SMPTE 304-2009
Revision of
SMPTE 304M-2003

SMPTE STANDARD

Television — Broadcast Cameras — Hybrid Electrical and Fiber-Optic Connector

Table of Contents

Approved
June 4, 2009

Foreword

SMPTE (the Society of Motion Picture and Television Engineers) is an internationally-recognized standards developing organization. Headquartered and incorporated in the United States of America, SMPTE has members in over 80 countries on six continents. SMPTE's Engineering Documents, including Standards, Recommended Practices and Engineering Guidelines, are prepared by SMPTE's Technology Committees. Participation in these Committees is open to all with a bona fide interest in their work. SMPTE cooperates closely with other standards-developing organizations, including ISO, IEC and ITU.

SMPTE Engineering Documents are drafted in accordance with the rules given in Part XIII of its Administrative Practices.

SMPTE Standard 304 was prepared by Technology Committees S22 and 32NF.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Standard. However, attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. SMPTE shall not be held responsible for identifying any or all such patent rights.

Introduction

This section is entirely informative and does not form an integral part of this Engineering Document.

The product described within this updated version of the standard is fully backward compatible with all products that complied with previous versions of the Standard.

1 Scope

This standard defines a connector primarily intended for use in television broadcasting and video equipment, such as camera head to camera control-unit connections. It defines hybrid connectors, which contain a combination of electrical contacts and fiber-optic contacts for single-mode fibers. It also contains dimensional tolerances which ensure nondestructive mating of the electrical and optical interfaces, and functional operability of the electrical interface. Functional operability of the optical interface is dependent upon fiber preparation and termination and is, therefore, not guaranteed by this standard.

The connector described in this standard is intended for use primarily with the hybrid fiber optic camera cable described in SMPTE 311; however, this connector may be used independently to meet other requirements.

2 Conformance Notation

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative" or individual paragraphs that start with "Note:"

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword “reserved” indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword “forbidden” indicates “reserved” and in addition indicates that the provision will never be defined in the future.

A conformant implementation according to this document is one that includes all mandatory provisions ("shall") and, if implemented, all recommended provisions ("should") as described. A conformant implementation need not implement optional provisions ("may") and need not implement them as described.

3 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

SMPTE 311-2009, Television — Hybrid Electrical and Fiber-Optic Camera Cable

IEC 60950-1 (2005-12), Information Technology Equipment — Safety — Part 1: General Requirements

4 Connector Specifications

4.1 Structural Requirements

The connector system shall consist of a plug-and-jack arrangement. It shall feature a push-pull quick connect/disconnect coupling mechanism. The plug shall be identified by a color-code marking.

Each connector shall contain two keyed fiber-optic contacts, with cylindrical spherical butting ferrules. The ferrules shall be ceramic and the optical alignment mechanism shall be a ceramic split sleeve contained in the contacts on the plug. Appropriate dust caps for all connector configurations shall be used as protection against contamination during unmated situations.

4.2 Contact Requirements

The connectors shall house two fiber-optic contacts, two auxiliary electrical contacts, and two low-voltage contacts.

4.3 Classifications

Connectors covered by this part shall be classified as:

- Name: Hybrid connectors
- Coupling: Push pull
- Configurations:
    - Cable plug (to mate with connector on camera) color coded for identification;
    - Cable jack (to mate with base station);
    - Jack, panel mount (installed on camera);
    - Plug, panel mount (installed on base station).
    - Cable Jack, panel mount(installed on patch panels)
    - Cable plug , panel mount (installed on studio wall boxes / OB vans)

Note: Other styles of connector with other back-end mounting arrangements are available and are fully intermateable with the variants above**.**

4.4 Field Serviceability

The connectors shall be designed to permit field termination, replacement, and repair by trained personnel, using assembly instructions supplied by the connector manufacturer, and with the appropriate tooling.

5 Mechanical Interface Dimensions

5.1 Mating Interface Dimensions

The mating interface dimensions for each connector configuration (plug and jack) shall be in accordance with Figures 1 and 2 and Tables 1 and 2. All dimensions are metric.

5.2 Shell Keying and Color Coding

The connectors shall have polarization keys in accordance with Figures 3 and 4 and Tables 3 and 4. The shells shall have a red color coding.

5.3 Contact Arrangements

The contacts shall be located in accordance with Figure 7.

