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InterConnect Wiring

E-BOOK SERIES

The Wonderful World of Wiring

A Compilation of InterConnect Wiring's 2016 Blogs Relating to Aerospace Electrical Design, Manufacturing, and Testing.

Written By:
Clare Elizabeth McGarrey
Vice President & Co-Founder of InterConnect Wiring
12 January 2017

InterConnect's Why: Why Do We Do What We Do? Because the only thing better than saving a project in danger is doing it right in the first place!

A publication of InterConnect Wiring.

InterConnect Wiring, L.L.P.
5024 West Vickery Blvd.
Fort Worth, TX 76107 USA
817-377-9473
www.interconnect-wiring.com

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INTRODUCTION

In 2016 *InterConnect Wiring* created **The Wonderful World of Wiring** newsletter. This newsletter included thirty-six (36) blogs about various aspects of electrical wiring in the aerospace sector. This book is a compilation of these articles (blogs) and is written to educate the common man. The information herein is not intended for electrical engineers or PhDs; rather, its purpose is to share simply written, short topics on aerospace wiring.

This book has been divided into seven (7) chapters. Each chapter covers 3-8 blogs. The seven categories include:

1. Wiring Harnesses
2. Panels
3. Engineering Design
4. Connectors
5. Wire
6. Testing
7. The Three Qs (Q3)

It is my intention to make this an informal and fun book to read while teaching you a thing or two about **The Wonderful World of Wiring.**
Enjoy!

Clare McGarrey

HARNESS ASSEMBLY

What is a Wiring Harness?

By John Ashour

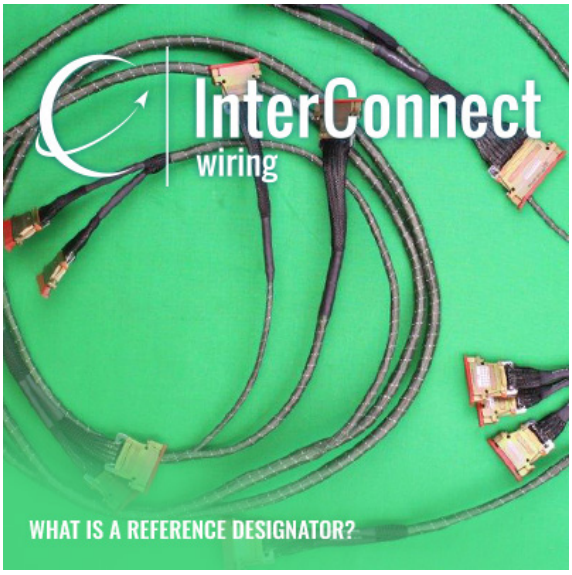
InterConnect is starting a series of blogs to discuss different aspects of aircraft electrical wiring harnesses. For the next 38 weeks, InterConnect will provide definitions, descriptions, and photos of not only common parts used to manufacture wiring harnesses but also discussions of how to design wiring harnesses as well as lessons learned when designing wiring harnesses. Today's blog is "What is a wiring harness?".

To put it simply, a wiring harness is a group of wires bundled together. A wiring harness can be very small in size such as a small group of wires found in your computer or car. A wiring harness can also be very huge such as some of the ones that InterConnect manufactures for aircraft. These huge wiring harnesses may have thousands of wires in them and hundreds of connectors. The finished wiring harness may weigh over 100 pounds and cost over $50,000. When I meet people and they ask what a wiring harness is, I give them the example of an extension cord. When you buy an extension cord you are buying a small wiring harness. Wiring harnesses have many different names including: electrical wiring harnesses, looms, cable assemblies, coax cables, RF cables, injection molded cable assemblies, fiber optic cables, and many times are simply called harnesses.

Wiring harnesses are important for aircraft because they can be installed as one unit instead of one wire at a time. It is much easier to build them on a table in a production area such as InterConnect Wiring's production area as opposed to putting in wires one at a time in an aircraft and then connecting each wire to a connector or terminal or a splice. It is much easier and faster to route a group of wires already bundled together than routing them individually.

What is a Reference Designator?

By Chris Bettinger



Reference Designators label the location on a wiring harness to ensure assembly is straightforward on the aircraft. The reference designator usually consists of one or two letters followed by a number. The convention of Plug (P) and Jack (J) when assigning references for electrical connectors in assemblies where a J (or jack) is the more fixed and P (or plug) is the less fixed of a connector pair, without regard to the gender of the connector contacts.

Shrink tubing is used for harness identifiers, reference designators, cover for wires, and in solder sleeves and splices. The common material for shrink tubing is polyolefin. Shrink tubing is manufactured at a small diameter then is expanded to a larger diameter. When heated, the tubing 'recovers' to the predetermined diameter. Most shrink tubing only change in diameter, not in length. Most aircraft shrink tubing will recover to ½ of the diameter it started. Some of the more expensive tubing will recover to ¼ of the diameter it started. Typical shrink tubing part number's begin with M23053, P5034, P5381, and P5382.

What is Braiding?

By Jeanie Peel

Braid is composed of threads woven tightly around a wire bundle. Braid can be textile, metal or any other material that can be threaded onto a spindle type braiding machine. Many electrical harnesses installed in aircraft are braided. Braiding is important for electrical harnesses as it provides a protective layer from chaffing, heat and other wear and tear to electrical harnesses.

InterConnect currently has 19 braiding machines of various magnitudes that are used to braid an assortment of harness diameter sizes. We can braid anything from a single wire using a 16 carrier braiding machine to a bundle of wires over a 3” diameter using a 48 carrier braiding machine.

If you want to see our braid machines in action, please schedule a tour. Make sure you wear a pair of our disposable ear plugs in the braid room. It’s very loud when all the machines are running.

What is a Synthetic Harness?

By Clare McGarrey

In the aerospace industry, or at least here at InterConnect Wiring, we use the term Synthetic Harness. Now I cannot remember if InterConnect came up with the term or if it was our customer, Lockheed Martin, but I do remember when it did come to fruition.

It was back in 1999 and InterConnect was asked to make something different than we usually do. Back then we predominately made F-16 wiring harnesses or F-16 loose wire assemblies (LWAs) also known as kits. Lockheed approached us and said, “Can you make a combination between a kit and a wiring harness?” and we said, “Yes, we can. What shall we call it?” That is when I think that Lockheed and InterConnect collaboratively decided to call it a Synthetic Harness. Recently I looked up the word “synthetic” in the dictionary and it says, “Not natural”. Well, that makes sense.

When a wiring harness is made, all connectors are terminated on all ends, the harness is completely braided (or string tied), and all points are hooked up to the DITMCO test machine where the harness is tested for continuity and insulation resistance.

In the case of a kit or LWA, wires are braided (individually or together as the drawing calls for) but no ends are terminated. Loose pieces of hardware like terminals, contacts, connectors, back shells, wafers, and shrink tubing are placed into individual bags, identified, then kitted together (with the braided wires) into a large bag to form a LWA. Kits are mostly used on upgrade programs to alter a current aircraft configuration to a new, different or better one, such as the F-16 Taiwan and the F-16 Indonesia upgrade programs we recently completed with Lockheed Martin. In the past, InterConnect has produced many kits for its customers like the F-16 CCIP and the F-16 NVIS programs, to name a few.

