Explanations with recommendations on the use of F-full and S-full steel ropes are put forward for when in operation, wire ropes are subjected to: tensile stress, bending stress, pressure, abrasion and torsional stress.

Tensile stresses on ropes occur when a load is suspended, no matter whether the ropes operate over sheaves and thus are moving, or whether they are used as a support in ropeways, bridges, or for anchoring purposes. The load on the rope and the rope tension may be calculated for choosing the right rope. Pulsating tensile stresses occur with stationary and also with running ropes on account of differences in the longitudinal tensile forces. They can become dangerous and may be prevented by the use of a thicker rope.

Bending stresses occur with all ropes operating over sheaves and subjected to bending. A difference is made between a) the reverse bending performed in one direction and b) the reverse bending performed in opposite directions in S-form over at least two sheaves. In the case of a normal reverse bending according to a), the rope travels from the straight into the curved and returns into the straight direction. In the case of a reverse bending b), the rope operates during one working cycle, like two reverse bendings according to a), and in opposite directions. Therefore, the arrangement of sheaves should be such as to avoid reverse bendings, since otherwise the service life of the rope will be seriously reduced.

The pressures occurring between the rope and the rope sheave, as well as pressures between the component parts of the rope, are very disadvantageous for the performance of the rope. They are known as 'Hertz pressures', and may be computed to a certain degree. These pressures have an injurious effect on service life. The results of pressures are abrasion and fatigue of the wires. Moreover, abrasion of the wire is caused by friction. In this connection, mention should also be made of the temperatures due to friction. If the wire surface is heated beyond the Ac3-point (iron-carbon diagram), the formation of martensite occurs resulting in immediate wire breakage.

In certain cases wire ropes are subjected to torsion. There are cases where, during one working cycle, the rope is untwisted and twisted back, and there are cases where it constantly rotates in one direction, around its own axis. Always additional torsional stress on the stranded wires results in a temporary or permanent slackening and lengthening of the rope structure.

In most cases, the machine builder can prevent torsions of the rope by rope guidance and arrangement of drum and sheaves. There are, however, machines which, to a certain extent, always cause the ropes to untwist and twist back when in operation. Such a constant untwisting and twisting back of the rope can only be prevented by choosing a rope construction being insensitive to rotation. The F-full steel ropes and S-full steel ropes cannot be considered as non-rotating constructions. On account of their compact structure, both special ropes are, however, less sensitive to reciprocating torsional stresses.

Pressures between the component parts of the rope can be reduced by adequate rope constructions. For instance, by using F-full and S-full steel ropes a minimum of pressure within the ropes is achieved due to the linear contact between the component parts of the ropes. In order to reduce the pressures between the rope and the rope sheave, the machine builder has to see to it that the rope sheave has a sufficiently large diameter. Moreover, the sheave groove must be exactly dimensioned for the rope diameter to fit in. The radius of the sheave groove has to be: \( r = 0.53 \times d \) where \( r \) = radius of the sheave groove in mm, \( d \) = rope diameter in mm.

F-full steel ropes and S-full steel ropes are so precisely dimensioned that the normal variations in rope diameter, as are usual with other ropes, does not occur.

Undersized drums and particularly rope sheaves always increase the bending stresses. Any advantage of using small drums and sheaves when designing a machine will be eliminated by the later disadvantages caused by the constant replacement of ropes and downtime of the machine.

Where high bending stresses are involved, the special constructions of the F-full and S-full steel ropes guarantee the longest possible service life. The F-full steel rope is successfully used in building machines and building equipment, with the exception of cranes. The dimensions of drums and sheaves are not prescribed to conform to a particular standard, therefore, the following approximate values to be observed for this special rope are recommended: a) for high-duty machines: drum diameter 27 \( \times \) \( d \), sheave diameter 30 \( \times \) \( d \); b) for low-duty machines: drum diameter 22 \( \times \) \( d \), sheave diameter 25 \( \times \) \( d \) where \( d \) = rope diameter in mm. The S-full steel rope was originally designed for use in driving pulley elevators. Dimensions of driving pulleys and rope sheaves should be 40 \( \times \) \( d \) where \( d \) = rope diameter in mm.

In addition to this, the S-full steel rope has given excellent results for serial lifting equipment and cranes where the load is supported by two or more lines. Dimensions of the ropes, the drum and the rope sheaves have to conform to DIN 15 020, P.M. Section IX, and other rules.

The above survey and explanation of the factors which affect the service life and performance of a rope is intended to recommend each machine builder to consider that when designing a machine to be equipped with a wire rope the rope expert should be contacted for advice. The explanations are also intended to refer to some advantages offered by the all-purpose ropes, F-full and S-full steel ropes, which were developed for two important fields of application.