6 Performance

The connectors shall meet the following minimum requirements:

- Optical:
  - Wavelength: 1250 nm – 1625nm
  - Insertion loss: 0.5 dB maximum
  - Return loss: Better than – 45 dB

Note: Prior versions of this standard specified wavelengths down to 1100nm.

- Electrical:
  - Auxiliary electrical contacts:
    - Voltage: 600 V ac
    - Current: 10 A
  - Low-voltage contacts:
    - Voltage: 42 V ac or 60 V dc
    - Current: 1 A
  - Environmental:
    - Temperature: –40°C to +75°C
    - Humidity: 0 % to 95% RH (at +40°C)

Note: The degree of waterproofing is left for manufacturing implementation.

7 Safety

The design of the connectors shall meet the requirements of IEC-60950-1, 2nd edition, Information Technology Equipment — Safety — Part 1: General Requirements.

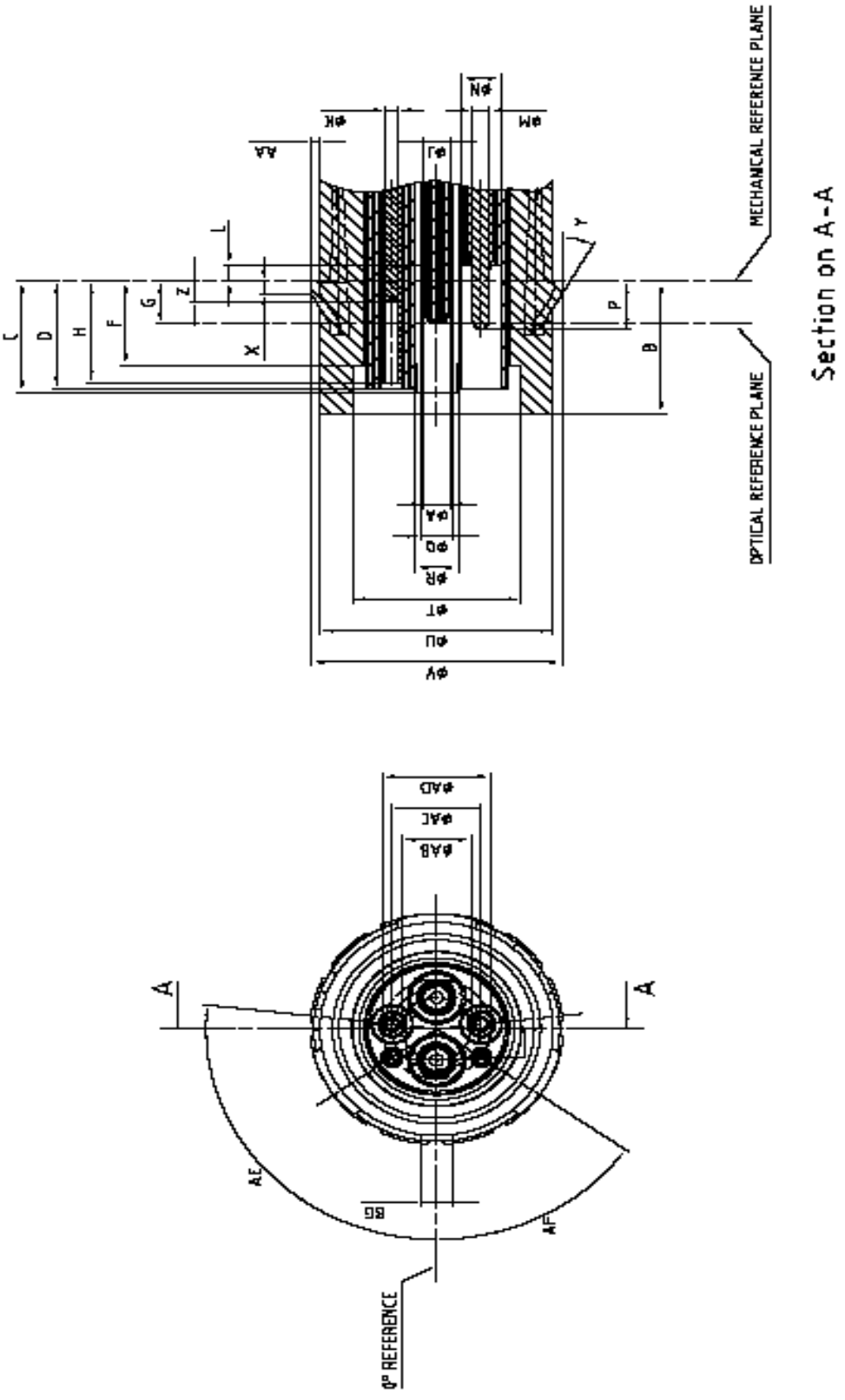


Figure 1 – Plug mating interface

Table 1 –Plug mating dimensions

	Specifications (mm)			
Dimensions	Minimum	Nominal	Maximum	Description
A	—	/	—	Split sleeve inside diameter [1)]
B	11.0	/	11.25	Connector shell to reference plane
C	8.70 [4)]	/	10.17	Split sleeve to reference plane
D	9.0 [4)]	/	9.4	Insert dimension
F	6.8 [4)]	/	7.15	Shell dimension
G	3.25	/	3.89	Optical to mechanical reference plane [2)]
H	7.0	/	8.9	Low-voltage contact location
J	Ø 1.999	/	Ø 2.0	Diameter of optical ferrule
K	Ø 0.87	/	Ø 0.9 [4)]	Low-voltage contact inside diameter
L	1.3	/	2.0	Split sleeve to reference plane
M	Ø 1.27	/	Ø 1.3	Auxiliary electrical contact outside diameter
N	Ø 3.05	/	Ø 3.1	Insert inside diameter for auxiliary electrical contact
P	3.1	/	4.3	Auxiliary electrical contact location
Q	Ø 2.48 [4)]	/	Ø 2.52 [4)]	Split sleeve outside diameter
