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## CeeLok FAS-T\* Nano Circular Connectors

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### 1. SCOPE

#### 1.1. Content

This specification outlines the performance, test, and quality requirements for the TE Connectivity (TE) NANONICS\* CeeLok FAS-T Nano Circular connector series. These products cover a range of nanominiature circular, high density electrical connectors, both plugs and receptacles, suitable for use in high reliability environments including military and soldier-worn applications, down-hole, avionics, instrumentation, etc. where performance and weight are of primary concern. The mating interface for the high speed connector packages 8 contact positions in a T-shaped pattern to improve signal integrity through uniform crosstalk cancellation. Data transmission rates of 10 Gb/s are achieved when terminated to proper cable.

#### 1.2. Qualification

When tests are performed on the subject product line, procedures specified in Table 1 shall be used. All inspections shall be performed using the applicable inspection plan and product drawing.

#### 1.3. Description

##### A. General

CeeLok FAS-T Nano Circular connectors are permanently assembled, non-field repairable devices which consist of seamless pin and socket contacts which are crimp-terminated to conductors which are housed in a thermoplastic insulator that is then shrouded by an outer metal shell for added durability, ruggedness, polarization, and sealing capability. The connector types are such that plug connectors use pin contacts that are recessed within the connector shell, and receptacles use socket contacts which are also recessed within the shell.

##### B. Contacts

The contact system consists of size 30 pins and sockets which are seamless and are designed for permanent crimp-style terminations. The socket contact contains the spring member that provides the contact engagement normal force.

##### C. Form Factors

These circular connectors are available in two basic styles for each gender. Plug connectors can be Quick Disconnect (push-pull coupling mechanism) or Threaded Coupling. Receptacle connectors can be Flush Mount (also known as *front* panel mount), or more traditional Panel Mount (also known as *rear* panel mount). Flush Mount receptacles can only mate with Quick Disconnect plugs, but Panel Mount receptacles can mate with either type of plug so they offer more design flexibility.

#### 1.4. Connector Classifications (NANONICS legacy part numbering nomenclature)

##### A. QCM

Basic Quick Disconnect Series. It can be a plug or receptacle and can be further broken down into the following subgroups.

##### 1. QCM \* \* \* F

Suffix of "F" designates a front Flush Mount Receptacle

##### 2. QCM \* \* \* P

Suffix of "P" designates a rear Panel Mount Receptacle

##### 3. QCM \* \* \*

With no suffix, this designates a Plug

##### B. TCM

Basic Threaded Coupling Series. This applies to plug connectors only.

##### C. FCM

Flanged Coupling Quick Disconnect Series. This applies to plug connectors only.

##### D. Alternate Finishes

The letter "M" in the classifications listed above refers to the standard material and finish which is Electroless Nickel plated Aluminum. Replacing the "M" with an "S" signifies that the main shells

will be made from stainless steel. All components may not be of the exact same material and finish. Refer to the connector product drawings for specifics.

E. Accessories

All connector classifications except for the Flush Mount receptacles can accommodate the option of a factory-installed straight or right angle backshell. Straight backshells are designated by the letters "BC" at the end of an applicable NANONICS part number. Right angle backshells are designated by two-character codes "R1" through "R8" at the end of an applicable NANONICS part number. The "R" designates the right angle backshell option, and the number 1-8 designates the direction of the backshell exit with regard to the connector key/keyway. Refer to the connector product drawings for specifics.

F. Standard Connector Configurations

1. Pigtail Wired utilizing MADISON 30AWG 10G TurboTwin Pair CABLE\* (100 ohm differential pair; four pairs per connector).
2. Vertical Mount Through-Hole (PCB) utilizing 28AWG A-A-59551 uninsulated copper wire

## 2. APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the latest edition of the document applies. In the event of conflict between the requirements of this specification and the product drawing, the product drawing shall take precedence. In the event of conflict between the requirements of this specification and the referenced documents, this specification shall take precedence.

