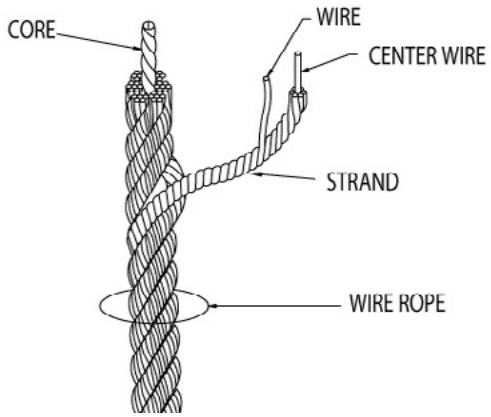
CABLE MANUFACTURING & ASSEMBLY CO. INC.

CHOOSING THE BEST CONTROL CABLE FOR YOUR APPLICATION

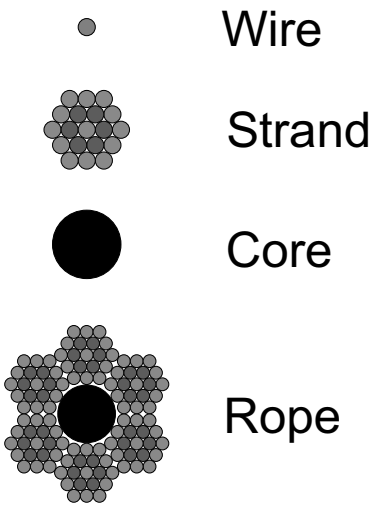
Understanding Cable Construction

Cable construction is the combination and arrangement of wires in a rope. Many individual steel wires are helically-laid together to form a wire rope. A strand is when two or more wires are wound concentrically in a helix. These strands are typically wound around a center wire and then around the core. The lay of the strand is the direction that the wires orbit the core.

Cable / Wire Rope Construction



Individual Elements of Wire Rope



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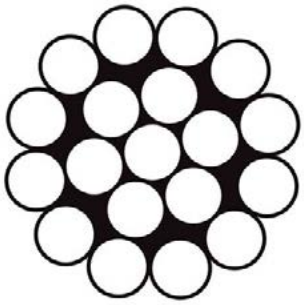
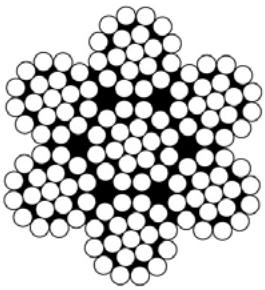
Numerous wire rope constructions exist, each with unique properties and end uses. Below are some examples of commonly used wire rope constructions.

1x19



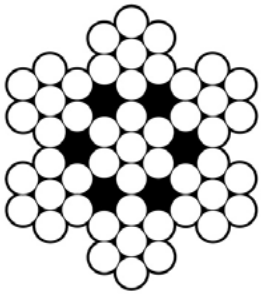
- Single 1x7 strand wrapped with 19 wires
- Smoothest construction
- Strongest with lowest stretch and flexibility
- Resists compressive forces
- Used for push-pull controls / pull-pull controls

7x7



- Seven 1x7 strands
- Moderately flexible
- Less suitable when abrasion is a factor
- Durable for general-purpose construction, since it balances strength flexibility
- Used for pull-pull controls
- Small diameter cable can be used over pulleys

7x19



- Seven 1x19 strands
- Highly flexible
- Durable wire rope but has less strength than 1x19
- Used over pulleys, drive cables, reciprocating applications, and lanyards

Typical Applications

Cables are central to system designs, since they provide the transfer of motion or mechanically control an item. Push-pull and pull-pull cable assemblies are especially useful when the transmission of force requires routing around bends and in varying directions.

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Actuating Devices

- Adjustment
- Alignment
- Braking
- Connecting
- Controlling
- Counterbalancing
- Cycling
- Driving
- Hoisting
- Traversing

Actuating Devices

- Capturing
- Connecting
- Grounding
- Hanging
- Restraining
- Securing
- Stopping
- Supporting
- Tripping

Industries that may use control cables include: automotive, heavy truck, power sports, marine, latching, aerospace, durable medical equipment, outdoor power equipment, industrial utility vehicles, off road/agriculture, office equipment and seating, consumer deliverables/appliances, and residential furniture.

Defining Criteria

When choosing the appropriate cable design for a system, the general requirements and all potential factors that affect the cable's performance should be reviewed. The cable's environmental exposure and routing are top considerations when determining the best push-pull or pull-pull cable for a specific application.

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Environmental Exposure

All environmental factors that may potentially impact cable performance should be considered when choosing a cable design.

- Temperature extremes / ambient temperature
- Pressure extremes / vacuum
- Moisture / Steam
- Contact with liquids (chemicals, lubricants, fuel, etc.)
- Friction / abrasion
- Shock / vibration
- Radiation
- Corrosive elements

General Requirements/ Characteristics

Mapping out specific criteria that is required for the cable assembly narrows down the type of construction best suited for an application.

