INTERNATIONAL STANDARD

ISO 23570-2

First edition
2005-11-01

Industrial automation systems and integration — Distributed installation in industrial applications —

Part 2: Hybrid communication bus

Systèmes d'automatisation industrielle et intégration — Installation distribuée dans les applications industrielles —

Partie 2: Bus de communication hybride

Reference number
ISO 23570-2:2005(E)

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Published in Switzerland

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 23570-2 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC 1, *Physical device control*.

ISO 23570 consists of the following parts, under the general title *Industrial automation systems and integration — Distributed installation in industrial applications*:

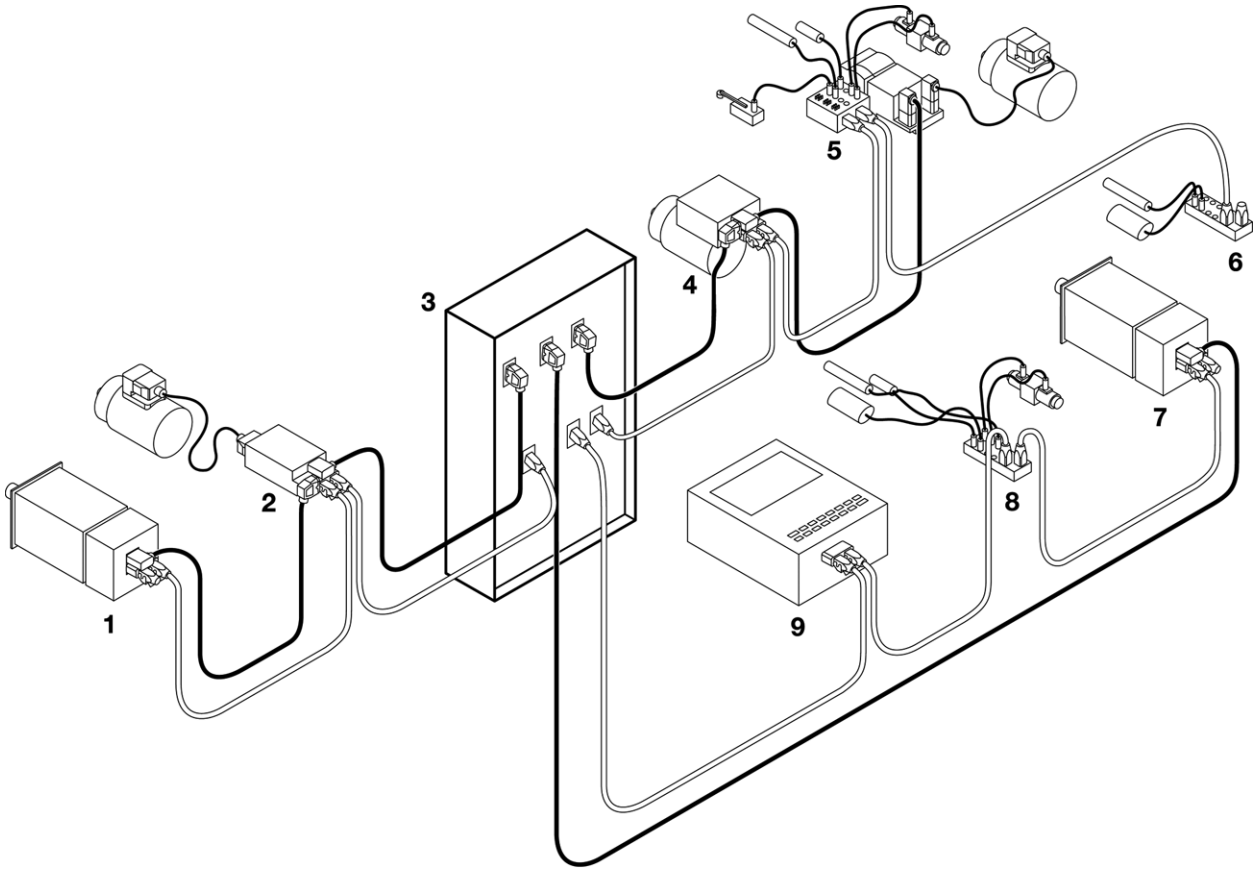
— *Part 1: Sensors and actuators*

— *Part 2: Hybrid communication bus*

— *Part 3: Power distribution bus*

Introduction

Modern machine tools for the discrete parts manufacturing industry are complex systems, consisting of subsystems for material preparation (metal removal, material forming, etc.), material handling, fixturing and transfer lines for moving parts from one station to another. Each subsystem, in turn, is itself a complex system, including many sensors, actuators and control elements that receive and transmit electric signals and/or require electric power. To reduce down time in case of failure, most of them use cable assemblies for quick replacement. Proper operation of the system as a whole requires co-ordination of the subsystems, which requires more cables and connectors. As a consequence of this complexity, a large variety of cables and connectors is required for the proper operation of such a machine tool. The increasing number of sensors, actuators and control elements leads to an increasing variety of such cable assemblies. This variety results in increased maintenance costs, due to complexity, large spare parts inventory and increased training costs for maintenance personnel.



Key

1 motor with integrated electronics (e.g. a stepping motor)
2 fixed speed motor with separate motor controller
3 power distribution and control cabinet
4 fixed speed motor with attached motor controller
5 variable speed motor with integrated I/O module together with sensors and actuators
6 I/O module with a set of sensors
7 motor with integrated electronics (e.g. a stepping motor)
8 I/O module connected to a set of sensors and actuators including a hydraulic/pneumatic valve
9 remote control terminal

Figure 1 — System components addressed in ISO 23570

ISO 23570 prescribes a set of requirements for cables, connectors, and parameter selections within these elements, which, if implemented completely, will greatly reduce the wiring complexity and maintenance cost of such machine systems. Benefits will occur to the manufacturer of such systems in the form of decreased complexity costs and to the user of such systems in the form of decreased down time because of decreased parts inventory and simplified maintenance training.

The technology described in ISO 23570 may have applicability to other industries and processes; there is no intention of restricting it to discrete parts manufacturing.

There are three main areas addressed within ISO 23570:

— the interconnection of sensors and actuators to the system backbone;

— a hybrid system backbone containing an information path (a fieldbus) and a source of power to the field devices;

— a power trunk capable of providing power to all the auxiliary motors in the system.

Large power devices, such as spindle motors for metal removal, are not covered by ISO 23570.

Machine tools described in ISO 23570 are subject to constraints imposed by national and international safety standards. It is the intent of ISO 23570 to specify system elements that support the compliance with such standards.

In Figure 1, the solid cable represents the power distribution bus providing three-phase a.c. power for electric motors. The open cable represents a hybrid communication bus, containing both a fieldbus communication channel and low voltage power.

The centre of Figure 1 shows (3) a control cabinet serving three sets of distribution buses. This box contains the fieldbus communication front end, the low voltage power supplies and the three-phase power supplies.

To the left of the control cabinet are (1) a motor with integrated electronics and (2) a fixed speed motor with a separate motor controller. Both units are linked to the control cabinet by both the communication bus and the power distribution bus.

To the right of the control cabinet are (4) a fixed speed motor with an attached motor controller, (5) a variable speed motor with an integrated I/O module connected to several sensors and actuators, and (6) another I/O module connected to several sensors and actuators, including a hydraulic/pneumatic valve. The I/O module (6) is linked to the control cabinet only by the hybrid communication bus.

In front of the control cabinet are three more units, (7) a motor with integrated electronics, (8) another I/O module connected to several sensors and actuators including a hydraulic/pneumatic valve, and (9) a remote control terminal.

Figure 1 is intended to illustrate the variety of interconnections possible using the elements of ISO 23570.

ISO 23570-1 provides the requirements for sensors, actuators, and I/O modules that support this system requirement. This part of ISO 23570 provides the requirements for a shared communication and low voltage power distribution system. ISO 23570-3 provides the requirements for distribution of power to the low power motor systems.

While significant reduction in maintenance and operational costs may be achieved by adoption of individual parts of ISO 23570, the greatest benefit will occur only if all parts are implemented.

