



CABLE ASSEMBLY & WIRE HARNESS LENGTH TOLERANCES

Once all of the dimensions are established in a product, the creative design process is finished, right? Well, not exactly.

In the real world, product dimensions deviate from exact designed values due to a variety of reasons. However, diligent production work can make them come close. But, how close is “close enough”?

Answering this surprisingly difficult question involves struggling with two opposing “forces”—product function and cost of production.

Product Function

The creative design process normally produces the ideal dimensions for a product. Careful thought and the testing of prototypes can reveal that proper function is still possible if the actual dimensions deviate a little from the ideal.

Unfortunately, problems can occur ranging from poor performance to complete failure of function as the dimensional deviations become larger

Cost of the Product

Since producing a product to closer tolerances requires better, more expensive machines and tools, the cost of the product rises as tolerances become tighter. Quite often, this is a non-linear effect. There are tolerance thresholds beyond which the cost of the product can change dramatically. This occurs when a limitation in a machine prevents conformance to the new tolerance range, which requires the use of a better (more expensive) machine to meet the new tolerances, or more precise manufacturing and quality verification methods.





CABLE ASSEMBLY & WIRE HARNESS LENGTH TOLERANCES

Seeking a Balance Between Function and Cost

The key to minimizing both the cost of a product and defects in production is a good balance between the two opposing forces mentioned above. Balancing these forces can require decades of experience in the industry along with written analyses and proposals to executives, prototype construction and testing, and even field trials.

These are daunting tasks for any conductive assembly designer, especially one who is inexperienced or comes from a more mechanical background. In too many cases, the designer will simply reference the infamous "standard tolerance block." Unfortunately, most of these contain values that were developed for products that are quite different from the product pictured in the drawing. At best, this will initiate a long series of dialogs between the vendor and the customer to adjust each value to a more realistic level.

A better way out of this difficult spot is to seek help from your cable or harness manufacturer, or an individual in your company that has designed conductive assemblies before.

Advice from Industry Experts

In many industries, organizations exist that represent a compilation of the collective knowledge and experience of perhaps hundreds or thousands of people who work with products just like yours.





CABLE ASSEMBLY & WIRE HARNESS LENGTH TOLERANCES

In the wire harness and cable assembly industry, two such organizations include the Association Connecting Electronics Industries (formerly the Institute for Printed Circuits - IPC) and the Wiring Harness Manufacturers Association.

Together, these organizations developed and published the IPC /WHMA-A-6202 standard that covers a very wide variety of topics related to wiring harnesses and cable assemblies. One of the topics covered is length tolerances in section 11 of the standard.

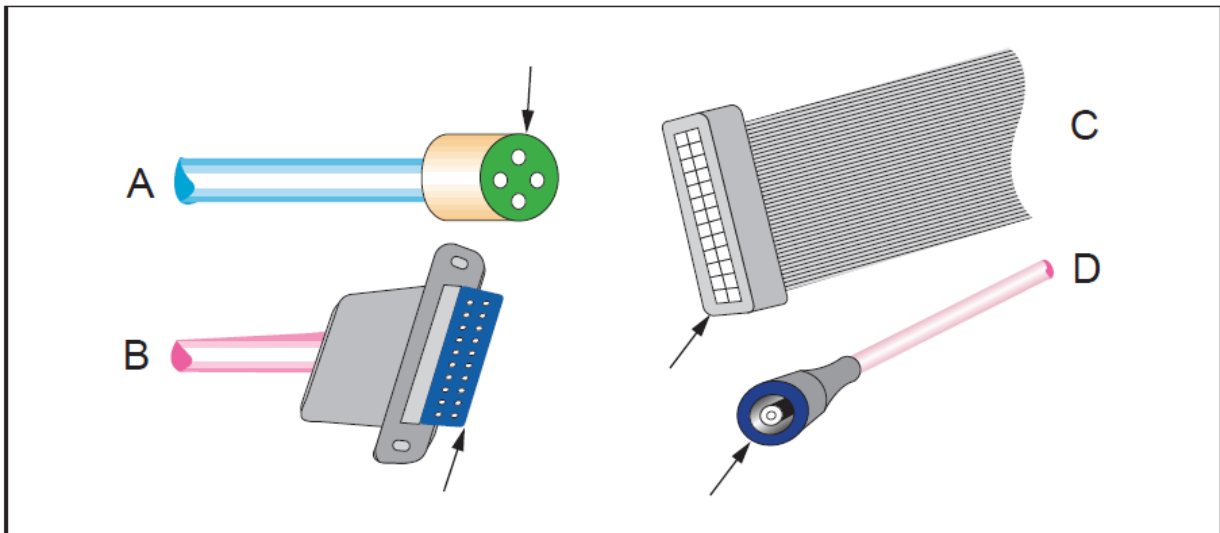
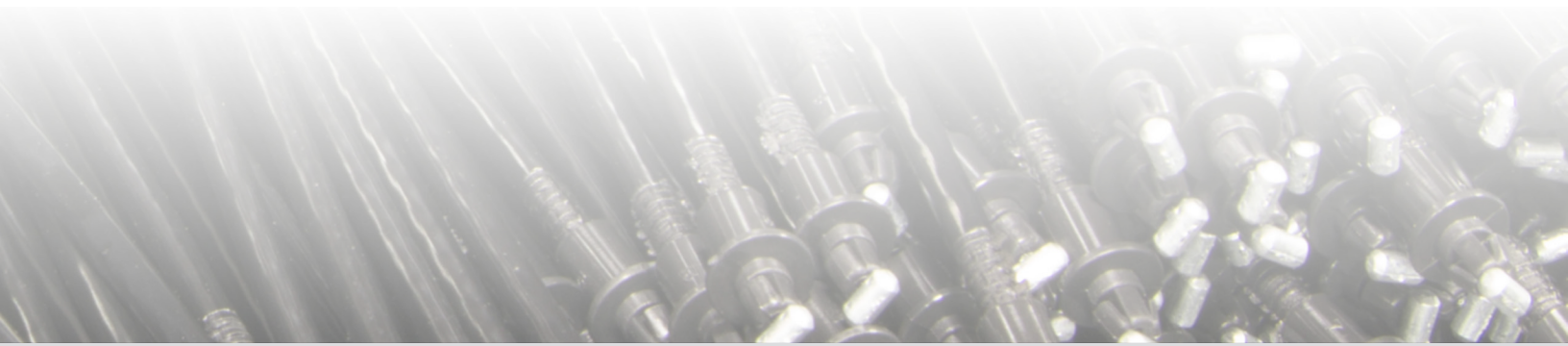