Now back to a synthetic harness. When an aircraft harness is completely made, and all points (ends) are terminated; we can call that a natural harness. When a kit is made and obviously no points are terminated; we can call that a natural kit or LWA. So, to come up with a Synthetic Harness, you combine a wiring harness and a kit. Therefore, a Synthetic Harness is a harness that has one connector that is terminated to the wires and the other ends of the wires are floated (not terminated). Then, the synthetic harness is coiled up, bagged, and kitted along with the loose parts (connectors, contacts, tubing, etc.) that will be terminated at a later time.

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What is a Synthetic Harness?

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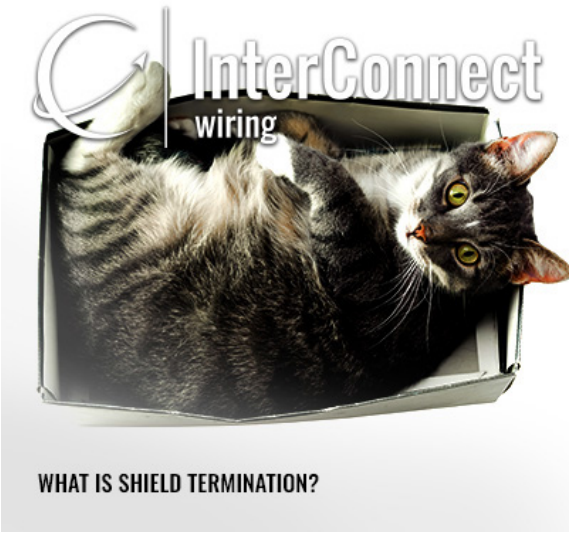
The obvious question now is, “Why would Lockheed Martin, L-3, Boeing, Bell Helicopter, or Sikorsky want to buy a Synthetic Harness?” Good question. The main reason that a synthetic harness is ordered is when the length of the wires are not known enough to terminate both (or multiple) ends. The one end that is terminated with the connector is installed in the aircraft and the loose wires are routed to the other appropriate aircraft locations. After routing in the aircraft, the wires are then cut to “as needed” lengths and then terminated to the connectors.

I hope you now understand what a synthetic harness is and I didn’t just confuse you even more! I also really hope that you are enjoying our bi-monthly blogs and are learning everything there is to know about electrical aircraft systems. Please be sure to check us out on Facebook, twitter, You Tube, LinkedIn, and Instagram! There are many pictures of serious, silly, and fun InterConnect activities. I’m not sure why there are so many photos of me!!

What is Cable Shield Termination?

By Michael Janney



In the commercial aerospace and defense industry we find a high concentration of electrical wiring in a relatively small area. The overall goal is to design the equipment and components as small as practical and locate the equipment in a compact, easily accessible area. This includes all wiring harnesses, cable assemblies, and aircraft relay panels. A small space like this is not conducive to minimizing electromagnetic interference (EMI); therefore, to combat the effects of EMI, a metallic shield is placed around the electrical conductors in a wire then coated with insulation, such as TKT.

So, to answer the question, “What is a cable shield termination?” it is where a shield (obviously of a shielded wire) is terminated to another component. There is a wide variety of termination methods including:
1) Attaching a solder sleeve and jumper wire to the shield then the jumper wire is connected to the connector’s backshell.
2) Attaching a solder sleeve and jumper wire to the shield then routing the jumper wire to a contact cavity in a connector.
3) Attaching a solder sleeve and jumper wire to the shield and the jumper wire is “daisy chained” to the jumper wire of other shields.
4) Placing a piece of shrink tubing over a shield and it is floated (not connected) to any conductor or ground point.

The purpose of a shield in a shielded wire is to eliminate EMI that is caused by the electrical current in the conductor of a wire. Likewise, a shield limits EMI caused by other nearby wires. Shields eliminate crosstalk between wires so you have a clear signal. The most common practice in the aerospace industry is to terminate the shields to a jumper wire then the jumper wire is connected to a ground point. In many cases the ground point is the backshell of a connector which ultimately connects to the air frame.Contact Us if you would like more information about how to terminate a shield.

What is a Wire Termination?

By Joshua Bryant

A wire termination is the work performed to the end of a wire that allows it to connect to a device (connector, switch, terminal, etc.). There are many types of terminations in the aircraft industry, but we can boil them down into two basic categories: crimp and solder.

A crimp termination is performed when the device requires a contact or terminal. The wire insulation is stripped, and the contact or terminal is attached to the wire using a crimp tool. The tool crimps the contact or terminal onto the wire conductor. This type of termination is most often used on the aircraft wiring harnesses and circuit breaker panels that InterConnect produces for various aircraft including the F-15, C-130 and UH-60, to name a few.

A solder termination is performed when the wire conductors attach directly to the device. This requires stripping off the wire insulation and applying flux and solder to connect the wire to the device. The J- STD-001 (Requirements for Soldered Electrical and Electronic Assemblies) gives the specific details on how to properly solder.

InterConnect has a very stringent Training Program for all of our assemblers to learn how to crimp contacts and terminals as well as solder. Each year, assemblers are re-trained on how to terminate wires according to J-STD- 001, IPC-A- 610, and IPC-A- 620. Additionally, here at InterConnect, we create specific training programs according to the specifications referenced by our customers. So, for example, for F-16 wiring harnesses and panels, Lockheed Martin calls out 16PR145 and 16PR8817. Therefore, we have a training program for terminating wires and preforming other assembly processes based on these two specifications for this particular (F-16) platform for this particular (Lockheed Martin) customer.

It is vitally important that all wire terminations are performed correctly. You can trust InterConnect Wiring to manufacture your aircraft electrical wiring harnesses, relay panels, black boxes, and mux assemblies to your exact specifications. To learn more about terminating wires and how aircraft wiring harnesses are designed, download your free copy of our eBook.

Why are Wiring Harnesses Sometimes Called Looms?

By Clare McGarrey

When the president of InterConnect Wiring, John Ashour, asked me to write this blog, I had no idea what the answer was to the question. Since John and I started InterConnect in 1993 I don't think I ever remember a harness being called a "loom". So, I was happy to take on the challenge of writing this blog to not only inform the reader, but inform myself as well.

In the last 23 years I have only thought of InterConnect as a manufacturer of F-35 wiring harnesses, B-1B cable assembles, F-16 fiber optic cables, V-22 harnesses, UH-60 circuit breaker panels, and F-15 power panels. Never, until now, have I thought of us as the maker of a wiring loom. Come to find out, we are. Here is what I found in my research. The term "loom" was commonly used in the aerospace and automotive industry half a century ago. A wiring loom, also known as a harness, wire harness, cable assembly, wiring assembly or wiring harness, is an assembly of wires which transmit signals or electrical power. The wire looms are bound together by braiding, straps, cable ties, cable lacing, sleeves, electrical tape, conduit, a weave of extruded string, or a combination thereof. So, the word wiring harness and wire loom are interchangeable. In the dictionary it says that the word loom means: "An apparatus for making thread or yarn into cloth by weaving strands together at right angles."

Well that now makes perfect sense. At InterConnect Wiring or incredible assemblers weave together hundreds of wires creating one large beautiful electrical tapestry. Therefore, a wire loom is a well-crafted work of art that InterConnect creates from multiple wires, contacts, and connectors weaved together and bound by braid or lacing tape.

Check out a photo of one of our wiring looms. In fact, I plan to update our website to state that InterConnect manufactures wiring looms. I had no idea!

