What is a CDP cable?

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Referring to the multiconductor cables used to connect the geophones to a seismograph, a really good geophysicist once asked me, "What's the difference between a CDP cable and a refraction cable?" Now this person was well-versed in a variety of geophysical methods; in fact, he is the author of books and teaches classes in geophysics. And he's a practitioner, not an academic. You would recognize his name. If this person didn't know the difference, perhaps many don't.

It occurred to me that with the onset of 3D seismic, and the decline in geophysical companies, the people who know how a CDP cable works are retiring and even dying off. Recently, one of my customers purchased a new CDP cable that was wired incorrectly—almost half the conductors were missing. If a cable manufacturer doesn't know how to build a cable, we're on perilous ground.

I assumed that something as thoroughly embedded into geophysical consciousness as CDP cables would have been thoroughly documented, but I could find no reference that explained CDP cables, (or the more politically correct term CMP cables) on the Internet or in the Digital Cumulative Index of SEG, EAGE, ASEG and CSEG publications, 1936-2003, available on the SEG Web site.

Humbly, I leap into the breech.

A geophone cable is of course a multiconductor cable with a connector on either end and with individual connectors or "takeouts" for the geophones at intervals along the cable. We informally classify them as either refraction cables or CDP cables. Of course the cable doesn't know what application it will used for, but tradition is a powerful force in geophysics.

Before we tackle CDP cables, let's consider a simple refraction cable diagramed in Figure 1. The most common type has 24 conductors, 12 takeouts, and a 27-pin connector on each end. When you spread out the cable, it looks the same from either end, which prevents you from spreading it out backwards. The 12-takeout refraction cables use a 27-pin connector with the part number NK-27-21C, originally manufactured by Cannon. There are probably better choices, but the Cannon connectors are rugged and have been the standard for over 50 years.

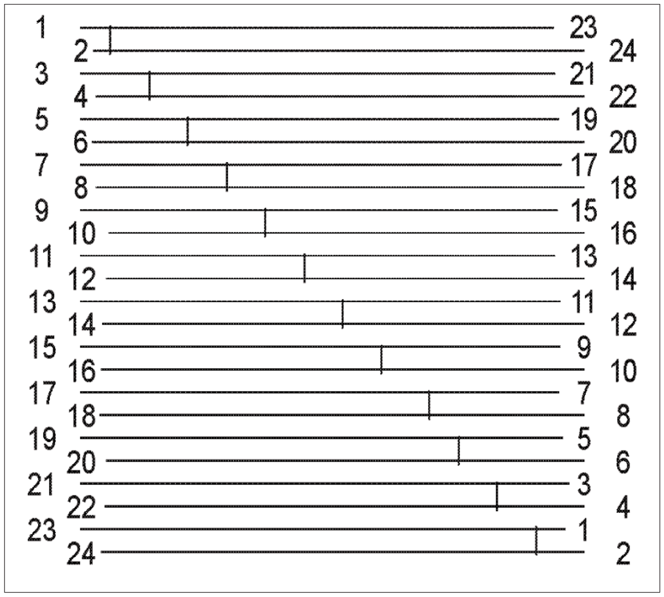

Figure 1. A 12-takeout refraction cable.

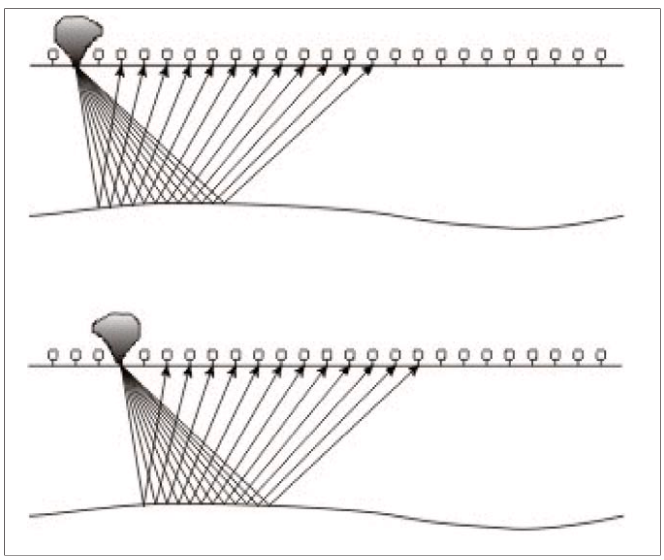

Figure 2. CDP reflection survey geometry.

