

BS EN 16602-70-08:2015



BSI Standards Publication

Space product assurance — Manual soldering of high- reliability electrical connections

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National foreword

This British Standard is the UK implementation of EN 16602-70-08:2015.

The UK participation in its preparation was entrusted to Technical Committee ACE/68, Space systems and operations.

A list of organizations represented on this committee can be obtained on request to its secretary.

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ISBN 978 0 580 86584 8

ICS 25.160.50; 49.140

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2015.

Amendments issued since publication

Date	Text affected
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EUROPEAN STANDARD

EN 16602-70-08

NORME EUROPÉENNE

EUROPÄISCHE NORM

January 2015

ICS 25.160.50; 49.140

English version

Space product assurance - Manual soldering of high-reliability electrical connections

Assurance produit des projets spatiaux - Soudage manuel
des connexions électriques à fiabilité élevée

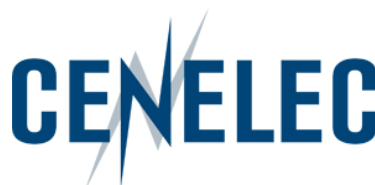
Raumfahrtproduktsicherung - Manuelles Löten von hoch-
zuverlässigen elektrischen Verbindungen

This European Standard was approved by CEN on 18 October 2014.

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Table of contents

Foreword	9
Introduction.....	10
1 Scope.....	11
2 Normative references	12
3 Terms, definitions and abbreviated terms.....	13
3.1 Terms from other standards.....	13
3.2 Terms specific to the present standard	13
3.3 Abbreviated terms.....	20
4 Principles of reliable soldered connections.....	22
5 Preparatory conditions	23
5.1 Calibration	23
5.2 Facility cleanliness.....	23
5.3 Environmental conditions.....	23
5.4 Lighting requirements	24
5.5 Precautions against static discharges	24
5.5.1 General	24
5.5.2 Precautions against ESD during manufacturing	24
5.5.3 Protective Packaging and ESD Protection	25
5.5.4 Packing and filler materials	26
5.6 Equipment and tools	26
5.6.1 General	26
5.6.2 Brushes.....	26
5.6.3 Cutters and pliers.....	26
5.6.4 Bending tools	27
5.6.5 Clinching tools.....	27
5.6.6 Insulation strippers	28
5.6.7 Soldering irons and resistance soldering equipment	29
5.6.8 Soldering tools	30

6 Materials selection	31
6.1 General.....	31
6.2 Solder	31
6.2.1 Form	31
6.2.2 Composition	31
6.3 Flux	32
6.3.1 Rosin-based fluxes.....	32
6.3.2 INH1 corrosive acid flux	33
6.3.3 Application of flux.....	33
6.4 Solvents.....	34
6.5 Flexible insulation materials.....	34
6.6 Terminals.....	35
6.6.1 Materials	35
6.6.2 Tin-, silver- and gold-plated terminals.....	35
6.6.3 Shape of terminals	35
6.7 Wires	35
6.8 PCBs	36
6.8.1 Boards	36
6.8.2 Gold finish on conductors.....	36
6.9 Component lead finishes	36
6.10 Adhesives (staking compounds and heat sinking), encapsulants and conformal coatings.....	36
7 Preparation for soldering.....	38
7.1 General.....	38
7.1.1 Tools	38
7.1.2 Components.....	38
7.2 Preparation of conductors, terminals and solder cups.....	38
7.2.1 Insulation removal	38
7.2.2 Surfaces to be soldered	39
7.2.3 De-golding of gold-plated leads and terminals.....	40
7.2.4 Constraints on degolding and pretinning methods.....	41
7.2.5 Pretinning of stranded wires.....	42
7.2.6 Pre-tinning of component leads and solid-wire conductors.....	42
7.3 Preparation of the soldering bit	43
7.3.1 Fit.....	43
7.3.2 Maintenance	43
7.3.3 Plated bits	43

7.3.4	Tip in operation	43
7.4	Maintenance of resistance-type soldering electrodes	44
7.5	Handling (work station)	44
7.6	Storage (work station)	44
7.6.1	Components	44
7.6.2	PCBs	44
7.6.3	Materials requiring segregation	44
7.7	Preparation of PCBs for soldering	45
7.7.1	Process	45
7.7.2	Demoisturization methods	45
7.7.3	Storage of prepared PCBs	45
8	Mounting of components	46
8.1	General requirements	46
8.1.1	Introduction	46
8.1.2	Heavy components	46
8.1.3	Metal-case components	46
8.1.4	Glass-encased components	47
8.1.5	Stress relief of components with bendable leads	47
8.1.6	Stress relief of components with non-bendable leads	48
8.1.7	Reinforced plated-through holes	50
8.1.8	Lead and conductor cutting	50
8.1.9	Solid hook-up wire	50
8.1.10	Location	50
8.1.11	Conformal coating, cementing and encapsulation	50
8.2	Lead bending requirements	51
8.2.1	General	51
8.2.2	Conductors terminating on both sides of a non-plated-through hole	51
8.3	Mounting of terminals to PCBs	52
8.4	Lead attachment to PCBs	53
8.4.1	General	53
8.4.2	Clinched leads	53
8.4.3	Stud leads	55
8.4.4	Lapped round leads	56
8.4.5	Lapped ribbon leads	56
8.5	Mounting of components to terminals	56
8.6	Mounting of connectors to PCBs	58
9	Attachment of conductors to terminals, solder cups and cables	59