How are Wiring Harnesses Built?

By John Ashour

In the past year, InterConnect Wiring released a blog entitled “Why Do Aircraft Have Wiring Harnesses?“ and another blog entitled “What is a Wiring Harness?”. Based on these two blogs a reader should know what they are and why they exist but one aspect remains; how are they built? Although they can range in size from a small bundle with two wires and two connectors to a very large, heavy, complicated one that contains over 5,000 wires and over 100 connectors they are basically made the same way. The purpose of this blog is to list and describe the basic five step process of how wiring harnesses are built.

Step 1 – Wire Cut and Marking

Every wire in an aircraft wiring harness has its own unique identification number. (See blog “Why Does Each Wire on an Airplane Have Its Own Identification Number?”.) The first step in wire harness manufacturing is to (1) measure, (2) mark, and (3) cut each wire individually. For most OEM military or commercial wiring harnesses, the preferred method to mark a wire is laser wire marking. (See blog “What is Laser Wire Marking?”.) A good laser wire marking machine will do all three tasks. After this process is accomplished for each wire in a wiring harness the next step is to layout the wires.

Step 2 – Wire Layout

Wire layout is just what it sounds like; an assembler takes each wire and lays them out – one at a time – onto a HAD. (See blog “What is a HAD?”.) The HAD shows how wires are routed from one end point to another. The HAD also shows where a wire ‘breaks-out’ from the main bundle. It should be noted that some wires have a metal shield around the main conductors while others do not. (See blog “Why do some wires have a metal shield around them?”.) Additionally, some wires are different gauges. (See blog “What is Wire Gauge?”.) After all wires are routed, they are then grouped together using either string tie or tape. Once this process is done the next step is Wire Termination. Wire termination is the most complicated process and the most problematic.

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How are Wiring Harnesses Built?

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Step 3 – Wire Termination
Every conductor in a wire is somehow terminated. (See blog “What is a Wire Termination?”.) For example, a twisted, shielded pair requires six terminations – one for each end of Conductor 1 (or two terminations), one for each end of Conductor 2 (or two terminations), and one for each end of the Shield (or two final terminations). Some people fail to remember that shields on shielded wires are also conductors and need to be terminated. (See blog “What is a Cable Shield Termination?”.) Wires are generally terminated by (1) stripping the insulation away from them, (2) crimping contacts onto the conductors, and (3) inserting them into a connector contact cavity (see blog “What is a Contact Cavity?”) per its insert arrangement (see blog “What is an Insert Arrangement?”). Every connector or endpoint in a wiring harness has its own unique identification number which is called a reference designator. (See blog “What is a Reference Designator?”.) After all conductors have been terminated at all reference designators the wire termination process is complete and the wiring harness is moved onto a very important next step; testing.

Step 4 – Testing
Every wiring harness that InterConnect makes undergoes some type of test. In most cases InterConnect uses very sophisticated, automatic test machine made by a company called DITMCO. For most customers InterConnect will test for continuity (see blog “What is Continuity Testing?”) as well as insulation resistance testing (see blog “What is insulation resistance testing?”). In a few cases, customers will instruct that InterConnect only ‘beep out’ a wiring harness. (See blog “What Does It Mean To ‘Beep Out’ A Wiring Harness?”.) Once a wiring harness fully passes testing it is sent to the final process called dress-out.

Step 5 – Dress-Out
The fifth and final process in building a wiring harness is dress-out. Dress-out consists of (1) heating-up and shrinking-down tubing, (2) making sure reference designators are located properly, (3) making sure wire harness identifiers are located properly, (4) putting dust cover caps or ESDS bags on connectors to protect them, and (5) final inspection. Once dress-out of a wiring harness is complete, it is ready for packaging and shipment.

For the past year, InterConnect has been releasing many blogs about aircraft wiring harnesses. This blog has had many links to a variety of topics. If you read this blog and did not have to hit a hyperlink to find out what a term was, you have done very well in reading our blogs and are to be praised! Congratulations!

Please continue to follow our blogs and check out some of our photos of our involvement at various military aerospace conferences over the last few months.

PANELS

What is the Difference Between a Circuit Breaker Panel and a Power Panel?

By Jeanie Peel

Do you know where your circuit breaker box is located in your home? Did you know that the circuit breaker box in your home is very similar to a circuit breaker panel in an F-15?

Both in a home and in an aircraft, a circuit breaker box or panel is a protective device for opening a circuit automatically when excessive current is flowing through it. A circuit breaker may be reset to restore the circuit after a fault causing excessive current has been corrected. The Circuit Breaker Panel is an electrical protecting safety device. That's one reason every electrically powered item must be protected by a circuit breaker; whether it be a home, fighter jet, utility helicopter, cargo airplane, Archangel, etc.

A Power Panel controls the electrical power for each panel and component in the aircraft. Most airplanes have a dedicated avionics circuit that would be connected to one of the primary circuits with a relay. The avionics master power panel allows the pilot to depower all avionics with a single switch instead of turning off each individual item.

To summarize, both circuit breaker and power panels are needed to protect the electrical systems in an aircraft. Circuit breakers are used to protect the system from overload while the Power Panel turns off an entire section of the avionics with one switch. Click here to see a very cool video of an aircraft in which InterConnect helped design, engineer and build all of the electrical wiring harnesses. Power and Circuit Breaker Panels can be seen in the video. It is well worth the 2 minutes and 32 seconds it takes to watch!

What is a MUX Panel and How are Humans Like One?

By Michael Janney

Humans are great at multi-tasking. We constantly receive data from all directions and multiple sources at the same time. We receive this data through one of our five senses. We process this data and make decisions that affect the directions we are planning for the moment.

Let's say you're on the way to a book store when you walk by a bakery and smell fresh bread, you see a bicyclist headed straight at you on the sidewalk while noticing the white "WALK" street crossing light is illuminated and you glance at your watch and see you have 15 minutes until the book store closes. You make a split second decision to continue walking towards the book store before it closes since it is ok to cross the street instead of stopping for the fresh bread and simultaneously step aside from the oncoming bicyclist. Your senses received multiple inputs which were transmitted to your brain. Your brain processed the data, and transmitted the response to your legs to step aside and continue forward. This is very much like a MUX panel, also known as a multiplex, multiplexer or multiplexor. An aircraft MUX panel is an electronic device that receives data from multiple input sources (with their own dedicated electrical circuits) and transmits the received data out on only one dedicated electrical circuit. Mux panels create a significant reduction in material costs and weight savings associated with the eliminated electrical circuitry. If you have any questions about aerospace MUX panels why not ask the world's leading supplier of F-16 MUX panels? InterConnect Wiring.

Just one more thing… Be careful crossing the street when you are near a bakery! Below is a picture of a mux panel and enjoy these Thanksgiving Bread Recipes that some of us at InterConnect Wiring will be using this year.

What is a Relay Panel?

By Joshua Bryant

Here is a quiz. Which definition do you think applies to the aircraft electrical wiring industry when it comes to a relay?

A. A supply (as of horses) arranged beforehand for successive relief.
B. A race between teams in which each team member successively covers a specified portion of the course.
C. An electromagnetic device for remote or automatic control that is actuated by variation in conditions of an electric circuit and that operates in turn other devices (as switches) in the same or a different circuit.

