CABLE MANUFACTURING & ASSEMBLY CO. INC.

CHOOSING THE PROPER CONDUIT FOR YOUR APPLICATION

Why Use Conduits?

Conduits allow control cables to be routed in non-linear paths for push-pull and pull-pull applications. By using conduits, cables can travel in specialized paths to accommodate system designs and navigate around obstacles. Thanks to the flexibility of conduits and their distinct characteristics, cable routing can be integrated into simple or complex designs.

With the proper conduit and cable selection, systems will have precision mechanical motion. While conduits primarily serve to route cables around bends in a system, they also:

- Seal out contaminants
- Cushion cable strands
- Resist abrasion
- Increase life cycle capability of cable
- Maximize system efficiency
- Protect cables from outside influences (corrosion, water, fire, etc.)

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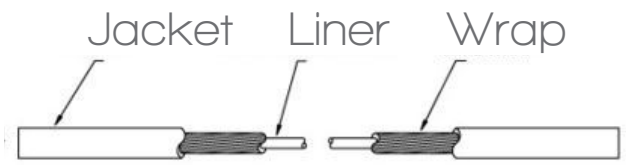
Understanding Your Conduit Requirements

Understanding the differences and benefits of conduits will help make choosing a type easier for your design needs. When deciding on conduit, consider the possible factors that could affect the integrity of your cable system:

- Potential for impact by an external system
- High rate of flexing
- Abrasion
- Moisture and humidity
- UV exposure
- High temperature
- Hazardous contaminants
- Solvents, Acids, Oils
- Salt water
- Complex or confusing arrangements
- Fire
- Wind damage
- Pests

Types of Conduits

Several types of conduits commonly used are: braided reinforced, bowden, and long lay. The conduit unit is comprised of a wire wrap and may include a liner, a jacket, or both. For example, a long lay conduit has both a liner and a jacket.



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Conduit Comparison

In the table below, the conduit types are compared regarding their various properties.

	Braided Reinforced	Lightweight with liner braid for stiffness and minimal crush resistance	Seat latch, release assemblies, gas spring control, pull-pull applications with minimal bends
	Bowden-Unlined, Bare/Round Wire	Good flexibility, compression strength, and crush resistance	Medium-duty lower efficiency throttle controls, PTO Controls
	Bowden-Unlined, Jacketed/Round Wire	Good flexibility, compression strength, and crush resistance	Medium-duty controls, medium throttle controls
	Bowden-Lined, Jacketed/Flat or Round Wir	Fairly flexible, high efficiency, good compressive strength and crush resistance	Remote latch, push-pull controls, Jacket protects cable from bends in routing
	Long Lay	Relatively stiff, high compressive strength, good crush resistance	Clutch cables, brake cables, heavy-duty push-pull controls, marine throttles, shift control cables, applications with multiple bends and high loads

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Material Comparison

Conduit liners and jackets are made from a wide variety of materials such as acetal resin, polyethylene, polypropylene, TPE, and nylon. Some materials are more rigid while others have flexible properties. Each material offers various benefits that make it suitable for different cables and applications. The chart below details typical conduit materials and the unique features for each.

Conduit Liner

Acetal (ACE)	High strength, rigid, and ultra slippery; cable can move and flex; strong resistance to impact and wear; good moisture, heat, and solvent resistance
Polyethylene (PE)	Economical and lightweight; good chemical resistance and flexibility; high tensile strength, resilience, and abrasion resistance; strong moisture and UV resistance
Teflon (TFE)	Low-friction, mechanical toughness, and corrosion resistance; strong chemical resistance and extremely resistant to high temperatures
Nylon (NYL)	High strength, relatively stiff, and lightweight; adequate flexibility; high temperature properties; good impact resistance; exceptional resistance to oil, grease and solvents

Conduit Jacket

Polyethylene (PE)	Economical and lightweight; good chemical resistance and flexibility; high tensile strength, resilience, and abrasion resistance; strong moisture and UV resistance
Polypropylene (PP)	Economical and lightweight; high corrosion resistance and abrasion resistance; resists alkalis/acids and has low moisture absorption; lower impact strength
Thermoplastic Elastomer (TPE)	Durable compound with plastic and rubber-like properties; highly resistant to moisture and chemicals; easily manages temperature changes; good flexibility and strength
Nylon (NYL)	High strength, relatively stiff, and lightweight; adequate flexibility; high temperature properties; good impact resistance; exceptional resistance to oil, grease and solvents

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Material Comparison (Continued)

The material will be selected based on application-specific criteria including:

- Environment and operating temperature ranges and extremes
- Axial and side loaded requirements
- Exposure to chemicals and contaminants
- Assembly method to mating part or mounting surface
- Actual part function

Conduit Selection

Selecting the proper conduit for a cable assembly is essential to optimum performance. If the wrong sizing or material is chosen, the system will experience unnecessary lost motion and friction. The components must be properly designed to work together to achieve cable efficiency—the measure of how quickly, smoothly and easily the cable moves during operation.

Identifying the appropriate conduit can be overwhelming, given the variety of system designs, routing requirements, loads, temperatures and duty cycles. Many applications use braided, reinforced conduits with a polypropylene coating (relatively stiff) or nylon coating (more flexible and heat resistant). Other applications require a lightweight conduit with extra stiffness. Cables in high accelerations and decelerations, for example, must be stiff enough to resist additional stresses from the quickly changing speeds and light enough to limit forces during acceleration.

All conduit and core combinations should include a reasonable clearance between the inner I.D. and the core O.D. The clearance between the conduit and core directly relates to friction on the cable. If the clearance is larger, less friction will be applied to the cable. In a push-pull application, for example, the additional space may cause buckling. For most light and medium duty pull-pull applications, a clearance of.015 to .025 between the conduit I.D. and the cable O.D. is recommended.

Obtaining reliable operation in highly dynamic push-pull and pull-pull applications requires the right conduit. The best conduit design will emerge by analyzing application-specific criteria, the number of bends in the system, and then strategically choosing the appropriate conduit type, diameters, and materials.

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Contact CMA With Questions

Let us help choose the best conduit and cable pairing for your application. The engineering professionals at CMA are experienced with diverse applications, industries, products, and systems.

Contact us to speak with an expert on choosing the right conduit for your project.