9.1	General.....	59
9.1.1	Conductors	59
9.1.2	Terminals	59
9.2	Wire termination	59
9.2.1	Breakouts from cables	59
9.2.2	Insulation clearance	59
9.2.3	Solid hook-up wire.....	60
9.2.4	Stress relief	60
9.3	Turret and straight-pin terminals	60
9.3.1	Side route	60
9.3.2	Bottom route	60
9.4	Bifurcated terminals	61
9.4.1	General	61
9.4.2	Bottom route	61
9.4.3	Side route	62
9.4.4	Top route	63
9.4.5	Combination of top and bottom routes.....	64
9.4.6	Combination of side and bottom routes	64
9.5	Hook terminals.....	64
9.6	Pierced terminals	65
9.7	Solder cups (connector type)	66
9.8	Insulation sleeving	66
9.9	Wire and cable interconnections	67
9.9.1	General	67
9.9.2	Preparation of wires	67
9.9.3	Preparation of shielded wires and cables	67
9.9.4	Pre-assembly	68
9.9.5	Soldering procedures	68
9.9.6	Cleaning.....	69
9.9.7	Inspection	69
9.9.8	Workmanship	69
9.9.9	Sleeving of interconnections	69
9.10	Connection of stranded wires to PCBs.....	70
10	Soldering to terminals and PCBs.....	72
10.1	General.....	72
10.1.1	Securing conductors	72
10.1.2	Thermal shunts	72

10.1.3	High-voltage connections	72
10.2	Solder application to terminals	73
10.2.1	Soldering of swaged terminals onto PCBs	73
10.2.2	Soldering of conductors onto terminals (except cup terminals).....	73
10.2.3	Soldering of conductors onto cup terminals.....	74
10.3	Solder application to PCBs	74
10.3.1	Solder coverage	74
10.3.2	Solder fillets	74
10.3.3	Soldering of component leads to plated-through holes	74
10.3.4	Solder application	75
10.4	Wicking.....	76
10.5	Solder rework	76
10.6	Repair and modification	76
11	Cleaning of PCB assemblies	77
11.1	General.....	77
11.2	Ultrasonic cleaning	77
11.3	Monitoring for cleanliness	77
11.3.1	Cleanliness testing	77
11.3.2	Testing frequency	78
11.3.3	Test limits.....	78
11.3.4	Test method.....	78
12	Final inspection	79
12.1	General.....	79
12.2	Acceptance criteria	79
12.3	Visual rejection criteria.....	80
13	Verification procedure.....	81
13.1	General.....	81
13.2	Vibration	81
13.3	Temperature cycling	84
13.4	Microsection	84
14	Quality assurance.....	85
14.1	General.....	85
14.2	Data.....	85
14.3	Nonconformance	85
14.4	Calibration	85
14.5	Traceability	86

14.6 Workmanship standards	86
14.7 Inspection	86
14.8 Operator and inspector training and certification	86
15 Workmanship standards.....	88
15.1 Soldered clinched terminals.....	88
15.2 Soldered stud terminals	89
15.3 Soldered turret terminals.....	90
15.4 Solder turret terminals	91
15.5 Soldered bifurcated terminals	92
15.6 Soldered hook terminals	93
15.7 Soldered cup terminals	94
15.8 Soldered wire to shielded cable interconnections	95
Annex A (normative) Report on manual soldering of high-reliability electrical connections - DRD.....	98
Annex B (informative) Solder melting temperatures and choice	102
Bibliography.....	103

Figures

Figure 5-1: Profiles of correct and incorrect cutters for trimming leads	27
Figure 5-2 Examples of non-approved types of mechanical strippers	28
Figure 8-1: Assembly of underfilled TO-39 and TO-59, and adhesively staked CKR06	48
Figure 8-2: Methods for incorporating stress relief with components having bendable leads	49
Figure 8-3: Methods for attaching wire extensions to non-bendable leads.....	50
Figure 8-4: Minimum lead bend	51
Figure 8-5: Leads with solder termination on both sides	52
Figure 8-6: Types of terminal swaging	53
Figure 8-7: Clinched-lead terminations - unsupported holes	54
Figure 8-8: Clinched lead terminations - plated through-holes	54
Figure 8-9: Stud terminations	55
Figure 8-10: Methods of through-hole lapped termination.....	57
Figure 8-11: Method of stress relieving parts attached to terminals	57
Figure 9-1: Side- and bottom-route connections to turret terminals	61
Figure 9-2: Bottom-route connections to bifurcated terminal.....	62
Figure 9-3: Side-route connection to bifurcated terminal.....	63
Figure 9-4: Top-route connection to bifurcated terminal.....	64

