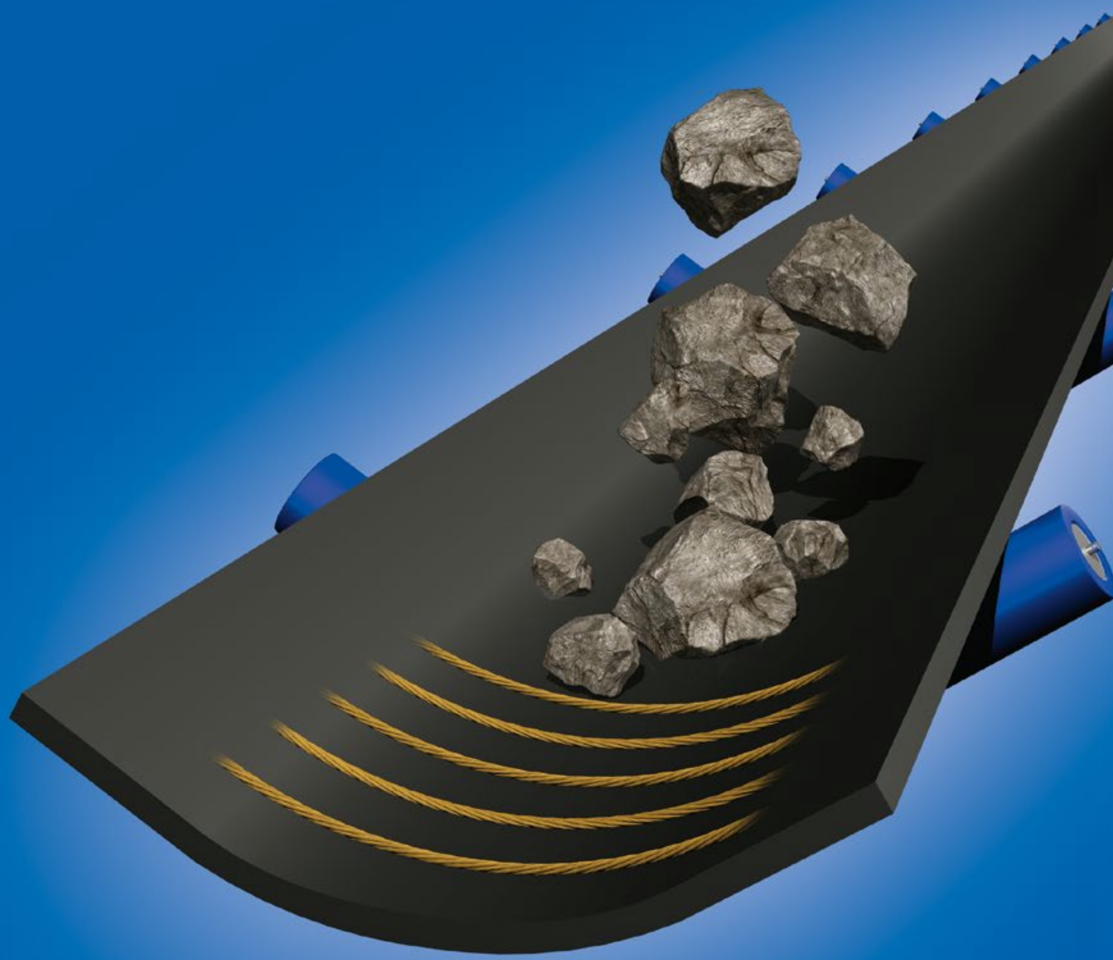
PHOENOTEC™

Active Conveyor Belt Protection System



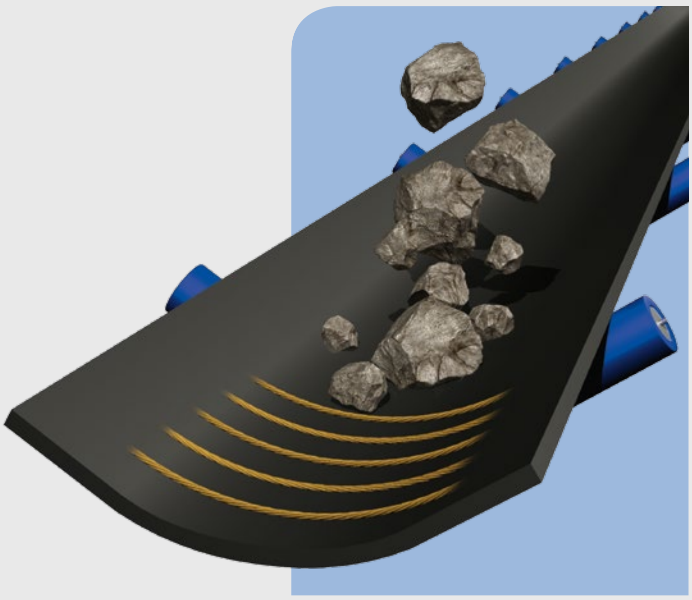
PHOENIX

Extreme Conveyor Belt Solutions

PHOENOTEC™

The variable protection system for steel cord and textile conveyor belts

The operational life of a conveyor belt is influenced to a large extent by the stresses caused by the impact of the conveyed material at the feeding or transfer point. Moreover, critical situations can occur by tramp material, frozen idlers, etc. which puncture or even rip the conveyor belt.
The aim of an effective reinforcement system is to substantially increase the reaction forces opposing the conveyed material as it drops on the belt.



The PHOENOTEC system was successfully introduced after many years of research. It has proven its outstanding performance in hundreds of applications.

The PHOENOTEC system consists of non-metallic special cords spaced at a certain interval and arranged at right angles to the belt length. These high-elongation cords consist of synthetic fibre. They are incorporated by a special process into either the top cover or the bottom cover or the top and bottom covers of the belt.

The PHOENOTEC protection system is tailor-made to suit the individual requirements. Different cord diameters and pitches for both top and bottom covers are available.

