

**The Rochester  
Corporation**

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To Whom It May Concern:

**Subject:** *A General Discussion On: New Cable Installation, Preparation and Operational Guidelines for cables running on non-traction winch systems*

*The importance of proper installation unto a winch cannot be overlooked and is essential in assuring prolonged cable life and performance. Typically, the "as manufactured" product is shipped on reels under low tensions. Cable wraps are generally applied using a thread-lay practice, but adherence to this practice is loosely followed. The necessity to assure a fully thread-laid product from the factory is not required since the cable will be removed from the shipping reel onto the winch used for operations.*

*During spooling unto a winch, it is important to maintain a consistent thread lay where gaps between the cable wraps have been removed. Cable wraps should be tight to restrict movement during subsequent wraps. Critical is the initial layer, referred to as the bed layer or wrap. This bed layer should fill the entire surface of the drum making contact with both inside edges of the reel flange. Most often, filler materials are required to assure proper spacing at the interfaces of the flange to assure an even and smooth bed layer. Although flat drums can be used to support the initial bed wrap, attention should be directed to the operational loads expected of the cable. Higher service loads typically required improved support of the bed layer. Again, it is the bed layer that determines the overall effectiveness of the entire cable installation process; therefore support of this layer is critical. For higher loads, it is common to utilize reels comprising grooved drums. These drums are grooved to a radius that closely match that of the cable thereby improving the support provided to the bed layer. Once the bed layer is established, is smooth and even, additional layers can be wrapped until the entire length of cable has been installed.*

*During the installation process, it is important for the operator to know the expected cable loads to be encountered. Since the winch will act as the main load support for the product, it is necessary to assure that the cable wraps are at a sufficient tension to support the operational loads. Improper loading of a cable during the installation procedure can cause cable damage resulting in premature line failure. This is particularly true if spooling tensions are significantly lower than the operational loads. The end result of such a condition generally results in cable crushing or flattening, its pulling down into the underlying wraps (referred too as knifing in), and in some cases places compressive loads on the cable structure itself. This effect can cause high*

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attenuation rates of constructions utilizing optical fibers that are packaged in a tight-buffer configuration. To avoid premature cable failure due to improper installation tensions, it is recommended that the cable be loaded, as a minimum, 45% to 60% of its expected working load. It is not uncommon to encounter recommendations from other suppliers that exceed this value. It is necessary to understand that once a cable product is deployed for the first time, the actual load profile experienced by the cable will be transferred to the winch. It is the underlying layers that were not exposed to the working load that requires adequate pre-tensioning to support the newly acquired load profile. Excessive installation loads can place unnecessary stress on the cable resulting in a degradation of service life. It also requires the use of reinforced reels and drums to support the higher loads, which are more expensive and costly to operate.

Due to the manufacturing methods used to construct cable, it is not uncommon for the product to display a twist element. This inherent torque property, which we refer to as cable "cast" can cause the product to form a loop while laid-out under little or no tension. Most often, the weight of the cable by itself is sufficient to prevent the formation of loops due to the torque balance design of the cable package. To improve the operational readiness of the product, dummy loads (loads similar to expected tool weight) can be attached to the cable for deployment of the full length. Any manufacturing induced torque resident within the cable structure is diminished and deployment will help create the tension profile on the winch expected for typical operations.

Recommended bending diameters are provided to assure customer expectations for cable life. "The larger the better" approach applies to bend diameters when it comes to prolonging cable life. Naturally, limitations on space restrict the operation of some cables to bend diameters smaller than recommended. Attached is a discussion of this issue along with a graph that depicts the effect bend diameters play on cable serviceability. It is recognized that the data was obtained from wire rope structures, however it is assumed that a correlation exists between the umbilical type cable and wire rope.

