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Nationales Vorwort

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Änderungen

Gegenüber DIN EN 16603-10-03:2014-12 wurden folgende Änderungen vorgenommen:

a) Umsetzung der eingegangenen Änderungswünsche zur gleichwertigen ECSS-Norm;

b) redaktionelle Überarbeitung.

Frühere Ausgaben

DIN EN 14824: 2005-10
DIN EN 16603-10-03: 2014-12

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Nationaler Anhang NA
(informativ)

Begriffe und Abkürzungen

Reihenfolge und Inhalt der folgenden Begriffe sind identisch mit denen im Abschnitt Begriffe der Englischen Fassung.

3.1 Begriffe aus anderen Normen

a) Für die Anwendung dieser Norm gelten die Begriffe aus ECSS-S-ST-00-01 sowie insbesondere folgende Begriffe:

1) Inbetriebnahme;

2) Flugmodell;

3) Lebensdauer;

4) Flug-Prototypmodell;

5) Qualifikationsmodell;

6) Raumsegmentelement;

7) Raumsegmenteinrichtung;

8) Raumsegment-Untersystem;

9) Strukturmodell;

10) System;

11) Prüfung.

b) Für die Anwendung dieser Norm gelten folgende Begriffe aus ECSS-E-ST-10-02:

1) Modellphilosophie.

c) Für die Anwendung dieser Norm gelten folgende Begriffe aus ECSS-E-ST-31:

1) Abnahme-Temperaturbereich;

2) Bemessungstemperaturbereich;

3) Mindest-Einschalttemperatur;

4) erwarteter Temperaturbereich;

5) Bereich der Qualifikationstemperatur;

6) Temperatur-Bezugspunkt (TRP).

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d) Für die Anwendung dieser Norm gelten folgende Begriffe aus ECSS-E-ST-32:

1) Sicherheitsbeiwert (FOS);

2) Grenzlast (LL);

3) Auslegungs-Höchstdruck (MDP);

4) Überlastprüfung.

e) Für die Anwendung dieser Norm gelten folgende Begriffe aus ECSS-E-ST-32-02:

1) Berstdruck;

2) Auslegungs-Berstdruck;

3) Prüffaktor;

4) Prüfdruck.

3.2 Spezielle Begriffe für diese Norm

3.2.1
äquivalenter 24-Stunden-Lärmexpositionspegel
äquivalenter Dauerschallpegel (Leq), in dBA, dem die Besatzung über einen Zeitraum von 24 h ausgesetzt ist

Anmerkung 1 zum Begriff: 0 dBA entsprechen 20 µPa.

3.2.2
verkürzte Funktionsprüfung
AFT, en: abbreviated functional test
siehe „**reduzierte Funktionsprüfung (RFT)**“

3.2.3
Abnahmestufe
Prüfstufe, die durch die Erhöhung des Schärfegrades eines extremen Niveaus, das während der festgelegten Lebensdauer des Produktes zu erwarten ist, zum Zwecke der Ausführungsverifizierung erforderlich ist

3.2.4
Abnahmespanne
Erhöhung des Schärfegrades der umweltbezogenen, mechanischen, elektrischen, EMV-bezogenen oder betrieblichen extremen Niveaus, die für die festgelegte Lebensdauer des Produktes zu erwarten sind, zum Zwecke der Ausführungsverifizierung

Anmerkung 1 zum Begriff: Diese Spanne kann eine Erhöhung einer Stufe, eine Erweiterung eines Bereiches, eine Verlängerung der Dauer oder von Beanspruchungszyklen sowie beliebige sonstige angemessene Verbesserungen des Schärfegrades umfassen.

3.2.5
bemanntes Raumsegmentelement
Ausführung des Raumsegmentes, durch die die sichere Anwesenheit der Besatzung an Bord sichergestellt wird

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3.2.6
Haltezeit
Zeitdauer, die benötigt wird um sicherzustellen, dass die internen Teile oder eine Unterbaugruppe einer Raumsegment-Einrichtung das thermische Gleichgewicht erreicht haben, und die ab Beginn der Temperatur-Stabilisierungsphase gemessen wird, d. h. wenn die Temperatur die geplante Prüftemperatur zu- oder abzüglich der Prüftoleranz erreicht

3.2.7
Umweltprüfungen
Prüfungen, die an einem Produkt durchgeführt werden, indem (gemeinsam oder getrennt) Umgebungsbedingungen nachgebildet werden, wie sie während des Betriebslebenszyklus des Produktes anzutreffen sind

Anmerkung 1 zum Begriff: Umweltprüfungen decken natürliche und künstlich erzeugte Umgebungen ab.

3.2.8
vollständige Funktionsprüfung
FFT, en: full functional test
umfassende Prüfung, die die Unversehrtheit aller Funktionen der zu prüfenden Einheit in allen Betriebsarten einschließlich des Bereitschaftsmodus und in allen vorhergesehenen Übergängen nachweist

Anmerkung 1 zum Begriff: Das Hauptziel dieser Prüfung ist es nachzuweisen, dass keine Konstruktions-, Herstellungs- und Integrierungsfehler aufgetreten sind.

Anmerkung 2 zum Begriff: FFT gibt es auf den verschiedenen Ebenen der Zerlegung eines Raumsegmentelementes. Bei Satelliten werden sie auch als Systemfunktionsprüfung (SFT, en: system functional test) oder integrierte Systemprüfung (IST, en: integrated system test) bezeichnet.

3.2.9
maximale erwartete Beschleunigung
Wert der Beschleunigung, der aus den kombinierten Wirkungen der Beschleunigung im Beharrungszustand und des Einschwingvorgangs der Einheit ermittelt wird, wie sie während ihrer Lebensdauer anzutreffen sind

Anmerkung 1 zum Begriff Dieser Begriff entspricht dem Begriff Grenzlast (wie in E-ST-32 festgelegt).

Anmerkung 2 zum Begriff: Beispiele für Ereignisse während der Lebensdauer sind Transport, Handhabung, Motorzündung, Brennschluss und Stufentrennung.

3.2.10
maximal erwartetes akustisches Spektrum
Höchstwert des zeitgemittelten Effektivwertes des Schalldruckpegels (SPL) in jedem Frequenzband, der innerhalb der Nutzlastverkleidung, des Orbiters oder des Laderaumes bei Flugvorgängen vorkommt

Anmerkung 1 zum Begriff: Z. B. Abheben (Start), angetriebener Flug oder Wiedereintritt.

Anmerkung 2 zum Begriff: Das maximal erwartete akustische Spektrum der Umweltprüfung wird in Oktaven oder 1/3-Oktavbändern über einen Frequenzbereich von 31,5 Hz bis 10 kHz angegeben. Die Dauer des maximalen Umgebungswertes ist der Gesamtzeitraum, in dem die Gesamtamplitude innerhalb von 6 dB der maximalen Gesamtamplitude liegt.

3.2.11
maximal erwartete Stoßbelastung
ungünstigste Fälle des Ansammelns von Stößen an der Montageschnittstelle durch alle möglichen Ursachen

Anmerkung 1 zum Begriff: Z. B. sind Ursachen für Stöße: pyrotechnische Einrichtungen zur Stufentrennung, Trennung der Nutzlastverkleidung oder Satellitentrennung, nicht explosive Betätigungseinrichtungen, Mechanismen mit Energiefreisetzung, Verriegelung von Zubehör und Kraftstoffventile.

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Anmerkung 2 zum Begriff: Stöße können anhand ihrer zeitlichen Entwicklungen, des Stoß-Antwortspektrums oder der Impulsgeometrie beschrieben werden.

Anmerkung 3 zum Begriff: Zusätzliche Informationen siehe ECSS-E-HB-32-25.

3.2.12
maximal erwartetes Spektrum zufallsverteilter Schwingungen
maximal erwartete Umgebung, mit der das Raumsegmentelement und die Raumsegmenteinrichtung aufgrund von zufallsverteilten Breitbandschwingungs-Zwangsfunktionen innerhalb des Startelements oder Raumsegmentelements während des Fluges oder durch den Transport und die Handhabung am Boden beansprucht werden

Anmerkung 1 zum Begriff: Z. B. akustisches Feld beim Abheben (Start), aerodynamische Anregungen und übertragene Körperschallschwingungen.