Advantages of PHOENOTEC

- **The number of injuries is dramatically reduced thanks to the buffer effect of the highly elastic high strength synthetic cords.**
- **The PHOENOTEC cords are not connected to each other preventing scalping of the covers in case of slitting.**
- **There are no special requirements on the conveyor system, for instance troughing angle or pulley diameters.**
- **PHOENOTEC increases the steel cord pull-out strength of the belt. This gives much higher safety and a longer life expectancy.**
- **The dynamic splice strength is increased substantially.**
- **The bearing stress between steel cord and high tension pulleys is more evenly distributed.**
- **PHOENOTEC synthetic cords are resistant to corrosion and rotting**
- **No distortion or twisting as a result of slitting.**
- **The belt edges do not pose a risk of injury to the operating personnel or to the conveyor in case of protruding wires.**

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The practical application

PHOENOTEC offers important practical advantages:

The system does not detract from the belt's flame resistant properties.

Since the synthetic cords have a high elongation, the belt troughability with PHOENOTEC reinforcement is hardly less than of a non-reinforced belt – in contrary to steel reinforced conveyor belts.

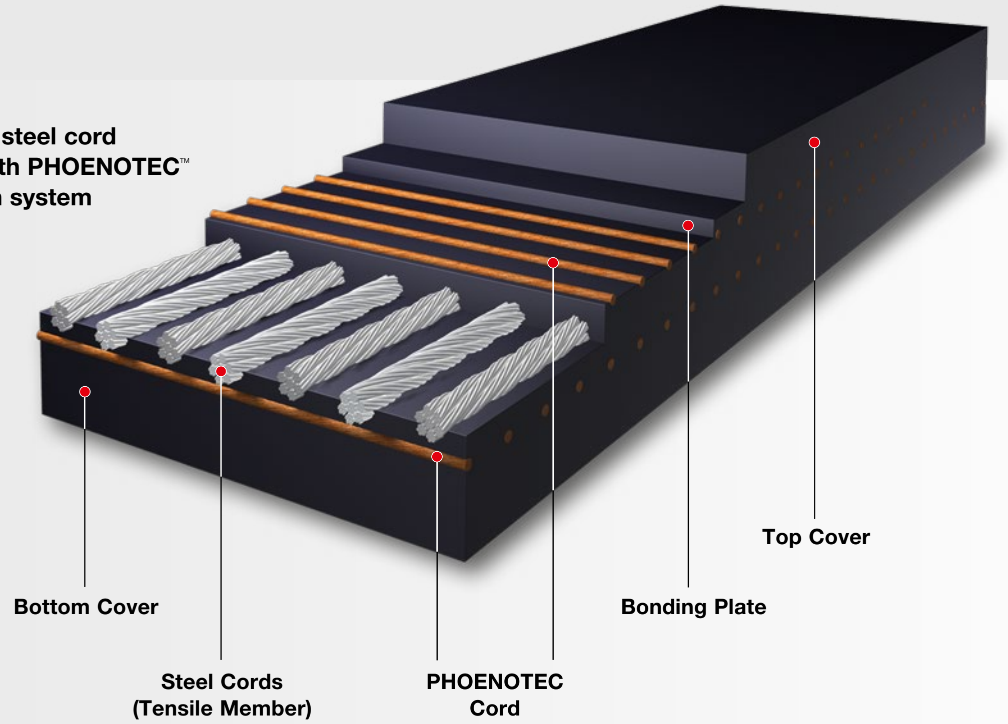
PHOENOTEC reinforced conveyor belts place no extra demands on the pulley diameter. The tracking of the belt is not affected by PHOENOTEC.

As practical experience has shown, steel cord conveyor belts with steel reinforcement can be so distorted or even twisted as a result of slitting that they cannot be repaired. Such an effect cannot occur with PHOENOTEC reinforced belts.

If the edges of the belt become damaged, PHOENOTEC does not pose a risk of injury to the operating personnel or to the conveyor – something which can easily occur in the case of protruding wires from steel reinforcement.

In the event of local belt injury, PHOENOTEC reinforced belts can be repaired in situ without difficulty by hot or cold vulcanizing.

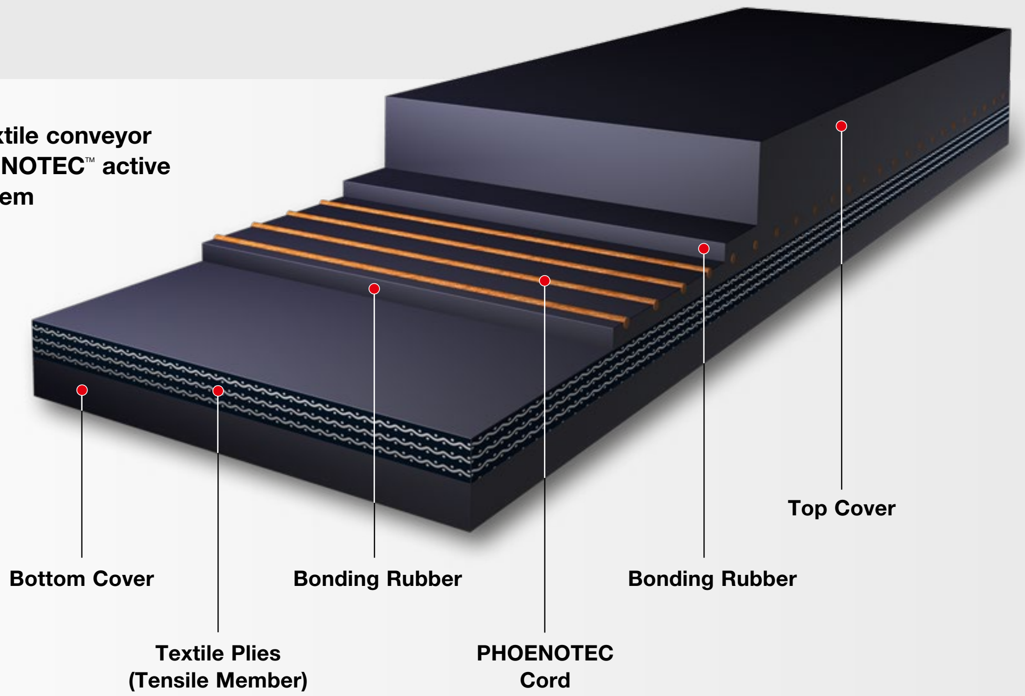
PHOENOCORD™ steel cord conveyor belt with PHOENOTEC™ active protection system



PHOENOTEC can be easily integrated in any belt splice. The splicing procedure is the same as without PHOENOTEC.

