

By John Dignan- Senior Engineer and Founder

## *ID That Connector!*



Without doubt, you're going to run into a situation where the connectors involved in the system you're servicing is going to need to be replaced. Maybe just the contacts need replaced from corrosion. Or perhaps you destroyed the connector body while trying to make tests in the system.

I've done it myself many times where I "MUST" know what voltages and signals are present on the wires involved but don't have connectors to build an adapter. I've cut into the cable cover and hook up my test leads to individual wires. It works but it trashes the connector and overall circuit.

To repair the cut in point you need pins, or sockets, maybe the connector body and the tool to install it or solder the pins in. With the right parts, tools and instructions you can repair any connection to "as new" status. The following Tech Notes Column I hope will get you on the right path to successful repairs.



I started researching connectors in an effort to create adapters for the harnesses involved in my Ag-Tester product line. The cable shown to the left is a TEE harness used to interface with any RAVEN boom or control valve. One group in the input side going to the display and the other group connects to the valve.

any valve used in the industry.

Photo at the right, shows a similar, in-line TEE cable where it is designed to interface with any sensor used by RAVEN. Then from these connections we can adapt to all types sensors used in agriculture.



The idea is then from those connections I can adapt to virtually

Just these two cables include 16 different connectors from 5 different companies.

My old friends at Ag-Express in Sulphur Springs Indiana built all my harnessing. They are very good at it. They know all the equipment manufacturers and have most of the connectors in stock or can get them quickly. Before I can have them build harnesses I need to know what I want. As they explained to me early on, they are not in the research business. I've been on a mission the last couple of months finding who's who in the connector world and tracking down catalogs and suppliers. I hope to save you some of the research pain.



When identifying connectors remember; "It's all in the details". If you don't have a digital micrometer, buy one! It's a well spent 30 dollars or so at the home improvement store.

You're going to find the connector measurements are either in 1/1000, .001 of an inch or in metric, millimeters. It took me a while to think in those terms. There are 25.4 MM in one inch. A lot of electronics is designed in 1/10 of an inch including circuit board layout and connector spacing. 2.54 millimeters is the same as 1/10 inch. The micrometer I use is shown in photo above. Let's take a close look at some of the connectors you'll see on a regular basis.



Before we get started with connector ID, let's see if you need a little "sex education" refresher. Two connectors are shown to the left. Is the connector on the left the male or the female? If you guessed MALE for the connector on the left, you picked what most people would guess and you're WRONG! It's a FEMALE. Electrical connectors are ALWAYS sexed based on the electrical connection; "Pins and Sockets". The pin side is the male and the

socket side is the female.

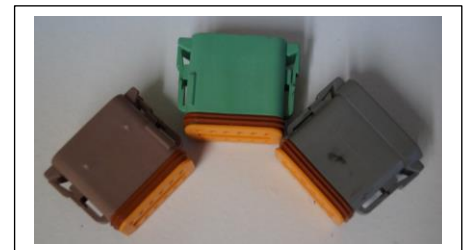
The connectors to the right are from Deutsch and are very widely used across agriculture and industry. The product line is immense. The DT series is very popular. Ladd Industries is the exclusive world-wide distributor for Deutsch. You can go to their web site and download the catalogs. They also have great tech support and a connector identification folder that you might find very helpful. The link to the product catalog is <https://laddinc.com/products/online-catalog/>. They also are the distributor for the AMPSEAL 16 product line. I've run into AMPSEAL connectors on some Ag-Leader and John Deere machines.



The DT series of Deutsch connectors is pretty straightforward. I've seen three different DT series connectors on lots of machines. The connectors to the left all kind of look the same with the difference being the connection size. Size directly affects the current capacity of the connector. DT-M is the smallest and is used for low current signals, 7 ½ amps maximum. The DT is the standard and is very popular in many applications and is good to 13 amps. The DT-P is a large connection popular for power connectors and other high current applications with 25 amp maximum capacity.

Deutsch does have the part number on each connector. Get your magnifying glass and look carefully. It's there! When you buy the connector you need to buy the body, pins or sockets and a wedge that keeps the connections in place and solid. The connection can be used without the wedge, but you've got to be very careful attaching the mating connector.