R	Ø 4.48	/	Ø 4.55	Insert dimension
T	Ø 12.97	/	Ø 13.05	Shell inside diameter
U	Ø 17.95	/	Ø 18	Shell outside diameter
V	Ø 19.35	/	Ø 19.6	Latch outside diameter
X	0.8 [4)]	/	1.2	Latch dimension
Y	27°	/	33°	Latch dimension
Z	0.6 [4)]	/	2.4	Low-voltage contact depth
AA	0.76	/	0.83 [4)]	Amount of movement on the latching sleeve
AB		5.3		Optical contact location[3)]
AC		6.9		Auxiliary electrical contact location[3)]
AD		8.4		Low-voltage contact location[3)]
AE		96°30’		Auxiliary electrical contact location [3)]
AF		55°		Low-voltage contact location [3)]

[1)] The connector alignment feature is a split sleeve. The feature shall accept a gage pin with dimensions of 1.9995 – 2.0000 to the center of the alignment device with a force of 1.46 -3.42N under the condition that another gage pin in inserted into the feature from the other side”.

[2)] Dimension **G** is given for a ferrule end face center of a plug end when not mated. To mate the ferrule must be movable by a certain axial compression force; therefore the dimension **G** is variable. Ferrule compression force shall be 3 N to 8 N when the compressed position of the ferrule end face is in the range of 0.1 mm to 0.6 mm.

[3)] The position of the contacts within the connector is related to the insert dimensions given in Fig 5, nominal values are provided here for reference purposes. However the manufacture of the connector shall be such that there is a minimum of ± 4 degrees of float to allow the contacts to take up their correct position during mating.

[4)] This value is given to document existing designs only; it is not normative and need not be met to ensure conformance to this standard.