If you answered A, you really like horses. If you answered B, you really like running. If you answered C, you would be correct!
A relay is basically another word for a switch. It could be a switch that turns something on/off or a switch that alternates between two items. In turn, a relay panel is a panel that holds one or more relays that sends power or signal to equipment based upon the input received.

You can think of a relay panel kind of like a dispatch service. Someone calls the dispatch office (input), the dispatchers inform the runners (activate relay), and the runner performs the tasks (output). Typically, the relay panel will have multiple relays making multiple connections simultaneously.

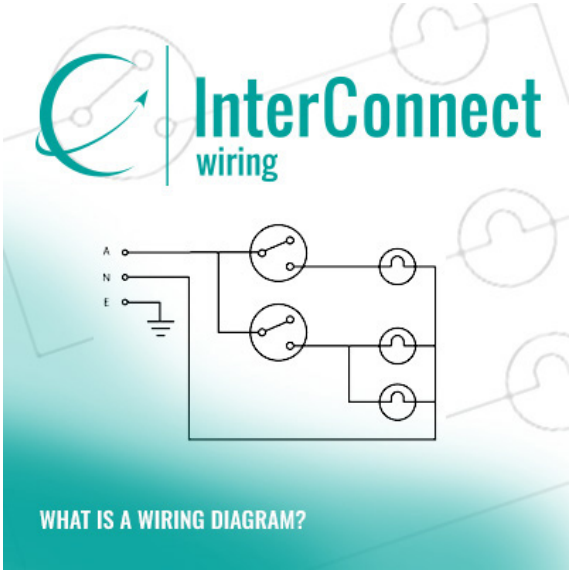
When it comes to aircraft, it is paramount that the relays are wired correctly so that the power and signal perform the proper task. InterConnect has wired and tested hundreds of different F-15 relay panels, F-16 relay panels, and UH-60 relay panels over the years. You can trust that your critical equipment operates perfectly in our hands.

To see an aircraft relay panel in person, please visit with us at one of the many 2017 Aerospace Conferences InterConnect Wiring is attending. We look forward to seeing you there!

ENGINEERING DESIGN

What is a Wiring Diagram?

By Nam Tran



A wiring diagram is a simplified conventional pictorial representation of the physical connections and physical layout of an electrical system or circuit. Wiring diagrams show how the aircraft wires are connected and where they should be located in the electrical system, as well as the physical connections between all the components. This makes a wiring diagram useful in manufacturing or troubleshooting an electrical system or circuit for various aircraft including the F-16, F-15, V-22, and UH-60.

The difference between a wiring diagram and schematic is the schematic only shows the plan and function for an electrical circuit, but is not concerned with the physical layout of the wires.

At InterConnect Wiring, we frequently use wiring diagrams to generate a Routing List (a point-to-point termination database). Once the terminations are in a database format we can extract Reference Designator Lists, Work Instructions for assembly, Batch Files for laser wire and Ref Des ID marking as well as many other valuable pieces of aircraft electrical harness and circuit breaker production data.

What is a BOM?

By Randall Robinson

I once asked my wife if she knew what the BOM was for something. The look I received was pure confusion and bewilderment. For example, “what is the BOM for parmesan chicken” is not the usual question a wife expects from her husband. Though poorly worded the question is valid. What is a BOM and how would it apply to a recipe for parmesan chicken?

A BOM, or the Bill of Materials, can be defined as a list of raw materials, components, and assemblies that make up a particular end item. The term BOM is a standard nomenclature for the aerospace industry on both the commercial and military sides. It is common in many production industries around the world. It does not seem to have a particular origin and has been common use for a long period of time. Going back to the parmesan chicken, the BOM would be your ingredients and might include the needed tools to cook this fabulous dinner.

BOMs, in their simplest form, are a single list of parts for an end item. However, a BOM can be complex as well. An assembly can call for sub-assemblies within its BOM and each one of those sub-assemblies have their own BOMs. Subsequently, BOMs can have multiple levels to them. Accuracy means that the BOMs of all assemblies including any sub-assemblies must be included in the overall BOM of the main assembly.

In summary, the Bill of Material, or the BOM, includes the ingredients for the end item assembly and any sub-assemblies that are called out. The importance of the BOM for InterConnect Wiring comes down to accuracy and quality of our products. InterConnect uses BOMs in estimating, planning, production, and quality review. The BOM is the foundational building block for accuracy in everything that InterConnect produces. Click here for the BOM of an aerospace cable assembly and here for a very simple Parmesan Chicken BOM (refer to “ingredients” for BOM) as well as cooking instructions.

What is a Routing List?

By John Ashour

A routing list (commonly called an 'RL') for an aircraft is a list of each wire in a wiring harness. Routing Lists are used on all aircraft including F-16, F-22, F-35, V-22, UH-60, CH-53K, etc. It is called 'routing' because it contains the endpoints of each wire. For example, wire NAV-121-22 may go from reference designator P3320 to reference designator J3321. Thus it is 'routed' from P3320 to J3321.

Besides listing wire numbers and reference designators, routing lists also contain much more information. Depending on the aircraft company, such as Lockheed Martin, Boeing, Rockwell Collins, Bombardier, or Dassault Systemes, that information typically includes: (1) wire length, (2) wire gauge, (3) contact cavity that the wire is terminated into for both reference designators, (4) how the wire is terminated (such as a contact part number), (5) wire part number, (6) system number for that wire, and (7) type of signal for that wire (such as power or data). A portion of a sample routing list is shown below.

One final note: There are many other names for a routing list. The name changes from one company to another. Some other names include: (a) wire list, (b) point to point list, (c) pin out list, and (d) termination list.

For more information concerning routing lists, please contact the sales team at InterConnect Wiring by calling 817-377-WIRE [9473] or emailing us at sales@interconnect-wiring.com.

What is a HAD?

By Chris Bettinger

A HAD is a Harness Assembly Drawing used to aid in the manufacturing of electrical wiring harnesses. HADs are used in the aerospace industry for all aircraft platforms including the AH-1F, AH-1Z, B-1B, B-52, C-130, EC-130, F-15, F-16, F-22, etc. Before production of a harness, a HAD is printed in full scale (1:1) to ensure the exact dimensions are met. Each HAD has 4 principal parts:

1. The Title Block – This displays the title, drawing scale and standard tolerances.

2. The Revision Block – This is used to designate changes and revisions to the drawing.

3. The Part Illustration – This is the full scale drawing of the harness.

4. General Notes – This is used to eliminate repetitive local notes.

Once the HAD is created it is printed and placed on a table where the harness is assembled right on top of it. Depending on the customer, terminology for a HAD can differ. Lockheed Martin, Boeing, SES, and L-3 may use the term HAD while other companies such as Sikorsky, Northrop Grumman, and BAE may use terms like mylar, form board, T101 or T105. No matter what term is used, these are all manufacturing aids and are the exact same thing. At InterConnect Wiring, for our trunk electrical wiring harnesses, whether braided, double braided or string-tied, we use the term HAD.

If you need a quote for us to design a HAD for you, please touch here. Be sure to check out InterConnect's other engineering design capabilities when you view that page.

What is Crosstalk in a Wiring Harness?

By Nam Tran

Did you ever wonder why some wires are bundled together in one aircraft wiring harness and others are not? Why does this wiring harness have 6 break outs while this other harness has only two? Why didn't the Lockheed Martin, Boeing, or InterConnect engineer just add those two wires to the larger harness? There are several reasons, but one important answer is crosstalk.