Figure 9-5: Connections to hook terminals	65
Figure 9-6: Connections to pierced terminals	65
Figure 9-7: Connections to solder cups (connector type).....	66
Figure 9-8: Methods for securing wires.....	69
Figure 9-9: Connection of stranded wires to PCBs	71
Figure 10-1: High voltage connection	73
Figure 10-2: Minimum acceptable wetting on component side.....	75
Figure 15-1: Soldered clinched terminals	88
Figure 15-2: Soldered stud terminals.....	89
Figure 15-3: Soldered turret terminals with twin conductors	90
Figure 15-4: Soldered turret terminals with single conductors.....	91
Figure 15-5: Soldered bifurcated terminals.....	92
Figure 15-6: Soldered hook terminals.....	93
Figure 15-7: Soldered cup terminals.....	94
Figure 15-8: Hand-soldered wire to shielded cable interconnections	95
Figure 15-9: Hand-soldered wire to shielded wire interconnections	96
Figure 15-10: Hand-soldered wire interconnections - details of defects	97

Tables

Table 6-1: Chemical composition of spacecraft solders	32
Table 6-2: Fluxes.....	33
Table 7-1: Clearances for insulation	39
Table 7-2: Solder baths for degolding and pre-tinning	41
Table 9-1: Dimensions for Figure 9-9	71
Table 13-1: Sine survey.....	82
Table 13-2: Minimum severity for sine vibration testing	83
Table 13-3: Minimum severity for random vibration testing for all applications except launchers	83
Table 13-4: Minimum severity for random vibration testing for launcher	83
Table B-1 : Guide to choice of solder types	102

Foreword

This document (EN 16602-70-08:2015) has been prepared by Technical Committee CEN/CLC/TC 5 “Space”, the secretariat of which is held by DIN.

This standard (EN 16602-70-08:2015) originates from ECSS-Q-ST-70-08C.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2015, and conflicting national standards shall be withdrawn at the latest by July 2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This document has been developed to cover specifically space systems and has therefore precedence over any EN covering the same scope but with a wider domain of applicability (e.g. : aerospace).

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

The main part of this Standard is based on recommendations from the National Aeronautics and Space Administration and European soldering technology experts. Modifications have been incorporated into the text to provide for the specific requirement of low-outgassing electrical systems which are required by scientific and application satellites. Other additions have been made in the light of recent technological advances and the results of verification test programmes. The methods and workmanship contained in this document are considered to be fully approved for normal spacecraft requirements.

1

Scope

This Standard defines the technical requirements and quality assurance provisions for the manufacture and verification of manually-soldered, high-reliability electrical connections.

The Standard defines acceptance and rejection criteria for high reliability manufacture of manually-soldered electrical connections intended to withstand normal terrestrial conditions and the vibrational g-loads and environment imposed by space flight.

The proper tools, correct materials, design and workmanship are covered by this document. Workmanship standards are included to permit discrimination between proper and improper work.

The assembly of surface-mount devices is covered in ECSS-Q-ST-70-38.

Requirements related to printed circuit boards are contained in ECSS-Q-ST-70-10 and ECSS-Q-ST-70-11.

Verification of manual soldering assemblies which are not described in this standard are performed by vibration and thermal cycling testing. The requirements for verification are given in this Standard.

This standard does not cover the qualification and acceptance of EQM and FM equipment with hand soldered connections.

The qualification and acceptance tests of equipment manufactured in accordance with this Standard are covered by ECSS-E-ST-10-03.

The mounting and supporting of components, terminals and conductors prescribed herein applies to assemblies designed to operate within the temperature limits of -55°C to $+85^{\circ}\text{C}$.

For temperatures outside this normal range, special design, verification and qualification testing is performed to ensure the necessary environmental survival capability.

Special thermal heat sinks are applied to devices having high thermal dissipation (e.g. junction temperatures of 110°C , power transistors) in order to ensure that solder joints do not exceed 85°C .

This standard may be tailored for the specific characteristic and constraints of a space project in conformance with ECSS-S-ST-00.

Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this ECSS Standard. For dated references, subsequent amendments to, or revision of any of these publications do not apply. However, parties to agreements based on this ECSS Standard are encouraged to investigate the possibility of applying the more recent editions of the normative documents indicated below. For undated references, the latest edition of the publication referred to applies.

EN reference	Reference in text	Title
EN 16601-00-01	ECSS-S-ST-00-01	ECSS system - Glossary of terms
EN 16602-10-09	ECSS-Q-ST-10-09	Space product assurance - Nonconformance control system
EN 16602-20	ECSS-Q-ST-20	Space product assurance - Quality assurance
EN 16602-70-02	ECSS-Q-ST-70-02	Space product assurance - Thermal vacuum outgassing test for the screening of space materials
EN 16602-70-10	ECSS-Q-ST-70-10	Space product assurance - Qualification of printed circuit boards
EN 16602-70-11	ECSS-Q-ST-70-11	Space product assurance - Procurement of printed circuit boards
EN 16602-70-28	ECSS-Q-ST-70-28	Space product assurance - Repair and modification of printed circuit board assemblies for space use
EN 16602-70-71	ECSS-Q-ST-70-71	Space product assurance - Data for selection of space materials and processes
	ESCC 23500	Requirements for lead materials and finishes for components for space application
	EN 61340-5-1	Protection of electronic devices from electrostatic phenomena - General requirements
	EN 61340-5-2	Protection of electronic devices from electrostatic phenomena – User guide
	MIL-STD-883 Rev.G	Test methods and procedures for microelectronics

3

Terms, definitions and abbreviated terms

3.1 Terms from other standards

For the purpose of this Standard, the terms and definitions from ECSS-ST-00-01 apply.