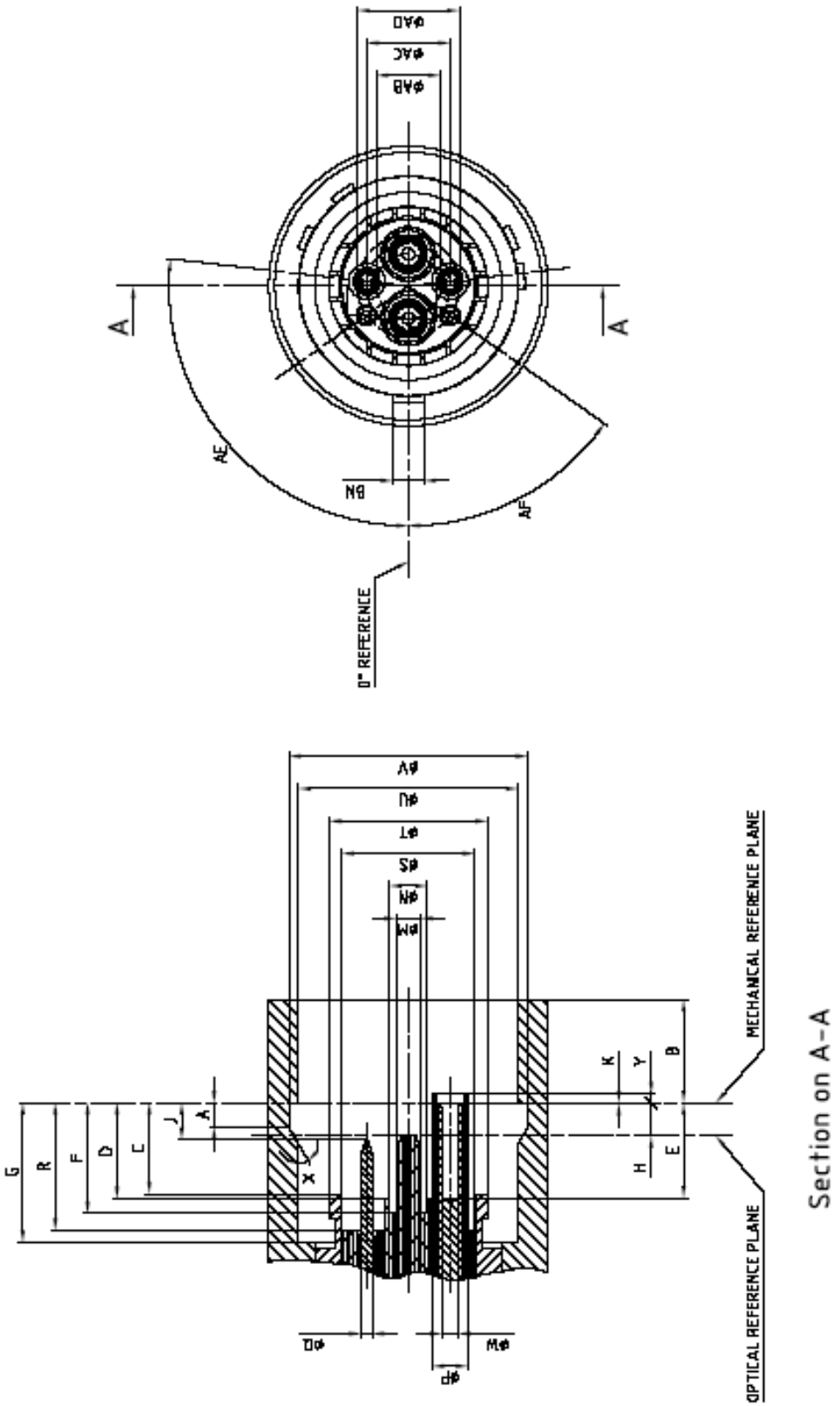


Figure 2 – Jack mating interface

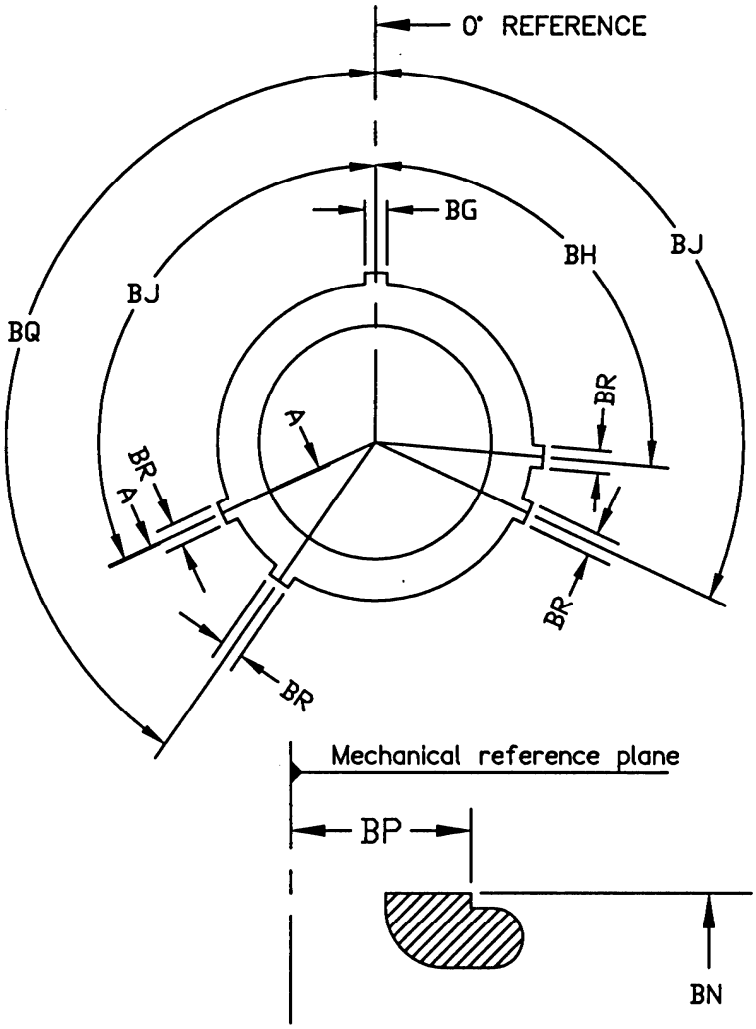
Table 2 – Jack mating dimensions

	Specifications (mm)			
Dimensions	Minimum	Nominal	Maximum	Description
A	1.95	/	2.15 [3)]	Latch groove dimension
B	8.45	/	8.55	Groove location
C	7.35	/	7.65	Grounding crown dimension
D	7.73	/	8.93	Insert dimension
E	7.7	/	7.85 [3)]	Auxiliary electrical contact depth
F	10.27	/	11.0 [3)]	Insert dimension
G	11.35	/	11.7	Shell depth
H	2.66	/	3.10	Optical to mechanical reference plane [1)]
J	2.97	/	3.85	Low-voltage contact location
K	0	/	1.0	Auxiliary electrical contact location
M	Ø 1.999	/	Ø 2.0	Diameter of optical ferrule
N	Ø 3.0 [3)]	/	Ø 3.2	Insert inside diameter
P	Ø 2.9 [3)]	/	Ø 2.95	Insert dimension
Q	Ø 0.86	/	Ø 0.90	Low-voltage contact outside diameter
R	10.33	/	10.9	Insert location
S	Ø 10.9	/	Ø 11.9	Insert outside diameter
T	Ø 13.02	/	Ø 13.05	Grounding crown outside diameter
U	Ø 18.1	/	Ø 18.14	Shell inside diameter
V	Ø 19.7	/	Ø 19.9 [3)]	Latch groove diameter
W	Ø1.27	/	Ø 1.33 [3)]	Auxiliary electrical contact inside diameter
X	27°	/	33°	Latch dimension
Y	0.1	/	1.1	Insert dimension
AB		5.3		Optical contact location[2)]
AC		6.9		Auxiliary electrical contact location[2)]
AD		8.4		Low-voltage contact location[2)]
AE		96°30’		Auxiliary electrical contact location [2)]
AF		55°		Low-voltage contact location [2)]

[1)] Dimension **H** is given for a ferrule end face center of a plug end when not mated. To mate the ferrule must be movable by a certain axial compression force; therefore the dimension **H** is variable. Ferrule compression force shall be 3 N to 8 N when the compressed position of the ferrule end face is in the range of 0.1 mm to 0.6 mm.

[2)] The position of the contacts within the connector is related to the insert dimensions given in Figure 6. Nominal values are provided here for reference purposes. However the manufacture of the connector shall be such that there is a minimum of +/- 4 degrees of float to allow the contacts to take up their correct position during mating

[3)] This value is given to document existing designs only; it is not normative and need not be met to ensure conformance to this standard.



Section A-A

Figure 3 – Plug key arrangement

Table 3 – Plug key dimensions

	Specifications (mm)		
Dimensions	Minimum	Nominal	Maximum
BG	2.38	/	2.43
BH	/	95º ±0'30''	/
BJ	/	115º ±0'30''	/
BN	Ø 18.95	/	Ø 19
BP	3.3	/	3.5
BQ	/	145º ±0'30''	/
BR	1.78	/	1.83

