Technical Literature

Plasma® Working Line Manual

CORTLAND®

Table of Contents

General Information

Cortland Plasma® working lines are a lightweight, safer-to-use alternative to steel wire rope.

Plasma ropes are made using UHMWPE (ultra-high molecular weight polyethylene) fiber which has been enhanced using Cortland's patented recrystallization process.

Usage

Precautions

The following sections include tables of relevant precautions that should be observed and executed, prior to and during operations where Plasma® working lines are used.

General Precautions

The following precaution points should be followed to ensure safe use of Plasma working lines.

Never shorten the rope by knotting and never use a rope which contains a knot anywhere
Never attempt to pull a rope that is resting under an object
Never place heavy objects on top of the rope
Never run over the rope with a vehicle
Only the soft eyes on the end of the rope should be used to pull loads

Chemical Contamination

The strength of Plasma ropes can be degraded by certain chemicals. This includes chemicals in the form of solids, liquids or gases. Cortland or a qualified representative should be consulted before Plasma ropes are used in chemically active environments. If the rope surface shows any signs of chemical contamination, the extent of the contamination should be assessed. If the contamination is external to the rope then the chemical should be washed off. If it is suspected that the contaminants have penetrated inside the rope then the nature of the chemical should be documented and communicated to a Cortland representative for evaluation.

Temperature

Temperatures exceeding 60° Celsius (140°F) will reduce the load bearing capacity of the rope. Cortland should be consulted if the rope is to be used in environments where this temperature is expected to be exceeded. Low temperatures are generally not a concern. Ice should be removed from the rope before usage.

Handling and Storage

The following guidelines should be followed when handling Cortland Plasma synthetic ropes.

Avoid dragging the rope on the ground.
Avoid putting ropes into contact with abrasive surfaces. Contact surfaces should be smooth and the winch drum surfaces should be deburred, polished, and kept clean, especially if the winch had previously been outfitted with steel wire rope.
Uninstalled rope in storage should be kept in a dry environment, away from direct sunlight and heat.
Do not weld, cut, or grind metal near where the ropes are being stored or close to the winch. Welding material and sparks may damage the rope.

Rigging

Ensure that the connecting hardware has a lifting/pulling capacity equal to or greater than what is required. Also ensure that the interfacing surfaces are smooth and free of defects and other irregularities which could harm the rope. If the interface surface is rough, special protective wear pads can be added to protect the rope.

Keep tags away from the load bearing surfaces.
Ensure that the rope does not come into contact with any rough edges during an operation.
Ensure that there is no twist in the rope as it is being used.
Stationary contact points should be avoided along the rope except when connecting to the thimble in the eye. Any routing sheaves should have a D:d ratio of 12:1 or greater. The strength and longevity of the rope may be compromised if sheaves with smaller D:d ratios are used.
In case the rope is required to come into contact with hard stationary surfaces, ensure that those surfaces are smooth, rounded and free of rust and burrs.

Inspection Points

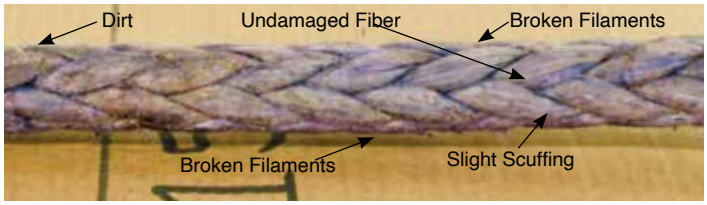
It is recommended that inspections be carried out on the rope before and after every operation by a trained person, as the rope is being paid out. Inspection results should be logged.

It is recommended that a thorough inspection be conducted every 6 months by laying out the rope and carefully inspecting the rope. Results should be logged and any major damage should be noted and reported to Cortland.

The following is a list of damage types that may occur on Plasma® high performance synthetic fiber rope lines that should be noted during an inspection.

