ÖLFLEX® VFD

Variable Frequency Drive Cables to Meet Your Needs

LAPP

Connectivity solutions that keep you moving.

LAPP's next generation of industrial cable solutions is designed specifically to enhance performance in Variable Frequency Drive (VFD) motor applications. Our VFD cables deliver unmatched reliability and efficiency in the most demanding industrial environments, offering advanced protection against electromagnetic interference and exceptional durability under harsh conditions. Backed by extensive research and development, these cables are engineered to reduce motor wear, improve energy savings, and boost overall system efficiency. Explore how our cutting-edge technology is reshaping the future of motor control solutions, ensuring your operations stay ahead in both performance and safety.

Benefits of Using ÖLFLEX® VFD Cables

Energy Savings & Efficiency

VFD systems powered by ÖLFLEX® VFD cables optimize energy usage by controlling motor speeds and reducing energy waste. Running motors at variable speeds can decrease power consumption by up to 30%, translating into significant cost savings over time.

Reduced Motor Wear

By smoothing the power delivery to motors, ÖLFLEX® VFD cables help reduce wear and tear, especially in high-load applications such as pumps and conveyors. This results in fewer breakdowns, less downtime, and extended motor life.

Minimized Downtime

Thanks to enhanced electromagnetic interference (EMI) shielding, ÖLFLEX® VFD cables reduce disruptions caused by electrical noise. This leads to more reliable operations, ensuring your systems keep running smoothly, even in environments where electromagnetic interference is prevalent.

Durability

Strong oil, flame, and mechanical crush resistance means LAPP VFD cables are robust enough to provide crucial motor control in even the most demanding industrial environments. Our VFD cables offer tinned conductors to limit oxidation. And our tinned copper braid shielding provides improved resistance to EMI and RFI. Whether selecting our VFD 1XL, which has the smalled OD in the market, or our VFD 2XL that is tested to 6000V, our full range of VFD cables will maintain connectivity for the long haul to keep your production lines running.

Advanced Technical Features

Superior EMI Shielding

Electrical noise from VFDs can wreak havoc on sensitive industrial equipment. ÖLFLEX® VFD cables are designed with EMI shielding technology, which includes tri-laminate foil and high-coverage tinned copper braid. This advanced shielding minimizes electromagnetic interference and ensures smooth motor performance even in noisy environments.

Temperature Resistance

Industrial motors generate high heat, which can degrade cable performance over time. Our advanced insulation materials withstand extreme temperatures up to 105°C, providing consistent performance in hot environments and preventing damage from heat-related stresses.

Durability in Harsh Conditions

Built with specially formulated thermoplastic and elastomer compounds, ÖLFLEX® VFD cables excel in demanding environments. These cables are engineered to maintain their integrity when exposed to oil, chemicals, or mechanical stress. They also pass stringent flame tests and are crush and impact-resistant, ensuring long-lasting reliability. Additionally, conductors are tinned to limit oxidation.

Superior Jacket Construction

Built Many LAPP VFD cables are built with a specially formulated thermoplastic and elastomer (TPE) compound jackets. This combines excellent flexibility, durability, and resistance attributes.

ÖLFLEX® VFD 1XL

A robust, oil- and UV-resistant shielded motor cable for VFD drives. Enhanced electrical properties of XLPE insulation provide problem-free performance and result in a reduced outer diameter for the smallest cable diameter available. Increased flexibility eases installation in crowded panels and tight spaces, and reduced labor costs where conduit is required. UL TC-ER rating allows for installation without conduit.

Available with Canadian standards.

- TC-ER per UL 1277
- Reduced diameter
- High oil and flame resistance
- Continuous flex rating (VFD 1XL)

VFD in Data Centers

In data centers, where uptime and efficiency are paramount, cooling systems are a critical component that ensure the seamless operation of countless servers.

Challenges:

- Data centers are notorious for high energy consumption.
- Up to 40% of total energy usage could be dedicated to cooling systems.
- Cooling requirements can vary by time of day and location.

VFD motor advantages:

- Precisely regulate motor speed.
- Ensure only the required amount of energy is used to provide optimal airflow.
- Extend the lifespan of equipment by reducing mechanical stress and heat generation.
- Scalable to allow for adjusting cooling capacity according to demand.

