MAKING YOUR OWN ADAPTERS FOR THE BIG MACK & SUPER MACK CRT TESTERS

by: John P. Young

INTRODUCTION

Owning an older CRT tester/Rejuvenator is a lot like playing a roulette wheel with adapter socket numbers around the rim. You pull the back off that TV or computer monitor whose CRT you want to test, read the picture tube number, open your CRT Setup Book, and hope that the adapter number that you just hit on that imaginary roulette wheel corresponds with one that you have in your collection. If it doesn't, a valuable piece of test equipment will probably go back on the shelf and sit there. This represents a waste of good equipment, since these testers have the potential to test and rejuvenate, if necessary, almost any CRT, new or old. But adapters for the newer CRTs are hard to find. So, now what do you do?

Well, you COULD search for a supply house that has the one you need, or you could watch and wait for that adapter to come up for sale on ebaY, but you might grow old in the process. That's because Sencore no longer stocks or manufactures any of these adapters, and those "popular " ones, like sockets 17, 20, 23, X23, and 24, are as rare as hens' teeth. Socket 23 covers almost all GE/RCA CRTs made after 1985, and 24 handles the Sony in-line Trinitrons. Socket X23 is a must for testing mini-neck CRTs, like those used in computer monitors. About the only way to get one of these is to buy a tester that has these sockets with it. But, even if you buy one of the many newer Sencore CRT testers online, there's no guarantee you'll get one with the adapter socket you need.

Another solution – and a very GOOD one – is to buy the latest (year 2000) CRT setup book for the Sencore CR70, build a universal adapter for your Mack, and use that system instead of adapters. I'll explain how to do that at the end of this paper. The CR70 setup book is a good investment anyway, since it contains the pin outs for every CRT that it lists, eliminating the need for base diagrams or schematics. But you might not be able to find a CR70 setup book.

So, you may have to BUILD your own adapters. It's NOT hard to do. All you need is an Amphenol 86-CP11 plug, a few feet of multi-conductor cable with color-coded wires, the proper wiring diagram for your tester and the socket you need, and the actual socket for the picture tube you want to test. You will find two of those "needs" right here in this paper (the diagrams), and the rest can be found at various electronics parts centers.

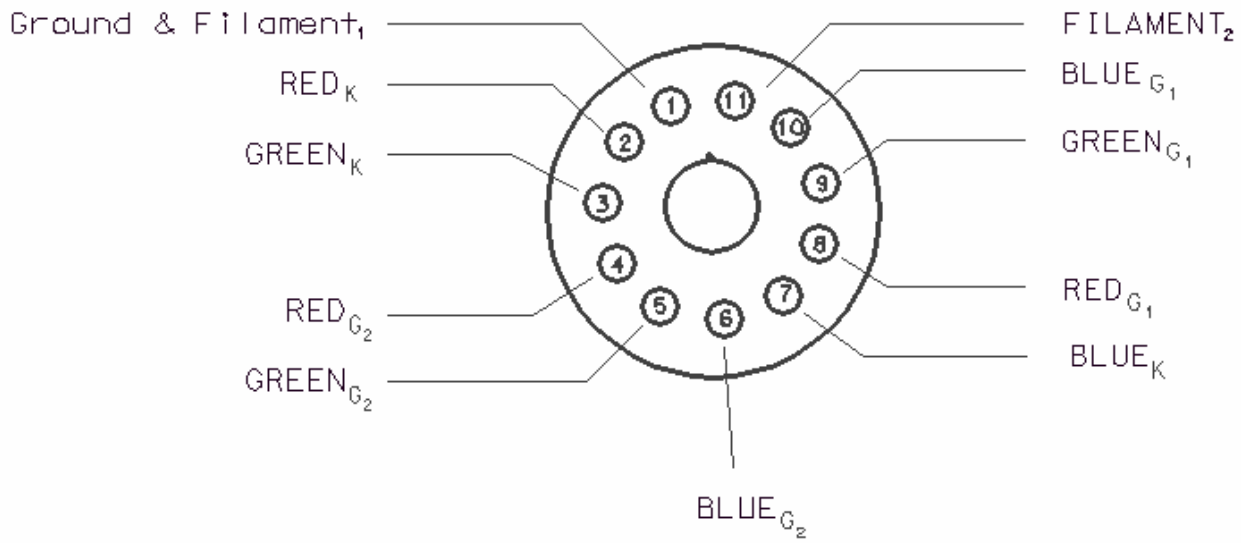
All a CRT tester does is generate typical voltages for the red, blue, and green cathodes (K), the control grids ($G_{1)}$ and screen grids (G_2), and the heaters (filaments), and output those through a cable and adapter setup to the picture tube under test. In the case of the Big Mack and Super Mack, the adapters plug into an 11-pin socket made by Amphenol. The reason I said "7 or 11-conductor cable" is that a large number of adapter sockets have the red, blue and green G_1 and G_2 connections tied together, because the base arrangements in the CRTs they are intended to test were designed that way. The others require 11 individual connections.

ANOTHER way to build the adapter you need is to find the right one for another brand of tester, like the B&K 467 or 470, cut off its plug, and wire the leads into an Amphenol 86-CP11 plug. But FIRST, you need some wiring diagrams!

THE SENCORE BIG/SUPER MACK SOCKET

The figure below shows the Amphenol SOCKET on these two Sencore units, with the holes facing TOWARD you. It was hand-drawn with CADD, so please forgive me if it's not exactly to scale.

The Amphenol/Sencore 86-CP11 Socket



An important point to remember is that this layout is also the proper arrangement when you are looking at the BACK SIDE (the WIRE side) of an Amphenol PLUG.

So at this point, if you happen to have the adapter socket you need in another brand that uses an enclosed CRT socket with individual leads to a common plug (like B&K Precision), ALL you need now is the Amphenol PLUG and shield, and a soldering iron or gun, and you're in business. Even if you don't have the wiring diagram for the "non-Sencore" adapter, you can use a continuity tester or a digital multimeter to create your own wiring diagram.

But let's say you DON'T have such an adapter. So now, it's up to you to build one. To do that, you need the correct socket for the CRT under test, a length of 7 or 12-pair multi-conductor wire, and the Amphenol plug.

So, now it's on to the Parts List! (next page)

PARTS LIST

Part & Number	Description	Possible Source
Amphenol 86-CP11	Plug & shield	Leeds Electronics 68 North 7th Street Brooklyn, NY 11211 Phone: 718 963-1764 email: sales2@leedselect.com
Belden 8487 or 9439 or similar	7-conductor cable	Cumberland Electronics www.cumb.com
Belden 8457 or 8466 or 9457 or similar	12-conductor cable	Cumberland Electronics www.cumb.com
HPS1600, etc *	CRT sockets:	Cumberland Electronics www.cumb.com

* The socket you need will vary. HPS1600 corresponds to socket 23, which is probably the one you'll use the most for post-1985 GE/RCA TV picture tubes.

The CRT sockets are the toughest to find. If you surf the web for sources, you'll get thousands of "hits." But you'll also quickly discover that these sources are MANUFACTURERS, who will only sell to companies like Sencore or B&K. There's even one that has the EXACT sockets we all want: pre-wired, enclosed sockets with 6"-12" color-coded leads, like the ones B&K uses on their adapters. But those manufacturers won't even answer your email, unless you plan to establish a business account with them and commit to buying sockets in lots of 100,000, or something like that.

Most wholesalers or retailers like Leeds only carry the older ones, and whether you own a Big or Super Mack, you probably have sockets 1 through 16, or 1 through 18. You may be able to salvage the one(s) you need from a defunct TV or computer monitor. Cumberland Electronics carries the one that works for Socket 23, which is HPS1600, at a cost of around $3. The base on this is a JEDEC B10-277 pattern. If that means nothing to you, don't worry about it for now. All you need to know is that the JEDEC base number corresponds to a certain type of picture tube neck and base, such as mini-neck, small-neck, and large-neck CRTs.

With respect to the wire, almost any 18 to 22 gauge, 300 – 600V, unshielded cable with enough conductors will do. I say UNSHIELDED, because the shield is unnecessary, it gets in the way, and it could cause a short circuit – you'll have to cut it way back, anyway. So why pay extra for it? And obviously, since the Amphenol plug is only an 11-pin plug, you'll end up wasting one conductor when you have to use the 12-conductor cable. But it's better than not having enough conductors. (If you can find an 11-conductor cable, feel free to use it!)

A word about the colors in the wire you selected. Since I don't know what wire you'll use, I can't select them for you. But BLACK is typically the ground in electronics, so I would use that for the Ground/Filament 1 connection (pin 1). Since there is NO orange color gun, I would use that for filament 2 (pin 11). From there, the rest is up to you. You will probably have one each of red, blue, and green-jacketed wires, and I recommend them for the red, blue, and green Cathodes (k). It will be difficult to use the standard electronics color-code for these wires, since it's unlikely that the wire you find will have colors that correspond to those used for the filaments, cathodes, grids, etc.

Let's look at a 12-conductor cable, Belden 8466. This is a 300-volt, 18-ga., unshielded audio cable, and the larger gauge makes it a little bit more inconvenient to work with. But the colors are very convenient!

