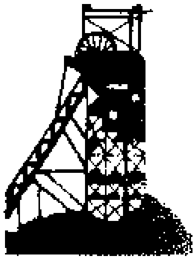

“Haggie Hints”

by George Delorme

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Haggie North America - *Meeting your hoisting needs!*

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Guide and Rub Ropes – types, pros/cons, tensioning and maintenance

DISCUSSION:

The first points to be made are:

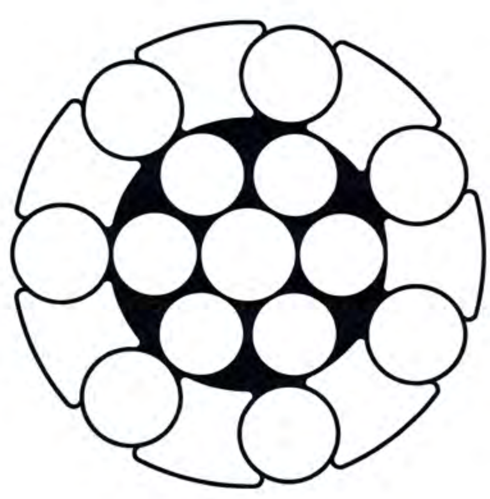
- the use of Guide or Rub ropes should only be considered when there are an “even” number of hoist ropes (with opposite lay directions)
- loading and unloading should be from one elevation only at the bottom and top of the shaft i.e. no multiple loading stations.

While there are installations working with a single hoist rope (which must be of a Non-Spin class) with the conveyances controlled by rope guides, the control offered to the conveyance is risky at best. Properly tensioned guide and rub ropes will handle impact loads without much displacement, but a relatively light, STEADY force will cause the ropes to be displaced easily. As an example, if you were able to kick a guide or rub rope in the mid shaft area, there would be virtually no movement however, if you applied a steady pressure, a considerable deflection would occur. Since no spin resistant rope has a perfect torque balance throughout its life, the steady rotational force (usually caused by the outer strands being stronger) will cause the conveyance to move off it desired path and may strike another object. It is for this reason that there can only be one loading/unloading level, equipped with “Spears” or a section of rigid guide to insure the conveyance will not move.

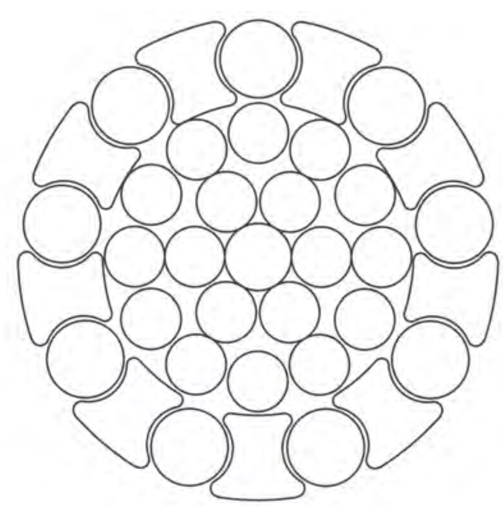
GUIDE & RUB ROPE TYPES

In theory, any type of steel wire rope can act as a guide or rub rope but the performance may not be at all satisfactory. At this point, I should clarify that a guide rope is attached to a conveyance via some type of "slipper" while a rub rope is not attached to a conveyance and its primary function is to prevent two conveyances from colliding. From this point on, I will refer to both types as guide ropes unless I am referring specifically to the rub rope.

The main desirable features of a guide rope are that it must be stiff, robust and will withstand high external wear without the wires breaking and unraveling. If we consider the many types of ropes available, the best solution is the Half Locked Coil (HLC). This rope has the outer cover comprised of alternate pairs of round and "half locked" or "H" shaped wires. The outer layer is usually spun in the right hand direction while the inner layer(s) of round wires are spun in the opposite direction. The one main advantage of this rope is that even if the soft outer wires are worn to a great extent and do break, they will not come out of lock until at least 40% of the outer wire altitude has been worn away. The following sketches show two HLC cross-sections.