ÖLFLEX® VFD Cables Outperform Standard Cables

When comparing ÖLFLEX® VFD cables to standard motor cables, the advantages are clear. Standard cables often fail to manage the electrical noise and high-frequency signals generated by VFD's, leading to premature cable failure and motor issues. Key differences in our VFD cables improve motor operations.

Feature	ÖLFLEX® VFD	Standard cables
EMI Shielding	Superior EMI shielding	Minimal or no EMI shielding
Temperature Resistance	XLPE (plus) insulation, up to 105°C	Basic PVC insulation, less resistant
Durability	Superior oil, flame, and crush resistant	Prone to damage under harsh conditions
Energy Efficiency	Optimized for VFD systems, reducing wear	Often cause motor overheating
Installation	Easier handling with flexible jackets	Stiffer, harder to install

VFD TGK FLX SYMMETRICAL

High HP motors typically require a large AWG cable with symmetrical grounds. These heavy cables are difficult to route. LAPP's VFD TGK FLX SYMMETRICAL cable makes installation less cumbersome with flexible stranding copper conductors and braided shielding. Our tighter bend radius allows it to be maneuvered in small spaces. The three insulated ground conductors are engineered in symmetrical positions adjacent to the power conductors reducing the effects of common mode current. The foil and braided shielding protects sensitive equipment from EMI.

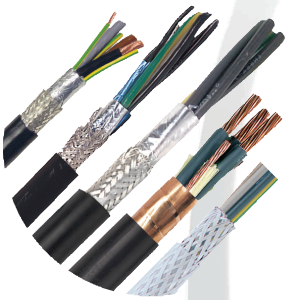
- TC-ER per UL 1277
- XHHW-2 insulated conductors
- Operating temperature -40°C to +90°C
- High oil & flame resistant TPE jacket
- Tight bend radius

Our online ÖLFLEX® VFD Cable Seletor tool can help you find the best cable to fit your needs with these key pieces of information:

- Motor Full Load Current: A
- Motor Voltage: V
- Voltage Drop: %
- Run Length: ft

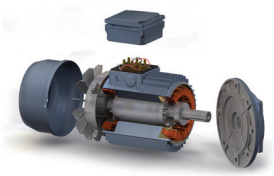
Find Your VFD Cable Now

ÖLFLEX® VFD cables



SKINTOP® cable glands

Technical data



Photographs are not to scale and are not true representations of the products in question.
Recommended SKINTOP® assumes minimal OD variance. Additional configurations are available; please see our SKINTOP® section.
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ÖLFLEX® VFD 2XL

Flexible VFD cable; 600V/1000V/2000V; UL & c(UL) TC-ER approval

ÖLFLEX® VFD 2XL is a robust oil- and UV-resistant shielded motor cable for VFD drives. The XLPE (plus) insulation with enhanced electrical properties can withstand twice the dielectric voltage test, provides extended performance, and is suitable for 2kV applications.

Recommended Applications

VFD drive and motor connections; pumps; compressors; conveyors; elevators; extruders; presses; HVAC; on/off, slow down/speed up applications

Approvals

Cable Attributes				pages 10-11
OIL	OR-03	FLAME	FR-03	
MOTION	FL-01	MECH.	MP-03	

Construction

Conductors: Finely stranded tinned copper

Insulation: XLPE (plus)

Shielding: Barrier tape; triple layer foil tape (100% coverage); tinned copper braid (85% coverage); tinned copper drain wire

Jacket: Specially formulated thermoplastic elastomer (TPE); black

Application Advantage

- One cable for applications up to 2kV
- Low capacitance design
- Industrial grade phthalate-free jacket designed for harsh environments
- UL TC-ER & c(UL) CIC/TC approved
- Reduces space and weight in tray
- No conduit required due to TC-ER rating

Complete the installation			
	SKINTOP® MS-M BRUSH		EPIC® ULTRA HB (

ÖLFLEX® VFD 2XL with Signal

Flexible VFD cable with a control pair; 600V/1000V/2000V; UL & c(UL) TC-ER approval

ÖLFLEX® VFD 2XL with Signal is a robust oil- and UV-resistant shielded motor cable for VFD drives, with a pair for brake or temperature sensor. The XLPE (plus) insulation with enhanced electrical properties can withstand twice the dielectric voltage test, provides extended performance, and is suitable for 2kV applications.

