

Remote I/O systems for hazardous areas

Interconnected equipment as a factory-built system

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Figure 1: Field station for use in Zone 1 with integrated terminal and control stations (closed)



Figure 2: Field station for use in Zone 1 with integrated terminal and control stations (open)

Remote I/O technology in instrumentation offers so many advantages for the installer and user of process engineering systems that its use is gaining more and more acceptance. For operation in hazardous areas, the inputs and outputs of the system are designed largely intrinsically safe so that the connected, intrinsically safe field devices can be installed in Zone 0, 1 or 2, depending on local conditions.

Remote I/O systems with intrinsically safe circuits are generally customer specific designs and this applies not only to the design of the measuring systems but also to the mechanical part of the enclosures or cabinets used. The effort and expenditure required for commissioning and generating the required explosion protection documentation for the user are far simpler, if the manufacturer sup-

plies an interconnected, factory-built remote I/O system which is both tested for function and explosion protection, fully assembled, wired and documented accordingly. This means that installation on the construction site is restricted simply to bus connection and connection of the individual field devices.

This procedure is recommended primarily for installation of the field station in Zone 1 since compliance with the requirements of explosion protection is then largely the responsibility of the manufacturer. Field stations for use in Zone 1 generally use a combination of types of protection, besides Intrinsic safety, 'i', e.g. Increased safety, 'e' and Flameproof enclosure, 'd'. Besides complying with the requirements applicable to the individual pieces of equipment, the manufacturer must also note their interconnection and, if

applicable, requirements resulting from the installation regulations IEC respectively EN 60079-14, and must confirm that they have been complied with in legally binding manner.

Zone 1 field station

Figures 1 and 2 show one example of such a field station for use in Zone 1, which uses various types of protection. The enclosure with type of protection, 'e' contains a terminal incorporating EEx me [ib] technology, operating elements comprising EEx de technology and a remote I/O system incorporating EEx de [ia, ib] technology. The field circuits incorporate type of protection, 'ia' or 'ib' or incorporate EEx de technology (for high-power solenoid valves). In addition, 4-wire transmit-

ters can be supplied by the field station. The output signals can be switched off by a mushroom stop button.

The connection to the control room, i.e. for power supply and the process control system, is made using a so-called hybrid cable. This cable contains lines for the 24 V power supply, the Profibus DP connection for the terminal and a fibre optic link for the remote I/O system. The optical power is limited by special isolating repeaters which also convert to an intrinsically safe Profibus DP or Standard Profibus DP. It is only by correct and compliant interconnection of the individual components that the operator can really make use of the advantages of operating and monitoring systems, operating and indicating elements and remote I/O systems for use on site.

Obligation of the manufacturer

Only suitable, correspondingly certified and marked electrical equipment, which complies with the essential health and safety requirements of the European Directive 94/9/EC may be used in hazardous areas.

The manufacturers of explosion protected electrical equipment must have an appropriate QM system for product tests and inspections during production in accordance with the Directive. The effectiveness and application of this QM system are monitored by notified bodies, which take appropriate measures, e.g. conduct regular audits.

The manufacturer of explosion protected equipment must enclose with his consignment an EC Certificate of Conformity in which he declares that he has complied with all requirements of the EC Directive. The individual piece of equipment must be marked so that the user can find all important information on the nameplate. Figure 3 shows an example of marking of a field station for installation in Zone 1.

Specification of the equipment category allows the operator to see in what zone

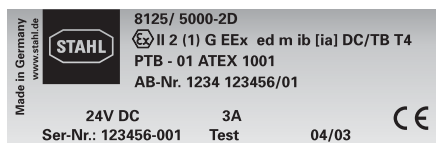


Figure 3: Nameplate of field station 9498

according to the zone classification the field station may be used. The explosion group and temperature class which must be matched to the flammable substances used in the plant section are also important. Complete marking of the remote I/O system by the manufacturer provides the user with a high level of safety for use in hazardous areas and makes his choice easier. It also makes compliance with the regulations for operation as simple as possible.

In addition, the manufacturer must supply operating instructions with his equipment, containing information on safe putting into service, use, assembling and dismantling, maintenance (servicing and emergency repair), installation, adjustment. The operating instructions must allow intended use by the operator and must draw the operator's attention to possible incorrect operation and possible errors to be expected. Information on possible ambient conditions (chemical, thermal, mechanical stress and dust and water protection etc.) must be contained for equipment to be installed outdoors.

