

## ETHERNET CABLES AND CONNECTORS FOR INDUSTRIAL ENVIRONMENTS

### INTRODUCTION

Ethernet products were initially designed for the office environment, but over time, Ethernet networks have become more widely accepted as the preferred protocol in the industrial environment. Although the performance criteria for Category 5e and Category 6 products are the same for both environments, the requirements to protect the products from the environmental conditions can be very different.

### INDUSTRIAL VS. OFFICE ENVIRONMENT

The office environment is a much more protected environment. Climate is controlled with heating and air conditioning, the air is dust and moisture free, and the products are secure from accidental damage by being enclosed in walls, conduits and air plenums.

The industrial environment is quite different. Products can be exposed to more extreme temperatures, humidity, moisture, lubricants, vibration, dust, ultraviolet light, electromagnetic interference (EMI) and accidental damage.

### INDUSTRIAL NETWORK DESIGN CHALLENGES

The challenge for industrial network designers or controls engineers is to know what products to use for the industrial environment. Selecting the right products can include countless hours of reviewing manufacturer specifications and confirming that each component on the network will meet the criteria for that particular application. Selecting the wrong product could eventually lead to product failure, which can bring down your network and cause thousands of dollars in production downtime.

One solution can be to put all cabling in conduit and enclosures, but the reality is that this can be expensive, take up critical space, and creates moves, adds and changes (or MACs). With an abundance of products from many manufacturers to meet these extreme environments, it can be difficult to select the right products to meet your specific criteria in creating a complete industrial network by using multiple manufacturers.

### ANIXTER LEVELS OF INDUSTRIAL ENVIRONMENTS

After seeing a need in the industry to make industrial infrastructure product selection easier, Anixter's engineers worked with leading manufacturers to establish a manufacturer-neutral Anixter Levels program for Industrial Environments. Levels is a highly engineered product [selection guide](#) that defines application criteria for common industrial environments and then maps specific products into those environments, making sure that all products meet or exceed the environments' applicable criteria.

Even though the Levels program offers an end-to-end solution for industrial networks, this particular article will focus on Ethernet cable and connectors that meet the Levels program and thus meet the majority of users' industrial environments. First, we need to define the environmental Levels.

### DEFINITION OF LEVELS

**LEVEL 1** – Level 1 is a controlled area located inside an industrial facility where cabling components are secured from physical damage and protected from harsh or industrial environments. This level is typically located inside a climate-controlled area where the connecting and reconnecting of cables and patch cords is infrequent. These areas can include industrial offices, control rooms and environmentally controlled enclosures.

**LEVEL 2** - Level 2 is located inside an industrial facility where cabling and components are subjected to more extreme ambient temperatures, humidity and potential damage. This level is typically located inside a light industrial facility where machines and devices require occasional connection and reconnection for maintenance and movement. These areas could include assembly, dry packaging, warehouse and enclosed cabinets.

**LEVEL 3** - Level 3 is located in a harsh industrial area where cabling and components are exposed to oil, solvents, cleaning agents, lubricants, water, wide varying temperatures, humidity and dust. These areas can be subject to wash downs, heavy vibrations and occasional forces of shock. Machine operators frequently connect and reconnect plugs and receptacles to move, clean or maintain equipment. These areas could include automation islands, robotics, welding, heavy machining, industrial equipment and exposed environments.

Each Level has been defined by minimum criteria for an assortment of applicable mechanical, ingress and climate conditions. For a complete list of criteria, visit [anixter.com/levels](http://anixter.com/levels). It is important to make sure the products used can meet the harshest Level they will reside in. If a cable is going from a Level 1 control room to a Level 2 packing station in the plant, the cable used should be Level 2.

### ETHERNET CABLES AND CONNECTORS

**Level 1** Category 5e and Category 6 cables are similar or the same as office environment cables as they are in climate controlled and protected areas such as a shipping office or control room. The Level 1 cables come in riser and plenum constructions. Level 1 cable must meet or exceed the minimum criteria of 0° C to 60° C and 20 lb. pulling tension. The connectors for Level 1 are plastic RJ45 connectors with no ingress protection rating.

**Level 2** Ethernet cables are constructed with industrial-grade PVC and can meet or exceed -10° C to 60° C and 40 lb. pulling tension. They are UV and oil resistant and can withstand at least 45 cycles of abrasion testing. The connectors are ruggedized RJ45s that have an ingress protection of IP20 and can withstand -10° C to 60° C. The connectors also have a protective industrial PVC boot that protects against UV and mechanical damage.

**Level 3** Ethernet cables are constructed with a double industrial-grade PVC jacket that can withstand 75 cycles of abrasion testing and is UV and oil resistant. They can meet or exceed -40° C to 70° C operating temperatures and have

40 lb. pulling tension. In a Level 3 environment, ingress protection is rated at IP67 that can withstand spraying with water, solvents or lubricants. For Category 5e, M12 D coded connectors are most common. D coded connectors can only terminate two-pair cables, so two-pair Category 5e cables are available in a Level 3 construction. Category 6 must be four pairs and thus an M12 X coded connector is the most common. Both M12D and X connectors are IP67 rated and meet -40° C to 70° C operating temperatures.

The most common construction for the Levels cable is unshielded with solid conductors. Using this as the basic construction keeps the cost down for the majority of applications. For those applications where conditions are more extreme, modifiers have been added to the basic construction that meets all the same criteria to cover cabling criteria such as stranded conductor cables for added flexibility or shielding for electromagnetic interference protection.

### CONCLUSION

Although we have covered only Ethernet cables and connectors, other products that have been categorized in the Levels program include patch cords, patch panels, fiber optic cables, power supplies and Ethernet Switches. Using the Levels program will make product selection for your industrial network infrastructure simple, reliable and cost effective while assuring that you are using the right product for the environment where the products will be installed and operated.

Visit [anixter.com/levels](http://anixter.com/levels) to get more details on criteria testing and a list of product categories that have been mapped into the Levels program.

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