Recommended Applications

VFD drive and motor connections; pumps; compressors; conveyors; elevators; extruders; presses; HVAC; on/off, slow down/speed up applications

Approvals

Cable Attributes				pages 10-11
OIL	OR-03	FLAME	FR-03	
MOTION	FL-01	MECH.	MP-03	

Construction

Conductors:Finely stranded tinned copper

Insulation: XLPE (plus)

Shielding: Barrier tape; triple layer foil tape (100% coverage); tinned copper braid (85% coverage).

Signal Pair: 18 or 14 AWG TC conductors, individually shielded with TC Drain wire.

Jacket: Specially formulated thermoplastic elastomer (TPE); black

Application Advantage

- One cable for applications up to 2kV
- Low capacitance design
- Industrial grade phthalate-free jacket designed for harsh environments
- UL TC-ER & c(UL) CIC/TC approved
- Reduces space and weight in tray
- No conduit required due to TC-ER rating

Complete the installation			
	SKINTOP® MS-SC		EPIC® ULTRA HB

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ÖLFLEX® VFD 1XL

Flexible VFD cable; 600V/1000V; UL & c(UL) TC-ER approval

ÖLFLEX® VFD 1XL is a robust oil- and UV-resistant shielded motor cable for VFD drives. Enhanced electrical properties of XLPE (plus) insulation provide problem-free performance where precision control is critical. The new leaner design enables reduced cable diameters and increases flexibility. UL TC-ER rating allows for installation without conduit.

Recommended applications

VFD drive and motor connections; pumps; compressors; conveyors; elevators; extruders; presses; HVAC; on/off, slow down/speed up applications.

Approvals

Cable attributes			pages 10-11
OIL	OR-03	FLAME	FR-03
MOTION	CF-01	MECH.	MP-03

Construction

Conductors: tinned copper fine wire

Insulation: XLPE (plus)

Shielding: barrier tape; triple layer foil tape (100% coverage); tinned copper braid (85% coverage); tinned copper drain wire

Jacket: specially formulated thermoplastic elastomer (TPE); black

Application advantage

- Low capacitance design
- UL TC-ER & c(UL) CIC approved
- Industrial grade phthalate-free jacket design for harsh environments
- Reduces space and weight in tray
- No conduit required due to TC-ER rating
- Resistant to a wide range of disinfecting solutions used in the food, beverage, chemical and related industries, according to ECOLAB® PM 40-1 test procedure

Complete the installation	
 SKINTOP® MS-M BRUSH	 EPIC® ULTRA HB

ÖLFLEX® VFD 1XL with Signal

Flexible VFD cable; 600V/1000V; UL & c(UL) TC-ER approval

ÖLFLEX® VFD 1XL w/Signal is a robust oil- and UV-resistant shielded motor cable for VFD drives. Enhanced electrical properties of XLPE (plus) insulation provide problem-free performance where precision control is critical. The new leaner design enables reduced cable diameters and increases flexibility. UL TC-ER rating allows for installation without conduit.

Recommended applications

VFD drive and motor connections; pumps; compressors; conveyors; elevators; extruders; presses; HVAC; on/off, slow down/speed up applications.

Approvals

Cable attributes			pages 10-11
OIL	OR-03	FLAME	FR-03
MOTION	FL-02	MECH.	MP-03

Construction

Conductors: tinned copper fine wire

Insulation: XLPE (plus)

Shielding: barrier tape; triple layer foil tape (100% coverage); tinned copper braid (85% coverage); tinned copper drain wire.

Signal Pair: 18 or 14 AWG TC conductors, individually foil shielded with TC Drain wire.

Jacket: specially formulated thermoplastic elastomer (TPE); black

Application advantage

- One cable for applications
- Low capacitance design
- UL TC-ER & c(UL) CIC approved
- Industrial grade phthalate-free jacket design for harsh environments
- Reduces space and weight in tray
- No conduit required due to TC-ER rating
- Resistant to a wide range of disinfecting solutions used in the food, beverage, chemical and related industries, according to ECOLAB® PM 40-1 test procedure

Complete the installation	
 SKINTOP® MS-M BRUSH	 EPIC® ULTRA HB

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ÖLFLEX® VFD 1XLC

Flexible VFD cable; 600V/1000V; c(UL) CIC/TC-ER approval

ÖLFLEX® VFD 1XLC is designed to meet Canadian standards. A robust oil- and UV-resistant shielded motor cable for VFD drives. c(UL) CIC/TC-ER rating allows for installation in exposed areas without conduit where TECK 90 cable can be used. Enhanced electrical properties of XLPE insulation provide problem-free performance where precision control is critical.