This part of ISO 23570 provides the requirements for a shared communication and low voltage power distribution system that support this system requirement.

Industrial automation systems and integration — Distributed installation in industrial applications —

Part 2:
Hybrid communication bus

1 Scope

This part of ISO 23570 specifies the interconnection of elements in the control system of machine tools and similar large pieces of industrial automation. This specification includes cable types, sizes and sheath colours, connector types and contact assignments, and diagnostic functions appropriate to the sensors and actuators.

This part of ISO 23570 specifies the cabling for fieldbus communications and the distribution of power to the modules on this communications bus.

This part of ISO 23570 does not address operation of such equipment with respect to safety issues. Appropriate safety standards should be consulted for such requirements.

2 Conformance

Producers of modules, connectors, cable and cable assemblies may claim conformance to this part of ISO 23570 if they meet the requirements of Clause 5, including either 5.2 or 5.3.

Producers of discrete part manufacturing equipment may claim conformance to this part of ISO 23570 if all the components of the discrete part manufacturing equipment that are subject to the requirements of Clause 5 meet those requirements consistent with either 5.2 or 5.3.

3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60204-1:2000, Ed. 4.1, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 61076-2-101:2004, *Connectors for electronic equipment — Part 2-101: Circular connectors — Detail specification for circular connectors M8 with screw- or snap-locking, M12 with screw-locking for low voltage applications*

IEC 60529:2001 Ed. 2.0, *Degrees of protection provided by enclosures (IP code)*

IEC 60793-2-40:2002-03, *Optical fibres — Part 2-40: Product specifications — Sectional specification for category A4 multimode fibres*

4 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

4.1
IP Code
coding system to indicate the degrees of protection provided by an enclosure against access to hazardous parts, ingress of solid foreign objects, ingress of water and to give additional information in connection with such protection

[IEC 60529]

4.2
module
network unit capable of communicating on the communication bus

4.3
network unit
unit present on the hybrid communication bus, which draws its power from one of the power circuits in that bus

4.4
M12
connector meeting the requirements of IEC 61076-2-101, whose diameter is 12 mm

4.5
M12×1
M12 connector with a threaded coupling whose threads have a pitch of 1 mm

4.6
POF
plastic optical fibre

4.7
LED
light emitting diode

5 Requirements

5.1 General

This part of ISO 23570 specifies a hybrid cable system capable of supporting fieldbus communications and of supplying auxiliary power to components on the bus. Two approaches to a communication channel are provided, one based on fibre optics and the other based on twisted pair cabling.

This part of ISO 23570 also requires the system to support two independent 24 volt DC supply systems.

NOTE The intention behind specifying these dual power systems is to provide the system designer with a facility by which safety related devices can be switched off independently of one another.

For the purposes of this part of ISO 23570, the two power supplies shall be identified as A and B. Power supply A is the supply that is assumed to be unswitched; power supply B is the supply that is assumed to be switched.

The network topology supported by this part of ISO 23570 is that of a daisy chained multi-drop system. These network elements may be combined into a star topology; however, requirements on star topology networks are outside the scope of this part of ISO 23570.

Each unit on the network shall be equipped with two connectors, one looking upstream to the power supplies, and the other looking downstream.

All components specified by ISO 23570 shall be rated IP65 and IP67 as defined in IEC 60529.

All low voltage control cables that are not otherwise specified in ISO 23570 shall have a sheath colour of grey.

5.2 Fibre optic based systems

5.2.1 Cables and cable assemblies

Each cable shall contain two POF wave-guides, one for transmitting and one for receiving. The fibre optics shall have nominal characteristics as given in IEC 60793-2-40:2002 for fibre type A4.

Each cable shall contain 4 copper wires, whose cross-sectional area is between 1,5 mm^2 and 2,5 mm^2. The cable sheath shall be resistant to all common industrial lubricants and coolants. The supplier of cable assemblies shall provide a list of lubricants and coolants that are compatible with the cable. The sheath colour shall be violet.

NOTE See Annex A for further elaboration of the colour specification.

A network connector meeting the requirements of 5.2.2 shall terminate each end of a cable assembly. One end of the cable assembly shall have male connections for copper circuits; the other end shall have female connections for the copper circuits. The connectors for the fibre optic channels shall be male at both ends of the cable assembly.

Some uses of such cables may require constant flexing such as use in drag chain operations. The cable shall be characterized as to whether it is suitable for such an operation.

5.2.2 Connectors

Connectors shall be polarized so as to avoid incorrect mating.

The contacts for the copper connectors shall have a current carrying capacity of 5 A or greater, per contact.

NOTE Annex B provides further specification for connectors satisfying these requirements.

Contacts 1 to 4 of the connector shall be used to transmit the power supply voltages as specified in Table 1.

Table 1 — Contact assignment for hybrid cable – fibre optic based

Contact	Circuit
Contact 1	Power supply A + 24 Vdc
Contact 2	Power supply A 0 V
Contact 3	Power supply B 0 V
Contact 4	Power supply B + 24 Vdc
Contacts T-R	Fibre optic channels

5.2.3 Network units

Each network unit shall be equipped with two fixed connectors, each meeting the requirements of 5.2.2. One connector shall be male with respect to the copper circuits and the other connector shall be female with respect to the copper circuits. Both connectors shall be female on the fibre optic circuits. Each connector shall carry one receiver and one transmitter as active fibre optic elements.

NOTE The intention is that the network unit will be placed in the hybrid bus so that the power is fed to the male copper circuit connector of the network unit. Strict adherence to the requirements for network units, for cable assemblies, and for power supplies provided in this part of ISO 23570 will ensure that this occurs.

In some applications, it may be required that the network unit be able to be removed from the network for servicing without interrupting the network or power service. To meet this requirement, the network unit shall be composed of two separate components, one that may be removed and one that maintains the network connection. The details of how this is to be accomplished are outside the scope of this part of ISO 23570. Network units shall be characterized as to whether they are suitable for such an operation.

5.2.4 Network termination

The final node in the network shall include a cover on its downstream plug to meet environmental requirements.

5.3 Twisted pair based systems

5.3.1 Cables and cable assemblies

Each cable shall contain a shielded twisted pair of wires for network communication. The wires shall be appropriate for the bus technology being used. Each cable shall contain 4 copper wires whose cross-sectional area is between 1,5 mm^2 and 2,5 mm^2 for carrying power.

The cable sheath shall be resistant to all common industrial lubricants and coolants. The supplier of cable assemblies shall provide a list of lubricants and coolants that are compatible with the cable. The sheath colour shall be violet.

NOTE See Annex A for further elaboration of the colour specification.

A network connector meeting the requirements of 5.3.2 shall terminate each end of a cable assembly. One end of the cable assembly shall have male connections; the other end shall have female connections.

Some uses of such cables may require constant flexing such as use in drag chain operations. The cable shall be characterized as to whether it is suitable for such an operation.

5.3.2 Connectors

The connectors shall have a positive coupling facility requiring either no tools or simple hand tools for closing or opening.

Connectors shall be polarized so as to avoid incorrect mating.

The contacts for the power wires shall have a current carrying capacity of 5 A or greater, per contact.

NOTE 1 Annex C provides further specification for connectors satisfying these requirements.

Contacts 1 to 4 of the connector shall be used to transmit the power supply voltages and contacts A and B shall provide connection to the twisted pair communication wires as specified in Table 2.

A separate contact shall be provided for attachment to the shield of the twisted pair. This contact shall be realized by a metal plate that separates the connector into two compartments, one for power, the other for signal.

NOTE 2 Such a contact is indicated in Figure C.1 by the thickness measure BJ. The corresponding contact in the female connector is shown of dimension CV in Figure C.4, and by the triangular contacts in Figures C.5 and C.6.

Table 2 — Contact assignment for hybrid cable – twisted pair based

Contact	Circuit
Contact 1	Power supply A + 24 Vdc
Contact 2	Power supply A 0 V
Contact 3	Power supply B 0 V
Contact 4	Power supply B + 24 Vdc
Contacts A-B	Shielded twisted pair

5.3.3 Network units

Each network unit shall be equipped with two fixed connectors, each meeting the requirements of 5.2.2. One connector shall be male and the other connector shall be female.

