

THE ENGINEERING EQUIPMENT AND MATERIALS USERS ASSOCIATION

A DESIGN GUIDE FOR THE ELECTRICAL SAFETY OF INSTRUMENTS, INSTRUMENT/CONTROL PANELS AND CONTROL SYSTEMS

PUBLICATION No. 178 : 1994

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ISBN 0 85931 080 9

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THE ENGINEERING EQUIPMENT AND MATERIALS USERS ASSOCIATION

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FOREWORD

This document has been prepared following discussion within EEMUA Member Companies and also with added advice from The Health and Safety Executive (HSE). Its content is therefore not only authoritative but has been prepared to assist compliance with existing and pending legislation.

Whilst considerable technical information is available in British, European and International standards and in Trade Association and Manufacturers literature, the incidence of electrical shock, burns and arcing during installation, commissioning, routine maintenance and testing continues. This has suggested that a need exists for a largely non-technical document describing safety considerations for application to the overall design philosophy.

The advice given applies equally to specifiers, designers, builders and installers of electrical instrument and control panels. Whilst its initial concept was to meet requirements for instrument and control purposes the guidance given applies equally from small equipments through to, for example, the control aspects of large motors.

Fundamental principles to be followed at all times are;

- That all instrumentation and control equipment should be installed to facilitate accessibility and maintenance.
- That they should be protected against any external influence to which they may be subjected including electromagnetic interference.
- That the overall integrity of any control system should not be damaged or destroyed as a result of examination, maintenance, authorised alteration or expansion.
- That inappropriate alterations to wiring or to programmes of programmable systems are avoided and that safety functions are preserved.
- Supplementary to the above, but not detailed in this publication, is an inherent requirement to provide effective work instructions and, where necessary, permits to work,

Many of the accidents and injuries ascribed to electrical faults could be eliminated by attention to detail at all stages.

1. SCOPE

The advice given in this design guide is intended to assist not only panel builders, who must satisfy the tightly specified requirements of large companies and utilities, but also those panel builders upon whom the client will rely entirely to produce a panel to meet the end application and which also complies with legislation concerning worker health and safety. Reference is made to The Electricity at Work Regulations 1989 and it is recommended that this document is studied.

This Design guide is concerned solely with means to minimise potential dangers resulting from inadvertent contact with parts which may be live at dangerous voltages. It does not address hazards attributable to any other cause.

This guide is intended to apply to instruments used to measure, indicate, compute, control, record etc, which use electricity and which are suitable for use in process control and similar applications. However, as the requirements are based on the safe use of electricity they will be equally applicable to electrical equipment used for other purposes.

Minimum requirements only are included. Where, for example, live working on voltages above 50/60V 50 Hz or 120V d.c. may be anticipated and be unavoidable additional precautions and equipment will be required. These will include provision and use of insulated tools, special equipment and protective clothing.

The Document covers in 4 chapters:-

- Instruments
- Instrument/Control panels
- Control systems.
- General observations from an inspectors viewpoint and Legal aspects

European Directives including the 'Use of Workplace Equipment Directive' and the 'Safe use of Equipment in Potentially Explosive Atmospheres Directive' place increasing emphasis on the aspect of 'Foreseeable misuse' and attention should also be given to this aspect.

The EMC Directive which was adopted throughout the EC in 1992 and becomes mandatory in 1996 for all new equipment, is based on the need for Electromagnetic Compatibility between electrical and electronic equipments. There is a possibility that, with poorly designed equipment, magnetic radiations from one item could affect the operation of another item. Thus they should neither cause excessive electromagnetic interference or be unduly susceptible to it. Designers should be aware of the regulations and ensure that suitable precautions are taken.

It is not the purpose of this Design Guide to suggest methods which may be used to ensure compliance with the EMC Directive, but designers and users are reminded that they have a Duty to ensure that only approved equipment is used. The safety of persons and plant could be at risk where equipment fails to comply with these regulations.

The employment of 'Competent persons' to undertake work, is a requirement of the Electricity at work Regulations 1989. This requirement for competency should be brought to the attention of all concerned, whether it is with design, manufacture, installation commissioning or any other activity where incompetence could compromise the safety of equipment and personnel.