Recommended applications

VFD drive and motor connections; pumps; compressors; conveyors; elevators; extruders; presses; HVAC; on/off, slow down/speed up applications.

Approvals

Cable attributes			page 648
OIL	OR-03	FLAME	FR-03
MOTION	FL-02	MECH.	MP-03

Construction

Conductors: tinned copper fine wire

Insulation: XLPE (plus)

Shielding: barrier tape; triple layer foil tape (100% coverage); tinned copper braid (85% coverage); tinned copper drain wire

Jacket: specially formulated thermoplastic elastomer (TPE); black

Application advantage

- Low capacitance design
- c(UL) CIC/TC-ER approved
- Industrial grade phthalate-free jacket design for harsh environments
- Reduces space and weight in tray
- No conduit required due to TC-ER rating
- Resistant to a wide range of disinfecting solutions used in the food, beverage, chemical and related industries, according to ECOLAB® PM 40-1 test procedure

Complete the installation			
	SKINTOP® MS-M BRUSH		EPIC® ULTRA HB

ÖLFLEX® VFD 1XLC with Signal

Flexible VFD cable; 600V/1000V; c(UL) CIC/TC-ER approval

ÖLFLEX® VFD 1XLC with Signal is designed to meet Canadian standards. A robust oil- and UV-resistant shielded motor cable for VFD drives. c(UL) CIC/TC-ER rating allows for installation in exposed areas without conduit where TECK 90 cables can be used. Enhanced electrical properties of XLPE insulation provide problem-free performance where precision control is critical.

Recommended applications

VFD drive and motor connections; pumps; compressors; conveyors; elevators; extruders; presses; HVAC; on/off, slow down/speed up applications.

Approvals

Cable attributes			page 648
OIL	OR-03	FLAME	FR-03
MOTION	FL-02	MECH.	MP-03

Construction

Conductors: tinned copper fine wire

Insulation: XLPE (plus)

Shielding: barrier tape; triple layer foil tape (100% coverage); tinned copper braid (85% coverage); tinned copper drain wire

Signal Pair: individually foil shielded with TC drain wire

Jacket: specially formulated thermoplastic elastomer (TPE); black

Application advantage

- One cable for applications
- Low capacitance design
- c(UL) CIC TC-ER approved
- Industrial grade phthalate-free jacket design for harsh environments
- Reduces space and weight in tray
- No conduit required due to TC-ER rating
- Resistant to a wide range of disinfecting solutions used in the food, beverage, chemical and related industries, according to ECOLAB® PM 40-1 test procedure

Complete the installation			
	SKINTOP® MS-M BRUSH		EPIC® ULTRA HB

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ÖLFLEX® VFD SLIM

Reduced-diameter VFD cable; 600V/1000V; UL & c(UL) TC-ER approval

ÖLFLEX® VFD SLIM is a reduced-diameter shielded motor cable for VFD drives. It is designed with the LAPP Surge Guard insulation system, which includes a semiconductive layer made to withstand nonlinear power distortions associated with VFD drives and to disperse increases in voltage caused by wave reflection, spikes, in-rush current, and harmonics. It is resistant to a wide range of disinfecting solutions used in the food, beverage, chemical and related industries.

Recommended applications

VFD drive and motor applications; web presses; HVAC; conveyors; on/off, slow down/speed up applications

Approvals

Cable attributes			page <?>
OIL	OR-03	FLAME	FR-03
MOTION	FL-01	MECH.	MP-03

Conductors: finely stranded tinned copper

Insulation: LAPP Surge Guard insulation system

Shielding: barrier tape; triple layer foil tape (100% coverage); tinned copper braid (85% coverage)

Jacket: specially formulated thermoplastic polymer; black

Application Advantage

- LAPP Surge Guard insulation protection
- UL TC-ER & c(UL) CIC/TC approved
- Double shielded for extra protection
- Resistant to a wide range of disinfecting solutions used in the food, beverage, chemical and related industries, according to ECOLAB® PM 40-1 test procedure

