

Systematic Safety

Plug-in Power Supply in the Ex-Area

A new system of electrical plug-and-socket connectors from 10 A to 125 A for the first time allows quick and low-cost maintenance of all electrical apparatus without isolating, dis-connecting or need for a hot-work permit.



Picture 1: Explosion-protected plugs and sockets from 10 A to 125 A (source: Cooper).

Despite its significance, the problem can be circumscribed in a few words. Apparatus used in hazardous areas must be supplied with electrical energy in such a way that the ambient atmosphere cannot be ignited under any circumstances. This requirement is fulfilled by all proven ex-connection and distribution systems according to the relevant standards. The problem arises when the connected apparatus needs to be replaced, repaired or serviced. In such a case, elaborate preparations, such as safe isolation of the electrical connection, disconnection or prevention of the explosive atmosphere by maintenance measures, are usually necessary. These preparations generally require a hot-work permit. Such measures are necessary, since the explosion protection of the connection is no longer effective during the disconnection of the apparatus, thus posing a potential hazard. The consistent use of explosion-protected plug-and-socket connections, which can be connected or disconnected during system operation even at full load, provides an elegant solution not only to these problems.

Merely by pulling the plug, the apparatus is visibly and safely separated from the power supply, thus significantly increasing the personal safety of the maintenance staff. Since no onsite electrical work is necessary for the mechanical replacement of the apparatus, these tasks can be carried out completely by a works craftsman or service technician. If all factors are considered, a savings potential of about 68 percent (cost-benefit analysis by CEAG Sicherheitstechnik GmbH, May 2003 for a model system with 2000 measuring points and a 15-year life-cycle), besides the considerable increase in work safety and significantly reduced downtimes in production.



Picture 2: Simply by pulling the plug, the current can be removed from the drives (source: Bayer AG).

Explosion-protected plug-and-socket-connections for large electrical apparatus with currents between 16 A and 125 A have been on the market for a long time. These plugs and sockets are not live when unplugged. They are designed in such a way, that when a plug is inserted into a socket, voltage is only applied and thus current conducted after complete contact between pin and sleeve. When plug and socket are separated, the process is reversed: Voltage is removed before the plug is pulled out. Thus, break sparking is prevented. In large plugs and sockets, switching is performed via a separate circuit breaker which is only released after the plug is locked in the socket, in smaller plugs and sockets, switching is released di-

rectly when the plug is locked in the socket. In all cases, high-quality switch mechanisms are used which are fully functional even at full inductive loads (AC-3 switching capacity). The status of plugs and sockets of such design can be monitored via parallel auxiliary contacts and can therefore be integrated in the production process.



Picture 3: Socket combinations with flange socket, 4-pole, 500 V (32 A) for drive power supply and 3-pole, 24 V (16 A) for TMS. The blue connection cable for the intrinsically safe auxiliary contact can be seen clearly (source: Bayer AG).

Since permanent installation of electric drives in the ex-area leads to considerable recurring costs (isolation, disconnection, hot-work permit), in modern industrial systems, power is being increasingly supplied to drives via plug-and-socket connectors. The advantages of such a system is impressive: After the plug is pulled, a visible all-pole separation of the drives from the mains supply is effected. This allows the electric drives to be replaced without the need for an electrical specialist or a hot-work permit. Besides the considerably improved work protection, this means a great saving in time which can be decisive during running operations. Moreover, via an intrinsic-

ly safe current loop (NAMUR signal), the status of the plug-and-socket connection can be continuously reported to the central control system via an auxiliary contact and remote I/O. By this means, process flows can be controlled and, for instance, in case of an emergency, the processes can be shut down under full control, i.e. the release of given processes can be prevented or affected areas of the process technology can be relieved.



Picture 4: Test arrangement for testing switching contacts of explosion-protected plugs and sockets (source: Cooper).

Plug-and-socket combinations can be used for control of variable-speed drives. Here, the socket enclosure has a 4-pole flange socket for the drive power supply as well as a 3-pole low-voltage socket for the TMS. The socket combination can be monitored safely via auxiliary contacts with extremely low transition resistance and resistance combination regarding its switch state (NAMUR signal). In this kind of connector, the very different voltage ranges have to be implemented within a single enclosure. Especially important for controlling variable-speed drives is of course the full AC3- switching capacity, since the load on the contacts increases considerably when the frequency is reduced. Test series studied by a well-known switch-gear manufacturer showed that at the normal mains frequency of 50 Hz, the break sparking exists for 2 milliseconds max. With decreasing frequency, this period

of time increases which can cause damage to conventional switches and even to the destruction of the contacts.

