

# RIGID COAXIAL TRANSMISSION LINES AND CONNECTORS

## 75 OHMS

*(From EIA Standards Proposal No. 720 formulated under the cognizance of EIA Subcommittee TR-21.2 on Air Dielectric Coaxial Lines and Fittings, and Committee TR-21 on Transmission Lines and Fittings)*

### SCOPE

This standard pertains exclusively to gas-filled rigid coaxial transmission lines and their connectors containing electrically transparent supporting structures. This standard does not apply to any semi-flexible transmission lines or connectors.

It is the intent of this standard to provide complete mechanical interchangeability for all lines and connectors. The drawings referred to in the standard do not in any way restrict electrical design parameters and are referred to for the purpose of confining the manufacturer within the necessary mechanical limits to make his electrical compensation, while still providing mechanical interchangeability.

### 1. SIZE

1.1 Definition: The size of a coaxial line is defined as the nominal outside diameter of the line, expressed in inches. The size of the connector is defined by the nominal outside diameter of the line with which it is used.

1.2 Standard: The standard line sizes are specified in Table I. The standard connector sizes are given in working drawings 1, 2, and 3.

### 2. DIMENSIONS

#### 2.1 Definitions:

2.1.1 *Average Wall Thickness* is one-half the difference between the corresponding inside and outside diameters at any cross-section perpendicular to the axis.

2.1.2 *Maximum Deviation* of the wall thickness from the average wall thickness (eccentricity) at any cross-section is the difference between the average wall thickness and either the maximum or minimum wall thickness, whichever difference is greater.

2.2 Standard: Dimensions and tolerances for the lines are specified in Table I and for the connectors on drawings 1, 2, and 3.

### 3. CHARACTERISTIC IMPEDANCE

3.1 Definition: The characteristic impedance of a coaxial transmission line is the driving impedance of the forward traveling transverse electromagnetic wave.

3.2 Standard: The characteristic impedance for each line size is shown in Table I.

### 3.3 Method of Determination:

3.3.1 For a structurally uniform section of transmission line the characteristic impedance shall be calculated from the appropriate theoretical expression.

3.3.2 For a structurally non-uniform line having electrically transparent individual supports, the characteristic impedance shall be determined experimentally with measuring equipment or by conventional transmission line and network theory of the necessary accuracy.

3.3.3 For a structurally non-uniform line achieving electrical transparency by means of a systematic supporting structure, the characteristic impedance shall be determined between groups of supports.

NOTE: Connectors shall be included as part of the transmission line and shall comply with the requirements specified for the transmission line.

## 4. ATTENUATION PER UNIT LENGTH

4.1 Definition: Attenuation is the decrease with distance in the direction of propagation of a quantity associated with a traveling transverse electromagnetic wave.

4.2 Standard: Attenuation shall be expressed as a power ratio in decibels per unit length of line at a specified frequency and with specified conductor temperature.

4.3 Method of Determination: Attenuation shall be determined by a suitable method of measurement.

## 5. VSWR OF A TRANSMISSION LINE

5.1 Definition: The VSWR of a transmission line is that VSWR introduced by irregularities in the transmission line, when terminated in its characteristic impedance.

5.2 Standard: VSWR shall be indicated as a peak and/or average value, and shall be as required for the application.

5.3 Method of Determination: VSWR shall be determined experimentally. The point by point method using the slotted transmission line technique shall be the standard method. Frequency separation between measured points shall be sufficiently close to define any VSWR peaks. Other methods of measurements are permissible providing their accuracy can be demonstrated as adequate.

A statement of VSWR shall include the length of the sample, frequency range, and configuration of the sample (whether elbows or other fittings are included, etc.).

## 6. POWER AND VOLTAGE RATINGS

6.1. Definition: The power rating or voltage rating of a line and connectors is that value of transmitted power or voltage which permits satisfactory operation of the line assembly and

provides an adequate safety factor below the point where injury or appreciably shortened life will occur.