Complete the installation			
	SKINTOP® MS-SC		EPIC® ULTRA HB

ÖLFLEX® VFD with Signal

Flexible VFD cable with a control pair; 600V/1000V; UL & c(UL) TC-ER approval

ÖLFLEX® VFD with Signal is an extremely oil- and UV-resistant shielded motor power cable for VFD drives, with an additional pair for brake or temperature sensor. It is designed with LAPP Surge Guard insulation, which includes a semiconductive layer made to withstand nonlinear power distortions associated with VFD drives and to disperse increases in voltage. It is resistant to a wide range of disinfecting solutions used in the food, beverage, chemical and related industries.

Recommended applications

VFD drive and motor connections with temperature sensors or brake mechanisms; web presses; HVAC; on/off, slow down/speed up applications

Approvals

Cable attributes			page <?>
OIL	OR-03	FLAME	FR-03
MOTION	FL-01	MECH.	MP-03

Conductors: finely stranded tinned copper

Insulation: LAPP Surge Guard insulation system

Shielding: barrier tape; triple layer foil tape (100% coverage); tinned copper braid (85% coverage)

Jacket: specially formulated thermoplastic polymer; black

- LAPP Surge Guard insulation system
- UL TC-ER & c(UL) CIC TC approved
- Double-shielded for extra protection
- Contains pair for brake or temperature sensor
- Resistant to a wide range of disinfecting solutions used in the food, beverage, chemical and related industries, according to ECOLAB® PM 40-1 test procedure

Complete the installation			
	SKINTOP® MS-SC		EPIC® ULTRA HB

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ÖLFLEX® FD VFD

Continuous flex VFD cable; 600V/1000V; UL & c(UL) TC-ER approval

ÖLFLEX® FD VFD is a shielded continuous flex motor supply cable. It is designed with the LAPP Surge Guard insulation system, which includes a semiconductive layer made to withstand nonlinear power distortions associated with VFD drives in industrial applications. It is resistant to a wide range of disinfecting solutions used in the food, beverage, chemical and related industries. For bending cycles and operation parameters, see www.lappusa.com

Recommended Applications

VFD drives and motor connections in continuous flex applications; plastic extrusion; on/off, slow down/speed up applications

Approvals

Cable Attributes			pages 10-11
OIL	OR-03	FLAME	FR-03
MOTION	CF-02	MECH.	MP-03

Construction

Conductors: Finely stranded bare copper

Insulation: Lapp Surge Guard insulation system

Shielding: Barrier tape; triple layer foil tape (100% coverage); tinned copper braid (85% coverage)

Jacket: Specially formulated thermoplastic polymer; black

Application Advantage

- Continuous flex rated for cable chain applications
- Double-shielded for extra protection
- UL TC-ER & c(UL) CIC/TC approval
- Resistant to a wide range of disinfecting solutions used in the food, beverage, chemical and related industries, according to ECOLAB® PM 40-1 test procedure

Complete the installation	
 SKINTOP® MS-SC	 EPIC® ULTRA HB

ÖLFLEX® VFD 2XL SYMMETRICAL

Symmetrical 2kV motor supply cable for large HP VFD drives; UL & c(UL) TC approval

ÖLFLEX® VFD 2XL SYMMETRICAL is a robust oil- & UV-resistant large AWG 2kV VFD cable designed with three symmetrical grounds and a helical copper tape shield. It is resistant to a wide range of disinfecting solutions used in the food, beverage, chemical and related industries

Recommended Applications

VFD drive & motor connections for large HP applications; pumps; compressors; conveyors; elevators; extruders; HVAC; large presses; on/off, slow down/speed up applications

Approvals

Cable Attributes			pages 10-11
OIL	OR-03	FLAME	FR-03
MOTION	FL-01	MECH.	MP-03

Construction

Conductors: Bare stranded copper

Insulation: XLPE (plus) + 3 bare stranded copper grounds

Shielding: Helical copper tape (100% coverage)

