitous spots under the most difficult of circumstances.

# We safely handle even the most unique installation!

■ The planning process is the key to success

Upon receipt of the tender documents, our staff in the sales, installation and technical departments go into action. In close cooperation, quantities are calculated and technical specifications are generated. Installation methods are analysed, tested as to their feasibility and described down to the last detail.

A host of things have to be carefully considered: Roads and streets that have to be bridged or crossed are often subject to certain requirements, the same applies to watercourses or waterways, rough terrain, existing structures, precipitous working heights or ongoing sporting and other events in stadia and sports grounds.

# INSTALLATION IN GENERAL

For the final construction planning, the load-bearing systems are disassembled into their individual components, the construction process is accurately planned, and the production of adjoining building components is predetermined. Together with the planners, the framework conditions necessary for the installation i.e. intermediate stages of installation, connection of the cables to the structure connections, guidance of forces and tensibility are depicted and calculated.

## Installation Calculations

During the individual installation steps various load cases occur (i.e. when lifting the radial cable system of a stadium roof) that are closely examined in our installation calculations. This guarantees that maximum admissible forces are never exceeded during installation. The installation calculations provide geometry and forces for individual construction phases and at the same time serve as parameters for force and geometry measurements carried out by our installation team later on.

## On the construction site

With our sophisticated installation equipment we are in a position to apply tension forces in a controlled manner, even if we work with large cable diameters, tension forces can furthermore be accurately recorded at any time. In addition to that, we develop and produce special tools, based on the respective requirements in the installation of load-bearing structures, which – if need be – are examined and approved by the authorities. Using hydraulic systems and cable tension metres we can take force measurements also of already finished load-bearing structures. All forces measured and the final geometry are entered into the structure file.

The hands-on experience that we have acquired covers many areas, from the construction of the most varied types of bridges, via the construction of stadium roofs, the construction of fixed and movable roof segments, cable-supported glass curtain walls or membranes to the construction of purpose-built structures such as vivariums, open air enclosures for birds and climbing paths. A high degree of prefabrication makes short installation periods possible.

Presice prestressing, on a main cable and hanger construction.

Measuring cable forces with a cable tension meter.

General installation instructions are documented in our "Assembly instruction" documentation. The documentation provides an overview of minimum requirements when working with cables. Disregard of the general installation documentation can lead to damage of the cables and the whole load-bearing structure.

Prefabricated tension elements and especially cables are subject to specific requirements which have to be strictly adhered to during production, shipping and storage.

## Shipping

When shipping cables, it is essential to make sure that the cables do not suffer any damage during transportation since this would lead to both impaired corrosion protection and impaired visual appearance. Cables are shipped in wooden crates, coiled or uncoiled, in rings or rolled up on reels.

For the loading process, the cables must be fastened in an appropriate way – either directly on the cable or on appropriate load bearing packing equipment:

- If the packing equipment is load bearing, careful handling of it – i.e. avoiding damage to it – will exclude damage to the cables.
- If the cables are coiled into rings and stored lying on squared timber, they have to be fastened with at least three Polytex slings which are offset to one another at an angle of 120 °. Chains, wire rope slings and similar load bearing equipment must not be fastened to the tension elements.

For sea freight regulations as to seaworthy packing have to be strictly adhered to.

Laying out VVS-cables with a mobile unreel stand – here a tensioning ring, National Stadium Main Bowl Complex, Abuja.

## Storage

Galvanized cables and components should be stored in dry and clean conditions – appropriate ventilation must be guaranteed. The following conditions must be adhered to:

- Components must be protected from accidental damage on the building site i.e. vehicles bumping into the cables, etc.
- Surrounding air must be free of sanding or cutting dust of corrosive steels
- Cables must not be stored lying in water
- Components must be protected from uncoiling, slipping and twisting

## Handling

Competent handling of the cables at any given time during the installation process is absolutely essential. Depending on the form in which they are delivered, the cables are either directly taken up for installation or have to be coiled or uncoiled beforehand. While the cables are handled, any damage to them must be avoided. Warming, sanding or cutting of prefabricated tension elements on the construction site is inadmissible.

Installation of the ring cable connector is always carried out manually – here inserting and aligning of connectors, National Stadium Main Bowl Complex, Abuja.

Important Handling Recommendations:

- For cables that are delivered uncoiled in wooden crates or fastened to a wooden board:
  The cables are connected directly out of the transport facility and brought to the installation site. When the cables are taken up, it is essential that they are not bent too much. The maximum bending radius must not fall short of 15x cable diameter.
- For cables delivered on reels:
  The cables are either directly unreeled or the reel is taken up by an unreel stand and the cable is unreeled subsequently. The bending radius must not fall short of 15x cable diameter here either.
- For cables delivered in cable rings:
  A turn table is used for uncoiling. For the uncoiling process, the cable is drawn from the turn table, at the same time the turn table is driven in circumferential direction. Pulling the cable off the turn table with a crane is possible, however, bending radii (larger than 15x cable diameter) must be strictly adhered to.