The PHOENOTEC reinforcement should also be used with conveyor belts having textile tension carriers, for example, in conjunction with bucket-wheel equipment and stackers, under crushers; generally, in fact, where belts are subject to continuous heavy impact. This includes the transport of coarse material for screening, such as basalt, building and mining waste, broken glass, ore, fluorspar, barytes, steel mill and foundry waste, limestone, and magnesite.

POLYFLEX™ textile conveyor belt with PHOENOTEC™ active protection system



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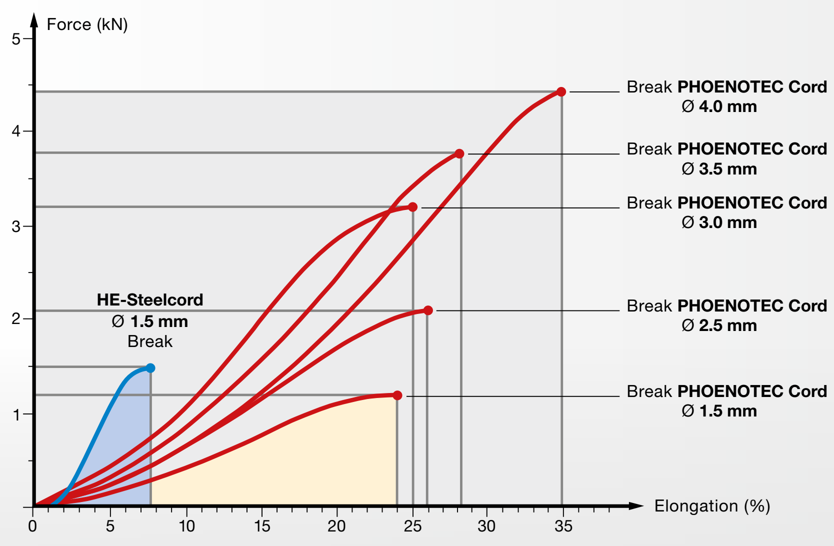
The protection system

If a high-elongation steel cord of about 1.5 mm diameter and a PHOENOTEC cord of about 1.5 mm diameter are loaded in the longitudinal direction of the cord until they break, comparison of the force/elongation behaviour gives the following result:

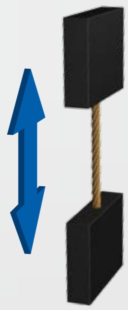
Whereas both cords are similar with respect to the breaking load, there is a substantial difference in the elongation at break, with the synthetic cord having more than three times the elongation of the steel cord. The area under the force/elongation curve, the so-called tensile effort as per DIN 53815, of the much more stretchable synthetic cord is several times that of the less stretchable steel cord. This demonstrates that PHOENOTEC cords absorb much more energy than steel cords. The relations are similar in the case of synthetic cords of other diameters.

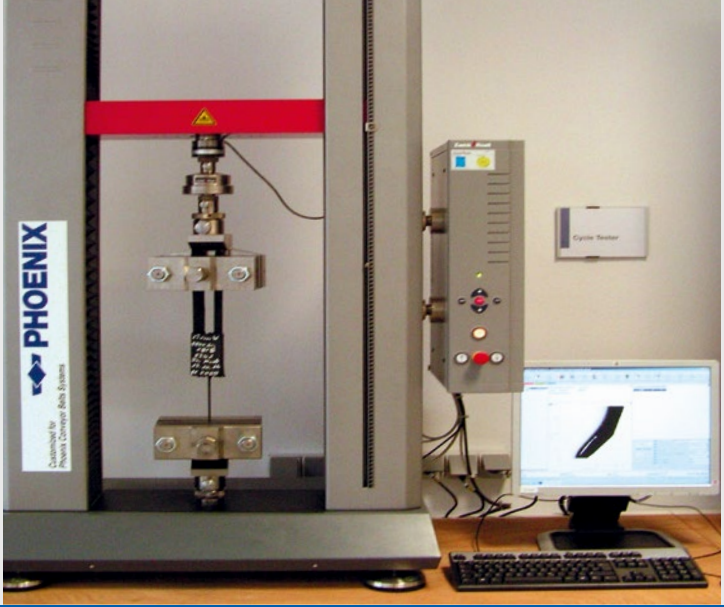
If single cords of steel and synthetic material are vulcanized into rubbber sheets and loaded to destruction vertically to their longitudinal axis, similar results are obtained in respect of the force/elongation behaviour and the associated fracture energies.

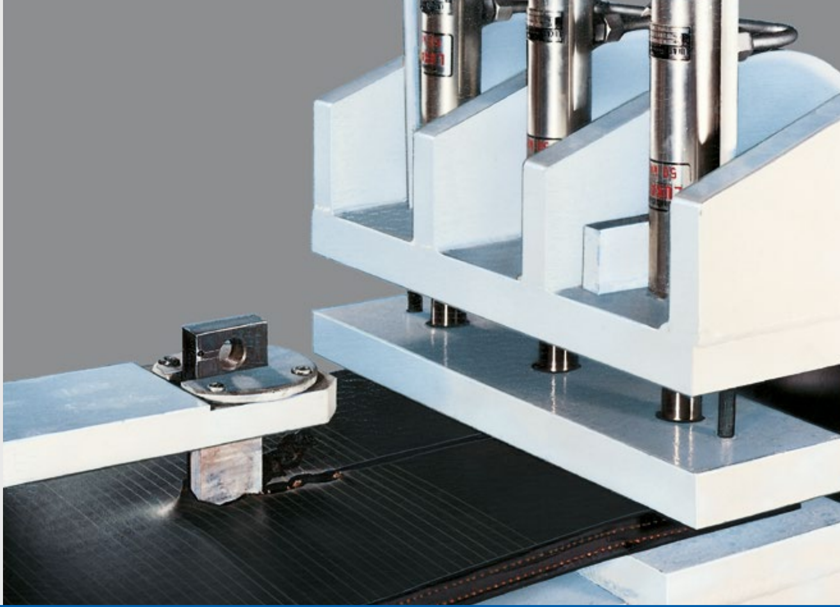
If several cords are loaded to destruction vertically to their longitudinal axis, in case of synthetic cords, a stronger cumulative effect was apparent such that the load peaks for the individual cord fractures lay substantially above the breaking load values for the individual cords. Since also the force reduction after the individual cord fracture is inferior relative to the maximum force than is the case with steel cords, the result is inevitably higher fracture energy for the destruction of the whole package.