For the purpose of this Standard, the following terms from ECSS-Q-ST-70-28 apply:

repair
rework

3.2 Terms specific to the present standard

3.2.1 approval authority

entity that reviews and accepts the verification programme, evaluating the test results and grants the final approval

3.2.2 base laminate

see “substrate”

3.2.3 bifurcated (split) terminal

terminal containing a slot or split in which wires or leads are placed before soldering

3.2.4 bit

removable heat store of a soldering iron

3.2.5 blister

delamination in a distinct local area or areas

3.2.6 bridging

build-up of solder or conformal coating between parts, component leads or base substrate forming an elevated path

NOTE See “fillet”.

3.2.7 clinched-lead termination

conductor or component lead which passes through a printed circuit board and is then bent to make contact with the printed circuit board pad

NOTE The clinched portion is not forced to lie flat on the pad and some innate spring back is desirable before this form of termination is soldered.

3.2.8 cold flow

movement of insulation, for example Teflon (PTFE), caused by pressure

3.2.9 cold solder joint

joint in which the solder has a blocky, wrinkled or piled-up appearance and shows signs of improper flow or wetting action

NOTE It can appear either shiny or dull, but not granular. The joint normally has abrupt lines of demarcation rather than a smooth, continuing fillet between the solder and the surfaces being joined. These lines are caused by either insufficient application of heat or the failure of an area of the surfaces being joined to reach soldering temperature

3.2.10 component

device which performs an electronic, electrical or electromechanical function and consists of one or more elements joined together and which cannot normally be disassembled without destruction

NOTE 1 The terms component and part can be interchanged.

NOTE 2 Transistors, integrated circuits, hybrids, capacitors.

3.2.11 component lead

solid wire which extends from and serves as a connection to a component

3.2.12 conductor

lead or wire, solid or stranded, or printed circuit patch serving as an electrical interconnection between terminations

3.2.13 conformal coating

thin protective coating which conforms to the configuration of the covered assembly

3.2.14 connection

electrical termination

3.2.15 contact angle

angle enclosed between half-planes, tangent to a liquid surface and a solid-liquid interface at their intersection

NOTE In particular, the contact angle of liquid solder in contact with a solid metal surface. An approximate value for this can be determined by shadow projection or other means, by measuring after the solder has solidified. The contact angle is always the angle inside the liquid

3.2.16 contamination

particles, liquids, gases, materials and micro-organisms which by their presence can disturb the performance of an item

3.2.17 corrosion

deterioration of a metal by chemical or electrochemical reaction with its environment

3.2.18 cracked solder joint

soldered connection which has fractured or broken within the solder

3.2.19 dewetting

condition in a soldered area in which the liquid solder has not adhered intimately, characterized by an abrupt boundary between solder and conductor, or solder and terminal/termination area

NOTE This is often seen as a dull surface with islands of thicker shiny solder.

3.2.20 disturbed solder joint

unsatisfactory connection resulting from relative motion between the conductor and termination during solidification of the solder

3.2.21 electrical connection

conductive connection in electrical or electronic circuits

3.2.22 eutectic alloy

alloy of two or more metals that has one distinct melting point

NOTE One eutectic solder is a tin-lead alloy containing 63 % Sn and 37 % Pb which melts at 183 °C

3.2.23 fillet

smooth concave build-up of material between two surfaces

NOTE Example: A fillet of solder between a component lead and a solder pad or terminal, or a fillet of conformal coating material between a component and printed circuit board

3.2.24 flux

material which, during soldering, removes the oxide film, protects the surface from oxidation, and permits the solder to wet the surfaces to be joined

3.2.25 flux activity

property of a flux which allows the smallest contact angle between molten solder and a solid surface

NOTE See also “rosin”.

3.2.26 glass meniscus

glass fillet of a lead seal which occurs where an external lead leaves the package body

3.2.27 haloing

condition existing in the base laminate of a printed circuit board in the form of a light area around holes or other machined areas on or below the surface of the laminate

3.2.28 hook terminal

terminal formed in a hook shape

3.2.29 icicles

see “solder icicle”

3.2.30 interfacial connection

conductor which connects conductive patterns between opposite sides of a printed circuit board

NOTE Normally a plated-through hole.

3.2.31 lap joint

joining or fusing of two overlapping metal surfaces with solder without use of any other mechanical attachment or support

3.2.32 measling/measles

condition existing in the base laminate of printed circuit board in the form of discrete white spots or “crosses” below the surface of the base laminate, reflecting a separation of fibres in the glass cloth at the weave intersection

NOTE During soldering this can be caused by excessive heat.

3.2.33 multi-layer circuit board

product consisting of alternate laminates of printed circuit substrates and insulators, bonded together by simultaneous application of heat and pressure prior to drilling and plating holes for interconnections

NOTE See also “printed circuit board”.

3.2.34 pad

termination of a conducting surface on a printed circuit board to which leads are soldered to form electrical connections

NOTE These can be described as either functional, where an active track is terminated, or non-functional, where the pad is isolated.

3.2.35 pits

small holes or sharp depressions in the surface of solder

NOTE This can be caused by flux blow-out due to entrapment or overheating

3.2.36 plated-through hole

hole in which metal is deposited on the inside surface

NOTE 1 Adapted from IEC Multilingual dictionary.