NOTE The intention is that the network unit will be placed in the hybrid bus so that the power is fed to the male copper circuit connector of the network unit. Strict adherence to the requirements for network units, for cable assemblies, and for power supplies provided in this part of ISO 23570 will ensure that this occurs.

In some applications, it may be required that the network unit be able to be removed from the network for servicing without interrupting the network or power service. To meet this requirement, the network unit shall be composed of two separate components, one that may be removed and one that maintains the network connection. The details of how this is to be accomplished are outside the scope of this part of ISO 23570. Network units shall be characterized as to whether they are suitable for such operation.

5.3.4 Network termination

The final node in the network shall include a network terminator on its downstream plug appropriate for the bus technology being used.

5.4 Module

5.4.1 General

Each module shall include two connectors conforming to either 5.2 or 5.3 as appropriate.

EXAMPLE Modules include I/O modules that interface sensors and actuators on the fieldbus. Modules also include motor controllers and other auxiliary equipment capable of communicating on a fieldbus.

Each module shall derive the power for its own operation from power supply A.

Each module shall be equipped with an M12×1 8-contact female connector compatible with the M12×1 8-contact male connector specified in IEC 61076-2-101:2004, which shall be used to specify 7 bits of the module's address on the fieldbus.

5.4.2 Address plugs

To provide transparency in addressing modules on the fieldbus, this part of ISO 23570 requires the use of programmable plugs to identify modules specified in 5.4.

The plug shall consist of an M12×1 8-contact male connector as specified in IEC 61076-2-101:2004 and a means to tie contacts to earth. For each bit selected, the corresponding contact (1-7) of the plug shall be tied to earth, contact 8. Contact 1 shall correspond to the least significant bit (LSB) of the address; contact 7 shall correspond to the most significant bit (MSB). A circuit tied to earth shall be interpreted as a one; an open circuit shall be interpreted as a zero.

An address plug shall have a mounting ring so that it may be permanently attached to the system component, (not the module) that it identifies.

NOTE The intent is to provide a facility by which the fieldbus identity of system components (as illustrated in Figure 1) may be maintained even though the module that provides the interface to the machine needs to be replaced due to servicing.

5.4.3 I/O modules

I/O modules are modules that provide network interface to sensors and actuators. The general requirements on sensors and actuators are provided in ISO 23570-1. This part of ISO 23570 provides requirements on I/O modules with respect to these sensors and actuators.

Each sensor/actuator channel shall be assigned a channel number. The numbering shall begin at 1. Depending on the fieldbus technology used, this channel number may be part of the fieldbus address of the sensor/actuator.

Each sensor/actuator whose channel number is odd shall be provided with power from the B power supply (i.e. contacts 3 and 4 on the network cable assembly). Each sensor/actuator whose channel number is even shall be provided with power from the A power supply (i.e. contacts 1 and 2 on the network cable assembly).

The I/O module shall contain 4 LEDs indicating the state of the system. The conditions and colours of these LEDs are given in Table 3.The module shall contain identification for these LEDs.

NOTE The LEDs indicated in Table 3 are in addition to the LEDs required for the channel status as prescribed in ISO 23570-1.

Table 3 — I/O module operating indicators

LED	Indication	Condition
First LED	Green	Power supply A is on
	Dark	Power supply A is off
Second LED	Green	Power supply B is on
	Dark	Power supply B is off
Third LED	Red	Module error
	Dark	Module OK
Fourth LED	Green	Communication bus operation OK
	Dark	Communication bus failure

5.5 Power supplies

Power supplies used in this application shall comply with the requirements for PELV (protective extra low voltage) as prescribed in 6.4 of IEC 60204-1:2000. The rated value of the power supplies shall be 24 Vdc with tolerance of − 15 % and + 20 %. The ripple shall be less than 5 %.

The power supply shall provide power output on a female fixed type connector as specified in 5.2.

Annex A
(informative)

Reference colours

In order to make the colour requirement precise, the following reference values for colours are provided.

Table C.1 — Colour reference[1)]

Colour	RAL code	CMYK[a] %
Orange	RAL 2003	0,52,100,0
Green	RAL 6018	70,0,90,0
Violet	RAL 4001	60,70,5,10
Yellow	RAL 1021	0,10,100,0
Black	RAL 9005	100,100,100,95
Grey	RAL 7040	20,5,10,40

[a] Cyan, magenta, yellow and black.

1) RAL colours defined and maintained for worldwide use by: RAL Deutsches Institut für Gütesicherung und Kennzeichnung e.V.

Annex B
(normative)

Design specification for fibre optic hybrid connectors

B.1 Fibre optic hybrid cable connector

B.1.1 General

All fibre optic hybrid cable connectors have male connections for the fibre optic paths. The connectors have either male or female connections for the power circuits. The terms male and female in B.1.2 and B.1.3 refer to the power circuits.

B.1.2 Male fibre optic cable connector

Figure B.1 provides a drawing of the male connector. The two optical wave guides are at the bottom of the drawing. The centre contact in the upper half of the connector is not used. The other four contacts provide the power supply circuits.

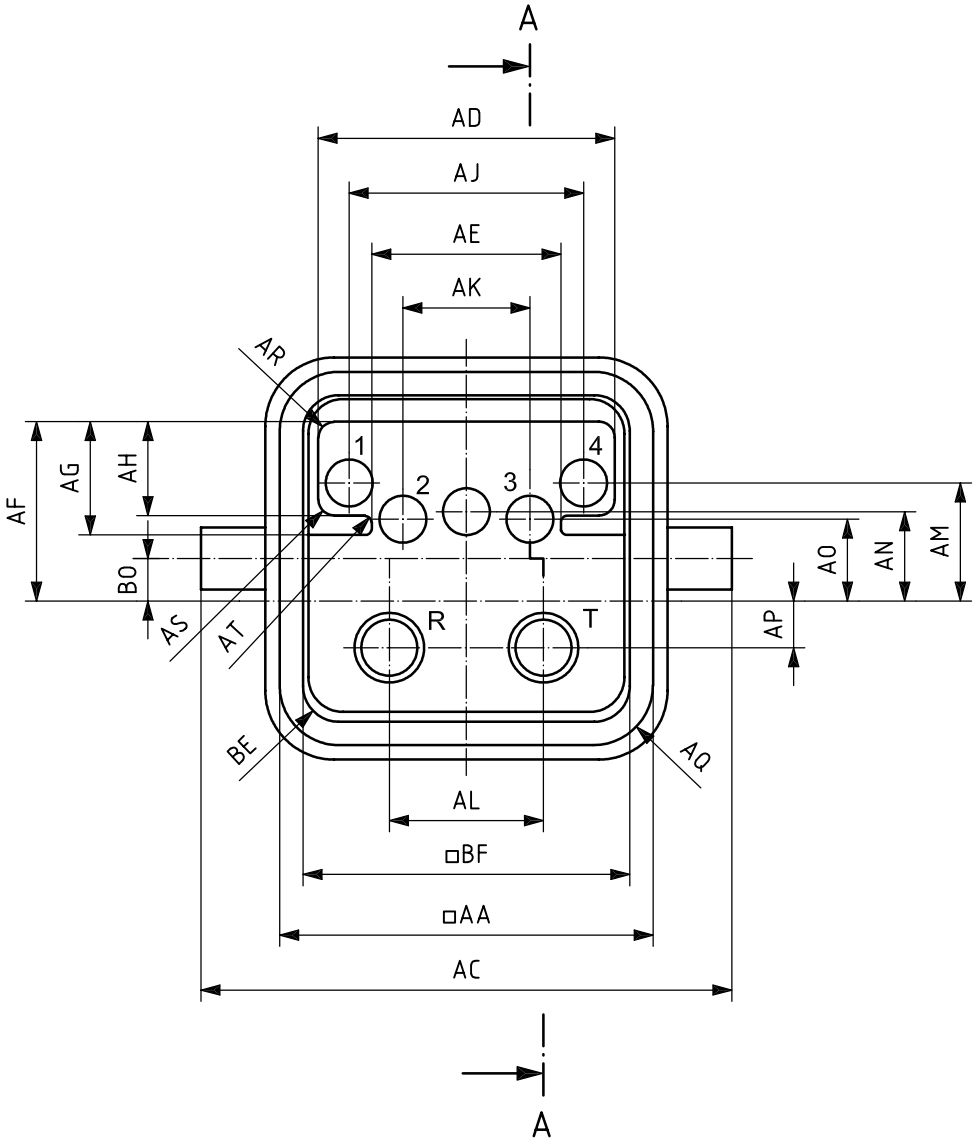


Figure B.1 — Male fibre optic cable connector

Figure B.2 shows a side view of the connector through section A-A. Note that this section has an offset so as to pass through contact 3 and through the T wave guide.