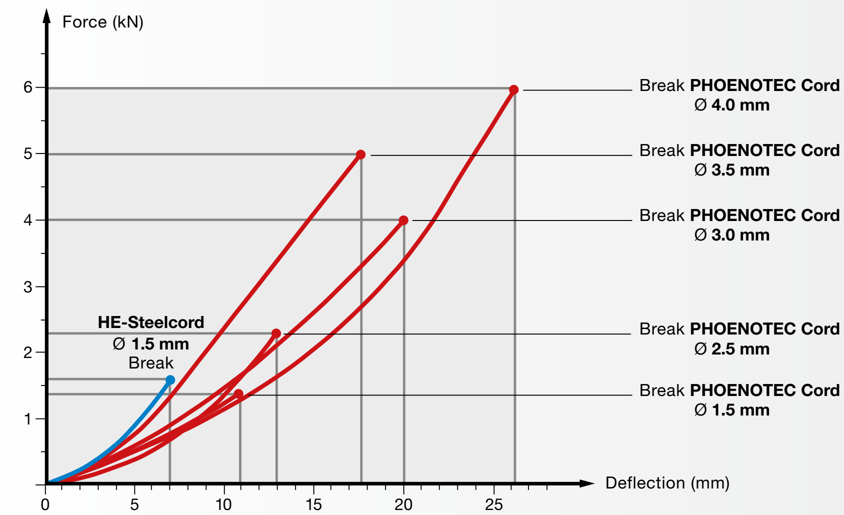


Force/elongation behaviour of different PHOENOTEC cords and of a high steel cord, loaded in axial direction

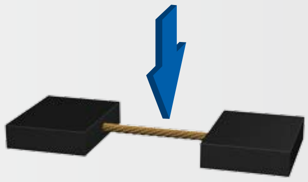


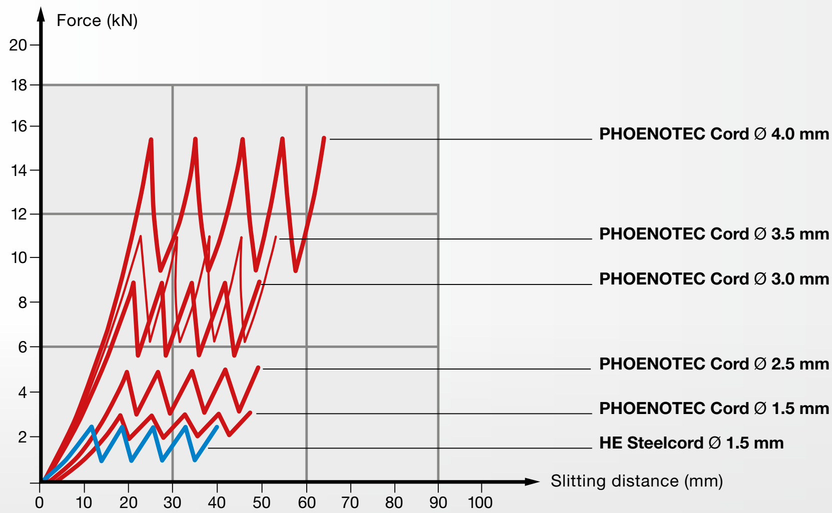




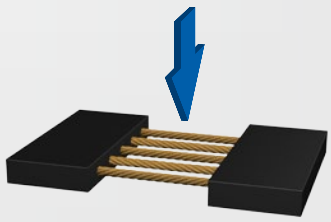


Force/elongation behaviour of different PHOENOTEC cords and of a high elongation (HE) steel cord, embedded in rubber and loaded at right angles to their longitudinal axis





Force/elongation PHOENOTEC cords and of HE steel cord assemblies, embedded at right angles to their longitudinal axis



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Ongoing success story...

... with the downhill conveyor belt at the El Abra mine in Chile. The overland conveyor system at the El Abra mine first went into operation in June 1996. It is part of an exceptional project, the centerpiece of which is the CV-103 system. This incorporates a PHOENOCORD St 6800 steel cord conveyor belt measuring 20,000 m in length and 1,600 mm in width. After 19 years of continuous service and 900 Mt of conveyed copper ore, the belt was finally replaced. Its exceptional service life was made possible not least by the PHOENOTEC protection system and the especially wear and abrasion resistant carrying and running side covers of the belt.

The covers of the belt's carrying and running sides were equipped with the special PHOENOTEC synthetic single-cord transverse reinforcement – an additional wear protection system that doubles the belt's resistance to impact damage and ripping.

Physical Data Comparison of PHOENOCORD St 6800 (indices)

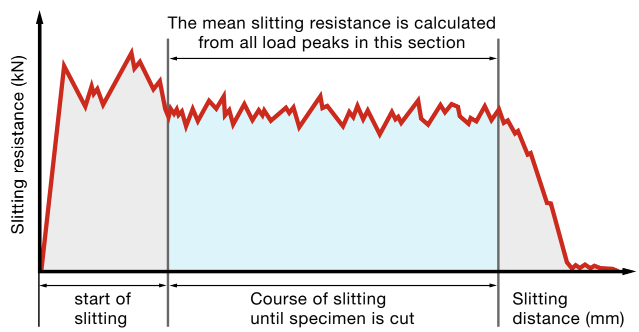
Parameter	Target / Standard	Supplied 20 years ago	After 19 years of operation
Abrasion resistance	100	142	129
Tensile strength	100	108	106
Elongation at break	100	131	107
Tear resistance	100	145	143
Cord pull-out strength	100	123	106

The slitting resistance

PHOENIX developed a test rig which works at close-to-practice speeds of several meters per second. The principle of the test is that, by using a piece of conveyor belt measuring 400 x 700 mm and clamped at one end, a slitting tool is pulled in the direction of the tensile member. The slitting resistance resulting over the slitting distance is measured and registered.