NOTE 2 Also known as a supported hole. The configuration is used to provide additional mechanical strength to the soldered termination or to provide an electrical interconnection on a double-sided or multi-layer printed circuit board.

3.2.37 potting compound

compound, usually electrically non-conductive, used to encapsulate or as a filler between components, conductors or assemblies

3.2.38 printed circuit board (PCB)

product resulting from the process of selectively etching unwanted copper from one or both surfaces of a copper-clad insulating substrate to form a desired circuitry pattern which is subsequently solder- or gold-plated

NOTE The term printed circuit board covers the following families:

- single sided;
- double sided, rigid or flexible;
- multilayer, rigid or flex-rigid.

3.2.39 resin

natural substance that is usually transparent or translucent and yellowish to brown

NOTE Resins are formed in plant secretions and are soluble in organic solvents, but not water. This is a generic term, rosin being the specific term with regard to soldering (see "rosin").

3.2.40 resistance soldering

method of soldering by passing a current between two electrodes through the area to be soldered

3.2.41 rosin

natural resin obtained as the residue after removal of turpentine from the oleoresin of the pine tree, consisting mainly of abietic acid and related resin acids, the remainder being resin acid esters

NOTE It is non-corrosive and electrically non-conducting. Rosin is the basic constituent of the rosin flux family (see ISO EN 29454).

3.2.42 rosin-soldered joint

unsatisfactory connection which has entrapped rosin flux

3.2.43 selective plating

area of a plated circuit board that is designed to have a different plated finish than the rest of the board

NOTE Example: A gold-finished RF board that supports tin-lead terminations (land areas).

3.2.44 shield

metallic sheath surrounding one or more wires, cables, cable assemblies, or a combination of wires and cables that is used to prevent or reduce the transmission of electromagnetic energy to or from the enclosed conductors

NOTE The shield also includes an insulating jacket that can cover the metallic sheath

3.2.45 solder

non-ferrous fusible metallic alloy of two or more metals (usually tin and lead) used when melted to join or fuse metallic surfaces together and to provide a low resistance electrical path

3.2.46 solderability

property of a surface which allows it to be wetted by molten solder

NOTE Standard tests exist to assess the solderability of conductors. Surfaces are considered to have a "good solderability" if, following the procedures of this standard, solder wetting can be achieved within 3 seconds and dewetting does not occur before 8 seconds.

3.2.47 solder coating

surface coated with a thin, uniform layer of solder

3.2.48 solder-cup terminal

hollow, cylindrical terminal closed at one end to accommodate one or more conductors

3.2.49 solder icicle

conical peak or sharp point of solder usually formed by the premature cooling and solidification of solder upon removal of the heat sources

3.2.50 solder pad

termination area on a printed circuit conductor

3.2.51 soldering

process of joining metallic surfaces through the use of solder without direct fusion of the base metals

3.2.52 soldering time

time required for a surface to be wetted by solder under specified conditions

3.2.53 stress lines

three forms of stress lines can appear on a finished solder fillet:

- a. lines or folds running parallel to the mounting surface usually denote excessive soldering times or temperatures and also rework. They are probably caused during soldering by differential expansions, i.e. between the printed circuit board substrate which expands a far greater distance than the metallic material of the joint
- b. lines running perpendicular to the mounting surface are commonly caused when the soldering iron bit is removed too slowly from a liquid solder joint
- c. lines running circumferentially around the mid section of the solder fillet caused by shrinkage during the last stage of solidification

3.2.54 stress relief

method or means to minimize stresses to the soldered termination or component

NOTE Generally in the form of a bend or service loop in a component lead, solid or stranded wire to provide relief from stress between terminations, as that caused, for instance by movement or thermal expansion

3.2.55 stud termination

upright conductor termination through a printed circuit board

3.2.56 substrate

supporting dielectric material upon which the elements of a circuit are deposited or installed

3.2.57 termination/terminal area

conductive surface on a printed circuit board used for making electrical connections

NOTE Also referred to as printed circuit pad, solder pad.

3.2.58 thermal shunt

device with good heat-dissipation characteristics used to conduct heat away from an article being soldered

3.2.59 tinning

coating of a surface with a uniform layer of solder before it is used in a soldered connection

3.2.60 tip

application surface at the end of the soldering-iron bit

3.2.61 turret terminal

round post-type grooved stud around which conductors are fastened before soldering

3.2.62 wetting

flow and adhesion of a liquid to a solid surface, characterized by smooth, even edges and low contact angle

3.2.63 wicking

flow of molten solder or cleaning solution by capillary action

NOTE Occurs when joining stranded wire; solder is drawn within the strands, but normally not visible on outer surface of strands. Wicking can also occur within the stress relief bend of a component lead.

3.2.64 wire

single metallic conductor of solid, or stranded, construction, designed to carry current in an electric circuit, but which does not have a metallic covering, sheath or shield

NOTE For this standard, "wire" refers to "insulated electric wire".