Anmerkung 2 zum Begriff: Bei unterschiedlichen Bereichen von Raumsegmenteinrichtungen oder unterschiedlichen Achsen können unterschiedliche Spektren vorliegen. Die Schwingungspegel der Raumsegmenteinrichtung beruhen auf Messungen der Schwingungsantwort oder auf Modellvorhersagen, die an den Befestigungsstellen der Raumsegmenteinrichtung während akustischer Prüfungen am Boden oder während des Fluges vorgenommen wurden. Die Dauer der maximalen Umgebung ist der Gesamtzeitraum während des Fluges, in dem der Gesamtpegel innerhalb von 6 dB des maximalen Gesamtpegels liegt.

Anmerkung 3 zum Begriff: Die spektrale Leistungsdichte beruht auf einer Bandbreitenanalyse mit einer Frequenzauflösung von 1/6 Oktaven (oder schmaler), über einen Frequenzbereich von (20 bis 2 000) Hz.

3.2.13
erwartete Höchsttemperatur
Höchstwert des erwarteten Temperaturbereichs

3.2.14
erwartete Mindesttemperatur
Mindestwert des erwarteten Temperaturbereichs

3.2.15
Einkerben
Verringerung des Eingangspegels oder Spektrums zur Begrenzung der Strukturantworten bei Resonanzfrequenzen entsprechend der Qualifizierungs- oder Annahmelasten während einer Schwingungsprüfung

Anmerkung 1 zum Begriff: Einkerben ist ein allgemein anerkanntes Verfahren der Schwingungsprüfung, mit dem das übermäßige Prüfen einer zu untersuchenden Einheit vermieden wird. Die Umsetzung des Einkerbens unterliegt der Genehmigung durch den Kunden und, sofern maßgeblich, auch der Genehmigung durch die für die Startvorrichtung zuständige Stelle.

3.2.16
Betriebsarten
Kombination von Betriebskonfigurationen oder -bedingungen, die während der Produkt-Lebensdauer bei Raumsegmenteinrichtungen oder Raumsegmentelementen auftreten können

Anmerkung 1 zum Begriff: Zum Beispiel: Ein- oder Abschaltmodus, Befehlsmodus, Anzeigemodus, Lageregelungsmodus, Modus mit ein- oder ausgefahrener Antenne sowie Dreh- oder Stabilisierungsmodus.

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3.2.17
Leistungsprüfung
Prüfung zur Verifizierung, dass die zu prüfende Einheit entsprechend ihrer Spezifikationen funktioniert, unter Berücksichtigung ihrer Betriebsanforderungen

Anmerkung 1 zum Begriff: Leistungsprüfungen sind missionsspezifisch, weshalb ihre Einzelheiten in dieser Norm nicht festgelegt sind.

3.2.18
Prüfung der Polarität
Prüfung zur Verifizierung der richtigen Polarität der Funktionsketten (hauptsächlich Lage- und Bahnregelungssystem (AOCS)) oder Einrichtungen des Raumsegmentelements von den Sensoren bis zu den Bedienteilen durch eine Anzahl von Schnittstellen und Prozesse

Anmerkung 1 zum Begriff: Polungsfehler können während des Entwicklungsprozesses hervorgerufen werden: bei der Schnittstellendokumentation, der Konstruktion, der Hardwareherstellung, der Softwareentwicklung, beim Zusammenbau, der Verschaltung und Prüfung von Satelliten, in Satelliten-Datenbanken.

Anmerkung 2 zum Begriff: Ein Polungsfehler kann von jeder Komponente der Funktionskette hervorgerufen werden: durch die Ausführung eines Sensors oder Bedienteils, die Montage eines Sensors oder Bedienteils, die Halterung, die Schnittstellenelemente, Softwarealgorithmen.

Anmerkung 3 zum Begriff: Eine Polaritätsumkehr im Regelkreis des abgesicherten Modus kann zum Verlust eines Satelliten führen.

Anmerkung 4 zum Begriff: Der Begriff „Vorzeichenprüfung“ ist synonym.

3.2.19
Qualifizierungsstufe
Prüfstufe, die durch die Erhöhung des Schärfegrades einer Abnahmestufe zum Zwecke des Nachweises der Ausführungsspanne erforderlich ist

3.2.20
Qualifizierungsspanne
Erhöhung des Schärfegrades der umweltbezogenen, mechanischen, elektrischen, EMV-bezogenen oder betrieblichen extremen Niveaus, die für die festgelegte Lebensdauer des Produktes zu erwarten sind, zum Zwecke des Nachweises der Ausführungsspanne

Anmerkung 1 zum Begriff: Diese Spanne kann eine Erhöhung einer Stufe, eine Erweiterung eines Bereiches, eine Verlängerung der Dauer oder von Beanspruchungszyklen sowie beliebige sonstige angemessene Vergrößerungen des Schärfegrades umfassen.

3.2.21
reduzierte Funktionsprüfung
RFT, en: reduced functional test
Teilmenge der **vollständigen Funktionsprüfung** zur Verifizierung der Unversehrtheit der Hauptfunktionen der zu prüfenden Einheit, mit einem ausreichend hohen Vertrauensgrad in einer relativ kurzen Zeit

Anmerkung 1 zum Begriff: Der Begriff „verkürzte Funktionsprüfung (AFT)“ ist synonym.

3.2.22
Restlebensdauer
Zeit, die übrig ist, bevor ein Produkt nicht länger in der Lage ist, die zulässigen Mindestleistungsanforderungen einschließlich Verfügbarkeit zu erfüllen

Anmerkung 1 zum Begriff: Die Kriterien dafür können z. B. hinsichtlich der Gebrauchstauglichkeit oder baulichen Festigkeit abgeschätzt werden.

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3.2.23
Auflösung
kleinster ablesbarer Wert einer Größe in einem Messsystem

Anmerkung 1 zum Begriff: Die Auflösung wird bei der Bewertung der Gesamtunsicherheit berücksichtigt.

3.2.24
Resonanzsuche
Frequenzhub von sinusförmigen Schwingungen mit niedrigem Pegel zur Charakterisierung der Hauptresonanzmodi als Vorbereitung auf Durchläufe mit höherem Pegel, und um mögliche Ausführungsmängel infolge der Durchläufe mit höherem Pegel aufzuzeigen

Anmerkung 1 zum Begriff: Die Resonanzsuche ist auch als „Signaturprüfung", „Schwingungsprüfung mit sinusförmigen Schwingungen mit niedrigem Pegel", „Niedrigpegel-Sinus-Sweep", „Niedrigpegel-Sweep" oder „Niedrigpegel-Prüfung" bekannt.

3.2.25
Nachschwingzeit
T60
Zeitdauer, die zur Verringerung des Schallpegels um 60 dB benötigt wird, nachdem die Schallquelle abgeschaltet wurde

3.2.26
Stoß-Antwortspektrum
SRS, en: shock response spectrum
grafische Darstellung einer transienten Wellenform, die durch die Antwort einer Reihe von Schwingungserzeugern mit einem Freiheitsgrad unter Anwendung eines festgelegten Verstärkungsfaktors Q bestimmt wird

Anmerkung 1 zum Begriff: Das Stoß-Antwortspektrum kann für beliebige interessierende Eingabe- oder Antwort-Parameter festgelegt werden (Auslenkung, Geschwindigkeit oder Beschleunigung). Bei Konstruktionen in der Raumfahrt ist es üblich, die Eingabe-Transienten bezüglich der Beschleunigung festzulegen.

Anmerkung 2 zum Begriff: Es wird üblicherweise ein Verstärkungsfaktor Q für die Beschleunigung von 10 gewählt, was einem Faktor für die kritische Dämpfung von 5 % entspricht. In Situationen, bei denen die Dämpfung bekannt ist, kann Q entsprechend gewählt werden.

