

## Camesa Recommended Cable Maintenance Program

### Inspections performed after every job:

Perform visual inspection cable at rope sockets.

Check electrical insulation/continuity.

Perform visual inspection for serious kinks along the rig-up line.

Inspect for loose armor.

Inspect splices for cracked shims and loose armor (open hole cables)

Inspect cable for any abnormalities (kinks, shiny spots, heavy pitting, and crossed wires).

Whenever reheading check for brittleness.

If abnormally high tensions were encountered while pulling out of the hole the cable should be pulled down and reinstalled with the proper tension profile.

### Inspection for Brittleness

1. Take 8 armors from each layer (outer and inner).
2. Wrap each armor wire around its own diameter for 5 complete wraps.
3. Unwrap the wire until it is straight. Good armor wire will not break when subjected to this test. If none of the armor wires breaks, the test is completed. Otherwise proceed to the next step.
4. If any wires from either layer breaks during the wrapping, the armor has lost too much ductility to be reliable. Cut off a portion of cable and return to Step 1.
5. Wires breaking during the unwrapping would indicate some ductility has been lost. If 2 or more of the wires from either layer break during the unwrapping, scrap a portion of cable and try again. If only 1 of the wires break, the cable probably has sufficient ductility for use, but is approaching the end of its service life and should be checked frequently.
6. You must use good judgment. If most of the wires in both layers break while unwrapping (instead of a few), you are close to a catastrophic failure; your safety factor is gone. At this point, cutting 500 ft or 1,000 ft and checking again is better than chancing a broken cable.

### Inspection for remaining cable life

Cables are lost or retired due to either mechanical damage, or to the normal wear and tear of field use.

Mechanical damage includes:

Bird-cages and kinks due to mishandling or loose armor.

Crossed armor wires

Drum Crush

Insulation Damage

Most cables are retired due to normal wear. Checks for normal wear should be done on a regular basis. A cable does not wear out the individual armor wires wear out.

Cut off 50 ft from the tool end of the cable and remove the armors from about two ft of cable. Separate the inner and outer armor wires into two piles.

Using a solvent, clean any dirt, mud, rust, or corrosion from the wires.

Measure the diameter of the armor wires at the widest point then, measure at the narrowest point, do this for 8 wires. A 25% or more loss of diameter is unacceptable. If there is more than 25% reduction, cut off a portion of the cable and check further up. This is just a recommendation you may decide to cut off some cable with less than a 25% reduction.

Perform a Brittleness test, if the cable fails cut off a portion of cable and check further up.

## Maintenance

Cable maintenance begins with a pull down and inspection, frequency of inspection will depend on many variables such as well conditions, well depth, maximum and minimum tensions, well fluids, etc.

### A suggested schedule:

After the first 25 runs, if cable appears to be seasoning normally and no issues are detected then inspect every 100 runs. This frequency is flexible and will vary depending on the variables listed.

Maintenance should include, but may not be limited to:

- Inspect for loose armor and tighten if necessary.

- Inspect for brittleness and cut back to good cable if necessary.

- Inspect for kinks and other bad spots and correct problems.

- Inspect splices for cracked shims or loose armor and redo if necessary

- Check conductor for shorts or opens.

- Check for drum crushing and reinstall if necessary.

- Check for excessive corrosion and pitting of armor wires.

- Brush outer armor wires and coat with a suitable line oil.

EM cables are run in very hostile environments, inspection of the cable and reporting of potential problems by the wireline unit operator is important for maintaining proper cable condition.

A properly filled out line record book is the most important tool for proper maintenance.

Regular maintenance should be performed at a qualified Service Center.

### Alloy Cables:

Alloy cables must be monitored and serviced much more frequently than galvanized steel cables. Alloy cables should be returned to a qualified servicing facility for inspection and servicing after every job. If operational considerations cannot support this level of maintenance, exercise increased care in following running speed and tension guidelines. This can help minimize the possibility that armor looseness will develop before servicing/tightening can take place. These precautions may appear expensive, but they are much less expensive than damaging a long length of expensive alloy cable on a critical well.