IDC insulation displacement technology

Secure contacts save time

Users and manufacturers are familiar with the constant quality, time, and cost pressures in industrial installations. IDC connection technology – perhaps the most innovative electrical connection technology since the invention of tension spring technology – presents an interesting alternative and offers an increased savings potential (Figure 1, lead image).

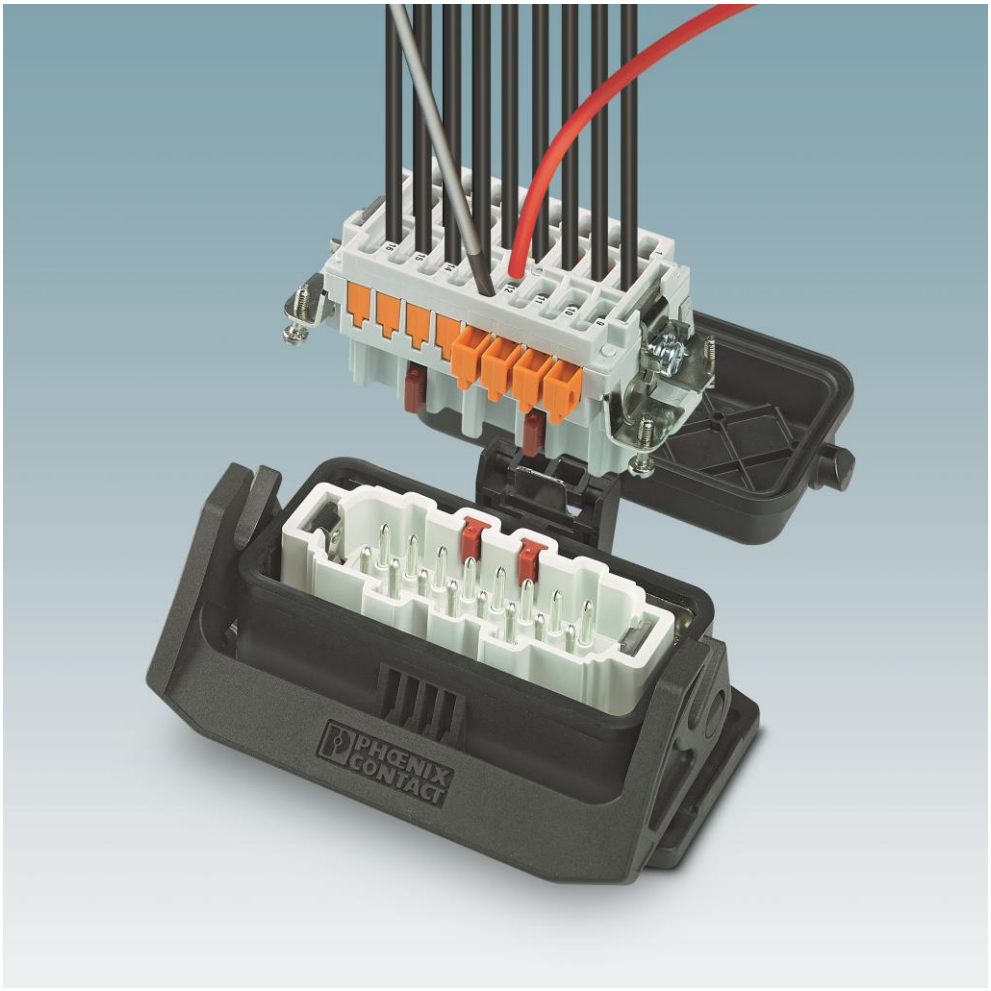

Figure 1, Lead Image - IDC connection for industrial plug-in connectors – this connection technology has been used for over a decade in a diameter range from 0.34 to 2.5 mm².

“IDC” stands for *Insulation Displacement Connection*. Its main advantage is that there is no need for cable preparation; this saves 60 to 80 percent of the time usually spent on screw connections. The last 20 years have seen extensive experience with IDC connections: for different cable diameters, for rigid and flexible conductors with different insulation materials, and for different environmental conditions. The limits of what could be done were exceeded again and again, thereby constantly creating new fields of application for this technology.

This insulation-displacement contact method has been established for many years already in automotive applications, telecommunications, and information technology. Today, IDC technology is available for numerous additional industrial applications. IDC contacts are considered suited for industrial applications if they can accept both rigid and flexible cables, cover a larger range of diameters, penetrate various conductor insulation types, and are easy to use in harsh industrial conditions. The electrical connection must always remain reliable and function over the long term.

Advantages of IDC connection technology

IDC connection technology offers a whole series of noteworthy advantages:

- 60 percent time savings for individual cable connections, and up to 80 percent for multiple cables
- High reliability through a defined contact force that doesn’t depend on the user
- Can be connected several times
- No splicing required for flexible cables
- Visual recognition of switching status, for example with a coloured control element
- No special tools required as for LSA technology (solder-, screw-, and insulation-free technology) or for crimp contacts
- Standard screwdriver or wire cutters suffice
- High vibration protection
- Tested for shock loads up to 350 g
- Approved for use in mechanical engineering, wind energy systems, railway applications, and power plants – up to Ex applications

LSA technology has been used in communications technology since the early 1970s for main distributors in switching centres, and since the early 1980s in line technology and installation distributors. Today, LSA technology is also a conventional method to connect network sockets, as in a computer network. The principle resembles the crimp procedure for an RJ45 plug.