Table 1: Belden 8466 Color Codes

1	BLACK	2	WHITE
3	RED	4	GREEN
5	ORANGE	6	BLUE
7	WHITE/BLACK	8	RED/BLACK
9	GREEN/BLACK	10	ORANGE/BLACK
11	BLUE/BLACK	12	BLACK/WHITE

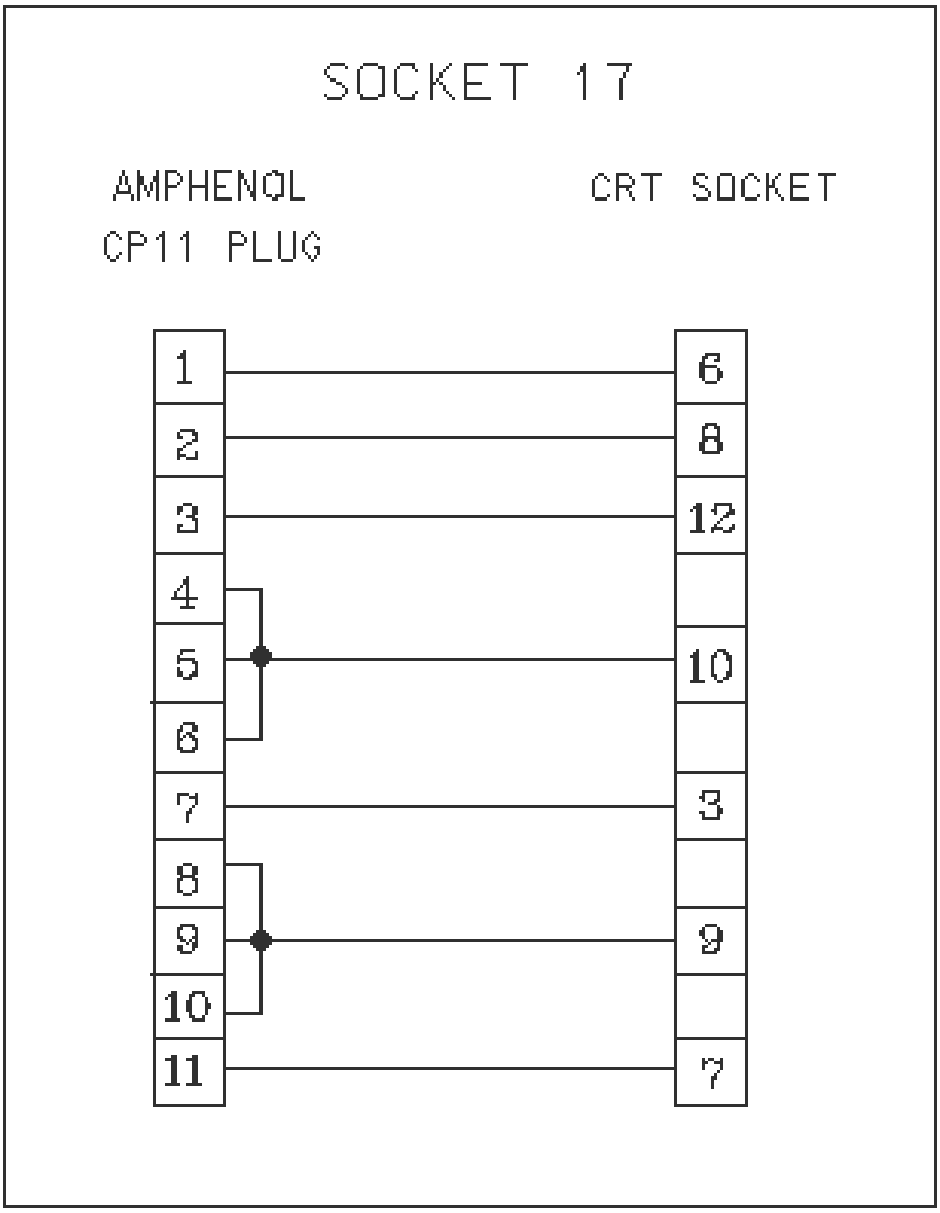
You could use the red, blue, and green wires for the respective cathodes (K), the red/black, green/black, and blue/blacks for the screen grids (Red G_1, etc), and three of the remaining four wires for the control grids (G_2). The orange/black should be used for the Filament/Ground pin, and the plain orange for the Filament 2 pin.

From here, it's time to get to the wiring. DON'T forget to slip the protective shell over the wire before you solder the first set of wires to the Amphenol plug and CRT socket, and use some heat-shrink tubing to make the CRT socket end more manageable, and to help provide lateral stability to the socket pins. The odds are, you WON'T be able to find enclosed CRT sockets, like the B&K series adapters, and since CRT sockets that were intended for soldering into a CRT driver board have little support for the pins on the back side, the pins can move around a fair amount when the socket is used for this "alternate" purpose.

Here's a tip! If you're an experienced hobbyist or technician, you COULD bring 7 or 11-conductor cable from the plug into a small project box, with a terminal strip in it. Then, you could wire several different CRT sockets to the strip to make an adapter that covers a large number of CRTs. Sockets that have pins 4,5,6 and 8,9,10 tied together, like sockets 17, 23, and X23 could be connected together into a single plug adapter this way, making it a VERY convenient adapter to have indeed. The same could be done with several sockets that use 11 individual wires. Just don't "mix and match" the two types or the sockets that DON'T have those pins tied together will be shorted out by the ones that do. If you're a REAL expert, you could use wafer or even individual switches to isolate the sockets, but it may not be worth the effort.

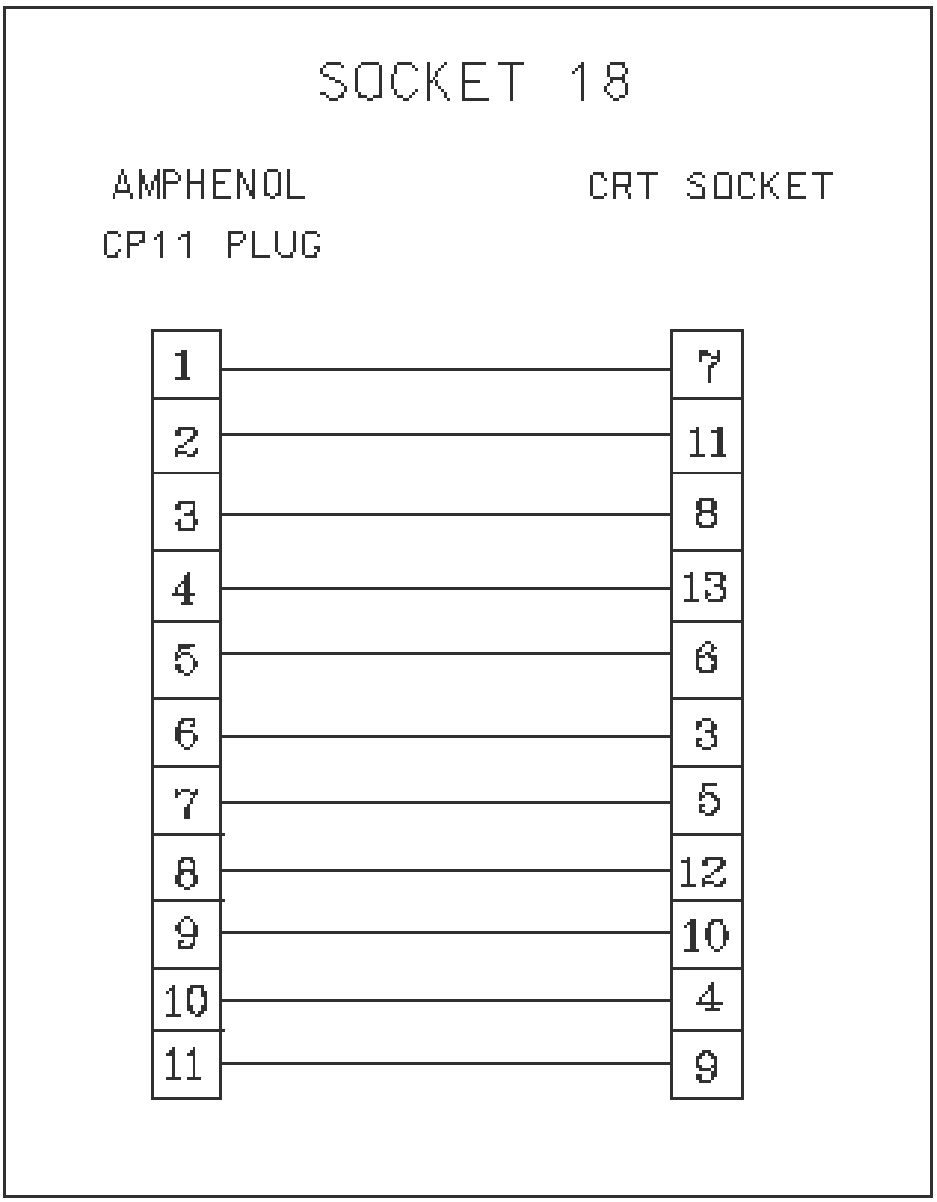
If you make the wires from the Amphenol Socket to the box 12"-18", and the wires to the individual sockets about the same length, you can set your Mack at a more convenient location than the original cord allows. This is especially true with the Big Mack, since its "factory" cord is shorter than the Super Mack's. In any case, don't go overboard - 12" to 18" should be long enough.

To get you started, I've included wiring diagrams for sockets 17, 18, 19, 20, 23, 24, 26, and a number of commonly used "X" sockets (including the VERY desirable X23) on the following pages, as well as a list from Sencore of all socket adapters and their pinouts for sockets 1 through 26, and all but four of the "X" sockets up to X27. Based on my 1993 CR168/31A setup book, the sockets I list represent 95% of the tubes you will ever encounter. I list each one individually so you can simply print the diagram you need. I've found that this avoids confusion when you're trying to solder together an adapter and view the diagram at the same time.

