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EUROPEAN COOPERATION
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FOR SPACE STANDARDIZATION

Space Product Assurance

Material selection for controlling stress-corrosion cracking

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Foreword

This standard is one of the series of ECSS Standards intended to be applied together for the management, engineering and product assurance in space projects and applications. ECSS is a cooperative effort of the European Space Agency, National Space Agencies and European industry associations for the purpose of developing and maintaining common standards.

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

The formulation of this standard takes into account the existing ISO 9000 family of documents.

This standard has been prepared by editing ESA PSS-01-736, reviewed by the ECSS Technical Panel and approved by the ECSS Steering Board.

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Scope

This document sets forth the criteria to be used in the selection of materials for spacecraft and associated equipment and facilities so that failure resulting from stress-corrosion will be prevented.

Three categories of materials are listed in Tables 1, 2 and 3 of this document. They represent metal alloys with a high, moderate and low resistance to stress-corrosion cracking.

The stress-corrosion susceptibility of alloys included in this document was determined at ambient temperature

- by means of laboratory tests in which specimens were either sprayed with salt water or periodically immersed and withdrawn;
- by exposing specimens in sea coast or mild industrial environments;
- by subjecting fabricated hardware to service conditions.

Use of the criteria established herein should, therefore, be limited to designs for service involving similar exposure conditions.

Behaviour of the listed materials at elevated temperature and in specific chemical environments other than those mentioned above shall be ascertained by means of additional testing.

Weldments present a special problem in designing for resistance to stress-corrosion cracking. In addition to the susceptibility of the parent metals, it is also necessary to consider the filler metal and the microstructural effects of heat introduced by the welding operations and subsequent heat treatments. Because of the additional variables that shall be considered, susceptibility data are not as extensive for weldments as for alloys in mill form. Design criteria for weldments in this document are limited to aluminium alloys, selected stainless steels in the 300 series and other specific alloys listed in Table 1.

This document is intended to provide general criteria to be used in designing for resistance to stress-corrosion cracking. Specific test data and other detailed information are not included.

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Normative references

This ECSS Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these apply to this ECSS Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

ECSS-P-001	Glossary of terms
ECSS-Q-70	Space product assurance - Materials, mechanical parts and processes.
ECSS-Q-70-37	Space product assurance - Determination of the susceptibility of metals to stress-corrosion cracking.
NASA-MSFC-SPEC 522B (July 1987)	Design criteria for controlling stress-corrosion cracking
MIL-H-6088	Heat treatment of aluminium alloys
ANSI H.35.1	American national standard alloy and temper designation systems for aluminium

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Definitions and abbreviations

3.1 Definitions

For the purposes of this standard, the definitions given in ECSS-P-001 apply. The following terms and definitions are specific to this standard and shall be applied.

Stress-corrosion

the combined action of sustained tensile stress and corrosion that may lead to the premature failure of materials.

3.2 Abbreviations

The following abbreviations are defined and used within this standard.

Abbreviation	Meaning
DML	Declared Materials List
SCC	Stress-corrosion cracking

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Stress-corrosion

4.1 Definition

Stress-corrosion may be defined as the combined action of sustained tensile stress and corrosion that may lead to the premature failure of materials. Certain materials are more susceptible than others. If a susceptible material is placed in service in a corrosive environment under tension of sufficient magnitude, and the duration of service is sufficient to permit the initiation and growth of cracks, failure will occur at a stress lower than that which the material would normally be expected to withstand. The corrosive environment need not be severe in terms of general corrosive attack. Service failures due to stress-corrosion are frequently encountered in cases where the surfaces of the failed parts are not visibly corroded in a general sense. If failure is to be avoided, the total tensile stress in service shall be maintained at a safe level. There is no absolute threshold stress for stress-corrosion, but comparative stress-corrosion thresholds can be determined for materials subjected to controlled conditions of test. Estimates of the stress-corrosion threshold for a specific application shall be determined for each alloy and heat treatment, using a test piece, stressing procedure and corrosive environment that are appropriate for the intended service.

4.2 Grain orientation

Rolling, extrusion and forging are the most common processing operations employed in the production of standard forms of wrought metal. All of these produce a flow of metal in a predominant direction so that when viewed microscopically, is the metal neither isotropic nor homogeneous. As a result, the properties of the metal vary according to the direction in which they are measured. The extent of directional variation depends on the property of interest. For susceptibility to stress-corrosion cracking, the directional variation can be appreciable and shall be considered in the design of manufactured product.

The anisotropy of grain orientation, produced by rolling and extruding, is illustrated in Figure 1. Taking the rolled plate as an example, it is conventional to describe the direction of rolling as the longitudinal direction, the direction perpendicular to the longitudinal axis and in the plane of the plate as the long transverse direction, and the direction through the thickness of the plate as the short transverse direction.