Crosstalk is a disturbance caused by the electric or magnetic fields of a nearby transmitted signal affecting a signal in an adjacent circuit. When a signal travels down a pair of wires in a wiring harness, the signal emerges from the other end, but the field that the signal creates around that pair can bleed over into adjacent wiring and creates crosstalk.

This effect can manifest itself as unstable, inaccurate or noisy signals. In turn these signals can cause erratic or incorrect instrument readings, erroneous input to aircraft control systems, poor audio or visual output and other similar undesirable results. To reduce the crosstalk in a wiring harness, a twisted pair with shielded cable is frequently used. When an interfering signal is applied equally to both sides of the twisted pair, the interfering signal is neutralized.

Another typical method used to reduce crosstalk is to physically separate signals of different types into separate harnesses, or separate branches of the same harness. Since crosstalk is very dependent on proximity, a small separation can yield a significant improvement in signal quality. In this photo you can see aircraft wiring harnesses that InterConnect Wiring not only made, but designed as well. During design, InterConnect's engineering team spent extensive time determining where to separate wires to prevent crosstalk, how to bundle them along the forward and aft fuselage, and where to place the clamps. In the picture, wires which are similar (such as a signal wires or power wires) are bundled together and clamped along three separate channels. To hear more about InterConnect Wiring, and learn about InterConnect's "WHY", view this video.

Why do Aircraft Have Wiring Harnesses?

By John Ashour

InterConnect is starting a series of blogs to discuss different aspects of aircraft electrical wiring harnesses. For the next 38 weeks, InterConnect will provide definitions, descriptions, and photos of not only common parts used to manufacture wiring harnesses but also discussions of how to design wiring harnesses as well as lessons learned when designing wiring harnesses. Today's blog is "What is a wiring harness?".

To put it simply, a wiring harness is a group of wires bundled together. A wiring harness can be very small in size such as a small group of wires found in your computer or car. A wiring harness can also be very huge such as some of the ones that InterConnect manufactures for aircraft. These huge wiring harnesses may have thousands of wires in them and hundreds of connectors. The finished wiring harness may weigh over 100 pounds and cost over $50,000.

When I meet people and they ask what a wiring harness is, I give them the example of an extension cord. When you buy an extension cord you are buying a small wiring harness. Wiring harnesses have many different names including: electrical wiring harnesses, looms, cable assemblies, coax cables, RF cables, injection molded cable assemblies, fiber optic cables, and many times are simply called harnesses. Wiring harnesses are important for aircraft because they can be installed as one unit instead of one wire at a time. It is much easier to build them on a table in a production area such as InterConnect Wiring's production area as opposed to putting in wires one at a time in an aircraft and then connecting each wire to a connector or terminal or a splice. It is much easier and faster to route a group of wires already bundled together than routing them individually.

What is an Aircraft Modification Kit?

By Colton Peel

A modification kit is a set of wires and parts used to make upgrades to an aircraft. There are two main reasons for aircraft upgrades. The modification kits, sometimes called Loose Wire Assemblies (LWAs) are used to either standardize the aircraft or to improve service life.

Standardizing the aircraft helps facilitate quick repairs in the field and get the planes back in the air as quickly as possible. Improving service life for an aircraft not only helps with safety, but helps a country to save money.

Even though the first F-16 flew in 1976, there are still over 1000 flying in the United States and many more flying for other countries around the world. For FY2015 and FY2016, the DoD budgeted $19.1 and $32.6 million for F-16 aircraft modifications. The F-16V, the latest F-16 configuration, includes numerous enhancements designed to keep the F-16 at the forefront of international security. As Lockheed Martin's Licensee for all F-16 electrical products, InterConnect will be supporting the United States and the F-16 modification programs for many years to come.

CONNECTORS

What is the Difference Between a Plug and a Recepticle?

By Angella Martin

Connectors are used on electrical wiring harnesses and are essentially enclosures (i.e., shells) which house contacts with wires. The electrical connection into the system at the contact termination is either a soldered or crimped connection (which is removable from the connector using a special tool). The shell and insert may be moisture resistant or a hermetic seal. The inserts in each connector must be oriented for correct mating, and the shell or insert usually contains a keying feature to prevent mis-mating that could damage the connector or result in an electrical problem.

Connector plugs and receptacles most commonly used for military aircraft were developed in the 1930s. They set the standard for the modern Military Standard (MIL-STD) and Military Specification (MIL-SPEC) connectors. One of the biggest challenges in assembling electrical harnesses is providing the correct connector plugs and receptacles for each reference designator of an electrical harness.

Don't be confused about the differences between a receptacle and a plug. The difference between a plug and receptacle is that plugs have prolonged connecting pins which fit into a mating socket called a receptacle. A receptacle connector is sometimes called a jack. A receptacle will have mounting features such as a flange with holes. Every electrical harness will have a variety of connector plugs and receptacles.

What does all this mean? It simply means that every connector plug will have a mating connector receptacle and every connector receptacle will have a mating connector plug in the aircraft. If you want to see some connector plugs and receptacles on the shop floor, schedule a tour. We will show you how connector plugs and receptacles mate together in military aircraft harnesses and panels for the F-16, UH-60, F-22, and AH-1.

Why is it better to use military connector part numbers instead of commercial part numbers when either designing new aircraft or updating existing aircraft?

By John Ashour

InterConnect has been designing and assembling aircraft electrical wiring harnesses now for over 23 years. During this period, we have seen a number of design mistakes dealing with electrical connectors.

The biggest mistake is that a customer begins to callout vendor part numbers instead of military connector part numbers on the Bill of Materials (BOM). The primary reason they do this is they are trying to save money. In most cases, Commercial-Off-The-Shelf (COTS) parts are less expensive than military part numbers. Unfortunately, in many cases they do not stay that way. Once a connector manufacturer realizes that their part number is listed on the BOM, they raise the prices since they are sole source. Connector manufacturers work hard to get companies who design aircraft electrical wiring harnesses to use their part numbers instead of military ones.

Besides pricing, a connector manufacturer can change their design and specification almost at will without coordinating the changes with the wiring harness design companies who callout their connector part numbers. These revisions or design changes can have adverse effects on what they were originally designed to be.

Military connector part numbers allow more competition in the aircraft industry. Additionally, to manufacture a military connector part number the manufacturer has to be qualified and listed on the Qualified Products List (QPL). QPL's are well maintained and periodically tested as opposed to some COTS parts. For more information about military parts (also called standard parts) versus COTS parts, please read InterConnect's eBook "An Introductory Guide For Engineers Designing Aircraft Wiring Harnesses".

What is a Standard Part vs. a NonStandard Part?

By Chris Vardy

In the 1980's, the fast food chain Wendy's had a commercial advertising chicken sandwiches with a tag line stating "parts are parts". InterConnect Wiring has been assembling wiring harnesses and electrical panels with both standard parts and non-standard parts for the past 23 years. But parts are parts, right?

When the Department of Defense started building weapon systems, it decided to make standard specifications and parts that all branches of the US Armed Services (Army, Navy, Air Force, Marines, and Coast Guard) could use. These standards are called military specifications. The US Department of Defense is in charge of them. Most are controlled and kept updated in Philadelphia. These parts have been changing over to Aerospace Standards controlled by the Society of Automotive Engineers but QPL authority remains with DOD.