Anmerkung 3 zum Begriff: Das Stoß-Antwortspektrum ermöglicht die Charakterisierung der Stoßwirkung, um ihren Schärfegrad oder ihr Schädigungspotential abzuschätzen.

Anmerkung 4 zum Begriff: Es gibt verschiedene Darstellungen des Stoß-Antwortspektrums, einschließlich des positiven, negativen, Primär-, Residual- und Maximax-Spektrums. Das letztgenannte SRS umfasst die vier davor genannten und wird für die Stoßprüfung am häufigsten verwendet.

3.2.27
Vorzeichenprüfung
siehe „Prüfung der Polarität"

3.2.28
Temperaturzyklus
Wechsel von einer Anfangstemperatur zur selben Temperatur, mit Auslenkungen innerhalb eines festgelegten Bereiches

3.2.29
Temperaturplateau
Zeit während festgelegter Schritte einer Umweltprüfung, bei Erfüllung festgelegter Stabilisierungskriterien, die für ein Temperaturniveau gelten

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Anmerkung 1 zum Begriff: Die festgelegten Kriterien erfassen die Zeitpunkte des Beginns und des Endes des Temperaturplateaus sowie dessen Gesamtdauer.

3.2.30
Prüfblock
Zusammenfassung mehrerer Prüfungen, die nach Disziplinen in Gruppen eingeteilt sind

3.2.31
Eingangstoleranz für die Prüfung
Grenzwerte oder zulässiger festgelegter Bereich von Werten einer festgelegten Prüfstufe oder einer festgelegten Prüfdauer, ohne die Ziele der Prüfung zu beeinträchtigen

Anmerkung 1 zum Begriff: Dieser Bereich wird üblicherweise als Abweichung von einem festgelegten Wert spezifiziert, oder als expliziter Bereich zulässiger Werte. Er kann symmetrisch, wie z. B. $40 \pm 0{,}1$, oder asymmetrisch, wie z. B. $40\ {}^{-0{,}2}_{+0{,}1}$, sein.

3.2.32
thermische Prüfung bei Raumdruck
Prüfung, die bei Raumdruck und unter zuvor festgelegten Temperaturbedingungen durchgeführt wird, um die Fähigkeit des Prüfkörpers zum Betrieb entsprechend den Anforderungen nachzuweisen

Anmerkung 1 zum Begriff: Die Temperaturbedingungen können als Temperaturniveau, -gradient, -differenz und -schwankung angegeben werden.

Anmerkung 2 zum Begriff: Der Raumdruck ist der Druck auf dem Niveau der Erdoberfläche (etwa 1 013 hPa).

Anmerkung 3 zum Begriff: Die Benennungen „temperature cycling test at room pressure“ und „room pressure temperature cycling test“ (dt. beides „Temperaturwechselprüfung bei Raumdruck“) sind synonym.

Anmerkung 4 zum Begriff: Die „Temperaturwechselprüfung bei Raumdruck“ wird auch als „Temperaturwechselbeanspruchung“ bezeichnet (z. B. in US-Normen).

3.2.33
thermische Prüfung bei Missionsdruck
Prüfung, die bei Missionsdruck und unter zuvor festgelegten Temperaturbedingungen durchgeführt wird, um die Fähigkeit des Prüfkörpers zum Betrieb entsprechend den Anforderungen nachzuweisen

Anmerkung 1 zum Begriff: Die Temperaturbedingungen können als Temperaturniveau, -gradient, -differenz und -schwankung angegeben werden.

Anmerkung 2 zum Begriff: Der Druck ist repräsentativ für den missionsabhängigen Druck. Zum Beispiel der atmosphärische Druck auf dem Mars oder der Venus, der Druck in einem Landegerät oder während eines Ballonauf- oder -abstiegs, ein Druckmodul einer Raumstation.

Anmerkung 3 zum Begriff: Die Benennungen „temperature cycling test at mission pressure“ und „mission pressure temperature cycling test“ (dt. beides Temperaturwechselprüfung bei Missionsdruck) sind synonym.

3.2.34
thermisches Vakuum
Prüfung, die unter Vakuum unter zuvor festgelegten Temperaturbedingungen durchgeführt wird, um die Fähigkeit der Prüfeinheit zum Betrieb entsprechend den Anforderungen nachzuweisen

Anmerkung 1 zum Begriff: Die Temperaturbedingungen können als Temperaturniveau, -gradient, -differenz und -schwankung angegeben werden.

Anmerkung 2 zum Begriff: Die Benennungen „temperature cycling test in vacuum“ und „vacuum temperature cycling test“ (dt. beides Temperaturwechselprüfung unter Vakuum) sind synonym.

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3.3 Abkürzungen

Für die Anwendung dieser Norm gelten folgende Abkürzungen.

Abkürzung	Bedeutung	
AFT	verkürzte Funktionsprüfung	(en: abbreviated functional test)
AIT	Zusammenbau, Verschaltung und Prüfung	(en: assembly, integration and test)
AIV	Zusammenbau, Verschaltung und Verifizierung	(en: assembly, integration and verification)
AVT	Abnahme-Schwingungsprüfung	(en: acceptance vibration test)
CCB	Konfigurationslenkungsausschuss	(en: configuration control board)
CoG	Schwerpunkt	(en: centre of gravity)
DRD	Definition der Anforderungen an Dokumente	(en: document requirements definition)
EC	Europäische Kommission	(en: European Commission)
EGSE	elektrische Bodenunterstützungsgeräte	(en: electrical ground support equipment)
EM	Systemtechnik-Modell	(en: engineering model)
EMC	elektromagnetische Verträglichkeit	(en: electromagnetic compatibility)
EMCCP	Plan zur Steuerung der elektromagnetischen Verträglichkeit	(en: electromagnetic compatibility control plan)
EQM	Systemtechnik-Qualifikationsmodell	(en: engineering qualification model)
ESD	elektrostatische Entladung	(en: electrostatic discharge)
FFT	vollständige Funktionsprüfung	(en: full functional test)
FM	Flugmodell	(en: flight model)
FOP	Flugbetriebsplan	(en: flight operation plan)
GSE	Bodendienstgeräte	(en: Ground Support Equipment)
HFE	Technik der Humanfaktoren	(en: human factors engineering)
HMI	Mensch-Maschine-Schnittstelle	(en: human-machine interface)
ICD	Schnittstellenüberwachungsdokument	(en: Interface Control Document)
KIP	Hauptprüfpunkt	(en: key inspection point)
LCDA	mit dem Träger gekoppelte dynamische Analyse	(en: launcher coupled dynamic analysis)
LCL	Sperrstrombegrenzer	(en: latching current limiter)

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Abkürzung	Bedeutung	
LEOP	Phase des Starts und des Eintritts in eine vorläufige Umlaufbahn	(en: launch and early orbit phase)
MDP	maximaler Bemessungsdruck	(en: maximum design pressure)
MIP	vorgeschriebener Prüfpunkt	(en: Mandatory Inspection Point)
MoI	Trägheitsmoment	(en: moment of inertia)
NC	Geräusch-Kriterium	(en: noise criterion)
NCR	Nichtkonformitätsbericht	(en: nonconformance report)
NRB	Nichtkonformitäten-Prüfausschuss	(en: Nonconformance Review Board)
OSPL	Gesamtschalldruckpegel	(en: overall sound pressure level)
PFM	Flug-Prototypmodell	(en: protoflight model)
PIM	passive Intermodulation	(en: passive intermodulation)
PSD	spektrale Leistungsdichte	(en: power spectral density)
PT	Leistungsprüfung	(en: performance test)
PTR	Review nach der Prüfung	(en: post test review)
QM	Qualifikationsmodell	(en: qualification model)
r.m.s.	Effektivwert	(en: Root Mean Square)
RF	Hochfrequenz	(en: radio frequency)
RFT	reduzierte Funktionsprüfung	(en: reduced functional test)
SEP	Systemtechnik-Plan	(en: system engineering plan)
SFT	System-Funktionsprüfung	(en: system functional test)
SPL	Schalldruckpegel	(en: sound pressure level)
SRS	Stoßreaktionsspektrum	(en: shock response spectrum)
SVT	System-Validierungsprüfung	(en: system validation test)
TB	Wärmebilanz	(en: thermal balance)
TC	Fernsteuern	(en: telecommand)
TCS	thermisches Steuerungssystem	(en: thermal control system)
TM	Telemetrie	(en: telemetry)

