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SPECIFICATION-1918 (A)

COAXIAL CABLE, RADIO FREQUENCY, SEMI-RIGID, DELAY LINE ASSEMBLIES AND CONNECTORS

A.M. Bray

S U M M A R Y

This specification is intended for the procurement of a stable radio frequency coaxial cable, for use in direct burial conditions and resistant to insect attack.

The slash sheets /01 to /20 give details of finished delay line assemblies.

The contents of this document are similar to a full military specification and feature design, performance, acceptance and packaging requirements.

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1. SCOPE

This specification provides standards and details requirements to be complied with, for the manufacture, performance, acceptance and procurement of coaxial cable, delay line assemblies and connectors.

1.1 Classification

The materials defined within the specification shall be classified under the Australian Defence Cataloguing System. Catalogue Group/Class and descriptions for this specification shall be: 5935 Connectors, Coaxial, Radio Frequency . 5995 Assemblies, Delay Line . 6145 Cables, Coaxial, Radio Frequency, Semi rigid.

1.2 Intended use and notice of special conditions

The cables, delay line assemblies and connectors supplied under the requirements of this specification are for use in a remote Australian site. The bulk of the cable is for direct burial and is designed to be insect resistant. Other cables will be used as linkages and installed in below-ground bunkers. Technical aspects of the proposed installation demand that special conditions will be attached to any contract that may be let to supply materials to this specification. In summary these will be as follows.

(1) The purchaser will recommend that the finished products be obtained from a single source of supply; a manufacturer who shall be capable of meeting all the requirements of this specification shall be preferred. In particular there shall be complete compatability between the performance characteristics of the bulk cable and the delay line assemblies.

(2) A Weapons Research Establishment representative (Acceptance Officer) shall be given full facilities at the manufacturer's site for stage 1 acceptance.

(3) Because of the need to meet planned installation dates which coincide with "wet" and "dry" "outback" Australian conditions delivery will be an important part of the acceptance criteria of a bid.

2. DEFINITIONS

2.1 Cable, type 1

Drum lengths of cable for direct burial and covered with a polythene interlayer jacket and an insect resistant outer jacket.

2.2 Cable, type 2

Cut lengths of cable for finished delay line assemblies. There is no requirement for any jackets.

2.3 Cable assembly, type 1

Accurately cut, straight cable, terminated, identified, and tested for electrical length. Type 2 cable.

2.4 Cable assembly, type 2

Accurately cut, coiled or formed cable, terminated, identified, and tested for electrical length. Type 2 cable.

2.5 Cable assembly, type 3

Accurately cut, straight cable, terminated, identified, tested for electrical length, for direct burial, using type 1 cable.

2.6 Acceptance Officer

Officer acting for Chief Superintendent, Applied Physics Wing, Weapons Research Establishment at the cable manufacturer's site for the purposes of stage 1 acceptance of cables and delay line assemblies.

3. IDENTIFICATION

Marking of codes or manufacturer's identifications are acceptable although not mandatory; no indentations or scratches are allowable on the outer finish of the insect resistant type cable.

Identification sleeves shall be fitted to all the delay line assemblies; suitable numerical characters shall be grouped as specified in the specification sheets WRE-SP-1918/01 to WRE-SP-1918/20 appended to this specification.

4. APPLICABLE SPECIFICATIONS AND STANDARDS

The latest issue of the following specifications and standards are included as a portion of the specification to the extent designated herein. Detailed requirements of this specification shall take precedence over contradictory portions of the following documents.

4.1 Specifications

AUSTRALIAN

Australian Telecom 1142, Cable, Insect Resistant

U.S. FEDERAL

L-P-390 - Plastic, Molding and Extrusion Material, Polyethylene and Copolymers (Low, Medium and High Density).

WW-T-700 - Tube, Aluminium Alloy, Drawn, Seamless; General Specification for.

U.S. MILITARY

MIL-C-17 - Cables Radio Frequency, General Specification for.

MIL-G-45204 - Gold Plating, Electrode deposited.

MIL-P-116 - Preservation, Packaging, method of.

4.2 Standards

U.S. FEDERAL

FED-STD-228 - Federal Test Method No. 228, Cable and Wire, Insulated; Methods of Testing.

U.S. MILITARY

MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.

4.3 Other Publications

American Society for Testing Materials

ASTM B 566 - Copper Clad Aluminium Wire

ASTM D 638 - Tensile properties of plastics

ASTM D 412 - Tension Testing of Vulcanised Rubber

Alternative and equivalent documents issued in the country of origin of the bidder may also be acceptable, providing they are reproduced in the English language; such a listing, together with addresses where they may be obtained should be included with the bid.

5. WORKMANSHIP STANDARDS

The workmanship shall be of the best accepted standards for these types of cables, delay lines and connectors. The standard should give reliable continuous service, subject to reasonable handling and maintenance. The delay lines shall be assembled in accordance with standard military and commercial assembly procedures accepted within the industry.

6. INTERCHANGEABILITY

All replaceable parts shall be manufactured to definite standards for tolerances, clearance and finish in order that such parts may be field-installed.

7. TECHNICAL GUIDES, DRAWINGS, CATALOGUES AND OTHER DATA

7.1 Bidding

Each offer shall be accompanied by sufficient technical data to allow a complete comparison to be made between every requirement of this specification and the capabilities of the item being offered.

7.2 Installation

To ensure efficient installation, testing, operation and servicing, complete technical information (in English) shall be provided.

8. RESPONSIBILITY

The Seller shall accept responsibility for the manufacture, performance, reliability, and packaging of the cables, delay line assemblies and connectors as defined in this specification.

Note: The Chief Superintendent, Applied Physics Wing, Weapons Research Establishment is seeking assurances that the shelf-life of the cable is equal to or greater than ten years. The assurance is to be given with respect to the electrical performance and stability characteristics.

Tenderers are invited to respond to the above note when returning their bids.

9. ENVIRONMENT

9.1 Site information

The cables and delay lines are to form part of a system which is to be stable against temperature variations over a long period of time. Cables and delay lines are generally to be installed below ground level, either by direct burial at 1.2 m or in bunkers. Temperature variation for buried cable is estimated to be within the range $+12^{o}C$ to $+28^{o}C$.

Many terminated cable ends are exposed to weather at ground level, when that occurs, temperature extremes are $-7^{o}C$ to $+70^{o}C$.

The installation site is expected to flood for short periods during the wet season.

Cables might be attacked by termites (locally called "white ants"). Termites connected with attacks on cable in Australia are, Mastotermes, Coptotermes and Nasutitermes.

9.2 Requirements

Cables, delay line assemblies and connectors offered by the bidder shall be capable of meeting the performance requirements of this specification when exposed to environmental conditions as described in the site information paragraph (9.1).

10. REQUIREMENTS

10.1 General description

The cable of types 1 and 2 shall be of the coaxial style of construction, semi rigid, with semi solid (foamed) dielectric core, and solid inner and outer conductors. In addition, type 1 cables shall be covered with a polyethylene interlayer jacket, and finished with an outer jacket for resistance against attacks by insects. The coaxial cable shall exhibit low loss characteristics to radio frequencies, and shall be extremely stable in the environmental conditions as outlined in paragraph 9.1.

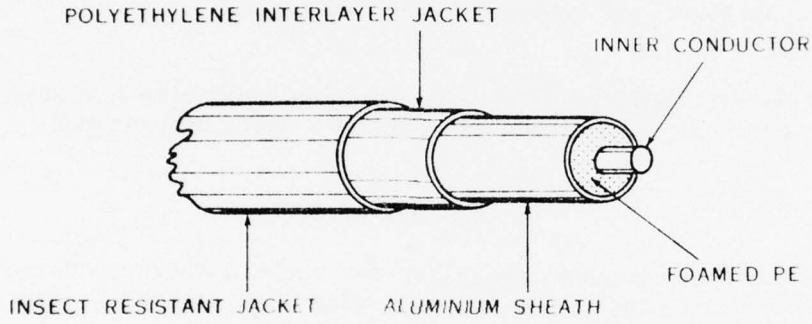


Figure 1. Cable cross-section

10.2 Materials

The materials for the principal components of the cables shall be as specified herein; only virgin material shall be used in the fabrication of the principal components.

10.2.1 Inner conductor

The inner conductor shall be solid annealed copper-clad aluminium wire, conforming to ASTM.B.566 Class 15A. The overall nominal diameter of the inner conductor shall be 2.9718 mm (0.117 in). When measured according to the method detailed in Section 13.5.1, all diameter measurements shall be in the range 2.91 to 3.03 mm (0.115 to 0.119 in).

10.2.2 Dielectric core type

The material shall be of the following specified type: Cellular polythene dielectric foam construction, nominal effective dielectric constant of 1.50.

10.2.3 Outer conductor

Shall be constructed of pure aluminium seamless tubing. Solid and smooth to form a sheath over the dielectric core. The seamless aluminium tubing shall have a purity to specification WW-T-700 or the equivalent commercial quality.

The nominal outer conductor I.D. shall be 8.2550 mm (0.325 in).

The nominal outer conductor O.D. shall be 9.5250 mm (0.375 in).

When measured according to the method detailed in Section 13.5.1 all measurements on the outer conductor shall conform to the following:

I.D. in the range 8.09 to 8.42 mm (0.318 to 0.331 in)
O.D. in the range 9.33 to 9.72 mm (0.367 to 0.383 in)

10.2.4 Interlayer jacket

The material shall be tough, flexible and non-hygroscopic. The jacket shall cover the cable tightly and evenly in a manner consistent with the physical, mechanical, environmental and dimensional requirements. Polyethylene type 111a conforming to L-P-390 type 111, class M, grade 2, or the equivalent shall be used, coloured black. Nominal radial thickness of the jacket shall be 0.7620 mm (0.030 in).

10.2.5 Insect-resistant jacket

(a) A hard plastic jacket shall be extruded over the interlayer jacket, conforming to the specifications of paragraph 2 of Australian Telecom Specification 1142 to the extent indicated below. It shall be a close fitting, uniformly extruded jacket of an approved plastics material. The jacket shall be free from all repairs, defects, abrasions or other imperfections and shall present a smooth gloss surface.

(b) The jacket shall have a nominal radial thickness of 0.3810 mm (0.015 in).

(c) Nylon 11 ("Rilson" BMN Black) Nylon 12 ("Grilamid" L20H9288) and ("Vestanid" L1801") are currently approved hard plastics materials and are preferred. Other materials may be approved.

(d) The cable manufacturer shall provide complete information (at the time of bidding) relating to the trade name, chemical composition and properties of the material they propose to use as the insect-resistant finish, if other than the preferred types. In all cases, the manufacturer shall state the material intended to be used.

(e) Light and thermal stabilisers - all polyamide material shall contain homogeneously distributed light and thermal stabilizers or inhibitors as protection against exposure to sunlight or ultra-violet radiation or the effects of elevated temperatures during processing. When carbon black is used as a constituent, it shall be finely dispersed in the proportion of not less than 2% by weight.

(f) Moisture content

(i) The moisture content of the polyamide resins used shall not exceed 0.1% by weight.

(ii) Where drying is required at the cable manufacturer's plant, it shall be done in accordance with the recommendations of the supplier in order to avoid degradation of the polymer due to hydrolysis or oxidation.

(iii) The Acceptance Officer shall have the right to remove samples of resin granules from the hopper for laboratory evaluation of moisture content.

(g) Extruder dwell-time - the temperature of the molten resin shall not exceed 260°C and the maximum duration of time that the molten resin is held at this temperature (dwell-time) shall not exceed 15 min. Where the extrusion is carried out at temperatures less than 260°C the dwell-time may be doubled for each 10°C decrease in temperature.

(h) Tensile stress at yield and elongation at break

(i) The median (defined in (iii) below) of the tensile stresses at yield and elongation at break of five specimens of the insect-resistant jacket taken from the completed cable shall be in accordance with the values shown below when tested by the method described in Appendix III.

(a) Tensile stress at yield (minimum)	31,026 kn/m^2 (4500 lbf/in^2)
(b) Elongation at break (minimum)	230%

(ii) The median of the tensile stress at yield and elongation at break of five specimens of the insect-resistant jacket taken from the completed cable and artificially aged in an approved weatherometer by subjection to ultraviolet radiation in the range 2750 to 4400 angstrom for a minimum of 300 hours, shall not vary by more than 20% from the median value obtained for the unaged specimens, when tested by the method described in Appendix III.

(iii) The median for five observations is defined as the value of the third observation when the observed values are arranged in order of magnitude.

The finished cable shall conform to the view as shown in figure 1, for cable type 1. Cable type 2 omits the polyethylene interlayer jacket and the insect resistant jacket.

10.3 Operational

Unless otherwise specified the operational requirements shall be as specified herein.

10.3.1 Eccentricity

When measured by the method of paragraph 13.5.2 the percentage eccentricity shall not exceed 7%.

10.3.2 Adhesion of cable components

When tested as specified in paragraph 13.5.3 the conductor adhesion shall be approximately 348 N (78 lbf) for a 51 mm (2 in) test sample.

10.3.3 Continuity

When cables are tested as specified in paragraph 13.6 each conductor shall be continuous.

10.3.4 Voltage withstanding

When cables are tested as specified in paragraph 13.7 there shall be no breakdown, flashover, or sparkover.

10.3.5 Insulation resistance

When cables are tested, the insulation resistance per 304.8 m (1000 ft) shall not be less than 100,000 MΩ

10.3.6 Characteristic impedance

When cables are tested as specified in paragraph 13.9 the characteristic impedance shall be 50 ± 2 Ω.

10.3.7 Attenuation

When cables are tested as specified in paragraph 13.10 the attenuation shall not exceed 2.0 dB per 100 m (0.61 dB per 100 ft) at 30 MHz when tested at 20°C. Attenuation at temperatures other than 20° shall be acceptable if the attenuation compares with the curves illustrated in figure 2.