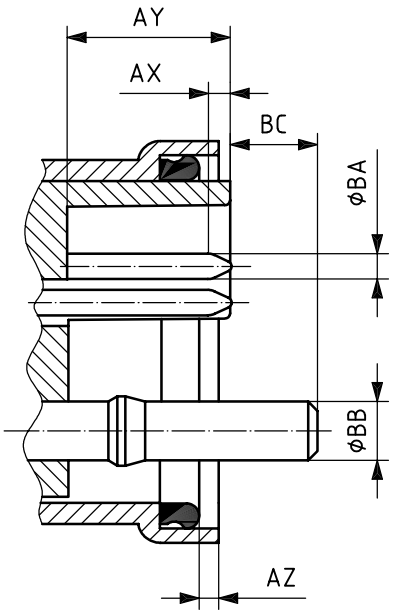


Figure B.2 — Male connector section through A-A

Figure B.3 shows a side view of the housing of the male connector.

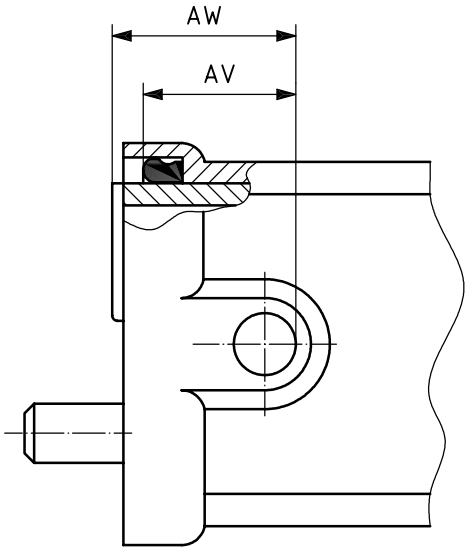


Figure B.3 — Male connector side view

Dimensions for this connector are given in Table B.1. All dimensions are in millimetres unless otherwise indicated.

NOTE This part of ISO 23570 specifies only those dimensions necessary to achieve the objectives of the standard. Hence, some entries are not present. An actual implementation will need to specify all the dimensions.

Table B.1 — Dimensions of male fibre optic cable connector

Letter	Max.	Min.	Nom.
AA		24,6	
AC	35,2		
AD	19,8	19,5	19,7
AE	12,7	12,5	12,6
AF	12,05	11,85	11,9
AG	7,5	7,4	7,5
AH	6,4	6,3	6,3
AJ	15,6	15,4	15,5
AK	8,5	8,3	8,4
AL	10,3	10,1	10,2
AM	7,9	7,7	7,8
AN	6,0	5,8	5,9
AO	5,5	5,3	5,4
AP	3,2	3,0	3,1
AQ	4,1		

Letter	Max.	Min.	Nom.
AR	1,1	0,9	1,1
AS	1,1	0,9	1,1
AT	0,6	0,4	0,4
AV	10,3	9,7	10,0
AW	12,35	11,75	12,0
AX	1,6		
AY		10,7	
AZ		0,5	
BA	1,62	1,54	1,6
BB	3,85	3,75	3,8
BC	5,8	5,5	5,65
BD	3,0	2,6	2,8
BE	2,6		
BF		21,2	

B.1.3 Female fibre optic cable connector

Figure B.4 provides a drawing of the female connector. The two optical wave guides are at the bottom of the drawing. The centre contact in the upper half of the connector is not used. The other four contacts provide the power supply circuits.

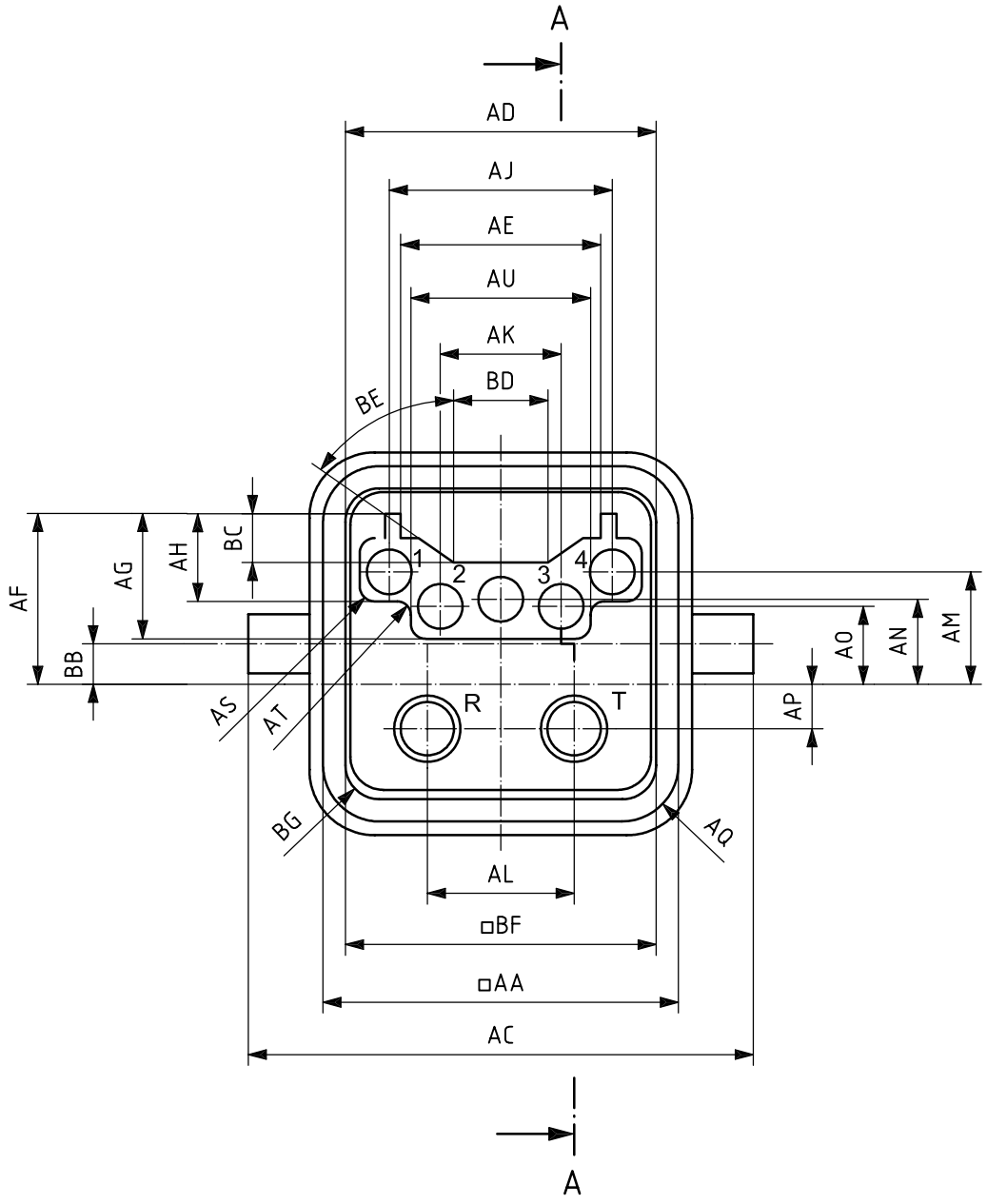


Figure B.4 — Female fibre optic cable connector

Figure B.5 shows a side view of the connector through section A-A. Note that this section has an offset so as to pass through contact 3 and through the T wave guide.