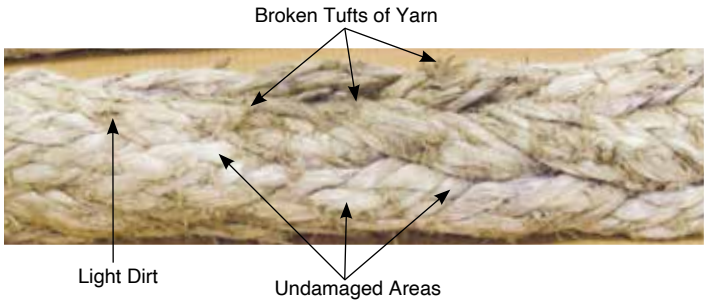
Surface Abrasion

Surface abrasion is the most common type of damage. Abrasion is the tearing or wearing of fiber, resulting in a loss of strength-bearing material. Abrasion is readily identified by the ragged appearance of the damaged fiber. Normally, the surfaces of the rope that do not run over the sheaves or rigging will have virtually no abrasion unless the rope is handled improperly. Abrasion could also take place if the rope were to come into contact with a fixed object, such as might occur if the rope jumped out of a sheave or was dragged across the deck. When a new rope is placed in service, contact with various surfaces will break some of the very fine filaments on the surface of the rope, giving it a slightly “fuzzy” appearance. This slight surface abrasion is normal and to a certain extent beneficial, as the broken filaments act as a protective cushion. This condition should stabilize after the rope has been in service for a period of time. The effect, if any, on the rope’s strength is minimal. Additional surface abrasion will be caused by relative movement between the rope and a contact surface. An example of slight surface abrasion is shown on the following page.



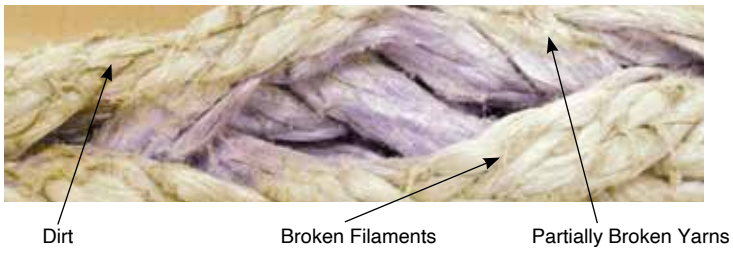
In this picture there is evidence of some broken surface filaments in a pattern along the axis of the rope. Some of the strands have a slightly scuffed appearance. It should be noted that there is also evidence of some light dirt on the rope's surface, as indicated by the gray discoloration. This is not abrasion and has no effect on the rope's strength. There is no evidence of any significant damage to the structure of any of the braid or individual strands. A comparison of the affected areas with sections of the braid that is undamaged (the bright yellow colored areas in the inner parts of the surface) shows that there is minimal fiber damage. An estimate of damaged material in this section is well under 1%. As mentioned above, discoloration due to dirt or other contaminants may be mistaken for abrasion.

More extensive abrasion damage can take place when there is significant relative movement between the rope and a contact surface. The photo below shows a section of moderate localized abrasion.



The damaged section runs in a line down the axis of the rope. The heavier abrasion is shown by the tufts of broken yarns in parts of the strands. The broken filament ends have pulled back to a point where they are trapped by the braid pattern of the individual strands, producing the tufted appearance. The strands on either side of the abrasion line are basically unaffected. Total fiber loss is estimated to be less than 5% along the line of abrasion.

The photo below shows heavy abrasion damage.



Unlike the previous example, the damage in this case is more wide-spread, involving more surface area around the rope's circumference. Large tufts of filaments have been broken and retracted back to the braid crossover points. Total fiber loss in this area is estimated at about 5%. Intermediate levels of abrasion can exist and can be described as slight to moderate and moderate to heavy. Based on this we can create an abrasion scale from 1 to 5 as seen in the table on the following page:

An abrasion level of 3 indicates an approximate strength loss of about 10% for Plasma® and an abrasion level of 5 indicates much more severe strength loss.

Surface Abrasion Scale	
Rating	Abrasion
1 **Slight**	
2 **Slight to Moderate**	
3 **Moderate**	
4 **Moderate to Heavy**	
5 **Heavy**	

Cuts

Although not as common as abrasion in the course of routine applications, cuts represent a greater potential hazard to overall rope performance. Cuts may be identified by the even, squared-off fiber ends at the point of damage. Obviously, rope strength is affected at the location of a cut, with the amount of strength loss dependent upon the depth and extent of the cut. The strength loss at the point of the cut may be estimated in the same manner as that used for abrasion. While small surface nicks have very little effect, deeper cuts can substantially reduce rope strength. Cuts extending at right angles to the rope's axis can cause the rope to become "unbalanced" since the damaged strands can no longer carry their share of the load. Cuts that extend along the length of the rope for even a few inches (~50mm / 2in) have probably damaged a significant portion of the 12 strands making up the finished rope. Consequently, severe cuts are sufficient cause to remove the damaged section from service. As with specific patterns of abrasion, cuts also indicate that there may be a problem somewhere within the rope handling system and the cause should be immediately identified and corrected. The photo below shows a fully cut strand.