2.1. TE Documents

- 501-134021: Qualification Test Report
- [408-10411](#): NANONICS Circular Connector Application and Maintenance Procedures
- [109-197](#): AMP Test Specifications vs EIA and IEC Test Methods
- [351-0050](#): Hydrostatic Immersion Test Procedure for NANONICS Environmentally Sealed Circular Connectors
- Product Drawings, as applicable

2.2. Industry Documents

A. Electronic Industries Alliance (EIA)

- EIA-364 Electrical Connector/Socket Test Procedures Including Environmental Classifications
- EIA-364-06 Contact Resistance Test Procedure for Electrical Connectors
- EIA-364-09 Durability Test Procedure for Electrical Connectors and Contacts
- EIA-364-13 Mating Unmating Forces Test Procedure for Electrical Connectors
- EIA-364-18 Visual and Dimensional Test Procedure for Electrical Connectors
- EIA-364-20 Withstanding Voltage Test Procedure for Electrical Connectors, Sockets and Coaxial Contacts
- EIA-364-21 Insulation Resistance Test Procedure for Electrical Connectors, Sockets and Coaxial Contacts
- EIA-364-23 Low Level Contact Resistance Test Procedure for Electrical Connectors and Sockets
- EIA-364-26 Salt Spray Test Procedure for Electrical Connectors, Contacts and Sockets
- EIA-364-27 Mechanical Shock (Specified Pulse) Test Procedure for Electrical Connectors
- EIA-364-28 Vibration Test Procedure for Electrical Connectors and Sockets
- EIA-364-29 Contact Retention Test Procedure for Electrical Connectors
- EIA-364-31 Humidity Test Procedure for Electrical Connectors and Sockets
- EIA-364-32 Thermal Shock (Temperature Cycling) Test Procedure for Connectors and Sockets
- EIA-364-35 Insert Retention Test Procedure for Electrical Connectors
- EIA-364-37 Contact Engagement and Separation Force Test Procedures for Electrical Connectors

- EIA-364-54 Magnetic Permeability Test Procedure for Electrical Connectors
- EIA-364-83 Shell-to-Shell and Shell-to-Bulkhead Resistance Test Procedure for Electrical Connectors
- B. IPC- Association Connecting Electronics Industries
  - J-STD-004 Requirements for Soldering Fluxes
  - J-STD-005 Requirements for Soldering Pastes
  - J-STD-006 Requirements for Electronic Grade Solder Alloys and Fluxed and Non-Fluxed Solid Solder for Electronics Soldering Applications
- C. International Standards (IEC)
  - IEC 60529 Degrees of Protection Provided by Enclosures (IP Rating)
- D. Telecommunications Industry Association (TIA)
  - ANSI/TIA-568-C.2 Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components

### 3. REQUIREMENTS

#### 3.1. Design and Construction

Product shall be of the design, construction and physical dimensions specified on the applicable product drawing and as summarized in this specification.

#### 3.2. Materials

Materials used in the construction of this product shall be as summarized below and as specified on the applicable product drawing. When a specific material is not identified, a material has been chosen which enables the connectors to meet all performance requirements of this specification.

##### A. Dissimilar Metals

When dissimilar metals are used in intimate contact with each other, protection against electrolysis and corrosion is provided by means of plating and/or passivation.

##### B. Contact Materials

Contacts are made from beryllium copper alloy.

##### C. Contact Plating

Contacts are gold plated over nickel plate. After contact forming, the approximate gold plating thickness is 30µinches in critical contact mating areas.

#### 3.3. Dielectric Materials

##### A. Molded Inserts

Circular connector inserts are molded from LCP, or other suitable engineered thermoplastic that enables the performance specified herein.

##### B. Embedment Compound

Contacts and conductors are permanently encapsulated within the insulators and/or shells using an epoxy potting compound. Alternate potting compounds may also be used to improve sealing and/or temperature cycling characteristics or to promote high-speed signal integrity.

#### 3.4. Metal Shells

##### A. Base Material

Standard metal shell housings are made from high strength aluminum alloy. Shells can also be made from stainless steel. The connector classification shall determine the shell material. See product drawings for more detail.

##### B. Shell Finish

Aluminum shells are plated with electroless nickel, and stainless steel shells are passivated. The connector classification shall determine the shell finish. Alternate shell materials and/or finishes can be specified on a custom basis. See product drawings for more detail.