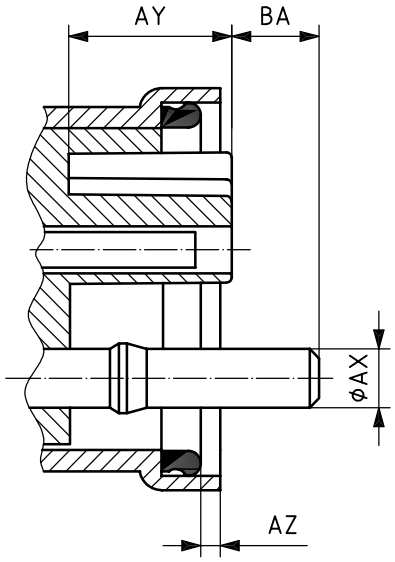


Figure B.5 — Female connector section through A-A

Figure B.6 shows a side view of the housing of the female connector.

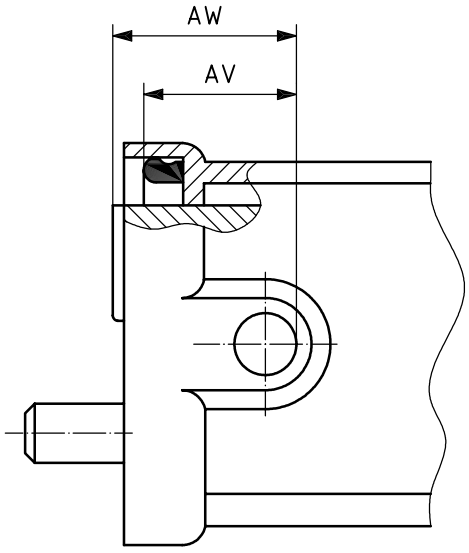


Figure B.6 — Female connector side view

Dimensions for this connector are given in Table B.2. All dimensions are in millimetres unless otherwise indicated.

NOTE This part of ISO 23570 specifies only those dimensions necessary to achieve the objectives of the standard. Hence, some entries are not present. An actual implementation will need to specify all the dimensions.

Table B.2 — Dimensions of female fibre optic cable connector

Letter	Max.	Min.	Nom.
AA		24,6	
AC	35,2		
AD	19,4	19,1	19,4
AE	14,1	13,9	14,0
AF	11,85	11,65	11,8
AG	8,6		
AH	6,0	5,9	6,0
AJ	15,6	15,4	15,5
AK	8,5	8,3	8,4
AL	10,3	10,1	10,2
AM	7,9	7,7	7,8
AN	6,0	5,8	5,9
AO	5,5	5,3	5,4
AP	3,2	3,0	3,1
AQ	4,1		

Letter	Max.	Min.	Nom.
AS	1,0	0,8	1,0
AT	1,0		
AU	12,4	12,2	12,4
AV	10,3	9,7	10,0
AW	11,9	11,5	11,8
AX	3,85	3,75	3,8
AY		10,3	
AZ		0,5	
BA	6,1	5,8	5,95
BB	3,0	2,6	2,8
BC	3,6	3,2	3,4
BD	6,8	6,3	6,5
BE	56°	54°	55°
BF		21,2	
BG	2,6		

B.2 Fibre optic hybrid fixed connector

B.2.1 General

Fixed connectors are used for mounting on network units. All fibre optic hybrid fixed connectors have female connections for the fibre optic paths. The connectors have either male or female connections for the power circuits. The terms male and female in B.2.2 and B.2.3 refer to the power circuits.

Fixed connectors also contain active transmitter and receiver units for the fibre optic signal.

B.2.2 Male fibre optic fixed connector

Figure B.7 provides a drawing of the male connector. The two optical wave guides are at the bottom of the drawing. The centre contact in the upper half of the connector is not used. The other four contacts provide the power supply circuits.

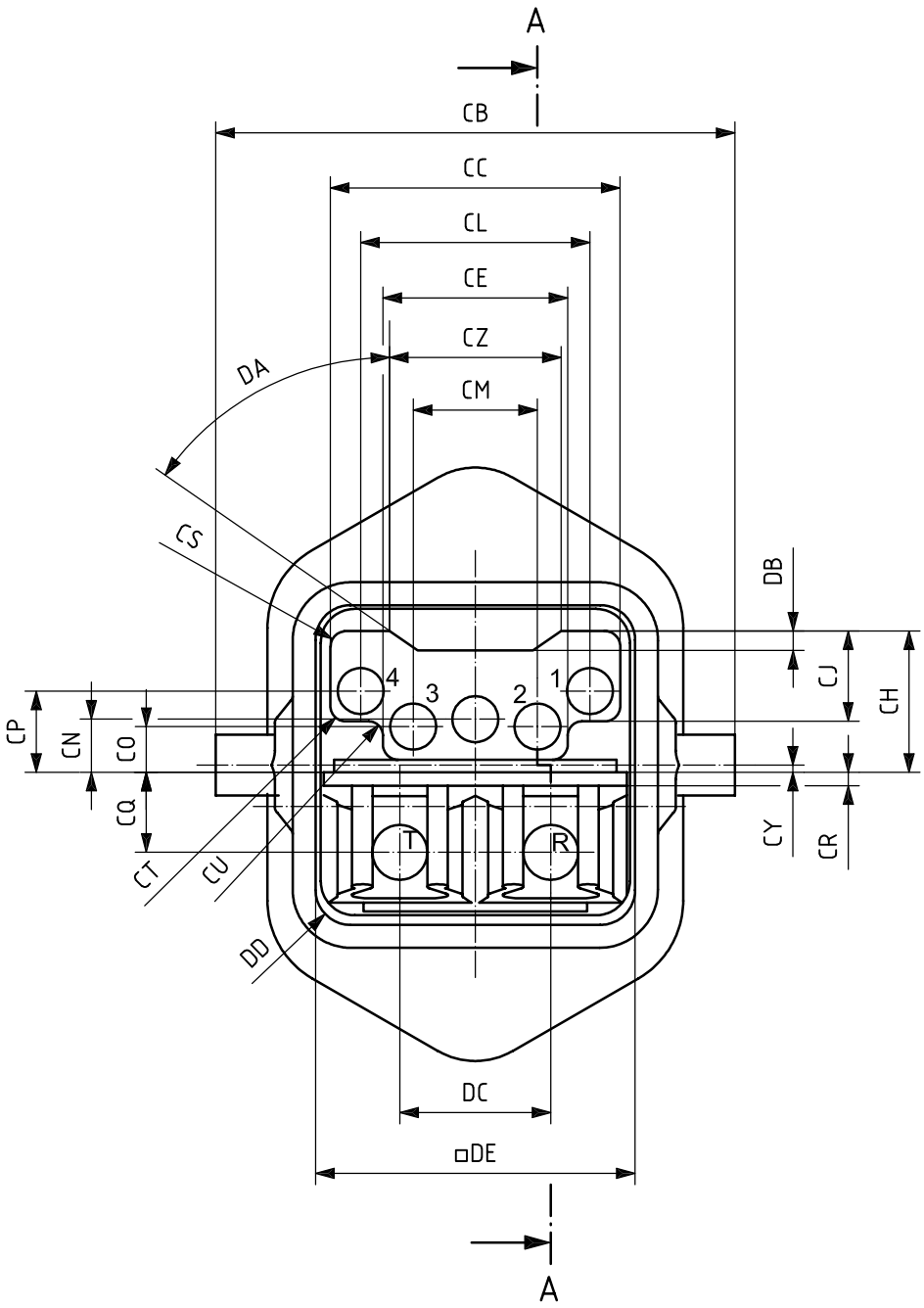


Figure B.7 — Male fibre optic fixed connector

Figure B.8 shows a side view of the connector through section A-A. Note that this section has an offset so as to pass through contact 2 and through the R wave guide.