Tasks of the user

The new ATEX Directive 1999/92/EC, regarding health and safety protection of workers potentially at risk from explosive atmospheres has now become applicable for users (employers) in hazardous areas since October 2002. This directive contains obligations of the employer relating to health and safety for employees working in hazardous areas. An essential part of this Directive relates to organisational precautions and explosion protection measures.

The employer is obliged to generate and keep up to date an explosion protection docu-

ment or equivalent reports on the assessment of explosion risks.

Assembly and installation of electrical systems in hazardous areas are regulated in Europe by the Installation Standard EN 60079-14, internationally by the identical IEC Standard IEC 60079-14 which guarantees harmonisation worldwide. All information listed in the documentation must be implemented correctly when assembling and installing a system. Use as intended in accordance with the manufacturer's operating instructions must be ensured. If no system certification is available for the remote I/O system specifying the parameters for the complete, intrinsically safe circuits, verifications of intrinsic safety must be calculated for the individual circuits. However, these are restricted to verification of intrinsic safety of the field circuits in a factory-built, installed field station. These circuits are simple intrinsically safe circuits (one source only), easily visible at a glance: 'one associated electrical apparatus' (input or output of the remote I/O system) and one intrinsically safe apparatus (field device). Verification must be provided by comparing the safety values of both devices in a simple way. The manufacturer can include this in his documentation, if he is aware of the data of the connected, intrinsically safe apparatus. This verification must also be provided for the intrinsically safe Profibus.

The shields of modern transmission cables also make special requirements necessary in respect to the quality of the potential equalisation to be implemented. For EMC reasons, these shields must be earthed at each enclosure entry and exit point. In order to achieve this, it is essential that the potential equalisation be designed in accordance with instructions. If the risk assessment analysis establishes that an installation is susceptible to overvoltages caused by lightning or to other overvoltages, it will be necessary to take corresponding precautions in order to avoid possible risks (e.g. use of overvoltage arresters).

Minimum distances must be maintained →

→ between intrinsically safe and non-intrinsically safe circuits. Here as well, manufacturers provide assistance in the form of individual consulting in the planning phase. This allows, in particular, for the special requirements of explosion protection and also avoids incorrect installation approaches in the field stations necessitating subsequent modifications.

Maintenance of the field stations

Maintenance of electrical installations in hazardous plants is regulated by Standard EN 60079-17 respectively the identical IEC Standard. Many diagnostic options on remote I/O systems and field units with type of protection Intrinsic safety ‚i‘ allow the operator to permanently check the function. Faults of components or devices and, frequently, also open circuit or short circuit in the sensor/actuator circuit are displayed on the diagnostic monitor. Failed components may be exchanged only with original parts of the manufacturer by reason of the functions of the devices and the requirements of explosion protection. However, other fault sources such as holes or cracks in the enclosure or damaged gaskets may favour the penetration of moisture or dirt. In such cases, the prescribed operating conditions are no longer complied with. Consequently, the relevant Standard EN 60079-17 requires periodic inspections to ensure regularly that the system is in proper working order or to determine required servicing and repair work.

In the case of remote I/O field stations, this is chiefly restricted to inspection of the interior and proper retightening of the electrical screw connections as and when necessary. Specified torques must be complied with in this case. Gaskets must be replaced if necessary. Further measures are specified in the operating instructions.

If a system is modified or extended, e.g. by replacement or additional installation of type-examined equipment, information must be

procured from the manufacturer in all cases. Here as well, authorised suppliers provide assistance with qualified on-site servicing and support in matters relating to explosion protection. They assist the user on a partnership basis throughout the entire lifecycle of the system and, with their competence and experience, make an important contribution towards prevention of explosions and associated damage to equipment and injury to persons.

Literature

- [1] EN 60079-14 / August 1997
Electrical apparatus for explosive gas atmospheres – Part 14: Electrical installations in hazardous areas (other than mines)
- [2] EN 60079-17 / August 1997
Electrical apparatus for explosive gas atmospheres – Part 17: Inspection and maintenance of electrical installations in hazardous areas (other than mines)