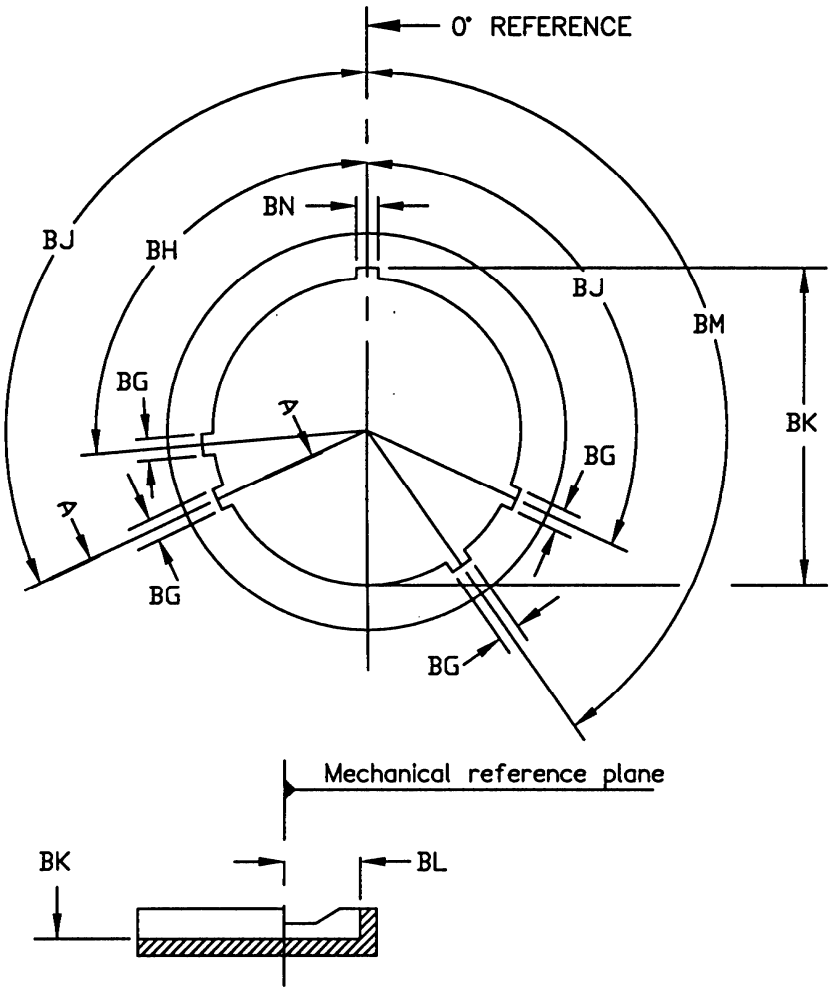
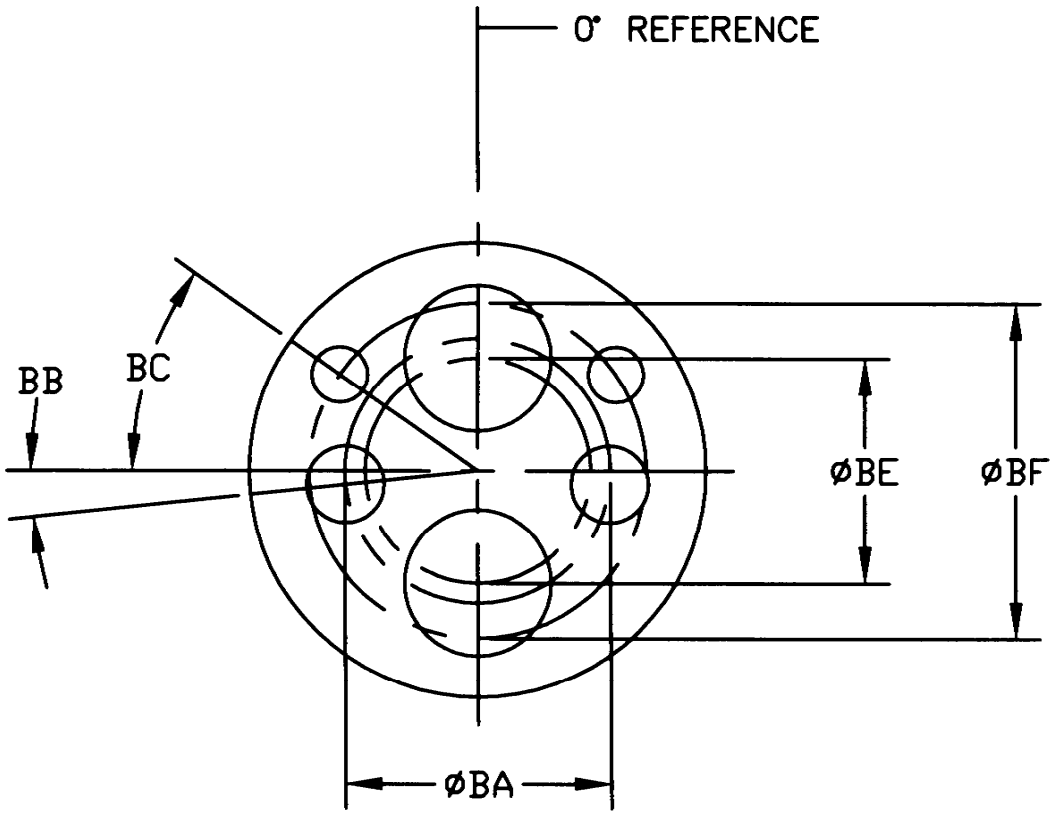