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Abkürzung	Bedeutung	
TPRO	Prüfverfahren	(en: test procedure)
TR	Test-Review	(en: test review)
TRB	Test-Review-Ausschuss	(en: test review board)
TRP	Temperatur-Bezugspunkt	(en: temperature reference point)
TRPT	Prüfbericht	(en: test report)
TRR	Prüfbereitschafts-Review	(en: test readiness review)
TV	thermisches Vakuum	(en: thermal vacuum)
T^{A}_{max}	Höchstwert des Abnahme-Temperaturbereichs bei einer Einheit TRP	(en: maximum value of the acceptance temperature range required at a unit TRP)
T^{A}_{min}	Mindestwert des Abnahme-Temperatur-bereichs bei einer Einheit TRP	(en: minimum value of the acceptance temperature range required at a unit TRP)
T^{D}_{max}	Höchstwert des Bemessungstemperatur-bereichs bei einer Einheit TRP	(en: maximum value of the design temperature range required at a unit TRP)
T^{D}_{min}	Mindestwert des Bemessungstemperatur-bereichs bei einer Einheit TRP	(en: minimum value of the design temperature range required at a unit TRP)
T^{Q}_{max}	Höchstwert des Bereichs der Qualifikations-temperatur bei einer Einheit TRP	(en: maximum value of the qualification temperature range required at a unit TRP)
T^{Q}_{min}	Mindestwert des Bereichs der Qualifikations-temperatur bei einer Einheit TRP	(en: minimum value of the qualification temperature range required at a unit TRP)
T_{Nop}	Nicht-Betriebstemperatur	(en: non-operating temperature)
T_{Op}	Betriebstemperatur	(en: operating temperature)
TSPE	Prüfspezifikation	(en: test specification)
TT&C	Satellitensteuerung und Bahnverfolgung	(en: telemetry, tracking and command)
TWT	Wanderfeldröhre	(en: travelling wave tube)
VCD	Verifizierungskontrolldokument	(en: verification control document)
VP	Verifizierungsplan	(en: verification plan)

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NORME EUROPÉENNE

EUROPÄISCHE NORM

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Space engineering - Testing

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European Foreword

This document (EN 16603-10-03:2022) has been prepared by Technical Committee CEN/CLC/JTC 5 “Space”, the secretariat of which is held by DIN.

This standard (EN 16603-10-03:2022) originates from ECSS-E-ST-10-03C Rev.1.

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 April 2023, and conflicting national standards shall be withdrawn at the latest by April 2023.

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 supersedes EN 16603-10-03:2014.

The main changes with respect to EN 16603-10-03:2014 are listed below:

- Scope: Clarification on applicability perimeter, including not covering space vehicle constellation
- Thermal Tests:
  - o New and more clear definitions, (thermal vacuum test, thermal test at room pressure and thermal test at mission pressure, they are no more in the Glossary),
  - o Thermal Ambient Test not used and substituted by Thermal Test at mission pressure,
  - o Alternative methods are addressed as reference to the Handbook
  - o “thermal” word in thermal parameters (cycles, levels, gradient and so on) changed as “temperature”,
  - o Test for switch on capability at equipment level was updated to cover test at maximum and minimum temperature,
  - o New requirement on power status during thermal tests at equipment level and parameter monitoring.
- Test on solar arrays and panel:
  - o overall align of the Testing Standard with the new version of ECSS-E-ST-20-08,
  - o new requirements for solar array performance tests in addition to flasher test,
  - o additional requirement for after storage phase,
  - o functional tests requirements at equipment level during thermal tests for solar arrays are now expanded.
- Pressure test:
  - o Overall alignment with new version of ECSS-E-ST-32-02,

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- o requirements on proof pressure test rephrased to enlarge the objective of the test.

- Input test Tolerance and measurement uncertainties:

  - o "tolerance" definition was substituted by "test input tolerance" whereas "accuracy of measurement" was deleted and substituted by "measurement uncertainty" to be in accordance with actual International Standards,

  - o some requirements rephrased to avoid confusion between "uncertainty" (quantitative evaluation) and "error" (quantitative, but unknown),

  - o Table 4-2 now addresses typical values for test centres and no more requirements.

- Sine burst test replaced Transient test at space segment equipment level, because rarely used, and it is merged with Transient at space segment element level.

- Microvibration and Audible noise:

  - o new requirements for microvibration in particular to cover signal measurement and background noise measurement and background noise mitigation actions,

  - o requirements on Audible noise were changed, and some deleted, at equipment level to account for the tight dependence on the mounting structure.

- Polarity test: new requirement for polarity test of non-critical modes.

This document has been prepared under a standardization request 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, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

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Introduction

The requirements on the systems engineering process are gathered in ECSS-E-ST-10; while specific aspects are further elaborated in dedicated standards, in particular: ECSS-E-ST-10-06, ECSS-E-ST-10-02 and the present standard (ECSS-E-ST-10-03)

In the System Engineering branch (ECSS-E-10) this standard aims at a consistent application of on ground testing requirements to allow proper qualification and acceptance of space products

Experience has demonstrated that incomplete or improper on ground testing approach significantly increase project risks leading to late discovery of design or workmanship problem(s) or in-orbit failure(s).

Testing is part of the system engineering process as defined in ECSS-E-ST-10. This starts at the early phase of the mission when defining verification process in terms of the model philosophy and sequences of tests and ends at the last testing phase prior launch.

In the level of decomposition of a space system, this standard addresses the requirements for space segment element and space segment equipment.

The document is organised such that:

- clause 4 provides requirements for overall test programme, test management test conditions, test input tolerances and measurement uncertainties;
- clause 5 provides requirements for Space segment equipment;
- clause 6 provides requirements for Space segment element;
- clause 7 provides requirements for Pre-launch testing.

Clauses 5 and 6 are organised as follows:

- general requirements for the products under test applicable to all models (clause 5.1 or 6.1);
- requirements applicable to qualification model (clause 5.2 or 6.2);
- requirements applicable to acceptance model (clause 5.3 or 6.3);
- requirements applicable to protoflight model (clause 5.4 or 6.4);
- detailed implementation requirements (clause 5.5 or 6.5);

In the clause providing requirements for each model (i.e. clauses 5.2, 5.3, 5.4, 6.2, 6.3 and 6.4), the first table of the clause:

- lists all types of test and defines their applicability and conditions;
- links to the second table of the clause that defines tests level and duration;

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- provides reference to the clause defining the detailed implementation requirements for the given test (clause 5.5 or 6.5).

For space segment equipment, the required sequence of tests, for each model, is defined by tailoring the two tables in clause 5.2, 5.3 or 5.4.

Since testing activities are part of the overall verification activities, test documentation to be produced (DRD's) are either specified in the ECSS-E-ST-10-02 (case of the test report) or in this document.

Annex D gives guidelines for performing the tailoring of this standard as well as the generation of the compliance and verification matrices.

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1 Scope

This standard addresses the requirements for performing verification by testing of space segment elements and space segment equipment on ground prior to launch. The document is applicable for tests performed on qualification models, flight models (tested at acceptance level) and protoflight models.

The standard provides:

- Requirements for test programme and test management,
- Requirements for retesting,
- Requirements for redundancy testing,
- Requirements for environmental tests,
- General requirements for functional and performance tests,

  NOTE 1 Specific requirements for functional and performance tests are not part of this standard since they are defined in the specific project documentation.
- Requirements for qualification, acceptance, and protoflight testing including qualification, acceptance, and proto-fight models' test margins and duration,
- Requirements for test factors, test condition, test input tolerances, and measurement uncertainties,
- General requirements for development tests pertinent to the start of the qualification test programme,

  NOTE 2 Development tests are specific and are addressed in various engineering discipline standards.
- Content of the necessary documentation for testing activities (e.g. DRD).

