



EASA
European Aviation Safety Agency

STCs: Internal and External Installations

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Internal and External Installations

- Typical STC Installations
- Classification of Change Criteria
- Applicable Structural Requirements:
 - All STC Applications
 - Internal Installations
 - External Installations
- Additional Considerations
- Conclusions



Typical STC Installations



**Internal
Installations**



**External
Installations**





Change Classification

SIGNIFICANT

- **EMS** (only if primary structural changes sufficient to invalidate the cert assumptions)
- **Human External Cargo** Must comply with the latest HEC certification specifications (*for the affected areas*)

**Latest
Amdt.**

MINOR

No appreciable effect on:

- Mass, balance, structural strength
- Reliability, operational characteristics, noise, fuel venting, exhaust emission
- Other characteristics affecting the airworthiness of the product

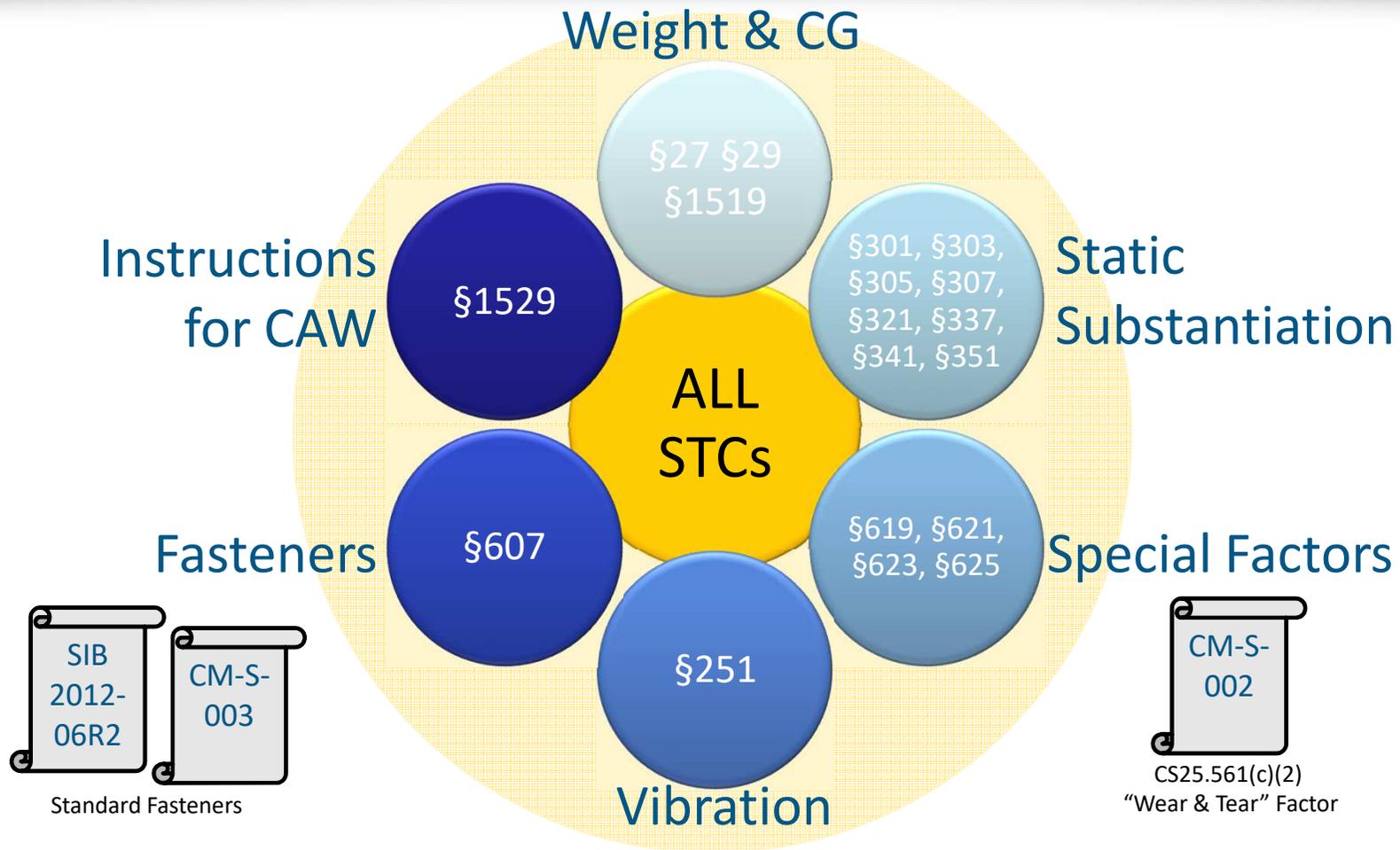
**As
TCDS**

MAJOR

- Everything else!