6.2 Standard: The power rating, at unity standing wave ratio unless otherwise limited, either shall not exceed that which will result in an inner conductor temperature of 100° C for copper conductors at an ambient temperature of 50° C and shall include a statement of all applicable limiting factors, or the rating shall be suitable for the application.

6.3 Method of Determination: The power or voltage ratings of a line including connectors shall be determined experimentally by breakdown, life and related tests.

## 7. UPPER FREQUENCY LIMIT

7.1 Definition: The upper frequency limit is that frequency above which the performance of the cable as used in the transverse electromagnetic mode is degraded by the propagation of the TE<sub>11</sub> mode in the cable.

7.2 Standard: In general, it does not seem advisable to use coaxial line frequencies greater than 0.95 of the TE<sub>11</sub> mode cut-off frequency. Supporting structures will further decrease the upper frequency limit. Practical experience has indicated that 0.95 of the TE<sub>11</sub> mode cut-off frequency in the overcut, undercut, or overcut-undercut insulator portion of the line will serve as a useful limit for most applications. The TE<sub>11</sub> mode cut-off frequency, for air dielectric, Teflon and polystyrene overcut and undercut insulators is specified in Table I.

(NOTE: Some line fittings may have a lower cut-off frequency than the line. Care must be taken in using transmission line systems at frequencies close to cut-off.)

7.3 Method of Determination: The cable manufacturer shall supply information that will allow the user to determine the upper frequency limit for his specific application.

## 8. CURVATURE

8.1 Definition: Curvature is the radial departure from a straight line between any two points on the external surface of a conductor.

8.2 Standard: Curvature shall not exceed 1/2" for any ten foot portion of the total length.

8.3 Method of Determination: Measurement of curvature shall not be altered by gravity or any other forces.

## 9. OUT-OF-ROUNDNESS

9.1 Definition: Out-of-Roundness is the difference between the major and minor diameters at any one cross-section of a conductor.

9.2 Standard: Out-of-Roundness shall conform to best commercial practice.

## 10. MATERIAL AND WORKMANSHIP

10.1 Material: To be specified by user.

10.2 Workmanship: The interior surface of the outer conductor, the exterior and interior surfaces of the inner conductor, and all mating surfaces of connectors and conductors shall be as free as possible from detrimental holes, burrs, die marks, or chatter marks or foreign materials.

## 11. PACKAGING AND PACKING

11.1 Each length of transmission line assembly shall have protective covering at both ends.

11.2 Packing shall be such as to assure that after shipping and handling the transmission line assembly shall meet the requirements of this standard.

## 12. PRESSURE TIGHTNESS

12.1 Definition: Pressure tightness is the ability of the transmission line and connector to maintain an internal pressure of dry gas, as commonly used to prevent the entrance of moisture or other foreign material.

12.2 Standard: The outer conductor and connector shall be capable of withstanding a pressure up to 60 lbs./sq. in. gage pressure without rupture. Gas leakage from a pressurized transmission line assembly shall not cause the pressure to drop more than 2 lbs./sq. in. in 24 hours, from an initial pressure of 10 lbs./sq. in. gage pressure, correction being made for temperature and barometric changes from start to finish of test.

12.3 Method of Determination: The pressure shall be determined experimentally. A shorter testing time than that specified above may be employed, if it provides the same time rate of leakage. Environmental conditions at the time of test shall be specified.

## 13. DESIGNATION

13.1 The designation for coaxial lines in accordance with this standard shall include the line size and the nominal characteristic impedance. For example for a 1 5/8 line it shall be as follows:

1 5/8 (75)

13.2 The impedance and size of the anchor insulators included with the connectors in this standard shall be marked as above. For example for a 3 1/8 connector it shall be as follows:

3 1/8 (75)

13.3 The designation numbers shall be marked on the outside surface of the outer conductor of each length of finished coaxial line in such a way as not to deform the inside surface of the conductor.