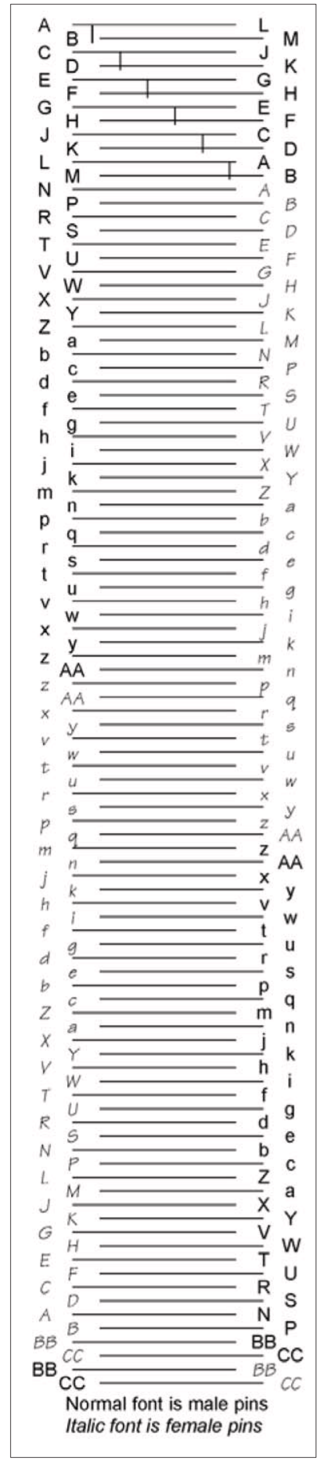

Figure 3. A 6-takeout CDP cable with 52 pairs of wires.

A CDP survey differs from a refraction survey in that the relative positions of the shot and geophones are constant, but moved along the ground. To

