

# Anderson Powerpole Connectors and You



*Wesley Cardone, N8QM*

March 2022

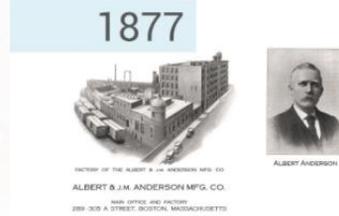


Wesley Cardone, N8QM

I thank you for attending this presentation of Anderson Powerpoles and You. These things are of tremendous use for Amateur Radio use. With just a little bit of knowledge you can be invincible with them.

# History Overview

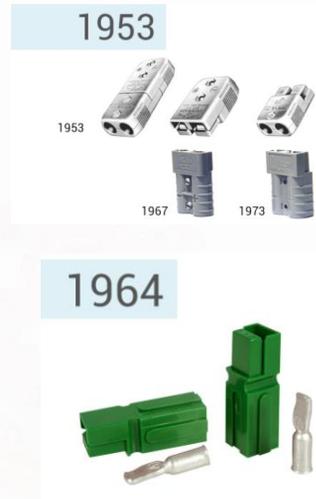
- An early version originally patented in 1958, submitted in 1953
  - Albert & J. M. Anderson Manufacturing Co.
- Primary Powerpole patent given in 1966.
- The PP75 connector in 2006
- Adopted by many segments of Amateur Radio as a 12-Volt standard connector
  - ARES
  - RACES
  - WICEN



Wesley Cardone, N8QM

# Anderson History

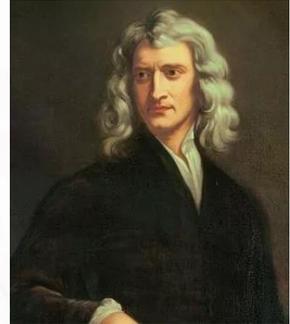
- Founded in 1877, Boston, Mass
- 1953: Invented the SB Connector
- 1964: Our genderless Powerpole invented



Wesley Cardone, N8QM

## Before going further... Consider Isaac Newton

- What is truth?
  - Isaac Newton revolutionized western civilization's manner of thinking.
- The scientific method? What's that?
- Newton was frustrated with the Greek's knowledge taught in schools.
  - Handed down from 200 BC
  - Garbage
  - But taught as truth as a standard curriculum
- The Geneva Bible of the 16<sup>th</sup> century and Newton



Wesley Cardone, N8QJM

I've found that many amateurs, and people in general, are highly opinionated on soldering and crimping. Discussions often become like politics and religion. Why do you suppose that is? I have the answer.

For politics and religion, discussions are more often than not of a subjective nature and therefore it's impossible to speak conclusively. But talk of solder and crimping is virtually 100% objective. There is no excuse for differences of opinions. Yet, I've found I often have to tread carefully.

Some of you have heard me present this before. I look to history and the nature of man to explain this. Up until Isaac Newton's day, there was no concept of logic in man's thinking. What this means is that there was no reason to think that you could repeat experiments. Now, this is almost impossible for us to grasp today but bare with me. Isaac Newton went to the finest schools of his day and he was frustrated with some of the teachings such as a teaching that a ten pound ball would fall ten times faster than a one pound ball. These were teachings handed down from the Greeks of 200 BC. But they were taught in Isaac Newton's day as truth.

What I am about to tell you is the absolute truth. It is a foundation of our society today and it is the reason why in western civilization there has been so much innovation in the last few centuries.

In Isaac Newton's day, the Geneva Bible came out and was revolutionary because it was the first Bible that was mass produced. For the first time EVER, bibles were affordable enough so that one could be in each family home. Geneva bibles were on the Mayflower.

Here's the critical piece: Isaac Newton looked at the Geneva Bible and saw logic in its nature and construction. He then reasoned that its author was also logical (meaning repeatability and predictability). He believed the Bible and saw its author as the creator of the universe. Newton then reasoned that the creation must also be logical in following with its creator. Thus was born the "creative method" that we all learned about in high school. You develop a concept. You then prove the concept with an experiment. A non-understanding of this concept is pretty hard for us to grasp today because we all grew up understanding the repeatability within nature but IT WAS NOT SO in Isaac Newton's day.