The other major variable with Deutsch DT series connectors is the "KEYING". You might have several 12 pin DT series connectors that all appear to be the same but they won't mate up. The connector color dictates the keying used with Deutsch DT series connectors. Notice the differences in the connectors to the right. Small changes are made to the connector shell so different colors won't mate.



Before leaving the Deutsch connectors let me mention AMPHENOL. For several years now I've been running into connectors that look just like, "almost", the Deutsch DT series connectors; slightly thicker plastics and no part numbers. I finally found them surfing the Mouser Electronics Connector Catalog. Mouser is a huge electronics distributor that has in inventory thousands of each part. They sell items one at a time of 5000 at a time. If you query, "connectors" at their web site you'll find they have over 15,000 items. <http://www.mouser.com/CatalogRequest/CatalogDownloads.aspx> is the link to download sections of their catalog. The connector section is a 75Mb download. Pages 1644 and 1645 show the Amphenol AT series connectors. They say they are fully compatible with the DT series from Deutsch. They only have the Grey connectors so they don't offer keying. I've not tried to mix the two but they should be compatible. That word "should" always scares me!



The next connector we'll look at is the Conxall, shown to the left. These connectors have been used by RAVEN for close to 40 years for Flow meters and other sensors. I thought they would be easy to find and even easier to order. I was WRONG! I have found that all the old names I've known over the years are not found under the original name. There are only a few primary companies that own all of the original manufacturers. The connectors we use in agriculture are considered "Automotive" applications and round connectors are simply referred to as circular connectors. Then under "Switchcraft", "circular connectors", one of the selections is the Conxall line.

I had trouble understanding the connector description and frankly my last order for connectors was wrong again! That was just a few days ago. I was close but missed a major component. The connector sub-categories are really quite simple.

There are three series of Conxall connectors. Micro, Mini, and Multi control the shell size. Multi is what we see on RAVEN liquid controllers and Mini is used on their new series computers and control systems. The connector is either a plug, a receptacle or a cable to cable connector, shown in the photo above. The receptacle is a panel mount that accepts the plug. Then you could have pins or sockets in any combination. So what did I miss? Connector size! Didn't know that was a variable. The connectors I ordered for the 3 pin RAVEN were correct but the 4 pin connectors used for RAVEN valves was wrong.

These connectors can have at least three different connection sizes. Connection size is measured like a wire gauge. I found that the connectors I received had the correct shell size but the wrong pins and sockets. What I bought were 20 gauge connections and what you need for RAVEN 4 pin connectors is 16 gauge! Once I found that, I discovered Mouser doesn't stock the 16 gauge! Before ordering connectors, check and study the details! You can download a wire gauge chart at [https://www.tedpella.com/company\\_html/wire-gauge-vs-dia.htm](https://www.tedpella.com/company_html/wire-gauge-vs-dia.htm). Your micrometer will allow you to check the pin size.

I finally found the 16 gauge connectors at Mouser Electronics, but you need to be very careful when ordering.

Another connector I felt would be easy to find is the Weather- Pack series. These have been around for years in all types of applications. They are still very popular. I have found them to be not nearly as weather tight as Deutsch and other newer technologies. I finally found these as Packard Electric Systems connectors. They are now part of Delphi Electronics as are many of the others you'll see out there. Here's a link to Mouser's site that lists all the Delphi connectors at Mouser.

<http://www.mouser.com/Search/Refine.aspx?Keyword=packard+electric+systems>.

There are almost 6,000 items! You can browse the page and click of the connector that looks like the one you want then find additional information from there.



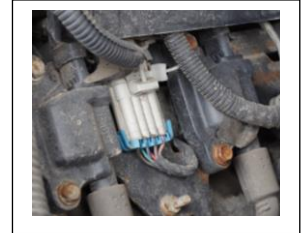
There are two different versions of these Weather- Pack connectors. The difference is the locking mechanism that holds the two mating connectors together. I've seen both on the same piece of equipment. Photo to the left gives you some detail.

The sexing terminology used is "Tower" for the female and "Shroud" for the male. Parts include the tower or shroud, pins or sockets and the insulator which is available in lots of sizes. The connectors are used by some component manufacturers.

