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**Zagotavljanje vesoljskih izdelkov - Visoko zanesljivi električni spoji z žičnim ovijanjem**

**(istoveten EN 50389:2005)**

Space product assurance - Wire-wrapping of high-reliability electrical connections

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EUROPEAN STANDARD

**EN 50389**

NORME EUROPÉENNE

EUROPÄISCHE NORM

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**Space product assurance –  
Wire-wrapping of high-reliability electrical connections**

Conformité des produits spatiaux -  
Connexion par enroulement  
des connexions électriques  
de haute fiabilité

Raumfahrt-Produktsicherung –  
Lötfreie elektrische Drahtverbindungen  
hoher Zuverlässigkeit

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This European Standard was approved by CENELEC on 2005-08-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in two official versions (English, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

**CENELEC**

European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**Central Secretariat: rue de Stassart 35, B - 1050 Brussels**

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## Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 107X, Process management for avionics (former CENELEC BTTF 91-3).

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50389 on 2005-08-01.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2006-08-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2008-08-01

It is based on a previous version <sup>1)</sup> originally prepared by the ECSS product assurance working group, reviewed by the ECSS Technical Panel and approved by the ECSS Steering Board. The European Cooperation for Space Standardization (ECSS) is a cooperative effort of the European Space Agency, National Space Agencies and European industry associations for the purpose of developing and maintaining common standards.

This European Standard is one of a series of space standards intended to be applied together for the management, engineering and product assurance in space projects and applications.

Requirements in this European Standard are defined in terms of what shall be accomplished, rather than in terms of how to organize and perform the necessary work. This allows existing organizational structures and methods to be applied where they are effective, and for the structures and methods to evolve as necessary without rewriting the standards.

The formulation of this European Standard takes into account the existing EN ISO 9000 family of documents.

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<sup>1)</sup> ECSS-Q-70-30A.

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## Introduction

This standard defines the requirements and quality assurance provisions for the manufacture of high-reliability wire-wrapped connections made with round single-strand silver-plated wire onto appropriately designed gold-plated terminals. Equipment design requirements, such as terminal spacing and terminal mounting are not included in this standard.

This standard deals with the mechanical and electrical stability of wire-wrapped connections operating under high vacuum, thermal cycling and vibration conditions imposed by space flight.

## 1 Scope

This standard specifies the methods for preparing and assembling the parts to be joined by wire wrapping, and the selection, calibration, use and certification of the wire wrapping tools.

The required wire-wrapped connections are illustrated in Figure 1.

This type of connection is similar to "Class A preferred" or "modified" connection detailed in MIL-STD-1130, and NASA NHB 5300.4(3H).

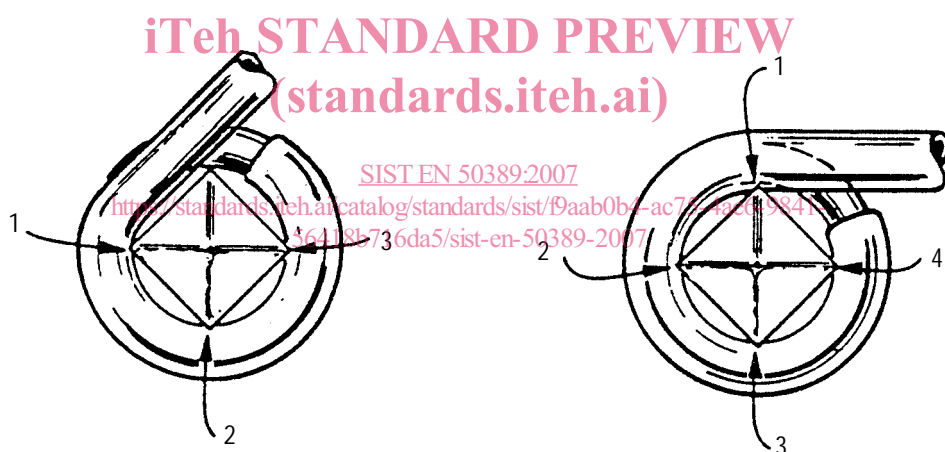
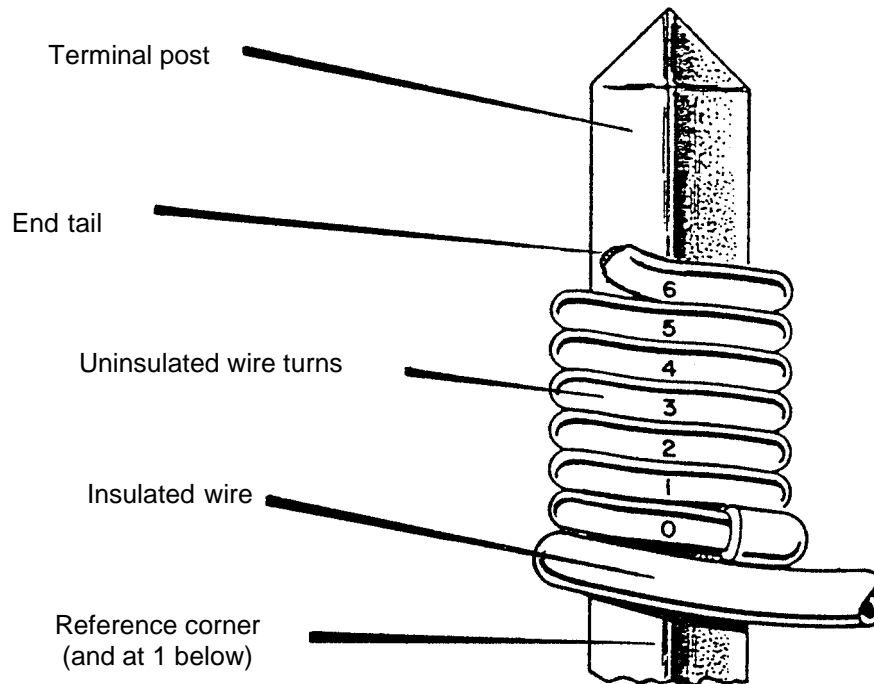
Only tested and qualified wire-wrapped connections are covered by this standard, which lists four wire sizes from 24 AWG to 30 AWG, and three terminal post sizes up to 1,78 mm maximum diagonal.