7 PAIR
1X 21(7+7I/6/1)



9 PAIR
1X37(9+9I/12/6/1)

If we consider the other constructions available, the downsides are:-

- Full Locked Coil (FLC) – locking properties of the outer cover are poor
- Spiral Strands – if a wire breaks, a very long length can be pulled out by the slipper causing a potential disaster.
- Stranded ropes – while the wires will only unravel for a relatively short length, because of their small diameter, minimal wear is available until a problem is encountered.

In discussing the HLC, there are several configurations available from most manufacturers with the most commonly used being the 7, 8 and 9 pair. As with any rope choice, each design or configuration has its strengths and weaknesses and the truly required characteristics for the application should be carefully considered but in the end, there is always a compromise. The temptation may be there to select the design with the largest outer wire i.e. 7 (or 8 pair in some cases) but there are several downsides with this construction that should be considered and they are mostly related to the installation and handling of these ropes. For the purpose of this discussion, I will discuss the 7 pair versus the commonly used 9 pair.

The 7 pair has 14 outer wires (7 round and 7 rails or half locks spun in the right hand direction) over 6 round wires (spun in the left hand direction) over 1 king wire. The 9 pair has 18 outer wires (spun in the right hand direction) over 12 intermediate round wires over 6 inner round wires (spun in the left hand direction) over a king wire. In comparing the two constructions, there are a few significant differences. As with a non-spin rope, the outer gallery, which is furthest from the center axis of the ropes, will have the controlling force. In the case of the 7 pair, there are 14 outer wires versus 6 inner wires so the torque and the number of turns coming out of the rope during installation will be substantial. On the other hand, the 9 pair has less torque since it has 18 outer smaller wires versus a total of 18 inner wires spun in the opposite direction. In addition, the 7 pair ropes will be very stiff to handle during installation. Also, with the vibration in the guide ropes being arrested at the top suspension gland, the coarser construction is more prone to fatigue failure and this potential damage is occurring within the gland which is not accessible for inspection. If this construction is used, then the periodical lifting of the guide ropes to change the section of rope subject to fatigue becomes very important.

The one advantage of the 7 pair, with its larger outer wire, is its ability to have more wear on one side. However, if the guide ropes are rotated 30 degrees or so every year as recommended, this advantage is minimized. As a comparison, the outer rail wire of the 7 pair has an altitude of 9.53mm versus 8.0mm for the 9 pair.

The charts attached show the differences in terms of wear ability. In most jurisdictions, guide ropes must be removed when a loss of 25% is shown by the EM testing equipment and generally, the loss occurs on the outer cover due to the wear between the slippers and the rope. While it is generally accepted that a wire will most likely break in a working (flexing) rope when it losses 33% of its diameter, a stationary guide rope's soft outer wire can be worn to a greater degree but what is most important is that if the wire happens to break, it does not come "out of lock" and entangles in the slippers. A half locked coil will not lose its locking properties until it has lost approaching 50% of its diameter with 40% wear being conservative. With a 47mm diameter 9 pair, the outer wires will have only been worn to 32.2% of their diameter when a 25% loss occurs so the wires will not lose their locking characteristics. The 7 pair outer wires would have only worn by 27.4%.

GUIDE & RUB ROPE TENSIONING

There are several methods to calculate the desired tension on guide ropes but in the end, they are all similar and the easiest to use is the following: -

Always start with 3 tonnes (6,614 lbs) for any depth and then add 0.5 tonnes (1,102 lbs) for every 100 meters (328 ft) of suspended guide rope. This is the nominal number and the tension should be varied at random to a maximum of +/- 10% of the nominal. This is to avoid a potential harmonic effect.