Circle of Requirements: all STCs

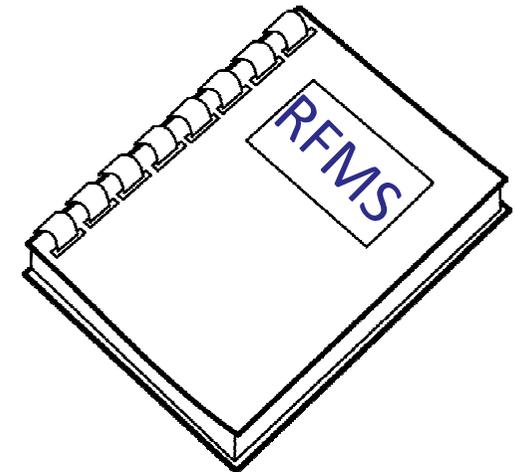
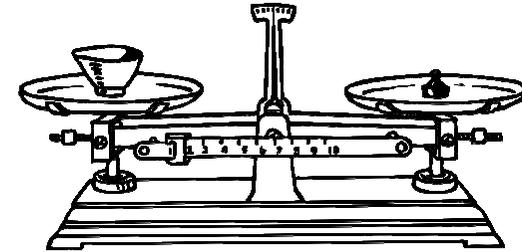




Weight and CG

§27 §29
§1519

- Weight and CG should be assessed
- If appropriate, separate into removable parts and fixed parts
- Ensure rotorcraft inside certified weight/CG envelope
- Publish in the Flight Manual Supplement to allow operators to manage the rotorcraft mass/cg.



