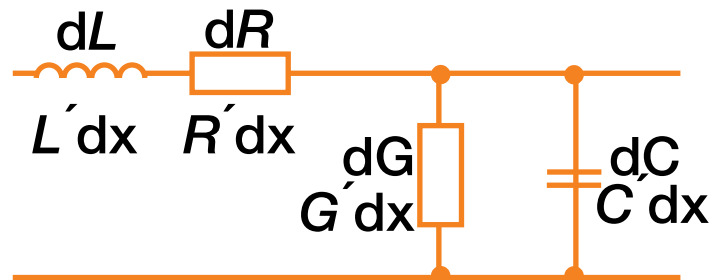


Chainflex[®] motor and servo cables enable variable frequency drives to operate safely and failure-free

Customers are demanding variable frequency drives (VFD) that are more compact and that come equipped with higher-power motors and more accurate frequency converters. Because of this, the user must consider the electrical characteristics of the system's motor or servo cables to ensure the entire VFD system functions properly. In this tech talk, you will learn about the appropriate insulation material you'll need for your electrical cables, changes happening within the market, and a new product from igus[®] that enables modern VFDs to operate safely without failing.

Properties of electrical cables

Every electrical cable has a certain inductance, capacitance and ohmic resistance depending on its structure and the materials used. The cable's ohmic resistance in an industrial environment depends mainly on the conductivity, cross section and length of the conductor. The capacitive values, on the other hand, are strongly dependent on the insulation material. Therefore, two identical cables with the same length and cross section will have completely different capacitive specifications if their insulation material is not the same.



Replacement circuit diagram for a cable element of a two-wire cable of length dx . For a required length, L' = Inductance, R' = Resistance, G' = Dissipation factor and C' = Capacitance are used for simplicity.

Proper insulation material as a central factor for capacitance

Today's generation of VFDs change their speeds by changing the frequencies of the drive voltage. If a high-capacitance cable is used, a significant amount of energy is lost for the capacitance of the cable alone. In the worst-case scenario, this could lead to unwanted reflections and voltage overlaps.

Many power, motor and servo cables are made with polyvinyl chloride (PVC) insulation because it is cost-effective and easy to process. However, PVC has an extremely high dielectric constant (ϵ_r). A higher ϵ_r increases the cable's capacitance, requiring more energy to charge and discharge the cable. This leads to higher losses and higher switching inaccuracies within the overall system.

Safe and reliable cables for high-frequency drives

igus[®] has been offering chainflex[®] motor and servo cables made of high-performance polymers for more than 15 years. These polymers have a lower ϵ_r and a high electrical resistance. The cables have been

extensively tested to withstand continuous movement inside energy chains and to provide power from the VFD to the motor safely and efficiently.

igus® is also the only supplier in the global market offering insulation material for its chainflex® motor and servo cables that has a low capacitance and can withstand the increased thermal requirements of the latest generation of motors. This new insulation was qualified after five years of testing in the igus® laboratory and after extensive practical tests.

Small motors require a new electrical supply

The maximum current carrying capacity of an electrical cable is defined as the permissible maximum conductor temperature at a given ambient temperature (usually marked on the cable). This can range from 70 degrees Celsius to 80 degrees Celsius for PVC and measures about 90 degrees Celsius for thermoplastic elastomer (TPE) materials. The data for the cable temperature is calculated independently of the connector used to terminate the cable.

Both the motors and connectors used to serve as heat sinks since older generation motors were bigger and had round, metallic connectors sized M23 or larger. However, today, customers are demanding more compact and more powerful motors with M18 or M16 connectors and additional plastic housing insulation.

Due to their small size, new motors get hotter when they run at the same power level as their predecessors. This means connecting power/servo cables are expected to absorb the waste heat. Although there are no consequences for the motor and the connected components in the short term, serious problems could occur in the long term.

Short circuits can happen inside the cable and near the connectors if the insulation material of the cable does not withstand the elevated temperatures, which could lead to fires in the worst-case scenario. Therefore, it is crucial for cable manufacturers to respond to market developments and design new insulation materials that can withstand current thermal requirements.

Largest variety of tested, verified and certified cables

The igus® range of cables is extensively tested under real-world conditions in the company's 29,600 square-foot test laboratory. Because of that, igus® is the only manufacturer on the market that offers a 36-month guarantee on all its cables.

The servo cable CF29 (with a bend radius of $5.4 \times d$) was tested with our new insulation material. In test number 5034, the cable withstood over 45 million strokes inside an energy chain. The data collected during the tests are included in the chainflex® service life calculator, an online tool that customers can use in advance to help determine how long a selected cable is expected to last.



Larger Metallic M23 vs smaller form Plastic M18 or M16 connectors

igus® offers the largest product range of cables for energy chains with more than 1,300 types available, including servo, motor, robot, bus, data and fibre optic. igus® also has the world's most comprehensive selection of international approvals, including UL, EAC and DNV-GL approval. All cables can be purchased as ready-to-connect readycables®.



Test shows heat propagating into the cable