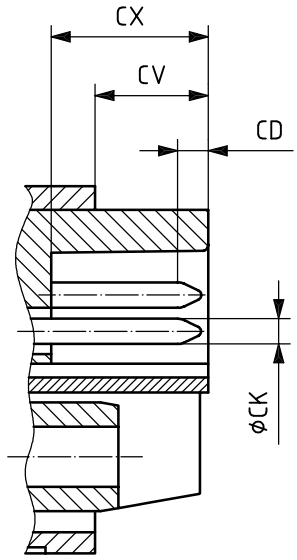


Figure B.8 — Male connector section through A-A

Figure B.9 shows a side view of the housing of the male connector.

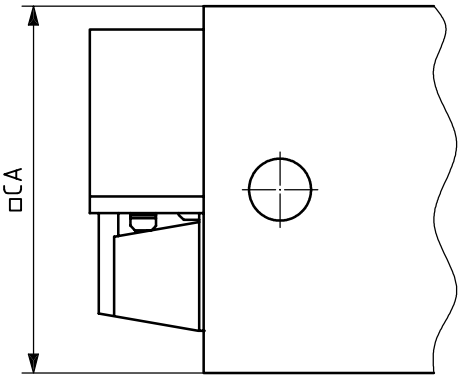


Figure B.9 — Male connector side view

Dimensions for this connector are given in Table B.3. All dimensions are in millimetres unless otherwise indicated.

NOTE This part of ISO 23570 specifies only those dimensions necessary to achieve the objectives of the standard. Hence, some entries are not present. An actual implementation will need to specify all the dimensions.

Table B.3 — Dimensions of male fibre optic fixed connector

Letter	Max.	Min.	Nom.
CA	24,2	23,7	
CB	35,2		
CC	19,8	19,5	19,7
CD	1,9		
CE	12,7	12,6	12,6
CH	9,55	9,45	9,55
CJ	6,4	6,3	6,3
CK	1,62	1,54	1,60
CL	15,6	15,4	15,5
CM	8,5	8,3	8,4
CN	3,6	3,4	3,5
CO	3,1	2,9	3,0
CP	5,5	5,3	5,4
CQ	5,85	4,85	5,5

Letter	Max.	Min.	Nom.
CR	1,1	0,9	1,0
CS	1,1	0,9	1,1
CT	1,1	0,9	1,1
CU	1,1	0,9	0,9
CV	7,6	7,3	7,55
CX		10,4	
CY	0,6	0,2	0,4
CZ	12,0	11,0	11,5
DA	46°	44°	45°
DB	2,1	1,7	1,9
DC	10,3	10,1	10,2
DD	2,6		
DE		21,2	

B.2.3 Female fibre optic fixed connector

Figure B.10 provides a drawing of the female connector. The two optical wave guides are at the bottom of the drawing. The centre contact in the upper half of the connector is not used. The other four contacts provide the power supply circuits.

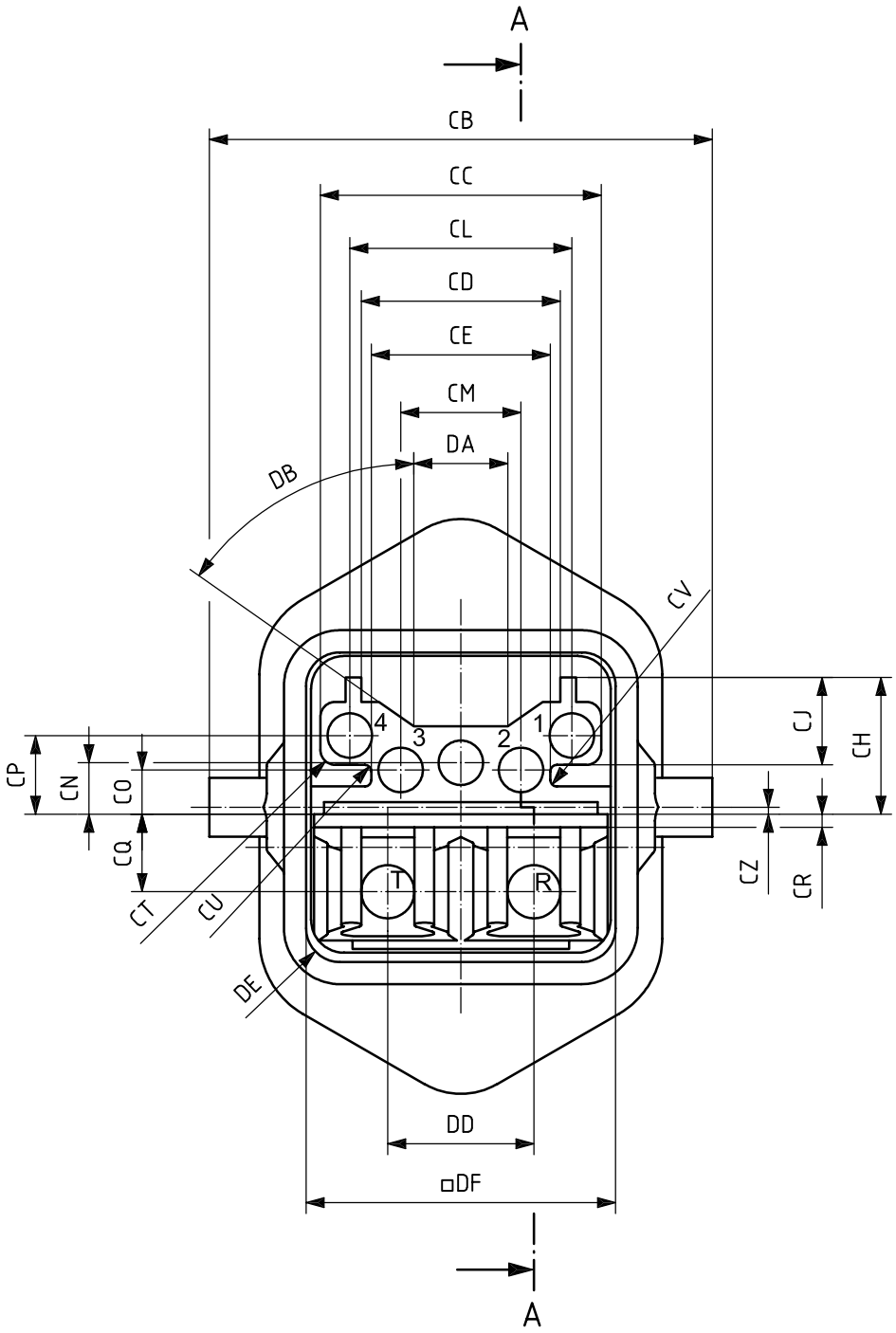


Figure B.10 — Female fibre optic fixed connector

Figure B.11 shows a side view of the connector through section A-A. Note that this section has an offset so as to pass through contact 2 and through the R wave guide.

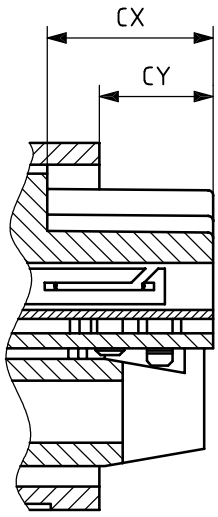


Figure B.11 — Female connector section through A-A

Figure B.12 shows a side view of the housing of the female connector.

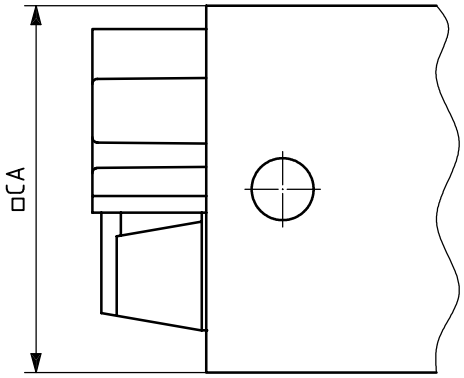


Figure B.12 — Female connector side view

Dimensions for this connector are given in Table B.4. All dimensions are in millimetres unless otherwise indicated.

