A guide to terminating fiber optics In the Jason/Argo DSL-120 system

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The purpose of this document is to describe a procedure for terminating the fiber in the Jason/Argo/AMS-120 system. There are 2 types of fiber to terminate, Steel Lite and Electro Lite. Both are manufactured by the Rochester Cable Co.. The main armored cable has steel Lite while the neutral tether has the Electro Lite. The main difference between the two types of fiber is that the Steel Lite fiber is wrapped in 7 strands of steel while the Electro Lite is wrapped in 7 strands of copper. This copper around the fiber is equivalent to a 16 gu. Wire. This is used as the current carrier in the tether.

In the Jason/Argo/AMS-120 system we have decided to terminate our fibers with ST connectors. This is done so a technician can break into the fiber link at many points to troubleshoot. A typical ST connection may have an average of ½ a Db of loss. This loss is acceptable to our power budget.

Both types of fiber are terminated with the same type of ST connector made by Amphinol. This is an all plastic connector as the current carrying copper of the Electro Lite is crimped to the back of the connector as a strain relief.

Please read and understand the procedure before attempting to install a connector. Terminating fiber optics requires a technique that is easily learned but does require some practice. A steady hand and a gentle touch are a necessity. Good luck.

Necessary Equipment

FIBER OPTIC TERMINATION KIT	FIBER OPTIC POLISH KIT	CONSUMABLES
THIS KIT SHOULD INCLUDE:	THIS KIT SHOULD INCLUDE:	ST CONNECTORS
CRIMP TOOL	ST POLISHING FIXTURE	EPOXY
MILLER WIRE STRIPPER	8X11 GLASS PLATE	PLASTIC CUPS
EXACTO KNIFE AND BLADES	3 GRADES OF ALOX PAPER	ACETONE
SMALL WIRE CUTTERS	COURSE,MED,FINE	COTTON SWABS
FIBER SCOPE	TAP WATER	KIM WIPES
SAPHIRE SCRIBE	KIM WIPES	WATER
HEAT BLOCK		masking tape
THERMOMETER		
SMALL HEAT GUN		
THERMAL WIRE STRIPPER		

Getting to the Fiber

The Electro Lite fiber of the tether is ecaced in a plyabe molded plastic core at the center of the tether. Great care must be taken when removing this core jacket. Do not knick the insulation on of the fibers as they will be carrying HI VOLTAGE.

Determine how much jacket you want to remove and score around it lightly with an Exacto Knife. Now you must dissect the jacket from the fibers. Once you have enough to grab hold of you Can peel it away. Always be careful of the bend radius of the fiber. The 3 fibers are color coded, Blue, Yellow and Clear.

This core material will swell up and turn mushy after a prolonged exposure to mineral oil. This takes about a year. It may be possible to repair the damage with long lengths of black heat shrink.

The Steel Lite fiber is in the main cable. Once the triple armor has been peeled back and terminated, the core of the cable is exposed. The outer PVC jacket surrounds 3 Steel Lite fibers, 3 12gu. copper wires and water block material. Once you have determined how much fiber is to be exposed, the PVC jacket is easily scored with a razor knife and removed. Remove the clear plastic wrap and the water block material will fall away readily.

When the core material has been stripped away and the appropriate length of fiber is exposed, the next step is to put on the stuffing tube hardware. This will be difficult to do when the fibers have ST connectors on them. You can either cut a hole in a blank stuffing rubber or use black heat shrink to build up the jacket to ½" , the smallest precut size.

Bring the end to be terminated to the bench where the fiber tools are. Immobilize the core so that the fibers will not be moved accidentally during the procedure.

Terminating the Fiber

Form a loop of masking tape and place it in an out of the way, but convevient place. Bare fiber is extremely hazarous. Any small pieces of fiber should be placed on the tape and disposed of safely.

Plug in the heat block and insert the thermometer. Set the heat block to 90 degrees Celsius.

Open an ST connector package. This contains the ST connector, a rubber boot, 2 crimp sleeves (1 large, 1small), a dust cap and a clear tube. Discard the small crimp sleeve and the clear tube.
Hold the ST connector up to the light and look through it from the back end. You should see light through it.

If you are terminating Steel Lite fiber, slide the rubber boot, small end first onto the fiber, followed by the large crimp sleeve.
If you are terminating Electro Lite fiber, first slide a 2" piece of ¼" I.D. black heat shrink on the fiber before the boot. This is for the electrical termination covered at the end of this procedure.

Use an Exacto knife to trim 2" of jacket from the end of the fiber. When trimming the Electro Lite be careful not to nick the copper strands. Straighten out all the strands so that none overlap and bend them to a 45 deg. angle at the jacket edge. Trim each strand to ½" in length.

Use the Miller stripper to remove the white buffer from the fiber. Do not try to remove too much at one time. Take it off in ½" or 3/8" bites. Strip the buffer down to a ½" from the steel or copper strands. The glass must be spotlessly clean. Fold a Kim wipe in half 3 times. Let it soak up some Acetone and wipe the glass fiber with it. Hold the fiber under a light. If any dark spots appear they must be removed. Use more Acetone. Unless the glass is clean it will not slide through the connector.