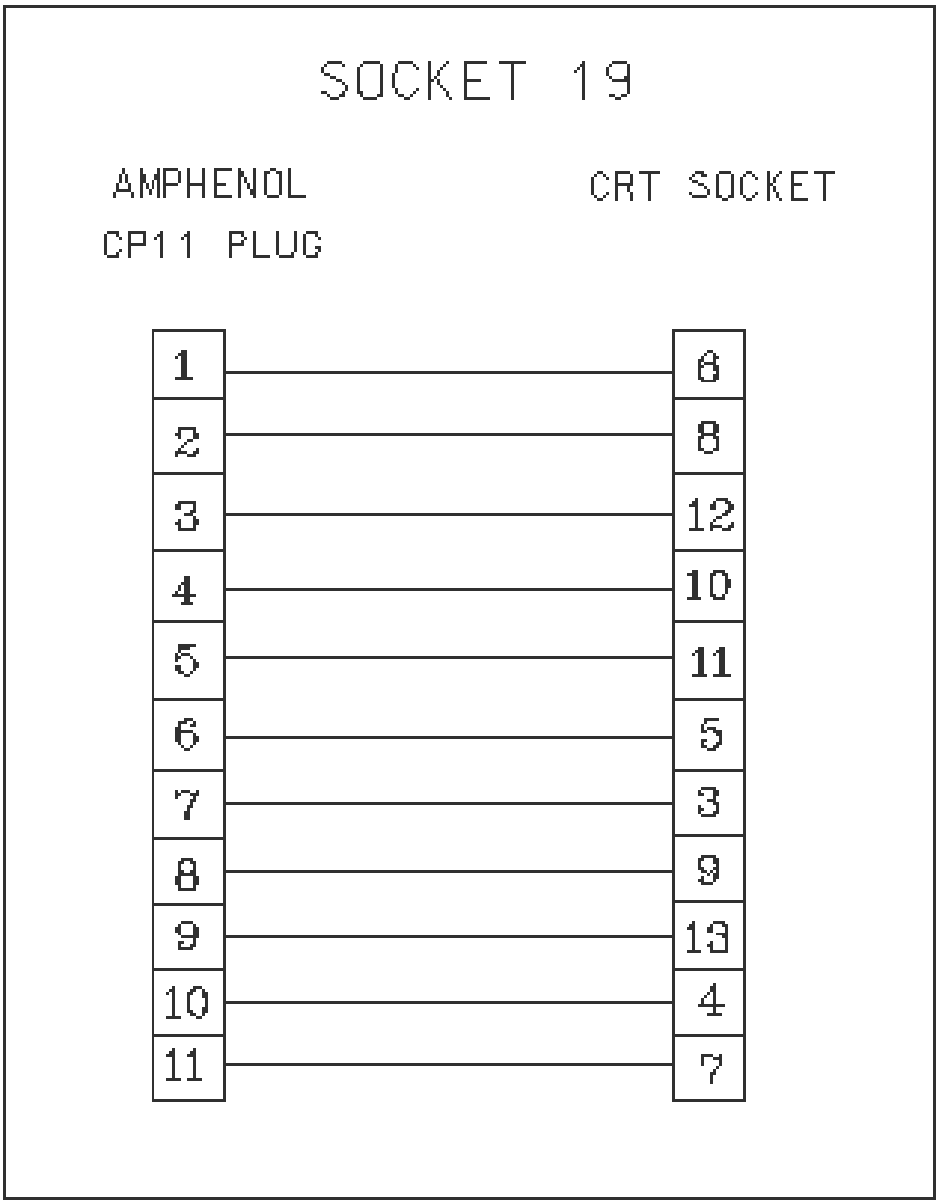


If you own a Big Mack with just the original 16 sockets, chances are this is the first adapter you yearned for. This one is probably the third most common adapter listed in the 1993 setup book. From the diagram, it's obvious that you can get by with a 7-conductor wire here, since this adapter ties all of the G1 and G_2 pins to a common pin on the CRT socket.

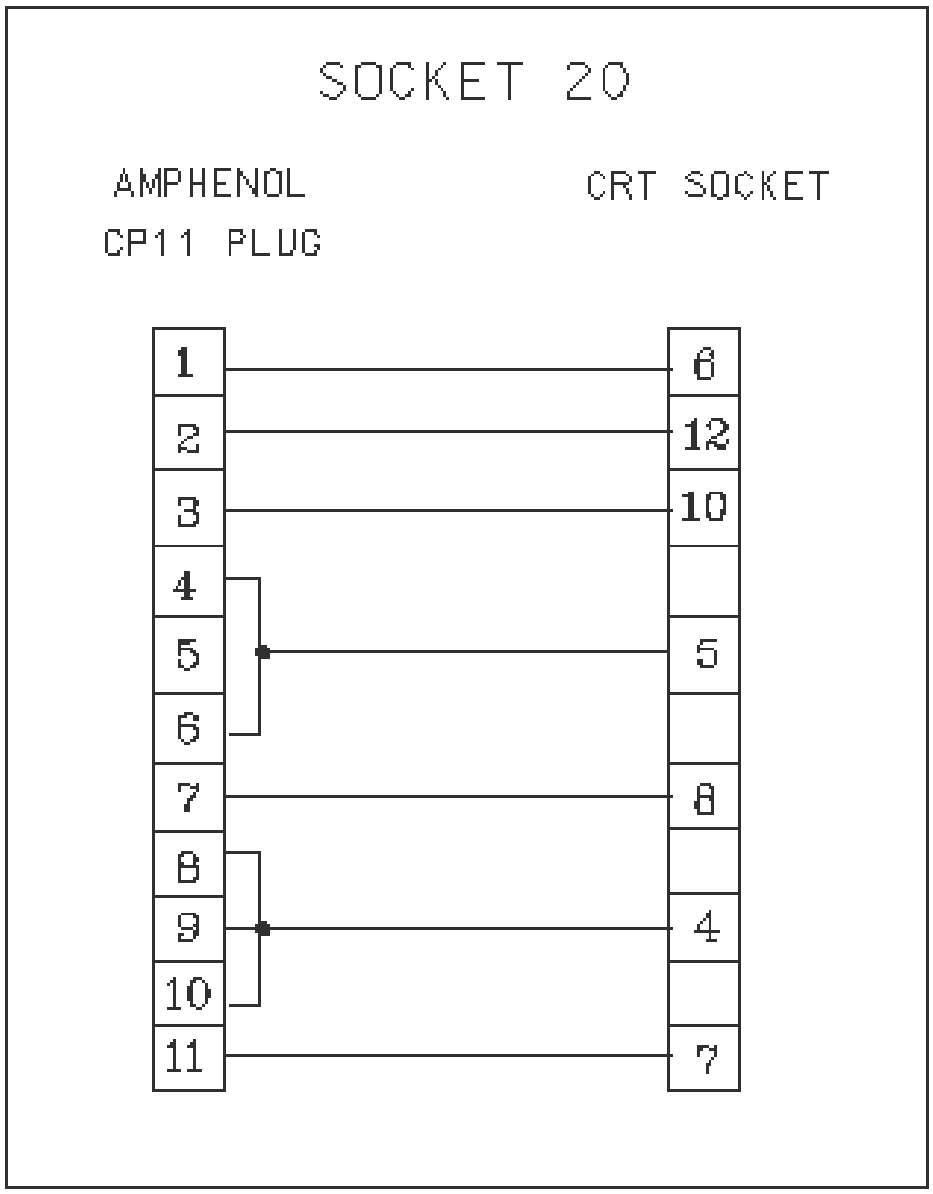
You can also make this adapter by carefully disassembling a socket 18 adapter, which is still available from Sencore, and rewiring it as a 17. But this operation is reserved for those who possess the patience to build a ship in a bottle, or tie Trout fishing flies. I made a socket 17 adapter this way, and I'll never do it again. But since I mentioned it, I've included a page at the end of this section with tips on how to do it.