2. INSTRUMENTS

Instruments are available for many purposes and for use in many industries.

An instrument can vary in complexity from, for example, a simple temperature indicator through to complex instruments including, for example, ones used for product analysis. Single instruments may, in addition to performing a local function, be provided with signal inputs or have signal outputs suitable for interconnection with other equipment. The means for using and providing any such interconnections may require special consideration, particularly where their use in potentially explosive atmospheres may be a requirement.

Essentially an instrument, as covered by this chapter, is a self contained unit which may be site or control room mounted. In the former case it will usually have some form of environmental protection and will have added features to meet essential safety requirements,

Where instruments are under consideration for use in safety related situations, appropriate guidance on this aspect will be found in EEMUA Publication No. 160 'Safety Related Instrument Systems for the Process Industries'

Essential requirements and other relevant information are outlined below.

2.1. Safe working voltages. See also 3.1.

It is generally considered that under normal conditions there will be no adverse shock effects from contact by the body with voltages of 50V ac 50/60 Hz or 120V d.c.¹ Where the location may be very wet only voltages below 25 ac are considered safe.

2.2. Live working

Where it is necessary to carry out adjustments or calibration with the equipment energised, and doors or covers removed to gain access, the equipment should be designed to facilitate or provide good accessibility to those parts which may be worked upon. Internal covers which may need to be removed to gain access should be fitted with captive screws or other captive form of fastener. Any components which may need to be removed should be removable from the front of the apparatus without the need to disturb other components or unrelated wiring. The possibility of inadvertent contact with live parts when removing any items should be considered and appropriate measures taken to ensure safety.

2.3 Enclosure

Equipment should be enclosed to prevent contact with live parts. The enclosure may form an integral part of the instrument or the instrument may be mounted within a separate enclosure. Plant side equipment operating in dusty or damp conditions should have enclosures with appropriate protection, in accordance with British Standard BS EN 60529:1992. against the ingress of particulate matter, including dusts and moisture.

¹See IEE Wiring Regulations 16th edition (BS7671 1992). Reg. 11-3.1 and 411-2 Safe Extra Low voltage (SELV)

The Ingress Protection or IP code is a 2 figure code where the first figure designates the limitation of the ingress of particulate matter and the second digit the ingress of moisture. IP ratings vary from IP 00 which has no protection, through to IP 68 where the 6 indicates dust tight and the 8 indicates suitability for continuous submersion in water to a depth to be specified. IP54 is suggested as a minimum requirement for panels exposed to external influences such as dirt, swarf, coolant splashes, rain showers and similar non corrosive or otherwise damaging forces.

2.4. Access to live parts

Live parts should only be accessible by the removal of doors or covers requiring the use of a key or tools (other than a screwdriver). Where an interlocked isolator is provided and live working is a requirement, a by-pass switch may be provided. The by-pass switch may be incorporated to provide power to certain parts only. It should be accessible only when the doors/covers are removed and it should revert to the off position when the door/cover is closed. Other means for by-passing the interlock may be approved. A label should be fitted to the outside indicating that live parts are exposed when covers are removed.

2.5 Isolation

In all cases it is to be possible to safely isolate the instrument. For preference the instrument should be automatically disconnected when the door is opened or cover removed and reconnection of power should be inhibited with the door open or covers removed. If the isolator is not integral with the instrument a label is to be attached indicating the location of the isolator. 'Isolate elsewhere' is not considered professional or adequate.

2.6. Terminal shrouding and segregation.

Terminals at voltages greater than 50V above earth or between terminals should be shrouded to prevent accidental contact when live. Terminals at voltages above 50V should be segregated from terminals at lower voltages. Terminals may also be grouped for other purpose. For example, input terminals may be grouped separately from output terminals, or terminations may be separated based on an associated multicore cable. Where instruments are purpose built, any such additional segregation should be included in general discussion and in the contract.

2.7. Earth terminal.

Each instrument should be provided with a protective earth terminal adjacent to the mains terminals. The protective earth terminal should be of sufficient capacity to accommodate a conductor equivalent in size to that of the power supply conductor, where this is $\leq 16 \text{ mm}^2$.² See Table 54 G for other sizes.

² IEE Wiring Regulations 16th edition. Reg. 543-4 Table 54 G.