Jacket: Specially formulated thermoplastic elastomer (TPE); black

Application Advantage

- 100% copper tape shield for EMI & RFI protection
- Low capacitance design
- UL TC-ER & c(UL) CIC/TC approved (CIC/TC approval depending on AWG)
- 3 ground design for optimal electrical performance
- Industrial grade phthalate-free jacket designed for harsh environments
- Flexible for easier routing
- Resistant to a wide range of disinfecting solutions used in the food, beverage, chemical and related industries, according to ECOLAB® PM 40-1 test procedure

Complete the installation	
 SKINTOP® MS-M BRUSH	 EPIC® ULTRA HB

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VFD TGK FLX SYMMETRICAL

Symmetrical GND motor supply cable for VFD drives

VFD TGK SYMMETRICAL is a flexible VFD cable that ensures ease of routing in the industrial platform. Superior shielding minimizes EMI to surrounding system. The insulated ground conductors are symmetrically positioned to reduce the effects of common mode current on motor and drive.

Recommended applications

VFD drive & motor connections for large HP applications; pumps; compressors; conveyors; elevators; extruders; HVAC; large presses; on/off, slow down/speed up applications.

Approvals

Cable attributes			page 648
OIL	OR-03	FLAME	FR-03
MOTION	FL-01	MECH.	MP-03

Construction

Conductors: bare copper

Insulation: XLPE insulation + 3 insulated symetrical grounds

Shielding: foil and tinned copper braid

Jacket: TPE black

Application advantage

- 85% foil and braid coverage for EMI & RFI protection
- Low capacitance design
- UL TC-ER approved with XHHW-2 insulated conductors
- 3 SYM ground design for optimal electrical performance

Custom Cable Assemblies from LAPP Harnessing Solutions

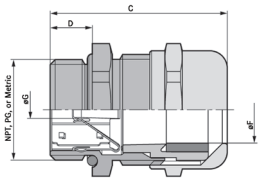
Standard, off-the shelf cables do not always meet the unique demands of industrial systems. That's why LAPP Harnessing Solutions offers custom cable assemblies that meet your specific needs. Whether you're looking for a compact cables with a connectors, flexible spiral cables, or fully assembled harnesses, our solutions ensure custom fit with reliability and efficiency.

Why Partner with LAPP Harnessing Solutions

- **Comprehensive Solutions**: Your single source for complete cable and connection systems.
- **Customized Excellence**: Assemblies meticulously designed to match your specific needs.
- **Decades of Mastery**: Benefit from over 30 years of specialized experience.
- **Operational Efficiency**: Streamline your costs. Let us handle inventory management.
- **Dedicated Expertise**: Our team of engineers and technicians offers end-to-end support, from needs assessment to post-installation quality checks.
- **Unmatched Quality Commitment**: Our facilities are IPC/WHMA certified, and we employ Lean Six Sigma practices to ensure the highest quality and efficiency.

SKINTOP® MS-SC

Nickel-plated strain relief for EMC applications with NPT, PG & metric thread



Approvals

NPT: cULus, cULus, CE, RoHS

PG: CE, RoHS

Metric: cULus, cULus, CE, RoHS, DNV-GL

Technical Data

Material:
- body: nickel-plated brass
- insert: polyamide
- bushing: CR
- O-ring: NBR

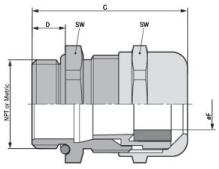
Locknuts: add SKINDICHT® SM-PE

Temperature Range:
- static: -40°C to +100°C
- dynamic: -25°C to +100°C

Protection: IP68, 10 bar when used with an O-ring
- metric: IP69
- NPT & metric: NEMA 1, 4X, 6, 12

SKINTOP® MS-NPT BRUSH/MS-M BRUSH

Nickel-plated brass strain relief for EMC applications with NPT & metric thread



Approvals

NPT: cULus, CE, RoHS

Metric: cULus, VDE, CE, RoHS, DNV-GL

Technical Data

Material:
- body: nickel-plated brass
- brush: brass
- insert: polyamide
- bushing: special elastomer
- O-ring: special elastomer

Locknuts: add SKINDICHT® SM-PE-M (metric glands only)

Temperature Range:
- static: -40°C to +100°C
- dynamic: -25°C to +100°C

Protection: IP68, 10 bar
IP69 (excludes NPT 2" plus, M63 plus)
NEMA 1, 4X, 6, 12 (excludes NPT 2" & 2" plus)

SKINTOP® BRUSH Add-on

EMC fitting for polyamide glands with metric thread

Approvals

CE, RoHS

Technical Data

Material:
- body: nickel-plated brass
- brush: brass

Temperature Range: -70°C to +200°C

Approvals: UL pending

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Oil Resistance

Level	USA	CSA*	Europe*
OR-00	Minimal oil resistance characteristics	–	–
OR-01	UL 758 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 1 day @ 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

*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.