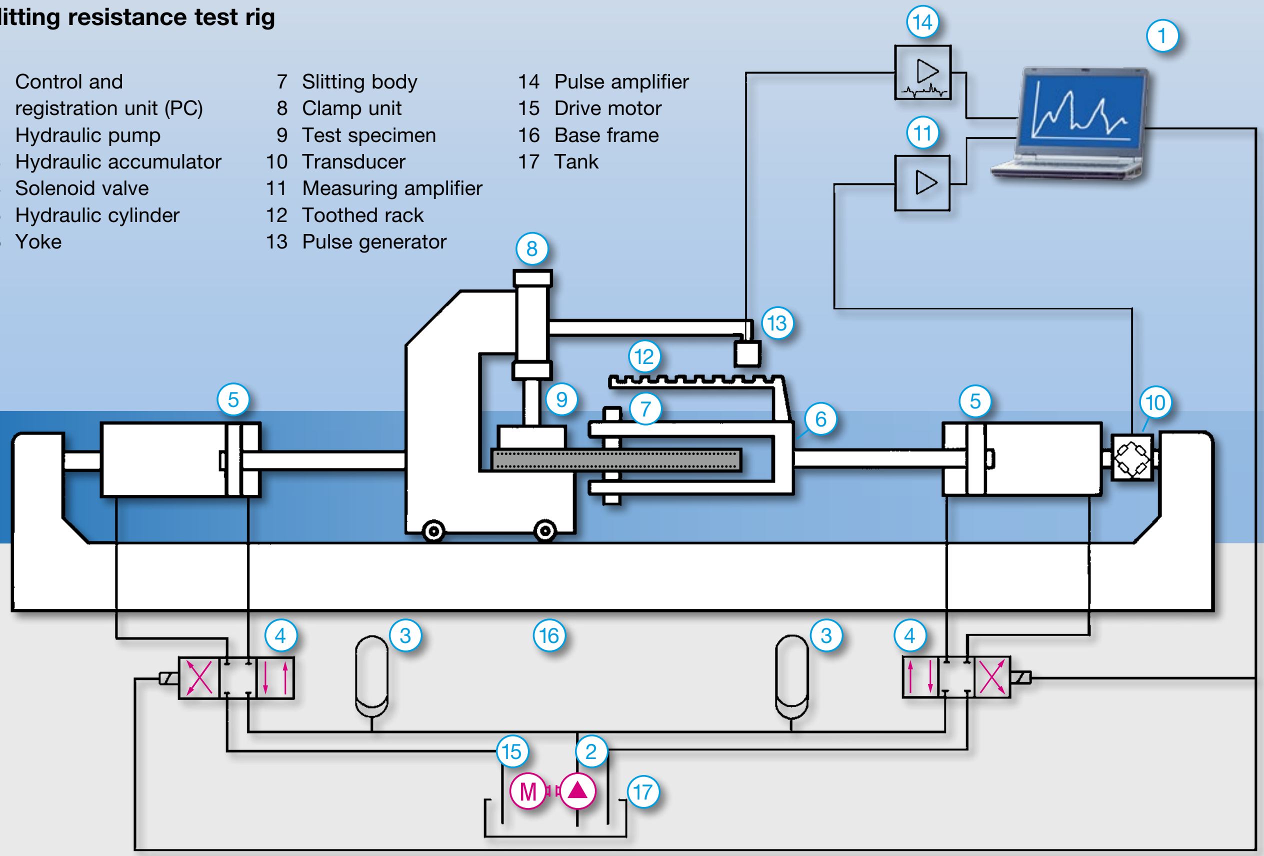
The test:
When a start command is given by the PC (1), the hydraulic pump (2) starts to run, and the hydraulic accumulators (3) become charged. After a preselected charging time has elapsed, the solenoid valves (4) change over. The accumulators discharge its contents to cylinders (5). Actuated by piston rods and yoke (6), slitting unit (7) and clamp unit (8) with test piece is drawn through the test specimen (9). The slitting resistance over the slitting distance is measured by means of transducer (10) and measuring amplifier (11) and recorded by the control and registration unit.

Determining the mean slitting resistance



Arrangement of PHOENIX slitting resistance test rig

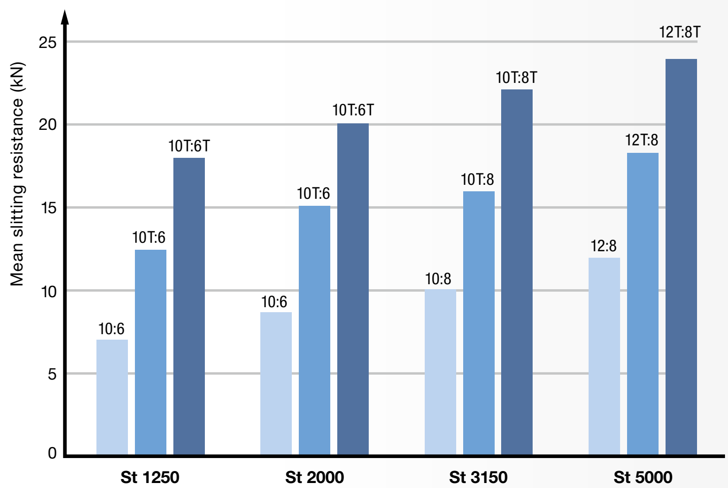
1 Control and registration unit (PC)
2 Hydraulic pump
3 Hydraulic accumulator
4 Solenoid valve
5 Hydraulic cylinder
6 Yoke
7 Slitting body
8 Clamp unit
9 Test specimen
10 Transducer
11 Measuring amplifier
12 Toothed rack
13 Pulse generator
14 Pulse amplifier
15 Drive motor
16 Base frame
17 Tank



During the slitting operation, with the aid of an electrodynamic pulse generator (13), the toothed rack (12) produces a pulse sequence which depends on the tooth pitch and the slitting speed and which is recorded with the aid of pulse amplifier (14) and registration unit. The slitting speed can be easily calculated by the PC and registered for each individual test.

At least three specimens are used to determine the slitting resistance. The load peaks are counted for each individual test and the arithmetical mean (mean slitting resistance) is calculated.

Also the quality of the bond between the belt components is evidenced in such a case of massive damage. For each type of belt, the test procedure described here provides proof of the effectiveness of additional reinforcement in top and bottom covers. Every customer is welcome to attend performance testing of „his“ conveyor belts.