Due to the specific aspects of the following types of test, this Standard does not address:

- Space system testing (i.e. testing above space segment element), in particular the system validation test,
- Testing peculiarities of space vehicles constellations,
- In-orbit testing,
- Testing of space segment subsystems,

  NOTE 3 Tests of space segment subsystems are often limited to functional tests that, in some case, are run on dedicated models. If relevant,

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qualification tests for space segment subsystems are assumed to be covered in the relevant discipline standards.

- Testing of hardware below space segment equipment levels (including assembly, parts, and components),
- Testing of stand-alone software,

  NOTE 4 For verification of flight or ground software, ECSS-E-ST-40 and ECSS-Q-ST-80 apply.

- Testing of two-phase heat transport equipment,

  NOTE 5 For acceptance and qualification testing of two-phase heat transport equipment, ECSS-E-ST-31-02 applies.

- Tests of launcher segment, subsystem and equipment, and launch facilities,
- Tests of facilities and ground support equipment,
- Tests of ground segment.

This standard may be tailored for the specific characteristic and constrains of a space project in conformance with ECSS-S-ST-00. Annex D gives guidelines for performing this tailoring.

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2 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 16603-10-02	ECSS-E-ST-10-02	Space engineering - Verification
EN 16603-20	ECSS-E-ST-20	Space engineering - Electrical and electronic
EN 16603-20-01	ECSS-E-ST-20-01	Space engineering - Multipactor design and test
EN 16603-20-06	ECSS-E-ST-20-06	Space engineering - Spacecraft charging
EN 16603-20-07	ECSS-E-ST-20-07	Space engineering - Electromagnetic compatibility
EN 16603-20-08	ECSS-E-ST-20-08	Space engineering - Photovoltaic assemblies and components
EN 16603-31	ECSS-E-ST-31	Space engineering - Thermal control general requirements
EN 16603-32	ECSS-E-ST-32	Space engineering - Structural general requirements
EN 16603-32-02	ECSS-E-ST-32-02	Space engineering - Structural design and verification of pressurized hardware
EN 16603-32-10	ECSS-E-ST-32-10	Space engineering - Structural factors of safety for spaceflight hardware
EN 16603-32-11	ECSS-E-ST-32-11	Space engineering - Modal survey assessment
EN 16603-33-01	ECSS-E-ST-33-01	Space engineering - Mechanisms
EN 16601-40	ECSS-M-ST-40	Space project management - Configuration and information management
EN 16602-10-09	ECSS-Q-ST-10-09	Space product assurance - Nonconformance control system
EN 16602-20-07	ECSS-Q-ST-20-07	Space product assurance - Quality assurance for test centres
EN 16602-40	ECSS-Q-ST-40	Space product assurance - Safety
EN 16602-70-01	ECSS-Q-ST-70-01	Space product assurance - Cleanliness and contamination control
	ISO 3740:2019	Acoustics - Determination of sound power levels of noise sources - Guidelines for the use of basic standards

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3 Terms, definitions and abbreviated terms

3.1 Terms from other standards

a. For the purpose of this standard; the terms and definitions from ECSS-S-ST-00-01 apply, and in particular the following:
   1. commissioning
   2. flight model
   3. lifetime
   4. protoflight model
   5. qualification model
   6. space segment element
   7. space segment equipment
   8. space segment subsystem
   9. structural model
   10. system
   11. test

b. For the purpose of this standard, the following terms and definitions from ECSS-E-ST-10-02 apply:
   1. model philosophy

c. For the purpose of this Standard, the following terms and definitions from ECSS-E-ST-31 apply:
   1. acceptance temperature range
   2. design temperature range
   3. minimum switch ON temperature
   4. predicted temperature range
   5. qualification temperature range
   6. temperature reference point (TRP)

d. For the purpose of this Standard, the following terms and definitions from ECSS-E-ST-32 apply:
   1. factor of safety (FOS)
   2. limit load (LL)
   3. maximum design pressure (MDP)
   4. proof test

e. For the purpose of this Standard, the following terms and definitions from ECSS E ST-32-02 apply:
   1. burst pressure
   2. design burst pressure

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3. proof factor
4. proof pressure

3.2 Terms specific to the present standard

3.2.1 24-hour equivalent noise exposure level

equivalent sound pressure level (Leq) to which the crew members are exposed over a 24-hour period; expressed in dBA

Note 1 to entry: 0 dBA corresponds to 20 μPa.

3.2.2 abbreviated functional test (AFT)

See "**reduced functional test (RFT)**"

3.2.3 acceptance level

test level required by increasing the severity of an extreme level expected to be encountered during the specified product lifetime for the purpose of workmanship verification.

3.2.4 acceptance margin

increase in severity of the environmental, mechanical, electrical, EMC, or operational extreme levels expected to be encountered during the specified product lifetime for the purpose of workmanship verification

Note 1 to entry: This margin can include an increase in level, an extension of range, an increase in duration or cycles of exposure, as well as any other appropriate increase in severity.

3.2.5 crewed space segment element

space segment design to ensure the safe presence of crew onboard

3.2.6 dwell time

duration necessary to ensure that internal parts or subassembly of a space segment equipment have achieved thermal equilibrium, from the start of temperature stabilisation phase, i.e. when the temperature reaches the targeted test temperature plus or minus the test tolerance

3.2.7 environmental tests

tests applied to a product simulating (together or separately) environmental conditions as encountered during its operational life cycle

Note 1 to entry: Environmental tests cover natural and induced environments.

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3.2.8 full functional test (FFT)

comprehensive test that demonstrates the integrity of all functions of the item under test, in all operational modes, including back-up modes and all foreseen transitions

Note 1 to entry: The main objectives of this test is to demonstrate absence of design manufacturing and integration error.

Note 2 to entry: FFT exists at the different level of decomposition of a space segment element. For satellite they also called system functional test (SFT) or integrated system test (IST).

3.2.9 maximum expected acceleration

acceleration value determined from the combined effects of the steady state acceleration and the transient response of the item as it will experience during its life time

Note 1 to entry: This term is equivalent to limit load (as defined in E-ST-32).

Note 2 to entry: Examples of events during life time are transportation, handling, engine ignition, engine burnout, and stage separation.

3.2.10 maximum expected acoustic spectrum

maximum value of the time average root-mean-square (r.m.s.) sound pressure level (SPL) in each frequency band occurring inside the payload fairing, orbiter, or cargo bay, which occurs during flight events

Note 1 to entry: E.g. lift-off, powered flight or re-entry.

Note 2 to entry: The maximum expected acoustic environment test spectrum is specified in octave or 1/3 octave bands over a frequency range of 31,5 Hz to 10 kHz. The duration of the maximum environment is the total period when the overall amplitude is within 6 dB of the maximum overall amplitude.

3.2.11 maximum expected shock

worst cases of the collection of the shock at their mounting interface due to every possible cause

Note 1 to entry: For example: causes of shocks are stage, shroud or satellite separation pyro devices, non-explosive actuators, mechanisms with energy release, appendage latching, and fuel valves.

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Note 2 to entry: Shocks can be characterized by their time histories, shock response spectrum, or impulse geometry.

Note 3 to entry: Refer to ECSS-E-HB-32-25 for additional information.

3.2.12 maximum expected random vibration spectrum

maximum expected environment imposed on the space segment element and space segment equipment due to broad band random forcing functions within the launch element or space segment element during flight or from ground transportation and handling

Note 1 to entry: E.g. lift-off acoustic field, aerodynamic excitations, and transmitted structure-borne vibration.