If cables are installed horizontally struts or spreader beams are to be used.

## Installation of cables

During installation the cables must not be dragged on the ground or over feather edges. In practice specifically developed reel stations have proved highly efficient for the movement of cables over even surfaces.

IMPORTANT NOTE!
Cables must not be twisted around their rotation axis when they are installed into the structure. Twisting around their longitudinal axis can considerably reduce the load bearing capacity of a cable.

## Tensioning of cables

Tensioning is carried out either directly via the cable or via the mounting parts on the terminals. If the cables are used directly for tensioning, specifically developed clamps will be used. Clamp forces are defined via the pre specified torque of the clamp botts. To avoid damage of individual wires of the cables, pre specified clamp forces must not be exceeded.

As a rule, documentation of the tensioning forces is required. Measurements are taken by a cable tension metre with a cable measure curve, which is drawn up during the final planning, or by a hydraulic tensioning device.

After tensioning the cables, the seizing wires, which prevent escaping of the wires, must strictly be removed.

Similar to technical monitoring and testing of the stability and safety of road bridges (DIN 1076), defined controls are also compulsory for civil engineering works. Extent, type and intervals are fixed on the basis of DIN 1076 and the specific requirements that the structure is subject to.

Routine controls of the building are recommended based on the following methods:

- Routine observation
  The structure – as far as it is accessible – is to be observed, without specific monitoring aids, paying attention to obvious deficiencies.
- Monitoring of the structure
  The structure is to be monitored, without aids such as monitoring vehicles or boom lifts, paying attention to obvious deficiencies.
- Inspection of the structure
  The structure is to be inspected by a competent engineer, who is in a position to assess static and constructive aspects of the structure. Inspection is also to be carried out in places which are difficult to access or inaccessible.

Construction elements that require special attention: i.e. pylon foot, pylon head, cable clamps, hanger cable clamps. (left to right).

Monitoring of the structure should be carried out yearly. Deviations as to specified form, position and geometry as well as damage of any kind are to be carefully monitored. Specifically in danger of being damaged are all connections in accessible areas, for instance cable connections close to access roads and by-passes.

A basic inspection of the structure is recommended every three years. Basic inspection replaces monitoring of the structure and performs more extensive tests at the structure. Access is to be gained to all areas and aids are to be used that allow an inspection of the whole load-bearing structure. This inspection of the load-bearing structure also examines cable-touching parts and the load-bearing structure for damage, deformations or incipient cracks.

Full inspection, which replaces basic inspection, is to be carried out every six years. It involves all examinations mandatory in basic inspection, as well as inspection of also the areas which are difficult to access using access aids such as boom lifts. Covered building parts (i.e. cable clamp) are to be opened. If necessary, individual components and building parts are to be carefully cleaned prior to inspection so that hidden damage can be detected, too. Depending on the condition the load-bearing structure is in, the responsible planner and/or a competent engineer can be consulted. After prolonged use of the structure, a supplementing non-destructive cable test of the inner layers of wires is recommended.

# MEINTENANCE



In addition to that, inspections become necessary at specific instances, i.e. if changes to the structure are to be assumed – especially after earthquakes, impacts of large objects, heavy storms, blizzards, breach of drainage lines and similar events.

In general well-trained and competent personnel, who command in-dept knowledge of the handling of cables and cable components, are to be em-ployed for the monitoring and inspection of structures. Findings as well as recognizable cause of damage are to be documented and entered into the structure file during all kinds of monitoring, inspection and routine observation.

We will be glad to draw up a maintenance concept which ensures the useful life of the load-bearing structure for many years – also in cooperation with your planning office.

Unreel stand for uncoiling cables in precipitous heights. Bending forces caused by the laying out of cables are not introduced into temporarily braced steel construction.

# ASSEMBLY INSTRUCTION FOR PRE-ASSEMBLED CABLE TENSION MEMBERS

CE 1771 ETA

ETA-11/0160



## Area of application:

These instructions apply to PFEIFER cable tension members made of stainless steel in compliance with European Technical Approva l ETA-11/0160.