Let's fast forward to the 21<sup>st</sup> century: With connectors and soldering it is physics and therefore 100% objective discussion. If Powerpoles don't work for you, then you can explain why they don't work. If your assessment is correct then the same will be true for everyone else. This is not a "to each his own" concept. In my presentation I may say that Acme Wires, Inc. says something but it is at least my goal that if I give you a conclusion that I will also have objective observations behind it.

## What is a Powerpole?



Cutaway view of a Powerpole connector.

Note that the contact must fit through the gap between the housing and the spring and that the contact is snapped over the end of the spring.

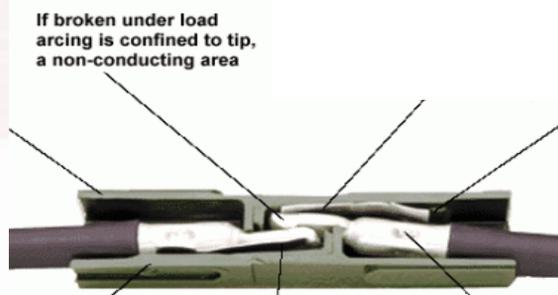


Wesley Cardone, N8QM

Here is a cutaway showing what is inside a Powerpole connector after you assemble it. It does not come from the factory this way as you will see in upcoming slides.

## Pull Apart Under Load

- Architecture retards the destructive arc.



Wesley Cardone, N8QJM

One of the manufacturer claims is that the topology of the connector retards arcing. Notice that there is a conducting area and there is a rounded edge if you look carefully. Try to visualize what happens when you pull a Powerpole connector apart. You can see in the illustration where the primary conduction area is when they are mated. Now pull them apart slowly and the last electrical contact is between the rounded edges which, under mating conditions, are not the primary conduction path. Separating the contacts under load will in many cases cause an arc in any contact including the Powerpole. The arc is always destructive and is capable of destroying the conduction path of a switch or conductor. But since the arc path in this case is with the secondary conduction area, the primary conduction area is preserved from damage.

## Wipe on Make or Break

- Advertises that a “wiping action” clears the contacts when mating and de-mating but this is true with all connectors.

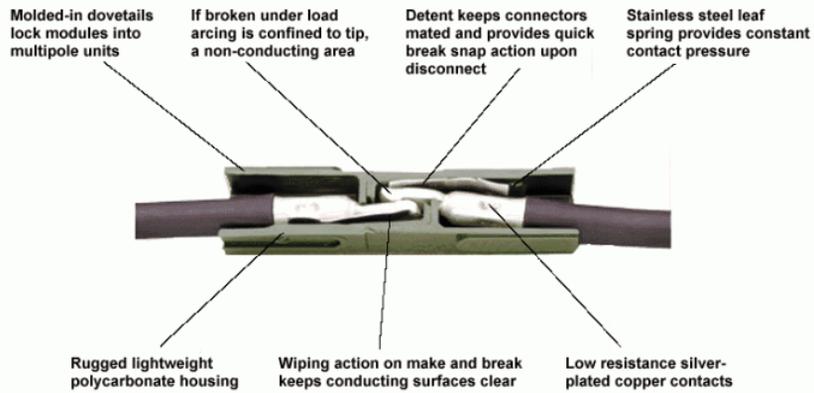


**Wiping action on make and break  
keeps conducting surfaces clear**

Wesley Cardone, N8QJM

They also make a claim of a wiping action to clear the contacts every time there is mating and de-mating. There may be some slight advantage the Powerpole has with this but it is clearly minor relative to being superior to other contacts.

## Mating Connectors



Wesley Cardone, N8QM

All four sides have grooved molding (as we will see later) to facilitate pairing.

# Genderless

- There is no male/female distinction

Wesley Cardone, N8QM

## Contacts

One Size  
housing fits all three.



