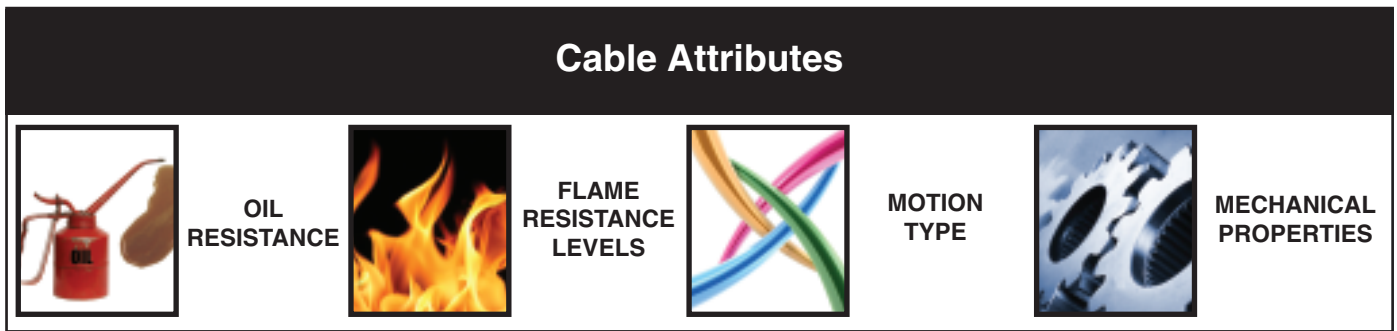


Cable Attributes



Over 50 years ago company founder, Oskar Lapp, designed and manufactured the world's first multi-conductor control cable. Ever since the Lapp Group has been known as the worldwide leader in flexible cable technology.

Through continual R&D and the extensive knowledge of our engineers; the Lapp Group has developed criteria which will aid the cable user in deciding which cable is best suited to their application.

As you will find on the following pages, the Lapp Group has brought cable specifying to a new level for the following product attributes: Oil Resistance, Flame Resistance Levels, Motion Types, and Mechanical Properties. By setting the criteria for such important attributes, our engineers have given the cable buyer a more precise and definitive way to choose the cable that's right for their specific application or environment.

The symbols located at the top of the page relate to applicable Lapp products and can be found on the product pages within this catalog. To help you choose the Lapp cable that best suits your requirements, we suggest you review the criteria and definitions on the following pages and familiarize yourself with the different levels.

The Lapp Group will strive to continue to provide creative solutions and the highest quality products you've come to expect.

*Disclaimer: These criteria are to be used as guidelines, and not definitive test results. Please contact your Lapp sales representative for specific testing results.

Fire Protection Logo



The Lapp Group has added the fire protection logo on the product pages for cables that comply to the new NFPA 79 2007 Standard and NEC 2008. For more information, regarding the new NFPA 79 standards, see page 660 or visit www.lappusa.com to download our white paper.

* NEC® is a registered trademark of the National Fire Protection Association.

Cable Attributes

Oil Resistance



Level	USA	CSA*	Europe*
OR-00	No oil resistance characteristics	-----	-----
OR-01	UL 62 One week test, In oil for 7 days @60°C 75% Unaged Tensile Strength 75% Unaged Elongation	C22.2 No.49 In oil for 7 days @60°C 75% Unaged Tensile Strength 75% Unaged Elongation	VDE 0281 Part 1 In oil for 7 days @60°C ± 30% Unaged Tensile Strength ± 30% Unaged Elongation
OR-02	UL Oil Res. I. In oil for 4 days @100°C 50% Unaged Tensile Strength 50% Unaged Elongation	C22.2 No.230 In oil for 4 days @100°C 50% Unaged Tensile Strength 50% Unaged Elongation	VDE 0472 Sect 803A In oil for 1day @100°C ± 25% Unaged Tensile Strength ± 25% Unaged Elongation
OR-03	UL Oil Res. II. In oil for 60 days @75°C 65% Unaged Tensile Strength 65% Unaged Elongation	C22.2 No.210.2 In oil for 4 days @100°C 65% Unaged Tensile Strength 65% Unaged Elongation	SEV TP 20 B In oil for 30 Days @70°C No cracking after bending
OR-04	UL AWM 21098 In oil for 60 days @80°C 65% Unaged Tensile Strength 65% Unaged Elongation	C22.2 No 0.3 For 60 days @80°C 65% Unaged Tensile Strength 65% Unaged Elongation	VDE 0472 Sect 803B In oil for 7days @ 90°C ± 25% Unaged Tensile Strength ± 25% Unaged Elongation
OR-05	In oil for 3 Weeks @100°C 100% Unaged Tensile Strength 110% Unaged Elongation		
OR-06	In oil for 7 days @180°C 80% Unaged Tensile Strength 60% Unaged Elongation		

*Note: These oil immersion standards are mentioned for purposes of reference only. Some Canadian and European test standards are not necessarily represented here as complete equivalents to the US Standards but have been referenced due to similarities in requirements. Refer to the individual standards for detailed test procedures and any comparable evaluations.