3.3 Abbreviated terms

For the purpose of this Standard, the abbreviated terms from ECSS-S-ST-00-01 and the following apply:

Abbreviation	Meaning
AWG	American wire gauge

ETFE	ethylene tetrafluoroethylene
ESD	electrostatic discharge
FEP	fluorinated ethylene propylene
INH1	IEC 61190-1-3 (2002) flux designation: inorganic, high activation (> 2 % halide)
PCB	printed circuit board
PSD	power spectral density
PTFE	polytetrafluoroethylene
RF	radio frequency
R_g	resistance to ground
R_s	surface resistance
ROH1	IEC 61190-1-3 (2002) flux designation: rosin, high activation (≥ 2 % halide)
ROL0	IEC 61190-1-3 (2002) flux designation: rosin, very low activation (< 0,01 % halide)
ROL1	IEC 61190-1-3 (2002) flux designation: rosin, low activation (< 0,15 % halide)
r.m.s.	root-mean-square
SMT	surface mount technology

Principles of reliable soldered connections

The following are the general principles to ensure reliable manually-soldered connections:

- Reliable soldered connections are achieved by using proper design, having control of tools, selecting the right materials, applying processes with precaution in a controlled work environment and taking into account inspection requirements.
- The basic design concepts to ensure reliable connections and to avoid solder joint failure are as follows:
 - Stress relief is an inherent part of the design, which reduces detrimental thermal and mechanical stresses on the solder connections.
 - Where adequate stress relief is not possible, a method of solder-joint reinforcement is incorporated.
 - Materials are selected such that the mismatch of thermal expansion coefficients is a minimum at the constraint points in the component-mounting configuration.
 - Materials and processes which result in the formation of brittle intermetallics, such as soldering to gold using tin-lead alloy, are avoided.
 - The assembled substrates are designed to allow inspection.

5

Preparatory conditions

5.1 Calibration

- a. Calibration status of tools and inspection equipments shall be verified according to clause 14.4.
- b. Records of the calibration and verification of the tools and inspection equipments shall be maintained.

5.2 Facility cleanliness

- a. Personnel facilities shall be separated from the soldering areas.

NOTE Example: Washrooms, eating areas, smoking facilities.
- b. Furniture shall be arranged to allow thorough cleaning of the floor.
- c. Areas used for soldering shall be kept free from contaminants.

NOTE Loose material such as dirt, dust, solder particles, oil or clipped wires can contaminate soldered connections.
- d. Working areas shall be kept free from any tools or equipment not used for the current task.
- e. Working surfaces shall be covered with an easily-cleaned hard top or have a replaceable surface of clean, non-corrosive, silicone-free paper.
- f. Tools used during soldering operations shall be free of visible contaminant.
- g. Excess lubricants shall be removed from tools before soldering starts.

5.3 Environmental conditions

- a. The soldering area shall have a controlled environment to limit the entry of contaminants.

NOTE It is good practice to solder in a clean room (see ISO 14644-1).

- b. Areas used for assembly or cleaning of parts and areas where toxic or volatile vapours are generated or released shall include a local air extraction system.
- c. The room temperature of the facility shall be maintained at $22\text{ °C} \pm 3\text{ °C}$.
- d. The relative humidity at room temperature of the facility shall be maintained at $55\% \pm 15\%$.
- e. The soldering area shall not be exposed to draughts.
- f. Air shall be supplied to the room through a filtering system that provides a positive pressure difference with respect to adjacent rooms.

5.4 Lighting requirements

- a. Lighting intensity shall be a minimum of 1080 lux on the work surface.
- b. At least 90 % of the work area shall be without shadows or severe reflections.

5.5 Precautions against static discharges

5.5.1 General

- a. An ESD Control Program in accordance with EN 61340-5-1 and EN 61340-5-2 shall be developed and implemented by the supplier.
- b. Electrostatic sensitive components shall be prepared, mounted, soldered and cleaned in an ESD protected area.
- c. Electrostatic sensitive components shall be kept as shipped (e.g. in anti-static tubes or foam) until assembly preparation.
- d. Containers for ESD sensitive components shall be so labelled.

5.5.2 Precautions against ESD during manufacturing

- a. The working bench shall have a static dissipative top with surface resistance (R_s) in the range $1 \times 10^4 \Omega$ to $1 \times 10^{10} \Omega$.
- b. The working bench shall have a static dissipative top resistance to ESD protected area ground (R_g) in the range $7,5 \times 10^5 \Omega$ to $1 \times 10^9 \Omega$.
- c. A wrist strap having a resistance to ESD protected area ground (R_g) in the range $7,5 \times 10^5 \Omega$ to $3,5 \times 10^7 \Omega$ shall be worn by the operator.
- d. Seating shall have static dissipative surfaces with resistance to ESD protected area ground (R_g) less than $1 \times 10^{10} \Omega$.

NOTE These measures prevent the build-up of static charges and avoid potential differences by keeping personnel, equipment and device leads at the same electrical potential, i.e. ground.

- e. Powered equipment at the work station shall be grounded.
 - NOTE The normal value of the resistance between the tip of the soldering system and the ground of the ESD protected area does not exceed 5 Ω . The measurement is generally performed at soldering temperature.
- f. A ground-fault circuit interrupter shall be installed.
- g. Protective clothing shall be made from static dissipative material.
- h. Gloves and finger cots shall be made from static dissipative material.
 - NOTE Tools, such as mounting aids, and consumables, masking tape, are expected to be conductive or static dissipative.
- i. Paperwork accompanying ESD sensitive components shall be contained in static dissipative bags or envelopes.
 - NOTE Example of accompanying paperwork are traveller logs, drawings and instructions.
- j. Paperwork shall not come into contact with ESD sensitive components.
- k. Ionised air in presence of high voltage or RF shall not be used.
 - NOTE Static charges on isolated parts or tooling can be dissipated using ionised air.