#### 3.5. Material Fungus Resistance

The standard materials used in the construction of these connectors are fungus inert.

- 3.6. Pure Tin  
NANONICS circular connectors do not use pure tin (tin content > 97%) on any standard solderable interfaces.
- 3.7. Flux  
When required, flux shall be rosin mildly activated (RMA), paste or liquid, or water soluble flux in accordance with J-STD-004 or an equivalent. Solder paste shall be in accordance with J-STD-005 or an equivalent. Soldering requirements shall be in accordance with J-STD-006 or an equivalent.
- 3.8. Design, Construction, and Physical Dimensions  
Connectors are designed such that pin and socket contacts will not be damaged during normal mating.
- A. Contact Design  
The contacts used in all NANONICS nanominiature connectors are seamless, and the spring member providing the mating normal force resides in the socket contact. A dimple located toward the entry of the socket contact biases the straight pin contact into intimate contact with the opposite side of the socket for a large contact surface area over approximately 180° of the inside of the socket contact.
1. Contact Wipe  
All contacts have a contact wipe of .015 inch minimum prior to the connector halves arriving at their fully mated position.
  2. Crimp Contacts  
Contacts are crimp-terminated and are non-removable from the insulator insert or shell.
  3. Contact Identification  
Due to the size of nanominiature connectors, there is no standard contact identification for position 1.
  4. Contact Arrangement  
The contact arrangement is as specified in the TE product drawings or catalog pages. The standard 10 Gig-E contact layout consist of 8 positions in a T-shaped pattern.
  5. Contact Alignment and Stability  
With all contacts in place, the alignment of pin and socket contacts shall permit engagement irrespective of buildup of allowable tolerances between shells, distortion of contacts due to crimping, and insulator location in the shell.
- B. Insulator Insert Design  
Inserts are designed such that they will not readily chip, crack, or break during normal service. The inserts are positively retained in the shell using an epoxy embedment compound.
1. Insulator Insert Heat Deflection  
Inserts and other related connector components are molded from, or machined from materials that are capable of withstanding short durations of extremely high heat typical of vapor-phase, wave, reflow, and infrared soldering techniques.
  2. Insulator Insert Durability  
Inserts and other related connector components are molded from, or machined from highly durable materials that are capable of withstanding harsh vibration and shock without evidence of deterioration such as chipping, cracking, or warping.
- C. Shell Design  
Metal circular shells are designed to positively retain the insulator insert such that it cannot be removed.
1. Polarization  
Shell polarization of circular connectors is achieved by use of an internal key feature on receptacle shells, and a corresponding keyway on plug shells. Multiple keys/keyways can be incorporated on a custom basis to provide additional polarization options and to help prevent accidental mismatching of adjacent connectors.
  2. Ancillary Hardware  
For circular receptacle connectors, jam nuts are included that allow the user to mount the connector assembly to a suitable panel or other device.

## 3. Intermateability

For 10 Gig-E circular connectors, all plug and receptacle configurations are completely intermateable regardless of shell material and/or finish with the exception being that threaded coupling plugs cannot mate with flush mount receptacles.

## 4. Interchangeability

All connectors having the same part number are completely interchangeable electrically and mechanically.

## 3.9. Ratings

Voltage:	500 Volts AC
Current:	1 Ampere maximum
Temperature:	-55 °C to 75 °C (Madison 102-1238 TurboTwin cable) -55 °C to 125 °C (Madison 102-2639 TurboTwin cable)
Characteristic Impedance:	100 Ohms
Frequency Range:	1 to 500 MHz

## 3.10. Performance and Test Description

Product is designed to meet the electrical, mechanical, and environmental performance requirements specified in Table 1. Unless otherwise specified, all tests shall be performed at ambient environmental conditions.