Note 2 to entry: A different spectrum can exist for different space segment equipment zones or for different axis. The space segment equipment vibration levels are based on vibration response measurements or model prediction made at the space segment equipment attachment points during ground acoustic tests or during flight. The duration of the maximum environment is the total period during flight when the overall level is within 6 dB of the maximum overall level.

Note 3 to entry: The power spectral density is based on a frequency resolution of 1/6 octave (or narrower) bandwidth analysis, over a frequency range of 20 Hz to 2000 Hz.

3.2.13 maximum predicted temperature

maximum value of the predicted temperature range

3.2.14 minimum predicted temperature

minimum value of the predicted temperature range

3.2.15 notching

reduction of the input level or spectrum to limit structural responses at resonant frequencies according to qualification or acceptance loads during a vibration test

Note 1 to entry: Notching is a general accepted practice in vibration testing to avoid over testing of the item under test. Implementation of notching is subject to customer approval and when relevant to Launcher authority approval

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3.2.16 operational modes

combination of operational configurations or conditions that can occur during the product lifetime for space segment equipment or space segment element

Note 1 to entry: For example: Power-on or power-off, command modes, readout modes, attitude control modes, antenna stowed or deployed, and spinning or de-spun.

3.2.17 performance test

test to verify that the item under test performs according to its specifications while respecting its operational requirements

Note 1 to entry: Performance tests are mission specific therefore their details are not specified under this standard.

3.2.18 polarity test

test to verify the correct polarity of the functional chains (mainly AOCS) or equipment of the space segment element from sensors to actuators, through a number of interfaces and processing.

Note 1 to entry: A polarity error can be generated throughout the development process: interface documentation, design, H/W manufacturing, S/W development, satellite AIT, satellite database.

Note 2 to entry: A polarity error can be generated by any component of the functional chain: sensor or actuator design, sensor or actuator mounting, harness, interface units, software algorithms.

Note 3 to entry: Polarity inversion on Safe Mode control loops can cause a satellite loss.

Note 4 to entry: This term "sign test" is synonymous.

3.2.19 qualification level

test level required by increasing the severity of an acceptance level for the purpose of design margin demonstration

3.2.20 qualification margin

increase in severity of the environmental, mechanical, electrical, EMC, or operational extreme levels expected to be encountered during the specified product lifetime for the purpose of design margin demonstration

Note 1 to entry: This margin can include an increase in level, an extension of range, an increase in duration or cycles of exposure, as well as any other appropriate increase in severity.

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3.2.21 reduced functional test (RFT)

sub-set of the **full functional test** to verify the integrity of the major functions of the item under test, with a sufficiently high degree of confidence, in a relatively short time

Note 1 to entry: The term "abbreviated functional test (AFT)" is synonymous.

3.2.22 residual life

time left before a product is no longer able to achieve minimum acceptable performance requirements, including availability

Note 1 to entry: Criteria can be estimated in terms of serviceability or structural strength for example.

3.2.23 resolution

minimum readable value of a quantity on a measurement system

Note 1 to entry: The resolution is accounted for in the overall uncertainty evaluation.

3.2.24 resonance search

frequency sweep of low level sinusoidal vibrations to characterise main resonant modes for preparing the higher level runs, and to show possible deficiencies in workmanship, as a consequence of high level runs

Note 1 to entry: Resonance search is also known as “signature test”, “low level sinusoidal vibration test”, “low level sine sweep”, “low level sweep” or “low level test”.

3.2.25 reverberation time (T60)

duration necessary for the sound level to decrease by 60 dB after the switch off of the sound source

3.2.26 shock response spectrum (SRS)

graphical representation of a transient waveform determined by the response of a set of single degree of freedom oscillators using a defined amplification factor Q

Note 1 to entry: The Shock Response Spectrum can be defined for any input or response parameters of interest (displacement, velocity, or acceleration). For aerospace structures it is common to define the input transient in terms of acceleration.

Note 2 to entry: The acceleration amplification factor Q is conventionally chosen equal to 10, corresponding to a factor of critical damping equal to 5 %. In situations when damping is known, Q can be chosen accordingly.

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Note 3 to entry: The Shock Response Spectrum allows characterizing the shock effect in order to estimate its severity or its damaging potential.

Note 4 to entry: There are several representations of Shock Response Spectrum, including positive, negative, primary, residual and maximax. The latter SRS envelopes the previous four and is the most commonly used for shock testing.

3.2.27 sign test

see “polarity test”

3.2.28 temperature cycle

transition from an initial temperature to the same temperature, with excursion within a specified range

3.2.29 temperature plateau

time, during specified steps of an environmental test, with fulfilment of specified stabilization criteria applicable to a temperature level.

Note 1 to entry: Specified criteria cover the instants of entry and exit of the temperature plateau, and its total duration.

3.2.30 test block

aggregation of several tests grouped by discipline

3.2.31 test input tolerance

limiting or permitted specified range of values of a specified test level or of a specified test duration without affecting the test objectives

Note 1 to entry: This range is typically specified as deviation from a specified value, or as an explicit range of allowed values. It can be symmetrical, as in 40 ±0,1, or asymmetrical, such as 40 -0,2/+0,1.

3.2.32 thermal test at room pressure

test conducted at room pressure and under predefined temperature conditions to demonstrate the capability of the test specimen to operate according to requirements

Note 1 to entry: Temperature conditions can be expressed as temperature level, gradient, difference and variation.

Note 2 to entry: The room pressure is the pressure at Earth surface level (about 1013 hPa).

Note 3 to entry: The terms "temperature cycling test at room pressure" and "room pressure

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temperature cycling test" are synonymous.

Note 4 to entry: The "temperature cycling test at room pressure" is also called "thermal cycling" (e.g., US standards).

3.2.33 thermal test at mission pressure

test conducted at mission pressure and under predefined temperature conditions to demonstrate the capability of the test specimen to operate according to requirements

Note 1 to entry: Temperature conditions can be expressed as temperature level, gradient, difference and variation.

Note 2 to entry: The pressure is representative of the mission dependent pressure. For example, Mars or Venus atmospheric pressure, pressure in a lander or during a balloon ascent/descent, a space station pressurized module.

Note 3 to entry: The terms "temperature cycling test at mission pressure" and "mission pressure temperature cycling test" are synonymous.

3.2.34 thermal vacuum

test conducted in vacuum under predefined temperature conditions to demonstrate the capability of the test item to operate according to requirements

Note 1 to entry: Temperature conditions can be expressed as temperature level, gradient, difference and variation.

Note 2 to entry: The terms "temperature cycling test in vacuum" and "vacuum temperature cycling test" are synonymous.

3.3 Abbreviated terms

For the purposes of this Standard the following abbreviated terms apply.

Abbreviation	Meaning
AFT	abbreviated functional test
AIT	assembly, integration and test
AIV	assembly, integration and verification
AVT	acceptance vibration test
CCB	configuration control board
CoG	centre of gravity
DRD	document requirements definition

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Abbreviation	Meaning
EC	European Commission
EGSE	electrical ground support equipment
EM	engineering model
EMC	electromagnetic compatibility
EMCCP	electromagnetic compatibility control plan
EQM	engineering qualification model
ESD	electrostatic discharge
FFT	full functional test
FM	flight model
FOP	flight operation plan
GSE	ground support equipment
HFE	human factors engineering
HMI	human-machine interface
ICD	interface control document
KIP	key inspection point
LCDA	launcher coupled dynamic analysis
LCL	latching current limiter
LEOP	launch and early orbit phase
MDP	maximum design pressure
MIP	mandatory inspection point
MoI	moment of inertia
NC	noise criterion
NCR	nonconformance report
NRB	nonconformance review board
OSPL	overall sound pressure level
PFM	protoflight model
PIM	passive intermodulation
PSD	power spectral density
PT	performance test
PTR	post test review
QM	qualification model
r.m.s.	root-mean-square
RF	radio frequency
RFT	reduced functional test
SEP	system engineering plan
SFT	system functional test

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Abbreviation	Meaning
SPL	sound pressure level
SRS	shock response spectrum
SVT	system validation test
TB	thermal balance
TC	telecommand
TCS	thermal control system
TM	telemetry
TPRO	test procedure
TR	test review
TRB	test review board
TRP	temperature reference point
TRPT	test report
TRR	test readiness review
TV	thermal vacuum
T^{A}_{max}	maximum value of the acceptance temperature range required at a unit TRP
T^{A}_{min}	minimum value of the acceptance temperature range required at a unit TRP
T^{D}_{max}	maximum value of the design temperature range required at a unit TRP
T^{D}_{min}	minimum value of the design temperature range required at a unit TRP
T^{Q}_{max}	maximum value of the qualification temperature range required at a unit TRP
T^{Q}_{min}	minimum value of the qualification temperature range required at a unit TRP
T_{Nop}	non-operating temperature
T_{Op}	operating temperature
TSPE	test specification
TT&C	telemetry, tracking and command
TWT	travelling wave tube
VCD	verification control document
VP	verification plan

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3.4 Nomenclature

The following nomenclature applies throughout this document:

a. The word “shall” is used in this Standard to express requirements. All the requirements are expressed with the word “shall”.

b. The word “should” is used in this Standard to express recommendations. All the recommendations are expressed with the word “should”.