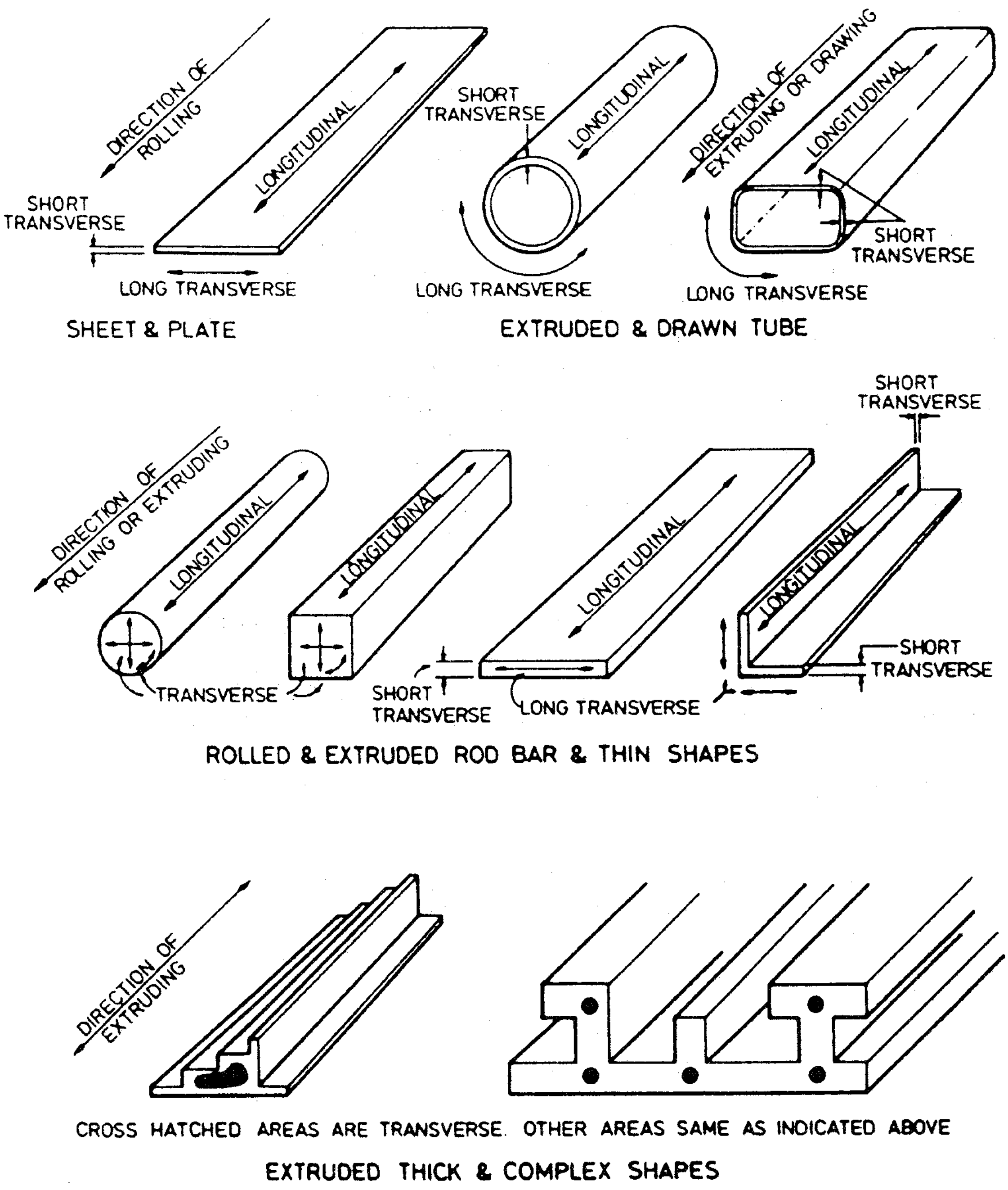


Figure 1: Grain orientations in standard wrought forms

For certain shapes, it is not possible to distinguish both a long and a short transverse direction on the basis of the simple rules for identifying those directions in a plate. As an example, consider the thick tee illustrated in Figure 2, where a region with both long and short transverse orientations has been identified on the basis of experience with that particular shape and a knowledge of the forming method.