Lubrication is perhaps often misunderstood as it is intended to not only lubricate, but also to provide corrosion protection. Although a working cable contains many individual moving parts, all which require lubrication, exposed armor layers provide numerous voids for trapping water and debris. This entrapment of corrosive material will result in accelerated deterioration of the galvanized steel wire layers. During the installation process, it is recommended to apply a corrosive inhibited lubricating grease and/or oil. The application will promote prolonged cable service, as it will provide the adequate lubrication to minimize self-inflicted abrasion, and the required inhibitors to protect against corrosion. To optimize the effectiveness of the combined lubricant/inhibitor, it is

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*important to fill all the open voids within the wire layers. Typically, heavy grease type materials and/or gel containing the required properties are sufficient for this purpose.*

*During cable operation, is it necessary to establish a preventive maintenance program to assure continual protection of the product. This would include the periodic rinsing of the cable with fresh water and application of corrosive inhibited lubricating oil. This material should preferably be a light penetrating type oil to allow penetration into the wire layers.*

*Periodic examination of all surface areas coming in contact with the cable product should also be apart of a preventive maintenance program. The importance of proper sheave alignment to the cable path is required to minimize cable abrasion and induced torque. Sheaves in contact with the cable should be adequately sized to properly support the high stresses place on the cable. Typical groove sizes would be machined 2% to 4% larger than the cable product and support 140° to 150° of the cable circumference. Worn or damaged sheave and guide rollers will accelerate cable failure and should be replaced immediately.*

*Often space available for the winch and handling system is limited causing compromises in the cable path. Reducing, preferably eliminating, any reverse bending along the cable path will further enhance the life of the product. Fleet angles between rollers and sheaves should also be kept to a minimum recognizing that angles of 1.5° or less are desirable. Angles greater than 1.5° have been used with success, but can accelerate cable degradation resulting in reduced life cycles. To enhance cable performance due to space limitations and increased fleet angles, sheaves should be mounted such that they self-center to the cable axis.*

*There are numerous factors to consider depending upon the application of the product. Each application may require its own specific set of parameters causing changes in the methods of handling the product. Proper care and handling of a cable product can greatly enhance its serviceability. This discussion was intended to be general in content and highlights some of the more important parameters that can affect the life and overall performance of a cable.*

## **BEND DIAMETERS**

*The issue of bending radius, bending angles, and proper sheave diameters are pertinent to customer expectations for cable life. Naturally, "the larger the better" when it comes to bend diameters in promoting cable life; Nonetheless, the term "better" is relative and is dependent on the method of operation and deployment, locality, maintenance program, lubrication method, and etc., etc..*