20, 18, 16 AWG  
15 Amp



14 & 12 AWG  
30 Amp



10 AWG  
45 Amp



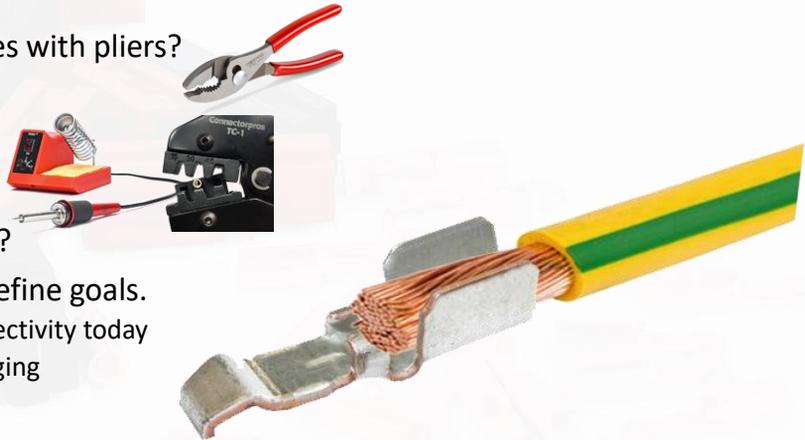
Wesley Cardone, N8QM

For amateurs there are three main size contacts that are available. There are much, much larger contacts available but these are generally not of interest to the amateur community. What makes this grouping of three sizes special is that all three are housed by the same fitting.

Always pay attention to the gage wire that the connector is specified to work for. This is critical in making you invincible. We will see later how Powerpole paraphernalia helps guide you through this.

## How Do You Attach a Wire?

- Fold in the flares with pliers?
- Solder?
- Fold & Solder?
- Crimp?
- Crimp & solder?
- Answer: First define goals.
  - Optimal connectivity today
  - Resistant to aging



Wesley Cardone, N8QM

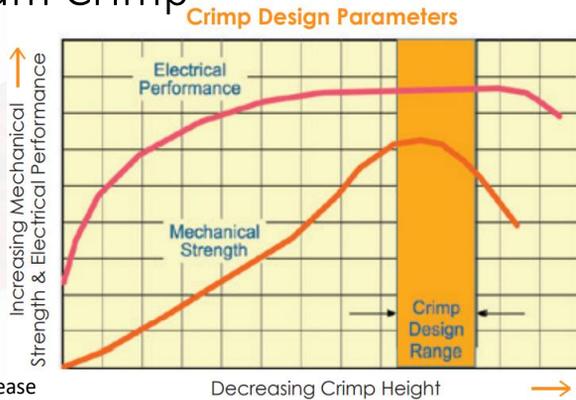
So, now we come to the \$64,000 question. We know that we have wires and we know that we have connectors and we know that in some way they must be connected. Let us also assume that our goal in attaching a wire to a Powerpole connector is to optimize the immediate connectivity while optimizing its longevity.

Why not just mash down the flares with some pliers you obtained from Ace Hardware? Maybe you are a fan of soldering. Maybe you might want to combine the two for a bold solution. Or, maybe you might want to follow my suggestion and crimp with no solder. Right now that is merely a suggestion, subjective, but the objective is coming.

You will be able to answer these questions as we proceed through the coming slides but I want your mind in thinking mode regarding this critical concept. If you take home nothing else from tonight's presentation, you must take this concept home with you.

## There is an Optimum Crimp

- Axes
  - Vert: Quality of connection
  - Horiz: Crimp depth
- Quality Curves
  - Red: Electrical quality
  - Orange: Mech strength
- Too little depth:
  - A lot of resistance
  - May pull apart
- Too much depth
  - Metal ruptures
  - Cavities and sudden resistance increase
- Moral of the Story: Read the instructions for heaven's sake.

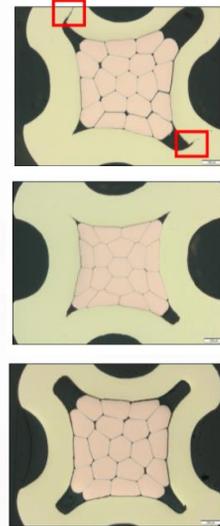


Wesley Cardone, N8QJM

You don't need to take THIS information home with you but what I do want you to realize is that there is a science to crimping that industry has gone to great lengths to optimize. Here's the key: if they can improve the crimping in wire harnesses sold, they are going to save money on warranty expenses. That is big.