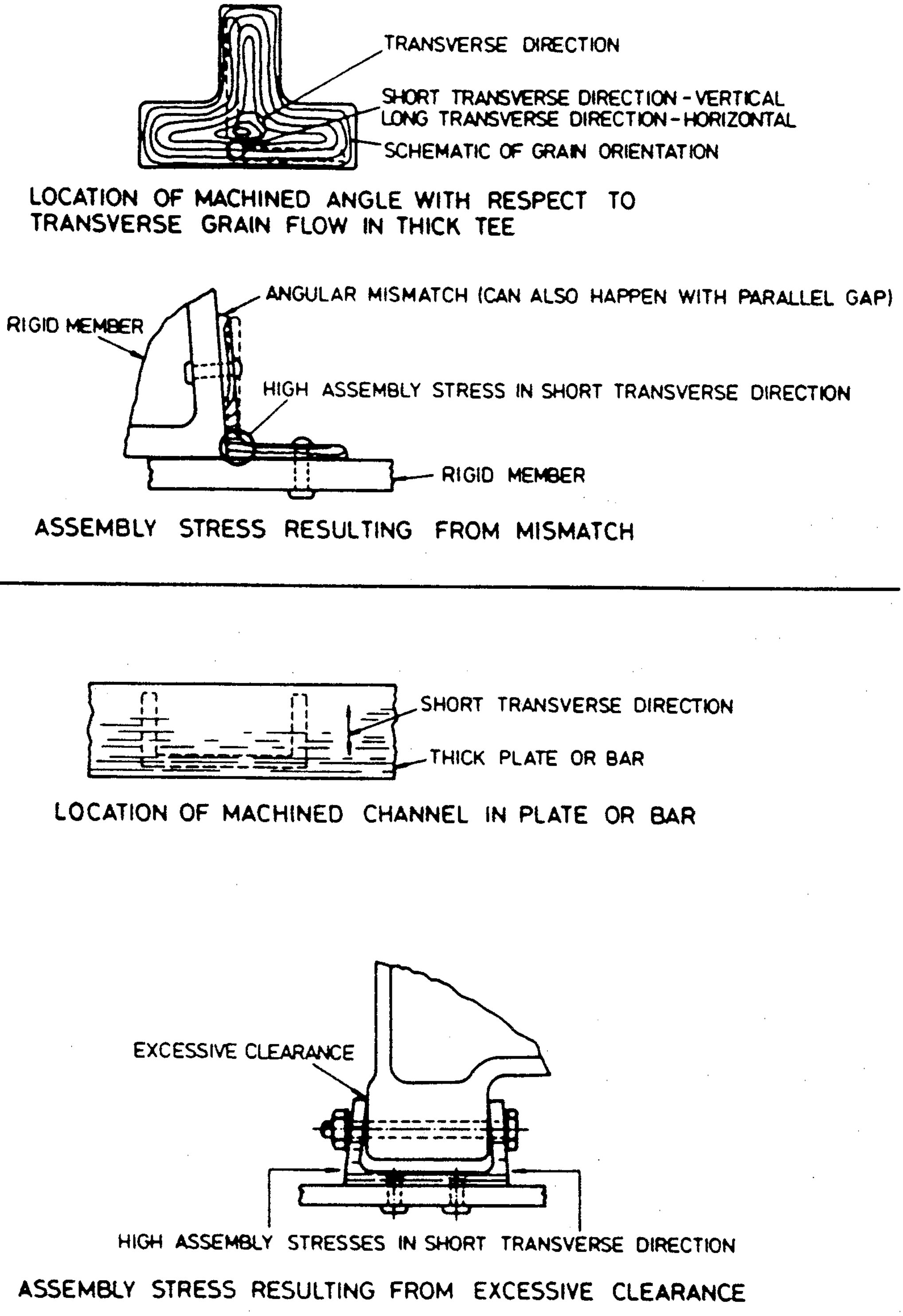
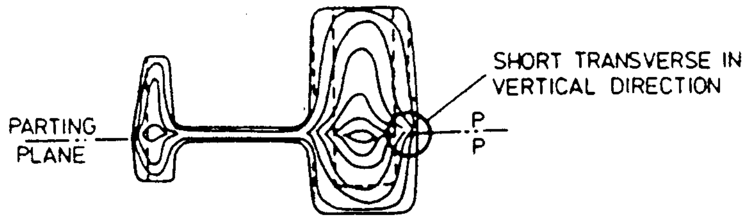
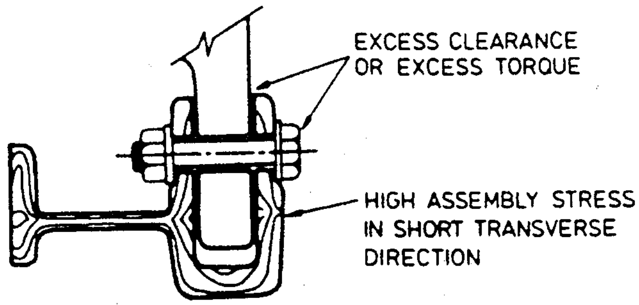


Figure 2: Examples of tensile stresses in short transverse direction applied during assembly

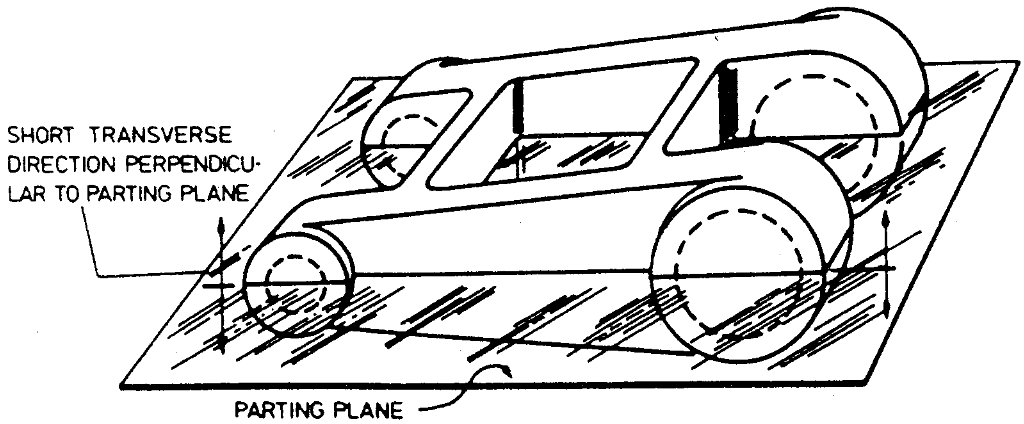
Forgings also require special consideration when identifying the short transverse direction. In a forging operation, the flow of metal is influenced and constrained by the shape of the die cavity. For complex shapes, there may be several regions where a short transverse direction exists. The direction perpendicular to the parting plane of the dies is always short transverse, as illustrated in Figure 3.