NOTE It is expected that, during tailoring, recommendations in this document are either converted into requirements or tailored out.

c. The words “may” and “need not” are used in this Standard to express positive and negative permissions, respectively. All the positive permissions are expressed with the word “may”. All the negative permissions are expressed with the words “need not”.

d. The word “can” is used in this Standard to express capabilities or possibilities, and therefore, if not accompanied by one of the previous words, it implies descriptive text.

NOTE In ECSS “may” and “can” have completely different meanings: “may” is normative (permission), and “can” is descriptive.

e. The present and past tenses are used in this Standard to express statements of fact, and therefore they imply descriptive text.

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4
General requirements

4.1 Test programme

a. A coherent test programme shall be established, encompassing each verification stage and level to implement the verification by testing.

NOTE 1 The testing programme is performed incrementally at different product decomposition levels.

NOTE 2 Refer to clause 3.1 for determining the type of item for which the test programme is defined (i.e. space segment equipment or space segment element) and to ECSS-S-ST-00-01 Glossary of terms.

NOTE 3 The number and type of testing levels depends upon the complexity of the project and on its characteristics in accordance with the Verification programme (see ECSS-E-ST-10-02).

NOTE 4 The test programme documentation is defined in 4.3.3.

b. The customer and the supplier shall agree the need to treat a space segment element as a space segment equipment.

NOTE This is typically the case for small instrument.

c. AIT Plan and test specifications shall be derived from the product requirements, verification plan and verification control document (VCD).

NOTE Verification plan and VCD are defined in ECSS-E-ST-10-02.

d. Test procedures shall be derived from test specifications and AIT Plan.

e. Test programme and its implementation shall be in conformance with safety requirements of ECSS-Q-ST-40 and ECSS-Q-ST-20-07.

4.2 Development test prior qualification

a. Development test of a product shall be completed prior to the start of its formal qualification testing.

NOTE Development tests are conducted over a range of operating conditions that can exceed the design range.

b. Development tests shall not be conducted on qualification or flight models or parts of it.

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c. Records of test configuration, test results and other pertinent data shall be maintained.

NOTE This kind of information can be used for investigation when failure occurs during the qualification and acceptance, or for other investigations.

4.3 Test management

4.3.1 General

a. The supplier shall assign clear responsibility for the implementation of the test programme.

b. The customer, or its duly appointed representative, shall have the right to participate to all test phases.

4.3.2 Test reviews

4.3.2.1 Test programme

a. The test programme shall be decomposed in blocks.

NOTE The general test programme is reviewed at the CDR as per ECSS-M-ST-10.

b. The definition of the blocks of requirement 4.3.2.1a shall be agreed between the customer and supplier.

NOTE 1 Test block definition depends mainly on the item under test, the facility and the contractual agreement. A test block can include one or more tests. For equipment, usually one test block covers the full test programme.

NOTE 2 Typical test blocks for space segment elements are:

- Integration
- Alignment
- Leak/proof pressure
- Mechanical (Static load test, sinusoidal, acoustic, random, modal survey, shock)
- EMC conducted
- EMC radiated/auto-compatibility/RF
- Thermal (TB/TV test)
- Functional and performance test
- Final preparation

c. Each test block shall include the following formal reviews:

1. test readiness review (TRR);

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2. post test review(s) (PTR);
3. test review board (TRB).

NOTE 1 TRRs from several blocks can be combined, TRRs can also be combined with a PTR of the previous block.

NOTE 2 Depending on the nature of the test, the customer can decide to establish additional key-points between formal reviews. Typical examples are transition between level and axes in vibration tests and transition between test phases in TV/TB tests.

4.3.2.2 Test readiness review (TRR)

a. A TRR shall be held before the start of the test activity to verify that all conditions allow to proceed with the test.

b. The TRR shall address the following topics:

1. test documentation availability and suitability, including:
   (a) approved AIT Plan,
   (b) approved test specification,
   (c) test predictions (when relevant),
   (d) approved test procedures (including contingency and emergency procedures),
   (e) approved measurement point plan,
   (f) approved test facility readiness report,
   (g) approved test schedule, and
   (h) acceptance data package of lower level items.
2. item under test configuration;
3. test configuration/set-up;
4. inspection status report of KIP, MIP, or both;
5. test facility, environmental conditions, test instrumentations, calibration, maintenance status;
6. cleanliness condition, hazard and safety;
7. ground support equipment (GSE) and infrastructures;
8. status of nonconformances that affect the item under test, its associated GSE, or the test facility;
9. waivers status, and deviations;
10. personnel qualification and availability;
11. results from test rehearsal using the test facility with or without the item under test, when relevant;
12. test pass/fail criteria completeness;
13. assignment of responsibilities;
14. test schedule.

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NOTE 1 For 4.3.2.2b.1(f), the content of the facility readiness report is defined in ECSS-Q-ST-20-07.

NOTE 2 The level of details according to which each topic is addressed, is different for the general test programme TRR than for each block test TRR.

c. The following parties shall participate to the TRR:

1. the chairperson, who is the product assurance manager of the authority responsible for the test;
2. product assurance from all involved parties;
3. project engineer from all involved parties;
4. AIT from all involved parties;
5. specialists, when necessary from all involved parties;
6. facility representative;
7. other as relevant.

NOTE For example launcher authority for tests related to launcher interface or other company representative that will take over the responsibility of the hardware after delivery.

d. All the open points shall be clearly identified and actions assigned with closure date before the execution of the test.

e. The output of the TRR shall be a decision to proceed with the test or not.

4.3.2.3 Post test review (PTR)

a. A PTR shall be held in order to formally declare the test completed and allow the release of the item under test and test facility for further activity.

NOTE The release of the test facility includes the breaking of the test configuration.

b. The PTR shall address the following topics:

1. verification that all test data were acquired, recorded, and archived in conformance with the test specification and test procedure requirements;
2. verification that the process for test anomalies and NCRs, raised during the test, was initiated, and all needed inspection, test data and test configuration were acquired;
3. confirmation that tests were performed according to the AIT Plan, the test specification and the test procedures, with the exceptions of what is covered by agreed procedure variations or NCRs or Open Works;
4. status of compliance of the item under test to the relevant requirement;
5. post test status of GSE;
6. post item under test configuration based on inspection and cleanliness report;

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7. identification of the open points with assignment of actions for their closure, as well as lessons learned drawn.

c. The following parties shall participate to the PTR:

1. product assurance;
2. project engineer;
3. AIT;
4. facility representative;
5. other, including specialist, as relevant.

NOTE For example launcher authority for tests related to launcher interface or other company representative that will take over the responsibility of the hardware after delivery.