Flame Resistance

Level	USA	CSA*	Europe*
FR-01	UL 62: Horizontal Flame Test One 30-second flame application. Cable must not emit flame or glowing particles.	FT2: One 30-second flame application. Cable must not emit flame or glowing particles.	VDE 0472 Part 804 One 1-minute flame application. Cable must not ignite or emit flames.
FR-02	UL VW-1 (UL 1581): Vertical Flame Test Five 15-second flame applications. Cable must not emit flame or glowing particles.	FT1: Vertical Flame Test Five 15-second flame applications. Cable must not emit flame or glowing particles.	IEC 60332-1 Flame application time varies by cable diameter. Cable must self-extinguish.
FR-03	UL 1581: Vertical Tray Test Exposed to flame (70,000 BTU) for 20 min. Damage cannot exceed 8 feet.	FT4: Vertical Tray Test Exposed to flame for 20 min. Damage cannot exceed 5 feet.	IEC 60332-3-24 Exposed to flame for 20 min. Damage cannot exceed 8.2 feet.

*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's Continuous Flex Test Method has earned UL Verification. UL performed a detailed audit of our continuous flex testing methodology claims of CF-01, CF-02, and CF-03. The UL audit included requirements of calibrated specialty equipment, a well trained staff, and controlled documentation in compliance with ISA 17025.

LAPP rates all of our products using a stringent set of standards. Our continuous flex testing methods have been meticulously developed over years combining engineering expertise and experience gained from working with a wide range of manufacturers working in harsh industrial environments. After evaluating a product's mechanical and electrical performance, we classify motion type attributes into precise Continuous Flexing (CF) categories which are defined in the Cable Attributes section of our catalog. This information is yet another technology tool LAPP provides customers to help them determine the best products for their individual requirements. Reference www.lappusa.com/cf-rating

Motion Type

Level	Description	Definition	Cycle Life Range
FL-00	Stationary	Low strand count for 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 flexing: basic*	Designed for basic continuous flex and cable chain applications Chain length up to 15 feet	1 - 2 million cycles
CF-02	Continuous flexing: moderate*	Designed for continuous flex and cable chain applications Chain length up to 30 feet	2 - 8 million cycles

* When comparing cycle life data between cables, the following critical variables must be evaluated: bend radius, distance, acceleration, speed & weight.

Mechanical Properties

Level	Description	Impact	Crush	Cold Impact	Cold Bend	Tensile	Elongation	Standard
MP-01	Average	–	*	*	–	1,500 psi	100%	ASTM D-412
MP-02	Good: independent lab-tested for crush & impact	10/50 lb	1,000/ 2,000 lbf	–	-25°C	1,700 psi	175%	UL 1277 ASTM D-412
MP-03	Very good: rated for Exposed Run use (-ER)	10/50 lb	2,500/ 4,200 lbf	-25°C (CSA-TC)	-40°C (UL 62)	2,300 psi	275%	UL 1277 ASTM D-412

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

Note: LAPP mechanical protection test values for each level meet or exceed the requirements of the standards referenced.

Size conversion

American Wire Gauge (AWG) to mm²

AWG	mm²
30	0.05
28	0.08
26	0.14
24	0.25
22	0.34
20	0.50
19	0.75
18	1.0
16	1.5
14	2.5

AWG	mm²
12	4
10	6
8	10
6	16
4	25
2	35
1	50
1/0	50
2/0	70
3/0	95

AWG	mm²
4/0	120
250	120
300	150
350	185
400	185
450	240
500	240
600	300
750	400

mm² to American Wire Gauge (AWG)

mm²	AWG
0.14	26
0.25	24
0.34	22
0.50	20
0.75	19
1.0	18
1.5	16
2.5	14

mm²	AWG
4	12
6	10
10	8
16	6
25	4
35	2, 1
50	1/0
70	2/0, 3/0

Motor Properties

AWG size selection chart per NEC

Drive HP	230V 3ø AWG	460V 3ø AWG	575V 3ø AWG
½ - 3	14	14	14
5	14	14	14
7 ½	10	14	14
10	8	14	14
15	6	10	12
20	4	8	10
25	2	6	8
30	1	6	8
40	2/0	4	6
50	3/0	2	4