Effect of double PHOENOTEC with different types of PHOENOCORD conveyor belts. Slitting speed: 2.5 m/s

- **No PHOENOTEC**
- **Top side PHOENOTEC**
- **Double PHOENOTEC**

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The impact resistance

The principle of the test is that a drop weight with impact body falls on a tensioned belt specimen. From the time sequence of the reaction and tension forces during impact, the impact energy can be determined under which the first belt damages occur.

The test:

A conveyor belt specimen (1) measuring 400 x 700 mm is held by clamping cylinders (2) and tensioned by tensioning cylinder (3). The tension force, the magnitude of which depends on the minimum belt breaking load, is measured during the test with the aid of transducer (4) and measuring amplifier (5).
Tripping of electromagnet (8) by trigger, (9) causes drop weight (6) and its impact head (7) to fall at a predetermined point on the test specimen. In the case of a steel cord conveyor belt the point of impact lies between two cords.

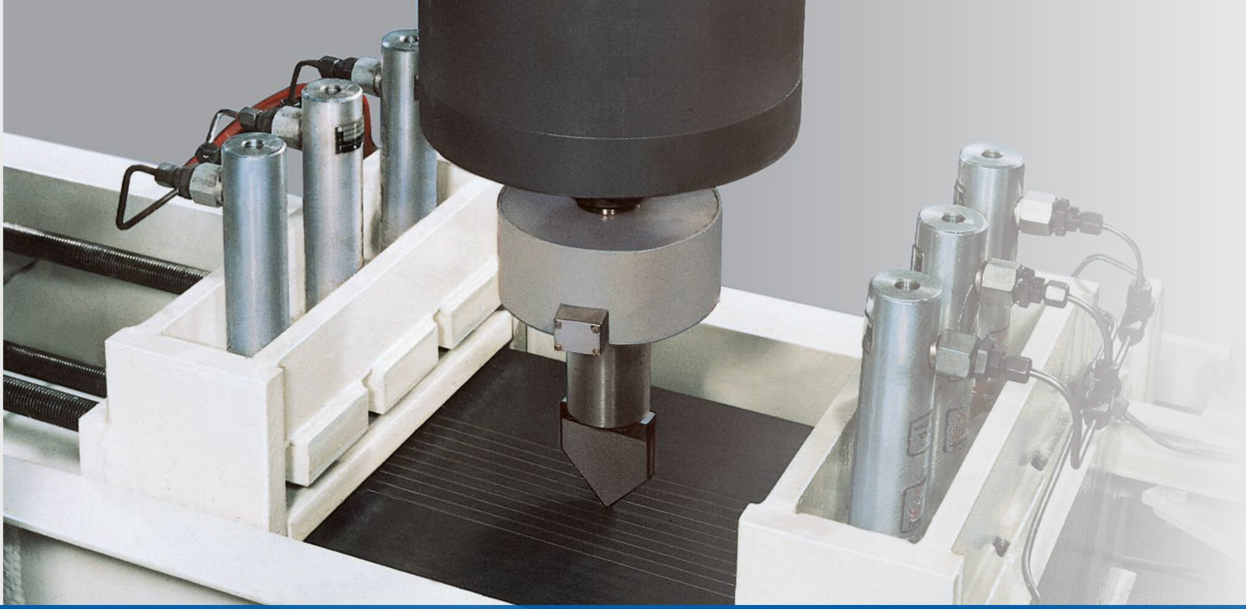
The time sequence of the impact force (reaction force) is ascertained by means of force transducer (10) and measuring amplifier (11). Reaction and tension forces are recorded by the registration device (PC) (12) which starts to run at the same time as the electromagnet is tripped.

To determine the impact energy that causes the first belt damages, the most exact method is measurement of the impact force when the impact head impinges on the conveyor belt specimen. A new specimen is used each time for different drop energies and the time sequence of the impact force during the test is measured.

While drop energies are small, such that no damage to the belt can be caused, the force/time curve is continuous. As the drop energy increases, the curve is at first relatively steady, but then sudden jumps and irregularities appear. Such irregularities are a sign that belt damage has occured during impact. With increasing drop energy, the belt tension, which is recorded in parallel with the reaction force, shows a corresponding sequence.

For the systematic determination of the impact energy under which the first belt damage occurs, the maximum values of the impact force found for the individual specimens can be plotted over the relevant impact energies. This shows that the reaction forces at first rise steeply with increasing drop energy, but then increase only slightly after the peak point (the first damage) has been passed. This pronounced change in the course of the curve shows that there has been a change in the belt's properties.

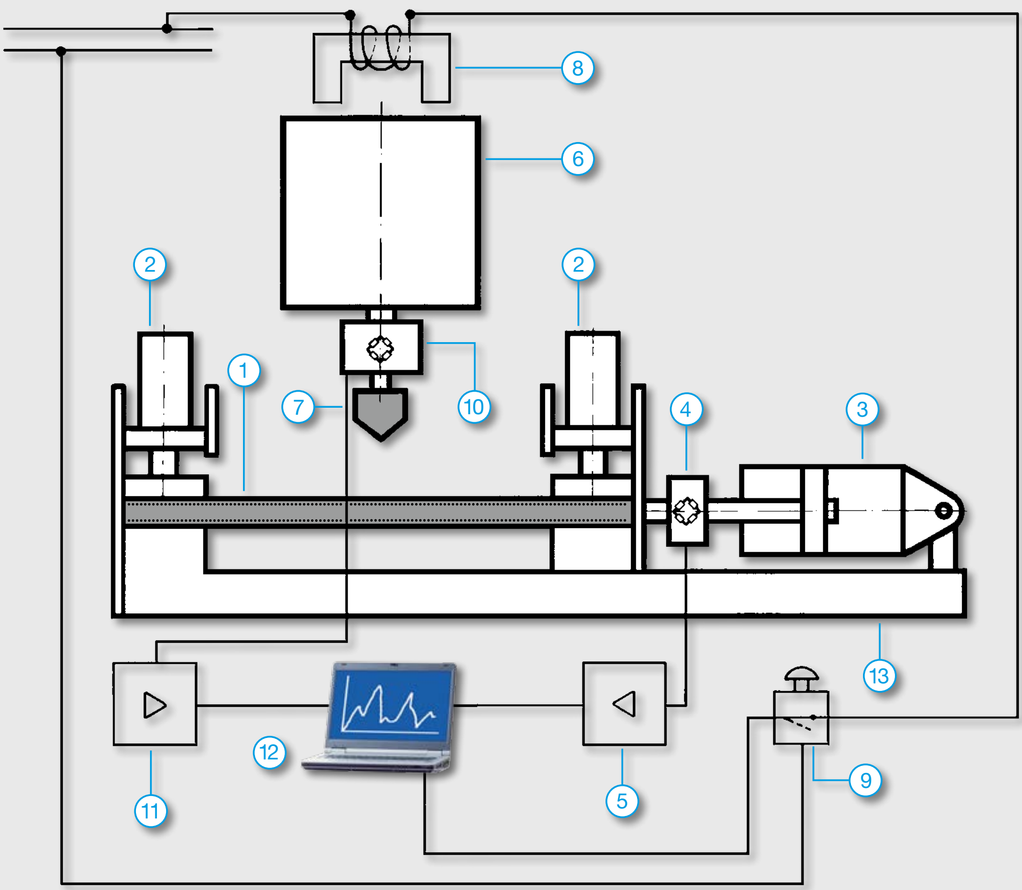
This test procedure allows proof of the effectiveness of additional reinforcement for any type of belt.