The type of industrial environment and other factors such as the duration of oil exposure and quantity of the liquid all attribute to the specific level of oil protection needed. Other parameters such as the surrounding ambient, temperature of the oil and the cable itself will also play a role in determining the cables ability to withstand this type of chemical exposure. In general, the greater the ability of the cable jacket to resist the possible devastating effects of oil, the longer it will perform uninterrupted in the application. Certain industries (Grinding, Machine tools, painting etc.) will require the highest degree of oil resistance available, while other applications (office buildings, residential dwellings, etc.) will only need a minimal amount of this type of protection. The Lapp Group provides a large product offering of cables in a wide array of different constructions that will the meet varying degrees of oil resistance required for your application.

Cable Attributes

Flame Resistance



	USA	CSA*	Europe*
FR-00	Little or no flame retardancy, cable ignites and burns easily, and will not extinguish itself	---	---
FR-01	UL 62, Horizontal Flame test one 30 second flame application, must not emit flame or glowing particles	FT2, one 30 second flame application, must not emit flame or glowing particles	VDE 0472 Part 804 one 1-minute flame application, must not ignite or emit flames
FR-02	UL VW-1 (UL 1581), Vertical Flame test with Bunsen burner, five 15 second flame applications, must not emit flame or glowing particles	FT1, Vertical flame test, five 15 second flame applications, must not emit flame or glowing particles	IEC 60332-1, flame application time varies by cable diameter, must self-extinguish
FR-03	UL Vertical Tray test (UL 1581) exposed to flame (70,000 BTU) for twenty minutes, damage cannot exceed 8 feet	FT4, Vertical Tray test exposed to flame for twenty minutes, damage cannot exceed 5 feet	IEC 60332-3-24, exposed to flame for twenty minutes, damage cannot exceed 8.2 feet
FR-03.1	UL Vertical Tray Fire Propagation exposed to flame for twenty minutes, damage cannot exceed 8 feet, smoke release not to exceed 95m ²	FT4-ST1, Vertical Tray Fire Propagation exposed to flame for twenty minutes, damage cannot exceed 8 feet, smoke release not to exceed 95m ²	IEC 60332-3-25, exposed to flame for 20 minutes, damage cannot exceed 8.2 feet.
FR-04	UL Flame test for Riser cables (UL 1666: 527,500 BTU) Flame spread cannot exceed 12 ft.; Measured temperature at any point cannot be greater than 850°F	----	----
FR-05	UL Flame test for Plenum cables (UL 910: 300,000 BTU) exposed to flame for twenty minutes, damage cannot exceed 5 feet, peak smoke optical density not to exceed .50	FT6, exposed to flame for twenty minutes, damage cannot exceed 5 feet peak smoke optical density not to exceed .50	IEC 61034-2 exposed to flame for a maximum of 40 minutes, minimum value of 60% light transmittance.

*Note: These flame standards are mentioned for purposes of reference only. Some Canadian and European test standards are not necessarily represented here as complete equivalents to the US Standards but have been referenced due to some similarities in requirements. Refer to the individual standards for detailed test procedures and any comparable evaluations.

Lapp cables are manufactured to comply with varying degrees of flame resistance requirements. Depending upon your application, certain levels of flame resistance are necessary in order to meet specific end use requirements. Flammability ratings generally determine the end use application, which is generally dictated by local or national electrical codes. Certain applications require a minimal amount of flame resistance such as UL 62 or CSA FT2 for flexible cordage. In this instance, the end use of these products do not deem the necessity of imposing a high flammability requirement. Other applications such as cables that will be installed permanently within an industrial building, commercial dwelling or family residence will most likely require a higher degree of flammability resistance such as a UL Vertical Tray or CSA FT4. Whatever the end use application, the Lapp Group offers a wide variety of cable products meeting different levels of flame resistance to meet your requirements.