## Other applicable techn. documents

- European Technical Approval ETA-11/0160
- PFEIFER Catalogue "Cable Structure" (section 3)
- DIN 1076 "Engineering construction work within the scope of roads and pathways"

## Supply and laying out of cable tension members

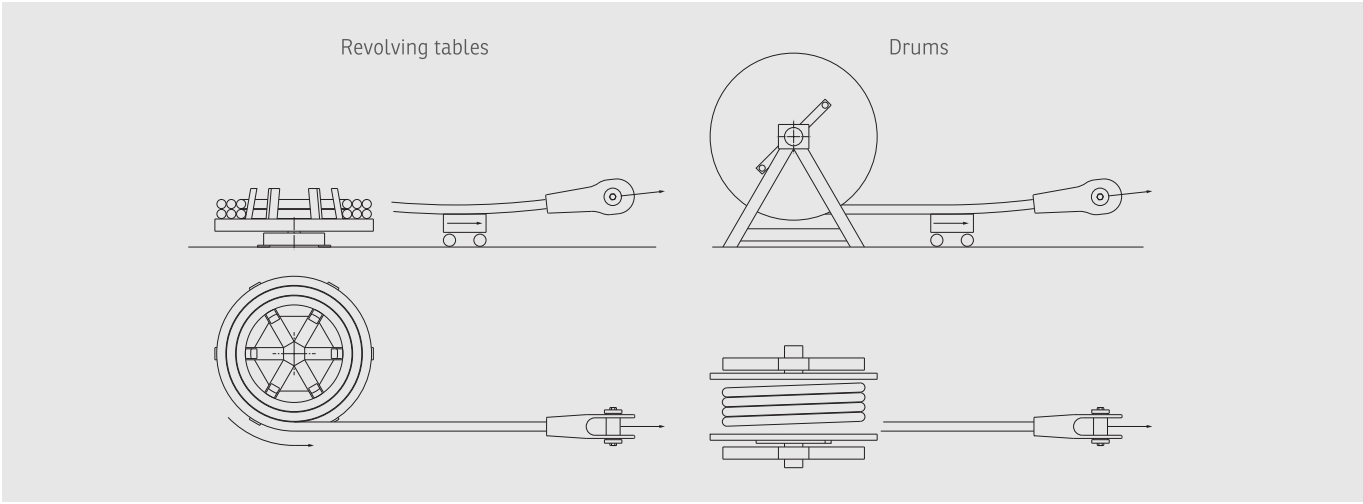
The cables has been stretched and marked under load in the manufactory. In this process cable creep and cone setting was considered. Therefore the cables will be "shorter" delivered on site. This can lead to a higher force during installation.

If no other agreements are made, 20°C was taken as a basis.

Cable tension members are generally supplied to the site on rings or coilers (Pfeifer Catalogue "Cablestructures", section 5).
Wound cables must be kept dry after delivery on site!
An appropriate revolving table has to be used for unwinding the rings and an appropriate winding frame for unwinding the coilers.
The revolving tables or drums should be fitted with a braking device.

The following points must be observed when unwinding the cable tension members:

- Cable tension members must not be twisted (observe surface line!)
- Cable tension members must not be pulled over sharp edges.
- Cable tension members must not be buckled (cable tension members must be supported accordingly). Bending radius must not be less than R = 15 x rope diameter.
- Corrosion protection must not be damaged.




## Removing packing materials

In order to avoid soiling, any provided packing materials on rope end fittings or applied clamps should only be removed just be fore installation.

## Checking before installation

All cable tension members must be checked thoroughly for any transport damage before installation.
Particular attention must be paid to the following points in this respect:

- Damage to corrosion protection
- Damage to thread
- Damage to rope wires

Damaged corrosion protection has to be repaired immediately.

Damages on galvanized surfaces have to be treated with zinc dust paint (the concerning areas have be to decreased before).
If necessary an existing additional coating can be repaired afterwards.

# ASSEMBLY INSTRUCTION FOR PRE-ASSEMBLED CABLE TENSION MEMBERS

CE 1771 ETA

ETA-11/0160



## Preparation for installation

Any thread on cable connections must be cleaned thoroughly and greased prior to installation.

Damaged or dirty threads must not be assembled because this could lead to the tension member unfit for use.

In order to avoid damages on the threads, turnbuckles (for example Typ 984, 985, 864 and partly 804) will be delivered in "completely screwed in" condition (shortest length). Prior to installation these turnbuckles have to be adjusted to the "built in" length (usual middle position) . The adjusting dimensions for the particular middle positions are shown in the respective catalogue sheets.

Note for cable tension members made of non-alloyed steel:

Any provided thread on hot-galvanised and spray-galvanised rope end fittings are generally untreated and only provided with temporary corrosion protection. For this reason, any such thread must be degreased immediately after installation and provided with lasting corrosion protection.

## Installation

Installation is generally carried out in compliance with an installation plan approved by a statics engineer / inspection engineer.

This plan must stipulate all important points for installation (e.g. installation process, order of installation, tensioning force).

Assignment to the correct installation position is to be ensured by marking all cable tension members.

Cable tension members must not be installed twisted. A surface line is generally marked on each cable tension members as a method of control. This line must not be twisted upon completion of elements.