Non-standard parts are parts that a company develops based on a military specification. As an example, when InterConnect assembles F-16 or F-22 harnesses designed by Lockheed Martin, most 'C' and 'P' specifications developed and controlled by Lockheed are based on military parts with a few minor changes. Non-standard parts provide a mechanism for a company to obtain a high-grade, quality part and have control over the part (instead of the DOD).
As for the Wendy's commercial, you can watch it here.

What is an Insert Arrangement?

By Eric Evans

The highly advanced military aircraft of today, such as the Lockheed Martin F-35 fighter or Boeing B-1 bomber, contain a large amount of specialized electrical equipment. Some examples include relay panels, circuit breaker panels, mux transformer panels, audio panels, navigation computers, weapons computers, and many more. This equipment is essential in enabling the aircraft to complete its designed mission, so it must be able to communicate with each other as well as with the pilot.

Electrical wiring harnesses are installed in the aircraft to connect all of the equipment to each other, the pilot, and the airframe. Each one of these harnesses contains a varying number of connectors, and each connector can contain anywhere from one to over one hundred wires. In order to understand what an insert arrangement is and why it is needed, let's break down the three basic components of a modern military circular connector.

1. Contacts – Placed on the end of each wire and held in place with a crimp or solder. Typically made of highly-conductive gold plated copper.

2. Insert – This holds all of the contacts in a specific orientation for correct mating and insulates them from one another. Typically made of reinforced epoxy resin or other composite material.

3. Outer shell – The enclosure that holds the insert and contacts. Typically made of die-cast aluminum and plated or anodized for corrosion protection.

In order for the connector to mate up with another component the contacts must be held in place in a specific orientation so that they are not damaged when the components are connected together. The specific orientation of the contacts is known as the insert arrangement. If you were to open up the latest Amphenol or TE
Connectivity catalog you would see many different variations of insert arrangements for a given connector size in order to facilitate the one to over one hundred wires that may be present.
Click here to see a great image of a connector's insert arrangement and the proprietary pin out aid that InterConnect Wiring's top engineers designed.

What is a Contact Cavity?

By Clare McGarrey

Do I need to see a dentist? Do I need to see a doctor? No. In our field of expertise, all you need to do is see an assembler. I looked up the word cavity and it said, “A cavity is a hollow in an object.” So, if you are at a dentist office, a cavity is a bad thing because it is a hole in your tooth. If you are at a doctor’s office and he talks about your abdominal cavity, he is simply referring to the space in your abdomen where your organs are located. In an aircraft like the C-130, V-22, or S-92, to find a contact cavity, first, all you have to do is look at a wiring harness or cockpit panel. Second, look at one of the connectors on the aircraft electrical wiring harness. Third, notice all of the small little holes inside of the insert arrangement of the connector. Those small holes in the connector are called the contact cavities. A contact cavity simply houses a contact (which has been crimped or soldered onto an aircraft wire) or a filler plug.

To see some great images of contact cavities in aerospace aircraft wiring harness connectors, refer to this blog written on Independence Day. You can also give me a call at 817.377.WIRE [9473] to discuss contact cavities or perhaps rewiring your fixed-wing aircraft or helicopter.

WIRE

What is Laser Wire Marking?

By Kevin Morris

Every wire on an aircraft must have its own unique identification number. The most common method to put this identifier on a wire is by laser wire marking. Laser wire marking is a method to place a permanent mark on a wire using a laser. Companies such as Spectrum Technologies and Tri-Star Technologies have designed machines to do this process. At first these machines were very large and expensive. Now, a company can buy desk-top models that are reasonably priced.

The permanent mark is formed when the laser interacts with the titanium dioxide in a wire's insulation. Titanium dioxide is already found in the insulation of an aircraft wire for other purposes including marking the white insulation in color. When the laser beam hits the wire it discolors the pigment in the insulation thereby leaving a permanent mark. Characters are formed from a metal disc that has cutouts of letters, numbers, and symbols. The disc turns as needed and the laser beam goes through the disc for a particular letter, number, or symbol.

When the beam exits the metal disk it is shaped as the desired character. It is an interesting process and very powerful technology. For more information about laser wire marking see InterConnect's previous blog "Four Reasons People Don't Require Laser Marked Wires". Also in the next few months read our blog "How Are Aircraft Wires Identified?".

Why do Some Wires have a Metal Shield Around Them?

By Candace Evans

In the 1970s when you were in your house watching TV, and someone plugged in a vacuum cleaner or turned on a blender, it completely affected the picture on the television. It magically produced terrible, crooked lines on the screen. For the younger reader who has never witnessed this before, take a look at the image attached to this blog.

The aerospace industry realized that interference like this could be detrimental to an aircraft, therefore, some wires in aircraft wiring harnesses and cockpit panels have metal shield around them. EMI (electromagnetic interference) is the disruption of operation of an electronic device when it is in the vicinity of an electromagnetic field (EM field) in the radio frequency (RF) spectrum that is caused by another electronic device.

Problems with EMI can be minimized by ensuring that all electronic equipment is operated with a good electrical ground system. In addition, cords and cables (wires) connecting the peripherals in an electronic system should, if possible, be shielded to keep unwanted RF energy from entering or leaving.

EMI in a flight control computer of an aircraft could cause it to produce unwanted commands and could result in an accident. If you have any questions, feel free to contact InterConnect's Vice President of Engineering, Mr. Marc Piloian, at 817.377.WIRE or any of our leadership. By the way, if you want to know why TVs don't react like they used to in the 1970s here's the answer:

Before: No Ground ===> Now: A good electrical grounding system.

Why Does Each Wire on an Airplane Have its own Identification Number?

By Marc Piloian

In brief – to ensure the airworthiness of the aircraft. Any modern aircraft, especially fighters like the F-15, F-16, F-22 and F-35 have thousands of wires. The integrity of the electrical wiring interconnect system (EWIS) affects the ability to gather data, communicate, fire weapons and even control the aircraft in flight.

Now imagine you're a technician manufacturing, testing, modifying or repairing part of the electrical system. Being able to identify exactly what wires you need to work on is critical to performing your job and keeping the electrical system in the correct configuration. The way this is accomplished is by giving every wire in the aircraft a unique identifier in the engineering data, maintenance manuals and on each wire itself. Typically the aircraft manufacturer assigns wire numbers to each wire segment during the design of the wiring system. There are variations between manufacturers but most rely on a system similar to that found in AS50881 where the wire ID is composed of several codes that help identify it's function. The ID is then applied to the wire itself during wire harness manufacturing.

Laser marking the ID is preferable wherever possible. In cases where the wire cannot be laser marked, identification markers are most frequently made from Mil-Spec shrinktubing with a thermal-printed ID.

What is Wire Gauge?

By Mark Strittmatter

Wire gauge is extremely important to the aircraft that InterConnect Wiring supports. Wire gauge is the measurement of the diameter of a wire, or the thickness of the wire. There are various wire gauges used within UH-60 wiring harnesses, F-15 wiring harnesses, C-130 electrical wiring harnesses, etc.

