SKALNAV

SHELL BUCKLING ANALYSIS REPORT

ENGINEERING ASSESSMENT DOCUMENT

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Project	LH2 barrel · Ariane-6-class (public geometry)
Project no.	PRJ-2026-017
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Report no.	**EAS-SAMPLE-2026-001**
Revision	**A**
Issue date	26 September 2026
Prepared by	J. Bloggs (fictitious)
Subject	Axial buckling check of an unstiffened LH2 tank barrel: R = 2701.275 mm (mid-surface), L = 3110 mm, t = 2.55 mm, AA2219
Purpose	Public sample report for the barrel shown in the Skalnav demo video. Geometry after Franzoni et al., Aerosp. Sci. Technol. 178 (2026) 113063; loads and w/t are illustrative. All company, customer, person and project data are fictitious.
Geometry	cylinder

ASSESSMENT RESULT

Adequate buckling reserve across the current operational envelope.

Minimum RF = **1.57**

Executive Summary

cylinder · 3 load cases · 26 September 2026

SAFE

1.57

minimum RF

governing: LC-2 Axial · NASA SP-8007 · axial buckling

MIN RF	GOVERNING	FAILURE MODE	R/t
1.57	LC-2	axial buckling	1059
on LC-2 · NASA SP-8007	NASA SP-8007 · axial		Z = 1325

RF ENVELOPE all 3 at or above RF = 1.0 · governing LC-2 · NASA SP-8007 · bars cut at RF 2.0

KEY INSIGHTS

- **Governing LC: LC-2 Axial · NASA SP-8007**
  axial buckling (RF = 1.57)
- **All 3 LCs at or above RF = 1.0**
  Mission load envelope sits within the allowable shell capacity.
- **Geometry: R/t = 1059, L/R = 1.15**

RECOMMENDATION

No corrective action required

CURRENT

min RF **1.57**

LC-2 Axial · NASA SP-8007 sits in the safe band (RF >= 1.50) for the loads assessed in this report.

Inputs and method

Every number in this report follows from these inputs.

Geometry, material and imperfection

Shell	cylinder	R (mid-surface)	2701.275 mm	L	3110 mm
t	2.55 mm	R/t	1059	L/R	1.15
Z (Batdorf)	1325	E	70000 MPa	ν	0.33
f_y	390 MPa	Imperfection	w/t = 1.00		

Load cases

Load case	Type	Loads	Method	Design capacity	RF
LC-1 Axial · Skalnav design value	axial	F = 240.0 kN	Skalnav design value	705.51 kN	2.94
LC-2 Axial · NASA SP-8007	axial	F = 240.0 kN	NASA SP-8007	377.77 kN	**1.57**
LC-3 Axial · ECSS-E-HB-32-24A	axial	F = 240.0 kN	ECSS-E-HB-32-24A	379.29 kN	1.58

RF (reserve factor) = design capacity / demand of the load case.

KDF (knockdown factor) = design buckling load / classical (perfect-shell) buckling load.

NASA SP-8007 axial knockdown, as implemented: $\gamma = 1 - 0.902 \cdot (1 - \exp(-\phi))$, $\phi = \sqrt{R/t}/16$. SP-8007-2020 Eq. 9 prints 0.901; at R/t = 1059 the two differ by 0.40 % in γ.

RF bands: below 1.00 fail · 1.00 to below 1.10 critical · 1.10 to below 1.50 marginal · 1.50 and above safe.

Method & assumptions

Method	Skalnav design value / NASA SP-8007 / ECSS-E-HB-32-24A

Engineering Assessment

3 load cases · selected from the envelope by significance

LC-2 Axial · NASA SP-8007 — Governing load case

GOVERNING GROUND

PARAMETERS

F_axial	240.0 kN	M_bend	—
P_int	0.00 MPa	RF	**1.57**

ENGINEERING RATIONALE

Ground pure axial-compression load case.

NOTES (MISSION PROFILE)

> Ground case, tank unpressurised. Same 240 kN load and barrel inputs as the other rows. NASA SP-8007 design curve as implemented (coefficient 0.902, see Inputs and method), set by R/t alone: KDF 0.2160, design load 377.77 kN.

CONCLUSION

In the safe band; no action required at the loads assessed.

LC-1 Axial · Skalnav design value — Ground load case

RESERVE GROUND

PARAMETERS

F_axial	240.0 kN	M_bend	—
P_int	0.00 MPa	RF	**2.94**

ENGINEERING RATIONALE

Ground pure axial-compression load case.

NOTES (MISSION PROFILE)

> Ground case, tank unpressurised. Model comparison: unstiffened elastic barrel, axial load only, illustrative load (not a vehicle load). Same barrel and inputs as the Skalnav demo video, w/t = 1.00 (illustrative). Skalnav design value: KDF 0.4033, design load 705.51 kN; classical buckling load 1749.18 kN.

CONCLUSION

In the safe band; no action required at the loads assessed.

LC-3 Axial · ECSS-E-HB-32-24A — Ground load case

RESERVE GROUND

PARAMETERS

F_axial	240.0 kN	M_bend	—
P_int	0.00 MPa	RF	**1.58**

ENGINEERING RATIONALE

Ground pure axial-compression load case.

NOTES (MISSION PROFILE)

> Ground case, tank unpressurised. Same 240 kN load and barrel inputs as the other rows. ECSS-E-HB-32-24A: KDF 0.2168, design load 379.29 kN.

CONCLUSION

In the safe band; no action required at the loads assessed.

Engineering Responsibility & Scope of Results

Skalnav is a calculation and decision-support tool for qualified professional users. It performs stability verifications according to the standards and methods identified in this report, in the program version stated in the footer. All results are based on the input data entered by the user and on the documented model assumptions.

All input data and all results must be independently reviewed, checked for plausibility, and released by a qualified, professionally competent person before any use. Results must not be used as the sole basis for the design, release, or acceptance of safety-critical components. Responsibility for the selection of the verification method, the interpretation of results, and their structural implementation lies exclusively with the user.

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