Another important factor for the use of these plug-and-



Picture 5: Plugs and sockets for up to 32 A for outdoor installations (source: Bayer AG).

socket connectors is the auxiliary contact with which the status (plugged or unplugged) can be transmitted via an intrinsically safe circuit (NAMUR signal) to a bus module. Since extremely small currents (approx. 1–2 mA) flow in intrinsically safe circuits, these contacts must provide a transition resistance approximating zero. For this purpose gold-point contacts are suitable as they fulfil the high demands thanks to their non-corrosive material. For the enclosure design it is important that the minimum distances to other live parts of the connector are strictly adhered to. For connection to the bus system of the control technology, remote I/O can be used for binary input signals.

Actors and sensors with a current capacity of up to 10 A were always controlled in the past directly via permanent installations. This kind of connection for these devices with a relatively low power consumption led to exactly the same problems during repair and maintenance as the large drives referred to above. Due to the significantly greater number of connection points, the problem here must be assessed as quantitatively considerably greater. As of this year however a solution is available for this area of explosion-protected electric installations.

The two largest manufacturers for apparatus in the ex-area will exhibit for the first time a fully compatible plug-and-socket system for currents up to 10 A at the Achema 2003. These plugs and sockets can be plugged and un-plugged under load in hazardous areas. They have the great advantage of having especially compact enclosure sizes which allows them to be integrated in all common field devices. Among other features, the system offers flange sockets, apparatus plugs, angle pieces, plugs and couplers.

These compact components do not have make-and-break contacts to switch off the voltage in the bushes of the sockets and couplers when separated, instead they provide reliable explosion protection by a flameproof encapsulation of the contacts during the plugging and unplugging process. This protection is attained by dividing the plugging and



Picture 6: Field device with explosion-protected plug and socket in nickel-plated brass (source: Cooper).

unplugging process into three movement phases. First, when the plug is inserted into the socket to its stop, a mechanical connection of the components is achieved and the flameproof encapsulation of the contacts is effected. Then, the plug is turned clockwise by 30° to its stop. Only now can the plug be plugged in completely, closing the electrical contacts. This three-phase process reliably ensures safe electrical and mechanical connection which is subsequently locked into place and sealed by a nut providing the high degree of protection IP 68.

The advantage of this new plug-and-socket connection

SAMSON



Visit us at INTERKAMA+
Hall 6, Booth K20

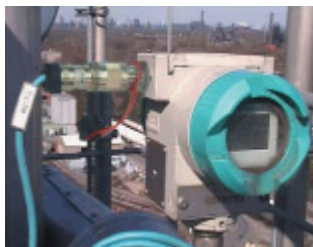
An all-round talent

- In SAMSON's Type 3730-2 i/p Positioner, everything revolves around just one rotary pushbutton: turn to select parameters, press to activate them. The large display is your window to the system. Alternatively, you can easily configure the positioner from a PC using the TROVIS-VIEW software.

The positioner works continuously to keep your process running smoothly, yet only consumes a small amount of power.

Its range of functions is rounded off by limit switches, position transmitters and solenoid valves.

Definitely a turn for the better.



Picture 7: Sensor connection via an explosion-protected plug and socket connection (source: Cooper).

system for the ex-area are vast. Thus, for instance, the maintenance staff can replace field devices during maintenance and repair on site without external help. This affords not

only reduced manpower, but also a considerable saving in time, especially during operation. Further advantages result for new installations or extensions of existing systems. Pre-assembled connection cables save time-consuming and – depending on the local conditions – possibly difficult isolation of the apparatus on site. Furthermore, pre-mounted devices, such as pumps, valves or lamps can be connected and disconnected via pre-assembled cables. Retrofitting of the installation is also possible using these plug-and-socket connection systems, providing a high degree of system flexibility.



Picture 8: Pump room with plugs and sockets for up to 32 A (source: Bayer AG).

Conclusion:

The consistent use of explosion-protected plugs and sockets for connecting electrical apparatus in hazardous areas increases the work and operating safety while sustainably cutting

costs. Even during the ongoing operation of a highly complex chemical plant, for instance, all apparatus connected via this plug-and-socket system can be disconnected in very short time and be visibly separated from mains power for replacement by similar apparatus. Isolation, disconnection or a hot-work permit are not necessary.

Wolfgang Twiste

Product Marketing Manager
at Cooper Crouse-Hinds GmbH
and responsible Press Officer

Cooper Crouse-Hinds GmbH,
Senator-Schwartz-Ring 26, D-59494
Soest, Germany