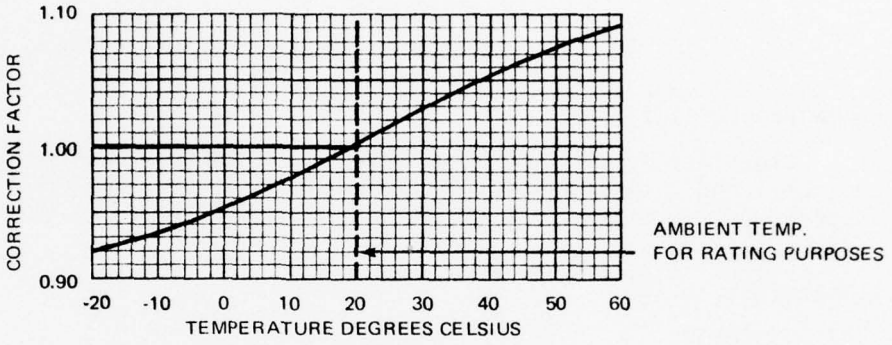


Figure 2. Attenuation, temperature correction

10.3.8 Velocity

The cable as specified herein when tested in accordance with paragraph 13.12 shall have an 81 ±2% velocity of propagation. (See sheets WRE-SP-1918/01 to WRE-SP-1918/20 for details of assemblies to be supplied to an electrical length, and to the schedule of quantities (Appendix I) where drum lengths will be shown as actual physical lengths. In many instances the final cut length is required to be a matched electrical length e.g. item (1) is quoted at 1540 m which will be cut into 10 increments on site, the 1540 m length assumes a velocity of 81%, should cable offered to the Acceptance Officer not be 81% then the acceptable length could be a minimum of 1570 m).

10.3.9 Phase stability

When cables are tested as specified in paragraph 13.11 the phase stability with temperature as determined by the coefficient of change in electrical length in parts per million per degree celsius (PPM/°C), shall not exceed 50 parts per million.

10.3.10 Outer conductor integrity

When cables are tested as specified in paragraph 13.13 there shall be no evidence of cracks, flaws, or other damage in the outer conductor material.

10.3.11 Dimensional stability

When cables are tested as specified in paragraph 13.14 the measurement of each end shall not exceed 25 μm.

10.3.12 Bendability

When cables are tested as specified in paragraph 11.15 there shall be no cracks, splints, fracturing, wrinkling or other damage in the solid outer conductor material. Cables shall achieve a minimum radius of 100 mm (4 in) without damage, or change to the electrical performance as specified.

10.3.13 Finish

All cables and delay lines shall be manufactured and processed in such a manner as to be uniform in quality and shall be free from any burns, die marks, chatter marks, foreign materials and other defects that will affect life, serviceability, or appearance. Workmanship shall be such as to enable the cables and delay lines to meet the applicable requirements of this specification.

11. REQUIREMENTS: DELAY LINE ASSEMBLIES

11.1 General description

Delay line assemblies shall consist of specified lengths of cable of types 1 and 2 with connectors attached. Assemblies shall comply with the specification sheets WRE-SP-1918/01 to WRE-SP-1918/20 appended to this specification.

11.2 Materials

11.2.1 Cable

Type 1 or type 2, as specified on individual specification sheets WRE-SP-1919/01 to WRE-SP-1918/20.

11.2.2 Connectors

As described in paragraph 12.

11.3 Operational

(a) Cable used shall comply with the requirements of paragraph 10.

(b) Connector used shall comply with the requirements of paragraph 12. Rear nut torque shall be loaded to Specification recommended by the connector manufacturer.

(c) Electrical length and tolerance shall be as specified on sheets WRE-SP-1919/01 to WRE-SP-1918/20 for individual assemblies, the reference plane for measurement of electrical length shall be the end of the outer mating contact, as indicated on sheet WRE-SP-1918/01. Electrical length measurement shall use the technique of Appendix II or another method of equivalent accuracy.

(d) Identification shall be provided as specified on the individual sheets WRE-SP-1918/01 to WRE-SP-1918/20.

(e) Preconditioning shall be as specified in paragraph 13.17, except that for the assemblies specified by WRE-SP-1918/01 to WRE-SP-1918/04 inclusive, WRE-SP-1918/06 and WRE-SP-1918/07 which shall use method (2), as specified on those sheets.

12. REQUIREMENTS: CONNECTORS

12.1 General description

(a) Connectors shall be of the design, construction and physical dimensions as specified herein.

(b) Connectors shall be, Coaxial, Radio Frequency, Series "N" Plugs, straight, field installable with no special tools (other than wrenches), be compatible with the aluminium outer conductor of cable types 1 and 2 of this specification, and be waterproof in flash flooding conditions.

(c) The specification for the materials and interface dimensions shall comply with MIL-C-39012.

(d) The connectors shall generally conform to the design as outlined in figures 3 and 4.

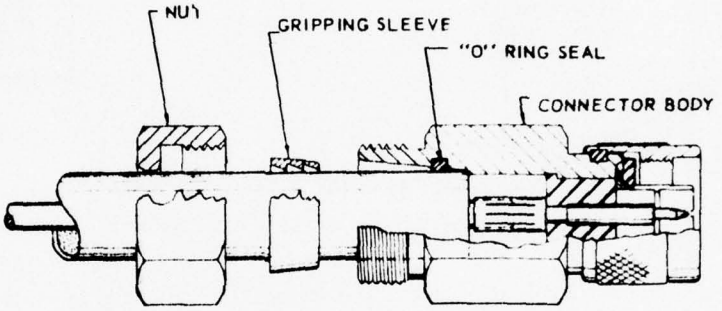


Figure 3. Connector

12.2 Engineering parameters

12.2.1 Impedance

50 ohms.

12.2.2 Frequency range

0 to 11,000 MHz.

12.2.3 Force to engage and disengage

Torque 70 g/m (6 in/lb) maximum.

12.2.4 Coupling mechanism (nut) retention force

444 N (100 lb) minimum.

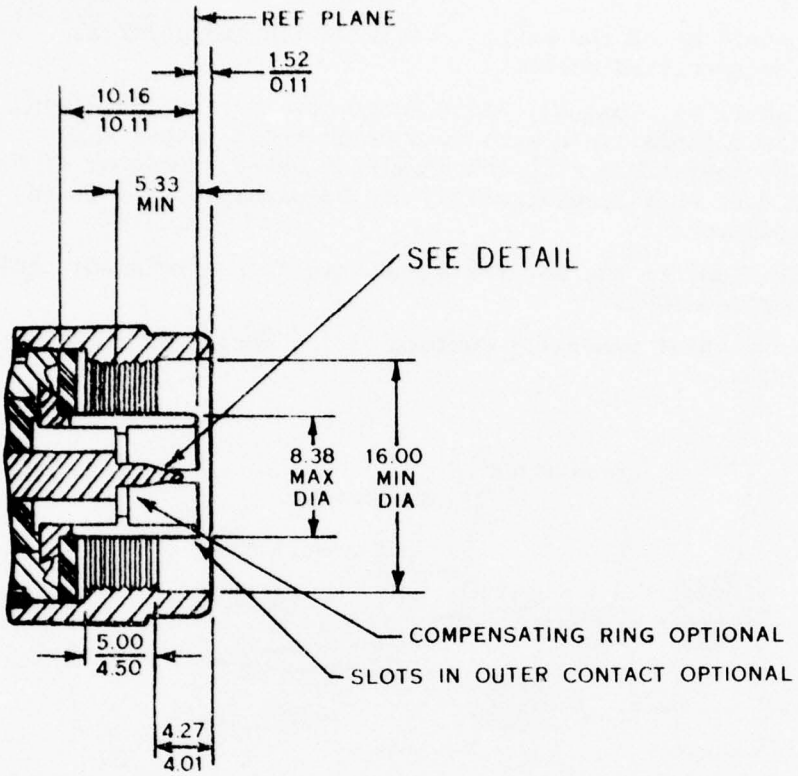
12.2.5 Mating characteristics

See figure 4 for dimensions. Outer contact:

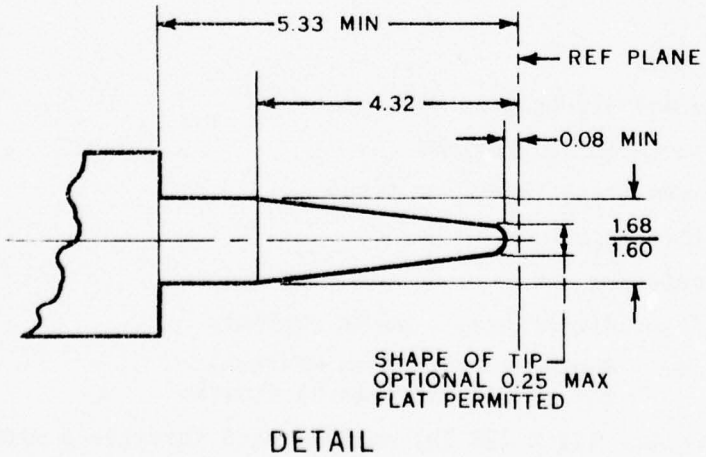
Test ring I.D. - 8.0264 mm (0.316 in maximum)
640 μm (16 micro-inch) finish.

Insertion force - 111 N (25 lb) maximum when inserted a minimum of 2.3622 mm (0.093 in).

Contacts with slotted members: All slotted members shall contact a 8.2296 mm (0.324 in) minimum diameter ring within 0.7874 mm (0.031 in) of their tip ends.



MM	INCHES
0.08	.003
0.25	.010
0.11	.016
1.52	.060
1.60	.063
1.68	.066
3.02	.119
3.15	.124
3.30	.130
4.01	.158
4.27	.168
4.32	.170
4.50	.177
5.00	.197
5.33	.210
8.38	.330
10.11	.398
10.46	.412
16.00	.630



DETAIL

Figure 4. Mating dimensions of connector

12.2.6 Insulation resistance

Method 302, test condition B, MIL-STD-202. 5000 MΩ minimum.

12.2.7 Contact resistance

Centre contact: 1.0 mΩ maximum initial.
1.5 mΩ maximum after shock tests of MIL-STD-202 methods, 202, 204, 213.

12.2.8 Corrosion (salt spray)

Method 101, test condition B, MIL-STD-202.

12.2.9 Voltage Standing Wave Ratio (VSWR)

A swept frequency VSWR test over the range 5 MHz to 30 MHz shall result in a VSWR not exceeding 1.03 at any frequency.

12.2.10 Dielectric withstanding voltage

Method 301 of MIL-STD-202. 2500 V rms at sea level.

12.2.11 RF high potentional withstanding voltage

Voltage and frequency: 1500 V rms at 5 MHz.

12.2.12 Corona level

Voltage - 500 V

Altitude - 70,000 ft.

12.2.13 Contact durability

Insertion and withdrawal force: 500 cycles at 12 cycles/min maximum. The mating force shall meet the mating characteristics requirements.

12.2.14 Barometric pressure (reduced)

Method 105, test condition C, MIL-STD-202.

12.2.15 Vibration, high frequency

Method 204, test condition E, MIL-STD-202. No discontinuities.

12.2.16 Shock

Method 202 of MIL-STD-202. Acceleration: 100 G's at 7 ms. No discontinuities.

12.2.17 Temperature cycling

Method 102, test condition C, MIL-STD-202. Connectors using both 85°C and 200°C cables shall be tested at 200°C only.

12.2.18 Moisture resistance

Method 106 of MIL-STD-202. No measurements at high humidity. Insulation resistance shall be at least 200 MΩ within 5 min after removal from humidity. Dielectric withstanding voltage shall be met.

12.2.19 Cable retention force

400 N (90 lb) minimum.

12.2.20 RF leakage

90 dB minimum, tested at a frequency between 2 and 3 GHz.

12.2.21 Insertion loss

0.15 dB maximum at 10 GHz.

12.2.22 Finish

Centre contacts shall be gold-plated to a minimum thickness of 0.00254 mm (0.0001 in) in accordance with MIL-G-45204 type II Class 2. Silver shall not be used as an underplate. All other metal parts shall be finished so as to provide a connector which meets the corrosion requirements of this specification.

12.2.23 Packaging

Connectors shall be cleaned and dried in accordance with MIL-P-116 or the equivalent commercial practice.

12.2.24 Unit packaging

Connectors shall be individually packaged; assembly instructions shall be included.

12.2.25 Packaging

The packaged connectors shall be packed in shipping containers in a manner that will afford adequate protection against damage during direct shipment from the supply source to Chief Superintendent, Applied Physics Wing, Weapons Research Establishment, Salisbury, South Australia.

12.2.26 Assembly instructions

In addition to assembly instructions to be included in the unit package, a further copy shall be forwarded with the tender documents. Instructions shall include:

(a) Cable preparation - stripping dimensions and tolerances.

(b) List and description of special tools if required.

(c) Pictorial presentation of sub assemblies and loose parts.

(d) Sufficient pertinent dimensions for verification of correct parts; as a minimum the cable entry openings for conductor, dielectric, outer conductor, and jacket shall be specified.

(e) Recommended cable clamp tightening torque.

13. QUALITY ASSURANCE

13.1 Responsibility for inspection

Unless otherwise specified in the contract or purchase order the supplier is responsible for the performance of all inspection requirements as specified. The supplier may use his own or any other facilities suitable for the performance of the inspection requirements.

The Acceptance Officer reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to the prescribed requirements.

13.2 Test equipment and facilities

Test and measuring equipment and inspection facilities shall be established and maintained by the supplier. A calibration system to control the accuracy of the measuring and test equipment shall be maintained.

13.3 *Inspection conditions*

Unless otherwise specified herein, all test inspection conditions shall be performed in accordance with the conditions as follows:

(a) Temperature: $25^{o}C \pm 10^{o}C$

(b) Relative Humidity: 60% ± 15%

(c) Atmospheric pressure: 725 mm ± 75 mm of mercury.

13.4 Methods of examination and test

Test parameters given in the following tests are not to be assumed as the cable operating conditions, temperatures or limits. Methods to pre-condition the cable for normal use are specified in paragraph 13.17. Methods of examination and test given in this specification shall be the only acceptable methods unless an alternative method has been agreed to by the Acceptance Officer prior to the performance of the test. The test methods described herein are the preferred methods.

13.5 Visual and mechanical examination

The cable shall be examined to verify that the design, construction, physical characteristics and dimensions, marking and workmanship are in accordance with the applicable requirements.

13.5.1 Diameter measurements

(a) Inner conductor and outer diameter of outer conductor. Measurements shall be made on a suitable length (300 mm, (12 in minimum) of cable taken from the end of the sample unit. Inner components shall be made accessible by stripping and removing the outer components carefully so as not to nick, cut, cold-work, or otherwise damage the component to be measured. Four points for measurement shall be located 30 to 100 mm (3 to 4 in) apart along the specimen length. Measurements shall be made at each point in two mutually perpendicular planes, so that a total of eight measurements is performed on each specimen. Measurements shall be made with a micrometer, caliper or any other instrument of equal accuracy.