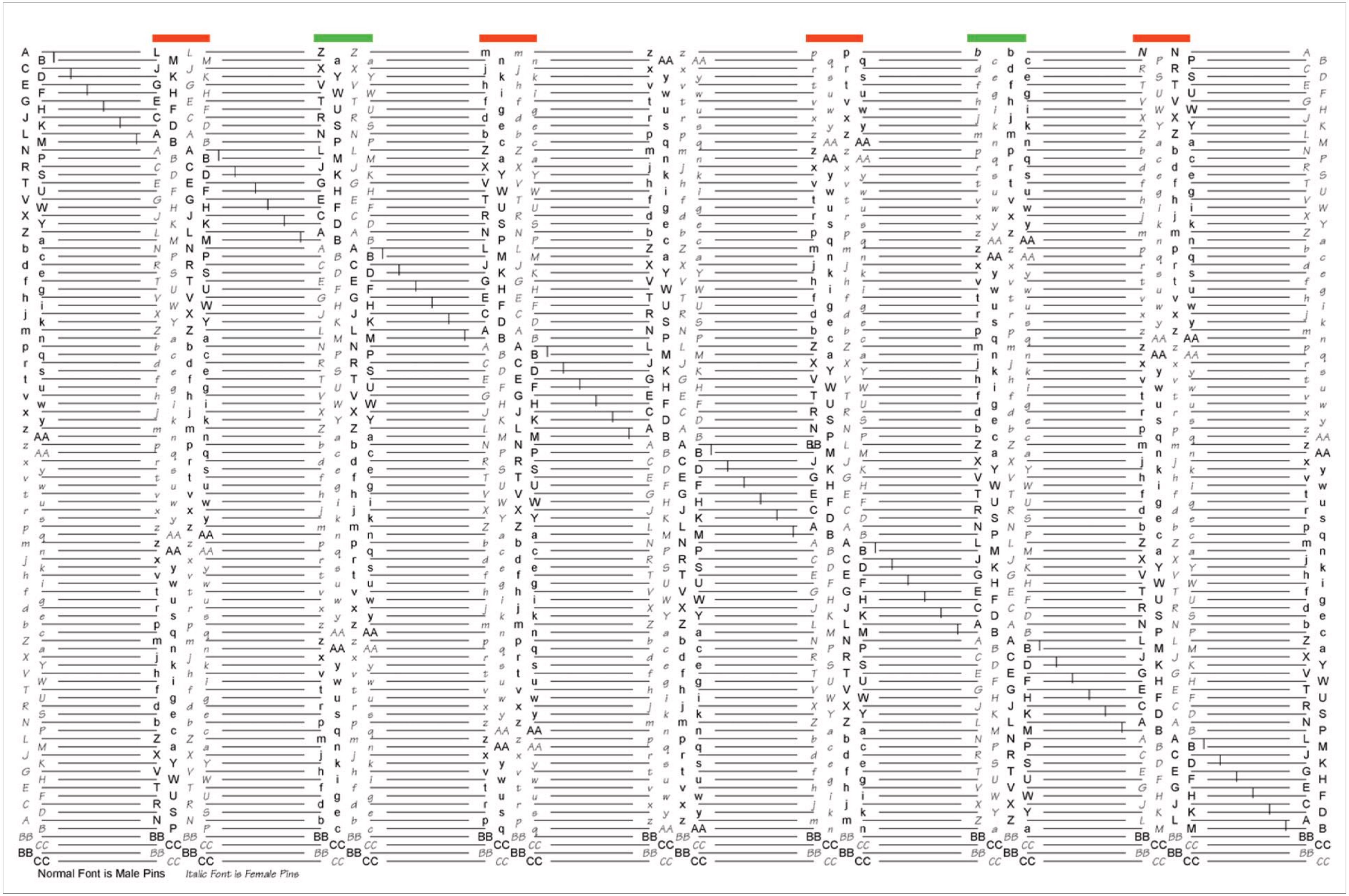

Figure 4. *Wiring diagram for Mark Products CDFP cables with Amphib 122 connector. The system has eight cables, each with 52 pairs of wires and six takeouts per cable.*

make the process more efficient, extra geophones are positioned and connected through a "roll-along" switch so that the active geophones are moved with the shotpoint as shown in Figure 2.

Of course we could perform CDP surveys with "refraction" cables by laying them end-to-end and using extension cables to connect them to a central seismograph. This is commonly done for small-scale surveys (up to 48 geophone stations and 24-channel seismographs), but for the typical reflection survey, it becomes more efficient to use CDP cables.

A CDP cable has extra conductors in addition to those needed for its takeouts, so that it also serves as an extension cable for other segments farther from the seismograph. For the typical CDP survey, a series of cables and geophones are laid out in a linear array and connected to each other. A properly designed CDP cable has the following attributes:

1) The end connectors are hermaphroditic; both male and female. Any end connector will mate with any other connector on another cable.
2) The cables are reversible. If you flip a cable end-for-end, it looks and is wired the same.
3) The cables have many conductors, but fewer takeouts.

CDP cables with as few as four and as many as 24 takeouts are common, and with 48 or 96 (or more) pairs of conductors. The number of takeouts is generally determined by the most basic of parameters—the maximum weight that a juggie can carry. For instance, if the takeouts are 55 ft apart and the cable has 96 pairs of wires, it gets pretty heavy, must be shorter, and will have fewer takeouts. On the other hand, a 48-pair cable with 24 takeouts at 10-ft intervals is manageable in the field.

So, how does a CDP cable actually work? Consider Figure 3, the drawing of a 6-takeout cable constructed with a 52-pairs of wires (including 4 spare conductors) and with a Mark Products Amphib-122 connector on each end. (A number of elegant hermaphroditic connectors were available during the boom years of 2D surveys; many have disappeared with the companies that made them. The Amphib-122, still available from the Mark Products Division of Sercel, is constructed with a pair of 61-pin Bendix connectors in a single housing.)

This is a complex wiring diagram, and not at all intuitive. When a CDP cable is purchased, one normally receives such a drawing. One might even be asked to check the drawing and signify approval. Good luck! Our generation owes a debt to the nameless geniuses who designed the early CDP cables without benefit of spreadsheets and word processors.

Fortunately, we have those tools. Let's take the diagram in Figure 3 and, with the aid of our computer, let's put another, identical cable next to the first. But first, rearrange the position of the conductors on the page so that the second cable becomes an extension of the first, creating a cable with 12 takeouts. While we're at it, let's add some more cables until we have a total of eight cables connected end-to-end with a total of 48 takeouts, as shown in Figure 4.

This task is easier than it looks using either spreadsheet or word-processing cut-and-paste tools. The key issue here is that all eight cables are identical and reversible. Only the position of the conductors on the drawing has been changed to show how the identical cables connect end-to-end to form a longer cable with more takeouts. Note that the spare conductors are just passed through for potential use in timing shots or communications.

This greatly simplifies the logistics of the typical reflection survey, besides making the juggie's job easier. In practice, the active stations will roll along the line. As one of the cables is passed through, it can be picked up and positioned at the forward end of the line in preparation for future shots.

To see another piece of magic, delete the second, fourth, sixth, and eighth columns of connectors (red bars in Figure 4). That will create a wiring diagram for a set of four CDP cables with 12 takeouts apiece. Once more, delete every other remaining connector column (green bars) and create a diagram for a pair of CDP cables with 24 takeouts apiece.

Is this information only useful as a historical footnote? Not until 3D surveys become as popular in shallow reflection surveys as they are for petroleum exploration. Surprisingly, I am informed that there are applications for CDP cables in electrical surveys. In any case, the information ought to written down as a tribute to the anonymous geophysicist that created the first CDP cable. And I would like to extend credit to Lynn Edwards of Geometrics, another brilliant anonymous technologist, who taught me how to move the conductors around in the cable drawing and to understand how they work. TLE

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