Drive HP	230V 3ø AWG	460V 3ø AWG	575V 3ø AWG
60	4/0	1	2
75	300 KCMIL	1/0	1
100	500 KCMIL	3/0	1/0
125	–	4/0	3/0
150	–	300 KCMIL	4/0
200	–	500 KCMIL	300 KCMIL
250	–	–	500 KCMIL
300	–	–	–
350	–	–	–
400 - 500	–	–	–

Note: The above table references the suggested wire AWG to use based on horse power (HP) and the full load current (FLC) × 125% per NEC Art. 430-122 (A). Amperes (FLC) were determined from NEC Art. 430-250:

Example:
To calculate AWG size, three factors must be known: motor HP, motor voltage, and full load current (FLC).

For a 30 HP and 460V motor, the FLC is 40A. Per NEC, FLC x 125% is required to calculate AWG size.

40A x 125% = 50 A, therefore the right AWG wire is 6 AWG per NEC Article 310.15.

See NEC table 310.15(B)(16) on previous page. 60°C column ampacities are referenced to avoid safety hazards that can occur when the maximum allowable temperature ratings of equipment and other non-cable components have been exceeded.

ADJUSTABLE SPEED DRIVE			
REG No. LAPP MOTOR EXAMPLE			
Power Input	Volts 460V	Power Output	Power 30 HP
	Amps 40A		Volts 500V
	Hertz 60 Hz		Amps 50A
Model No. LAPP MOTOR		LAPP	
Serial No. LAPP 12345			
ML No. 4DFJKJ48DK			

Voltage drop factors

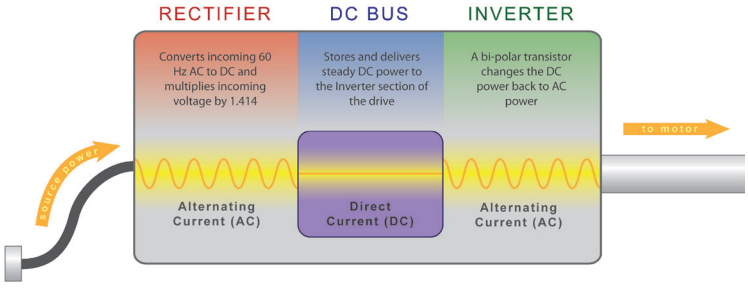
Volts at FLC @ 20°C

Drive HP	Voltage Drop Factor (VDF) 230V 3ø	460V 3ø	575V 3ø
½	0.00696	0.00348	0.00285
¾	0.01013	0.00506	0.00411
1	0.01329	0.00665	0.00538
1½	0.01899	0.00949	0.00759
2	0.02152	0.01076	0.00854
3	0.03038	0.01519	0.01234
5	0.04809	0.02405	0.01930
7 ½	0.02868	0.03481	0.02848
10	0.02105	0.04430	0.03481
15	0.02009	0.02738	0.03335
20	0.01914	0.02030	0.02868

Drive HP	Voltage Drop Factor (VDF) 230V 3ø	460V 3ø	575V 3ø
25	0.01575	0.01627	0.02030
30	0.01732	0.01914	0.02406
40	0.01203	0.01843	0.01962
50	0.01185	0.01506	0.01843
60	0.01125	0.01667	0.01436
75	0.00872	0.01385	0.01667
100	0.00676	0.01130	0.01429
125	–	0.01139	0.01139
150	–	0.00818	0.01052
200	–	0.00655	0.00872
250	–	–	0.00660

The table above references the voltage drop over distances. It was determined by using selection criteria of the Motor Properties Table. In order to determine the voltage drop, multiply the length by the data above.

Example:
To calculate voltage drop over a specified distance, two factors must be known: the distance to the motor and the voltage drop factor.
For a 30 HP and 460V motor, the voltage drop for a distance of 200 feet would be **200 x 0.01914 = 3.83 volts**



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