Detailed view of impact resistance test rig

Arrangement of impact-resistance test rig

1 Belt specimen
2 Clamping cylinder
3 Tensioning cylinder
4 Force transducer
5 Measuring amplifier
6 Drop weight
7 Impact body
8 Electromagnet
9 Trigger
10 Force transducer
11 Measuring amplifier
12 Registration device (PC)
13 Base frame



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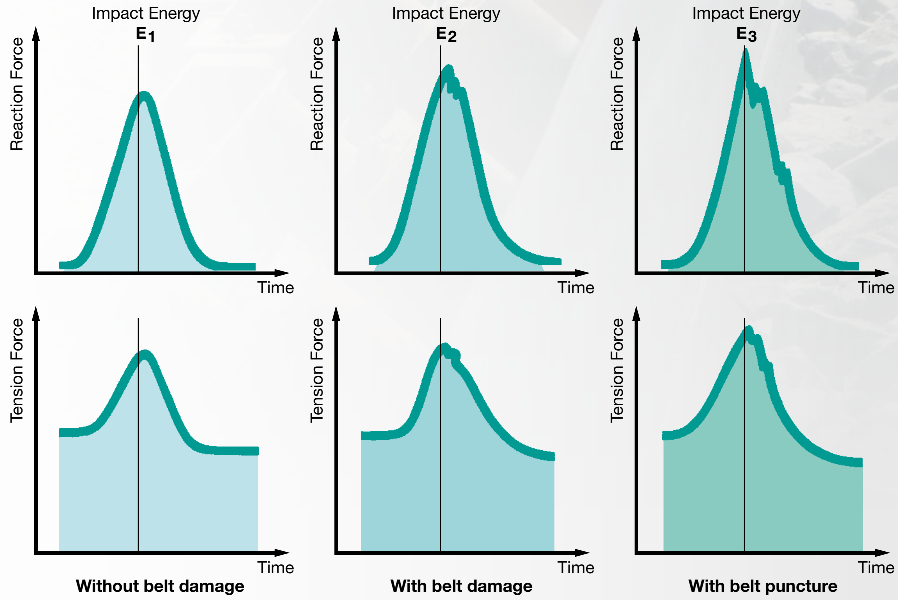
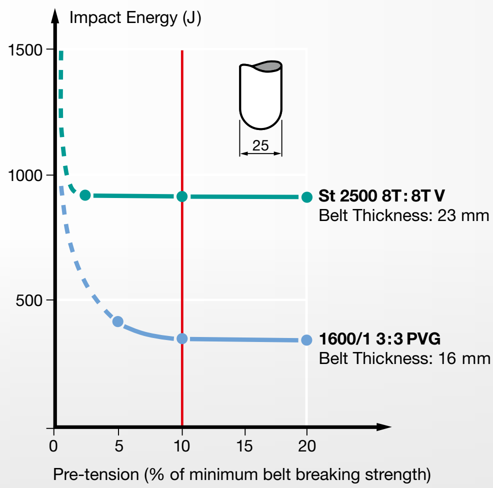
Reaction and tension forces during the impact test

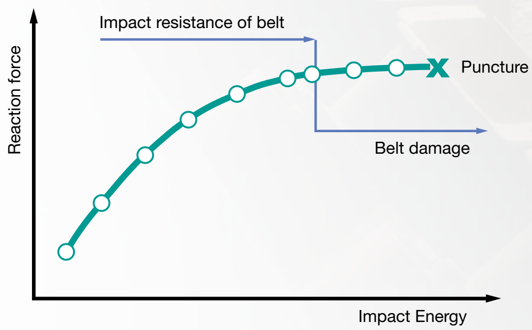
Graphs showing the reaction and tension forces during the impact-resistance test $E_1 < E_2 < E_3$



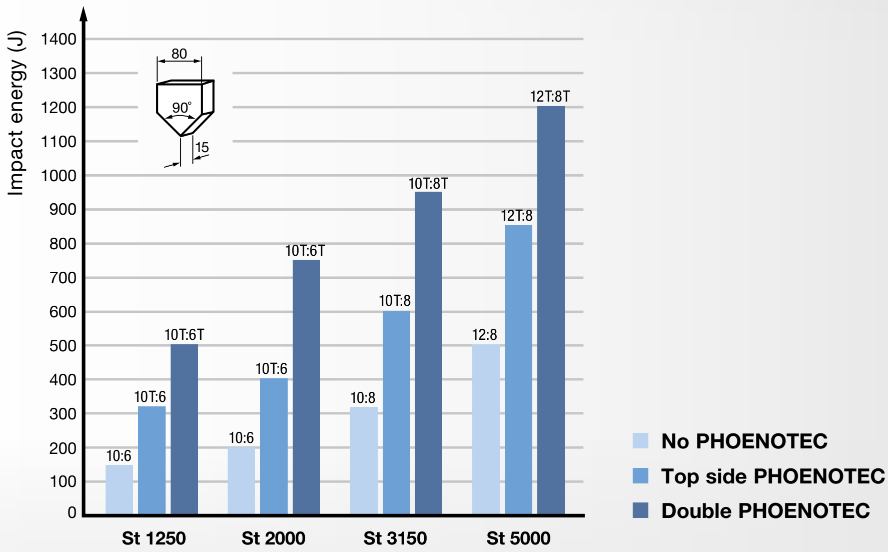
Impact resistance in dependence on pretension (% of minimum belt breaking strength)



Impact resistance:
Ascertaining the critical impact energy.