The use of thicker wire and larger terminals are not advised. Thicker wire than 24 AWG is generally multistranded and terminated by soldering (see ECSS-Q-70-08) or by crimping (see ECSS-Q-70-26).

Training and certification requirements for operators and inspectors are defined in 9.7 and in EN 13291-1.

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Shows either 3 or 4 corners of contact of insulation minimum  $\frac{3}{4}$  turn of insulated wire

**Figure 1 — Single wire-wrapped connection to square terminal and reference corner**

## 2 Normative references

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

EN 13291-1	<i>Space product assurance - General requirements - Part 1: Policy and principles</i>
EN 13291-2	<i>Space product assurance –General requirements - Part 2: Quality assurance</i>
EN 13701	<i>Space systems - Glossary of terms</i>
EN 14097	<i>Space product assurance - Non conformance control system</i>



ECSS-Q-70-02                    *Space product assurance - Thermal vacuum outgassing test for the screening of space materials*

ESA/SCC No. 3903            *Solid wires, electrical 350 V, for wire wrapping*

### **3    Terms, definitions and abbreviated terms**

#### **3.1    Terms and definitions**

For the purposes of this European Standard, the terms and definitions given in EN 13701 and the following apply.

##### **3.1.1**

##### **wire-wrapped connection**

this connection consists of a helix of continuous, solid, uninsulated wire tightly wrapped around the terminal post to produce a mechanically and electrically stable connection

NOTE    The number of turns required depends on the gauge of wire used. All completed wraps have an additional minimum of 3/4 turn of the insulated wire that is in contact with at least three corners of the terminal post (see Figure 1).

##### **3.1.2**

##### **terminal post**

post of square or rectangular section onto which the interconnection wire is wrapped

##### **3.1.3**

##### **a turn of wire**

this consists of one complete single helical ring of wire wrapped 360° around the terminal post, touching all four corners of the post

NOTE    For the purpose of counting turns, the number of times the wrapped wire passes and intercepts the reference edge of the terminal post after the first intercept of uninsulated wire and terminal post, constitutes the number of turns of uninsulated wire in the connection.

##### **3.1.4**

##### **reference corner**

corner of the terminal post at which the first turn of uninsulated wire contacts, and from which the number of turns of the wrapped wire are counted

##### **3.1.5**

##### **end tail**

end of the last turn of wire on the terminal post which may extend in a tangential direction instead of resting against the post

##### **3.1.6**

##### **gas-tight area**

contact area between the terminal post and wire which excludes gas fumes

## 3.2 Abbreviated terms

The following abbreviated terms are defined and used within this European Standard:

<b>AWG</b>	American wire gauge;
<b>ECSS</b>	European Cooperation for Space Standardization;
<b>ETFE</b>	ethylene-tetrafluorethylene;
<b>PTFE</b>	polytetrafluorethylene;
<b>PVDF</b>	polyvinylidene fluoride;
<b>PFA</b>	perfluoroalkoxy;
<b>RH</b>	relative humidity.

## 4 Preparatory conditions

### 4.1 Hazards, health and safety precautions

Particular attention shall be paid to health and safety precautions. A safety checklist is produced below:

- hazards to personnel, equipment and materials shall be controlled and reduced to a minimum;
- components, tools and controls shall be so located that personnel are not exposed to hazards such as electric shock, cutting edges, sharp points or toxic atmospheres;
- pneumatic air-powered wire-wrapping tools shall be connected to a regulated, lubricated and filtered air supply, and disconnected when not in use.