Fully Cut Strand

The cut can be readily identified by the squared off ends of the cut material. In this example one strand was severed. Other than the cut strand, there is very little evidence of other types of damage on this rope.

Pulled Strands

Generally, when the rope is under tension it is very difficult to pull a loop of material. Most pulls occur when the rope is relaxed. In addition to unbalancing the rope structure, pulls can create a dangerous situation if the loop gets hung up on some object while the rope is being handled. In most cases the pulled strand can be easily worked back into the body of the rope. If it cannot be worked back into the rope structure, the damaged section should be removed and the rope re-spliced or retired.

Pulled primary braid

Pulled primary braid strand

Burns

Virtually all synthetic fibers can be melted or charred due to exposure to elevated temperatures. This can be caused by heating due to high frictional contact between the rope and a fixed surface, or by exposure to some heat source such as a welding torch. Burns can be identified by a glassy fused area on the rope's surface and a black color.

Example of burned and partially melted fiber

Example of burned and partially melted fiber

Although burned fiber has lost all of its strength, the extent of the damage can vary. The damaged section should be removed, and the rope should be re-spliced or retired.

Internal Abrasion

Repeated tension and relaxation of the rope causes the strands to move relative to each other. This movement can, over time, produce abrasion of the strands where they cross over each other inside the rope, resulting in broken filaments similar to surface abrasion damage. The photo on the left below shows the rope braid opened with signs of light internal abrasion. Here is evidence of some broken filaments; however, damage is minimal. This picture can be compared with the picture to the right, which shows moderate external damage but minimal internal damage.

Surface abrasion, and light internal abrasion

Example of moderate external damage but minimal internal damage

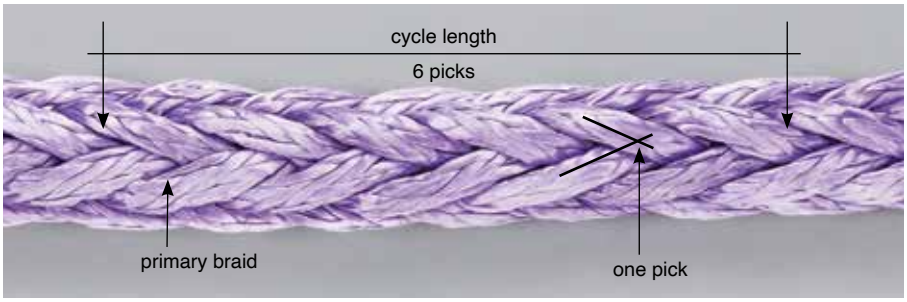
Internal Abrasion Scale	
Rating	Abrasion
1 **Slight**	
2 **Slight to Moderate**	
3 **Moderate**	
4 **Moderate to Heavy**	
5 **Heavy**	

Structural Deformation

The surface of the rope should be checked for any change in the shape of the rope or variations in the cycle length or diameter.

Change in shape
Although very rare, it is possible for one or more of the strands to partially or totally fail inside the rope, with the broken ends remaining trapped inside the structure of the final braid. When this happens, the diameter of the rope at the point of failure will reduce, producing an hourglass shape along the surface of the rope. If this happens the damaged section should be removed from service.

Cycle length and diameter
Cycle length and diameter of the braid should be measured at periodic intervals along the rope's length to make sure that there are no irregularities in the construction. Pronounced differences in either measurement at some location indicate some sort of structural problem. The rope should be inspected thoroughly, including inside the braid structure, if any variations in these measurements are found. The cycle length is determined by measuring the length of six consecutive picks along the rope's longitudinal axis. One pick is determined by each "V" that two adjacent strands form on the braid.