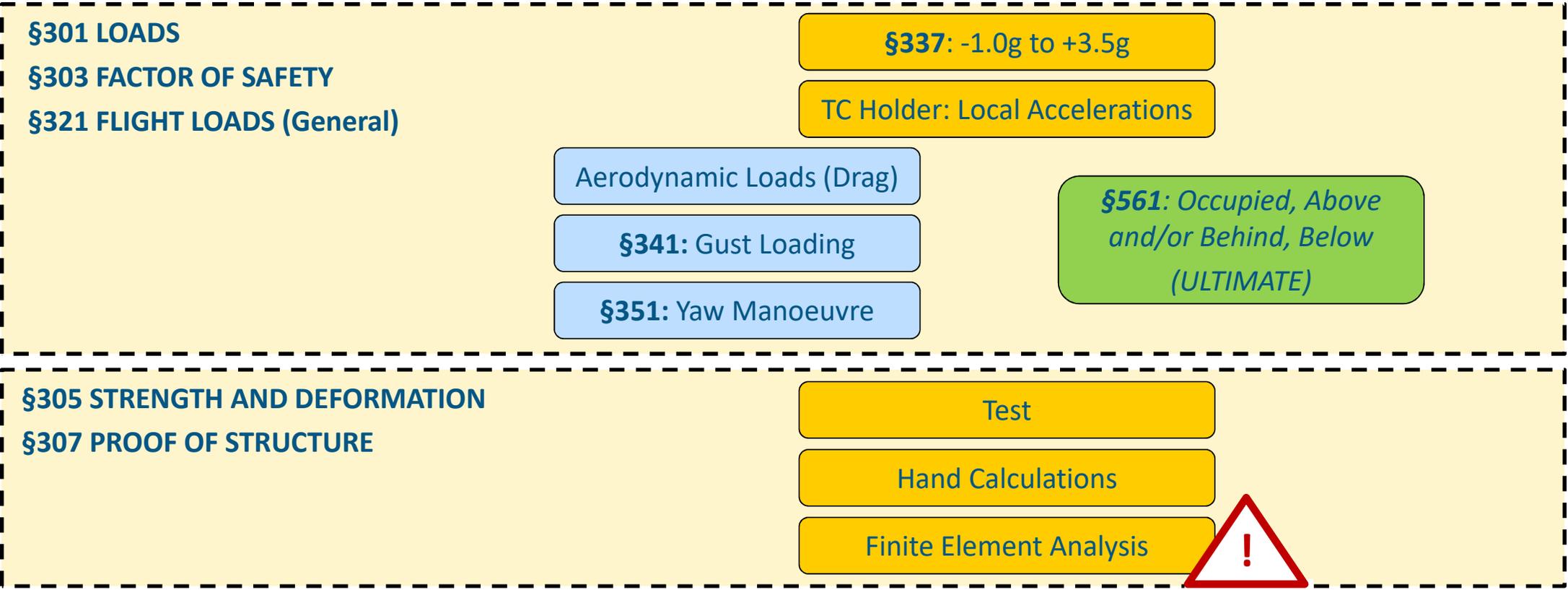


Static Substantiation

§301, §303,
§305, §307,
§321, §337,
§341, §351

EXTERNAL INSTALLATIONS

INTERNAL INSTALLATIONS



Validate



Static Substantiation

§301, §303,
§305, §307,
§321, §337,
§341, §351

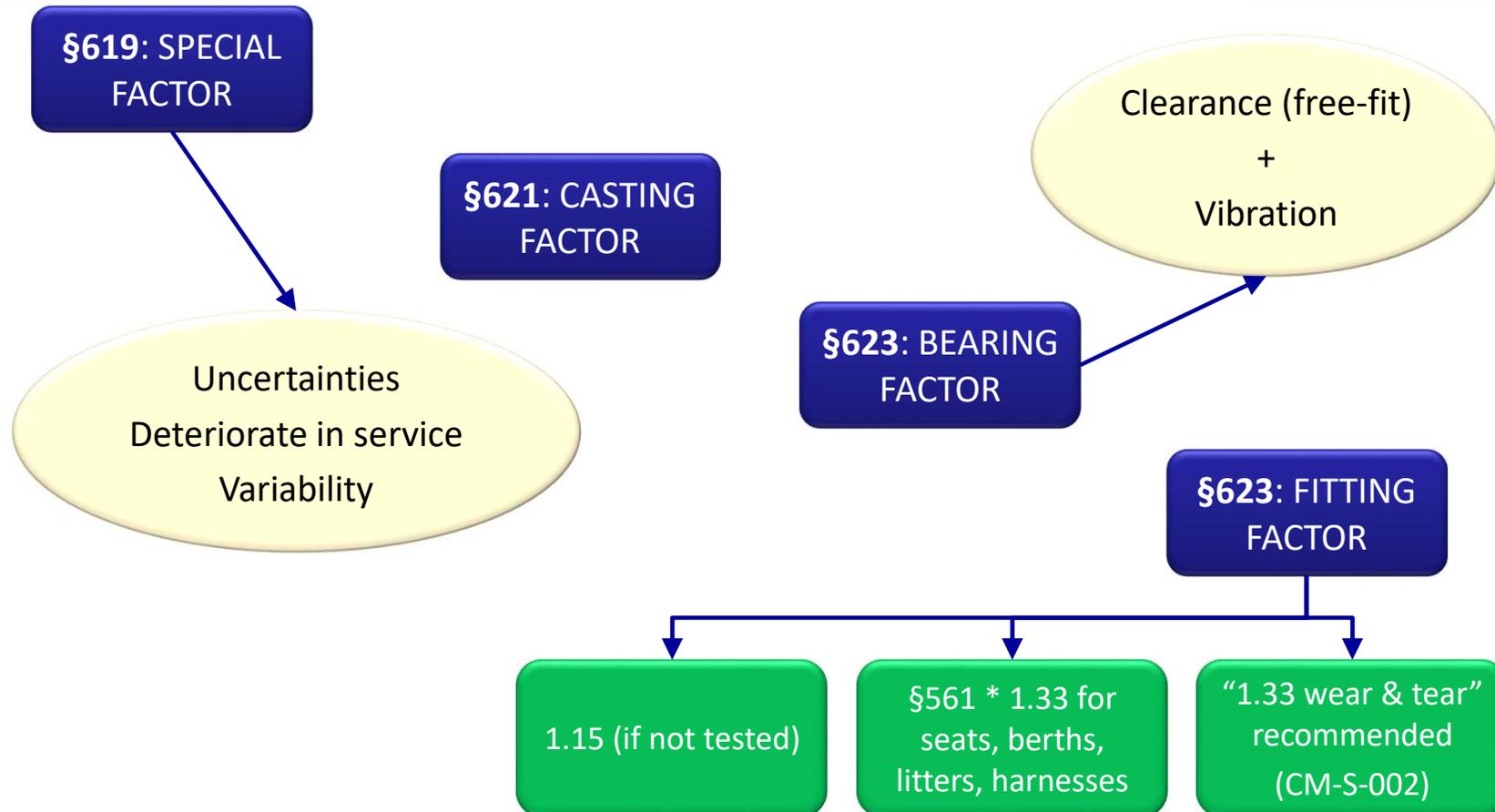
- Rotorcraft Structure Analysis (attachment point and local structure):
 - Strength of attachment points from TC holder (or TC holder NTO)
 - Reverse engineering
 - Analysis with conservative assumptions
 - Multiple variants: careful to cover “weakest” variant