The thickness determines the amount of electrical current a wire can safely carry. Wire gauge is referenced as AWG behind a number. AWG stands for American Wire Gauge. So, 22 AWG is 22 gauge wire. To make things a little more confusing, a wire gauge that is a larger number, such as 22 AWG or 24 AWG, is actually a smaller diameter wire. In contrast, a 4 AWG or 8 AWG is a much larger wire. Typically, in an F-16 wiring harness, matrix assembly, or cockpit panel, the wire gauges used most often are 20 AWG and 22 AWG. Wire gauge is used to measure both the electrical and non-electrical characteristics of wires; this is important to electrical wiring and to structural cable. The American Wire Gauge, developed by Messrs Brown & Sharpe in 1855 is what is primarily used in the United States.

To receive a free sample of wire with your name laser-marked on it (any gauge), email Clare McGarrey or fill out this contact sheet. Make sure to ask about the free wire sample in the message!

What is a Conductor in a Wiring Harness?

By Eric Evans

A conductor is a type of material that allows the flow of an electrical current in one or more directions. In an aircraft wiring harness these conductors are what power the aircraft and carry data back and forth between components. Some examples of materials that are good conductors include silver, gold, copper, and aluminum.
An aircraft like the F-16 or UH-60 can contain thousands of feet of electrical wires, and at the core of each of those wires lies the conductor(s). A wire may be as simple as a single conductor covered by an insulating material, or it may be composed of multiple individual insulated conductors grouped together and surrounded by an overall insulating jacket.

The picture below is an example of a multi-conductor cable that would be typical to find in an InterConnect wiring harness. You can see that the white and blue insulating jackets have been stripped back to expose the conductor material.

TESTING

What is Continuity Testing?

By Marc Piloian

In simple terms, a continuity test verifies that current will flow in an electrical circuit (i.e. that the circuit is continuous). The test is performed by placing a small voltage between 2 or more endpoints of the circuit. The flow of current can be verified qualitatively (e.g. by observing a light or buzzer in series with the circuit actuates) or quantitatively (e.g. by using a multimeter to measure the resistance between the endpoints).

Nearly all military aerospace platforms InterConnect manufactures for, from the F-16 and F-22, to C-130 and UH-60; require a qualitative test to confirm the integrity of the EWIS (Electrical Wiring Interconnect System). These tests require the resistance between circuit endpoint to fall below a certain value, typically from 2 to 4 ohms. The values can be higher for circuits containing coax or thermocouple wire, inline resistors or similar components. InterConnect utilizes wiring analyzers and automated test programs to not only verify the resistance of circuits, but also to confirm our products are wired according to the wiring diagrams or similar engineering requirements. In many cases when InterConnect rewires military aircraft, the entire EWIS is tested after installation but prior to applying power to the aircraft. Here is a photo of a United States Army National Guard UH-60 that InterConnect Wiring completely rewired and is performing continuity and other tests on, prior to operational flight check.

What is Insulation Resistance Testing?

By Mike Winters

Every electrical wire, whether it's in an F-16 cockpit panel, UH-60 circuit breaker, or V-22 wiring harness, is carefully protected with some type of electrical insulation. The wire itself is a conductor of electricity.

The insulation is opposite from the conductor; it should resist current and keep the current on its path along the conductor. The purpose of insulation around a conductor is similar to a water hose carrying water, and Ohm's Law of Electricity can be more easily understood with a water hose comparison. Pressure on water from a pump causes flow along the hose. If the hose were to spring a leak, you'd waste water and lose water pressure, eventually causing the hose to be destroyed completely. Similar to the loss of water, when there is a problem with the integrity of the insulation of the wire, what results is a loss in the current, affecting the capacity of the aircraft to fly properly. So, what's the purpose of insulation resistance testing?

Insulation resistance testing is used as a quality control measurement. The insulation resistance (IR) test (also commonly known as a Megger) is a spot insulation test which uses an applied DC voltage (typically either 250Vdc, 500Vdc or 1,000Vdc for low voltage equipment <600V and 2,500Vdc and 5,000Vdc for high voltage equipment) to measure insulation resistance in either kΩ, MΩ or GΩ. How significant is insulation resistance testing? Let us put it this way… If your father, mother, brother, son, or daughter was piloting an F-16, F-15, B-52, B-2, AH-1 or UH-60, would you think that the insulation integrity of the wires that make the aircraft fly are important?

Unequivocally, YES! Electrical insulation starts to age as soon as it's made and aging deteriorates its performance. Harsh installation environments, especially those with temperature extremes and/or chemical contamination, cause further deterioration.

We will pose this question to you again…. If your family member or best friend's life was at stake, would you settle for a company that simply "beeps out" their wiring harnesses and panels, checking only for continuity; or would you prefer a company that performs EXTENSIVE insulation resistance testing on 100% of all electrical wired products, including military and commercial wiring harnesses, aircraft panels, and aerospace circuit breaker panels? We at InterConnect Wiring recommend you not take that risk. Only buy your aircraft wiring harnesses from a company like InterConnect, whose processes REQUIRE extensive testing, 100% of the time, for continuity AND insulation resistance. Click here to see an article about InterConnect Wiring in the Aerospace Testing International Magazine (refer to page 91).

What does it Mean to “Beep Out” a Wiring Harness?

By Jason Moore

Wiring harnesses are crucial to aircraft as well as anything that requires electrical power. Often InterConnect has customers approach us because they have a project that is behind schedule, there’s an inoperable aircraft on ground, or a crucial modification needing to take place in the field before the aircraft can be mission ready.

Our customers sometimes want us to move fast like the roadrunner. Beep! Beep! This brings us to the question at hand, “What does it mean to ‘beep out’ a wiring harness?” To “beep out” a wire harness means to perform a simple continuity check. It is called “beep out” because when there is continuity, the basic audible continuity device, makes a noise. This noise sounds like the roadrunner’s “beep”.To see an article posted in 2014 about an aircraft that had to have 10,000 wires beeped out, touch here. What a time-consuming thing to “Beep Out” a wiring harness! Thank goodness for our DITMCO machines. At InterConnect

Wiring we go well beyond “beeping out” every wiring harness that we manufacture. Anything from F-22, F-16, F-15, EC-130, B-1B, etc. we go the distance; much farther than the roadrunner!

Final thoughts… in manufacturing flight-worthy wiring harnesses, cables, and panels, a simple “beep out” test is not adequate. A fully automated test is of utmost necessity. Refer to this article about qualitative tests to check the integrity of an aircraft’s Electrical Wiring InterConnect System (EWIS).

What is Megohm or Megger Testing?

By Mike Winters

What comes to mind when contemplating the strength of a wire? A lot of people only consider what can be seen on the outside. For example, how far the wire can be pulled before it breaks or how high of a temperature it can withstand before it melts. But what about breakdowns in the integrity of a wire that cannot always be detected with the human eye? What about a wire's "electrical" strength?

As soon as insulation is manufactured it starts to age. Over time its performance deteriorates and its ability to isolate the conductor is decreased. Subjecting the wire to harsh environments and temperature extremes accelerates insulation degradation even further. Damage to a wire's insulation during manufacturing such as a nick by a wire cutter can also lower the insulation's integrity. The simplest of tests used to detect breakdowns in wire insulation is a Megohm (or Megger) Test, also known as an Insulation Resistance (IR) test. During Megohm Testing, the test equipment applies a high direct current (DC) voltage, usually 500 to 1500 VDC, between a conductor and one or several other conductors for a specific time period. Since we are testing for wire insulation integrity we want little or no current to flow between the conductors. Thus, a high resistance value is expected – typically 35 to 100 Megohms.