Cable tension members are generally pulled into installation position using a suitable hoisting device (e.g. winch) or using a suitable lifting device (e.g. suspension bar, spreading bar). As described under no. 3, particular attention must be paid while doing so that there is no damage to the cable tension members. In particular, pay attention that the cable tension members is not buckled while lifting into place with suspension or spreading bars. In the case of heavy cable tension members, buckling of the cables at the suspension points can be prevented by using appropriate means; e.g. deflection saddles (deflection radius min. 15 x rope diameter).

Appropriate devices (hydraulic cylinders) must be used for the application of pre-tension force. Any provided thread may only be used for adjustments and not for the application of pre-tension forces.

Minimum screw-in depths of threads must be observed. The actual screw-in depths are to be recorded.

At screwed on nuts the minimum bolt overhangs according DIN 18800-7 / DIN EN 1090-2 have to be observed.

Threads on cable tension members must be secured against unwinding after adjustment (e.g. with locking nuts or gluing with bolt lock) unless otherwise specified. In particular bolts for security caps have to be glued. For bonding can suitable Loctite Threadlockers or similar products of other manufacturers to be used. It is essential that the processing instructions (pre-treatment of surfaces to be bonded) of the respective manufacturers are considered.

All seizing wires must be removed from the cable tension members after installation.

The seizing wires at the end of the ropes can stay in place during installation. They prevent individual wires from escaping from the rope binding if this is bent too much. The seizing wires must be removed after installation as otherwise it could have a negative effect on the corrosion protection.

Note for cables with inner filling:
Inner filling which is brought into the cables during stranding of the wires can escape to the surface when load has been hande d over to the cable.

Maximum inclination of the cable connecting plates:

The maximum inclination of the cable connecting plates (deflection angle to the cable axis) must not be more than 1°.

A "bird caging" (loosening of the outer wire layer) can appear on very short and unstressed cables with swaged end terminations. Normally the outer wire layer will be closed again after stressing of the cable. A small bird caging in the unstressed cable condition has no interference of the carrying capacity of the cable tension member.

## Supervision of rope operating equipment

Rope operating equipment must be kept under supervision and checked at regular intervals.

If no specific regulations exist for a construction, this supervision and inspection can be carried out in compliance with DIN 1076 "Engineering construction works within the scope of roads and pathways".

# ASSEMBLY INSTRUCTION FOR PRE-ASSEMBLED TENSION ROD SYSTEM TYPE 860

CE 1771 ETA

ETA-11/0160



## 1. Area of application

These instructions apply to PFEIFER-Tension Rod System made of non-alloyed steel in compliance with European Technical Approval ETA-04/0039.

## 2. Checking before installation

All tension rods must be checked thoroughly for any transport damage before installation.

Particular attention must be paid to the following points in this respect:

- Damage to corrosion protection
- Damage to thread
- Damage to components

Damaged corrosion protection has to be repaired immediately. Damages on galvanized surfaces have to be treated with zinc dust paint. If necessary an existing additional coating can be repaired afterwards.

## 3. Preparation for installation

Any thread on connections must be cleaned thoroughly and greased prior to installation.

Damaged or dirty threads must not be assembled because this could lead to the tension rods unfit for use.

## 4. Delivery and installation

The PFEIFER-Tension Rod System Type 860 is pre-assembled so as to facili-tate installation (see Fig. 1).

For installation the length of the tension rod system has to be adjusted to the system length by turning the Tension Rod and by aligning it such that the pin can be inserted without bending (see Fig. 2). Driving in the pin with a hammer is forbidden since it can cause damage to the fork connector!

The tension rod system is adjusted with a spanner. If used correctly, adjust-able spanners and screw wrenches (monkey wrenches) can also be practical. Special-design spanners are available on request. The locking nuts are then screwed back towards the Fork Connector until they are locked. A strap wrench can be used to tighten the locking nut so as to avoid damaging the surface (see Fig. 3).

In the scope of building supervision the minimal thread reach has to be checked for each fixing insert by appropriate measures.
Checks have to be documented and recorded by the responsible head of installation or chief erector. The minimal thread reach is achieved when the rod thread is completely covered by the locking nut. If threads with a special length are used, appropriate measures have to be taken to ensure that the minimal thread reach is achieved.

Fig. 1

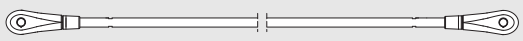


Fig. 2

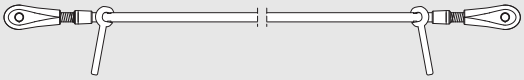
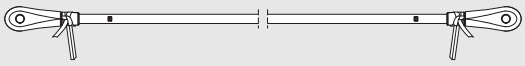


Fig. 3



If the galvanized surface is damaged during tightening, the damaged spots have to be repaired professionally so as to guarantee the necessary corrosion protection.

If the system length exceeds 10 m, the tension rod system has to be supported and stabilized with at least two round slings since otherwise the entire system is susceptible to buckling.

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