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Regarding Cables....

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A variety of cables are used in Gilderfluke & Co.'s Show Control and Sound Systems. This is intended to give you a quick lesson of how you cut and put the ends on the two most common types of cables.

Ribbon Cables: These are the most common type of cable in Gilderfluke & Company systems. Ribbon cable is made from a number of small gauge wires that are 'glued' together side-by-side.

Ribbon Cables can all be gray or colored coded with an industry standard sequence of colors. If the wire is all-gray, then the first wire is marked with a (usually red) stripe. If the wire is color coded, then the first wire is the brown one.

Ribbon cable comes in six, ten, fourteen, sixteen, twenty, twenty-five, twenty-six, thirty, thirty-four, forty, fifty, sixty, and sixty-four conductors. Most of the cables we use at Gilderfluke & Company are either ten or forty conductors. If you are unable to obtain a cable with the correct number of conductors, just get the next larger size. You can strip off the extra wires in just a matter of minutes.

Ribbon cables come in one hundred foot rolls. You should consider using a discrete wire cable with heavier gauge conductors for longer runs. These are available in longer 'put-ups'.

Most ribbon cables have no outer protective jacketing on them. This makes them unsuitable for pulling through conduit or applications where the cable must stand up to physical abuse. For these situations, a 'rolled ribbon' cable is available. This is a flat ribbon cable where the conductors are glued together only every foot or two, which are surrounded by a heavy protective jacket. Marks on the outside of the jacket show where the 'glued together' sections are, since you will need to find these to put the connectors on.

Connectors: The connectors that are used with ribbon cables are what are called Insulation Displacement Connectors. Depending on the type and sex of the connectors, they are referred to as 'IDS' for Insulation Displacement Sockets, 'IDM' for Insulation Displacement Male connectors, and 'IDE' for Insulation Displacement Edge connectors. These connectors have metal tabs that pierce the insulation around the wire as they are crimped into place on the ribbon cable. This means that an entire ribbon cable can be terminated in only seconds without any stripping or soldering!

If needed, connectors can be attached at many points along a cable. You are not limited to just putting connectors at the ends. If you need to connect cables, male and female connectors can be used.

At Gilderfluke & Company, we use T&B/Ansley brand insulation displacement connectors exclusively. The part numbers are (where the 'xx' is replaced by the number of pins needed):

609-xx30 for IDS Socket connectors
609-xx31HD for the matching strain reliefs for the IDS sockets
622-xx16 for IDM male connectors (with mounting ears)
622-xx06 for IDM male connectors (without mounting ears)
622-xx66HD for the matching strain reliefs for the IDM plugs
622-xx05 for IDE edge connectors (with mounting ears)
622-xx15 for IDE edge connectors (without mounting ears)

T&B/Ansley connectors are more expensive than the average ribbon cable connector, but they have some important advantages: In most cases the blades that pierce the wires are a 'tulip' design that contacts the wire at four points instead of the usual two, and all the contact surfaces are gold plated for reliability.

Do not use cheap connectors! If they are cheap, there is probably a good reason for it. You want to use connectors that have gold plating on their contact areas. If you don't, the contacts may oxidize over time and become unreliable.

Do not try to salvage used insulation displacement connectors! Once a cable has been crimped to a ribbon cable connector, the blades that pierce the wires are splayed just a little. This can cause a reused connector to be unreliable.

Tools: There are a number of different tools available specifically for use when terminating ribbon cables. The most common is a hand crimper available from many different suppliers (Radio Shack part number RSU 10274538). The best tool is a 3" to 4" bench vise. As long as the jaws are straight and parallel, this will work as well as any tool that is made specifically for ribbon cables.

Sometimes you will find yourself in a situation where you need to put the ends on a cable, but have no suitable tool available. Don't use a pair of pliers or a hammer! It is possible to improvise a better tool. The trick to getting a good crimp on a ribbon cable is applying even, parallel force to crimp it. This can be done by hinging a pair of 1" x 4" boards two or three feet long [1]. You can also use a single piece of lumber and a sturdy table top. Place the connector to be crimped eighteen to twenty-four inches from the hinge and parallel to it. Make sure that the wire exits the connector at a 90° angle. You can then apply an even pressure to crimp the connector using a 'c' clamp, good-sized pair of pliers or vise grips, or just some weight.