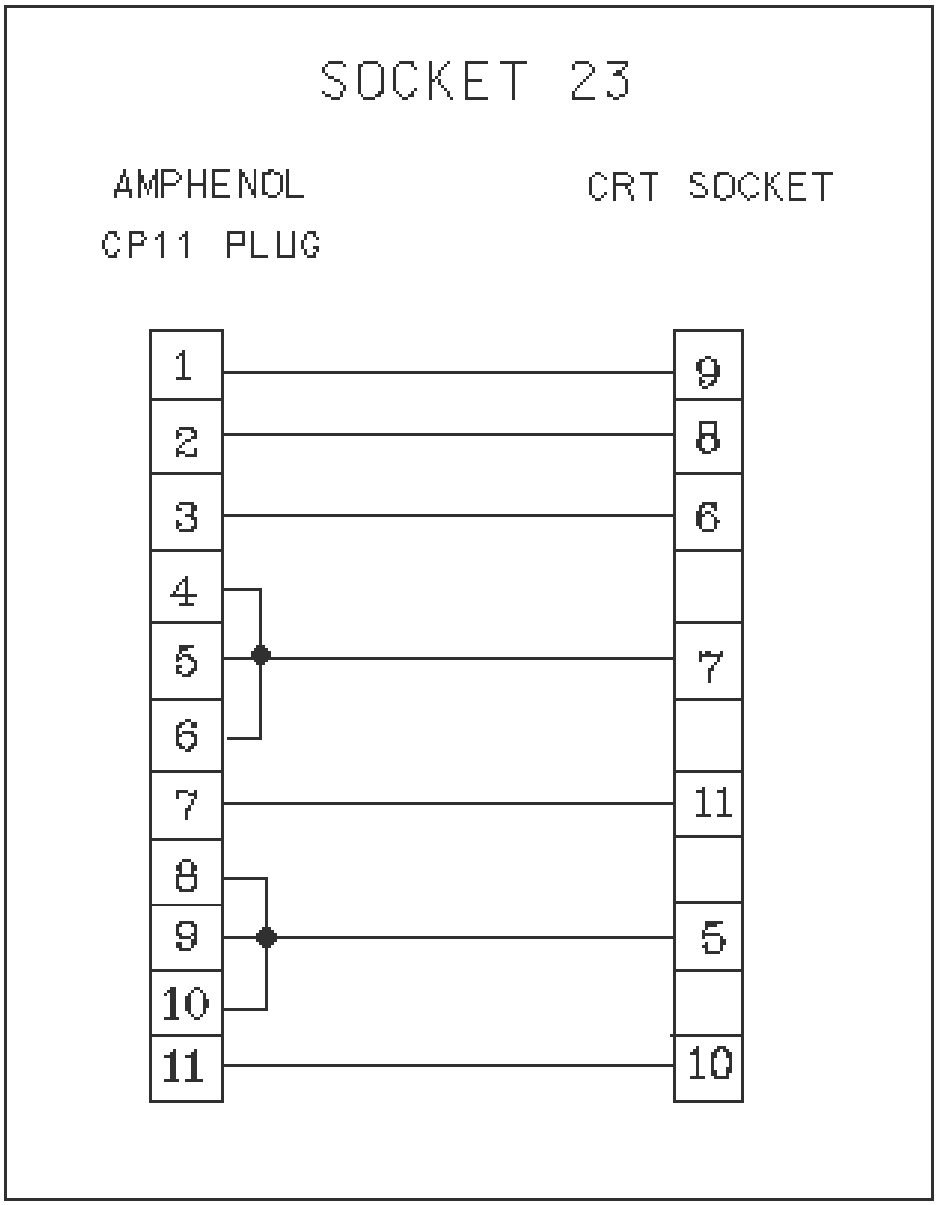
Socket 18 is one of those that require an 11-conductor cable. It's used less often than socket 17, but it's still common enough that you'll almost certainly have to have one. If the Sencore Parts Department still has one in stock, however, I recommend buying it instead of making it.



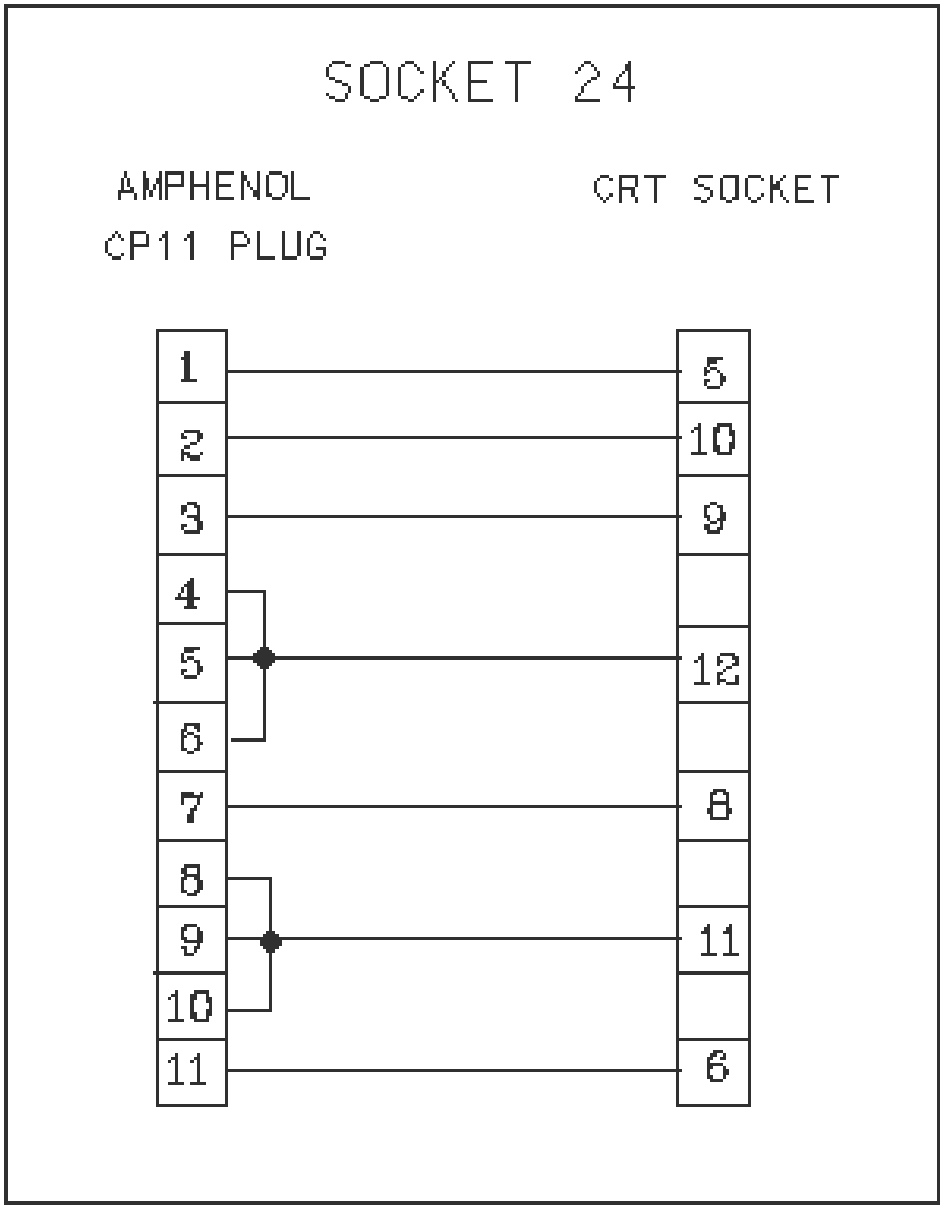
This is another useful but not commonly used socket. But in case you need it, and Sencore Parts is out of it, here's the diagram.



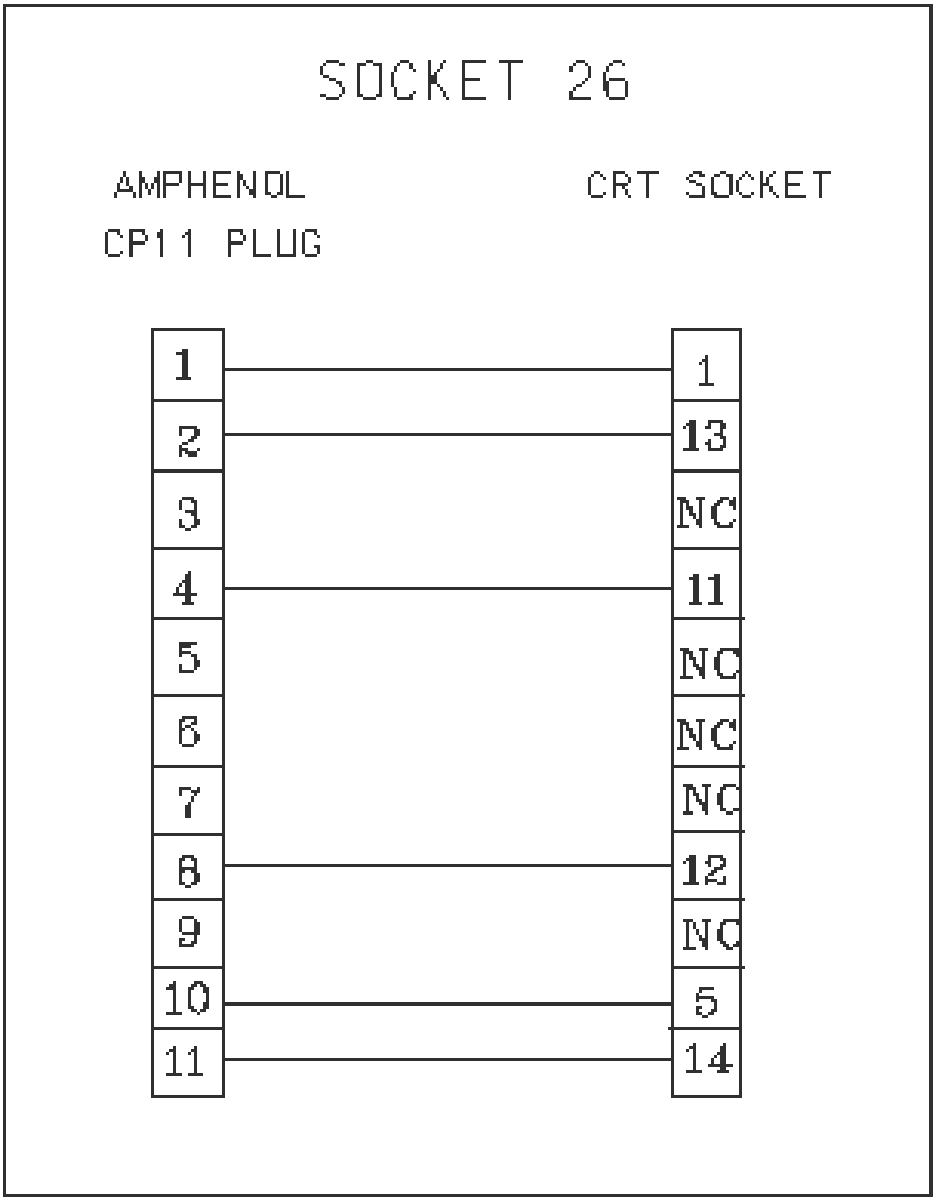
Here's another adapter that uses a 7-conductor cable. The frustrating fact is that on many of these, only one or two pin assignments change, but the difference is enough that you can't use an adapter you already have that is "close."