Figure 1: Measurement Points on Modular Connectors – IPC Task Group IPC/WHMA-A-620





CABLE ASSEMBLY & WIRE HARNESS LENGTH TOLERANCES

Before listing the tolerance suggestions given in this standard, it is helpful to discuss how the lengths of these products are measured.

As figures 1 and 2 show , the A-620 standard length tolerances assume that cables are measured starting with certain points on termination features.

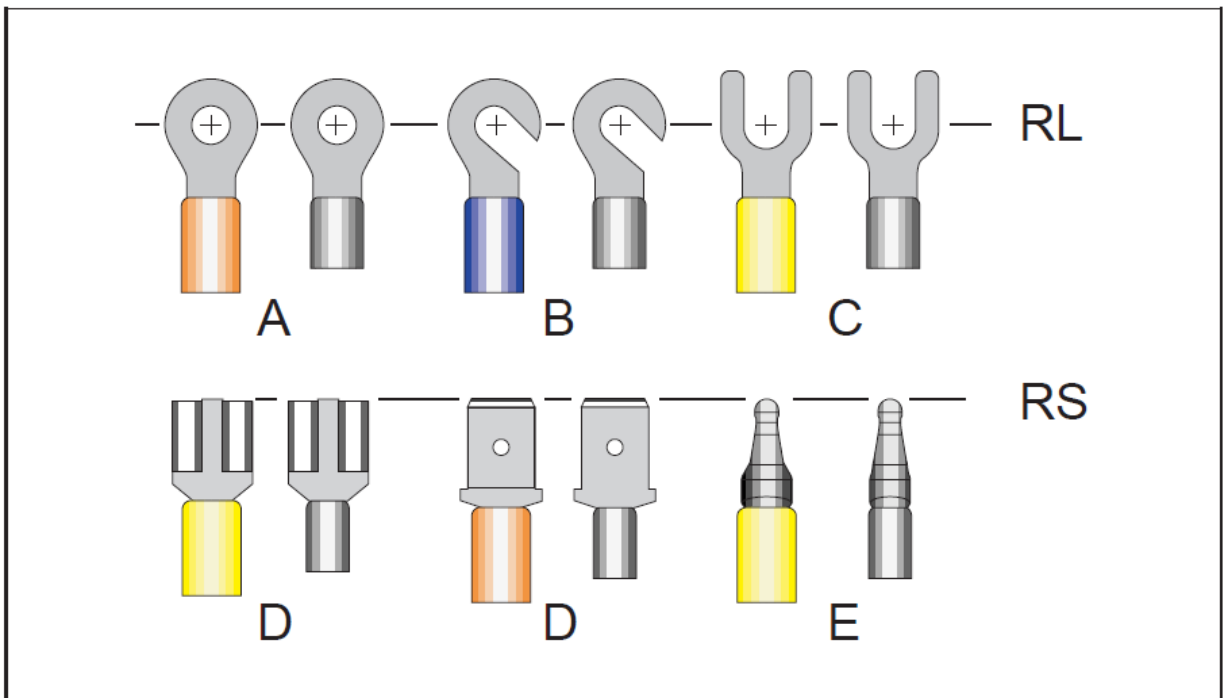
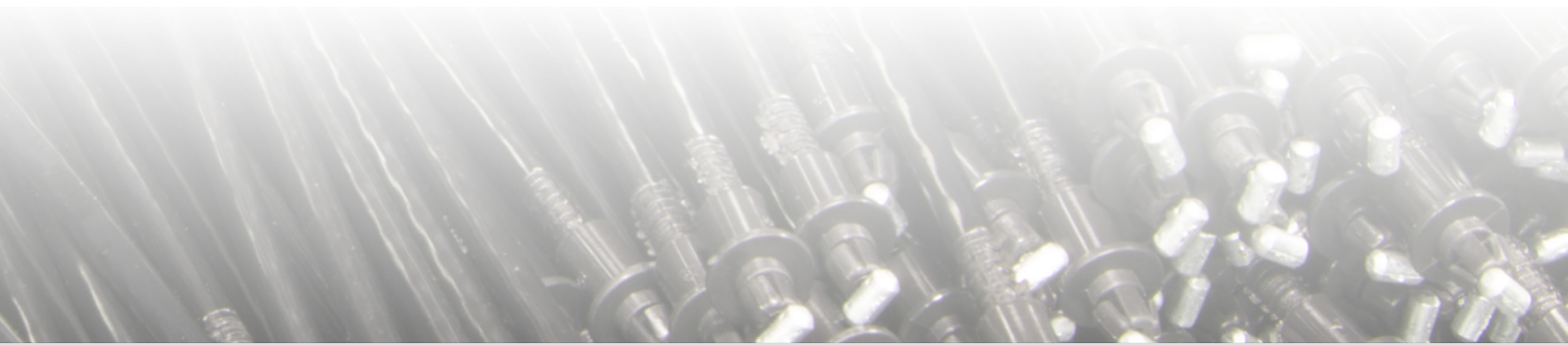