Attaching the Connector: There are four ways a ribbon cable can be inserted into an insulation displacement connector for crimping. Two of the ways won't work [2], and two of the ways will. One of these is what we prefer at Gilderfluke & Company. Your odds are 50% of getting it right no matter what!

The steps in crimping a ribbon cable connector are:

1) **Reverse the back if needed:** Often the part of the connector that holds the wire in place is asymmetrical. They are on T&B/Ansley 609-xx30 connectors that we use. As it happens, the way we prefer to crimp the connectors requires us to pop off this back and reverse them. You want to have the 'serrated' side located on the same side of the connector as the polarizing 'bump' (or pin #1 for connectors without a polarizing bump). This makes it easier to trim the wire in one of the following steps.

2) **Position the ribbon cable through the connector.** This is the part where you have to be careful! The number 'one' wire needs to be located at the number one mark on the connector. If the wire is all-gray, then the first wire is marked with a (usually red) stripe. If the wire is color coded, then the first wire is the brown one. The number one mark on most connectors is a small triangle molded into the plastic. It will be on the same side of the connector as the polarizing bump. Some connectors have an actual number '1' molded in.

   The ribbon cable needs to extend away from the connector on the same side as the polarizing bump and serrated side of the back piece. The wire must be held with as close to a 90° angle from the connector as possible. The wire must not be shifted to the left or right in the connector, but must be centered. The designs of the T&B/Ansley connectors make it hard to offset the wires.

   If you are adding a connector to the middle of a cable, you may need to remove the back to slip it onto the cable. This is done in the same way as removing the back to reverse it.

[1] If you use a router to make a groove in the boards to accept the connectors, and a guide to hold the ribbon cable at a perfect 90°, you can actually make a better crimp tool than any you can buy.

[2] You have a 50%/50% of crimping it on in a way that will work. A one in four chance of getting it right.

3) **Leave a little extra:** If this is the end of the cable, leave the wire extending through the connector an extra 1/4 to 1/2 inch. This will be trimmed off later.

4) **Position the cable & connector in your crimp tool:** Position the cable and connector in the crimp tool and make sure that the ribbon cable is at 90° to the connector.

5) **Double check pin one:** Just make sure that pin one is still at the same end of the connector as is the ribbon cable's wire number one.

6) **Squeeze it:** Apply a gentle even pressure until you hear the two ends of the connector click into position.

7) **Trim the excess:** If this is the end of the cable, you will need to trim off the extra wire you left sticking out of the connector. To do this you will need a very sharp knife. A single edged razor blade, X-acto or similar knife will work the best. The technique which works the best is to 'shave' off the excess wire. Just slide the edge of the knife down the edge of the connector. When you have done it correctly, it will leave just a nice square end on your cable that is flush with the edge of the connector. There should be no stray bits of wire remaining, as these could potentially short to their neighbors.

8) **Attach Strain Relief:** The strain relief is another little piece on the connector that helps hold the wire in place. Some connectors use these and others do not. To install it, fold the end of the cable back over the top of the connector and clip the strain relief in place. The cable should now extend away from the side of the connector with the polarizing bump on it.

9) **Test It:** After the second end has been put onto the cable, you can test it electrically. We use a tester from Beta Automation (model CTS-64) that can be used to test for any shorted or open conductors in the finished cable assembly. If you were careful, you will only rarely find a problem.

Modular Cables: The second most common connector used in Gilderfluke & Company systems are a modular 'telephone' style connector. These come in four position/four conductor 'handset' (RJ-08), six position/six conductor (RJ-12), and eight position/eight conductor (RJ-45). Beware of six position/four conductor (RJ-11) connectors and cables, as they will not work properly with Gilderfluke & Co. equipment. We need all six conductors.

Connectors can only be put at the ends of RJ- cables. Splitters and butt couplers are available if you need to join or split cables.