Here at InterConnect Wiring most of our wiring harnesses and panels are installed in military aircraft. A hazardous situation can exist if a wire insulation failure adversely affects equipment or causes personnel injury - especially while in the air. Therefore, we understand how extremely important it is for us to detect any insulation deterioration quickly in our electrical wiring products during the manufacturing process and take preventive measures. Every electrical test we run on our products includes Megohm Testing. We are very aware that wire insulation breakdown can exist even though they are not easily visible. We have made advancements over the years in testing our products to make sure that our wires are "electrically" strong. When we perform a Megger Test, a high resistance is desired; therefore, if a Borg tells us RESISTANCE IS FUTILE we laugh in their face. We are much tougher than they are and so are our aircraft electrical wiring harnesses!

What is Aircraft Ground Support Equipment?

By Mike Winters

Ground support equipment refers to the specialized tools and devices used to service military and commercial aircraft on the ground. Ground support equipment is used for routine maintenance or unscheduled repair and is critical for ensuring the various systems on the aircraft are working properly.

These tools can be grouped into a couple of types – aircraft handling and aircraft servicing. Aircraft handling would include equipment such as tow tractors, cranes, and dollies. Servicing equipment includes things like power generators, cabin pressure test units, fluid servicing units, munition loading systems, and electrical testers. Service equipment is often designed to be self-propelled, trailer mounted, or towed for maneuverability and mobility.

InterConnect Wiring has the capability to manufacture the electrical ground support assemblies and test equipment you need for many fixed-wing platforms such as the C-130, F-15, and F-16 as well as rotary-wing aircraft such as the Bell 525 and the Sikorsky UH-60. Our ground support customers include Lockheed Martin, BAE, and the USAF, to name a few. Some ground support equipment are very difficult to manufacture, so if you are an engineer or in supply chain management, be sure to know important questions prior to buying your aircraft ground support equipment. You can download our eBook to help you out.

Q3: QUALITY, QUANTITY, QUOTE

Why is AS9100 Important?

By Angella Martin

AS9100 is a standardized quality management system for the aerospace industry. This aircraft industry standard replaces the earlier AS9000 and fully incorporates the entirety of the current version of ISO 9000, while adding requirements relating to quality and safety. AS9100 is a company level certification based on the standard published by SAE titled “Quality Systems- Aerospace- Model for Quality Assurance in Design, Development, Production, Installation and Servicing”. Prior to development of AS9100 standards for Quality Management Systems (QMS), the U.S. military applied two specifications to supplier quality and inspection programs, MIL-Q-9858, Quality Program Requirements, and MIL-I-45208, Military Specification: Inspection System Requirements, respectively. For years these specifications had represented the basic tenets of the aerospace industry; however, when the U.S. government adopted ISO 9000, it withdrew those two quality standards.

Why is AS9100 important? Two reasons: customer requirement and benefits to the company. Large aerospace companies began requiring their suppliers to develop quality programs based on ISO 9000 and then subsequently, AS9100. Major aerospace manufacturers and suppliers worldwide require compliance and/or registration to AS9100 as a condition of doing business with them.

Many companies implement AS9100 and obtain registration because it assures customers that the company has a good QMS. A company with an effective QMS will meet customer expectations better than a company that does not have an effective QMS. Regarding benefits to the company, it has been proven that companies which implement and register to AS9100 have better operations, improved performance, and improved profitability.

In 1999 InterConnect became ISO 9001 Registered, passing their very first surveillance audit and every single subsequent audit since. In 2005 InterConnect became AS9100 Registered through a third party source. There is a big difference between AS9100 Registered and AS9100 compliant. A company that is AS9100 Registered has invested a significant amount of time and money to become third party registered.

A company that is simply “compliant” has neither invested the time or money, nor taken the steps necessary to become an actual registered company. Anyone can claim they are compliant to this very stringent standard, but only the best are fully Registered. In fact, only the best of the best pass every single audit, every single time, like InterConnect Wiring has done year after year.

Why are Aircraft Wiring Harnesses so Expensive?

By Chris Vardy

Why are aircraft wiring harnesses so expensive and what does this have to do with beer?I always get asked, “Why are aircraft wiring harnesses so expensive?” A very good question that has multiple answers. I like to compare it to the booming craft beer industry. Breaking it down to the basics, there are 2 main expenses, material and labor. When creating a “Craft Beer”, higher quality ingredients are used to create a unique flavor differing it from the “commercial” beers in the market.

InterConnect Wiring builds wiring harnesses mainly for military aircraft such as the F-16 and UH-60. In order to meet the government’s requirements, InterConnect is required to purchase components with manufacturer’s certification. Each part has very specific tolerances and requirements that far exceed commercial parts. InterConnect is not allowed to stop by the local auto parts store and purchase a few wires and connectors in order to manufacture wiring harnesses.

Craft beer manufacturers employ specialists that engineer uniquely flavored beers one batch at a time. InterConnect Wiring employee specialists that work on wiring harnesses one harness at a time. Most wiring harnesses consist of 1 to over 500 wires. Wires get laid out individually by a single person. Each wire contains 2 terminations; therefore, every harness contains anywhere from 2 to over 1000 terminations. Each termination, whether crimp or solder, is individually completed by hand and then inspected by another person. Also each harness has to be taped, tied, and/or braided in order to maintain its shape. After the harness is complete, it goes through a testing process that tests every termination. A large quantity of hands touch each harness before it gets shipped to the customer.

InterConnect is proud that it is a small business in the United States employing many hard working Americans. Our F-16 and UH-60 harnesses are individually “hand-crafted” in the USA with the finest “ingredients”. Contact InterConnect Wiring at 817-377- WIRE (9473) for more information about wiring harnesses.

How Many Wiring Harnesses Are In An Aircraft?

By Chris Dunham

How many wiring harnesses are in an aircraft? The answer to this question is like answering how many seeds are in a pumpkin? There are thousands of aircraft models made by hundreds of manufacturers in existence and each of them is a complex piece of electrical and mechanical engineering. There are a multitude of aircraft types such as bombers, helicopters, and jets. Because there is such a wide diversity in aircraft there is also a wide diversity in the number of harnesses in these aircraft.

Most aircraft range between 100-400 wiring harnesses. This can vary based on aircraft type, model, and general design. If an aircraft is retrofitted with all the “Bells and Whistles” so to speak, it can easily have upwards of 400 harnesses.

InterConnect has worked on a wide variety of aircraft since its founding in 1993. We have manufactured entire ship sets of harnesses for the Sikorsky H-92, which has 261 wiring harnesses. For the USAF F-15C/D EPDS Program, we assembled all of the 170 wiring harnesses and 20 electrical circuit breaker panels and matrix assemblies for each of the 73 aircraft. For the US Army National Guard UH-60 Black Hawk Rewire Program InterConnect manufactured 24 complete ship sets of 305 wiring harnesses and panels each, prior to installing them into the aircraft here in Fort Worth. Most recently InterConnect Wiring has designed and manufactured 101 wiring harnesses for each Iomax Archangel.

If you are in need of help with a wiring harness or an entire aircraft’s worth of electrical system, please contact InterConnect Wiring. InterConnect specializes in fast turnaround, saving “behind schedule” projects, and in developmental programs. If you have such a need, please contact us or request a quote.

By the way, on the average, a medium size pumpkin has 500 seeds.

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