(b) Outer conductor inner diameter. Measurements shall be made on four specimens, each 12 mm (0.5 in) approximately in length, taken from the end of the sample unit. The specimens shall be cut squarely and carefully deburred. Measurements shall be made by means of plug gauges, or an adjustable plug hold gauge and a micrometer, or any other instrument of equal accuracy.

13.5.2 Eccentricity of inner conductor

Lay the sample in a Vee-shaped trough to which a dial indicator has been rigidly fastened in such a manner as to preclude movement of the indicator with respect to the trough, and to allow a reading of the inner conductor position with respect to the outer surface of the cable. Four specimens each approximately 150 mm (6.0 in) long, shall be cut from the end of the sample unit. Prepare the specimen by exposing approximately 6 mm (0.250 in) of the inner conductor at one end of each specimen. The dial indicator shall be capable of yielding a resolution of at least 0.0025 mm (0.0001 in). The specimen shall be slowly rotated in the trough and the difference in dial indicator readings shall be noted through a rotation of 360^{o}. Care shall be taken to avoid bending the inner conductor during the rotation operation. The differences in the dial indicator reading is the total indicator reading (TIR), from which the % eccentricity

may be computed using the following formula:

$$\% \text{ Eccentricity} = \frac{\text{Difference in dial indicator readings}}{\text{Measured inner diameter of outer conductor}} \text{ X100}$$

13.5.3 Adhesion of conductors

(a) Two specimens of each cable shall be cut from the end of the sample unit. Each specimen shall be prepared as shown in figure 5. Stripping shall be done carefully; no more than 6 mm (0.250 in) of material shall be removed at one time.

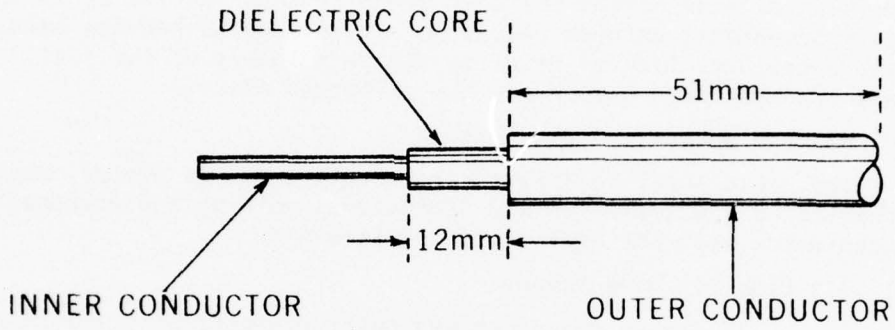


Figure 5. Stripping dimensions for cable

(b) The adhesion test shall be performed with a tensile tester and a test fixture such as shown in figure 6. The diameter of the hole in the test plate shall be such that there is a clearance of 0.1016 mm ± 0.0254 mm (0.004 ± 0.001 in) larger than the diameter of the dielectric core. The inner conductor extending through the test plate hold shall be pulled with a constantly increasing force at a rate not to exceed 12 mm (0.5 in) per minute. Avoid sudden pulls and jerking. Conductor adhesion shall be defined as the highest tensile tester reading obtained before either conductor-to-core bonds are broken. In performing this test, physical handling of the specimen shall be kept to a minimum to avoid specimen degration.

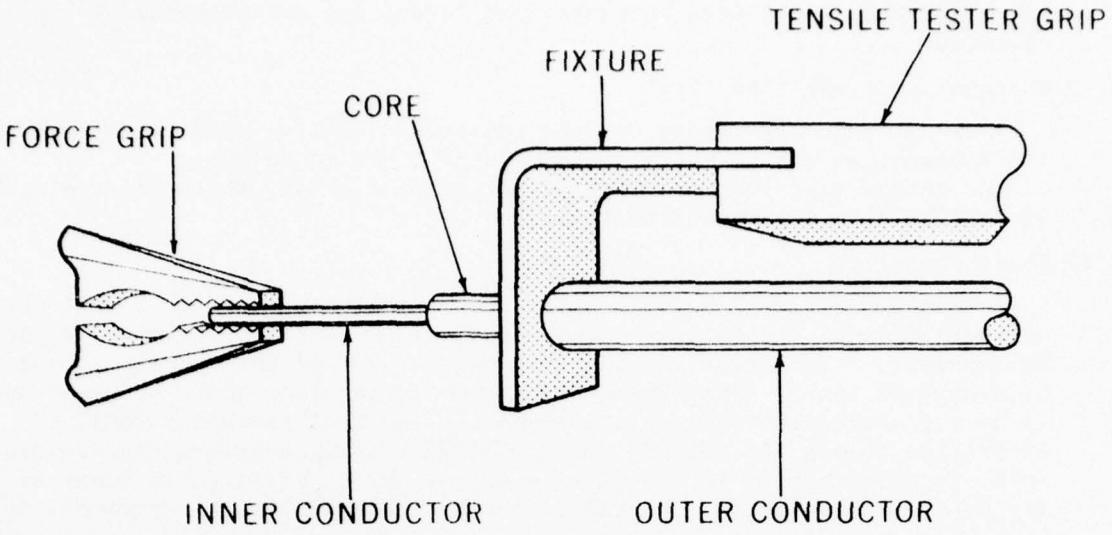


Figure 6. Typical text fixture

13.6 Continuity

To establish continuity, 25 V dc maximum shall be applied to both ends of each conductor of the cable through an appropriate indicator, such as an ohmmeter, light, or buzzer. The test voltage may be applied to the conductors individually or in series.

13.7 Voltage withstanding

The specimen shall be tested in accordance with method 6111 per FED-STD-228, except that the specimen shall not be immersed in water but tested dry. The test voltage of 3.5 kV at a frequency between 48 Hz to 62 Hz shall be applied to all samples for a minimum of 1 min. The test voltage shall be applied between the inner and the outer conductor, with the outer conductor grounded (earthed).

13.8 Insulation resistance

The specimen shall be tested in accordance with method 6031 per FED-STD-228, except that the cable shall not be immersed in water but tested dry. The following details shall apply:

(a) The length of the specimen shall be sufficient to insure that the insulation resistance at the specified limit shall cause at least one scale division of deflection on the equipment used. The tolerance on the measurement of the cable shall be ±10%.

(b) The test voltage applied shall be 200 V dc minimum, with the polarity of the voltage source being optional.

(c) The test voltage shall be applied between the inner and outer conductor, with the outer conductor grounded.

13.9 Characteristic impedance

The specimen shall be 3 m (10 ft) minimum and shall be prepared for testing by assembling appropriate connections to the cable ends. The equipment shall include a Time Domain Reflectometer (TDR). The rise time of the TDR shall be 150 picoseconds or less, and the vertical sensitivity of the system shall provide for a minimum resolution of one major scale division. A precision air-line of the same nominal characteristic impedance as the specimen shall be connected between the TDR and the connector-cable assembly. The characteristic impedance of the specimen

shall then be measured compared to the precision air-line. The connector-cable assembly shall then be turned end-to-end and the measurement repeated.

13.10 Attenuation (insertion loss)

A swept-frequency insertion loss technique shall be used to determine the attenuation within the frequency range 6 MHz to 30 MHz.

The method described in MIL-C-17 paragraph 4.8.8 is the preferred method for determining the insertion loss.

13.11 Phase stability

A specimen 15 m ± 2 m (50 ± 5 ft) long, shall be placed in a heat chamber at room ambient temperature. One end shall be left short circuited inside the chamber. The other end shall be brought out of the chamber to one end of a slotted line. The other end of the slotted line shall be connected to an r-f oscillator through a 5 dB pad. The test frequency shall be maintained during the test at 400 ± 0.01 MHz, using a heterodyne frequency meter lossely coupled to the oscillator, or any other suitable means of frequency measurement. The SWR of the system, without the specimen, shall be less than 1.01 at 400 MHz when terminated with a 50 Ω load. Using the probe position of the null of the standing wave indicator as a reference, the change in the position of probe is observed while the temperature in the chamber is varied through the applicable temperature cycle as specified. The difference between the reference null at each temperature is taken as the change in electrical length of the specimen. Measurements shall be made initially and at each step of the respective temperature cycle. The coefficient of change in electrical length shall be determined from the following formula:

$$K = \frac{\Delta V \times VP \times 10^6}{\Delta T \times L}$$

where K = Coefficient of change in electrical length, in parts per million per ^{o}C (PPM/^{o}C).

ΔV = Change in probe position.

VP = Velocity of propagation of the dielectric core, expressed as a fraction.

ΔT = Difference in temperature, between test temperature and reference temperature, in ^{o}C.

L = Length of the specimen inside the heating chamber.

13.12 Velocity

The VP in a cable may be found by resonating a lenfth of cable at 100 MHz or more, with one end short-circuited or open-circuited in accordance with the following formula:

$$\% VP = \frac{f_r \times \text{Cable length (m)}}{7.5 \times N} = \frac{f_r \times \text{Cable length (ft)}}{2.46 \times N}$$

where N = Number of quarter wavelengths in the cable specimen.

f_r = Resonant frequency (MHz).

13.13 Outer conductor integrity

Four specimens, approximately 600 mm (2 ft) long, shall be cut from the sample unit. The specimens shall be suspended in a heat chamber without touching one another or the walls of the chamber and conditioned for 1-1/2 hours minimum at the specified test temperature of 85°C. Heated air shall be circulated so as to maintain a uniform test temperature. After the conditioning period, the specimens shall be removed from the heat chamber and conditioned at room ambient temperature for 4 hours minimum. Examine the specimens for cracks, flaws, or other damage in the outer conductor material.

13.14 Dimensional stability

The specimen shall be 1 m (3 ft) minimum.

(a) Equipment - A surface measuring machine equal to a Rank-Taylor-Hobson "Tallysurf" and a replica kit for making casts shall be used.

(b) Procedure - The ends of the specimen shall be cut squarely and carefully deburred, debris removed and the cable ends cleaned suitably for casting.

(c) A cast of the end profile shall be made of both ends using a replica kit, the profiles should be identified. A measurement of the cast surface shall be taken at room ambient temperature, using the "Tallysurf" and recording the trace of the profiles.

(d) The specimen shall be placed in a heat chamber, coiled or straight, and conditioned for 6 hours minimum at +85°C test temperature. Heated air shall be circulated so as to maintain a uniform test temperature. After the conditioning period, the specimen shall be removed from the heat chamber and conditioned at room ambient temperature for 4 hours minimum.

(e) Using the replica kit make a second casting and repeat the measurement test as in paragraph (c). Compare the recorded traces for protrusion or contraction of the inner conductor. The measurement at each end shall not exceed 25 μm.

13.15 Bendability

Two specimens, each approximately 1 m long, shall be cut from the sample unit. The middle section of the specimen shall be formed for two complete turns around a mandrel of diameter 100 mm. (Although no special tools are needed to guide the cable as it coils around the mandrel, a mechanism may be provided so as to avoid any damage to the outer conductor). Remove the coiled specimen from the mandrel and examine the outer surface for cracks, splits, fracturing, wrinkling or other damage.

13.16 Inspection

Materials inspection, in-process inspection and quality inspection, prior to acceptance, shall be performed, the minimum requirements are specified herein.

13.16.1 Materials inspection

Materials inspection shall consist of certification supported by verifying data that the materials as listed and used in fabricating the cables and delay lines are in accordance with the applicable referenced specification or requirements of this specification, prior to fabrication.

Polyethylene; Aluminium tubing, seamless; Wire, aluminium, copper-clad; Nylon; R.F. Connectors.

13.16.2 In-process inspection

During manufacture of cable, the following tests shall be performed:

Continuity, Voltage withstanding (see paragraphs 13.6, 13.7).

13.16.3 Quality inspection

Samples shall be subjected to the inspections specified as follows:

In-process inspection (see paragraph 13.16.2 above).

Visual and mechanical examination, including physical dimensions (see paragraph 13.5).

Workmanship (see paragraph 5).

Insulation resistance (see paragraph 13.8).

Characteristic impedance (see paragraph 13.9).

Attenuation (see paragraph 13.10)

Phase stability (see paragraph 13.11)

Velocity (see paragraph 13.12).

Outer conductor integrity (see paragraph 13.13).

Dimensional stability (see paragraph 13.14).

Bendability (see paragraph 13.15).

13.16.4 Inspection lot

(a) The inspection lot shall consist of the number of units of product, offered for inspection at one time. All of the units of product in the inspection lot submitted shall have been produced during the same production period with the same materials and processes.

(b) A unit of product shall be 1600 m of cable, or varied by agreement with the Acceptance Officer.

(c) If a sample fails to pass inspection, the supplier shall take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same conditions. Acceptance of the product shall be discontinued until corrective action, acceptable to the Acceptance Officer, has been taken.

13.17 Pre-conditioning

Cable intended for use in the assembly of delay lines shall be pre-conditioned for normal use.

(a) Two methods shall be acceptable

(1) by the elapse of time (a few weeks) after manufacture, or

(2) a pre-conditioning cycle as specified herein.

(b) The mandatory exception to method (1) shall be those delay lines specified by sheets WRE-SP-1918/01 to WRE-SP-1918/04 inclusive, WRE-SP-1918/06 and WRE-SP-1918/07; such assemblies shall be pre-conditioned as specified in (c) below.

(c) The pre-conditioning procedure shall consist of three of the following temperature cycles:

(1) Step 1: Heat the cable to the temperature specified for the outer conductor integrity test and maintain for 1 hour minimum.

(2) Step 2: Return cable to room ambient temperature. Trim protruding core, if any, flush with the edge of the outer conductor.

(3) Step 3: Maintain cable at room temperature for 1 hour minimum.

(4) Step 4: Cool cable to -45°C and maintain for 1 hour minimum.

(5) Step 5: Return cable to room temperature and maintain for 1 hour minimum.

After the last temperature cycle (15 steps), maintain the cable at room temperature for 24 hours minimum before proceeding with further processing.

13.18 Acceptance

In addition to any standard clauses that may apply in a contract acceptance and purchase order the following acceptance procedures shall also apply:

Stage (1) Acceptance prior to shipment, at the Seller's plant by the Chief Superintendent, Applied Physics Wing, Weapons Research Establishment or his delegate (Acceptance Officer).

Stage (2) Final acceptance, after delivery to such a location as specified by Chief Superintendent, Applied Physics Wing, Weapons Research Establishment.

Stage (1) The Acceptance Officer shall be required to liaise with the Quality Assurance manager or his delegate, and be given reasonable access to data and facilities, to the extent that the Acceptance Officer may successfully oversight fabrication, processing, assembly, inspection, test and packaging prior to the shipment of cable and delay line assemblies.