Figure 4 – Jack key arrangement

Table 4 – Jack key dimensions

Dimensions	Specifications (mm)		
	Minimum	Nominal	Maximum
BG	2.02	/	2.07
BH	/	95º ±0'30''	/
BJ	/	115º ±0'30''	/
BK	18.55	/	18.75
BL	5.35	/	5.65
BM	/	145º ±0'30''	/
BN	2.52	/	2.57

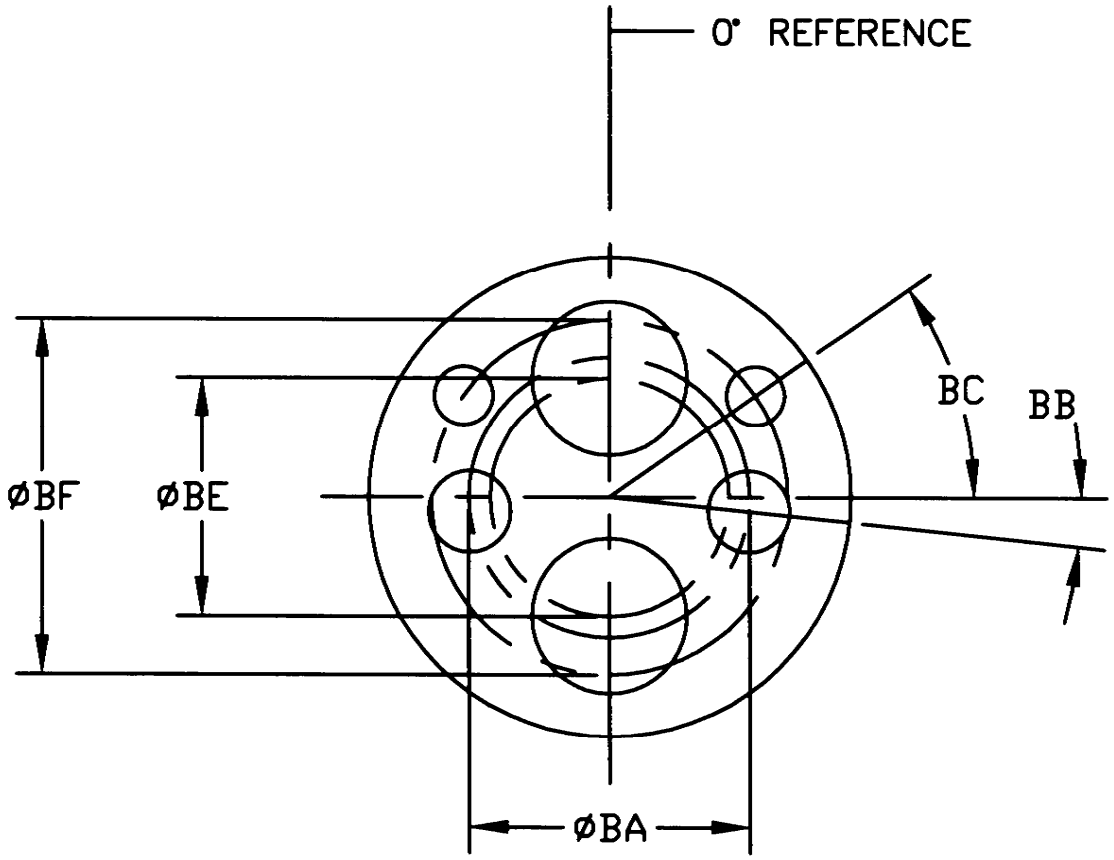


Note: Figure viewed from front face.