- Cable length and diameter
- Wire rope weight
- Material / galvanized or stainless steel
- Stainless Steel grade (302/304)
- Bare cable or coatings (nylon, HDPE, TPE)
- Regulatory requirements / safety concerns
- End fittings / terminals
- Cable assembly for Commercial or OEM

Routing/Mechanical Concerns

By identifying any mechanical issues in advance, system designers can choose the best cable assembly for their product.

- Flexing
- Bend radius / torsion angle
- Acceleration rate
- Stroke length
- Speed

In addition to the above considerations, the ideal cable design requires an analysis of the normal working load, which is the amount of force that can be applied to the rope without breakage. Many cables are manufactured with safety factors that are greater than the working load in order to exceed minimum strength requirements.

As an example, the chart below displays different specifications for a 1x19 cable construction. By determining the wire rope material and minimum breaking strength (working load + safety factor) for a particular application, the appropriate diameter can be identified.

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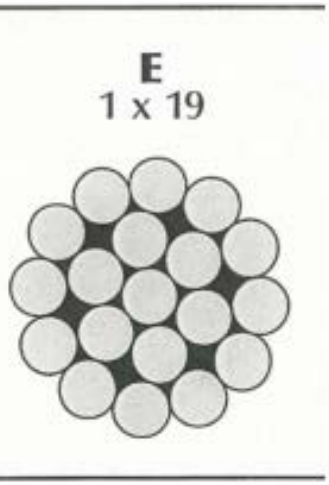
Commercial/OEM Specifications

Diameter in./mm	Tolerance (+) in./mm	CMA Part No.*	Galvanized Min. Breaking Strength Lb./Kg.	EA Value x10³	CMA Part No.*	Stainless Steel Min. Breaking Strength Lb./Kg.	EA Value x10³	Weight per M Ft. Lb./Kg.
1/32/0.8	.003/0.08	G031E	175/79	13	S031E	150/68	12	2/0.9
3/64/1.2	.003/0.08	G045E	350/159	18	S045E	300/136	21	4.29/1.95
3/64/1.2	.005/0.13	G047E	375/170	29	S047E	335/152	28	5.2/2.4
1/16/1.6	.006/0.15	G063E	500/227	52	S063E	500/227	50	8.5/3.9
5/64/2.0	.008/0.20	G078E	800/363	80	S078E	800/363	76	14.2/6.5
3/32/2.4	.009/0.23	G094E	1,200/544	116	S094E	1,200/544	111	20/9
1/8/3.2	.013/0.33	G125E	2,100/952	205	S125E	2,100/952	196	35/16
5/32/4.0	.016/0.41	G156E	3,300/1,497	320	S156E	3,300/1,497	305	57/26
3/16/4.8	.013/0.33	G188E	4,700/2,132	464	S188E	4,700/2,132	443	78/35
7/32/5.5	.015/0.38	G219E	6,300/2,857	630	S219E	6,300/2,857	601	101/46
1/4/6.5	.018/0.46	G250E	8,200/3,719	821	S250E	8,200/3,719	783	135/61
9/32/7.1	.020/0.51	G281E	9,900/4,490	1037	S281E	9,900/4,490	990	172/78
5/16/7.9	.023/0.58	G313E	12,500/5,669	1287	S313E	12,500/5,669	1228	210/95
3/8/9.5	.026/0.66	G375E	18,000/8,163	1847	S375E	18,000/8,163	1763	305/138



Selecting the Best Control Cable

Once these factors are reviewed, application-specific cable designs can begin. The most effective design will overcome environmental factors, manage the maximum load applied to the cable, and withstand any bends, abrasions or routing requirements.

Material selection also plays an important role in cable performance. Wire rope is typically made from either stainless steel or carbon steel. If corrosion is a factor, stainless steel in grades 302/304 provide trusted reliability for many applications. Galvanized steel is a cost effective alternative that can be used for wire rope as well.

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The comparison chart below provides a high-level overview of cable construction characteristics that aid in cable selection.

Characteristic	Greatest →			Least
Flexibility	7 x 19	7 x 7	1 x 19	1 x 7
Tensile Strength	1 x 19	1 x 7	7 x 19	7 x 7
Stretch Resistance	1 x 7	1 x 19	7 x 7	7 x 19
Relative Cost	7 x 19	7 x 7	1 x 19	1 x 7
Corrosion Resistance	Coated Stainless Steel	Bare Stainless Steel	Coated Galvanized Steel	Galvanized Steel

To ensure the appropriate cable is selected for an application, each factor that influences cable performance should be identified, evaluated, and prioritized. By assembling a thorough checklist of specifications, the best cable will be chosen, ensuring that all the system parts function as intended.

Contact CMA With Questions

Our engineers at CMA have extensive experience designing cable systems for diverse applications and environments. We can help design your industry-specific cable system for optimal performance and reliability.

Contact us to speak with an expert on choosing the best cable for your project.