NOTE This part of ISO 23570 specifies only those dimensions necessary to achieve the objectives of the standard. Hence, some entries are not present. An actual implementation will need to specify all the dimensions.

Table B.4 — Dimensions of female fibre optic fixed connector

Letter	Max.	Min.	Nom.
CA	24,2	23,7	
CB	35,2		
CC	19,4	19,1	19,4
CD	14,1	13,9	14,0
CE	12,4	12,2	12,4
CH	9,55	9,35	9,45
CJ	6,0	5,9	6,0
CL	15,6	15,4	15,5
CM	8,5	8,3	8,4
CN	3,6	3,4	3,5
CO	3,1	2,9	3,0
CP	5,5	5,3	5,4
CQ	5,85	4,85	5,5

Letter	Max.	Min.	Nom.
CR	1,1	0,9	1,0
CT	1,2	1,0	1,0
CU	0,5	0,3	0,5
CV	0,5	0,3	0,5
CX		10,77	
CY	7,6	7,3	7,55
CZ	0,6	0,2	0,4
DA	6,7	6,3	6,5
DB	56°	54°	55°
DC	3,6	3,2	3,4
DD	10,3	10,1	10,2
DE	2,6		
DF		21,2	

Annex C
(normative)

Design specification for twisted pair connectors

C.1 Male twisted pair cable connector

Figure C.1 provides a drawing of the male connector. The two contacts at the bottom of the figure, contacts 5 and 6, carry the communication signal on a twisted pair. The centre contact in the upper half of the connector is not used. The other four contacts provide the power supply circuits.

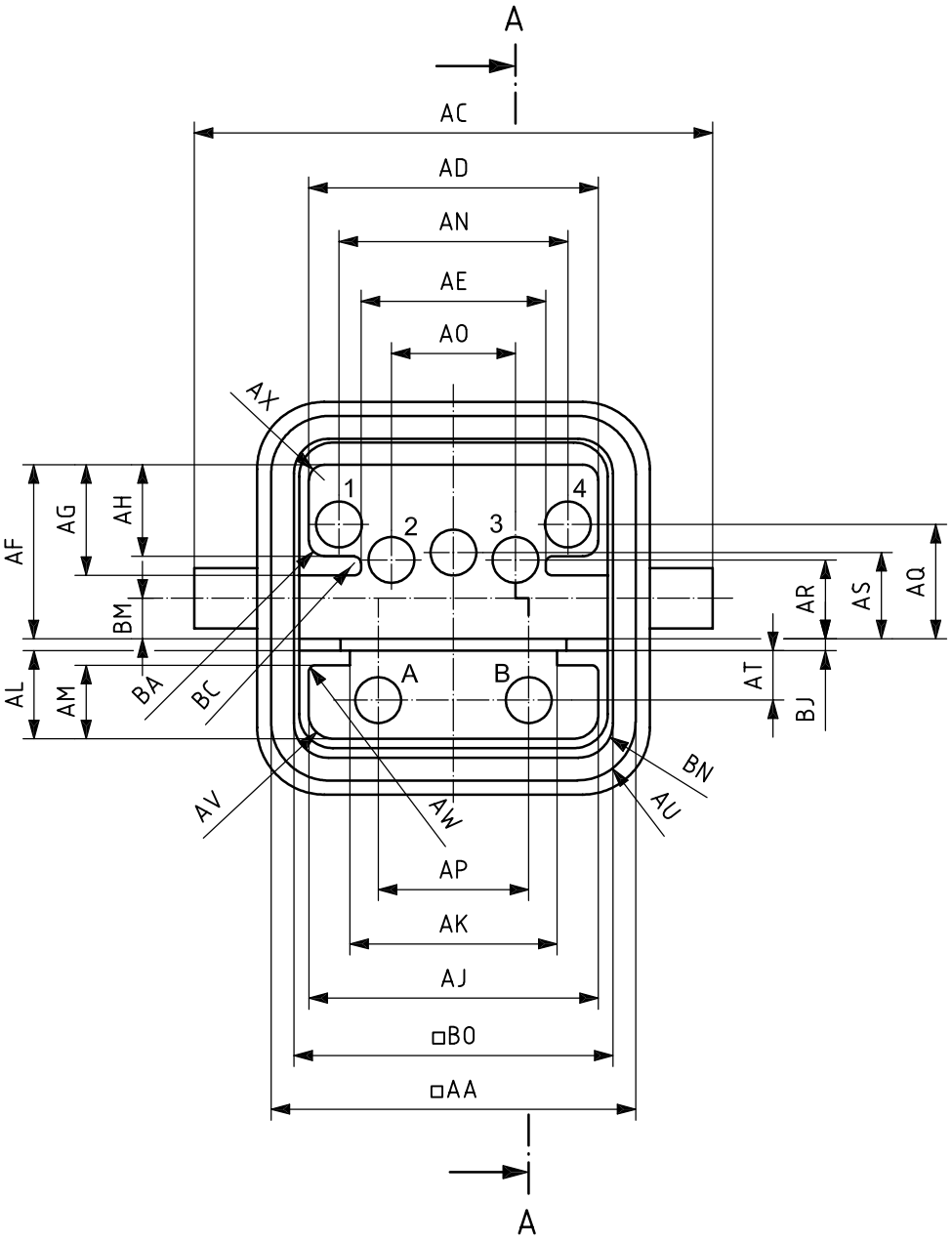
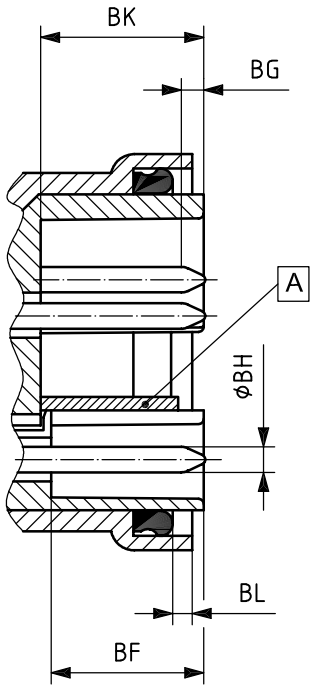


Figure C.1 — Male twisted pair cable connector

Figure C.2 shows a side view of the connector through section A-A. Note that this section has an offset so as to pass through contact 3 and through contact B.



NOTE The metal plate marked A provides shielding between the communication terminals and the power terminals.

Figure C.2 — Male connector section through A-A

Figure C.3 shows a side view of the housing of the male connector.

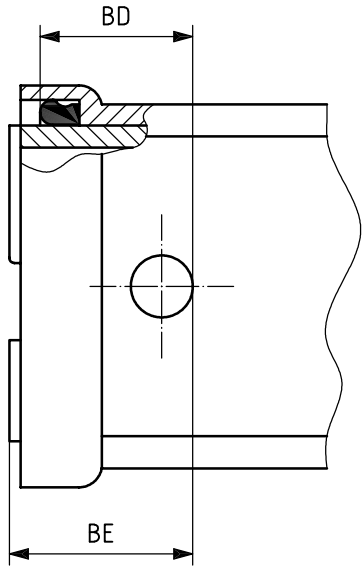


Figure C.3 — Male connector side view

Dimensions for this connector are given in Table C.1. All dimensions are in millimetres unless otherwise indicated.

NOTE This part of ISO 23570 specifies only those dimensions necessary to achieve the objectives of the standard. Hence, some entries are not present. An actual implementation will need to specify all the dimensions.