CROSS SECTION OF DIE FORGING SHOWING OUTLINE OF MACHINED PART



ASSEMBLY STRESS IN MACHINED FORGING WITH EXCESSIVE CLEARANCE



TYPICAL DIE FORGING, INTERFERENCE FIT BUSHINGS OR PINS IN HOLES SHOWN BY DASHED LINES IMPOSE SUSTAINED RESIDUAL TENSILE STRESSES IN TRANSVERSE DIRECTION

Figure 3: Examples of tensile stresses in short transverse direction resulting from assembly

The resistance of metals, particularly alloys of aluminium, to stress-corrosion cracking is always less when tension is applied in a transverse direction. It is least for the short transverse direction. Figures 2 and 3 were drawn to illustrate undesirable situations in which tensile stresses due to assembly have been applied in the short transverse direction. For optimum resistance to stress-corrosion cracking, similar situations shall be avoided in structural design.

4.3 Stress considerations

In designing for stress-corrosion resistance, it is important to realise that stresses are additive and that threshold stresses for susceptibility are often low. There have been a number of stress-corrosion failures for which design stresses were intermittent and of short duration, and only of minor significance in contributing to failure. Stress-corrosion cracking in those cases occurred because of a combination of residual and assembly stresses not even anticipated in design. All possible sources of stress shall be considered to ensure that threshold stresses are not exceeded. Unfortunately, for most service environments, accurate threshold stresses are difficult to assess. In addition to stresses resulting from operational, transportation and storage loads that are anticipated during design, assembly and residual stresses also contribute to stress–corrosion, and in many cases are the major contributors to stress-corrosion failure.

Assembly stresses result from improper tolerances during fit-up (Figures 2 and 3), overtorquing, press fits, high-interference fasteners and welding. Residual stresses are present in components of fabricated structures as a result of machining, forming and heat-treating operations. Some typical residual-stress distributions through plate and rod are illustrated in Figure 4 to provide an indication of the magnitudes of stress which can be developed as the result of conventional heat treating and forming operations.

4.4 Susceptibility of engineering alloys

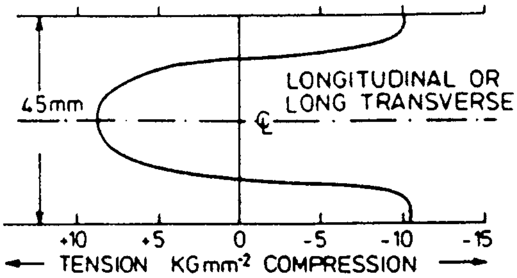
4.4.1 Aluminium

Many aluminium alloys exhibit excellent resistance to stress-corrosion cracking in all standard tempers. The high-strength alloys, however, which are of primary interest in aerospace applications, shall be approached cautiously. Some are resistant only in the longitudinal grain direction, and the resistance of others varies with the specific temper. Because metallurgical processing of aluminium alloys usually results in a pronounced elongation of grains, the variation of susceptibility with grain orientation is more extensive than for other metals. Also, because conventional processing methods are designed to optimise strength, residual stresses – especially in thick sections – are usually greater in aluminium products than in wrought forms of other metals. For this reason, wrought, heat-treatable aluminium products specified for use in the fabrication of hardware should be mechanically stress relieved (the TX5X or TX5XX temper designations) whenever possible.

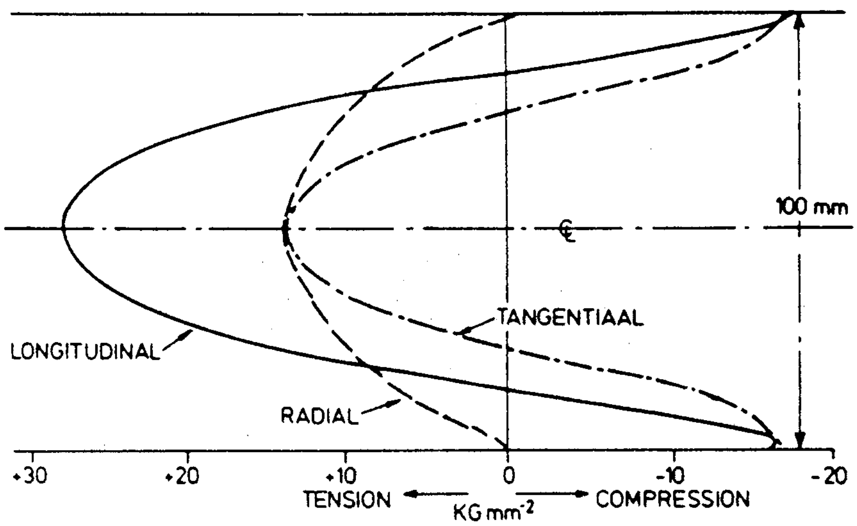
Both the residual stress distribution and the grain orientation shall be carefully considered in designing a part to be machined from wrought aluminium. Machining will not only alter the stress distribution but, as indicated in Figure 2, it may also result in the exposure of a short transverse region on the surface of the finished part which will be subjected to tension in service.