GUIDE & RUB ROPE TENSIONING METHODS

Normally, the guide ropes are suspended in the headframe by means of a wedge type gland (less frequently by a socket) sitting on a brass spherical seat which can be lubricated for ease of rotation. The spherical seat also allows for a slight "out of plumb". In my opinion, the safest and most reliable tension method is to use some form of cheese-weight stack at the shaft bottom. Rope stretch and temperature variations are automatically taken into consideration. Short of having the stack "hung up" on spillage, this is a "set and forget" system. If shaft depth is an issue, then the cheese-weight can be made of lead which has a much higher density than the conventional cast iron. At the bottom, an inverted suspension gland or a "long loop" cappel is best so that a length of rope can extend beyond the attachment point for the lifting of the guide ropes every 5 years.

Spring or hydraulic tensioning in the headframe have and are being used but they must overcome the guide rope weight before they impart any controlling force. With these systems, the greater problem is maintaining the tension at all times and in several cases, mid shaft collisions have taken place when the tension was lost. With the increasing use of Strain Gauges or other such load monitoring devices, this is becoming less of a problem. Sophisticated tensioning in the shaft bottom is not practical because of the potential hostile environment.

GUIDE AND RUB ROPE PLACEMENT

In general, these are the "rules of thumbs"

- Corner guide ropes offer the most control
- Guides along one side are smooth, but are weak on control
- If conveyances are closer than 18", rub ropes should be used
- Conveyance should not be closer than 12" from the shaft walls.
- Rub rope are placed close to the conveyance i.e. less than 1" so that early contact is made.

GUIDE AND RUB ROPE CAUTION DURING INSTALLATION

As mentioned above, guide ropes have varying degrees of non-spin characteristics, but in general, they are POOR compared to other ropes because they are a very robust construction. The torque is high and MUST be released during installation. Unless the end if freely suspended, a swivel must be used to release the torque during installation.

CARE AND MAINTENANCE

As mentioned earlier, the ropes should be rotated slightly, perhaps 30 degrees annually and lifted approximately 3 feet every 5 years. The former is to expose a fresh face to any side wear and the latter to remove the section of rope from service that has been exposed to the vibration at the top suspension gland. It should be remembered that side wear extending for at least the ropes lay length has the same effect on loss in strength as though the wear was completely around the rope which again reinforces the need to rotate the ropes.