Stage (2) General standard inspection and acceptance procedures as required by the contract acceptance and purchase order shall apply.

14. PACKAGING

Bulk quantities of cable shall be shipped on reels (drums) whose diameters shall be large enough to preclude the flattening of the cable and to prevent damage to the cable from reeling and unreeling.

14.1 Cable end treatment

For inspection and testing purposes, both ends of all cable lengths on the reels shall be brought out from the packages and secured. The ends of all cable lengths shall be moisture-proof sealed.

14.2 Reels (drums)

(a) Reels shall be constructed of wood, wood and metal, or metal, and shall be of the nonreturnable (single trip) type. All reel parts shall be of such quality and durability and mounted in such a manner that they shall not become loosened or damaged by shock and vibration encountered during transportation.

(b) The arbor hole in wood reels 1 m in diameter and larger shall be reinforced with a substantial metal bushing or metal plate to prevent excessive wear due to reeling and unreeling.

(c) A clean and smooth face shall be presented to the cable; scratches, nicks and dents in the nylon outer jacket will not be acceptable, chalk, powder or similar materials to improve the "slip" may be used to coat the reel inside faces.

14.3 Coils

Coils shall be preserved and packaged in accordance with the suppliers standard practice.

14.4 Straight short assemblies

Assemblies under 6 m long shall be preserved and packaged in boxes, suitably designed and constructed to protect the assemblies against shock and vibration encountered during transport. Connectors shall be fitted with covers to prevent the ingress of foreign materials and moisture.

14.5 Reel contents

Suitable labels shall be affixed showing the contents of the reel. Lenghts of cable supplied to this specification shall have a plus tolerance, a minus tolerance will not be acceptable.

APPENDIX I

SCHEDULE OF QUANTITIES

Item	Cable type	Form and packing	Quantity	Notes
1	1	Reels @ 1540 m	67	10 x 154 m lengths
2	1	Reels @ 1568 m	4	14 x 112 m lengths
3	1	Reels @ 638 m	1	2 x 154 + 3 x 110 m lengths
4	1	Reels @ 1278 m	22	Continuous length
5	1	Reels @ 1108 m	4	Continuous length
6	1	Reels @ 938 m	4	Continuous length
7	1	Reels @ 1536 m	2	2 x 768 m lengths
8	1	Reels @ 1196 m	2	2 x 598 m lengths
9	1	Reels @ 1712 m	1	4 x 428 m lengths
10	1	Reels @ 1384 m	1	4 x 258 + 4 x 88 m lengths
11(Option 1)	1	Reels @ 1300 m	35	Continuous length
11(Option 2)	1	Reels @ 1400 m	5	7 x 200 m lengths
12	1	Reels @ 529 m	1	Continuous length
13	1	Reels @ 1500 m	4	10 x 150 m lengths
14	1	Reels @ 1700 m	2	Various lengths
15	1	Assembly: WRE-SP-1918/01	518	1 m lengths
16	1	Assembly: WRE-SP-1918/03	518	4 m lengths
17	1	Assembly: WRE-SP-1918/02	20	2 m lengths
18	2	Assembly: WRE-SP-1918/04	918	0.428 m lengths
19	2	Assembly: WRE-SP-1918/05	476	0.6 m lengths
20	2	Assembly: WRE-SP-1918/06	17	0.648 m lengths
21	2	Assembly: WRE-SP-1918/07	918	0.855 m lengths
22	2	Assembly: WRE-SP-1918/08	17	1.296 m lengths
23	2	Assembly: WRE-SP-1918/09	374	1.5 m lengths
24	2	Assembly: WRE-SP-1918/10	918	1.711 m lengths
25	2	Assembly: WRE-SP-1918/11	17	2.592 m lengths
26	2	Assembly: WRE-SP-1918/12	34	3 m lengths
27	2	Assembly: WRE-SP-1918/13	442	3.422 m lengths
28	2	Assembly: WRE-SP-1918/14	17	5.184 m lengths
29	2	Assembly: WRE-SP-1918/15	204	6.843 m lengths
30	2	Assembly: WRE-SP-1918/16	17	10.368 m lengths
31	2	Assembly: WRE-SP-1918/17	68	13.686 m lengths
32	2	Assembly: WRE-SP-1918/18	17	20.736 m lengths
33	2	Assembly: WRE-SP-1918/19	34	27.373 m lengths
34	2	Assembly: WRE-SP-1918/20	17	41.472 m lengths

35. Connectors (in addition to those required for assemblies): 1914

Totals: Cable length - type 1: Reel lengths (1) 210379 m (2) 171879 m
Assemblies 2630 2630
213009 m 174509 m

Cable length - type 2: Assemblies 10000 m (approx.)

Assemblies: 5561

Connectors: Assemblies 11122
For on site installation 1914
(including spares)
13036

NOTE: Items 15 to 34 inclusive are for delay lines specified in terms of an electrical length between reference planes. Quoted physical lengths assume 81% velocity factor.

APPENDIX II

MEASUREMENT OF DELAY-LINE ELECTRICAL LENGTH

Equipment required for this method is as follows:

Vector voltmeter, HP 8405A and accessories
Signal generator, HP 8640B or similar
Frequency counter (if signal generator does not have one inbuilt)
Pads and loads as indicated.

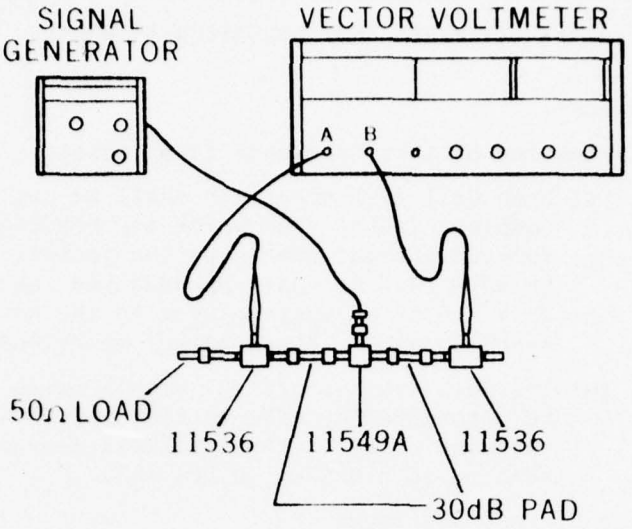
The equipment is set up as shown in figure II.1. The procedure is to first connect a 50 Ω load at X and set the vector voltmeter phase adjustment to zero (on the $\pm 6^{o}$ range), at about the frequency expected for resonance of the delay-line to be measured. The delay line to be measured is then connected in place of the load at X, with its free end either open-circuited or short-circuited. (If the latter, the short circuit used must place the short at the connector reference plane or else a correction must be made for any additional length introduced. An open-circuited type-N connector gives an effective open-circuit very close to the connector reference plane). The frequency is adjusted to give a minimum magnitude on probe B and a zero phase reading. This frequency, f_r (in MHz) is then used to calculate the electrical length, L, from

$$L = \frac{74.948\ N}{f_r}$$

where N is the number of quarter wavelengths in the resonant length of line. N is even if the line is short-circuited, odd if it is open-circuited. The system should be rechecked for phase zero with the load at X : if the pads are nominally identical the frequency sensitivity of the zeroing should be very small.

The theory on which the method is based is as follows. The initial nulling of phase removes the effect of any inequality in electrical length between the power splitter and the two probes. The pads serve to isolate the probes from each other. With a load at X, both probes read the forward wave amplitude, E_F. With the open- or short-circuited line connected at X, the voltage at B is the sum of forward and reflected waves, E_F and E_R, as indicated in figure II.2 whereas probe A continues to read E_F. With the frequency adjusted so that E_F and E_R are 180^{o} out of phase the magnitude reading at B is a minimum and the phase is zero. Thus the effective impedance at B is a minimum and the formula quoted follows from the usual rules for impedance transformation.

The length L, is measured from the position of probe B to the end of the delay-line, so a correction must be subtracted to give the delay-line length between reference planes. This correction is most conveniently determined by measuring an air-line whose electrical length is accurately known. The difference between the measured and quoted electrical lengths is the correction to be applied.



Figuration II.1. Equipment configuration

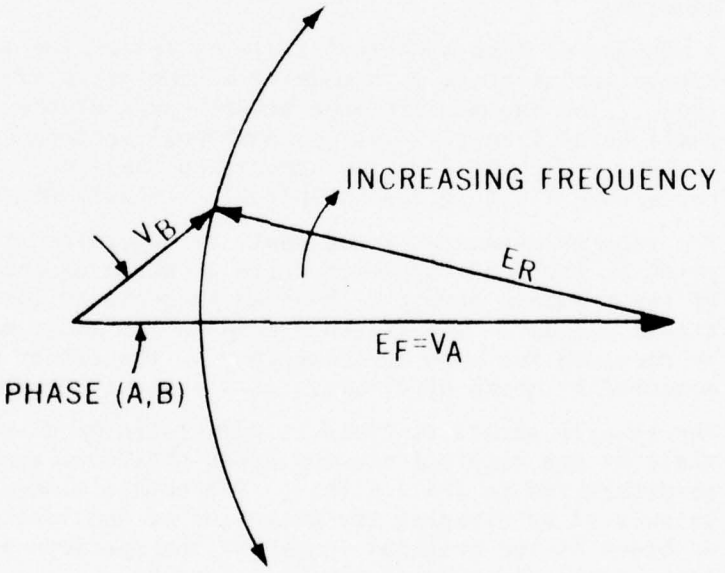


Figure II.2. Phasor relationships

APPENDIX III

INSECT RESISTANT JACKET: TYPE 1 CABLE - TENSILE STRENGTH AT YIELD AND ELONGATION AT BREAK

III.1 Test specimens

III.1.1 Preparation of test specimens from jacket

(a) Dumb-bell test specimens shall be cut from a portion of the complete jacket from which any bonding compound has been removed without damage to the jacket. Die "D" as specified in ASTM D412-66 shall be used and ink marks with centres 25.4 ± 0.08 mm apart placed on the narrow portion of the specimen with a bench marker described in the above methods.

(b) The mean cross-sectional area between the ink marks shall be determined by calculation from the smallest width and the mean value of the thickness measured with a micrometer reading to 0.025 mm (0.001 in).

III.2 Conditioning of test specimens

All test specimens shall be kept in an atmosphere of 65 ± 5% relative humidity at a temperature of 20 ± 1°C for a period of not less than 16 hours immediately before being tested.

III.3 Methods

(a) The temperature of test shall be 20 ± 5°C. The test shall be made within five minutes of removing the test specimen from the conditioning atmosphere and the test specimen shall receive a minimum of handling.

(b) A minimum of five specimens shall be tested for load at yield and elongation at break on a machine having grips of the self-tightening type. The maximum distance between jaws of the testing machine shall be 63.5 mm (2.5 in) for dumb-bell specimens cut from the jacket. The speed of jaw separation shall be 5.08 mm (0.20 in) per minute ± 25%, given as speed 'B' in ASTM D638.

(c) The tensile stress at yield shall be determined from the first point on the load-extension curve at which an increase in elongation of the specimen occurs without an increase in load. (See figure III.1). The distance between the gauge marks at break shall be recorded for each test specimen. The latter may be conveniently measured by means of dividers on a suitably graduated ruler.

(d) The tensile stress at yield is calculated by dividing the load at yield by the original minimum cross-sectional area of the specimen as determined in III.1.1 (b). Percentage elongation at break is calculated by dividing the extension of the specimen at the moment of break by the original length of the specimen as measured between gauge marks and multiplying by a hundred.

$$\text{Tensile Stress at yield} = \frac{\text{load at yield}}{\text{original cross-sectional area}} \quad (\text{kn/m}^2)$$

$$\text{Elongation at break} = \frac{\text{extension at break x 100}}{\text{original length}}$$

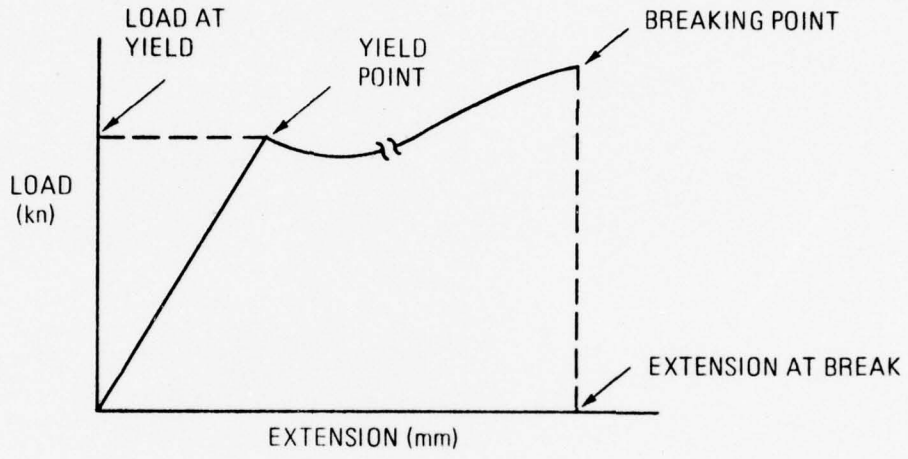
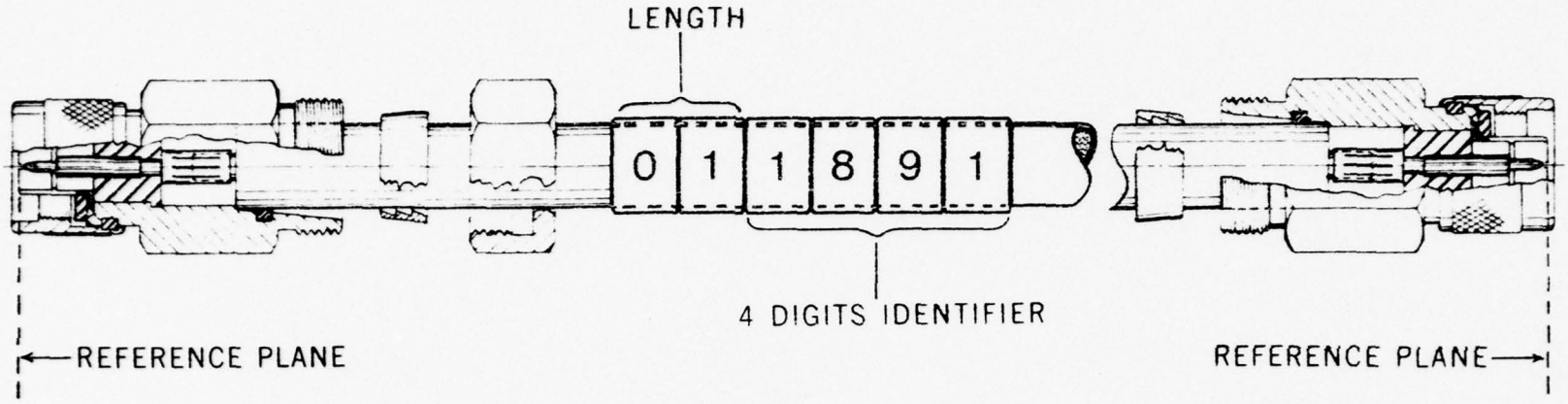


