

Making the **Right** Choice

How Important is Cable in a Vision Application?

How Important Indeed?

This is a case where one question might best be answered by asking a few others. How important is the reliability of the data you are transmitting? How important is the MTBF of your system? How much does it cost for you to replace a defective cable? And perhaps most importantly who gets the blame when a cable fails; your product or the cable?

Nine times out of ten no matter how you shake it if your data path doesn't work your product doesn't work.

It's hard for anyone to debate the fact that every aspect of a vision system is important. For example without some type of light source most systems can't 'see' an object. Without a lens there is no focal point. Without a sensor how do you gather an intelligible image? Without a processor and software an image can become useless. And so it is, in fundamentally every vision system used around the world regardless of the application. And that might be the end of it except, at some point virtually every vision system needs to transmit the data it has acquired in order to be useful. So how does that data get transmitted?

The Data Path

There are essentially three ways to move your data from one place to another.

There is:

1. Conductive core wire/cable (usually insulated copper or a copper alloy)
2. Fiber Optic
3. Wireless transmission

Regardless which of these three modes you use the integrity of the signal is the key to reliability. Simply put, if you can't get your data (all of it in tact) from one place to another in a timely manner your system will more than likely become useless.

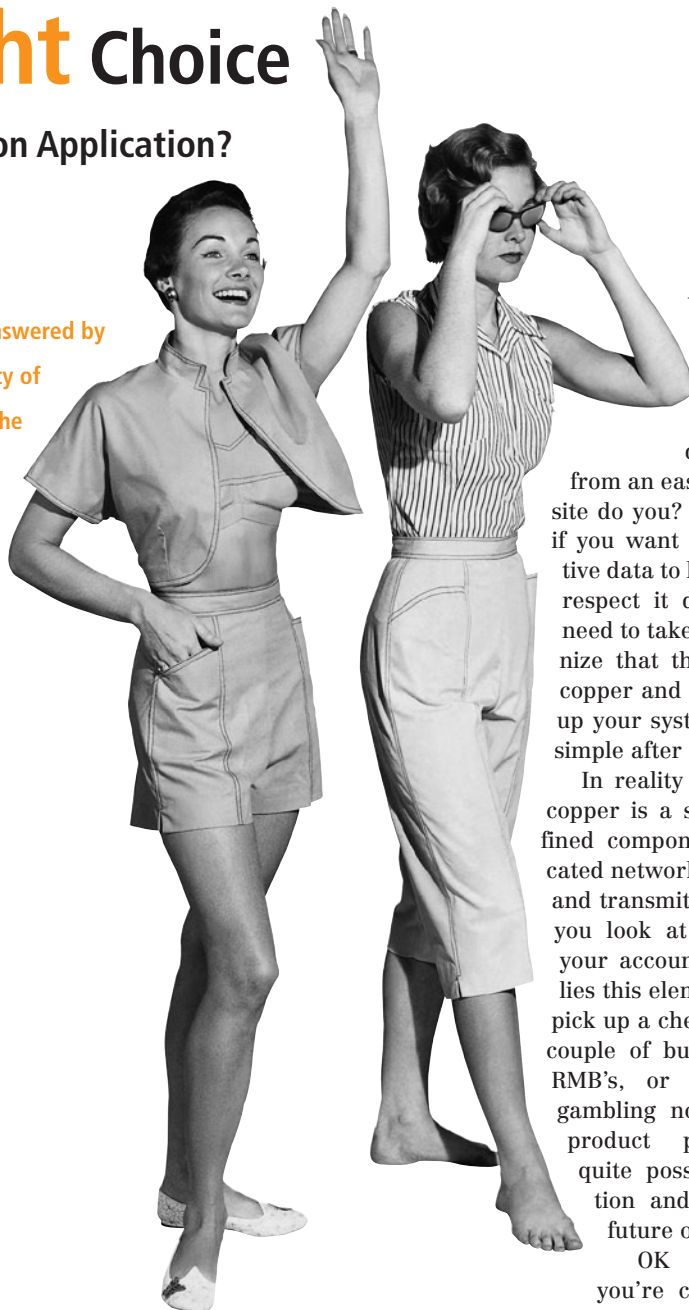
Copper

This article will not discuss either Fiber Optic or Wireless; even though they are

both extremely important data paths. For the sake of clarity we will only talk about the most common method of transmitting data; the copper wire cable.