4.4.2 Steel

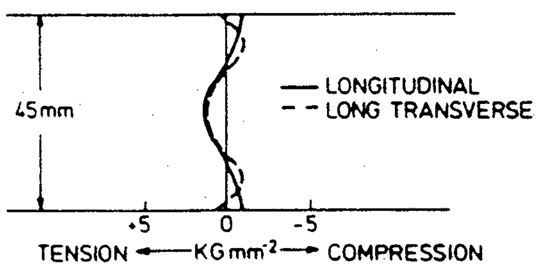
Carbon and low-alloy steels with ultimate tensile strengths below 1 225 MPa (180 ksi) are generally resistant to stress-corrosion cracking. Austenitic stainless steels of the 300 series are generally resistant. Martensitic stainless steels of the 400 series are more or less susceptible, depending on composition and heat treatment. Precipitation-hardening stainless steels vary in susceptibility from extremely high to extremely low, depending on composition and heat treatment. The susceptibility of these steels is particularly sensitive to heat treatment, and special vigilance is required to avoid problems due to stress-corrosion cracking.



7075-T6 PLATE, QUENCHED IN COLD WATER AND NOT STRESS RELIEVED



7075-T6 ROD, QUENCHED IN COLD WATER AND NOT STRESS RELIEVED



7075-T651 PLATE, STRETCHED 2% AFTER COLD WATER QUENCH

Figure 4: Typical residual stress distributions in 7075 Aluminium alloy shapes

4.4.3 Nickel

As a class, alloys with a high nickel content are resistant to stress-corrosion cracking.

4.4.4 Copper

Natural atmospheres containing the pollutants sulphur dioxide, oxides of nitrogen, and ammonia are reported to cause stress-corrosion cracking of some copper alloys. Chlorides present in marine atmospheres may cause stress-corrosion problems, but to a lesser extent than the previously listed pollutants, which indicates that industrial areas are probably more aggressive than marine sites to copper-base alloys. Many copper alloys containing over 20 % zinc are susceptible to stress-corrosion cracking even in the presence of alloying additions that normally impart resistance to stress-corrosion.

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Evaluation of metal alloys

This document does not purport to include all factors and criteria necessary for the total control of stress-corrosion cracking in all alloys. It is recognised that for many applications involving unfamiliar materials, or unusual combinations of materials and environments, existing data on stress-corrosion susceptibility will be insufficient.

To ensure adequate stress-corrosion resistance in these situations, it will be necessary to conduct a detailed evaluation of susceptibility. The results shall be submitted to the customer for review, and the customer's approval will be required before the material can be used or incorporated in a design under the circumstances in question. The medium for submittal will be the stress-corrosion evaluation form, attached to this document as annex A.

In addition, all materials applications other than those explicitly approved according to the criteria set forth in this document will need to be fully assessed by the customer, and for these cases sufficient information shall be given on the stress-corrosion evaluation form and/or the Declared Material List (DML).

The DML will summarise or reference the detailed information specified on the stress-corrosion evaluation form, along with any other information deemed necessary for the accurate assessment of the potential for stress-corrosion failure. Where possible, similar applications of the same or similar alloys should be submitted on the same DML.

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Materials selection criteria

6.1 High SCC resistance alloys

Alloys and tempers that testing and experience have shown to possess high resistance to stress-corrosion cracking are listed in Table 1. Their use is to be given preference.

6.1.1 Thin materials

Sheet material, less than 6,5 mm (0,250 inch) thick of the aluminium alloys listed in Table 2 and alloys used for electrical wiring, thermocouple wires, magnet windings and similar non-structural electrical applications do not require submittal via the stress-corrosion evaluation form.

6.1.2 Coated and plated materials

All electroplated, anodised and chemical-conversion coatings on otherwise acceptable materials are excluded from the requirements of this specification. Similarly coated or plated parts made from susceptible materials are not excluded. For example, even though 2024-T3 aluminium is anodised and 440C stainless steel is chrome plated, these materials are considered to have low resistance to stress corrosion, and their use is subject to the submittal of the information required by the stress-corrosion evaluation form.

6.1.3 Surface treated materials

Surface treatments such as nitriding and carburising are not excluded either. In fact, these treatments may make a stress-corrosion evaluation necessary for a material not normally considered susceptible. An example of this would be a low-strength plain carbon steel, carburised on the surface to a hardness corresponding to a tensile strength above 1 370 MPa (200 ksi). This steel would be considered to have low resistance to stress-corrosion, regardless of the strength of the core material.