## What's the Big Deal with the Crimp?

- Too much crimping (top) or too little (bottom)
  - Ruptures of crimp and wire strands (too much)
  - Cavities formed within crimped bundle (both)
  - Lower adhesion (both)
    - Increased resistance
    - Will oxidize
    - More likely to separate
    - Fire hazard
- Optimal crimping (middle)
  - Copper flow (Young's Modulus of Elasticity)
    - Elimination of cavities preventing oxidation
    - Optimal adhesion for mechanical strength
    - Minimal resistance for reduced hot-spot



Wesley Cardone, N8QM

Here's the story behind the curve set you just looked at.

With a crimp depth that is too great, the metal, both wire and contact, rupture unpredictably. The obvious effect is decreased mechanical strength which means decreased pressure resulting in increased resistance with an increased risk of fire or connector failure.

Likewise, with too little crimp depth just about the same effects occur except for the ruptured metal. Long term, we are talking oxidation with both which we otherwise call "aging."

But with optimal crimping there is a flow of copper strands eliminating cavities.

## Why Use Stranded Wire?

- Solid core wire is fine where there is no vibration.
  - Household wiring
  - PC hookup
  - Proto-boarding
- Stranded wire resists rupture
  - Automotive
  - Ballistic missiles
  - Marine



Wesley Cardone, N8QM

We all know that for automotive, ballistic missiles, and marine application we always want to use stranded wire since it resists rupture from bending and vibration. In amateur radio, stranded wire is probably about all that is used.

## Solder Works Great but...

- What problems may result without proper attention?
- How does this soldering look for these three wires?
- Do you see problems?
- If you were a company QC inspector, what would you say?



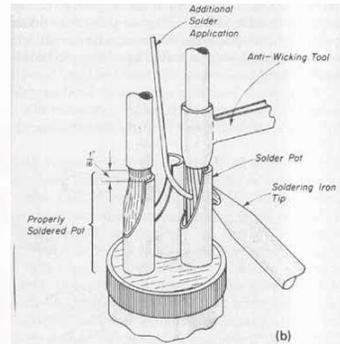
Wesley Cardone, N8QJM

Here is a photo of industrial soldering gone wrong. Do you see what went wrong?

Does anyone see what might have gone wrong?

## Solder Wicks up the Strands

- Solder has wicked up under the insulation
  - Nullifies stranded advantage
  - Premature aging expected
  - Insulation affected
- For industrial application would use an Anti-Wicking tool.



Wesley Cardone, N8QJM

Solder has wicked up the strands as evidenced by the malformed insulation. What effect does this cause? It is an effective way to create about a one inch of solid-core wire out of multi-stranded wire.

In industry they use an anti-wicking tool to prevent it. I don't think that any of us would go to that length including myself.

Here's something to think about regarding soldering and coax cable. Characteristic impedance is everything with coax cable. It is defined by the square root of the inductance per foot divided by the capacitance per unit length. The coax dielectric is mainly responsible for this relationship. What happens when you over heat the dielectric causing it to mal-form? We can address this later if there is interest but we will leave it as food for thought right now.

## Match Wiresize to Contact Amperage

- 15 Amp
  - 16 AWG, 18 AWG, 20 AWG
- 30 Amp
  - 12 AWG, 14 AWG
- 45 Amp
  - 10 AWG, 12 AWG
- Match die size to connector size.



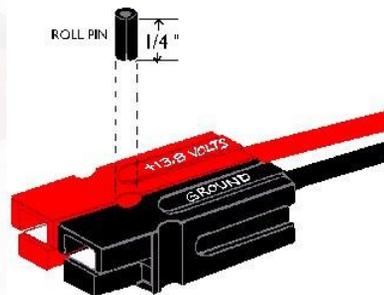
Wesley Cardone, N8QM

You need to always pay careful attention to wire sizing as I mentioned earlier. Powerpole current sizing is pretty easy to keep track of but what gage wires to use for a given Powerpole connector is a little bit more obscure and difficult to track. Shown in this crimper it is stamped directly on the tool which is a HUGE advantage. It is always right in front of you when crimping.

The big deal, though, is to match the crimper die to the size of Powerpole contact used. Do you want to be invincible with the Powerpole? You will not be invincible if you neglect this issue.

## Meshing Together

- Applications are almost always in pairs for power distribution.
- All four sides have slots or channels for pairing.