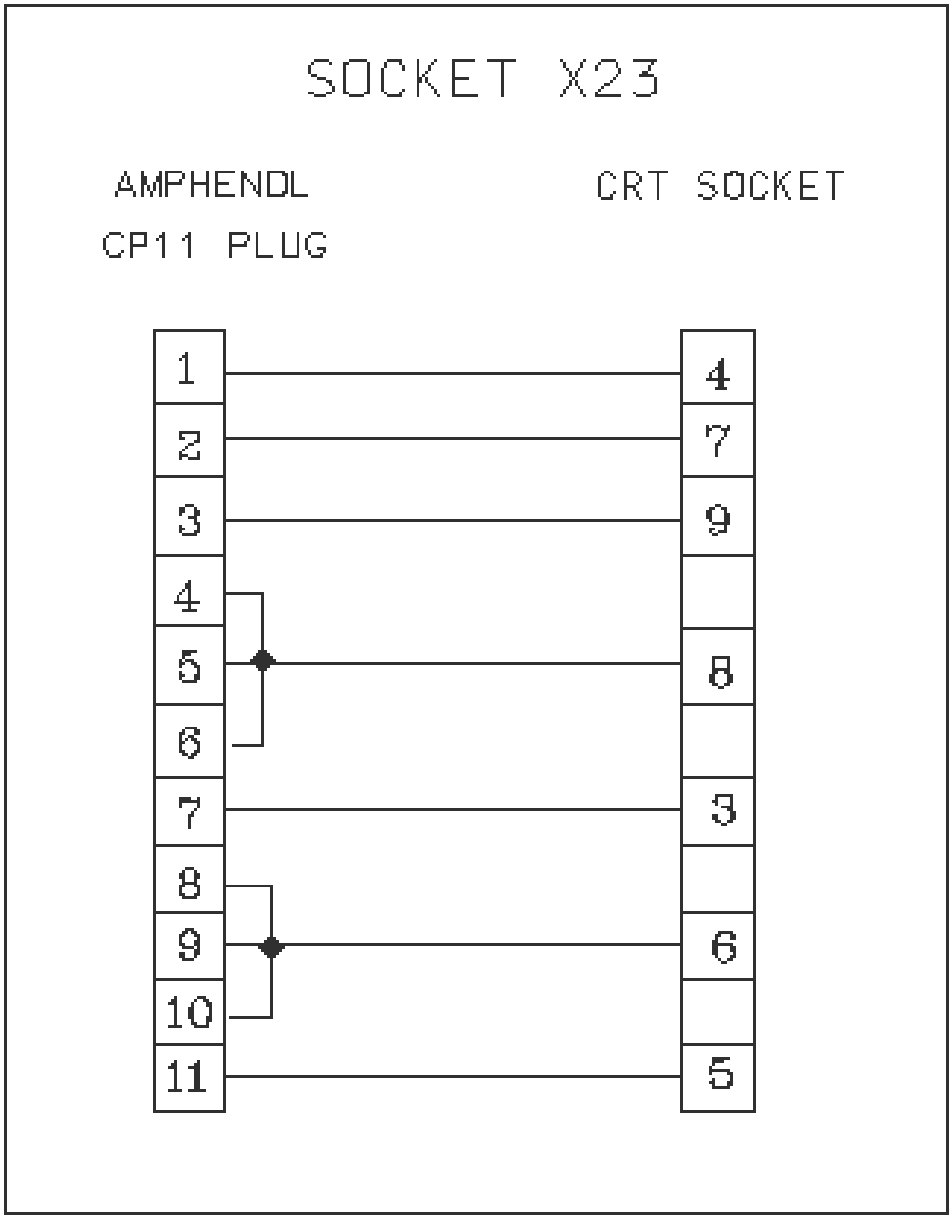
If you have THIS adapter, you can probably pay for your Mack by restoring most of your neighbors' picture tubes. That's because this socket covers virtually all GE/RCA picture tubes after 1985 (or even earlier). It worked for 3 of the 5 TVs in my house. One of the other sets needed socket 17, and the other needed socket X23. Sencore made this adapter by cutting a pie-slice shaped wedge out of the 13-pin plastic sockets used for adapter 18, etc. This works, but it makes it tricky to get on the CRT sometimes, and it's also weaker than the other adapters.



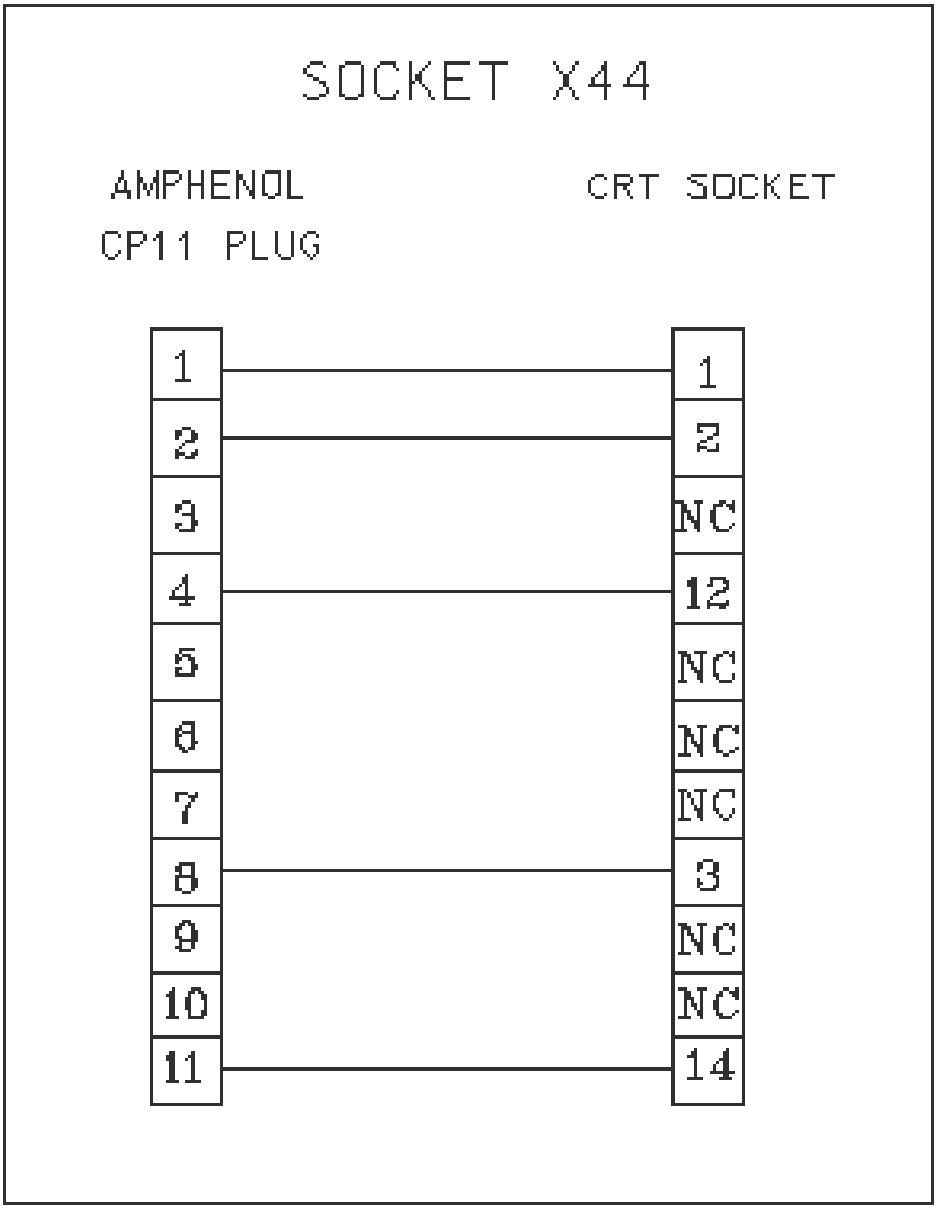
This one is for SONY TRINITRON in-line gun CRTs.