Position sensors used by Case, John Deere, Trimble, Ag-Leader and others are “reverse polarity”. These have the female connection in the shroud! In this case you need to build the connector backwards. You’ll find the pins and sockets don’t want to align properly but it works! A position sensor is shown to the right.



Another connector that is part of the Delphi family is the Metri-Pack Series of connectors. You don’t see these a lot in general agricultural electronics but I’ll bet all the connectors on your truck or cars electrical system are part of this great connector series. In the product directory they actually show a truck or car chassis with arrows pointing to different components on your car to identify connectors. The automotive industry seems to be standardized! Your air conditioning compressor has a particular connector as do the head lights! Wouldn’t that be something in agriculture!



A lot of the new John Deere machines are using these for all the outlying valves and sensors. Many of the PWM valve connections I’ve seen have been Metri-Pack. Once I studied the product line it was pretty simple to follow. Each connector can be weather tight or not. The different series connectors in the product line represent different current handling capacity of the connector. The most popular I believe are the 150 series, the 280 series and the 480 series.

The 150 series will handle from 0 to 14 amps can have from one to ten cavities. The term “cavities” indicates the number of pins or sockets available. That’s also called “positions” by some companies. The pins and sockets are square or rectangular and the specifications are in Square Millimeters so I won’t try to interpret other than there small.

The 280 series will handle up to 30 amps and for basic connections will handle eight connections or cavities. The Series 480 is the big guy! At least I thought it was big until I saw the 800 was also in the catalog. 60 Amp capacity!

If you think about it a 48 row corn planter with electric clutches draws a lot of power. Each row needs ½ amp approximately. 48 rows means 24 amps, and the current draw might be 60 feet or more behind the power source, the tractor. That takes very large wires or with very large connectors!

I found a great catalog on line for these connectors but I can’t remember where I found it on the web. Once I downloaded the pdf I forgot about it! Hopefully I’ll find it before the column goes out or you can find it at my web site, agtester.com. These connectors can look a lot like the Weather- Pack connectors.



I had a heck of a time finding the connector to the left. It’s called an APEX Connector.

I first started looking and then thought I identified it as a connector I had seen on a Deere machine. At the time I located it as a connector from FCI Automotive connectors. Later I opened up a CASE IH Combine side panel to look at sensor compatibility and saw what I thought was the same connector. Surfing the Mouser connector catalog I found the connectors again but from Delphi. No mention of FCI Automotive! I

found recently that Delphi has acquired FCI Automotive so here we go again. Part numbers are mostly the same but it’s now a Delphi Product.

I ordered from Mouser the connectors shown in the photo and they were right when they came in! I had trouble seeing the keying as it was presented in the Mouser catalog. Link is <http://www.mouser.com/catalog/catalogusd/648/1649.pdf>.



The little tabs on the lower part of the connector are the keying. These connectors are also color specific. If it's a black connector is keying index "A" and if it's grey, it's index "B".

The connector is available from two to fourteen cavities or connections. I found several different sizes on the CASE Combines running the full range of connectors.

The last connector might be the AMP connector. Very popular years ago with DICKEY-john radars, controllers and planter monitor. Still used today along with some of the new versions from the same company. Like all the others, I thought it would be easy to find and I was wrong even again! They are part of TE Connectivity. This link will take you to the Mouser page for AMP or Circular Connectors from TE Connectivity.

<http://www.mouser.com/catalogviewer/default.aspx?page=1610&highlight=571-2060611&catalogculture=en-US&catalog=648>. ]



In agriculture we are mostly using Series 1 connectors. The photo to the right shows the connectors from left to right, shell size 23, 17, 13 and 11. You'll find the eleven series on DICKEY- john Radars with 4 pins and shell size 23 on 37 pin planter monitor connectors. I'm still not sure what the 11 to 23 shell size numbers mean. I use the size 13 for the primary connection to my Ag-Tester units. The 17 is used on the RAVEN 400 series controllers. It's a solid connector that really is made to accommodate lots of connect/ disconnect situations.

