

Specification for

Interface between numerical controls and industrial machines

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- Electrical Research Association*
- Electricity Supply Industry in England and Wales
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- Institution of Electrical Engineers
- Ministry of Defence*
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- Association of Electrical Machinery Trades
- British Electrical Systems Association (BEAMA)
- British Textile Machinery Association
- Control and Automation Manufacturers' Association (BEAMA)
- Health and Safety Executive
- Institution of Production Engineers
- Machine Tool Industry Research Association

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National foreword

This British Standard has been prepared under the direction of the Power Electrical Engineering Standards Committee and is identical with the International Electrotechnical Commission (IEC) Publication 550. It also implements CENELEC Harmonization Document HD 373 issued by the European Committee for Electrotechnical Standardization.

Terminology and conventions. The text of the International Standard has been approved as suitable for publication, without deviation, as a British Standard. Some terminology and certain conventions are not identical with those used in British Standards.

Cross-references

International Standard	Corresponding British Standard
IEC 204-1:1965 } IEC 204-2:1967 }	BS 2771:1974 <i>Electrical equipment of machine tools. General purpose and mass production machines and their electronic equipment</i> (Technically equivalent)
ISO 1056:1975 } ISO 1057:1973 } ISO 1058:1973 } ISO 1059:1973 }	BS 3635 <i>The numerical control of machines</i> Part 1:1972 <i>Control input data</i> (Technically equivalent)

NOTE 1 Clauses 9 and 10 refer to an ISO project which may eventually result in the publication of ISO 4336 “Specification for interface signals between numerical control units and the electrical equipment of an NC machine”. Upon the publication of the ISO standard this British Standard will be reviewed.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 16, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 General

1.1 Scope

This standard applies to the interface between numerical controls (for explanations, see Clause 2) and the electrical equipment of industrial machines which are commanded by numerical controls.

1.2 Object

The purpose of this standard is to provide specifications for an interface between a numerical control and the other electrical equipment associated with the machine with the following objectives:

- a) to ensure the safety of personnel and property;
- b) to standardize all compulsory features (and some others) to the extent necessary for the safe use of equipment from different manufacturers;
- c) to define certain signals going through the interface, to make recommendations for standardizing their electrical characteristics and also to recommend methods of connection and installation.

2 Definitions

2.1

numerical control

the numerical control is the electrical and electronic equipment that receives commands in digital form from perforated tape or other types of input, as well as positional information of certain elements of the machine. The numerical control interprets certain of these numbers as requirements for new positions of the machine elements and gives appropriate commands of direction and velocity. The numerical control also interprets certain other numbers as a command of velocity, of discrete functions, of actions, etc.

2.2 Interface

The interface consists physically of the connections between the numerical control on the one hand and on the other hand the machine and the machine control electrical equipment.

Functional areas of interface

Figure 1, page 12, shows the areas of interface between the numerical control, the machine and the machine control equipment that are defined as “machine/numerical control interface”.

The interface is divided functionally into four groups (or types) of connections (see Figure 1). The composition of the groups does not depend on the arrangement of enclosures; they are valid in both cases, when machine control and motor drives are physically separate, and when either or both are in the enclosure of the numerical control.

2.2.1

Group I — Drive commands

connections commanding velocity or indicating servo error, and connections from the numerical control to motor velocity controls (see Figure 2, page 13)

this group includes in particular the connections to hydraulic servo-valves and to d.c. motors which are used for driving numerically controlled axes or machine spindles. It also includes the connections for velocity commands and outputs to the motors

2.2.2

Group II — Interconnections with measurement systems and measuring transducers

connections for measurement of position on linear and rotary axes and of spindle orientation; also for other measuring transducers associated with the numerical control, such as adaptive control signals. This group includes the connections for associated excitation and supply voltages, also tacho-generator signals when these are connected directly to the numerical control

2.2.3

Group III — Power supply and protective circuit

connections and recommended procedures for connecting the numerical control and the various parts to the protective circuit and to the main power supply system

2.2.4

Group IV — ON/OFF and coded signals

ON/OFF signals, both compulsory and optional, interchanged between the numerical control and the machine (see Figure 3 and Figure 4, pages 14 and 15) and other signals not belonging to Groups I, II and III

3 General requirements for interface connections

3.1 Connection of shielding

The shielding of cables shall be connected to the frame or to the protective circuit at the numerical control. The numerical control builder shall be responsible for these connections or shall indicate exactly their location if they are, as an exception, to be made outside the numerical control.

The user shall not connect the shielding at any other point to any metallic structure, nor by any alternative route to the frame or to the protective circuit, except by agreement of the numerical control builder.

The shielding shall have electrical continuity from the numerical control to the remote termination with the length of unshielded cable connection kept to a minimum.

The shielding shall not be used as a connection nor as a current-carrying element between the devices at each end of the cable.

All shielded cables shall be externally insulated to prevent accidental contact with any other metallic parts. This outer insulation shall either afford mechanical protection of the cable or it shall be additionally covered with a mechanically protective outer layer or layers.

3.2 Routing and spacing of cables

Where conductors from different groups run parallel to each other in the same raceway and also at their points of connection to the numerical control, they shall be separated by a sufficient distance and/or additional shielding shall reduce mutual interference effects to an insignificant level. Alternatively, each group shall have its own shield. It shall be the responsibility of the numerical control builder to give the advice necessary to fulfil this requirement.

The numerical control builder shall advise if it is necessary to group separately and shield the inputs and outputs of the Group IV connections.

In the case of Group II cables, connections to each measuring device shall be shielded separately.

Exceptions to this sub-clause are permitted in relation to connections of Groups I and II when their terminations at the machine are in proximity and they are functionally related and are low level signals. Specific examples are velocity command signals, such as voltage signals to d.c. motor drives and current signals to hydraulic servo-valves. Either of these may be associated with connections to measuring transducers.

3.3 Specification of cables

The numerical control builder shall recommend types of shielded cable suitable for use with the numerical control. These shall have an insulating cover over the shield and have suitable resistance to mechanical damage. Unless otherwise specified, the interior wires shall be in twisted pairs or groups with a recommended pitch of one full turn in 15 mm or less. Insulation and stranding shall be suitable for the purpose and the mechanical duty.

4 Recommendations and requirements for Group I interface

(Velocity command signals, see Figure 2, page 13.)

4.1 Isolation between numerical control and thyristor motor drives

Inside a motor control with thyristors, there shall be no electrically conductive connection between the power circuit of the motor and the numerical control except as specified in Sub-clause 4.2. Connections to the protective conductor shall be in accordance with Sub-clause 6.7.

Connections for the velocity command signals from the numerical control to the thyristor drives for axis motors may or may not comprise a zero-reference potential connection [see Figure 2 b) and Figure 2 a)]. The thyristor drive shall always be insensitive to common-mode inputs between its input terminals and the frame.

Where transistor switching devices are used rather than thyristors, this sub-clause does not apply.