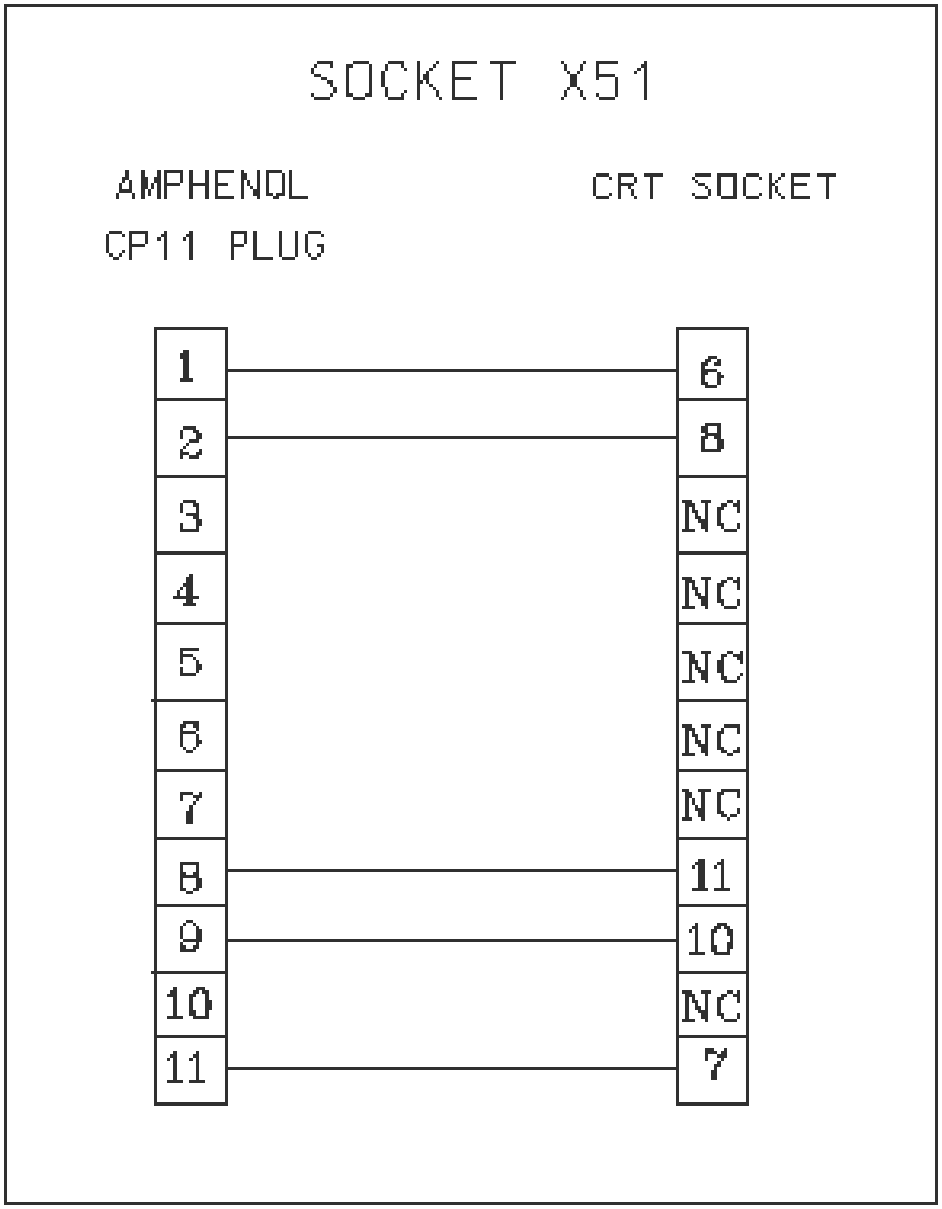
If you plan to repair projection TVs, this one is used for Advent, Magnavox, Sylvania, and RCA projection CRTs, which represents probably 75% of the sets in use. Note that due to the large number of open pins (NC, or No Connection) you can get by with a 6-conductor cable, here.



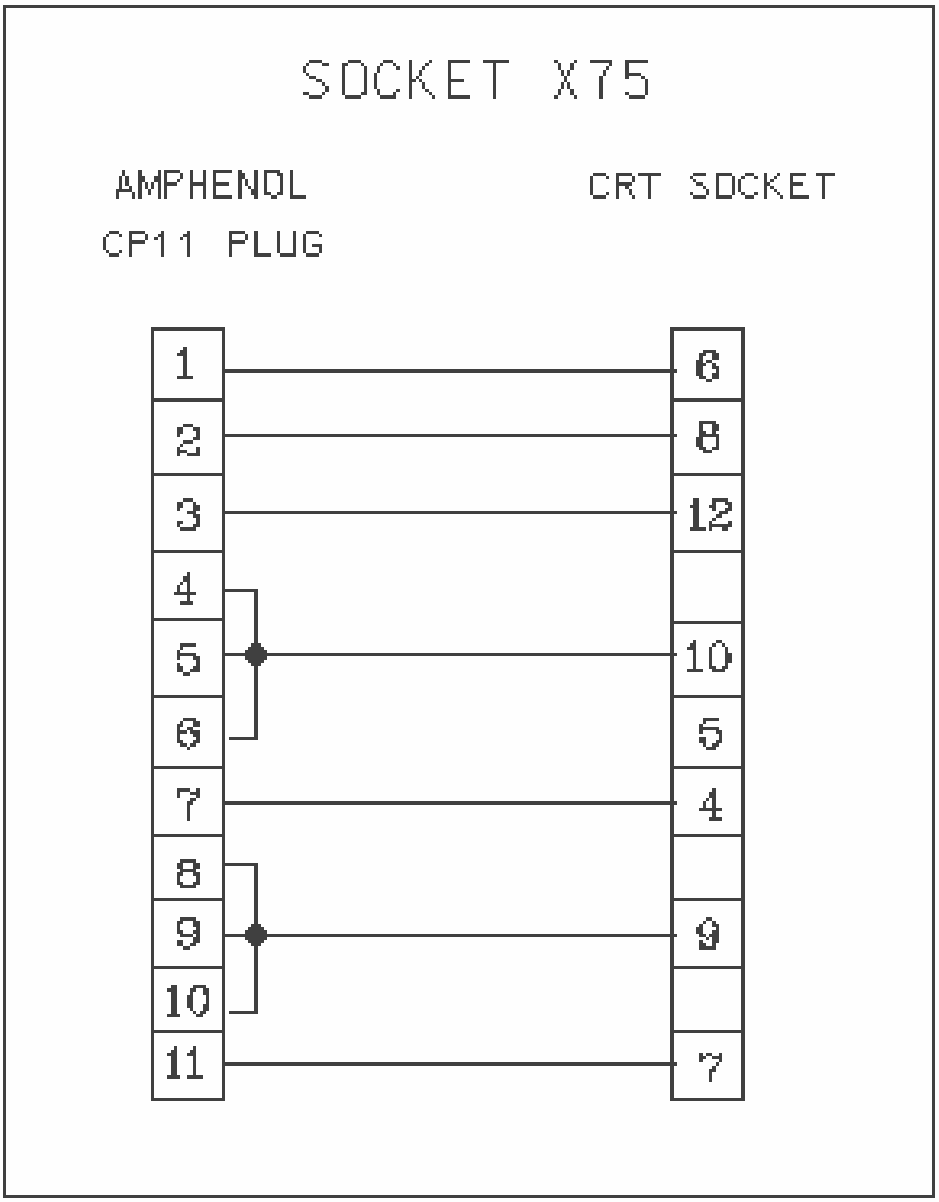
This is the “hot” socket adapter for the mini-neck CRTs. The CRT socket is a JDEC B8-228. An HPS1171 or HPD2171 by Hosiden or equivalent should work nicely. Or you can do what I did and salvage a socket from an old computer monitor with a “toasted” motherboard. The focus lead is not used, but the focus “cage” makes a convenient place to grip the socket.



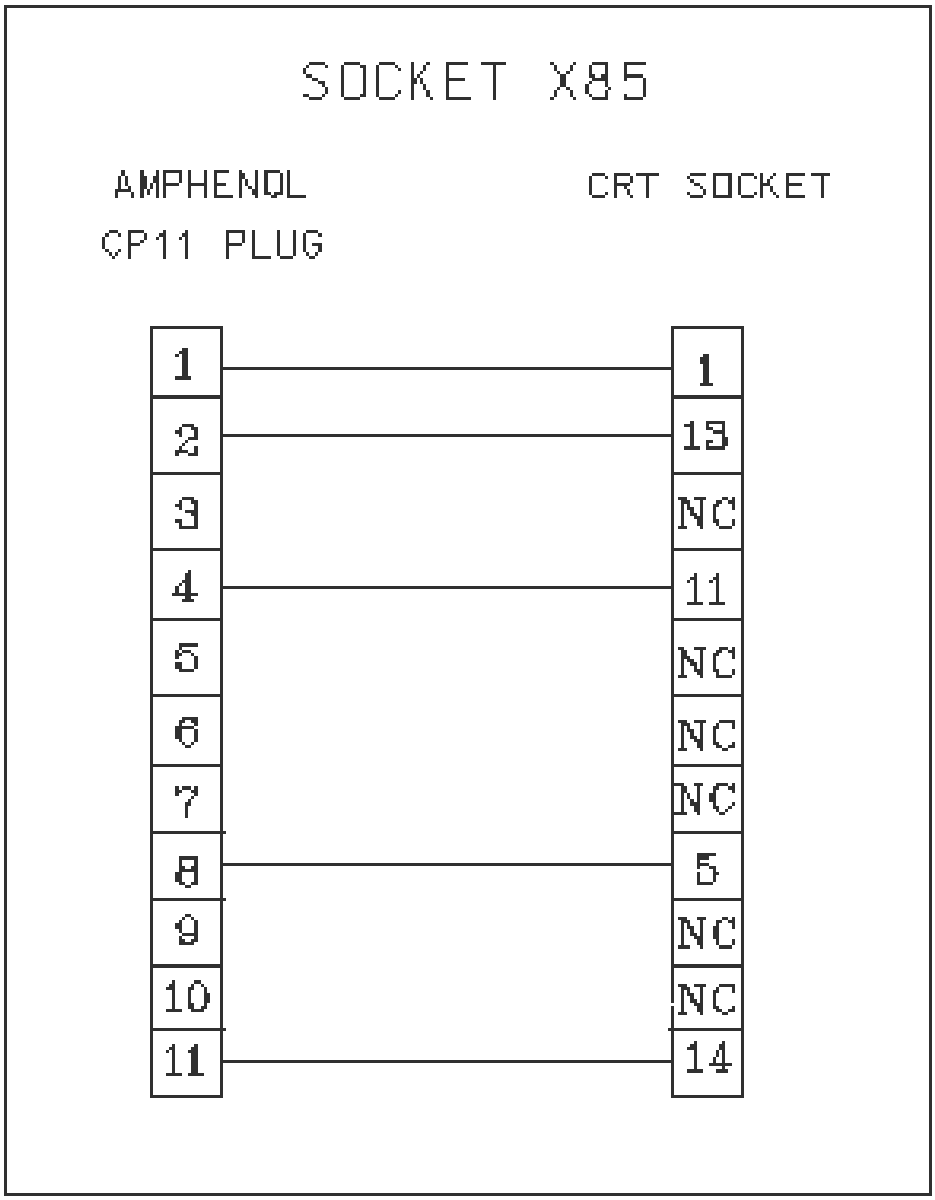
This adapter fits a large number of oscilloscope CRTs, such as the D14-363GY, a rectangular-screen, 6-inch tube used in modern scopes made by Instek, Hameg of Germany, and others.