Hold the fiber in one hand and the connector in the other. Brace one hand against the other and slide the fiber into the back of the connector. It should slide in easily but rarely does. Try rolling the connector between your fingers while gently pushing on the fiber. Be careful as the fiber may break. This part of the procedure is done mostly by feel. A little practice helps. If the fiber comes out the other end but hangs up, there is a bit of buffer on the side of the fiber that must be removed. Cleanliness of the glass is paramount to a good connector installation. When the fiber slides easily through the connector, remove it and set it aside.

Carefully fold the steel/copper strands forward so that the crimp sleeve can slide over them but not so tight that they cross over the fiber. You will slide the fiber into the back of the connector while the steel/copper will go on the outside of the ferrule to be crimped in place.

Mix a kit of epoxy and pour it in a small plastic cup. Set the cup on the heat block. In about 10 minutes all the bubbles from the mixing process will be gone and the epoxy will have a thin liquid texture.

Slide the crimp sleeve up to the edge of the steel/copper. Using a wooden stick from a cotton swab, apply a small drop of epoxy to the tip of the connector. This is where things get tricky. You have to move along quickly as the epoxy will thicken as it cools. Holding the fiber in one hand with the crimp sleeve in place and the connector in the other, slide the fiber into the back of the connector.
Gently push the fiber all the way home and then withdraw it a ¼". Stroke the fiber this way 3 or4 times. This will draw epoxy down into the hole. Gently slide the crimp sleeve over the steel/copper.

This is pretty easy with the copper but the steel can be tough. The potential to break the glass here is high so you might want to practice this a bit. When the crimp sleeve is in place, ensure that the connector sits squarely on the fiber and crimp it with the tool.

Using the side of a cotton swab gently slide it along the fiber as it comes out of the connector to remove as much epoxy as possible. Any remaining epoxy will be polished off later.

Use a small pair of cutters and trim the fiber to about ½". Dispose of the glass properly. Place the now terminated fiber connector in the heat block. Be very careful not to break the fiber coming out the end of the connector. The epoxy will cure in 30 minutes at 90 deg. Celsius.

Remove the connector from the heat block and allow it to cool. Make sure that the fiber is protected and will not break off. When cooled use the sapphire scribe to score the glass at the top of the epoxy bead. Gently push on the top of the fiber. It should break cleanly where it was scored. If the fiber only bends, rescore and try it again.

Polishing the connector

The polishing process is simple and requires only a few tools and supplies- a glass plate 8x11", a polishing fixture for ST connectors,3 grades of polishing paper, a microscope to examine the polished end, tap water and Kim wipes.

Polishing paper comes in 81/2" x 11" sheets. You get the most mileage from a sheet of paper if it is cut into quarters and it is much easier to handle. Fine paper is used as a finishing touch. It will not go a long way towards removing epoxy or scratches.

Rub a piece of course paper on the connector end using only the weight of the paper to grind down any sharp edges. Pour a little water onto the glass plate and place a piece of course paper on top. This will help hold the paper in place. Pour a little water on top of the paper and place the polishing fixture on the water. Insert the ST connector into the polishing fixture. With very little downward pressure. Rotate the fixture in a series of figure 8's – never in circles. The amount of polishing depends on how much epoxy is on the connector end.

After about 8 passes, look at the end of the connector. The epoxy turns orange when it has cured. If there is none visible you are ready for the medium paper. If any epoxy remains, try a couple of passes again with the course paper. Don't do this too much as the course paper can put some deep scratches in the glass that will be hard to remove.

The ST polishing fixture should be rinsed when switching to a different grade of paper so the grit is not carried over to a clean sheet.

Make about 20 passes with the medium paper. Try to use the whole piece of paper. Remove the connector from the polishing fixture and wipe of the tip with a Kim wipe. Insert the connector into the fiber scope and bring into focus.

Looking at the end of the connector, you should see it's smooth surface. It should be free of any scratches or bits of epoxy. Of course, it is not going to look that way. You will probably have to use 2 to 3 pieces of medium per connector.

Finally, do about 10 passes on a piece of fine grit. It makes a big difference, sort of like a final buff.

At this time the fiber is ready to check for light. If not in use, always have a dust cap on the connector tip.

If a newly installed connector fails to pass light, the fiber may have broken during installation. The most likely causes are:

1) when the crimp sleeve is pushed onto the back of the ST, it requires a fair bit of pressure. Ensure that the sleeve slides on straight and even. Do not put any lateral pressure on the fiber. As you push the fiber and crimp sleeve onto the back of the connector, you should se corresponding movement of the glass through the tip. If you don't see this movement then the glass may have broken.

2) when the epoxy has cured, the fiber extending from the connector tip is very vulnerable. If allowed to break without being scored first, the glass will shatter unevenly, most likely down inside the connector. This cannot be polished away.

Electrical Termination

The electrical termination is simple. All you do is attach a 16 gu. Drain wire to the copper Surrounding the fiber. Strip 1 ½" from the end of a 16 gu. Teflon wire. How far back from the connector you put the drain wire will be determined by the "J" Box you are going to put it into.

Use an Exacto knife to strip away a ¾" section of insulation. Put a little flux on it and wrap the 16 gu. Wire around it with at least 3 turns. Add a little more flux use a heat gun to solder the joint. The idea here is to get in with a lot of heat fast and get out.

After the solder job is complete, slid the piece of heat shrink over the joint and melt.

If you forgot to put the shrink on before the connector was put on, (it does happen) A 3/8" piece of heat shrink will slide over an ST connector. You can make up the bulk with some monkey dung. It's not elegant but it will work.