Impact resistance:
Effect of various types of steel-cord belt with reinforcement in top cover and in top and bottom covers.



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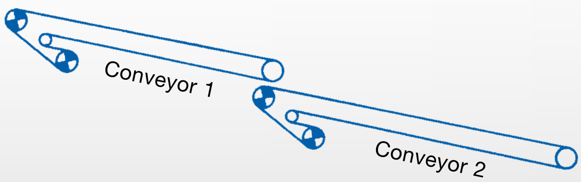
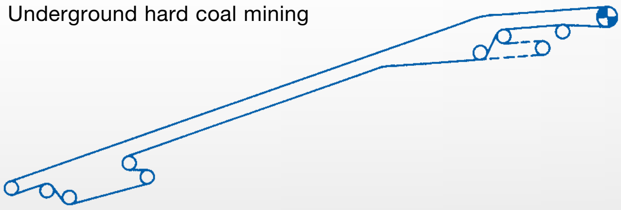
Typical applications of conveyor belts with additional synthetic cord reinforcement

1800 St 7800 19T : 10X
Overland conveyor copper mine



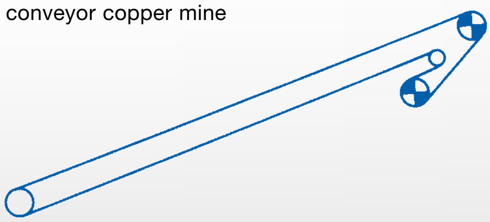
		Conveyor 1	Conveyor 2
Centre-to-centre	m	5905	5281
Lift	m	-536	-527
Belt speed	m/s	6.0	6.0
Conveying capacity	t/h	8700	8700
Drive power	kW	4 x 2500	4 x 2500

1400 St 7500 10T : 12T V
Underground hard coal mining



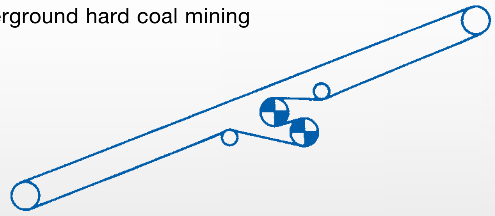
Centre-to-centre	m	3745
Lift	m	783
Belt speed	m/s	6.0
Conveying capacity	t/h	3500
Drive power	kW	2 x 3100

1600 St 6800 14T : 10TX
Overland conveyor copper mine



Centre-to-centre	m	9608
Lift	m	-495
Belt speed	m/s	6.1
Conveying capacity	t/h	8700
Drive power	kW	4 x 1800

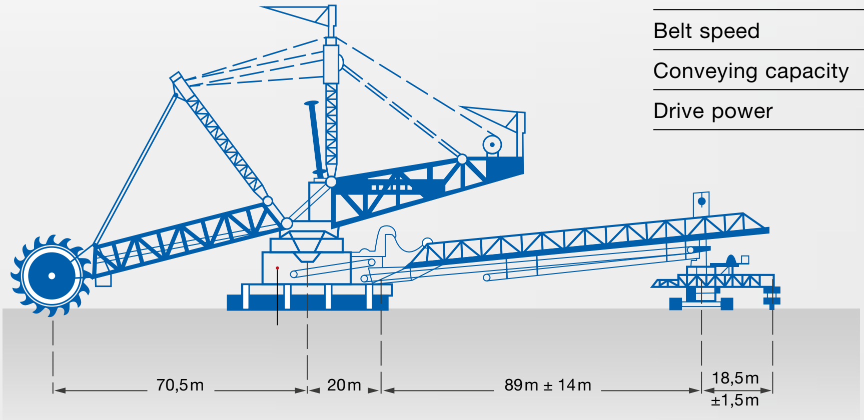
1400 St 5400 12T : 8T V
Underground hard coal mining



Centre-to-centre	m	1310
Lift	m	285
Belt speed	m/s	2.5
Conveying capacity	t/h	1700
Drive power	kW	4 x 560

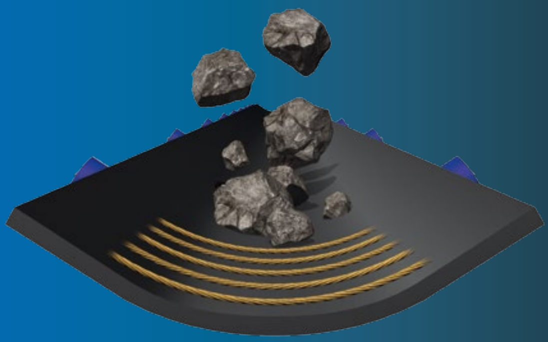
Personnel transport (top and bottom run)

3200 St 4500 25T : 8T V
Bucket wheel excavator



Centre-to-centre	m	6
Lift	m	4
Belt speed	m/s	6
Conveying capacity	t/h	up to 40,000
Drive power	kW	2000

Symbols: **X** abrasion resistant **T** PHOENOTEC active protection system **V** self extinguishing



PHOENOTEC is a highly effective active protection system for conveyor belts. For additional safety, components of the electronic PHOENOCARE system for rip detection and contactless data transfer are recommended. Please contact us for assistance.

Phoenix Conveyor Belt Systems has the most modern testing centre worldwide for developing conveyor belts. Extensive quality tests ensure the technological lead of Phoenix conveyor belts.

Phoenix production locations meet the ISO 9001 quality standard. The certification according to ISO 9001 comprises quality assurance during development, production, assembly and distribution. It therefore completely covers all of the areas which lead to higher standards of products and services. Phoenix Conveyor Belt Systems GmbH fabricates according to all the nationally relevant quality standards like DIN, SANS, MSHA, RMA, BS, AS, CSA, etc.

PH 8188 EN 02.17 (Mdw)

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