Figure III.1. Typical load/extension curve in tension of nylon showing load at yield for Die D test specimens

SPECIFICATION SHEETS WRE-SP-1918/01 TO WRE-SP-1918/20

All lengths quoted on this page are electrical lengths between reference planes

	Metres		Identification sleeve numbers
WRE-SP-1918/01	1.235	± 5 mm	1001 to 1518 incl.
02	2.469	± 3 mm	1519 to 1538 incl.
03	4.938	± 5 mm	1539 to 2056 incl.
04	0.528	± 2 mm	2057 to 2974 incl.
05	0.741	± 2 mm	2975 to 3450 incl.
06	0.800	± 2 mm	3451 to 3467 incl.
07	1.056	± 2 mm	3468 to 4385 incl.
08	1.600	± 2 mm	4386 to 4402 incl.
09	1.852	± 2 mm	4403 to 4776 incl.
10	2.112	± 2 mm	4777 to 5694 incl.
11	3.200	± 2 mm	5695 to 5711 incl.
12	3.704	± 2 mm	5712 to 5745 incl.
13	4.224	± 3 mm	5746 to 6187 incl.
14	6.400	± 3 mm	6188 to 6204 incl.
15	8.448	± 3 mm	6205 to 6408 incl.
16	12.800	± 4 mm	6409 to 6425 incl.
17	16.896	± 4 mm	6426 to 6493 incl.
18	25.600	± 4 mm	6494 to 6510 incl.
19	33.792	± 5 mm	6511 to 6544 incl.
20	51.200	± 5 mm	6545 to 6561 incl.



Constructional details:

1. Cable Assembly: Type 3

2. Connectors: Coaxial R.F. Series, "N" Male Plug straight, as specified in para 12, rear nut torque loaded to specification.

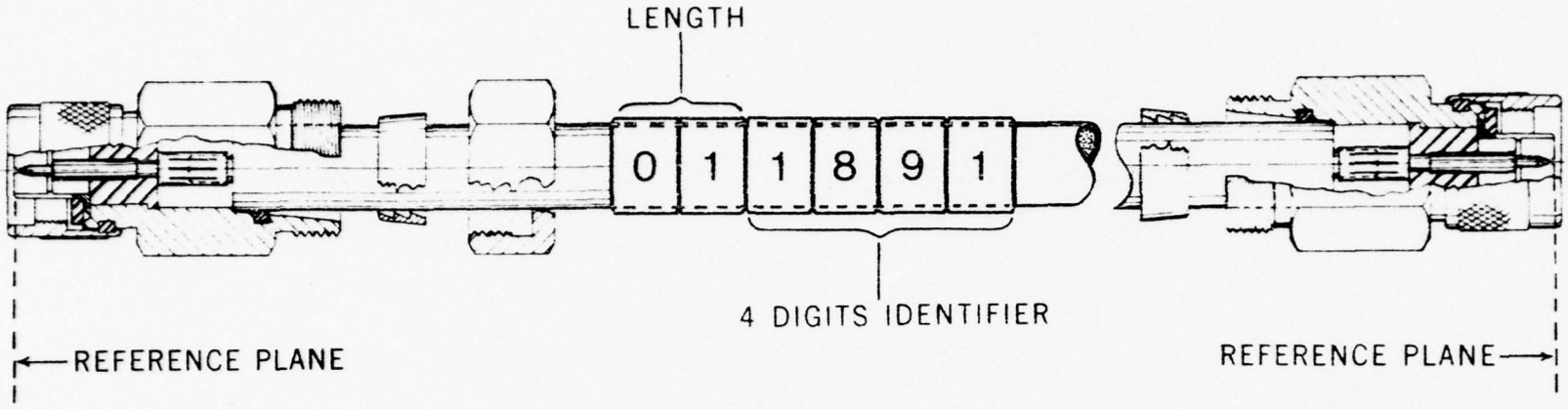
3. Assembly length: Designated by first two digits of identifier group.
This sheet refers to 1.235 m ± 5 mm electrical length measured from the reference planes (see sketch above).

4. Identification: A group of six sleeves shall be fitted.
(1) centrally placed when assembly under 1 m long.
(2) two groups adjacent to connectors when assembly longer than 1 m.
Sleeves shall be numerical, ascending, sequential.
Most significant figure nearest connector, if two groups used.
All assemblies made to this sheet shall bear identifiers as follows:
first two digits = 01 remaining four digits = 1001 to 1518 inclusive.

5. Preconditioning: A preconditioning cycle specified at para 13.17 (c) shall be applied to the cable prior to trimming.

WRE SPECIFICATION SHEET
DELAY LINE ASSEMBLY

WRE-SP-1918/02
1977



Constructional details:

1. Cable Assembly: Type 3

2. Connectors: Coaxial R.F. Series, "N" Male Plug straight, as specified in para 12, rear nut torque loaded to specification.

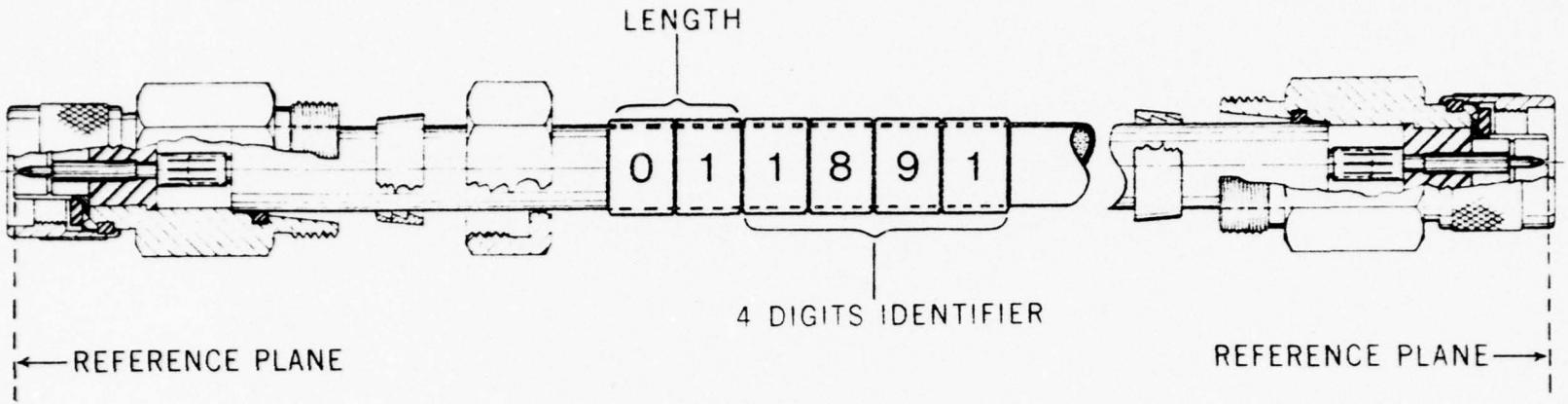
3. Assembly length: Designated by first two digits of identifier group.
This sheet refers to 2.469 m ± 3 mm electrical length measured from the reference planes (see sketch above).

4. Identification: A group of six sleeves shall be fitted.
(1) centrally placed when assembly under 1 m long.
(2) two groups adjacent to connectors when assembly longer than 1 m.
Sleeves shall be numerical, ascending, sequential.
Most significant figure nearest connector, if two groups used.
All assemblies made to this sheet shall bear identifiers as follows:
first two digits = 02 remaining four digits = 1519 to 1538 inclusive.

5. Preconditioning: A preconditioning cycle specified at para 13.17 (c) shall be applied to the cable prior to trimming.

WRE SPECIFICATION SHEET
DELAY LINE ASSEMBLY

WRE-SP-1918/03
1977



Constructional details:

1. Cable Assembly: Type 3

2. Connectors: Coaxial R.F. Series, "N" Male Plug straight, as specified in para 12, rear nut torque loaded to specification.

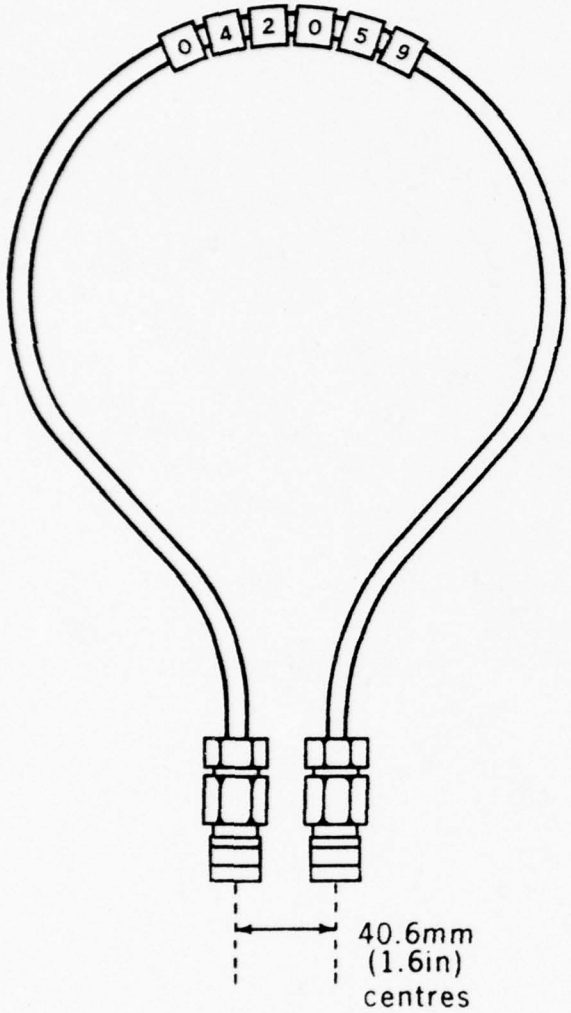
3. Assembly length: Designated by first two digits of identifier group.
This sheet refers to 4.938 m ± 5 mm electrical length measured from the reference planes (see sketch above).

4. Identification: A group of six sleeves shall be fitted.
(1) centrally placed when assembly under 1 m long.
(2) two groups adjacent to connectors when assembly longer than 1 m.
Sleeves shall be numerical, ascending, sequential.
Most significant figure nearest connector, if two groups used.
All assemblies made to this sheet shall bear identifiers as follows:
first two digits = 03 remaining four digits = 1539 to 2056 inclusive.

5. Preconditioning: A preconditioning cycle specified as para 13.17 (c) shall be applied to the cable prior to trimming.

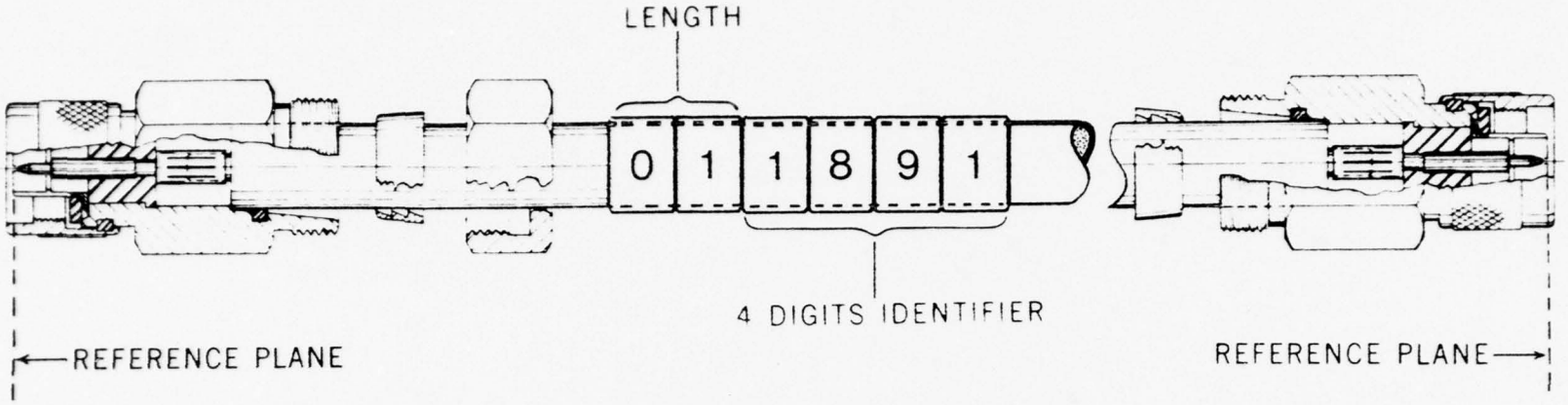
WRE SPECIFICATION SHEET
DELAY LINE ASSEMBLY

WRE-SP-1918/04
1977



Constructional details:

1.	Cable Assembly:	Type 2
2.	Connectors: 1	Coaxial R.F. Series, "N" Male plug straight, as specified in para 12, rear nut torque loaded to speicification.
3.	Assembly length:	Designated by first two digits of identifier group. This sheet refers to 0.528 m ± 2 mm electrical length measured from the reference planes.
4.	Identification:	A group of six sleeves shall be fitted, centrally positioned. Sleeves shall be numerical, ascending, sequential. All assemblies made to this sheet shall bear identifiers as follows: first two digits = 04 remaining four digits = 2057 to 2974.
5.	Preconditioning:	After bending and before final trimming to electrical length, this assembly, shall be pre-conditioned as specified in para 13.17 (c).



