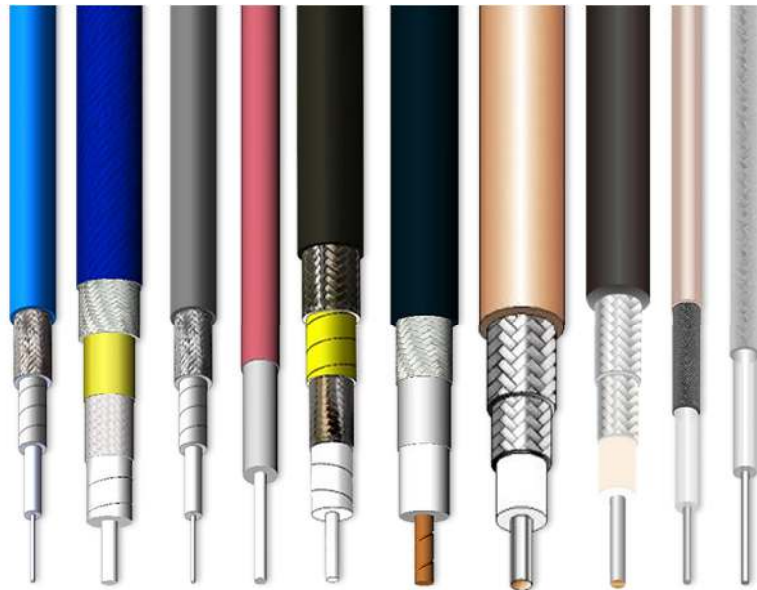


Application Note AN-24-01:

Coaxial Cable Properties and Selection Guide





Introduction

Coaxial cables are essential components in a wide range of applications, including telecommunications, broadcasting, medical imaging, and RF engineering. Understanding the properties of coaxial cables and selecting the right type for specific applications is crucial for ensuring optimal performance and reliability. This application note provides an overview of coaxial cable properties, details on various cable types, and a guide for selecting the appropriate cable for specific applications such as aerospace, defense, in-box connections, and telecommunications.

Coaxial Cable Construction

A coaxial cable consists of four main components:

No.	Name	Size (mm)	Material
1	Inner Conductor	1.02	Silver-plated copper
2	Dielectric	2.80	Low density PTFE
3	Inner Shield	2.95	Silver-plated copper tape
4	Interlayer	3.20	Low density PTFE
5	Outer Shield	3.62	Silver-plated copper braid
6	Jacket	4.20	FEP
7-9	Armor (optional)	6.50	Composite
10		6.70	PTFE

Tolerance: ±0.2mm [±0.008in]



- Inner Conductor:** Carries the RF signal. Made of copper or aluminum.
- Dielectric Insulator:** Surrounds the inner conductor, providing insulation and maintaining the spacing between the inner and outer conductors. Made of materials like polyethylene, Teflon, or foam.
- Outer Conductor (Shield):** Shields the inner conductor from external electromagnetic interference (EMI). Made of braided wire, foil, or a combination of both.
- Outer Jacket:** Protects the entire assembly from environmental factors. Made of PVC, polyethylene, or other protective materials.



Key Properties of Coaxial Cables

1. Impedance

- **Standard Impedances:** 50 ohms (common in RF and microwave applications), 75 ohms (common in video and CATV applications).
- **Importance:** Proper impedance matching between the cable and connected devices is critical to minimize signal reflection and power loss.

2. Attenuation

- **Definition:** Signal loss per unit length, typically measured in dB/meter.
- **Factors Affecting Attenuation:** Cable length, frequency of the signal, quality of materials used, and construction of the cable.
- **Importance:** Lower attenuation is preferred for long-distance signal transmission.

3. Capacitance

- **Definition:** Ability of the cable to store charge, typically measured in pF/meter.
- **Factors Affecting Capacitance:** Dielectric material and thickness.
- **Importance:** Lower capacitance is preferred for high-frequency signal transmission to avoid signal distortion.