Figure 2: Measurement Points on Terminals and Plugs– IPC Task Group IPC/WHMA-A-620





CABLE ASSEMBLY & WIRE HARNESS LENGTH TOLERANCES

To find the tolerance values recommended for a particular cable assembly or wire harness, begin by measuring the length of the cable in question from one reference point to the other reference point.

Then use that measurement to select the appropriate line in table 1 that gives the recommended tolerance range.

Cable Length Tolerance			
Metric		English	
≤0.3 mm	+25 mm -0 mm	≤1 ft	+ 1 in -0 in
>0.3 mm - 1.5 m	+50 mm -0 mm	>1 ft - 5 ft	+ 2 in -0 in
>1.5 m - 3 m	+100 mm -0 mm	>5 ft - 10 ft	+ 4 in -0 in
>3 m - 7.5 m	+150 mm -0 mm	>10 ft - 25 ft	+6 in -0 in
>7.5 m	+5% -0%	>25 ft	+5% -0%

I P C Task Group et al., "IPC A-620 Standards for Cable and Wire Harness Assemblies," Group, no. January (2002).

Example: For a cable measuring 4 ½ feet long, the recommended tolerance values are + 2 inches and -0 inches, which means that the cable should never be shorter than 4 ½ feet but may be up to 2 inches longer (4 ft, 8 inches).

The use of bilateral tolerancing (+X, -Y) is common for cable assemblies and wire harnesses because a cable that is a little too long is still useful, while a cable that is a little too short is completely useless since it would not achieve a connection at all or be strained to the point of being a future breakage risk with use.





CABLE ASSEMBLY & WIRE HARNESS LENGTH TOLERANCES

Conclusion

It is important to note that the designer of a cable assembly or wire harness is not absolutely bound by the IPC tolerance values. The length tolerance can be adjusted based upon the needs of the product.

However, the designer needs to be aware that significant departures from these recommendations may increase the cost of the cable assembly or wire harness, possibly by a large amount.

As a product designer in charge of providing specs for a cable assembly or wire harness, you may be unsure of what the length tolerances should be. CMA is your source for expert guidance and partnership to create the right wire harness for your project.





CABLE MANUFACTURING & ASSEMBLY CO. INC.

CABLE ASSEMBLY & WIRE HARNESS LENGTH TOLERANCES

Questions?

If you have questions or are interested in speaking with us about the proper conductive cables for your project, we are happy to help.

Contact CMA today!

Cable Manufacturing & Assembly Co. Inc.

10896 Industrial Parkway N.W.
PO Box 409
Bolivar, Ohio 44612-0409

Toll-Free: (800) 586-8404
Phone: (330) 874-2900

Email: cmaoh@cmacable.com