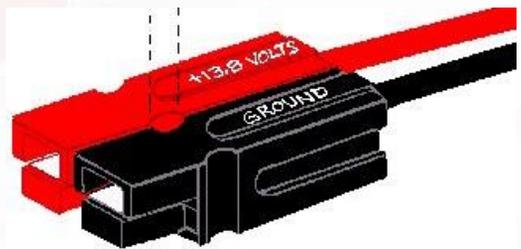
Wesley Cardone, N8QM

Probably 100% of your Powerpole applications will be to facilitate 12 Volt power distribution. You will therefore be using Powerpole connectors in pairs. Powerpole housings have mating grooves on all four sides that have been well thought out as we shall soon see.

When you mate a pair, be sure to use the mouse turd they give you with Powerpoles to keep a mated pair locked from moving out of alignment.

## Orientation for Proper Mating

- Must locate red housing on the right when facing housing away from you.
- Necessary for mating with like pair.



Wesley Cardone, N8QM

Here is something that will bite you when you least expect it. You can go to a lot of trouble to fabricate a Powerpole cable only to find that the red and black housings are on the wrong side causing you to, if you actually use it, mate a red supply housing with a black return housing.

You know what... I never learned how to spell very well. Maybe some of you could help me. How do you spell...blown fuse. Let's see. Blxzk...

But you know what...Powerpole has you covered if you do that as we shall see in the next slide.

## Protection from Mis-Mating

- Fortunately, if you get it wrong, they won't fit nicely if you get it wrong.
- Can try to mis-match but won't fully engage.



Wesley Cardone, N8QM

The red housing should go on the right side when facing away from you as shown in the upper part of the right photo. But suppose you get it wrong. Suppose you go to all the trouble of fabricating a cable the wrong way and then, while you are not paying attention, actually use it blowing a fuse...or worse... we won't talk about.

Powerpoles have you covered in two ways. It is impossible to fit a housing pair together in the wrong orientation. They won't fit. In addition, red housings will not readily mate with black housings.

When I attempted to pair a red and black housing on the wrong sides in preparation for this presentation, I found that the pair that I mated, no matter how hard I tried, I could not separate them. Help me spell again. How to you spell..."toast."

## Buy Extra Contacts

- Types available
  - Tin plated
  - Silver plated



Wesley Cardone, N8QJM

There are tin-plated and there are silver plated contacts. Tin plated work so don't be afraid to use them. But silver plated are better (maybe not a lot better).

## The Basic Essentials of a Powerpole

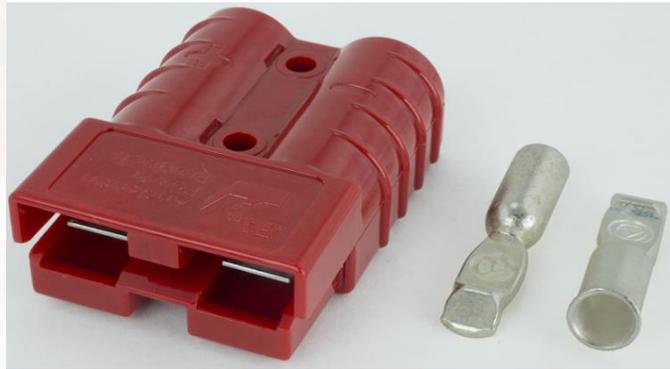
- **Connector Housing**
  - This is what you see
  - One size usually sufficient for amateur use
  - Colors: Red and Black
- **Connector Contact**
  - Crimp contact
  - Available in 3 different sizes
    - 15 Amp
    - 30 Amp
    - 45 Amp



Wesley Cardone, N8QJM

This is the way to go...buy a kit. There are various kits available as we shall see in an upcoming slide. Also, buy some additional contacts because you are going to go through these faster than you go through the housings.

## Very Large Loading Options



Wesley Cardone, N8QM

There are Powerpoles going up into the hundreds of Ampere capacities.

## Wire Strippers

- Do you want
  - to forever stop cutting your fingers?
  - consistent cut lengths?
  - fast and painless stripping?
- The traditional model in the lower portion works fine.
- The Knipex model is truly superior
  - Self-adjusts to wire size
  - Has a depth setting



Wesley Cardone, N8QM

I found that the Knipex wire stripper is fabulous. Highly recommended. For many years I've been using the one in the lower part of the photo but recently converted to the Knipex.