4.3.2.4 Test review board (TRB)

a. A TRB shall be held to review all results and conclude on the test completeness and achievement of objectives.

b. The TRB shall address the following topics:

1. test documentation availability, including:
   (a) test report as per ECSS-E-ST-10-02 Annex C,
   (b) facility report when relevant,
   (c) inspection report including cleanliness report,
   (d) list of NCRs,
   (e) copy of NCRs raised during test with the related NRB minutes of meeting, and associated request(s) for waiver, and
   (f) list of procedure deviations.
2. compliance with the test specification, and variations to the AIT Plan;
3. status of compliance of the item under test to the relevant requirement;
4. post test status of GSE;
5. post item under test configuration based on inspection and cleanliness report;
6. review of all still open NCRs raised during test in order to assess that there is no impact on the test objectives achievement;
7. lessons learned to be drawn.

c. The following parties shall participate to the TRB:

1. product assurance;
2. project engineer;
3. facility representative;
4. other, including specialist, as relevant.

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NOTE For example AIT, in support of project engineering, or launcher authority for tests related to launcher interface or other company representative that will take over the responsibility of the hardware after delivery.

4.3.3 Test documentation

4.3.3.1 General

Clauses 4.3.3.2 to 4.3.3.5 define the Test programme documentation (AIT Plan, Test specification, Test procedure, and Test report) generated at all product levels.

These documents are derived from the System Engineering Plan (SEP) and from the Verification Plan (VP).

4.3.3.2 Assembly, integration and test plan (AIT Plan)

a. The supplier shall establish the AIT Plan in conformance with the DRD in Annex A.

NOTE At space segment equipment level, the AIT Plan can be called test plan.

b. The agreed AIT Plan shall be available, at the latest, for the TRR of the test programme.

c. The way the requirement 4.3.3.2b is achieved shall be agreed between the customer and the supplier.

4.3.3.3 Test specification (TSPE)

a. The supplier shall establish the test specification in conformance with the DRD in Annex B.

b. The agreed test specification shall be available at the relevant test block TRR and on time to allow procedure preparation.

c. The way the requirement 4.3.3.3b is achieved shall be agreed between the customer and the supplier.

4.3.3.4 Test procedure (TPRO)

a. The supplier shall establish the test procedure in conformance with the DRD in Annex C.

b. The test procedure, derived from the agreed test specification, shall be available at the relevant test block TRR.

c. The way the requirement 4.3.3.4b is achieved shall be agreed between the customer and the supplier.

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4.3.3.5 Test report (TRPT)

a. The supplier shall establish the test report in conformance with the DRD in Annex C of ECSS-E-ST-10-02.

NOTE The test report describes test execution, results and conclusions in the light of the test requirements. It contains the test description and the test results including the as-run test procedures, the considerations and conclusions with particular emphasis on the close-out of the relevant verification requirements including any deviation.

b. The test report shall be available prior to the TRB.

4.3.4 Anomaly or failure during testing

a. Any failure or anomaly during testing shall be recorded.

b. All nonconformances shall be managed in conformance with ECSS-Q-ST-10-09.

c. The NRB shall decide on the necessity and extent of any retest activity in order to demonstrate the correctness of the disposition made.

4.3.5 Test data

a. Test measurements and the environmental conditions shall be recorded for subsequent evaluation.

b. A database of parameters shall be established for trend analysis.

c. Trend analysis shall be performed using test data acquired across sequences of tests.

4.4 Test conditions, input tolerances, and measurement uncertainties

4.4.1 Test conditions

a. The TSPE shall establish the required test conditions.

b. <<deleted>>

c. If an item is tested in conditions different from the ones in which it is expected to operate, then the test levels and durations shall account for the possible differences in behaviour.

NOTE In this case, the test levels and durations are modified based on analyses. For example to prevent effects of convective heat transfer that can reduce temperature differences.

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d. Cleanliness and contamination control for test programmes shall conform to ECSS-Q-ST-70-01.

e. The quality and safety management system used to operate and maintain test facility(ies) shall be recognized by the customer.

NOTE As example, in accordance to quality and safety management system requirements from ECSS-Q-ST-20-07.

f. Test facilities, tools and instrumentation shall not prevent to fulfil the tests objectives.

g. The EGSE or other support systems of the item under test shall:

1. not jeopardize the results of tests;
2. be immune to signals used for susceptibility tests;
3. be designed to comply with the applicable legislation, including safety (e.g. EC Directives).

h. The combination of test set-up, test levels, test durations, and operational modes shall not create conditions that can:

1. induce failures of the item under test,
2. lead to rejection of adequate item under test, or
3. create hazardous conditions.

4.4.2 Test input tolerances

a. The test input tolerances bands shall be agreed by the customer and specified in the TSPE.

b. For the purpose of 4.4.2a, test input tolerances shall account for the uncertainty budget and confidence level of the measurement instrument(s) and test equipment used to control and monitor the test parameters.

NOTE 1 JCGM 100 series, EA-4/16 and EA-4/02 guidelines and ISO/IEC 17025 general requirements can be used to build up the measurement uncertainty budgets.

NOTE 2 The test input tolerances specified in Table 4-1 are the allowable ranges within which the test parameters, as measured, can vary.

c. Quantitative requirements demonstrated by measured values shall account for associated uncertainties, and be compared with the specified test values.

d. The test input tolerances specified in Table 4-1 shall be applied to the specified test values.

e. <<deleted>>

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Table 4-1: Allowable test input tolerances

Test parameters	Test Input Tolerances
1. Temperature	Low High
above 80K, only at space segment equipment level. At space segment element level, see Table 6-2, Table 6-4, Table 6-6	Tmin +0/-4 K Tmax -0/+4 K
T< 80 K	To be defined case by case
2. Relative humidity	± 10 %
3. Pressure (in vacuum chamber)	
> 1,3 hPa	± 15 %
1,3 10-3 hPa to 1,3hPa	± 30 %
< 1,3 10-3 hPa	± 80 %
4. Acceleration (steady state) and static load	-0 / +10 %
5. Sinusoidal vibration	
Frequency (5 Hz to 2000 Hz)	± 2 % (or ±1 Hz whichever is greater)
Amplitude	± 10 %
Sweep rate (Oct/min)	± 5 %
6. Random vibration	
Amplitude (PSD, frequency resolution better than 10Hz)	
20 Hz - 1000 Hz	-1 dB / +3 dB
1000 Hz - 2000 Hz	± 3 dB
Random overall g r.m.s.	± 10 %
7. Acoustic noise	
Sound pressure level, Octave band centre (Hz)	
31,5	-2 dB /+4 dB
63	-1 dB /+3 dB
125	-1 dB /+3 dB
250	-1 dB /+3 dB
500	-1 dB /+3 dB
1000	-1 dB /+3 dB
2000	-1 dB /+3 dB
Overall	-1 dB /+3 dB
Sound pressure level homogeneity per octave band	+/- 2 dB
8. Microvibration	
Acceleration	±10 %
Forces or torque	±10 %
9. Audible noise (for Crewed space segment element only)	
Sound-power (1/3 octave band centre frequency)	

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Test parameters	Test Input Tolerances
32,5 Hz - 160 Hz	±3 dB
160 Hz – 16 kHz	±2 dB
9. Shock	
Response spectrum amplitude (1/12 octave centre frequency or higher)	
Shock level	- 3 dB/ + 6 dB 50 % of the SRS amplitude above 0 dB
10. Solar radiation	
in reference plane	± 4 % of the set value
in reference volume	± 6 % of the set value
11. Infrared radiation	
Mean value	± 3 % on reference plane(s)
12. Test duration	-0/+10 %

4.4.3 Measurement uncertainties

a. The allowable measurement uncertainties shall be agreed by the customer and specified in the TSPE.

NOTE 1 This is important for the selection of the test facility, test instrumentation and GSE.

NOTE 2 Table 4-2 provides typical values from test centers.

b. The measurement uncertainty shall be demonstrated based on approved calibration procedures, with traceability to international measurement standards.

c. All test instrumentation shall be within the normal calibration period at the time of the test.

d. Any anomaly of test instrumentation, detected at the first calibration sequence after the test, shall be reported.

e. <<deleted>>

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