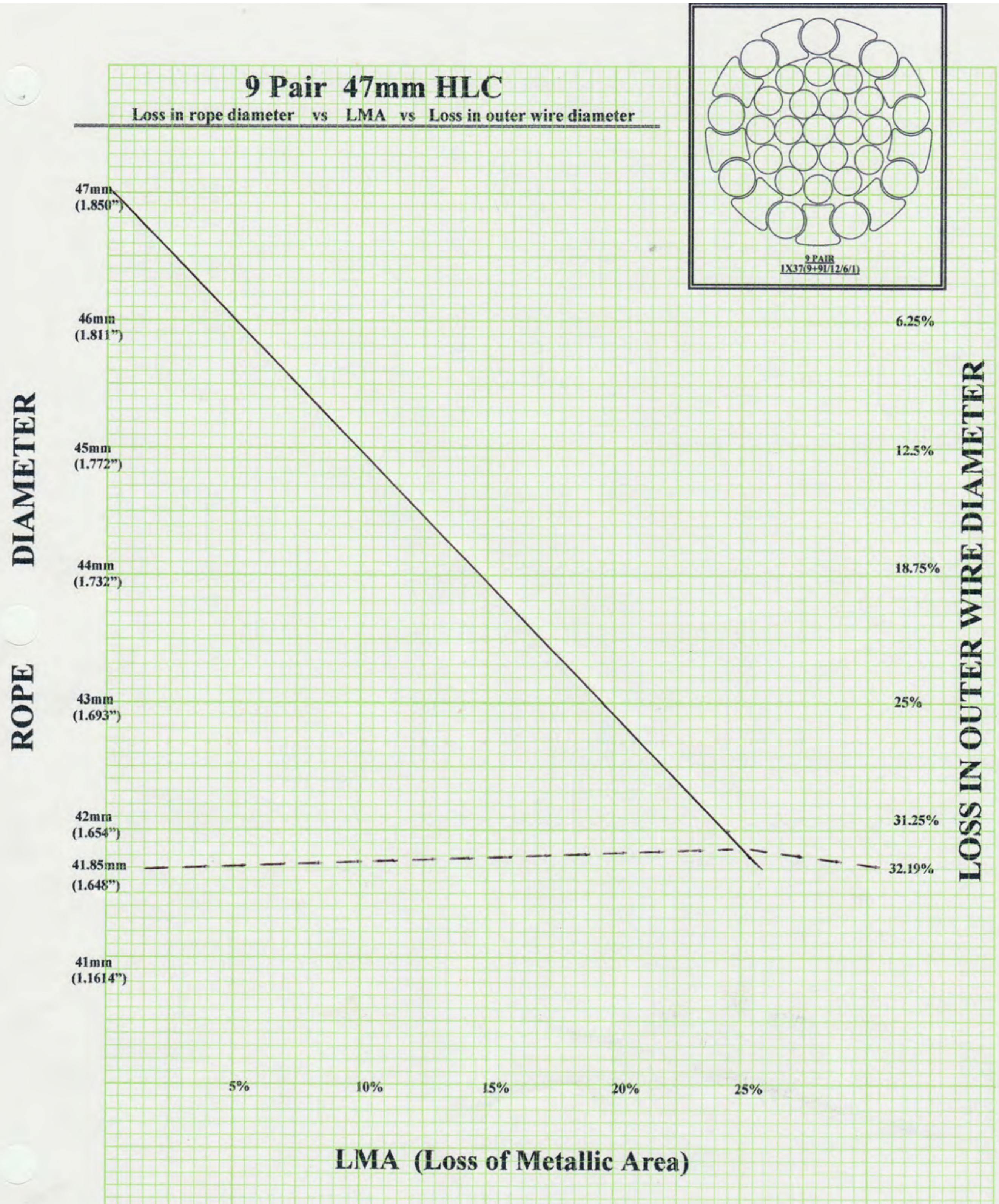
The entry point into the rigid guides (spears) at the top and bottom should be visually checked periodically to insure a smooth transition of the conveyance. If the conveyance shifts during the entry, excessive wear on the ropes may take place.

Lubrication, preferably with "open gear" grease, should be done regularly with special attention given to the lower sections where corrosion will be most probable.