Constructional details:

1. Cable Assembly: Type 1

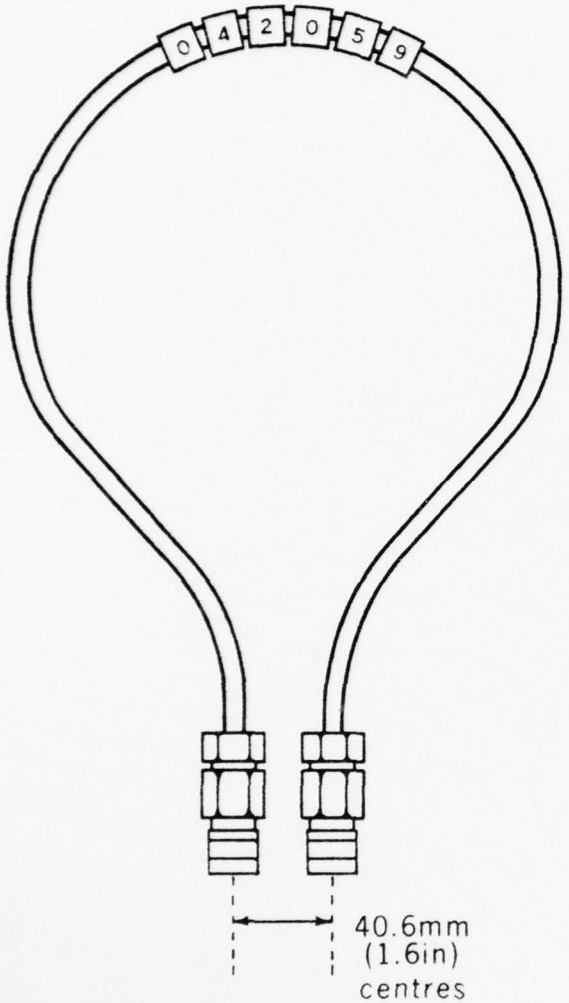
2. Connectors: Coaxial R.F. Series "N" Male Plug straight, as specified in para 12, rear nut torque loaded to specification.

3. Assembly length: Designated by first two digits of identifier group.
This sheet refers to 0.741 m ± 2 mm electrical length measured from the reference planes (see sketch above).

4. Identification: A group of six sleeves shall be fitted.
(1) centrally placed when assembly under 1 m long
(2) two groups adjacent to connectors when assembly longer than 1 m.
Sleeves shall be numerical, ascending, sequential.
Most significant figure nearest connector, if two groups used.
All assemblies made to this sheet shall bear identifiers as follows:
first two digits = 05 remaining four digits = 2975 to 3450 inclusive.

WRE SPECIFICATION SHEET
DELAY LINE ASSEMBLY

WRE-SP-1918/06
1977

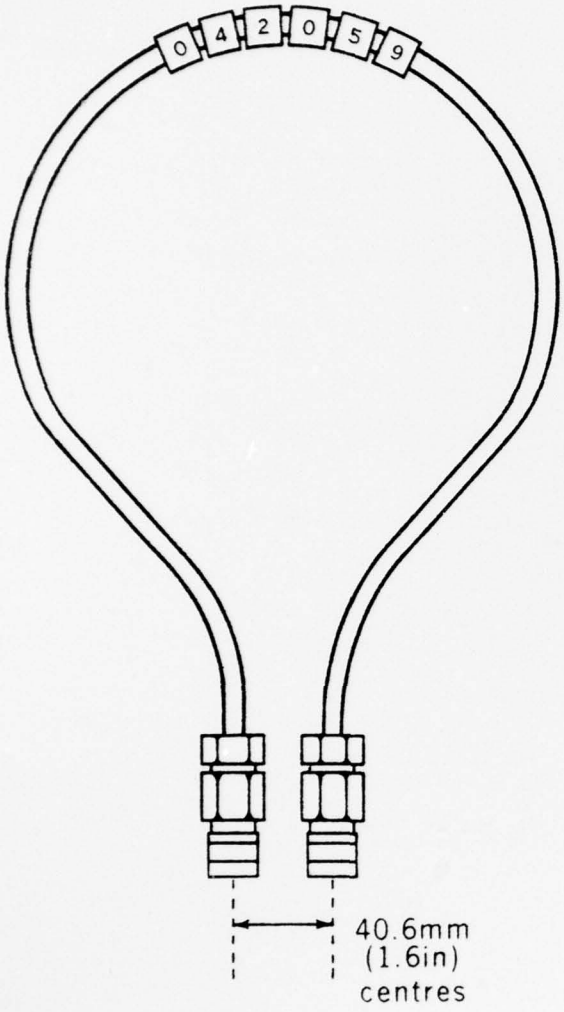


Constructional details:

1.	Cable:	Type 2 Aluminium smooth sheath.
2.	Connectors:	Coaxial R.F. Series, "N" Male plug straight, rear nut torque loaded to Specification.
3.	Assembly length:	Designated by first two digits of identifier group. This sheet refers to 0.800 ± 2 mm electrical length measured from the reference planes.
4.	Identification:	A group of six sleeves shall be fitted, centrally positioned. Sleeves shall be numerical, ascending, sequential. All assemblies made to this sheet shall bear identifiers as follows: first two digits = 06 remaining four digits = 3451 to 3467 inclusive.
5.	Preconditioning:	After bending and before final trimming to electrical length, this assembly, shall be pre-conditioned as specified in para 11.17 method (2).

WRE SPECIFICATION SHEET
DELAY LINE ASSEMBLY

WRE-SP-1918/07
1977



Constructional details:

1. Cable Assembly: Type 2

2. Connectors: Coaxial R.F. Series, "N" Male plug straight, as specified in para 12, rear nut torque loaded to Specification.

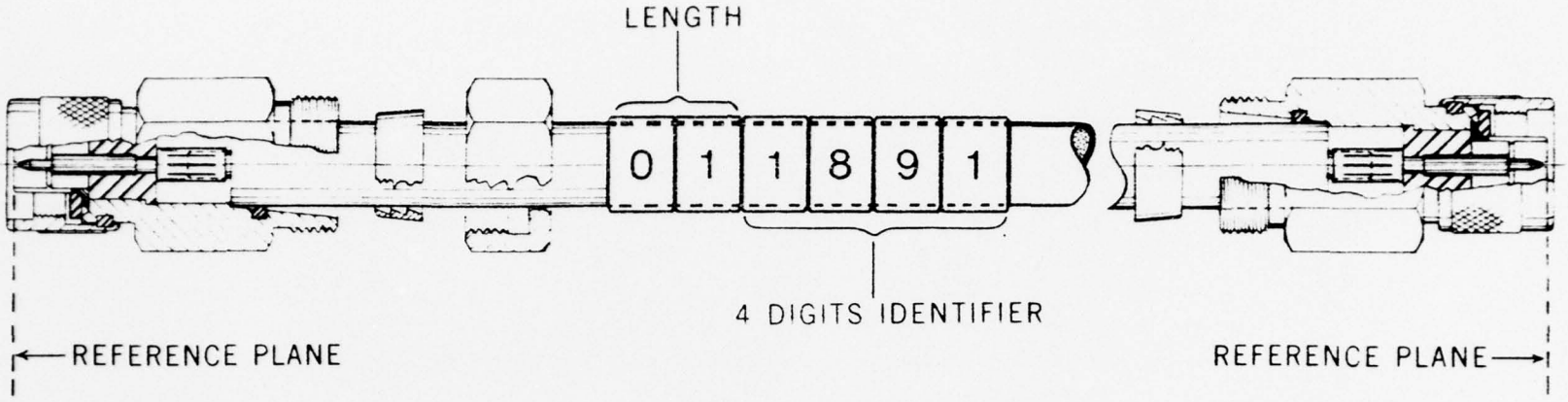
3. Assembly length: Designated by first two digits of identifier group. This sheet refers to 1.056 m ± 2 mm electrical length measured from the reference planes.

4. Identification: A group of six sleeves shall be fitted, centrally positioned. Sleeves shall be numerical, ascending, sequential. All assemblies made to this sheet shall bear identifiers as follows:
first two digits = 07
remaining four digits = 3468 to 4385 inclusive.

5. Preconditioning: After bending and before final trimming to electrical length, this assembly, shall be pre-conditioned as specified in para 13.17(c).

WRE SPECIFICATION SHEET
DELAY LINE ASSEMBLY

WRE-SP-1918/08
1977



Constructional details:

1. Cable Assembly: Type 1

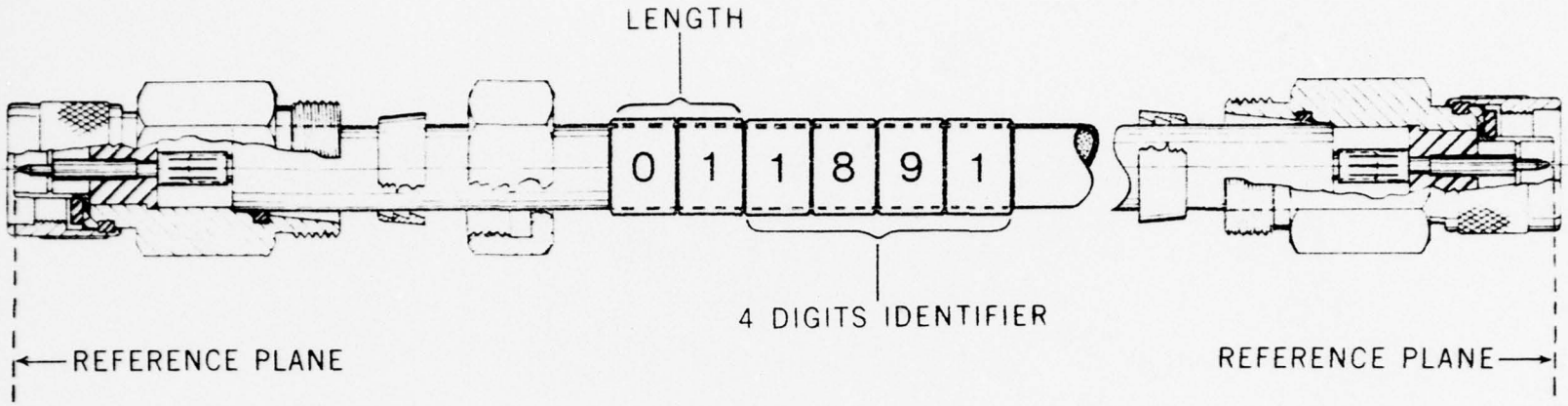
2. Connectors: Coaxial R.F. Series "N" Male Plug straight, as specified in para 12, rear nut torque loaded to specification.

3. Assembly length: Designated by first two digits of identifier group.
This sheet refers to 1.600 m ± 2 mm electrical length measured from the reference planes (see sketch above).

4. Identification: A group of six sleeves shall be fitted.
(1) centrally placed when assembly under 1 m long
(2) two groups adjacent to connectors when assembly longer than 1 m.
Sleeves shall be numerical, ascending, sequential.
Most significant figure nearest connector, if two groups used.
All assemblies made to this sheet shall bear identifiers as follows:
first two digits = 08 remaining four digits = 4386 to 4402 inclusive.

WRE SPECIFICATION SHEET
DELAY LINE ASSEMBLY

WRE-SP-1918/09
1977



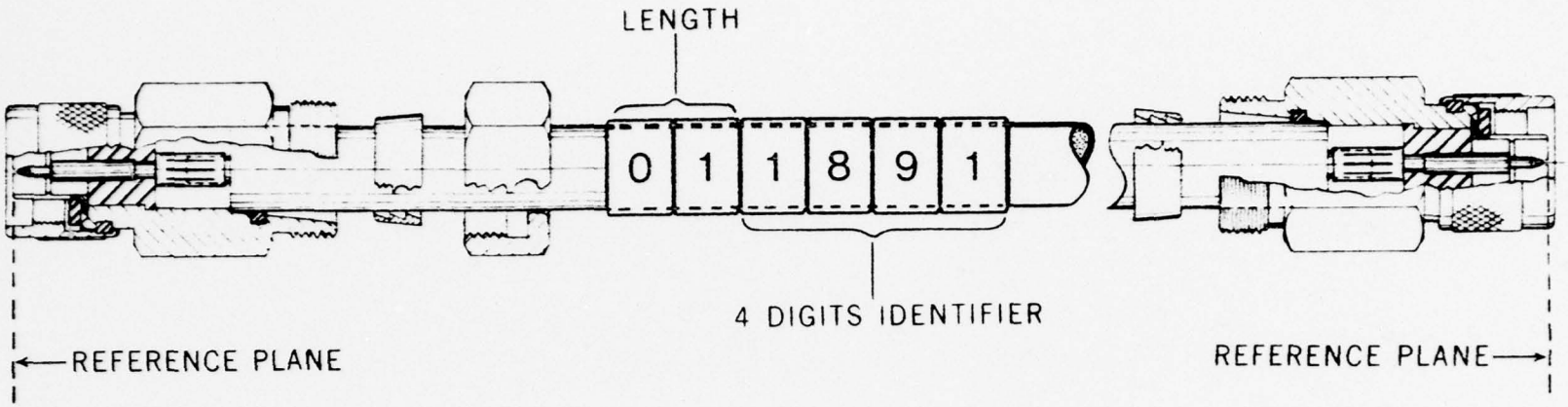
Constructional details:

1. Cable Assembly: Type 1

2. Connectors: Coaxial R.F. Series "N" Male Plug straight, as specified in para 12, rear nut torque loaded to specification.

3. Assembly length: Designated by first two digits of identifier group.
This sheet refers to 1.852 m ± 2 mm electrical length measured from the reference planes (see sketch above).

4. Identification: A group of six sleeves shall be fitted.
(1) centrally placed when assembly under 1 m long
(2) two groups adjacent to connectors when assembly longer than 1 m.
Sleeves shall be numerical, ascending, sequential.
Most significant figure nearest connector, if two groups used.
All assemblies made to this sheet shall bear identifiers as follows:
first two digits = 09 remaining four digits = 4403 to 4776 inclusive.