Cable, but how important can it be after all? I mean seriously, it's just a stretched out old penny covered with some kind of plastic, isn't it? What's the big deal? Why aren't you spending your time with more important things than cable? Besides you could probably just run down to the nearest discount outlet and grab a couple of cables at the last minute and shove them into your system. How sophisticated is cable? Oh sure maybe you throw in a couple of extra strands so it doesn't break as easily as solid wire (everyone knows that) but even at that it's not rocket science, right?

Wrong! You don't skimp on your lens? You don't pick up just any sensor chip

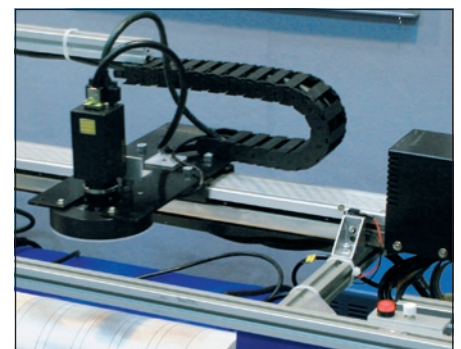


that happens to be on sale; or grab a couple of light bulbs at the discount store or download software from an easy-access freeware site do you? Of course not and if you want your highly sensitive data to be treated with the respect it deserves then you need to take the time to recognize that the 'simple strip of copper and plastic' that hooks up your system may not be so simple after all.

In reality that simple bit of copper is a significant and refined component in a sophisticated network of data receptors and transmitters. And however you look at it, way down at your accounting's bottom line lies this elemental truth; if you pick up a cheap cable to save a couple of bucks (or Euros, or RMB's, or whatever) you're gambling not only with your product performance but quite possibly your reputation and maybe even the future of your company.

OK so maybe now you're convinced and the lesson is learned. Cable is important and you will give it the respect that it deserves; if not so much for cable's sake as for the sake of your product. So then how will you decide?

Mostly that depends on what you need.



GigE Vision camera, GEVICAM GP-21400C inspecting printing quality with flexible cable assembly

Common Vision Cable Types

In the Machine Vision industry luckily there are only a few recognized 'standard' types of cable. There are some less used cable types but the most common are Analog video (using coaxial conductors), Camera Link (including MiniCL and PoCL), Firewire, GigE Vision, USB and perhaps in the future HDMI.

Getting the Right Cable

When you set out to select the ideal cable for your equipment you first need to make sure that the cable meets or exceeds the required industry specifications. Analog video cable needs coaxial conductors that are 75 Ω ideally with a tolerance of ~5% to ensure the best performance. Camera Link assemblies including MiniCL must be certified and must meet the stringent AIA Camera Link Appendix D specification. PoCL cables need to meet Appendix D & E. (For a current list of registered cable products visit www.machinevisiononline.org). FireWire cable should meet IEEE1394a (400Mbps) or IEEE1394b (800Mbps). The GigE Vision standard doesn't directly dictate cable requirements but is designed to function with Category 5 or better cable. USB 2.0 should meet the USB-IF specifications and HDMI must meet all applicable HDMI transmission documents.

In most industrial applications flex life is essential even if you might not think it is so it's important that you check into the flex life expectations of the cable in your assembly; and you should know how it was tested and when. Ask to see the test data and documented results. How many strands of wire are used in the construction and is it an alloy? A seven wire strand configuration is typical for most standard products and nineteen wire strands are most common in high-flex cable. Those statistics will give you a pretty good idea of how you can expect the cable to perform when you need it to.

What about environmental concerns? There's RoHS certainly (everybody's meeting that), but what about an extensive temperature storage and performance range (for example +80 to -50°C) what about resistance to UV degeneration for outside applications, or oil contamination, or abrasion, or water, or even to weld flash burns? If your equipment might end up in any type of factory environment (auto, pharmaceutical, food, wood, plastic, petro-chemical...etc.) then these are also important characteristics. That may seem like a lot to ask but it is possible to get cable with every one of those characteristics.