## 3.11. Test Requirements and Procedures Summary

Test Description	Requirement	Procedure
Initial Examination of Product	Meets requirements of product drawing	EIA-364-18 Visual examination and dimensional (C of C) inspection per product drawing
Final Examination of Product	Meets visual requirements	EIA-364-18 Visual examination
<b>ELECTRICAL</b>		
Low Level Contact Resistance (LLCR)	70 milliohms maximum	EIA-364-23 (See Figure 1)
Contact Resistance (CR) at Rated Current	70 millivolt drop maximum at 1 Amp	EIA-364-06 (See Figure 1)
Insulation Resistance (IR) (Unmated)	1 megohm minimum after step 6 1000 megohms minimum after 24 hours of conditioning 5000 megohms minimum all other conditions	EIA-364-21 500 ± 10% Volts DC initial 100 ± 10% Volts DC after humidity
Insulation Resistance (IR) at Temperature (Unmated)	1000 megohms minimum	EIA-364-21 500 ± 10% Volts DC (Cable 102-1238: 75°C) (Cable 102-2639: 125°C)
Dielectric Withstand Voltage (DWV) at Sea Level (Unmated)	One minute hold with no breakdown or flashover	EIA-364-20, Method A, Condition I 500 Volts AC before Humidity; 100 Volts AC after Humidity
Dielectric Withstand Voltage (DWV) at Altitude (Unmated)	One minute hold with no breakdown or flashover	EIA-364-20, Method A, Condition IV 100 Volts AC at 70,000 feet