Constructional details:

1. Cable Assembly: Type 1

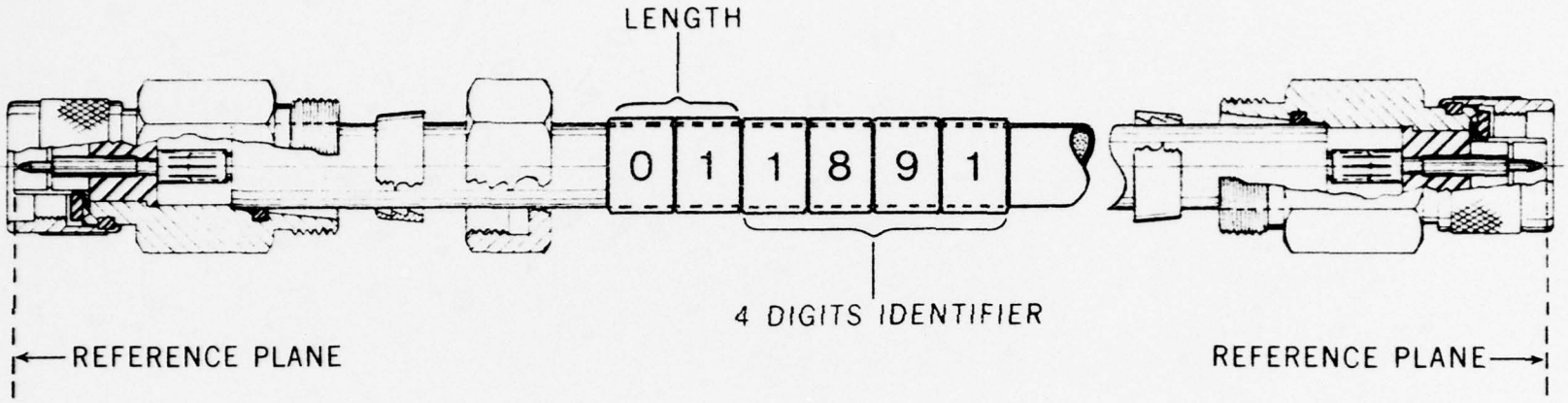
2. Connectors: Coaxial R.F. Series "N" Male Plug straight, as specified in para 12, rear nut torque loaded to specification.

3. Assembly length: Designated by first two digits of identifier group.
This sheet refers to 2.112 m ± 2 mm electrical length measured from the reference planes (see sketch above).

4. Identification: A group of six sleeves shall be fitted.
(1) centrally placed when assembly under 1 m long
(2) two groups adjacent to connectors when assembly longer than 1 m.
Sleeves shall be numerical, ascending, sequential.
Most significant figure nearest connector, if two groups used.
All assemblies made to this sheet shall bear identifiers as follows:
first two digits = 10 remaining four digits = 4777 to 5694 inclusive.

WRE SPECIFICATION SHEET
DELAY LINE ASSEMBLY

WRE-SP-1918/11
1977



Constructional details:

1. Cable Assembly: Type 1

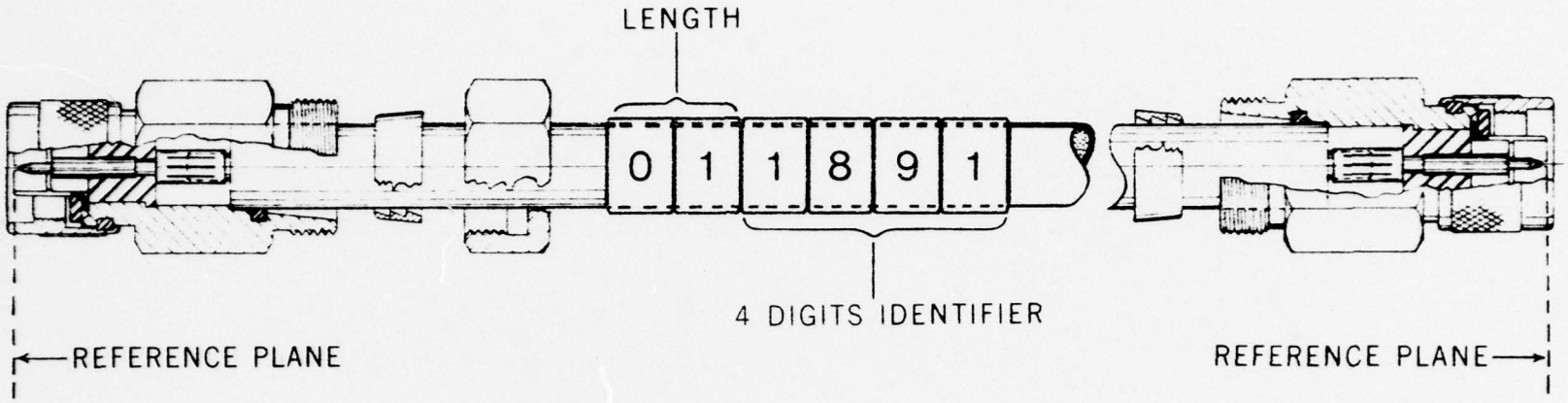
2. Connectors: Coaxial R.F. Series "N" Male Plug straight, as specified in para 12, rear nut torque loaded to specification.

3. Assembly length: Designated by first two digits of identifier group.
This sheet refers to 3.200 m ± 2 mm electrical length measured from the reference planes (see sketch above).

4. Identification: A group of six sleeves shall be fitted.
(1) centrally placed when assembly under 1 m long
(2) two groups adjacent to connectors when assembly longer than 1 m.
Sleeves shall be numerical, ascending, sequential.
Most significant figure nearest connector, if two groups used.
All assemblies made to this sheet shall bear identifiers as follows:
first two digits = 11 remaining four digits = 5695 to 5711 inclusive.

WRE SPECIFICATION SHEET
DELAY LINE ASSEMBLY

WRE-SP-1918/12
1977



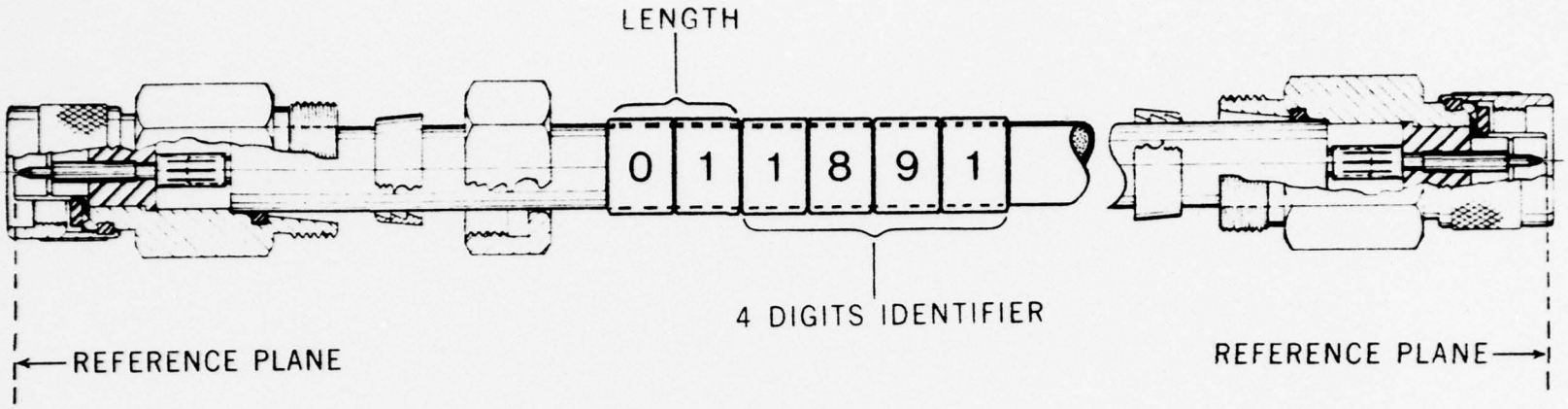
Constructional details:

1. Cable Assembly: Type 1

2. Connectors: Coaxial R.F. Series "N" Male Plug straight, as specified in para 12, rear nut torque loaded to specification.

3. Assembly length: Designated by first two digits of identifier group.
This sheet refers to 3.704 m ± 2 mm electrical length measured from the reference planes (see sketch above).

4. Identification: A group of six sleeves shall be fitted.
(1) centrally placed when assembly under 1 m long
(2) two groups adjacent to connectors when assembly longer than 1 m.
Sleeves shall be numerical, ascending, sequential.
Most significant figure nearest connector, if two groups used.
All assemblies made to this sheet shall bear identifiers as follows:
first two digits = 12 remaining four digits = 5712 to 5745 inclusive.



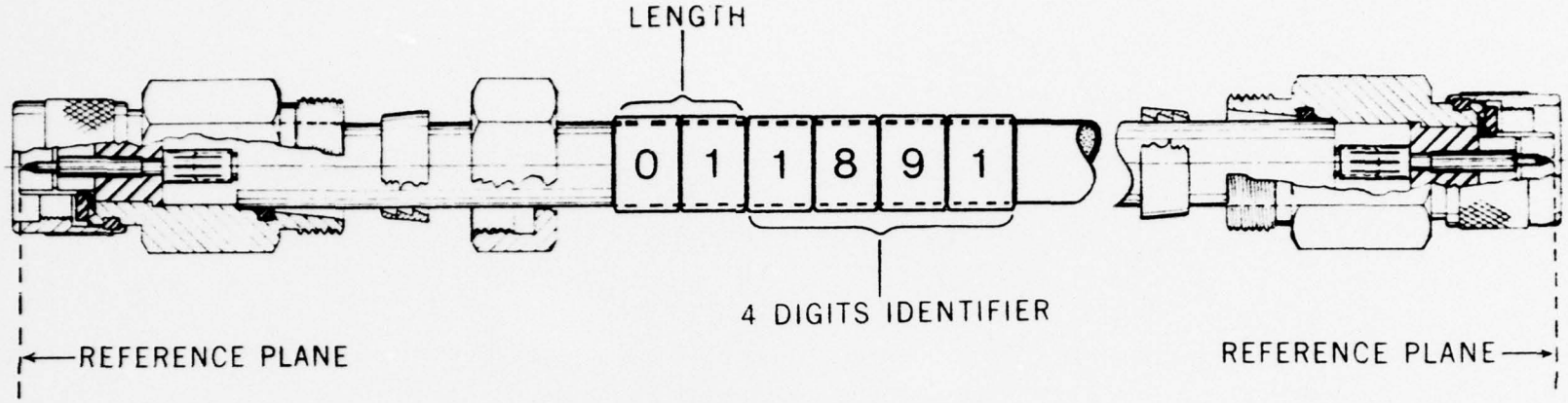
Constructional details:

1. Cable Assembly: Type 1

2. Connectors: Coaxial R.F. Series "N" Male Plug straight, as specified in para 12, rear nut torque loaded to specification.

3. Assembly length: Designated by first two digits of identifier group.
This sheet refers to 4.224 m ± 3 mm electrical length measured from the reference planes (see sketch above).

4. Identification: A group of six sleeves shall be fitted.
(1) centrally placed when assembly under 1 m long
(2) two groups adjacent to connectors when assembly longer than 1 m.
Sleeves shall be numerical, ascending, sequential.
Most significant figure nearest connector, if two groups used.
All assemblies made to this sheet shall bear identifiers as follows:
first two digits = 13 remaining four digits = 5746 to 6187 inclusive.



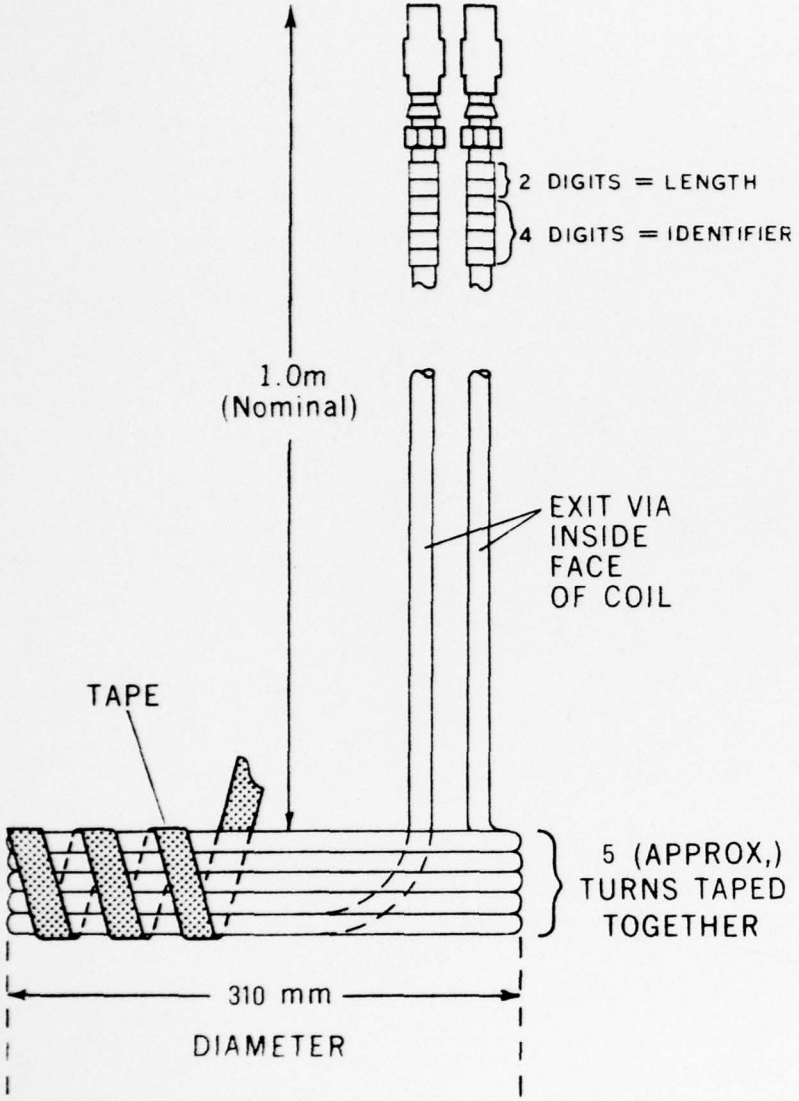
Constructional details:

1. Cable Assembly: Type 1

2. Connectors: Coaxial R.F. Series "N" Male Plug straight, as specified in para 12, rear nut torque loaded to specification.