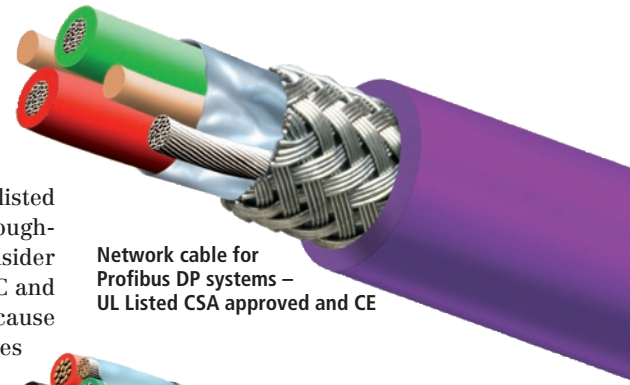
So how do you check into the environmental performance of the cable? One good way is to look at the material used for the jacketing. The most common jacket material is PVC but unfortunately PVC doesn't meet all of the previously listed requirements. If you need 'factory toughened' cable you should seriously consider a cable jacketed with a blend of PVC and TPE (Thermoplastic Elastomer) because this combination of materials gives you much of the function, performance and properties of a thermoset rubber (which is what you need) along with the process characteristics of a thermoplastic (that means it's cheaper than rubber for the cable manufacturer and the assembler to work with so it helps keep your overall costs down while providing the features you need and keeping quality up). Another unique benefit of the TPE material is that it has an attractive matte finish and it 'feels' better to you and your customers because it has an expensive 'rubbery-soft' touch.

So How Do You Pick the Ideal High-Performance Cable?

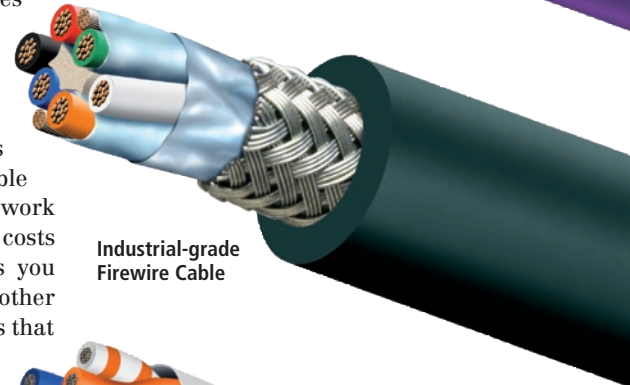
Start by going through the following check-list:

1. First and foremost; does it meet the established signal transmission criteria of the appropriate specification?
2. Does it perform mechanically with the flex life required by the majority of (or all of) your applications?
3. Does it meet all of the environmental challenges that will be presented, in the wide variety of applications that will make use of your product?
4. Is it a 'professional' appearing cable that is concentric with minimal convolutions and highly appealing cosmetics?
5. Is it a component that can be depended on to represent the high quality standards set by you and your organization?

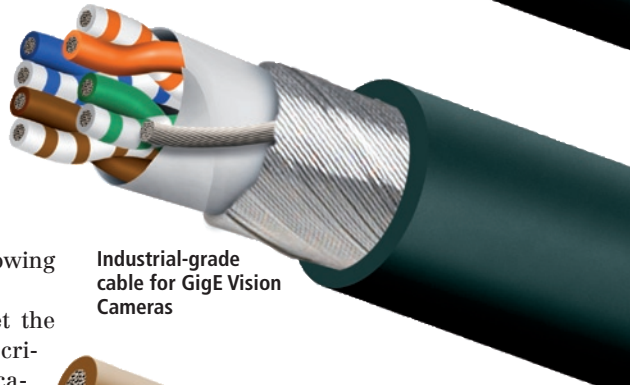
Here's the good news if you pay close attention to the selection of this very important component you will soon witness the elimination of problems and aggravations caused by substandard cable. That alone will significantly offset any additional costs you may have when procuring a better cable. The 'right' cable is a cable that is truly worthy of being attached to your equipment and is one that compliments the superiority of your system's performance not undermines it.



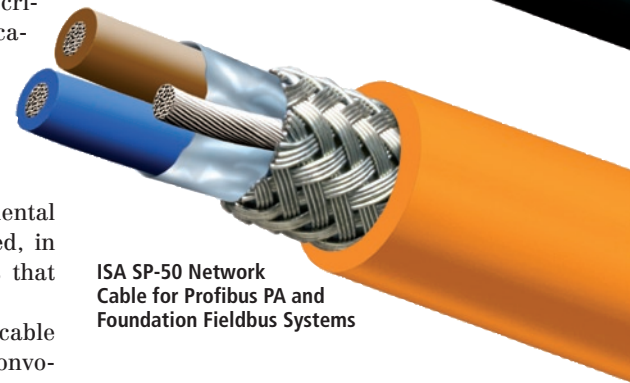
Network cable for Profibus DP systems – UL Listed CSA approved and CE



Industrial-grade Firewire Cable



Industrial-grade cable for GigE Vision Cameras



ISA SP-50 Network Cable for Profibus PA and Foundation Fieldbus Systems

And while you're making your decision on cables keep this in mind; cable is cheap and problems are expensive.

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