5.5.3 Protective Packaging and ESD Protection

- a. All ESD-sensitive items shall be contained within ESD-protective containers for movement between and within ESD-protected areas.
- b. ESD protective packaging shall display ESD warning signs.
- c. If the packaging is not ESD safe, it shall be labelled accordingly.
 - NOTE The objective of ESD protection is to prevent ESD to the item contained within, to allow for dissipation of charge, and to prevent charging of the ESDS item by an external electrostatic field.
- d. A container shall provide for mechanical and ESD protection whenever the ESD-sensitive electronic assembly is transported within a manufacturing plant or during shipment to external destinations.
- e. The container shall provide:
 - 1. an outer shell that provides adequate mechanical protection for the contents;
 - 2. foam or bubble wrap shock absorbing liners that have static shielding covers;
 - 3. a shielding package for the ESD sensitive contents.
- f. Pink-Polyethylene (pink-poly) bags, film, bubble wrap or foam near any ESD-sensitive item or within an ESD protected area shall not be used.

NOTE Pink-polyethylene provides little protection against ESD events and voltage fields and is a contamination source. The preferred alternative is the metallized static-shielding bag.

5.5.4 Packing and filler materials

- a. Shipping popcorn, foam liners and polystyrene foam shall not be used near ESD-sensitive items unless shielding overwrap protects them.

5.6 Equipment and tools

5.6.1 General

- a. New equipments and tools shall be inspected to ensure that they are not defective prior to use.

5.6.2 Brushes

- a. Medium-stiff natural- or synthetic bristle, ESD-safe, brushes shall be used for cleaning provided that they do not damage any surface to be cleaned or adjacent materials.
- b. Brushes shall be cleaned in a solvent in accordance with clause 6.4.
- c. Brushes shall not be damaged by the solvents used for PCB cleaning.
- d. Wire brushes shall not be used.

5.6.3 Cutters and pliers

- a. Cutting edge profiles and cutter usage shall be in accordance with Figure 5-1.
- b. The cutter used for trimming conductor wire and component leads shall shear sharply, producing a clean, flat, smooth-cut surface along the entire cutting edge.

NOTE 1 These measures minimize the transmission of mechanical and shock loads to delicate parts.

NOTE 2 Smooth, long-nose pliers or tweezers can be used for attaching or removing conductor wires and component leads.

- c. No twisting action shall occur during the cutting operation.
- d. Cutting edges shall be checked for damage and maintained in a sharp condition.

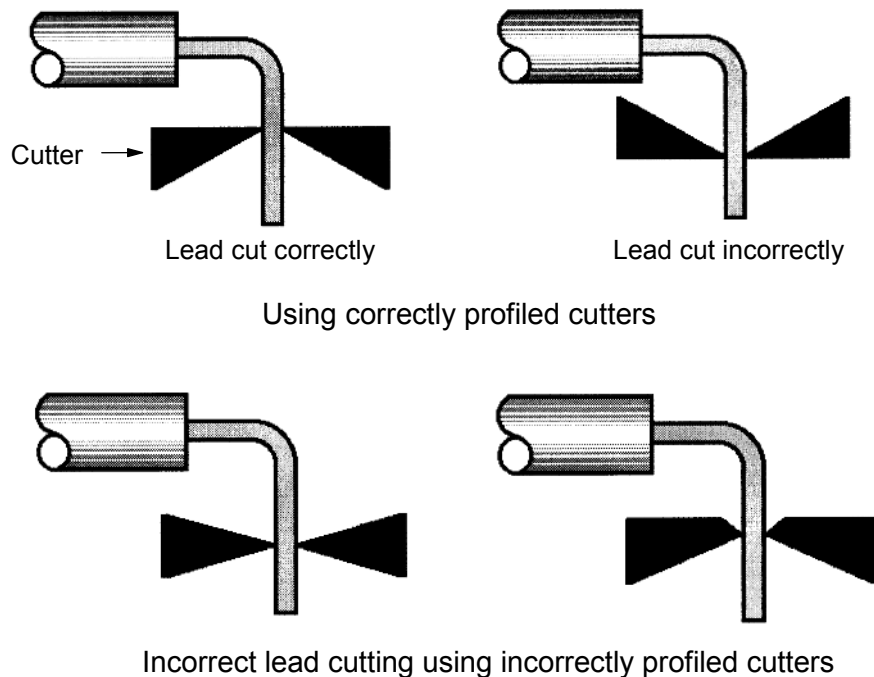


Figure 5-1: Profiles of correct and incorrect cutters for trimming leads

5.6.4 Bending tools

- Bare component leads shall be bent or shaped using tools, including automatic bending tools, which do not cut, nick or damage the leads or insulation.
- Components shall not be damaged by the bending process (see also clause 8.2).

NOTE It is good practice to use bending tools with polished finish. The preferred surface finish for shaping tools is hard chromium plating.

- Bending tools shall have no sharp edges in contact with the component leads.

5.6.5 Clinching tools

- Clinching tools shall not damage the surfaces of printed-circuit conductors, components or component leads.