*Figure 1 (cont)*

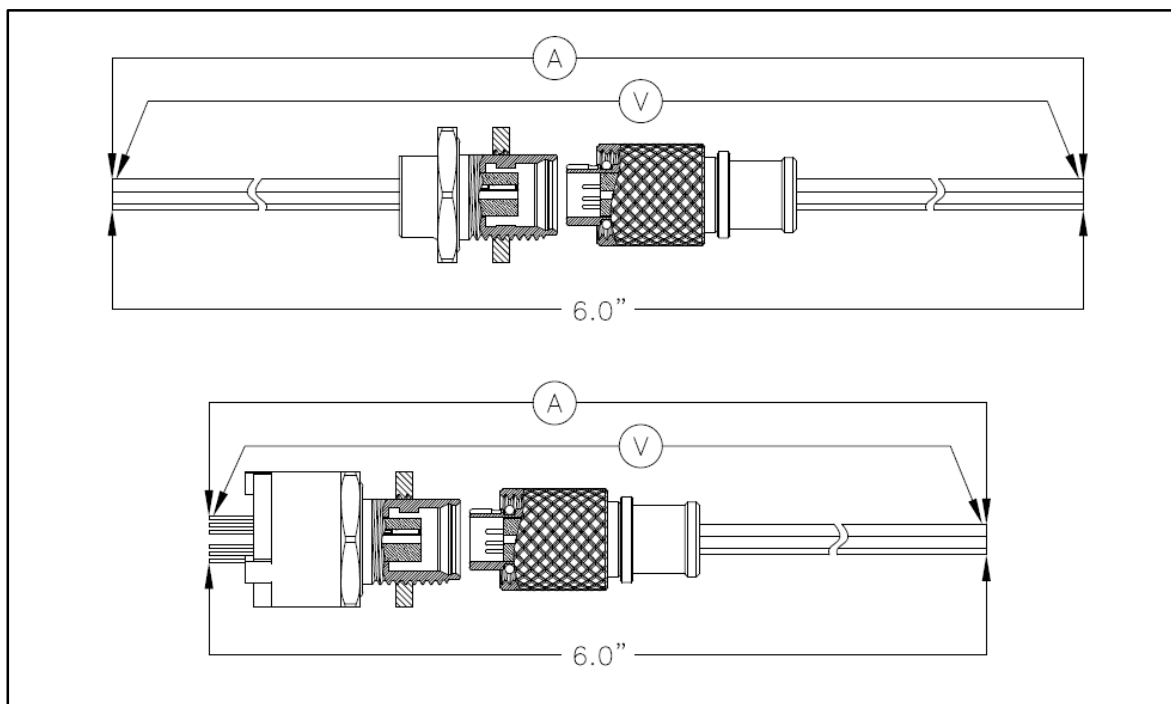
Test Description	Requirement	Procedure
Shell-to-Shell Conductivity (applies to Threaded Coupling Plugs mated with Panel Mount Receptacles only)	Electrical continuity	EIA-364-83 Ensure electrical continuity when a current of 1 ampere is applied
Return Loss (RL)	Per Cat 6A Limits <sup>1</sup> (see Footnote 1)	ANSI/TIA-568-C.2
Insertion Loss (IL)	Per Cat 6A Limits (see Footnote 1)	ANSI/TIA-568-C.2
Near End Cross Talk (NEXT)	Per Cat 6A Limits (see Footnote 1)	ANSI/TIA-568-C.2
<b>MECHANICAL</b>		
Contact Engagement and Separation Force (applies to Socket contacts)	6.0 oz. maximum engagement 0.5 oz. minimum separation	Using .0127 diameter test pin (tolerance +40 $\mu$ m/-00; Deltronic P/N 38310 or equivalent)
Contact Retention	.002 inch maximum contact displacement	EIA-364-29 Method B Apply axial load of 2.0 lb. minimum to the contact
Insert Retention	Inserts shall not dislodge from connector	EIA-364-35 Apply specified axial load of 50 psi (approx. .884 lb. for $\varnothing$ .150 insert)
Sinusoidal Vibration	No discontinuities of 1 microsecond or longer duration <sup>2</sup> (see Footnote 2)	EIA-364-28, Test Condition IV
Random Vibration	No discontinuities of 1 microsecond or longer duration (see Footnote 2)	EIA-364-28, Test Condition V, Test Condition Letter K, 90 minute duration in each of 3 perpendicular planes
Mechanical Shock	No discontinuities of 1 microsecond or longer duration (see Footnote 2)	EIA-364-27, Test Condition D
Durability	See Footnote 2	EIA-364-9 and TE 408-10411 Durability is dependent on shell base material and method of mating. Use "Pre-Aligned" mating method per TE 408-10411
Magnetic Permeability	2.0 Mu maximum	EIA-364-54 Apply indicator with 2.0 Mu pellet to all areas of the specimen
Coupling Torque (Threaded Coupling Plugs only)	10.0 in-lbs. maximum	EIA-364-13, Method A Measure torque necessary to mate specimens at a maximum rate of 12.7 mm [.50 in] per minute.
Uncoupling Torque (Threaded Coupling Plugs only)	4.0 in-oz minimum	EIA-364-13, Method A After all torque pre-load is removed and coupling nut is finger-tight, measure torque necessary to unmate specimens at a maximum rate of 12.7 mm [.50 in] per minute.
Jam Nut Torque (Receptacles only)	7.0 in-lbs. maximum (front flush mount shell with M7.0 thread) 20.0 in-lbs. maximum (rear panel mount shell with M8.0 thread)	With receptacle mounted to a plate or panel as specified by the product drawing, jam nut shall be tightened to the limits noted with no breakage, stripping, etc.
Connector Mating and Unmating Force (Quick Disconnect Plugs only)	8.0 lbs. maximum mating 2.0 lbs. minimum unmating	EIA-364-13, Method A An axial force shall be applied to the Coupling Sleeve. Note that this is not a breakaway force, this is the force required for the Coupling Sleeve to properly compress the internal retaining ring to permit proper mating or unmating.

*Figure 1 (end)*

<sup>1</sup> Contact TE AD&M Development Engineering for data related to High-Speed testing.

<sup>2</sup> Shall meet visual requirements, show no physical damage, and meet requirements of additional tests as specified in the Product Qualification and Requalification Test Sequence.

Test Description	Requirement	Procedure
<b>ENVIRONMENTAL</b>		
Thermal Shock (Temperature Cycling)	No damage detrimental to proper connector operation (see Footnote 2)	EIA-364-32, Condition I (Cable 102-1238: Subject mated specimens to 5 cycles between -55°C and 75°C) (Cable 102-2639: Subject mated specimens to 5 cycles between -55°C and 125°C)
Humidity (Mated)	Meet specified DWV and IR requirements in Electrical section	EIA-364-31, Method IV Steps 7a and 7b shall not be required.
Hydrostatic Water Immersion (mated)	No effects detrimental to proper electrical performance	IEC 60529, Code IPX8 1 meter minimum fresh water depth for a minimum of 2 hours. See also NANONICS document 351-0050. Does NOT apply to PCB connectors.
Water Jet Spray (Mated)	No ingress of water into the enclosure	IEC 60529, Code IPX6
Dust (mated)	No ingress of dust	IEC 60529, Code IP6X
Salt Spray (Mated)	No exposure of base metal which will affect performance, and shall meet specified LLCR and Mating/Unmating Forces (Quick Disconnect plugs) or Coupling/Uncoupling Torque (Threaded Coupling plugs)	EIA-364-26, Condition B (48 hours)