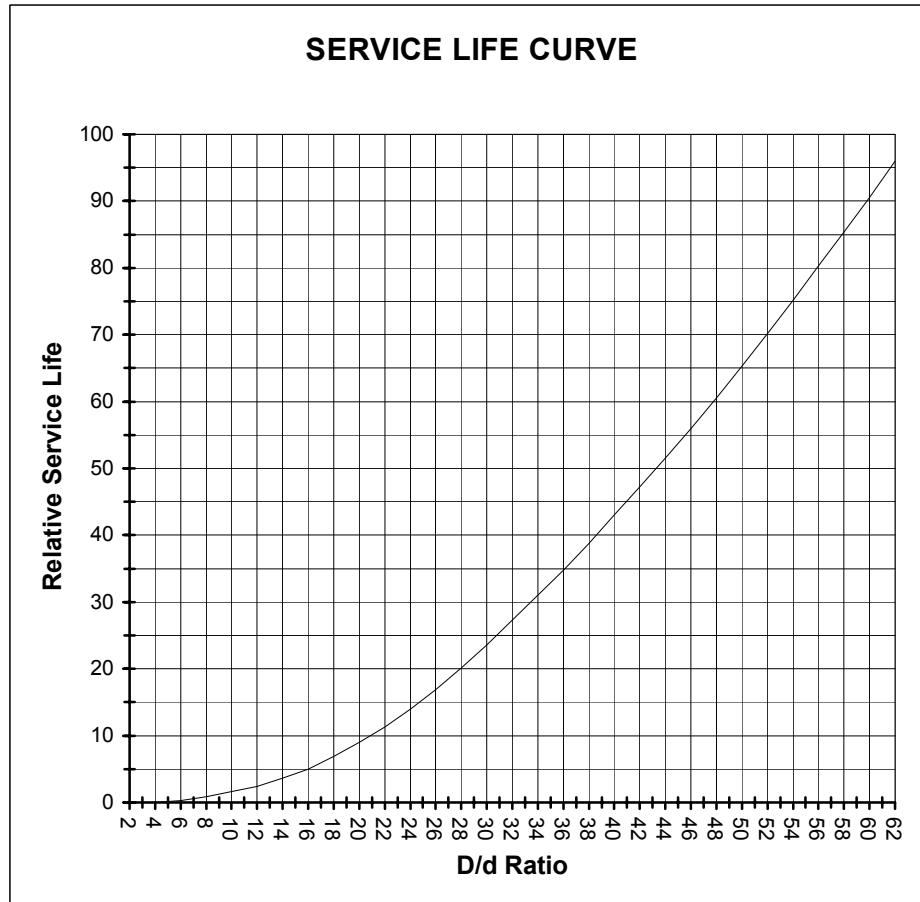
*The Rochester Corporation specifies on its DATALINE a bend diameter that shall yield good performance and service. If a sheave is used that is smaller than that specified, degradation to cable components will accelerate. On the other hand, larger sheaves will provide the opposite action resulting in prolonged life and service. Our recommendations are based on factors that have been proven to provide adequate cable life, life that is acceptable to most cable users.*

*It is not our intention to restrict cables from running over smaller than recommended sheaves, but to inform the customer that his action deviates from our standard and accepted practice. Selection of smaller sheaves will accelerate the degradation process. Again, the customer must decide if the loss in service merits the reduction in sheave diameter.*

*It is preferable to have a cable take a single deflection than several along its path. Regardless of the length of contact, once a cable takes the shape of its support member and conforms to the circumference, it has experienced the effects associated from it. Only if the load is such that the cable does not take the shape of each individual member is this method an improvement. It is also preferable for a cable to take a single plane deflection. Reverse bending around various sheaves will promote flex-induced fatigue resulting in reduced service life.*

*To summarize, recommended diameters are exactly that, recommendations based on past experience. Performing "cyclic bend over sheave" (CBOS) tests will aid the customer in establishing a workable bend diameter. Ultimately, operation (and evaluation) of the cable in the field will reveal whether or not the chosen sheave is of adequate size to provide the required serviceability.*

*Attached is a graph depicting a service life curve that was developed for wire rope products. The information presented is for reference only. Although we believe it is accurate information to the best of our knowledge, no warranty is given with respect to such information.*

**RELATIVE SERVICE CURVE OVER SHEAVES**  
(Laboratory testing on Wire Rope Constructions)

*How used:* Graph shows the effect of sheave size on the service received from the product. Assume that a 1" cable is used over a 16" sheave. This would be a D/d of 16:1 = 16. On graph a D/d of 16 gives a relative service life of 5.0. Now assume that the same 1" cable is to be used with a 24" sheave (D/d = 24:1 = 24). From graph a D/d of 24 gives a relative service life of 14. This means that changing from a 16" to a 24" sheave will produce an increase in service of 14:5 = 2.8. The larger sheave will provide approximately 2.8 times as much service as the 16" sheave (a 180% increase in life).

Data was taken on various wire rope constructions and laboratory data based on bending stresses that were introduced by a specially designed machine. The curve is a simple parabola having an equation of  $X^2=39y$ . Similar curves can be found in various wire rope publications. Only laboratory testing conducted on the specific cable in question will provide more meaningful data. This chart is provided as a reference only. Data was obtained from an unknown source; although we believe it to be accurate information to the best of our knowledge, no warranty is given with respect to such information.