Table C.1 — Dimensions of male twisted pair cable connector

Letter	Max.	Min.	Nom.
AA		24,6	
AC	35,2		
AD	19,8	19,5	19,7
AE	12,7	12,5	12,6
AF	12,05	11,85	11,9
AG	7,5	7,4	7,5
AH	6,4	6,3	6,3
AJ	19,8	19,7	19,7
AK	14,2	14,0	14,1
AL	6,05	5,95	5,95
AM	5,15	5,05	5,05
AN	15,6	15,4	15,5
AO	8,5	8,3	8,4
AP	10,3	10,1	10,2
AQ	7,9	7,7	7,8
AR	5,5	5,3	5,4
AS	6,0	5,8	5,9
AT	3,35	3,0	3,05

Letter	Max.	Min.	Nom.
AU	4,1		
AV	1,7	1,5	1,7
AW	0,5	0,3	0,5
AX	1,1	0,9	1,1
BA	1,1	0,9	1,1
BC	0,6	0,4	0,4
BD	10,3	9,7	10,0
BE	12,35	11,75	12,0
BF		10,0	
BG	1,6		
BH	1,62	1,54	1,6
BJ	0,85	0,75	0,8
BK		10,7	
BL		0,5	
BM	3,0	2,6	2,8
BN	2,6		
BO		21,2	

C.2 Female twisted pair fixed connector

Figure C.4 provides a drawing of the female connector. The two contacts at the bottom of the figure, contacts 5 and 6, carry the communication signal on a twisted pair. The centre contact in the upper half of the connector is not used. The other four contacts provide the power supply circuits.

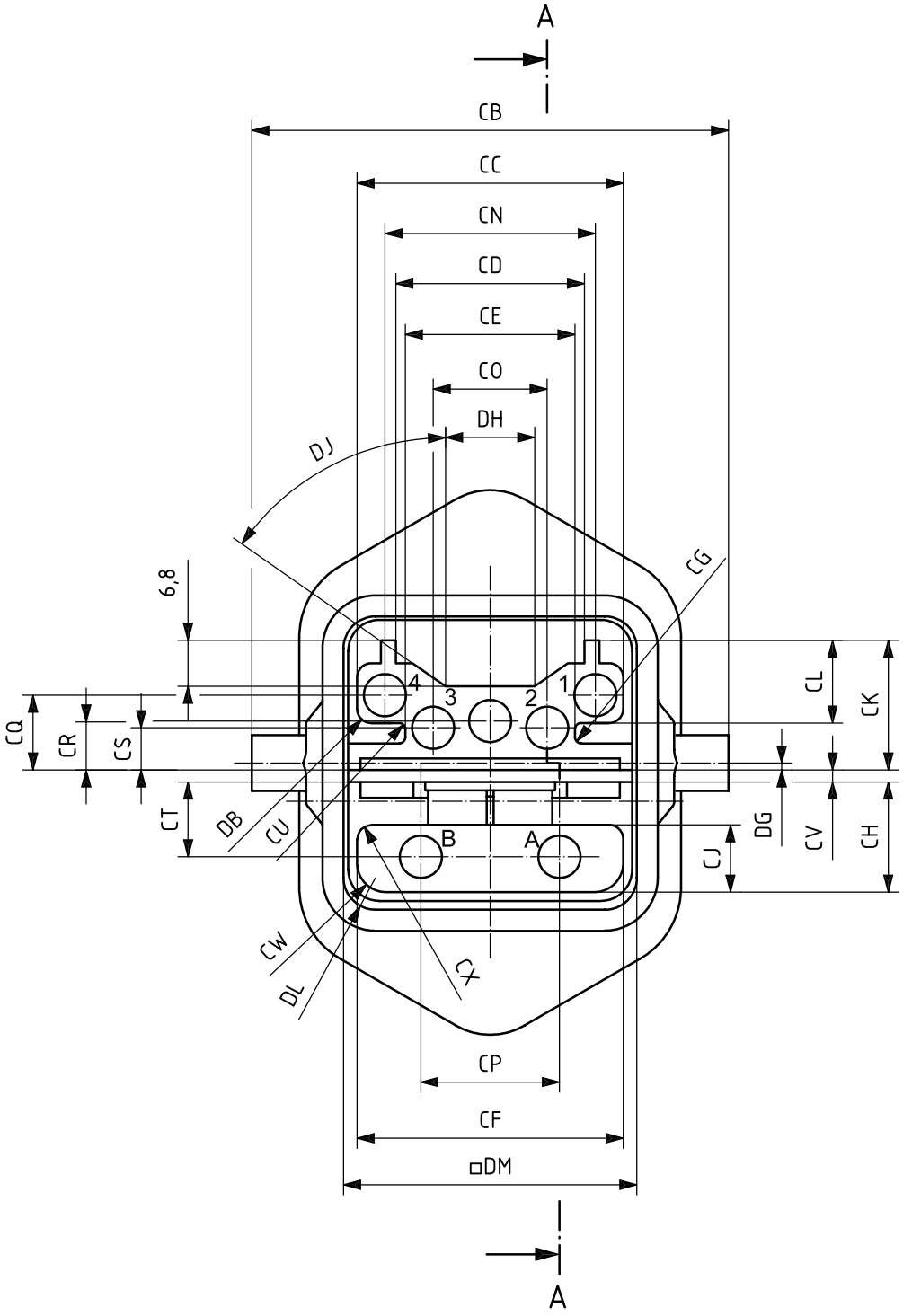


Figure C.4 — Female twisted pair fixed connector

Figure C.5 shows a side view of the connector through section A-A. Note that this section has an offset so as to pass through contact 2 and contact A.

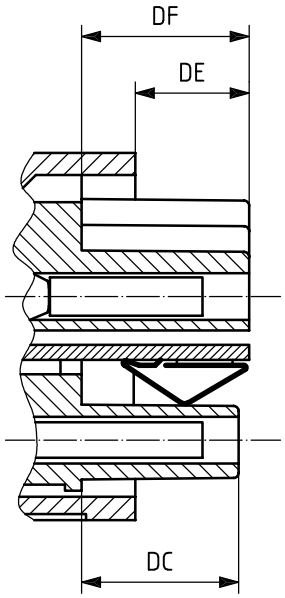


Figure C.5 — Female connector section through A-A

Figure C.6 shows a side view of the housing of the female connector.

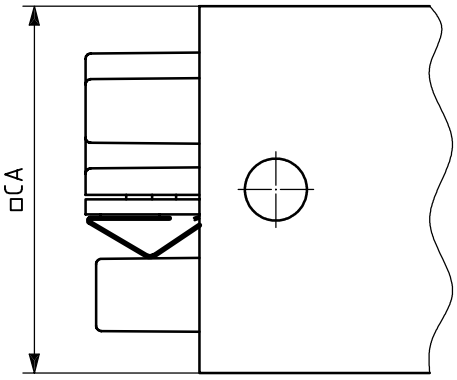


Figure C.6 — Female connector side view

Dimensions for this connector are given in Table C.2. All dimensions are in millimetres unless otherwise indicated.

NOTE This part of ISO 23570 specifies only those dimensions necessary to achieve the objectives of the standard. Hence, some entries are not present. An actual implementation will need to specify all the dimensions.

Table C.2 — Dimensions of female twisted pair fixed connector

Letter	Max.	Min.	Nom.
CA	24,2	23,7	
CB	35,2		
CC	19,4	19,1	19,4
CD	14,1	13,9	14,0
CE	12,4	12,2	12,4
CF	19,4	19,1	19,4
CG	0,5	0,3	0,5
CH	7,8	7,7	7,8
CJ	4,85	4,75	4,85
CK	9,55	9,35	9,45
CL	6,0	5,9	6,0
CN	15,6	15,4	15,5
CO	8,5	8,3	8,4
CP	10,3	10,1	10,2
CQ	5,5	5,3	5,4
CR	3,6	3,4	3,5

Letter	Max.	Min.	Nom.
CS	3,1	2,9	3,0
CT	5,3	5,2	5,25
CU	0,5	0,3	0,5
CV	1,1	0,9	1,0
CW	2,2	2,0	2,1
CX	1,1	0,9	0,9
DB	1,2	1,0	1,0
DC		10,3	
DE	7,6	7,3	7,55
DF		10,77	
DG	0,6	0,2	0,4
DH	6,7	6,3	6,5
DJ	56°	54°	55°
DK	3,6	3,2	3,4
DL	2,6		
DM		21,2	

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