### 4.2 Facility cleanliness

- Unless classified as a cleanroom, the areas in which wire-wrapping is carried out shall be maintained in a neat orderly fashion, with no loose material (such as dirt, dust, oils or clipped wires) that can cause contamination of the wire-wrapped connection. Furniture shall be kept to a minimum in the work areas and be arranged to allow easy and thorough cleaning of the floor.
- Working surfaces shall be covered with an easily cleaned hard top, or have a replaceable surface of clean, noncorrosive silicone-free paper.
- Tools used in the wire-wrapping operation shall be clean. Excess lubricants shall be removed before wire-wrapping starts.
- Before assembly, wire and terminal posts shall be visually examined for cleanliness, absence of oil films and freedom from tarnish or corrosion.

### 4.3 Environmental conditions

The wire-wrapping area shall have a controlled environment which limits entry of contamination. The area shall be continuously controlled as follows:

- room temperature:  $(22 \pm 3) \text{ }^\circ\text{C}$ ;
- relative humidity:  $(55 \pm 10) \%$ .

The work stations shall not be exposed to draught. Fresh air shall be supplied to the room through a filtering system so that there is a positive pressure difference with regard to adjacent rooms; the exhaust air shall be suitably restricted.

#### 4.4 Lighting requirements

The light intensity shall be a minimum of 1 080 lx on the work surface. At least 90 % of the work area shall be shadowless and without severe reflections.

#### 4.5 Configuration of process/workpiece

In order to ensure compatibility with the customer requirements and as a means of identifying potential problems, the supplier shall perform a review of the tools, materials and techniques which he plans to use for the work. The review shall cover each separate manufacturing step and consider the dimensions and metallurgical properties of the terminal post and wire such that they are guaranteed to be suitable for the manufacture of wire-wrapped connections. Special attention shall be paid to the appropriate choice of functional tools, particularly the type of power-driven wire-wrapping tool and associated rotary wrapping bit and stationary sleeve. The quality of a wrapped connection depends largely on the maintenance and adjusting of the cutting, stripping and wrapping tools.

Work shall be managed and organized such that tool bits and sleeves cannot be interchanged.

During handling and transportation, wrapped joints and their wires shall not suffer from any constraints likely to cause deterioration.

#### 4.6 Cleaning

The cleaning of materials where necessary, prior to wire-wrapping, shall be performed using one of the following solvents:

- ethyl alcohol, 95,5 % or 95 % pure by volume;
- isopropyl alcohol, best commercial grade, 99 % pure;
- any mixture of the above.

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Procedures for cleaning shall be generated before solvent cleaning is begun. Further cleaning or other treatments of the joint after wire-wrapping shall not be done.

Materials and workpieces shall be handled only with clean lint-free gloves or finger cots.

#### 4.7 Tools and equipment

##### 4.7.1 General

Before the first production of wire-wrapped connections, the tools shall conform to the control requirements of this subclause.

##### 4.7.2 Cutting tool

The cutting tool selected for use shall cut the conductor wire without causing flattening of the wire. Any tool not achieving this requirement shall be removed from the work area.

##### 4.7.3 Insulation strippers

###### a) Thermal strippers

Thermal-type insulation strippers may be used on types of wire insulation for which they are suited. Heat of the stripper shall be controlled to prevent blistering and excessive melting of insulation. Local extraction units shall be used if thermal stripping is employed, in order to avoid part contamination or health hazards due to resultant fumes.

**b) Precision cutting-type strippers**

Automatic power-driven strippers with precision, factory-set, non-adjustable cutting and stripping dies and wire guards may be used. Precision-type hand strippers with accurately machined and factory-preset cutting heads may be used with a caution about making certain that the die openings for wire sizes other than that being used are masked off. The conductor shall not be twisted, ringed, nicked, cut or scored by this operation.

**4.7.4 Wire-wrapping tools**

- a) The wire-wrapping tools (see Figure 2) shall be power driven. The tool shall be either an electrical tool (mains supply), or a pneumatic tool (supplied with regulated, lubricated and filtered air). It should be fitted with a "backforce" device to prevent overwrapping defect. Hand-powered or battery-powered wrapping tools shall not be used.
- b) A wrapping tool together with appropriate rotary bit and stationary sleeve shall be assigned to each wire gauge and terminal combination in use, and suitably marked to show the size for which it is calibrated.
- c) Refer to the tool manufacturer for appropriate selection of bit and sleeve for each wire/terminal post diagonal combination.
- d) The tool and associated accessories shall be checked for cleanliness and general satisfactory condition at up to  $\times 10$  magnification. The extremity of the bit shall be perfectly clean and smooth without blockages or faults. The sleeve should not have any sharp blockage in its neck, and shall be checked manually to ensure that the bit runs perfectly in the sleeve, without any hard or rough points of contact. Any tool not meeting the above requirements shall be removed from the work station for repair or replacement.
- e) The wire-wrapping tool shall not nick, ring, gouge, or scrape conductors, or damage the terminal post in any way during its operation.

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