4. Shielding Effectiveness

- **Definition:** Ability of the outer conductor to prevent EMI.
- **Factors Affecting Shielding:** Type of shield (braid, foil, or combination), coverage percentage, and materials used.
- **Importance:** High shielding effectiveness is critical in environments with significant EMI, such as aerospace and defense applications where signals must remain clean and uninterrupted.

5. Power Handling Capability

- **Definition:** Maximum power the cable can handle without damage.
- **Factors Affecting Power Handling:** Cable size, materials, and construction.
- **Importance:** Important for applications requiring high power transmission, such as in telecommunications base stations.

6. Flexibility and Durability

- **Definition:** Ability of the cable to bend without damage and withstand environmental factors.
- **Types:**
 - **Flexible Cables:** Suitable for applications requiring frequent movement or routing through tight spaces.
 - **Semi-Flexible Cables:** Combine flexibility with stable electrical performance, often used in military and aerospace applications.
 - **Rigid Cables:** Used where minimal bending is required, providing high stability and low attenuation.





- **Bending Radius:** Minimum radius the cable can be bent without damaging it. A smaller bending radius allows for tighter installations but requires careful handling to avoid damage.
- **Importance:** Critical for applications involving frequent movement, tight installations, or harsh environments.

Specific Application Examples



Aerospace and Defense

- **Applications:** High-frequency signal transmission for radar systems, secure communication links, and navigation systems.
- **Requirements:** High shielding effectiveness, robust construction, resistance to extreme temperatures and vibrations, and low attenuation.
- **Cable Types:** Semi-flexible cables with high shielding effectiveness and low-loss characteristics.





Telecommunications

- **Applications:** Signal transmission in base stations, antennas, and networking equipment.
- **Requirements:** Low attenuation, proper impedance matching, high power handling capability, and environmental resistance for outdoor installations.
- **Cable Types:** Flexible and semi-flexible cables with weather-resistant jackets and low-loss properties.

In-Box Connections

- **Applications:** Internal connections within electronic devices, including RF modules, transmitters, and receivers.
- **Requirements:** High flexibility, small bending radius, low capacitance, and proper impedance matching.
- **Cable Types:** Highly flexible cables with small diameter and tight bending radius.

Medical Imaging

- **Applications:** Signal transmission in MRI machines, ultrasound equipment, and other medical imaging devices.
- **Requirements:** High shielding effectiveness, biocompatible materials, and low attenuation to ensure accurate signal transmission.
- **Cable Types:** Flexible cables with high shielding and low-loss characteristics, often with specialized jackets for biocompatibility.



Selecton Guide

When selecting a coaxial cable, consider the following factors:

1. Applcaton Requirements

- **Frequency Range:** Ensure the cable supports the required frequency range with minimal attenuation.
- **Power Requirements:** Select a cable that can handle the maximum power levels of your application.
- **Impedance Matching:** Choose a cable with the correct impedance to match your equipment.

2. Environmental Consideratons

- **Indoor vs. Outdoor Use:** For outdoor applications, select cables with UV-resistant and weatherproof jackets.
- **Temperature Range:** Ensure the cable can operate within the required temperature range.

3. Mechanical Properties

- **Flexibility:** For applications requiring frequent movement, choose cables with higher flexibility.
- **Durability:** For harsh environments, select cables with robust construction and protective jackets.

4. Length and Routing

5. Shielding Requirements

- **EMI Environment:** Select cables with high shielding effectiveness for environments with significant electromagnetic interference.
- **Shield Type:** Consider braided, foil, or combination shields based on the level of EMI protection needed.

6. Budget Constraints

- **Cost-Effectiveness:** Balance the performance requirements with the budget. Higher-quality cables may have a higher initial cost but offer better performance and longevity.

Conclusion

Selecting the right coaxial cable is critical for ensuring optimal performance in various applications. By understanding the key properties of coaxial cables and considering the specific requirements of your application, you can make an informed decision that meets your needs. For further assistance or custom solutions, contact RFLOGY LLC for expert guidance and support.