Figure 5 – Plug insert arrangement (Informative)

Table 5 – Plug insert dimensions (Informative)

	Specifications (mm)			
Dimensions	Minimum	Nominal	Maximum	Description
BA	Ø 6.895	/	Ø 6.905	Auxiliary electrical contact
BB	6º 2 6´	/	6º 3 4´	
BC	34º 5 6 '	/	35º 4´	
BE	Ø 5.295	/	Ø 5.305	Fiber-optic contact
BF	Ø 8.395	/	Ø 8.405	Low-voltage contact

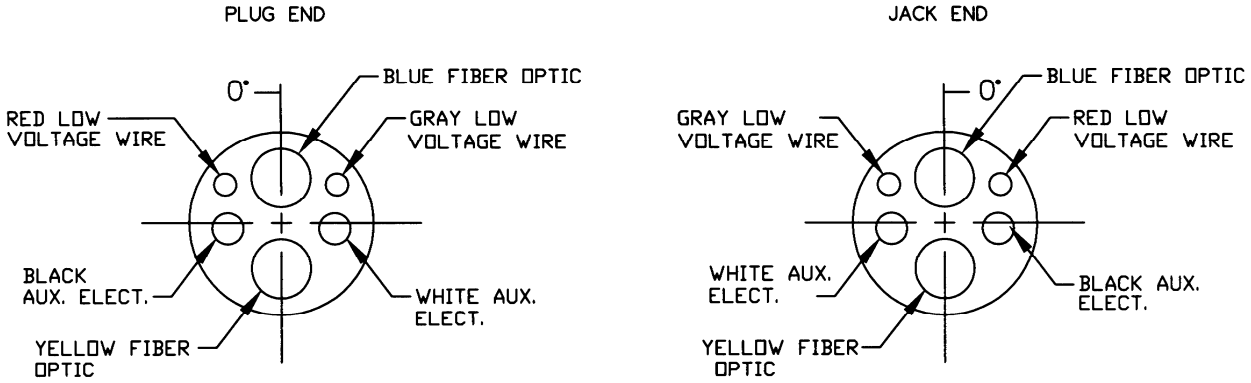


Note: Figure viewed from front face.

Figure 6 – Jack insert arrangement (Informative)

Table 6 – Jack insert dimensions (Informative)

	Specifications (mm)			
Dimensions	Minimum	Nominal	Maximum	Description
BA	Ø 6.895	/	Ø 6.905	Auxiliary electrical contact
BB	6º 2 6´	/	6º 3 4´	
BC	34º 5 6´	/	35º 4´	
BE	Ø 5.295	/	Ø 5.305	Fiber-optic contact
BF	Ø 8.395	/	Ø 8.405	Low-voltage contact



Note: Figure viewed from front face.

Figure 7 – Pin out wiring diagrams

Annex A (Informative)
Bibliography

ARIB BTA S-1005B, Interconnection for HDTV Studio Equipment. ARIB Technical Report (Japanese Only)

IEC 60793-1-1 (2008-04), Optical Fibers — Part 1-1: Measurement Methods and Test Procedures — General and Guidance

IEC 60874-1 (2006-10), Connectors for Optical Fibers and Cables — Part 1: Generic Specification

IEC 61076-1 (2001-06), Connectors with Assessed Quality for Use in D.C., Low Frequency Analogue and in Digital High Speed Data Applications — Part 1: Generic Specification

IEC 61300 (2003-06), Fiber Optic Interconnecting Devices and Passive Components — Basic Test and Measurement Procedures

IEC 61753-1 (2007-03), Fiber Optic Interconnecting Devices and Passive Components Performance Standard – Part 1: General and Guidance

TIA-492BA00-1988, Blank Detail Specification for Class IVa Dispersion, Unshifted Single-Mode Optical Waveguide Fibers

TIA / EIA-455-107-1999, Determination of Component Reflectance or Link/System Return Loss Using a Loss Test Set [FOTP-107]

TIA / EIA TSB62-1993, Information Test Methods for Fiber-Optic Fibers, Cables, Opto-Electronic Sources and Detectors, Sensors, Connecting and Terminating Devices, and Other Fiber-Optic Components (R2002)

UL 498-2002, Attachment Plugs and Receptacles