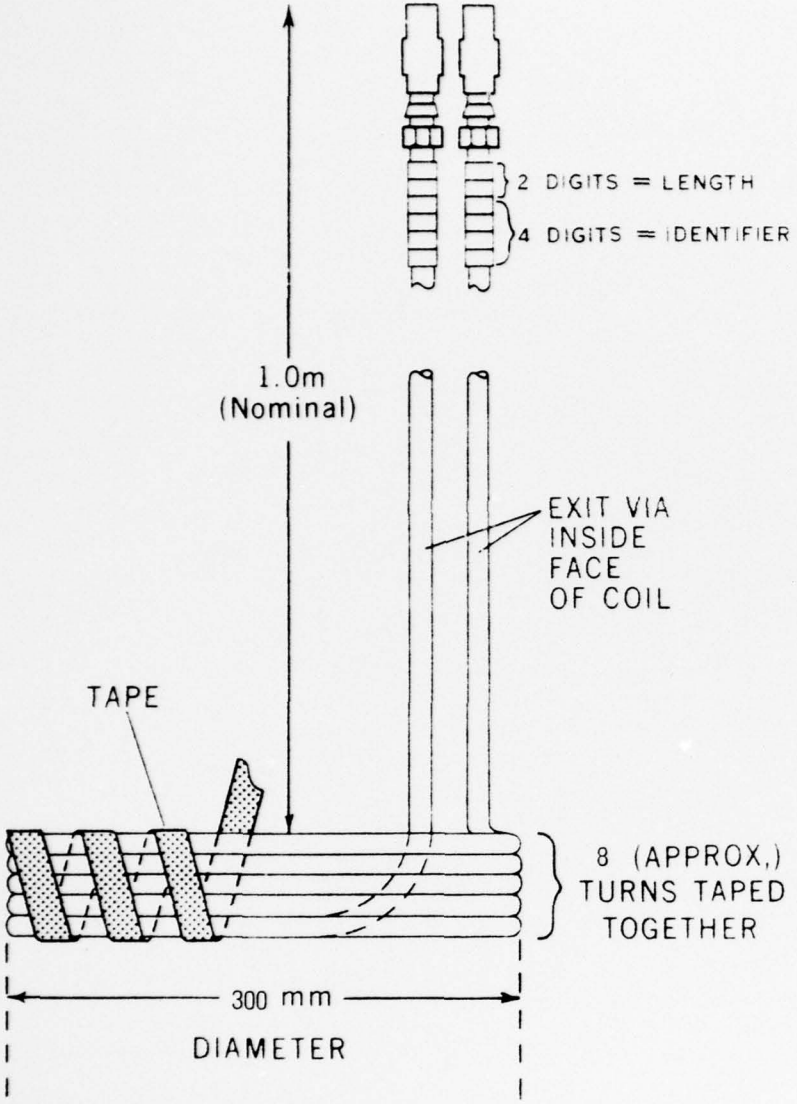
3. Assembly length: Designated by first two digits of identifier group.
This sheet refers to 6,400 m ± 3 mm electrical length measured from the reference planes (see sketch above).

4. Identification: A group of six sleeves shall be fitted.
(1) centrally placed when assembly under 1 m long
(2) two groups adjacent to connectors when assembly longer than 1 m.
Sleeves shall be numerical, ascending, sequential.
Most significant figure nearest connector, if two groups used.
All assemblies made to this sheet shall bear identifiers as follows:
first two digits = 14 remaining four digits = 6188 to 6204 inclusive.



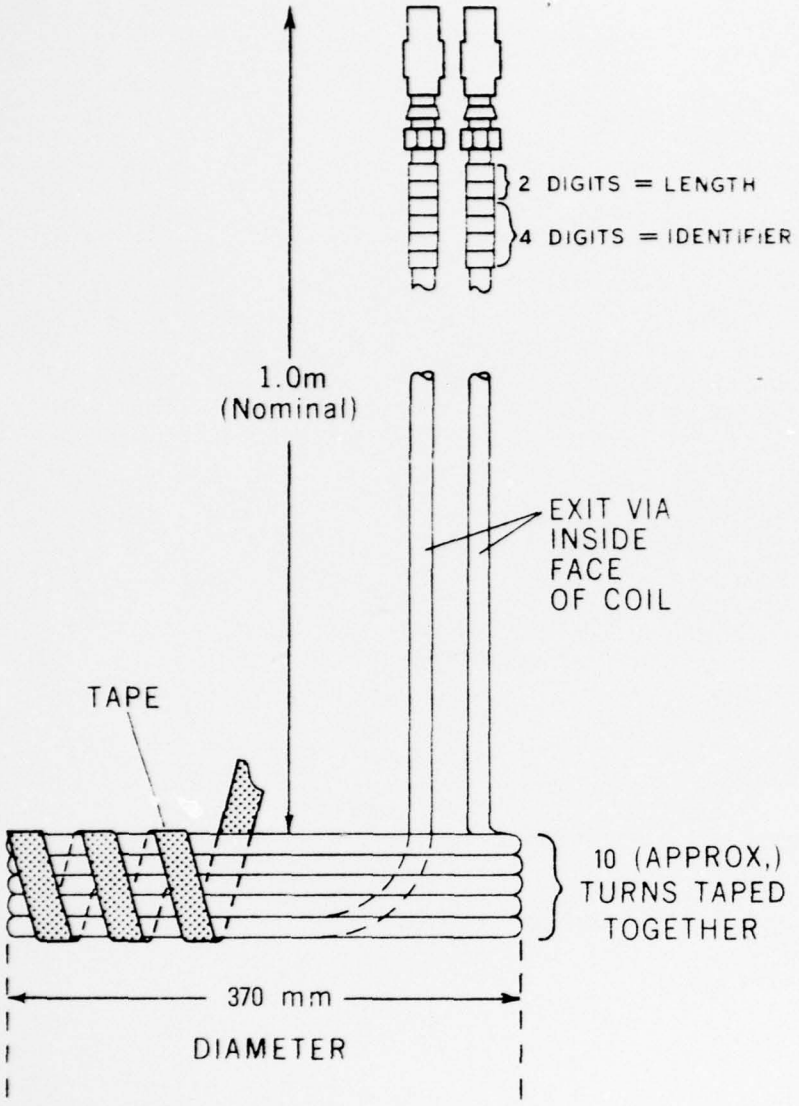
Constructional details:

1.	Cable Assembly:	Type 2
2.	Connectors:	Coaxial R.F. Series "N" Male Plug straight, as specified in para 12, rear nut torque loaded to specification.
3.	Assembly length:	Designated by first two digits of identifier group. This sheet refers to 8.448 m ± 3 mm electrical length measured from the reference planes (see sketch above).
4.	Identification:	A group of six sleeves shall be fitted. Two groups adjacent to connectors. Sleeves shall be numerical, ascending, sequential. Most significant figure nearest connector. All assemblies made to this sheet shall bear identifiers as follows: first two digits = 15 remaining four digits = 6205 to 6408 inclusive.



Constructional details:

1.	Cable Assembly:	Type 2
2.	Connectors:	Coaxial R.F. Series "N" Male Plug straight, as specified in para 12, rear nut torque loaded to specification.
3.	Assembly length:	Designated by first two digits of identifier group. This sheet refers to 12.800 m ± 4 mm electrical length measured from the reference planes (see sketch above).
4.	Identification:	A group of six sleeves shall be fitted. Two groups adjacent to connectors. Sleeves shall be numerical, ascending, sequential. Most significant figure nearest connector. All assemblies made to this sheet shall bear identifiers as follows: first two digits = 16 remaining four digits = 6409 to 6425 inclusive.



Constructional details:

1. Cable Assembly: Type 2

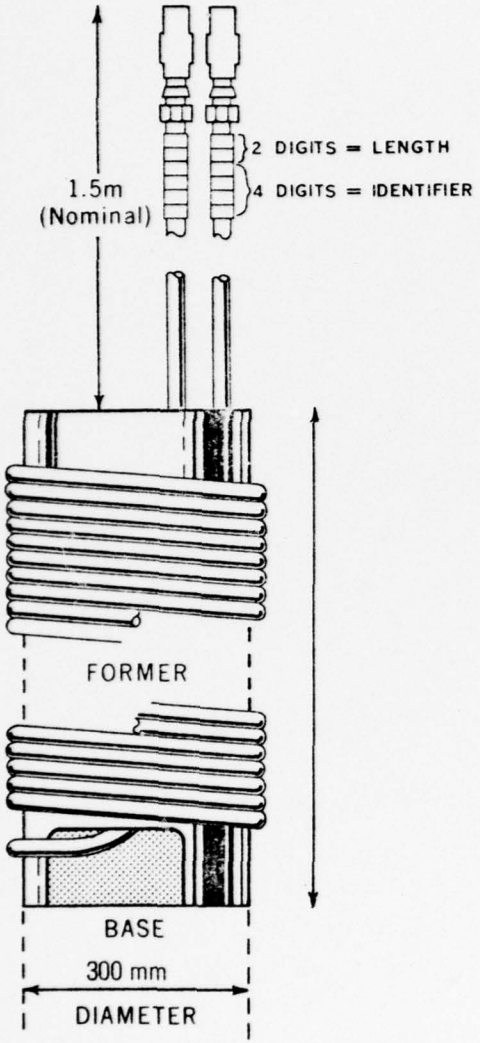
2. Connectors: Coaxial R.F. Series "N" Male Plug straight, as specified in para 12, rear nut torque loaded to specification.

3. Assembly length: Designated by first two digits of identifier group. This sheet refers to 16.896 m ± 4 mm electrical length measured from the reference planes (see sketch above).

4. Identification: A group of six sleeves shall be fitted. Two groups adjacent to connectors. Sleeves shall be numerical, ascending, sequential. Most significant figure nearest connector. All assemblies made to this sheet shall bear identifiers as follows: first two digits = 17 remaining four digits = 6426 to 6493 inclusive.

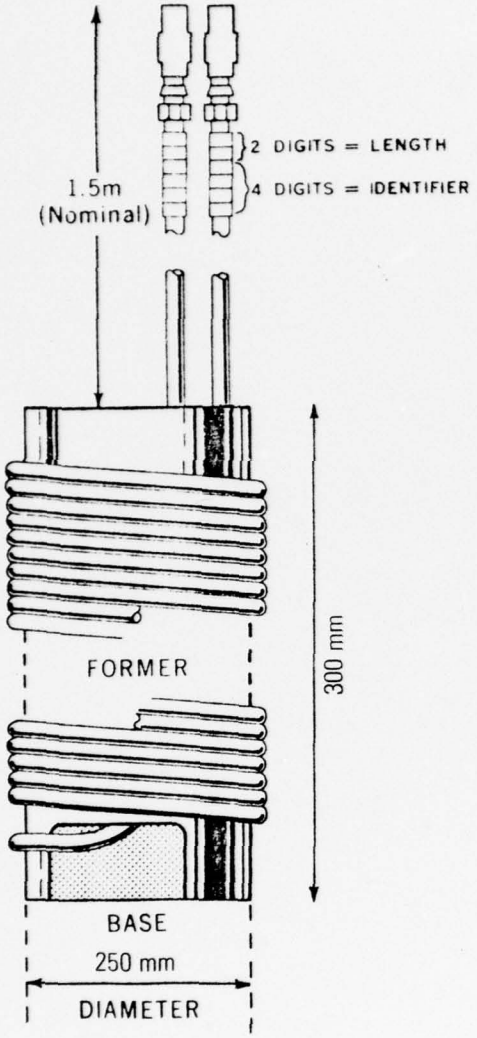
WRE SPECIFICATION SHEET
DELAY LINE ASSEMBLY

WRE-SP-1918/18
1977



Constructional details:

1.	Cable Assembly:	Type 2
2.	Connectors:	Coaxial R.F. Series "N" Male Plug straight, as specified in para 12, rear nut torque loaded to specification.
3.	Assembly length:	Designated by first two digits of identifier group. This sheet refers to 25.600 m ± 4 mm electrical length measured from the reference planes (see sketch above).
4.	Identification:	A group of six sleeves shall be fitted. Two groups adjacent to connectors. Sleeves shall be numerical, ascending, sequential. Most significant figure nearest connector. All assemblies made to this sheet shall bear identifiers as follows: first two digits = 18 remaining four digits = 6494 to 6510 inclusive.
5.	Former:	If the coil is securely taped a former need not be supplied.

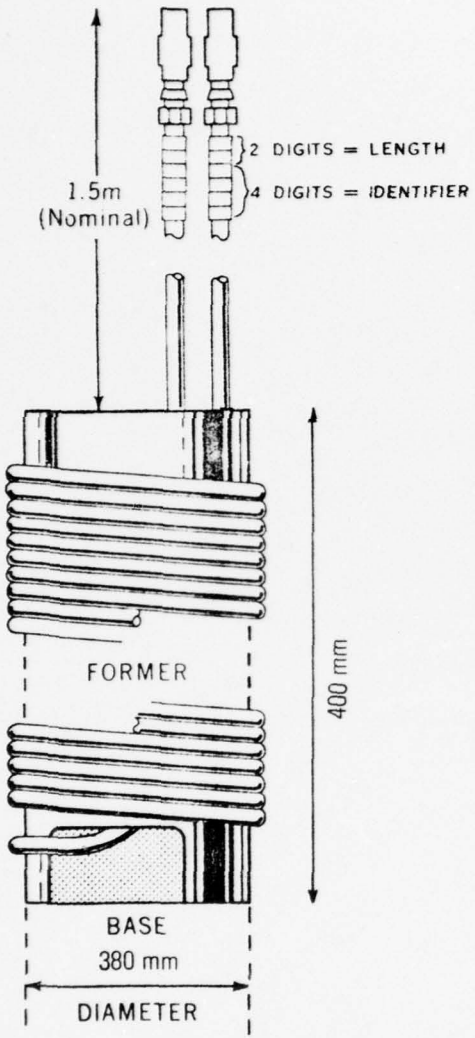


Constructional details:

1.	Cable Assembly:	Type 2
2.	Connectors:	Coaxial R.F. Series "N" Male Plug straight, as specified in para 12, rear nut torque loaded to specification.
3.	Assembly length:	Designated by first two digits of identifier group. This sheet refers to 33.792 m ± 5 mm electrical length measured from the reference planes (see sketch above).
4.	Identification:	A group of six sleeves shall be fitted. Two groups adjacent to connectors. Sleeves shall be numerical, ascending, sequential. Most significant figure nearest connector. All assemblies made to this sheet shall bear identifiers as follows: first two digits = 19 remaining four digits = 6511 to 6544 inclusive.
5.	Former:	If the coil is securely taped a former need not be supplied.

WRE SPECIFICATION SHEET
DELAY LINE ASSEMBLY

WRE-SP-1918/20
1977



Constructional details:

1.	Cable Assembly:	Type 2
2.	Connectors:	Coaxial R.F. Series "N" Male Plug straight, as specified in para 12, rear nut torque loaded to specification.
3.	Assembly length:	Designated by first two digits of identifier group. This sheet refers to 51.200 m ± 5 mm electrical length measured from the reference planes (see sketch above).
4.	Identification:	A group of six sleeves shall be fitted. Two groups adjacent to connectors. Sleeves shall be numerical, ascending, sequential. Most significant figure nearest connector. All assemblies made to this sheet shall bear identifiers as follows: first two digits = 20 remaining four digits = 6545 to 6561 inclusive.

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