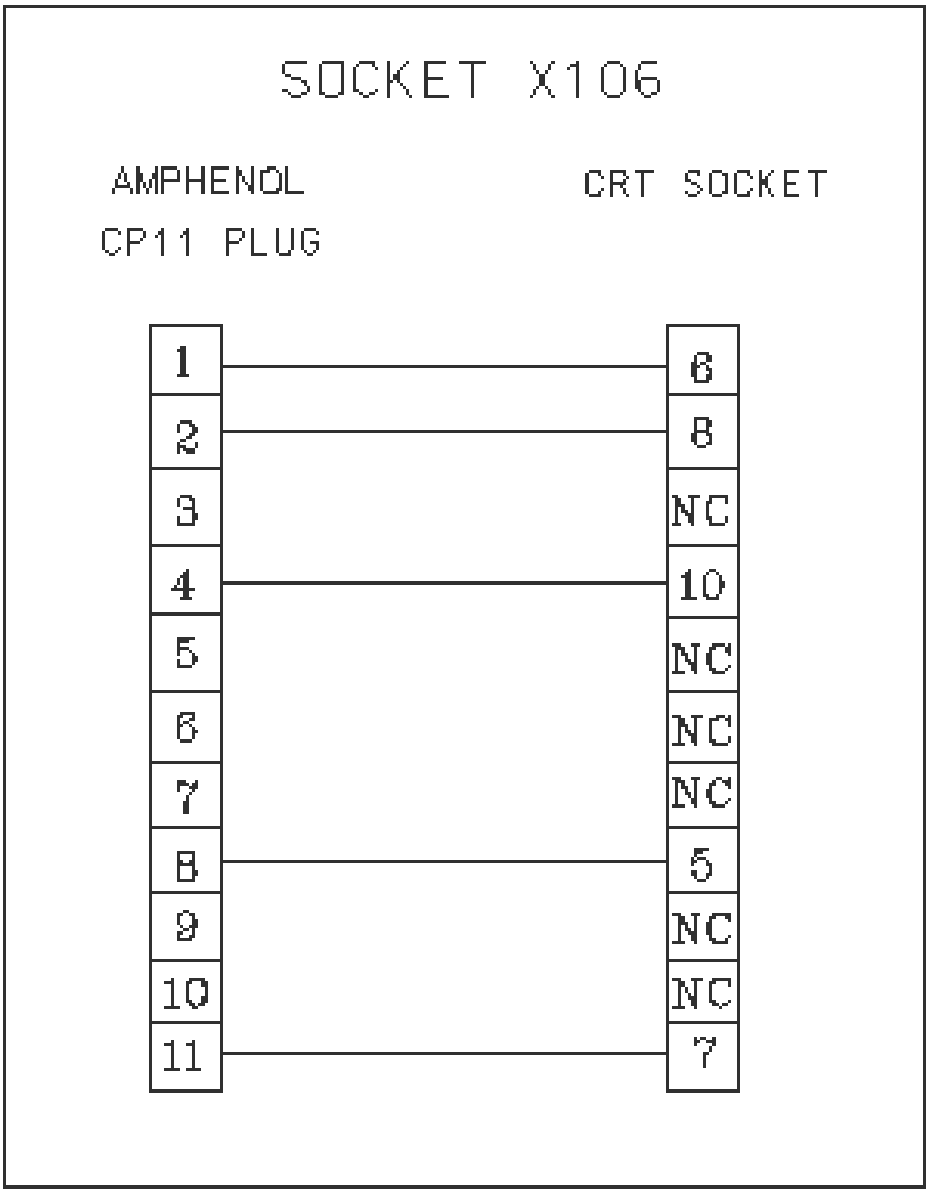
This adapter is for B&W tubes, and though I doubt that I'LL ever need it, it's listed quite a few times in the 1993 setup book. So, here it is, in case you ever decide to restore an old B&W TV.



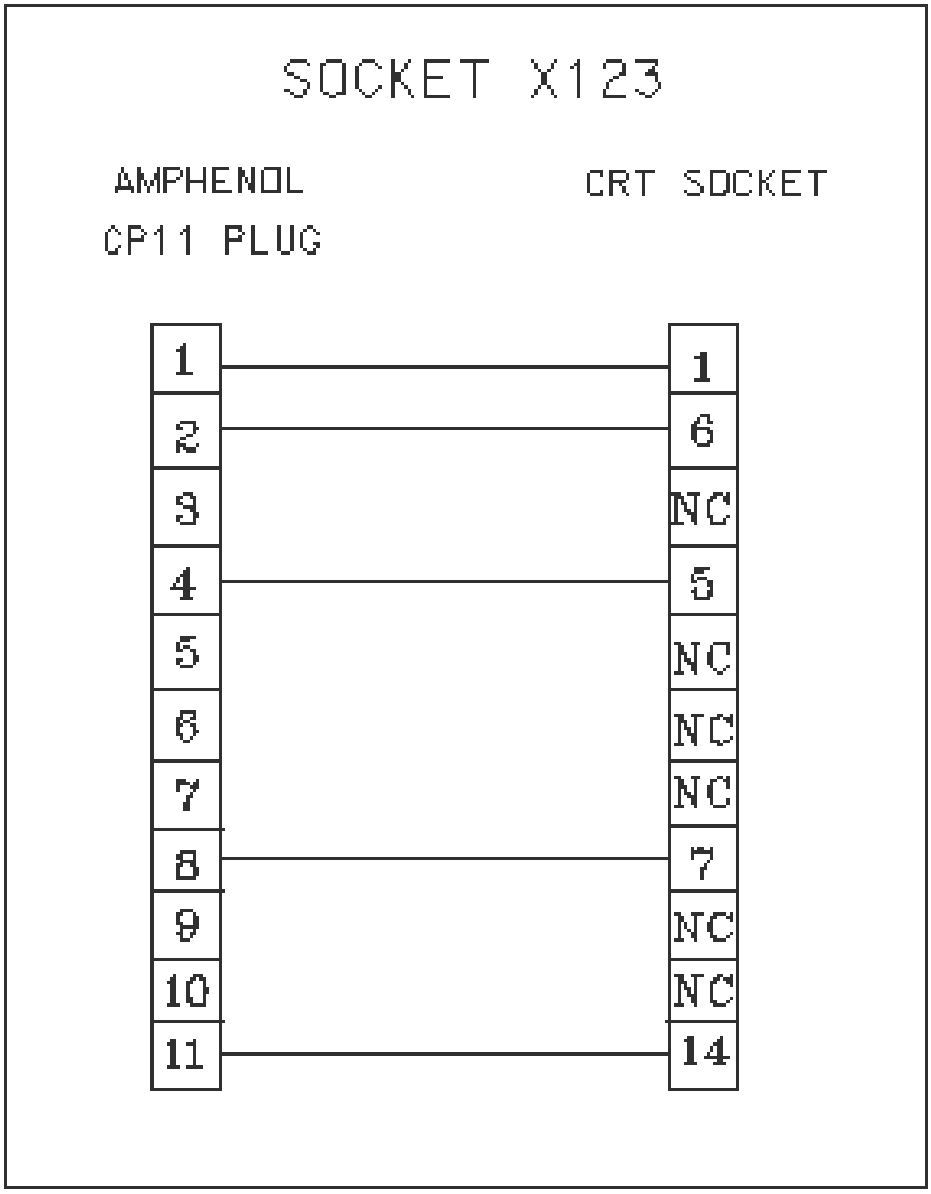
This socket is physically identical to the Sencore 23, so it uses the HPS1600/JEDEC B10-277 CRT socket. But, DON'T try to convert this into a socket 23. Like # 23, this socket was manufactured by taking a socket 18 or equivalent and cutting a pie-slice shaped wedge out of the CRT socket part to clear the focus cage on the CRT base, making it weaker than a regular socket. If you try to take it apart, the CRT socket will break along one of the CRT pin holes, and if you can't glue it back together, you will end up beating your forehead against your workbench. I know, because I've already tried it.



This is another projection TV tube adapter that shows up a lot in the ’93 setup book.



Another projection TV tube adapter socket. This one is used for a lot of 170 and 180-series CRTs, such as the 170JB22.



Last and probably least is this projection TV adapter. Physically, it looks just like the sockets 10, 11, 15, or 16 that came with the Big or Super Macks. So if you have more than one of either of those, you could rewire one to function as an X123. This adapter uses a screw in the base to hold it together, making it easy to take apart. But I wouldn't do it unless you really need one, because X123 is not used very often. It's better to use this diagram and a universal adapter.

Sencore was nice enough to search through their old hard drive data, and they found this almost complete list of CRT socket adapters and pinouts. Some of these are already reproduced in the diagrams above, and some are not. Though not 100% complete, this list covers, by far, the most commonly used adapters.