6.2 Moderate SCC resistance alloys

Alloys and tempers listed in Table 2 are moderately resistant to stress-corrosion cracking. They should be considered for use only in cases where a suitable alloy cannot be found in Table 1. A stress-corrosion evaluation form shall be submitted, and the customer's approval shall be obtained before any alloy or weldment listed in Table 2 can be used. Proposals to use materials listed in Table 2 for applications involving high installation stress, such as springs or fasteners, will not be approved.

6.3 Low SCC resistance alloys

Materials listed in Table 3 have been found to be highly susceptible to stress-corrosion cracking. They should be considered for use only in applications where it can be demonstrated conclusively that the probability of stress-corrosion is remote because of low sustained tensile stress (whatever its origin) in critical grain directions, suitable protective measures or an innocuous environment. The use of materials listed in Table 3 shall be substantiated by a stress-corrosion evaluation form.

6.4 Unlisted materials

The stress-corrosion resistance of alloys and weldments not listed in this document shall be ascertained either by means of tests conducted in an environment representative of the proposed application or by means of direct comparison with similar alloys and weldments for which susceptibility is known to be low. A stress-corrosion evaluation form shall be submitted and approval obtained for each proposed application of an alloy or weldment not listed in this document. In special cases where specific data are already available on a material under environmental conditions representative of anticipated exposure, a stress-corrosion evaluation form for use of this material within prescribed limits may be submitted for approval.

Table 1: Alloys with high resistance to stress-corrosion cracking

(a) Steel	Condition
Carbon steel (1000 series)	Below 1 225 MPa (180 ksi) UTS
Low alloy steel (4130, 4340, etc.)	Below 1 225 MPa (180 ksi) UTS[1]
(E) D6AC, H-11	Below 1 450 MPa (210 ksi) UTS
Music wire (ASTM 228)	Cold drawn
HY-80 steel	Quenched and tempered
HY-130 steel	Quenched and tempered
HY-140 steel	Quenched and tempered
1095 spring steel	Quenched and tempered
300 series stainless steel (unsensitised)[2]	All
400 series Ferritec stainless steel (404, 430, 431, 444, etc.)	All
21-6-9 stainless steel	All
Carpenter 20 Cb stainless steel	All
Carpenter 20 Cb-3 stainless steel	All
A286 stainless steel	All
AM350 stainless steel	SCT 1000[4] and above
AM355 stainless steel	SCT 1000 and above
Almar 362 stainless steel	H1000[5] and above
Custom 450 stainless steel	H1000 and above
Custom 455 stainless steel	H1000 and above
15-5 PH stainless steel	H1000 and above
PH 14-8 Mo stainless steel	CH900 and SRH950 and above[6,7]
PH 15-7 Mo stainless steel	CH900
17-7 PH stainless steel	CH900
Nitronic 33[3]	All
(E) Maraging steel MARVAL X12	All

1. A small number of laboratory failures of specimens cut from plate more than 2 inches thick have been observed at 75 % yield, even within this ultimate strength range. The use of thick plate should therefore be avoided in a corrosive environment when sustained tensile stress in the short transverse direction is expected.
2. Including weldments of 304L, 316L, 321 and 347.
3. Including weldments.
4. SCT 1000 = sub-zero cooling and tempering at 538 °C (1 000 °F).
5. H1000 hardened above 538 °C (1 000°F).
6. CH900 cold worked and aged at 480 °C (900 °F).
7. SRH950 = solution treated and tempered at 510 °C (950 °F).

(E) ESA classification not in NASA MSFC-SPEC-522A.

Table 1 Continued.

(b) Nickel Alloy	Condition
Hastelloy C	All
Hastelloy X	All
Incoloy 800	All
Incoloy 901	All
Incoloy 903	All
Inconel 600[3]	Annealed
Inconel 625	Annealed
Inconel 718[3]	All
Inconel X-750	All
Monel K-500	All
Ni-Span-C 902	All
René 41	All
Unitemp 212	All
Waspaloy	All

3. Including weldments

Table 1 Continued.

(c) Aluminium alloys:			
Wrought[1,2]		**Cast**	
Alloy	**Condition**	**Alloy[3]**	**Condition**
1000 series	All	355.0, C355.0	T6
2011	T8	356.0, A356.0	All
2024, rod bar	T8	357.0	All
2219	T6, T8	B358.0 (Tens-50)	All
(E) 2419	T8	359.0	All
(E) 2618	T6, T8	380.0, A380.0	As cast
3000 series	All	514.0 (214)	As cast[5]
5000 series	All[4,5]	518.0 (218)	As cast[5]
6000 series	All	535.0 (Almag 35)	As cast[5]
(E) 7020	T6[6]	A712.0, C712.0	As cast
7049	T73		
7149	T73		
7050	T73		
7075	T73		
7475	T73		

1. Mechanical stress relieved (TX5X or TX5XX) where possible.
2. Including weldments of the weldable alloys.
3. The former designation is shown in parenthesis when significantly different.
4. High magnesium content alloys 5456, 5083 and 5086 should be used only in controlled tempers (H111, H112, H116, H117, H323, H343) for resistance to stress-corrosion cracking and exfoliation.
5. Alloys with magnesium content greater than 3,0 % are not recommended for high-temperature application, 66 °C (150 °F) and above.
6. Excluding weldments.

