

## MECHANICAL TESTS OF THE STEEL WIRE ROPES AND STEEL WIRES

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In the article we are dealing with the problems of the steel wires and steel wire ropes testing, which are very often used today, and at the same time some negatives of the standards valid for steel wire rope testing are mentioned. In the article are mentioned also the drawbacks of new European standards which are implemented to the system of Slovak technical standards. From the rope quality assessment point of view the lifting capacity of the rope as a whole is important. In the article is briefly presented new shredder machine, with the maximum shredding force of 2500 kN. The steel wire ropes with 63 mm in diameter and maximum length of 6 m can be tested using this machine.

**Key words:** *test of wire, test of the steel wire rope, bending test of wire, test machine*

**Mehanička ispitivanja čeličnih užadi i čeličnih žica.** U članku se raspravlja o problematici ispitivanja čeličnih žica i užadi koja se danas vrlo često koriste, a istovremeno se spominju i negativne karakteristike normi važećih za testiranje čeličnog užeta. U članku su spomenuti i nedostaci novih evropskih standarda koji se uvode u sistem slovačkih tehničkih normi. Sa stajališta procjene kakvoće užeta, važan je kapacitet dizanja u cjelini. U članku je kratko prikazana nova kidalica s maksimalnom snagom kidanja od 2500 kN. Na tom stroju se mogu ispitati čelična užad promjera 63 mm i maksimalne dužine 6 m.

**Ključne riječi:** *ispitivanje žice, ispitivanje čeličnog užeta, ispitivanje žice savijanjem, ispitni stroj*

### INTRODUCTION

Norms stating quality parameters present a follow up to the norms containing methodical procedure of tests, and they specify exactly measuring devices and their equipment, environment, personal qualification for a quality and failsafe performance of individual tests. Quality result of ropes and wires tests is ensured by a quality manual, which presents a control document of accredited test laboratories [1]. Accredited test laboratories, besides quality test performance, guaranty impartiality and confidentiality for a customer, to which they are bound by the harmonized norm STN EN ISO 17 025. The steel ropes and wires test can be conducted on individual wires or on the whole [2 - 6]. Before making a rope by spinning individual wires producer carries out following:

- checking of diameters of individual wires,
- load carrying capacity test, (strength of individual wires),
- test of number of alternating bendings of individual wires,

- test of number of twisting of individual wires,
- test of amount of zinc coating on individual wires.

Wires are most frequently tested according to DIN 2078 or DIN 3051, or DIN 3078.

At present wires are tested according to harmonized standards of the series STN EN 10264, but in Slovakia also according to appropriate non-harmonized STN.

At present in Slovakia there are the first four parts of the STN EN 10264 standard proclaimed by SÚTN, which partially replaces above-mentioned standards. SÚTN has been preparing in years 2003 to 2004 the approval of a further standard (norm) (12 385), which will also be binding for steel rope test. These tests are carried out as control tests during work of a rope in authorized and accredited test floors [7 - 10].

### TOTAL ROPE TEST

Total rope tests are carried out in manufacturer facilities in order to proclaim accordance, and in an independent test floor for the need of a rope certification. In this test both

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mechanical - elastic properties of a rope and its design and correct lubrication of rope manifest themselves. Recently this test has been required quite often by rope users and in the norms of the 12 385 series has been mentioned as the procedure number one. The test has been carried out on various test tear off presses. Tear off presses must fulfill the requirements of the Act N0. 142/00 Coll. of L. and Regulation N0.210/00 on Metrology. In our accredited steel rope test lab a new tear off machine KREPET – BME/SKTC147 has been in operation, whose maximum tearing power is 2500 kN. The basic design of this machine is illustrated in Figure 1. The test sample of a rope is fixed in jaws of the machine by means of pouring the ends of the sample with



Figure 1. **Bearing structure of the tear off machine KREPET-BME 2500/SKTC147**  
Slika 1. **Izvlačna konstrukcija stroja KREPET-BME 2500/SKTC 147**

liquid metal in taper endings. At present the Slovak branch standard, determining technological procedure of pouring endings, is not valid. In pouring the endings the procedure is frequently carried out by former or current ČSN, which makes it possible to pour the sample endings by resin (bitumen) in a taper ending. The test is ended by tearing off one strand of the rope. In tearing off the power is recorded which is then given as real load bearing capacity of a rope. The real load carrying capacity of a rope characterizes its real

quality. On tear off machines it is possible to test also clamping devices produced from steel ropes, chains, etc. and then to assess their quality as a whole.

### KNOWLEDGE GAINED IN DESTRUCTIVE TESTS OF STEEL ROPES

By means of destructive tests of ropes and wires a manufacturer or a test floor can proclaim that a rope has been manufactured in desired quality as required by a relevant standard according to which tests have been conducted.

From deficiencies found in tests [7], in our test floor we consider the weightiest discord of STN 02 4301 with STN 42 0421 for conducting test by alternating bending. STN 42 0421 includes requirements similarly as DIN and ISO standards, but STN 02 4301 does not include these requirements.

The diameter of the bending roll stated by the standard STN 02 4301 for an interval of wires diameter is different than the one stated by the standard STN 42 0421.

A very serious deficiency of all standards (norms), e.g. also international standards is the fact that the test by twisting and alternating bending provide only minimum limit of number of twists and bends which individual wires have to sustain. Based on our experiences we suggest amending the numbers of twists and bends for the upper limit, which should not be overcome by the wire after passing the test with that number of twists and bends. The previous assertion results from the experience, which we gained with the test of rope of the tow H 130 at which all tested parameters complied with the relevant STN but the numbers of twists and bends reached up to the double amount of that stated by the norm.

By more detailed examination it was found that though the rope complied with STN 4301, on the wires there were visible pressings caused by the carrier, which pointed out at soft surface of the wires [5]. By metallographic and fractographic tests it was proved that the wires, especially their surface, were decarburated which caused enormous prolongation of the rope, diminishing its diameter and cross section under the permitted limit and in the end its quick impairment. Even though this given example is rare (unique) it would be advisable that our standards considered also these cases.

### CONCLUSION

Based on our experiences it can be stated that destructive tests of wires and ropes confirm the validity of conclusions given in literature, that the smallest the interval of scattering of mechanical-elastic properties of its wires, especially load bearing capacity, the higher the quality of

the rope. Recommended scattering is  $\pm 5\%$  from the medium measured load bearing capacity of wires [1]. The fulfillment of this requirement guaranties even loading of individual wires of a rope in cross section and influences the prolongation of service life of a steel rope.

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