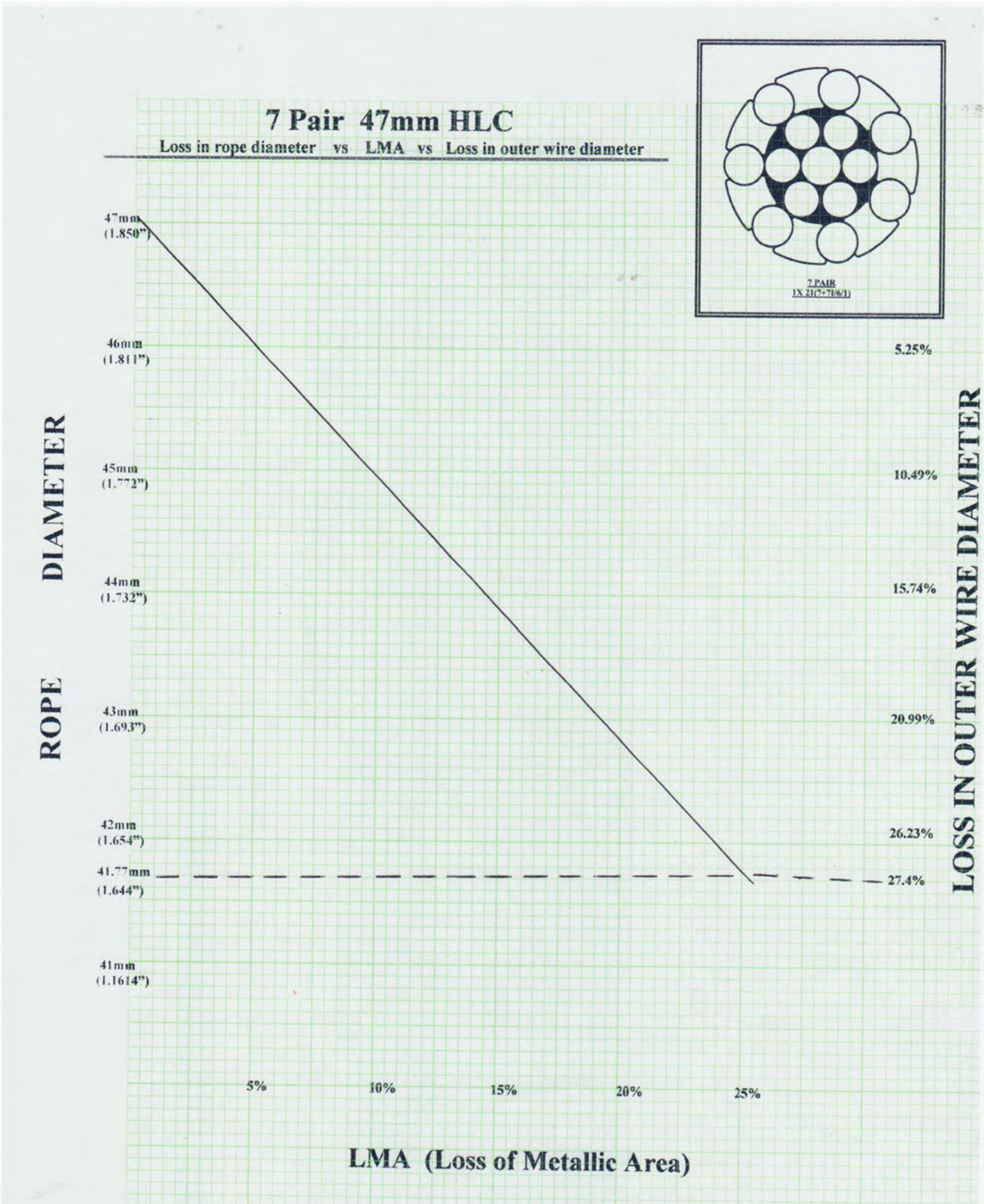
Cheeseweight components, especially the rod, should be inspected for corrosion and the sleeve at the bottom (used for alignment) should be clear of debris to insure the ropes can move up and down. Always assure that the stacks are not "hung up".

RECOMMENDATONS

Please note that we strongly recommend that guides and rubs be rotated 30 degrees or so annually and that they be lifted a few feet every 5 years to alter the fatigue point up at the suspension gland. The rotating of the ropes is relatively easy as they are on sitting on spherical brass seats. For the slight additional cost, it is highly recommended that ropes with galvanized coated wires be used to resist corrosion.



9 Pair 47mm HLC
Loss in rope diameter vs LMA vs Loss in outer wire diameter
9 PAIR
1X37(9+91/12/6/1)
ROPE DIAMETER
47mm
(1.850")
46mm
(1.811")
45mm
(1.772")
44mm
(1.732")
43mm
(1.693")
42mm
(1.654")
41.85mm
(1.648")
41mm
(1.1614")
6.25%
12.5%
18.75%
25%
31.25%
32.19%
LOSS IN OUTER WIRE DIAMETER
5%
10%
15%
20%
25%
LMA (Loss of Metallic Area)



7 Pair 47mm HLC
Loss in rope diameter vs LMA vs Loss in outer wire diameter
ROPE DIAMETER
47mm (1.850")
46mm (1.811")
45mm (1.772")
44mm (1.732")
43mm (1.693")
42mm (1.654")
41.77mm (1.644")
41mm (1.1614")
LOSS IN OUTER WIRE DIAMETER
5.25%
10.49%
15.74%
20.99%
26.23%
27.4%
5%
10%
15%
20%
25%
LMA (Loss of Metallic Area)