(E) ESA classification - not in NASA MSFC-SPEC-522A.

Table 1 Continued.

(d) Copper Alloy	
CDA no. [1]	Condition (% cold rolled) [2]
110	37
170	AT, HT [3,4]
172	AT, HT [3,4]
194	37
195	90
230	40
422	37
443	10
510	37
521	37
619	40 (9 % B phase)
619	40 (95 % B phase)
688	40
706	50
725	50, annealed
280, 524, 606, 632, 655, 704, 710	0
715, (E) 917, (E) 937	0

1. Copper Development Association alloy number.
2. Maximum per cent cold rolled for which stress-corrosion-cracking data are available.
3. AT – annealed and precipitation hardened.
4. HT – work hardened and precipitation hardened.

(E) ESA classification not in NASA MSFC-SPEC-522A.

(e) Miscellaneous Alloy (wrought)	Condition
Beryllium, S-200C	Annealed
HS 25 (L605)	All
HS 188	All
MP35N	All
Titanium, 3Al-2.5V	All
Titanium, 6Al-4V	All
Titanium, 13V-11Cr-3Al	All
(E) Titanium OMI 685, IMI 829	All
Magnesium, M1A	All
Magnesium, LA141	Stabilised
Magnesium, LAZ933	All

Table 2: Alloys with moderate resistance to stress-corrosion cracking

(a) Steel Alloy	Condition
Carbon steel (1000 series)	1 225 to 1 370 MPa
Low-alloy steel (4130, 4340, etc.)	1 225 to 1 370 MPa
Nitronic 32	All
Nitronic 60	All
403, 410, 416, 431 stainless steel	(see footnote1)
PH 13-8 Mo stainless steel	All
15-5PH stainless steel	Below H1000[2]
17-4PH stainless steel	All

1. Tempering between 370 °C and 600 °C should be avoided because corrosion and stress-corrosion resistance is lowered.
2. H1000 = hardened above 538 °C (1 000 °F).

(b) Miscellaneous Alloy	Condition
Magnesium, AZ31B	All
Magnesium, ZK60A	All
Magnesium (E) ZW3	

(E) ESA classification not in NASA MSFC-SPEC-522A.

Table 2 Continued.

(c) Aluminium alloys[1,2]			
Wrought		**Cast**	
Alloy	**Condition**	**Alloy**	**Condition**
2024 rod, bar, extrusion	T6, T62	319.0, A319.0	As cast
2024 plate, extrusions	T8	333.0, A333.0	As cast
2124 plate	T8		
2048 plate	T8		
4032	T6		
5083	All [3]		
5086	All [3]		
5456	All [3]		
7001	T75, T76		
(E) 7010	T736		
7049	T76		
7050	T736,T76		
7075	T76		
7175	T736,T76		
7475	T76		
7178	T76		
(E) Russian Al-Li 1420 and 1421	soln. treat + age		

1. Mechanically stress relieved products (TX5X or TX5XX) should be specified where possible.
2. Sheet, unmachined extrusions and unmachined plate are the most resistant forms.
3. Except for controlled tempers listed in footnote 3 of Table I (c), aluminium alloys. These alloys are not recommended for high-temperature application, 66 °C (150 °F) and above.

(E) ESA classification – not in NASA MSFC-SPEC-522A.

Table 3: Alloys with low resistance to stress-corrosion cracking

(a) Steel Alloy	Condition
Carbon steel (1000 series)	Above 1 370 MPa
Low-alloy steel (4130, 4340, etc.)	Above 1 370 MPa
(E) D6AC, H-11 steel	Above 1 450 MPa
440C stainless steel	All
18 Ni Maraging steel, 200 grade	Aged at 900 °F
18 Ni Maraging steel, 250 grade	Aged at 900 °F
18 Ni Maraging steel, 300 grade	Aged at 900 °F
18 Ni Maraging steel, 350 grade	Aged at 900 °F
AM 350 stainless steel	Below SCT 1000
AM 355 stainless steel	Below SCT 1000
Custom 455 stainless steel	Below H1000
PH 15-7 Mo stainless steel	All except CH900
17-7 PH stainless steel	All except CH900
(E) Kovar	All
(E) ESA classification not in NASA MSFC-SPEC-522A.	

Table 3 Continued.

(b) Aluminium Alloys[1,2]			
Wrought		**Cast**	
Alloy	**Condition**	**Alloy**	**Condition**
2011	T3, T4	295.0 (195)	T6
2014	All	B295.0 (B195)	T6
2017	All	520.0 (220)	T4
2024	T3, T4	707.0 (607, tern-alloy 7)	T6
2024 Forgings	T6, T62, T8	D712.0 (D612,40E)	As cast
2024 Plate	T62		
(E) Al-Li 2080	T8		
(E) 2618	T3, T4		
7001	T6		
7005	All		
(E) 7020	Weldments		
7039	All		
7075	T6		
7175	T6		
7079	T6		
7178	T6		
7475	T6		
(E) Al-Li 8090	All		
(E) BS L93	T6		
(E) Russian Al-Li 1441 and 1460	All		

1. Mechanically stress-relieved products (TX5X or TX5XX) should be specified where possible
2. Sheet, unmachined extrusions and unmachined plate are the least susceptible

(E) ESA classification – not in NASA MSFC-SPEC-522A.forms

Table 3 Continued.