## The Crimper & Considerations

- There are more expensive Powerpole crimp tools but this one does everything.
- Buy one that has the AWG sizing stamped on the face.



Now, about the cheapest crimper is about the best. I particularly like that all of the important info is stamped on the face of the crimp tool making it readily available to help you in decisions.

## Sleeves



Wesley Cardone, N8QJM

There are sleeve options that help a lot in making your connectors resistant to the weather. There is no hole on the end, so you have to snip off a little piece with some dykes which allows you to define the hole size you need.

## Recommend You Buy a Kit

- When you want to use these things you want them right away.
- A kit gives you a readily available selection.
- Recommend you buy extra contacts.



Wesley Cardone, N8QM

We talked about kits earlier. These are pretty cheap. I recommend you buy a good sized one.

## Apply Silicone Paste to Interfaces

- Silicone paste is always a helpful aid in power distribution.
- Retards oxidation
- Lubricates for smooth sliding
- Causes eye and skin irritation so use the brush.



Wesley Cardone, N8QM

It never hurt an electrical connector to smear a little silicone paste over the conduction paths. This works nicely for the Powerpole because the paste is then inside the housing where it will not be disturbed but yet always present.

Please be thinking about your questions because we are nearly at the end of the presentation.

## Insertion Tool

- Extremely helpful when attaching small gage wires.



Wesley Cardone, N8QJM

When you insert an 18 or 16 gage wire with connector into a Powerpole housing, it can be very tricky. If you are using 10 AWG wire it is not too bad. But may heaven help you if you are using the smaller wire. For these you really do need the insertion tool in order to save your fingers from grief.

## When Everything is Said and Done...

- It's the operator that makes the difference.
- What makes the difference?
  - Training

The most important system component is the **operator**. This person must be provided with the necessary information and training to enable them to make a perfect crimp. A high quality product, tooling, clear instructions and comprehensive training course will help ensure this can be achieved every time.

Cablecraft CTT offers full in-house training to all crimping standards. For more information see page 35.

Hexagonal Crimp  
Double Pass 'Collar'  
Effect



Indent Type Crimp

Hexagonal Crimp Single Pass

19



CABLECRAFT



AMP

Wesley Cardone, N8QM

We have nearly reached the end of my presentation so I now ask, “What’s it all about, anyhow?”

The answer is easy: You and training. You need to know what this stuff is all about if you want to be invincible with the Powerpole. But certainly you can just forget about crimping and stick with solder. Solder does work and for amateur radio purposes it usually works pretty well. And let us also say that solder is certainly and without question better than crimping that is less than optimal.

## Almost Done...

- Just one last slide before questions.
- Michigan dairy cows are the finest in the nation.
- I can prove it in the next slide.



Wesley Cardone, N8QM

And one last slide before questions...

Did you know that Michigan dairy cows are among the finest in the nation?

Didn't I tell you at the beginning of this presentation that when I tell you a subjective conclusion such as this that I would present logical reasoning for that conclusion?

## Michigan Dairy Cows the Finest...

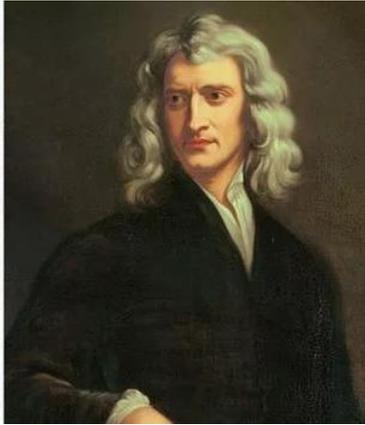
- They are outstanding in their fields.



Wesley Cardone, N8QM

You can see for yourself that Michigan dairy cows are outstanding in their fields.

# Powerpole Questions



Wesley Cardone, N8QM



You can be  
invincible with  
Powerpoles

I will now entertain questions. I could talk for another 30 minutes on Isaac Newton alone. Did you know that were it not for his mother, Newton would have lived his life as a dirt farmer?

I bet that I could do more pullups than this guy on the right. I'm thinking he's a wimp.