NOTE: WIRE BULK IS NOT SUBTRACTED FROM THESE MEASUREMENTS  
**Figure 2 –(LLCR and CR Measurements)**

## 3.12. Product Qualification and Requalification Test Sequence

Test or Examination	Test Group (a)				
	1	2	3	4	5
	Test Sequence (b)				
Initial Examination of Product	1	1	1	1	1
LLCR	4, 9	2, 6			
CR at Rated Current	5, 10	3, 7			
IR			2, 8		
DWV at Sea Level			3, 9		
IR at Temperature			4		
DWV at Altitude			5		
Shell-to-Shell Conductivity		4, 8			
Contact Engagement & Separation Force	2				
Contact Retention				3	
Insert Retention				4	
Sinusoidal Vibration	7(c)				
Random Vibration	7(d)				
Mechanical Shock	8				
Durability	6				
Magnetic Permeability				2	
Coupling Torque	3(d)				
Uncoupling Torque	11(d)				
Jam Nut Torque				5(e)	
Mating & Unmating Force	3(c), 11(c)				
Thermal Shock			6		
Humidity			7		
Hydrostatic Water Immersion					3
Water Jet Spray					2
Dust					4
Salt Spray		5			
Final Examination of Product	12	9	10	6	5


**NOTE**

- (a) See Paragraph 4.1.A.
- (b) Numbers indicate sequence in which tests are performed.
- (c) Applicable to quick-disconnect coupling connectors only.
- (d) Applicable to thread coupling connectors only.
- (e) Applicable to panel mount receptacle connectors only.

Figure 3

**4. QUALITY ASSURANCE PROVISIONS**

## 4.1. Qualification Testing

## A. Specimen Selection

1. Specimens shall be prepared in accordance with applicable Instruction Sheets or product drawings, and shall be selected at random from current production. If no current production exists, representative product shall be assembled for testing purposes. Test specimen quantities and configurations shall be as follows:



- Test Group 1 shall consist of 3 quick-disconnect wired plug and wired receptacle pairs (1925255-1 & 1925259-1) and 3 threaded coupling wired plug and mounted pcb receptacle mating pairs (1925252-1 & 1925261-1).
- Test Group 2 shall consist of 3 threaded coupling wired plug and pcb receptacle pairs (1925252-1 & 1925261-1).
- Test Group 3 shall consist of 2 quick-disconnect wired plug and wired receptacle pairs (1925255-1 & 1925259-1) and 2 threaded coupling wired plug and unmounted pcb receptacle mating pairs (1925252-1 & 1925261-1), as applicable.
- Test Group 4 shall consist of 2 quick-disconnect wired plug connectors (1925255-1) and 2 unmounted pcb rear panel mount receptacle connectors (1925261-1).
- Test Group 5 shall consist of 2 quick-disconnect wired plug and wired receptacle pairs (1925255-1 & 1925259-1).

B. Test Sequence

Qualification inspection shall be verified by testing specimens as specified in Table 2.

4.2. Requalification Testing

If changes significantly affecting the form, fit, or function are made to the product or manufacturing process, product assurance shall coordinate requalification testing, consisting of all or part of the original testing sequence as determined by development/product, quality, and reliability engineering.

4.3. Acceptance

Acceptance is based on verification that the product meets the requirements of Table 1. Failures attributed to equipment, test setup or operator deficiencies shall not disqualify the product. If product failure occurs, corrective action shall be taken and specimens resubmitted for qualification. Testing to confirm corrective action is required before resubmittal.

4.4. Quality Conformance Inspection

The applicable quality inspection plan shall specify the sampling acceptable quality level to be used. Dimensional and functional requirements shall be in accordance with the applicable product drawing and this specification.