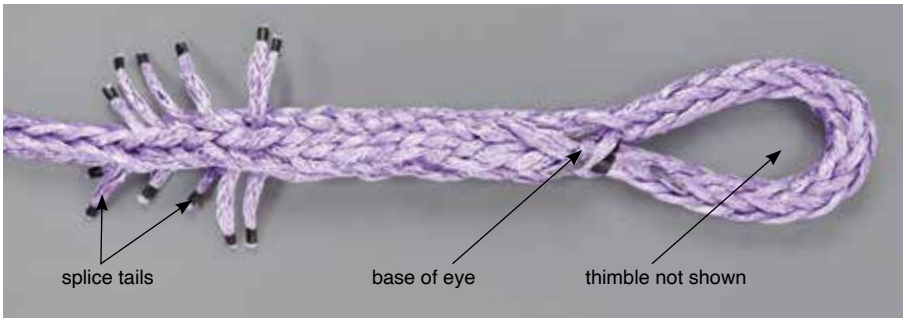


The diameter (or circumference) can be measured with a diameter tape, standard tape measure, or by wrapping a piece of twine around the rope and then measuring the length of twine. It should be noted that, as the rope is used, the cycle length will increase and the diameter will decrease somewhat, especially if the rope is subjected to high loads.

Splices

Eye splices and any end for end splices in the body of the rope should be checked during each inspection.

Eye splices
A typical eye splice is shown below:



The eye splice should be inspected for any signs of abrasion, cuts, dirt, etc. If the splice is new, it should be thoroughly inspected to make sure that it conforms to accepted splicing procedures. The eye should be seated properly in the thimble and not tilted to one side. If wear protection is used on the rope eye, it should be inspected for signs of damage. The tails of the tucked strands at the end of the splice should be checked to see if there has been any slippage. The eye and the body of the splice should be inspected to determine if any grit or dirt has penetrated into the rope. Any surface contamination should be washed off before the rope is used again.

End for end splices
If a cut or damaged section is found on the line, the damaged section may be cut out and the ends of the rope can be re-joined using an end for end splice. The picture below shows an example of an end for end splice. The two rope sections are shown in two different colors for clarity.

The splice should be inspected to ensure that the tucks are tight and not distorted and that the strands in the splice area have not been damaged. The tails of the tucking strands have been buried inside the rope to make a smooth transition from the rope into the splice. If the tails have pulled loose the rope should be relaxed and the tails reinserted into the rope.

Contaminants

The rope should be checked for the presence of abrasive contaminants and/or chemicals that can work into the interior of the rope structure. Abrasive particles, such as rust or grit, can damage the fiber over time. Any surface dirt or grit should be washed off the rope. Do not use degreasing compounds and avoid using high pressure hoses. While the materials used to make Plasma® rope are relatively impervious to most common chemical compounds and petroleum products, exposure to these, and other chemicals, should be avoided as a routine precaution. Damage due to chemicals is sometimes difficult to verify. The fiber may become brittle and/or discolored or show some other form of degradation. If there are any visual signs of chemical contamination, a strong chemical smell, discoloration in the coating, or brittleness in the fiber, a Cortland representative should be contacted.

Retirement Criteria

The following is an inspection guideline for use in the field, and recommended actions for elements if they occur.

Retirement Criteria

1	**External Abrasion**	Moderate and above (application dependent)	Consult Cortland
2	**Cuts**	Cut strands	Consult Cortland
3	**Pulls**	1 strand per 3 cycle lengths	Work back into rope if possible. If not then Consult Cortland.
		More than strand	Remove from service
4	**Burns**	Any	Remove from service
5	**Internal Abrasion**	Moderate and above (application dependent)	Remove from service and consult Cortland
6	**Structural Deformation**	Temporary compression	Work out compression
		Any other permanent deformation	Consult Cortland
7	**Splices**	Exposed tucking tails	Re-tuck tails in body of rope
		Loose tucks	Repair splice if possible. If not, re-splice immediately/retire.
8	**Contamination**	Dirt or grit	If moderate or heavy external contamination, wash material off of rope. Inspect internally. If moderate or heavy internal contamination, repair/retire
		Chemicals	If any suspicion of chemical contamination, consult Cortland.
		Oil or grease	If moderate to heavy, wash rope surface with mild detergent or liquid soap. If rope cannot be washed, then retire.
9	**Wear Protection (if present/ applicable)**	Damaged/cut wear protection	Replace wear protection

Notes

Cortland is a global designer, manufacturer, and supplier of technologically advanced ropes, slings, and strength members. Collaborating with customers, our team uses its experience in high performance materials and market knowledge to transform ideas into proven products.

For more than 35 years, our custom-built solutions have been developed for work in the toughest environments and to overcome some of the world's greatest challenges. They consistently enable our customers to meet the demands of the aerospace, defense, medical, research, subsea, marine, and energy industries.

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