All the connections in the Series One connectors are 16 gauge connectors. That's the same capacity as the Duetsch DT series and the basic Weather- Pack, along with the Metri-Pack 150 series and others in the same connector size range.

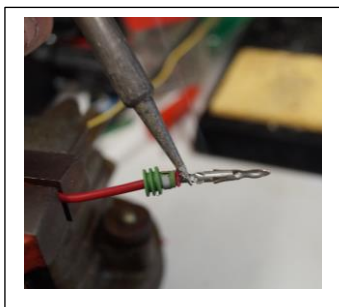
I could go on to the next and the next connector forever! Hopefully you're getting a grip on how these connectors are packaged and sold while watching for the details. I've bought a LOT of connectors over the years because "it was too expensive not to have the parts"! As soon as I thought I knew what I needed, I was wrong again. My last go-around with the wrong Conxall order from Mouser cost me another 100 dollars! Distributors that size won't allow returns.



If you're going to work with connectors, you'll need tools. To simply remove the pins or sockets, you need a specific tool called a "pin extractor". These are perfectly sized and shaped specific to a single type of connector. They cost typically 15 to 20 dollars. The DT series connectors from Deutsch have locking tabs inside the connector that are released with a small screwdriver.

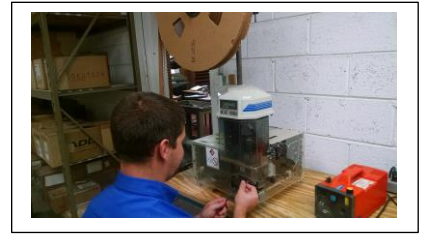


Ratcheting crimpers work very nicely attaching specific connectors very tightly to the wires. For years, my installation habit has been to try to pull the pin off the wire after installation. Pull hard! You're better off finding it is not tight enough before cable goes back into service. These crimpers are connector specific and will cost from 200 to 300 dollars or more.



Soldering the connection is another way to properly attach a pin or socket to a wire. Here there are two primary concerns. The tabs that mechanically attach the pin to the wire must be uniformly installed to insure the pin will still fit in the opening provided and lock in place. The shape must be accurate. The other issue is to insure the connection is soldered correctly using only rosin core solder.

Companies that build a lot of harnesses have automated crimpers and wire strippers. Pins and sockets come on a roll of 2,500 and the operator hits a foot switch to activate the machine.



We can't wrap up this discussion without addressing the concerns of the manufacturers. The folks that create all the tools we have today in agriculture have a vested interest and concern in the accuracy and quality of their cables. Most don't encourage field technicians the repair other than a complete cable replacement. That can be very time consuming and expensive. Having all the replacement cables on hand can become very expensive and I've learned the hard way about the cost of obsolete inventory.

In the last few years as a Trimble Dealer, I was impressed to find complete wiring diagrams with connector pin-outs and connector ID information at their dealer web site. The information is there for troubleshooting help but was extremely helpful when connectors needed replaced.



Hopefully you have found this information to be helpful. There are lots of sources for replacement connectors outside of the wholesale marketplace. You can use the Mouser or Digi-Key sites to identify the connector. Then contact an ag-supplier to actually buy what you need. Many times kits contain all the parts needed. You'll pay a little more at these suppliers, but you'll get the right parts the first time and some can help with the wiring information.

Agri-Motive has been around for years and offers custom cables and connectors. Their web link is <http://www.ag-electronics.com/>. Another supplier I've known is C&R Supply in South Dakota. You can contact them at <http://www.crsupply.com/>. I like to use Ag-Express in Sulphur Springs, Indiana. Their new web site should be complete this fall. You can contact John Slavens and his group at 765-533-4809. John is shown above displaying a few of the many connectors he stocks.

You can contact me at <http://www.agtester.com/>, my web site. Send me a couple photos of the valve or sensor and connector you're working with and I'll help you get it identified and the tools and parts you need. I've also posted for download key information and catalogs covering the connectors we've discussed and others. The link <http://www.agtester.com/products/tester-tee-harnessing/>, will get you there.

Let me know what you'd like to see in Tech Notes. The goal is to offer the Ag Technology Specialist the tools they need to effectively work in the field. I'll look forward to hearing from you.

John Dignan / Ag-Tester