(c) Copper alloys	
CDA no.[1]	**Condition (% cold rolled)[2]**
260	50
353	50
443	40
672	50, annealed
687	10, 40
762	A, 25, 50
766	38
770	38, 50, annealed
782	50

1. Copper Development Association alloy number.
2. Rating based on listed conditions only.

(d) Magnesium Alloy	Condition
AZ61A	All
AZ80A	All
WE54	All
ZCM711	All

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Annex A (normative)

Stress-corrosion evaluation form

A.1 Directions for completion

1-4 **Part identification**: information identifying a specific part being evaluated. These headings may be modified, if necessary.

5 **Material**: this should be identified as specified on the drawing. Specific alloy and temper designation of raw material from which the part is fabricated should be given.

6 **Heat treatment**: all thermal treatments which the part receives should be listed.

7 **Size and form**: approximate dimensions of raw material from which the part is fabricated should be listed. The raw material form (bar, plate, sheet, extrusion, forging etc.) should also be mentioned.

8 **Sustained tensile stresses**: an estimate of such stresses should be made. They should be listed according to their source (8 a. Process; 8 b. Assembly; 8 c. Design) and the basis on which the estimate has been made. The direction of the resultant stresses shall be indicated with respect to the grain orientation of the material. Reference shall be made to all instances when machining or other metal-removal operations expose short transverse grain orientation to stress (e.g. following machining of forged parts; removal of clad surfaces). Any special precautions taken to control stresses should be noted.

9 **Special processing**: any processes used for reducing tensile stresses (such as shot peening or stress-relief treatments) should be noted.

10 **Weldments**: a stress-corrosion cracking evaluation should be made of all weldments, and all information that may assist in the evaluation should be submitted. The alloy, form and temper of the parent metal, filler alloy if any, welding process, weld bead removed, post-weld thermal treatment or stress relief as listed in 10 a. to f. is the type of information required.

11 **Environment**: an evaluation should be made as to the corrosive environment to which the part will be exposed during its lifetime. This includes exposure during fabrication, assembly and component storage, as well as environmental conditions during use.

12 **Protective finish**: any finishes applied for corrosion protection or finishes that might affect the basic corrosion resistance of the component should be listed.

13 **Function of part**: the basic function of the part (or, if more pertinent, the assembly) should be listed.

14 **Effect of failure**: list the possible effects of the failure of the part (or assembly) on the overall function or mission of the major assembly involved.

15 **Evaluation of stress-corrosion susceptibility**: this should include the rationale underlying the material's selection and a short explanation as to why no stress-corrosion problem is expected.

16 **Remarks**: any additional information or explanatory notes not included in the preceding sections should be listed here. Relevant laboratory reports may be referenced.

A.2 Stress-corrosion evaluation form

Originator (Name, Organization, Address): ....

....

Used on system/subsystem: ....

Project: ....

1. Declared material list identification ....
2. Use and location ....
3. Number of identical parts ....
4. Manufacturer ....
5. Material ....
6. Heat treatment ....
7. Size and form ....
8. Sustained tensile stresses – magnitude and direction:
   a. Process residual ....
   b. Assembly ....
   c. Design, static ....
9. Special processing ....
10. Weldments:
    a. Alloy form, temper of parent metal ....
    b. Filler alloy (if none, indicate) ....
    c. Welding process ....
    d. Weld bead removed: Yes ( ) No ( )
    e. Post-weld thermal treatment ....
    f. Post-weld stress relief ....
11. Environment ....
12. Protective finish ....
13. Function of part ....

    ....
14. Effect of failure ....

    ....
15. Evaluation of stress-corrosion susceptibility

    ....
16. Remarks ....

    ....

    ....

Contractor's authorization: Customer's approval:

Annexes: (e.g. construction drawings for intended use; laboratory stress-corrosion test report in accordance with ECSS-Q-70-37).

ECSS Document Improvement Proposal

1. Document I.D.	**2. Document Date**	**3. Document Title**
ECSS-Q-70-36A	20 January 1998	Material selection for controlling stress-corrosion cracking
4. Recommended Improvement (identify clauses, subclauses and include modified text and/or graphic, attach pages as necessary)		
5. Reason for Recommendation		
6. Originator of recommendation		
Name:	Organization:	
Address:	Phone: Fax: E-Mail:	**7. Date of Submission:**
8. Send to ECSS Secretariat		
Name: W. Kriedte ESA-TOS/QR	Address: Keplerlaan 1 2200AG Noordwijk Netherlands	Phone: +31-71-565-3952 Fax: +31-71-565-6839 E-Mail: wkriedte@estec.esa.nl

Note: The originator of the submission should complete items 4, 5, 6 and 7.

This form is available as a Word and Wordperfect-Template on internet under
http://www.estec.esa.nl/ecss/improve/

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