A ready made RJ- cable will probably have one end reversed and will not work with Gilderfluke & Company equipment. Telephones need flipped connections. Computers do not. All of our systems need cables that are wired straight through. If you hold up both ends of the cables with the latches facing the same direction, the colors of the wires in both connectors should be in the same order.

A RJ-08 connector can be plugged into a RJ-11 or RJ-12 socket. A RJ-08, RJ-11 or RJ-12 connector can be plugged into a RJ-45 socket. Of course they will make contact only with the middle four or six contacts of the bigger connector.

Because modular telephone cables were designed for telephone use, they are especially well suited for applications that require flexing. For really high flex applications, coiled cords are available. Modular cable is available in lengths to 1000 feet, and a variety of colors. In applications where you need to run a lot of these cables, adapters are available to attach a number of modular jacks to a large twenty-five pair cable and back.

Connectors: As with the ribbon cable connectors, the ends on these cables are 'insulation displacement'. All four, six or eight wires are terminated at the same time by crimping on a connector. We use exclusively Amp brand connectors:

RJ-08 four conductor/four position- 5-641334-3
RJ-12 six conductor/six position- 5-641337-3
RJ-45 eight conductor/eight position- 5-554739-3

Tools: Unlike ribbon cables, there is no substitute for the appropriate tool for putting the ends on these cables. The tool that we use is a Wiedmüller/Paladin Tools 1530R. It will crimp all three of the main modular connectors. In a pinch, you can use a crimp tool from Radio Shack (part number 279-388) for crimping four or six conductor, six position RJ-11 or RJ-12 cables. These are really marginal tools and will probably break after a few uses. You shouldn't rely on one as your main crimp tool. Whatever crimper you choose, make sure that if it can crimp six position/six conductor RJ-12 ends. Many cheap tools will only crimp four conductor/six position RJ-11 ends.

Attaching the Connector: In most cases there are two ways a modular cable can be inserted into a RJ- connector for crimping. One of the ways won't work, and one of the ways will. Your odds are 50% of getting it right no matter what!

The steps in crimping a modular cable connector vary depending on the crimp tool you have:

1) **Cut the End Square:** Most crimp tools have a cutter that should be used to cut the end of the wire square and clean before it is terminated.

2) **Strip the Jacket:** RJ- wires need to have a bit of the jacket stripped off around the wires before they can be crimped (12 mm for RJ-45, and 6 mm for all others). **The insulation around the wires themselves must not be stripped**. There should be a stripper on your crimp tool that will strip off the exact correct amount of the jacket. If you strip off too much of the jacket, the connector won't have enough jacket to grab onto once the crimp is made. It uses the jacket for the mechanical connection between the cable and the connector so that when you pull on the cable, you are pulling on the jacket instead of the conductors inside the connector.

3) **Get Ready:** Insert the wire in the new connector. Facing the end of the cable with the release latch upwards, its wire color code is as follows:

	RJ-08	RJ-11	RJ-12	RJ-45
LEFT	n/a	n/a	n/a	#1 gray
	n/a	n/a	#1 white	#2 orange
	#1 black	#1 black	#2 black	#3 black
	#2 red	#2 red	#3 red	#4 red
	#3 green	#3 green	#4 green	#5 green
	#4 yellow	#4 yellow	#5 yellow	#6 yellow
	n/a	n/a	#6 blue	#7 blue
RIGHT	n/a	n/a	n/a	#8 brown

The wire MUST be inserted until the individual wires all reach the front of the connector. If the appropriate amount of the jacket was stripped off, then the jacket should be inserted into the connector until it reaches its stops.

4) **Crimp It:** Insert the connector in your crimp tool and squeeze it. When you remove the connector from the crimp tool, the gold contacts should be pushed all the way through the wires. The clear plastic should be gripping the wire jacket at the rear of the connector.

5) **Test It:** After the second end has been put onto the cable, you can test it electrically. We use a tester from Wiedmüller/Paladin Tools ('Patch Check' model number PA-1529) that can be used to test for any shorted or open conductors in the finished cable assembly. If you were careful, you will only rarely find a problem.