Big/Super Mack sockets listed by Socket Number

Amphenol Pin #	1	2	3	4	5	6	7	8	9	10	11		
CR31SKT	F1	RK	GK	RG2	GG2	BG2	BK	RG1	GG1	BG1	F2	70SKT	TYPE
1	1	11		10				2			12	UA	VIDEO
2	3	2		7				5			4	UA	VIDEO
3	1	7		3				2			8	4	VIDEO
4	1	7		2				3			8	4	VIDEO
5	3	2		6				5			4	6	VIDEO
6	3	1		6				5			4	6	VIDEO
7	1	6	4	5	5	5	3	7	7	7	8	4	VIDEO
8	1	4	5	3	7	11	13	2	6	12	14	8/UA	VIDEO
9	1	2	6	4	5	13	11	3	7	12	14	2	VIDEO
10	4	6	6	3	1	13	6	2	7	14	11	2	VIDEO
11	1	7	11	2	12	5	4	3	13	6	14	2	VIDEO
12	6	8	12	10	11	5	3	9	13	4	7	5/10	VIDEO
13	1	11	6	4	4	4	2	12	7	3	14	2	VIDEO
14	6	8	12	10	10	10	3	9	9	9	7	5/10	VIDEO
15	1	4	7	5	2	12	11	6	3	13	14	2	VIDEO
16	1	2	6	4	5	13	11	3	7	12	14	2	VIDEO
17	6	8	12	10	10	10	3	9	9	9	7	5/10	VIDEO
18	7	11	8	13	6	3	5	12	10	4	9	5/10	VIDEO
19	6	8	12	10	11	5	3	9	13	4	7	5/10	VIDEO
20	6	12	10	5	5	5	8	4	4	4	7	5/10	VIDEO
21	7	12	10	11	11	11	13	9	9	9	8	7	VIDEO
22	9	8	6	7	7	7	11	5	5	5	10	9	VIDEO
23	9	8	6	7	7	7	11	5	5	5	10	3	VIDEO
24	5	10	9	12	12	12	8	11	11	11	6	5/10	VIDEO
25	5	10	9	12	12	12	8	11	11	11	6	1	VIDEO
26	1	13		11				12		5	14	2	PROJ
X1	1	6	4	5	2	13	12	7	3	11	14	2	VIDEO
X2	1	13	2	11	7	5	4	12	14	3	6	2	VIDEO
X3													
X4													
X5	4	3		7				6			5	4	VIDEO
X6	4	4		6				3			5	UA	VIDEO
X7	3	2		6				5			4	6	VIDEO
X8	1	2	6	4	4	4	11	3	2	12	14	2	VIDEO
X9	6	8	12	10	10	10	3	9	13	4	7	2	VIDEO
X10													
X11	1	6	2	4	5	13	11	3	7	12	14	2	VIDEO
X12													
X13	1	2	6	5	4	13	11	7	7	7	14	2	VIDEO
X14	6	8	12	10	10	10	3	13	13	13	7	5/10	VIDEO
X15	5	9		4				3			6	1	VIDEO
X16	6	8	12	10	11	5	3	9	13	4	7	3	VIDEO
X17													
X18	6	5	9	4	4	4	10	8	8	8	7	UA	VIDEO
X19	4	4		2				1			3	UA	VIDEO
X20	5	3	9	10	10	10	E	4	4	4	6	UA	VIDEO
X21	4	3	7	6	6	6	9	8	8	8	5	UA	VIDEO
X22	6	5	9	4	4	4	10	1	1	1	7	UA	VIDEO
X23	4	7	9	8	8	8	3	6	6	6	5	13/UA	VIDEO
X24	1	2		5				3			14	UA	SCOPE
X25	6	8	12	10	10	10	3	9	9	9	7	3	VIDEO
X26	1	3		8				2			12	UA	SCOPE
X27	3	6		1				4			8	4	SCOPE

USING THE CR70 SETUP BOK WITH A BIG/SUPER MACK

The last date of publication for the CR168 and CR31A setup book was 1993; so obviously, you will someday encounter a CRT that is not listed at all in your setup book. But that doesn't mean you can't use your Big/Super Mack to test newer tubes. All you need is a setup book for the newer CR70 tester, or a base diagram for the CRT you wish to test, and a home made "universal" adapter

The easiest solution is to get your hands on a CR70 setup book. The last publication date for the CR70 was 2000, so this manual can give you up to 7 more years of listings. But, it will give you far more than that. It will give you the pin out arrangement for the CRT you wish to test!

You see, the CR70 isn't that much different from the Big or Super Mack. They both place a fixed bias on the cathodes and screen grids, and vary the control grid bias (G_1) for testing. Even the Bias settings are similar. After Sencore produced the Big Mack and Super Mack series, their engineers apparently realized that the number of CRTs on the market was increasing too fast to continue producing individual adapters: a technician would eventually need a box the size of Montana just to store them all. So in order to minimize the number of adapters, they designed the CR70 with switches to change the individual pin assignments for each type of socket (mini-neck, small neck, large neck, etc.). The position number of each switch on the CR70 for the filaments, cathodes and grids just happens to be the pin number for that element on the CRT socket. All you need is an Amphenol plug and shroud, a foot or two of 11-conductor wire, some mini labels to identify each lead, and eleven insulated "J" clips, and you can make a universal adapter that will let you test any CRT in the CR70 setup book with your Mack. A large number of CRTs have G_1 and G_2 for each color tied to the same pin (just like they are in some of the Mack adapters), so for those, you will have to clip all three of the appropriate leads to the proper CRT pin, or test each gun individually, and forego the color tracking test. But the versatility that this system provides is worth the extra investment in time.

Figure 3 below lists the Bias voltages shown in the CR70 manual versus the voltages produced at positions A through D on the Mack series of testers. This information is also in the back of the 1993 CR31/CR168 setup book.

TABLE 2: VOLTAGE SETTINGS FOR THE CR70 VS. THE BIG/SUPER MACK

CR70	**Big/Super Mack Equiv.**
-20 V	"A" = - 20 V
-36 V	"B" = -35 V
-52 V	"C" = -50 V
-68 V	"D" = -70 V

Obviously, these differences are not great enough to significantly affect the outcome of a test. So just set your Mack bias switch to the letter that is closest to the negative bias listed in the CR70 setup book.

HOW TO MAKE A SOCKET 17 ADAPTER FROM A SOCKET 18 or 19 ADAPTER

If you have the patience of a saint, or you just like punishment, it's possible to make your own professional-looking "right-from-Sencore" socket 17 adapter, by disassembling a socket 18 (or 19) and changing the internal wiring. It doesn't seem TOO difficult, until you get into it. If you only own one socket 18 or 19 adapter, DO NOT do this, because there is some risk involved, and if you break your good adapter, you are now short TWO adapters.

To keep it simple, I've broken down the process into steps.

1. Place the socket 18 adapter on it's top, and unsolder all of the pins on the Amphenol plug with a heavy-duty soldering gun (75 – 140 watts), and a rubber bulb-type desoldering tool. Radio Shack sells a perfect one for this task for about 4 bucks. Heat each pin on the Amphenol plug about halfway down, because some of the "factory" solder will have run down into the hollow pin. A bulb-type suction tool is a must here, to clear out all of the solder.

2. Using a nutdriver with a head whose outside diameter just fits into the hole on the CRT socket part of the adapter, gently rock it around until the factory glue "breaks." Care is needed here, or you risk breaking the socket itself, and then you get to glue the socket back together, if you can. Pull the CRT socket away from the plastic shell.

3. Unsolder all of the wires from the CRT socket part. You may be tempted to reuse them, but don't even try. They are too short, just as YOUR new wires will be when you are finished.

4. Using color-coded, 22-24 gauge telephone wire, create 3 inch long "pigtails" on each of the socket terminals you will be using. Note that on socket 17 and many others, you have two sets of pins on the CRT socket that connect to 3 pins on the Amphenol plug. You COULD try to install jumper wires in the base of the plug, but I advise against that. It's a knuckle buster to accomplish, and the risk of short-circuiting to another wire AFTER you've glued the assembly together is great. It's better to solder 3 wires with the same insulation color to the same CRT pin, and then feed them into the 3 adjacent pins on the Amphenol plug.

5. Strip all but about ¾ "of insulation from each of the wires, with the bare portion of each wire facing the Amphenol plug.

   At this point, you need to think about how you will fish each of those bare wire ends into the pins of the plug. One way is to leave the one you plan to install first the longest, and then cut each one that is next in line down by ¼". Each set of 3 wires that go from a single CRT socket pin into the plug pins could be left the same length. Do NOT solder ANYTHING, right now.

   Incidentally, this is NOT how I made my socket 17. I cut all the wires the same length, and as I fed each one in turn into its respective plug pin, I bent 1/8" of the end over so the wire would not pull back out of the pin as I installed the others. This plan works, but it creates bunched-up wires between the CRT socket and the Amphenol plug until you pull each one up tight through its pin. But it still works.

6. Pull each bare wire end in turn gently through its pin until the CRT socket is about 1/8" away from the Amphenol socket shell.

7. Using the diagram and a DMM or continuity tester, test each connection between the CRT socket, and the Amphenol plug. You may have to touch each wire end as it passes through its Amphenol plug pin, so that you get good continuity. Also, test adjacent pins on the Amphenol plug that aren't supposed to have continuity between them, to check for shorts.

8. Assuming all of your connections test good, coat the edges of the CRT socket with super glue (the gel type works best here), and push the CRT socket the rest of the way into the plug shell. It's not supposed to fit absolutely flush, so don't force it.

9. Gently pull the wires the last 1/8" through their pins until they are just snug, and solder each one. Cut off the excess, and polish rough spots off each pin with a small file like the ones found on folding pocket tools or Swiss Army knives. Label the new socket.

10. After the super glue dries, plug the socket into your Mack and a CRT for which the setup book specifies socket 17, and test! I recommend setting the filament voltage as low as possible and then bringing it up to the proper voltage in steps, just to be sure.