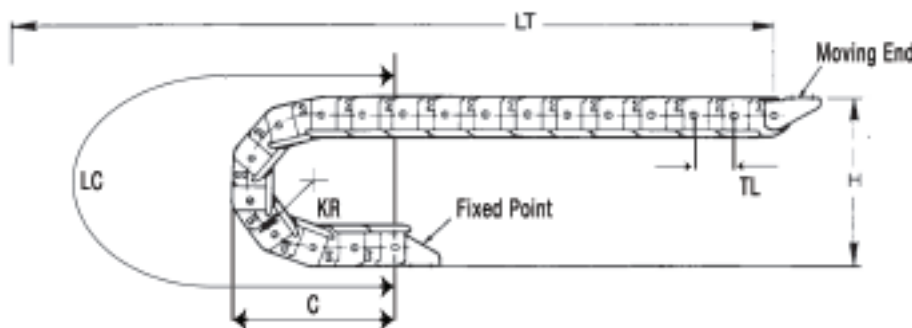
Cable Attributes

Motion



Level	Description	Definition	Cycle Life Range*
FL-00	Very Stiff (Static)	Low strand count and difficult to work with, used in static applications	---
FL-01	Flexible	Can be easily installed in machines, conduit and cable tray when applicable	---
FL-02	Highly Flexible	High flexibility with continuous flexing design attributes	---
CF-01	Continuous Moderate Flexing	Designed for Continuous Flexing and Cable Track Applications Applications - Chain Length up to 30 feet	2 - 8 million
CF-02	Continuous High Flexing	Designed for High Cycle Continuous Flexing and Cable Track Applications - Chain Length up to 30 feet	8 - 20 million
CF-03	Continuous High Flexing	Designed for High Cycle Continuous Flexing and Long Cable Track Applications - Chain Length up to 300 feet	8 - 20 million
T-01	Torsion	Designed to withstand Torsion Applications	2 million
TCF-01	Torsion & Continuous Flex	Designed for High Cycle Continuous Flexing and Torsion Applications	10 million

* When comparing cycle life data between cables, the following critical variables must be evaluated.



BR= Bend radius (in.)
LT= Distance of Travel Length (ft.)
A= Acceleration (ft./Sec₂)
S= Speed (ft./Sec.)

It is important to note that the test variables must be identical otherwise the comparison is invalid.

The Lapp Group's cable designs are evaluated under the most extreme test conditions. The cycle life testing ranges mentioned above do not indicate cable flex cycle failure, but is only an indicator of suggested range for the intended application. When Lapp continuous flex cables are installed correctly in the application, a longer service life will result. For almost half a century, Lapp products have been expertly designed, processed and manufactured with state of the art equipment, guaranteeing the finest flexible cable products available. Our credibility and expertise have classified Lapp as the "innovator" in the Industrial flexible cable and robotic industry.

Cable Attributes

Flex Life Testing Parameters



Test Conditions for Continuous Flex Cables:

Minimum Bend Radius Range Factor:	5.0 – 15.0 x Cable diameter
Bending Radius Range Factor During Testing:	4.0 – 12.0 x Cable diameter
Travel Distance Under Test Conditions:	18 Feet
Acceleration Under Test Conditions:	Varies up to 26 Feet per second
Temperature Range During Test:	+10°C to +22°C
Speed of Travel During Test:	Varies from 6.5 to 13 Feet per second



Test Conditions for Torsion Cables:

Standard Torsion Stress:	+/- 450°/ 1 meters
Severe Torsion Stress:	+/- 450°/ .5 meters
Bending Radius Range Factor During Test:	10.0 – 12 x Cable diameter



Cable Attributes

Mechanical Resistance



Level	Description	Impact	Crush	Cold Impact	Tensile	Elongation	Standard
MP-00	No extra-mechanical resistance properties	-	-	-	-	-	-
MP-01	Average	*	*	-	1500 Psi	100%	ASTM D-412
MP-02	Good – Independent lab tested for crush & Impact	10/50 Lbs.	1000/2000 Lbf.	-	1700 Psi	175%	UL 1277 ASTM D-412
MP-03	Very Good – Rated for Exposed Run use (-ER)	10/50 Lbs.	2000/4000 Lbf.	-25°C (CSA-TC)	2300 Psi	275%	UL 1277 ASTM D-412
MP-03.1	Very Good – Rated for Exposed Run use (-ER)	10/50 Lbs.	2000/4000 Lbf.	-40°C (CSA-TC)	2300 Psi	275%	UL 1277 ASTM D-412
MP-04	Excellent	**	**	-	3400 Psi	325%	ASTM D-1457
MP-05	Superior	**	**	-	4200 Psi	500%	ASTM D-412

* Impact and Crush tests not applicable for intended end use of product.

** Testing not required, however, if tested, these groups would meet or exceed UL 1277 Impact and Crush requirements by virtue of their superior mechanical properties.



Depending upon the specific application, a cable may be exposed to external factors and various types of abuse. The explicit type of industrial manufacturing or processing environment will determine the actual degree of mechanical protection that a cable requires. CNC machine centers, Mining, Food and Beverage plants, Automotive Assembly facilities, Machine tools, Data Processing, Automation, etc. applications all require a certain level of mechanical protection. The unintentional mishaps that occur everyday during routine manufacturing can range anywhere from a cable being struck by a falling object, to it being accidentally run over. There are many other types of mechanical abuse that are common in an industrial environment. With all the possibilities that your cable may be exposed to, you will need the protection and reliability that is provided in the many design configurations that are offered by the Lapp Group.