5.6.6 Insulation strippers

5.6.6.1 Thermal strippers

- a. The temperature of the stripper shall not burn, blister or cause excessive melting of the insulation.

NOTE 1 Thermal insulation strippers can be used for wire insulation types susceptible to damage by mechanical strippers.

NOTE 2 It is good practice to apply thermal strippers for use with AWG 22 and smaller wire sizes where there is a possibility of the wire stretching if a mechanical stripper is used.

NOTE 3 Local air extraction units can be used during thermal stripping.

5.6.6.2 Precision mechanical cutting-type strippers

- a. Mechanical strippers shall be of the following types:

1. Automatic power-driven strippers with precision, factory-set, cutting and stripping dies and wire guards, or
2. Precision-type hand strippers with accurately machined and factory-preset cutting heads.

NOTE Figure 5-2 shows some examples of unacceptable mechanical strippers.

- b. Stripping tools or machines shall fit the size of the wire conductor.

NOTE It is good practice to mask off the die openings for wire sizes not in use.

- c. The conductor shall not be twisted, ringed, nicked, cut or scored by the process.



Figure 5-2 Examples of non-approved types of mechanical strippers

5.6.6.3 Enamel stripping

- a. The enamel shall be removed by chemical or thermal means.

NOTE See also 6.7d.

- b. The enamel may be removed by mechanical means provided that visual inspection using a minimum magnification of x40 is carried out to ensure that the conductor is undamaged.

5.6.6.4 Verification of stripping tools

- a. Thermal and mechanical stripping tools shall be verified by sampling at the start of each production run.

5.6.7 Soldering irons and resistance soldering equipment

- a. The size and shape of the soldering iron and bit shall not damage adjacent areas or connections during soldering operations.
- b. Temperature-controlled soldering irons shall be used.

NOTE It is good practice to verify periodically the solder tip temperature.

- c. Files shall not be used for dressing plated copper soldering-iron tips.
- d. A selection of bit sizes and shapes appropriate to each soldering operation envisaged shall be available.
- e. The soldering iron or resistance-heating electrode shall heat the joint area to the solder liquidus temperature in a time between 1 second and 2 seconds.
- f. The soldering iron or resistance-heating electrode shall maintain the soldering temperature at the joint throughout the soldering operation.
- g. Thermal shunts (see 5.6.8.3) shall be used to protect thermally-sensitive components.
- h. For soldering of electronic components, the soldering-bit temperature shall be between 280 °C and 350 °C.
- i. A soldering-bit temperature lower than 280 °C may be used.
- j. A soldering-bit temperature up to 380 °C may be used for polyimide PCBs with heat sinks, wide tracks or ground planes.
- k. A soldering bit temperature up to 360 °C may be used for PCBs other than polyimide with heat sinks, wide tracks or ground planes.
- l. A soldering iron holder shall be used.

NOTE It is good practice to use a cage-type holder that leaves the soldering-iron tip unsupported when a temperature-controlled soldering iron is used.

5.6.8 Soldering tools

5.6.8.1 General

- a. The leads shall not be damaged during preparation and assembly.

5.6.8.2 Holding tools

- a. Holding tools used as soldering aids shall not be wetted by the solder during the assembly.

5.6.8.3 Thermal shunts

- a. Thermal shunts shall be used for the de-golding, pre-tinning and soldering of temperature-sensitive components.

NOTE An effective clamp-type thermal shunt can be constructed by sweating small copper bars into the jaws of an alligator clip.

- b. The heat sink shall be used when the non-thermal sensitivity of the device cannot be demonstrated.
- c. The thermal shunt shall not disturb the solder joint by mechanical interference.
- d. Shunts shall be applied and removed without mechanically damaging the component or the assembly.

NOTE Shunts can be held in place by friction, spring tension, or any other means that does not damage the finish or insulation.

5.6.8.4 Anti-wicking tools

- a. The conductor gauge sizes of the anti-wicking tools shall be marked on the tool.

NOTE Anti-wicking tools can be used for pre-tinning the stranded wires.

6

Materials selection

6.1 General

- a. Material selection shall be performed in accordance with ECSS-Q-ST-70-71.
- b. Components, subassemblies, assemblies and hardware for space flight applications shall not have tin finishes containing more than 97 % tin.
- c. Electrical/electronic components identified as having plated or metallized external surfaces with a tin finish containing more than 97 % tin may be pretinned with a tin-lead solder in accordance with 6.2.2b.

NOTE Tin whisker mitigation (barrier methods such as coating or sleeving) is addressed in the framework of an NRB or Approval Authority.

- d. Pretinning shall not degrade or damage the component.

NOTE See also 6.1c.

- e. Subassemblies, assemblies and mounting hardware identified as having lead-free surfaces (plated or metallised) shall be protected by process or design to prevent metallic whisker formation in the expected end-use application/environment.
- f. Operations carried out during degolding or pretinning shall not contravene the individual detailed specification for the component, PCB and terminations.

6.2 Solder

6.2.1 Form

- a. For soldering, ribbon, wire and preforms shall be used provided that the alloy and flux meet the requirements of this standard.
- b. For degolding and pretinning, solder alloys shall be supplied as ingots (without flux).

6.2.2 Composition

- a. The solder alloy shall have a composition specified in Table 6-1.

NOTE 1 See ISO 9453 for further details.