How IDC connection technology works

The individual wires are inserted into the connection space unprepared, meaning without stripping them, and pressed into the cutting clamp by means of a screw, press, or lever mechanism. In contrast to LSA technology, the “special tool” is always part of the IDC connection technology (as is the case, for example, with Quickon technology from Phoenix Contact), in the form of a splice body for multi-wire connections, or in the form of an orange-coloured actuation element for a commercially available screwdriver. When connected, the wire insulation is pushed aside without damaging the copper strands in an impermissible way or weakening their cross section. This process creates a force-defined, user-independent, gas-tight contact. The transition resistances of IDC connections lie in a range between screw and spring clamp connections.

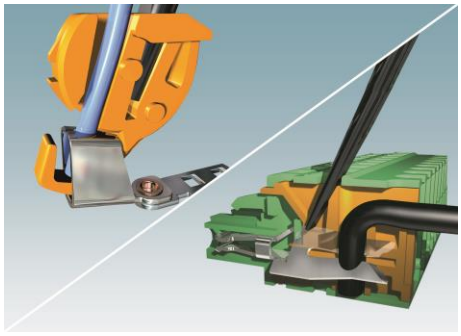

Figure 2 - Pipe contact (left) and flat contact – both shapes meet all of the requirements for reliable electrical characteristics.

For reasons of geometry, two different types of IDC contacts have been established: pipe contacts and flat contacts (Figure 2). In some applications, a flat contact is a better choice for geometrical reasons; in other applications, the pipe shape is advantageous. Pipe contacts offer a significantly greater diameter range in about the same design envelope. Manufacturing effort is slightly higher due to the more complicated shape and greater use of materials.

Requirements for IDC connections

IDC connections are subject to a series of requirements. For example, a cutting clamp must be made of the best possible conductive and corrosion-resistant material so that it can transmit the desired current from the conductor. The cutting contour must be designed in terms of shape in such a way that it can push aside and sever the wire insulation, while not cutting the strands if at all possible. In addition, the cutting clamp must possess sufficient contact strength to create a durable, gas-tight electrical connection and to clamp the conductor with sufficient mechanical strength (Figure 3). Additionally, the IDC connection must be elastic enough to facilitate the greatest possible diameter range for rigid and flexible wires (Figure 4).

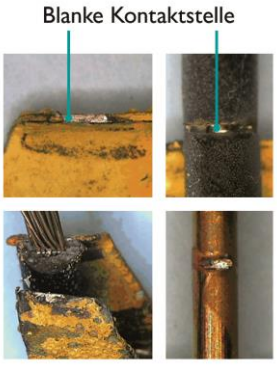

Figure 3 - Gas tightness in compliance with IEC 60512-6 – even after extreme weather simulations, the gas-tight electrical connection is verifiable using blank contact points, as shown in the examples of a pipe contact with a flexible cable (left) and with a massive cable with and without insulation (right) using blank contact zones.

Figure 4 - Energy distributor with multiple IDC connection – the CT (computed tomography) images (below) show the distribution of rigid and flexible cables in the contact zones.

It is also important that the cable diameter range specification is observed. If the cable is too thin, the insulation is not pushed aside properly because the contact gap is too large, and if the cable is too thick, it may be impossible to connect the cable, or the connector may be subjected to excessive displacement forces and become damaged. The cable in the IDC connection must be positioned in such a way that as many strands as possible remains within the cutting clamp, especially for flexible cables. The excess cable end should not be cut too short, so that the cable remains firmly seated in the IDC connection. It must be possible to perform the wiring of the same contact point at least ten times with different cable diameters in any sequence. Also, the storage and use temperature range in the environment must stay within the desired range.

Restrictions of IDC connection technology

IDC connection technology is not as common as other methods, such as screw connection technology. For this reason, a few system-related particularities should be pointed out. The installation of IDC connections should not be done in extremely low or extremely high environmental temperatures because this can cause major changes in the elasticity of the cable insulation. This is why it is recommended to perform wiring only within a temperature range between – 5 and + 50 °C. Only one cable can be connected per IDC contact point. Also, the wire insulation specifications must be met or approved for the specific application. Hard insulation materials such as Teflon or viscoelastic materials such as silicone can only be connected using special IDC connectors designed for this purpose. Rigid and flexible cables can be connected well. The minimum strand diameter should be taken into account for extremely flexible cables of category 6.

During removal, especially of individual cables, ensure that the orange actuation element is completely open. Otherwise, insulation fragments could remain in the connection space. Flexible cables also should not be pre-treated. They are only cut for length and then connected with their insulation in place. Before rewiring, the cable should be cut off behind the contact zone, which prevents the insulation from being cut through completely.

Conclusion: IDC for field use

The reliable use of IDC connection technology requires some basic knowledge that is easily taught and can be mastered by trained staff. IDC connection technology is appropriate for all fields of application, from mass production in the factory to field installations, thanks to its fast connection method and the fact that a special tool is not required.

For more information:
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At a glance –

IDC connection technology

IDC connection technology is an interesting alternative to today's established contact technologies, such as screw or spring cage. The advantages lie primarily in the fact that cables do not need to be prepared, such as stripping the insulation off and applying a splice protector, and in the user-independent contact force defined by the spring-loaded IDC terminal. IDC connection technology offers savings in installation costs as well as high reliability in handling in a broad field of applications.

The multiple positive characteristics and high market acceptance of IDC connection technology have also convinced Phoenix Contact. This is why the company has several products with IDC technology in its portfolio: terminal blocks, PCB connection technology, industrial plug-in connectors, and various customer-specific components in a diameter range from 0.14 mm² to 6.0 mm². These components have proven themselves in practice for years, and the product line is constantly expanding.