- Influence on Global Rotorcraft loading
 - Large masses far from the CG
 - Drag (total and lateral)



Special Factors

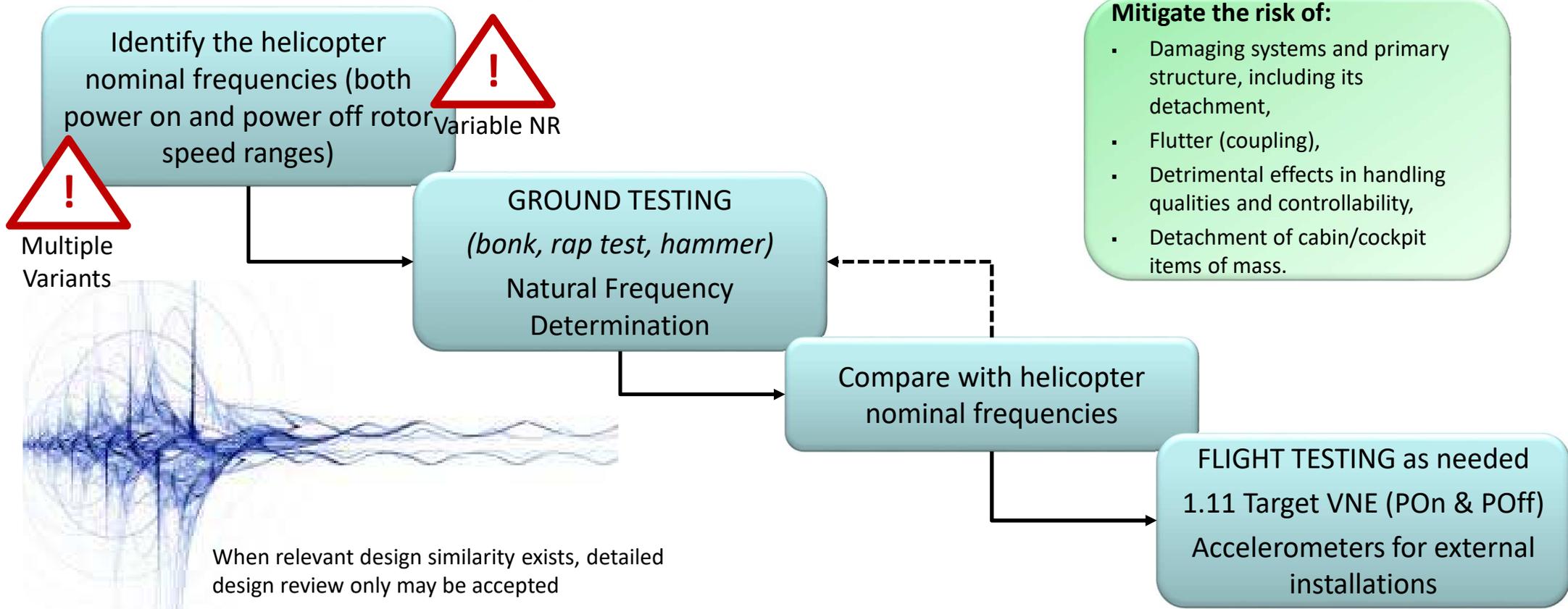
§619, §621,
§623, §625





➤ Objective: Prevent the risk of excessive vibration

(<https://www.easa.europa.eu/the-agency/faqs/rotorcraft>)





Fasteners

§607

Loss can jeopardise the safe operation of the rotorcraft



Independent double locking

[Adhesive is not considered to be a locking device]

STANDARD FASTENERS

SIN 2012-06R2
28 Oct 2013
Defective
Standard
Hardware

Cert Memo
15 Feb 2015
CM-S-003
Issue 1



- Is the **expected reliability sufficient** for intended use:
 - criticality (HAZ or CAT),
 - location,
 - level of redundancy,
 - margins of safety,
 - environment,
 - (adverse) service experience?
 - appropriate ICA



Instructions for Continued Airworthiness

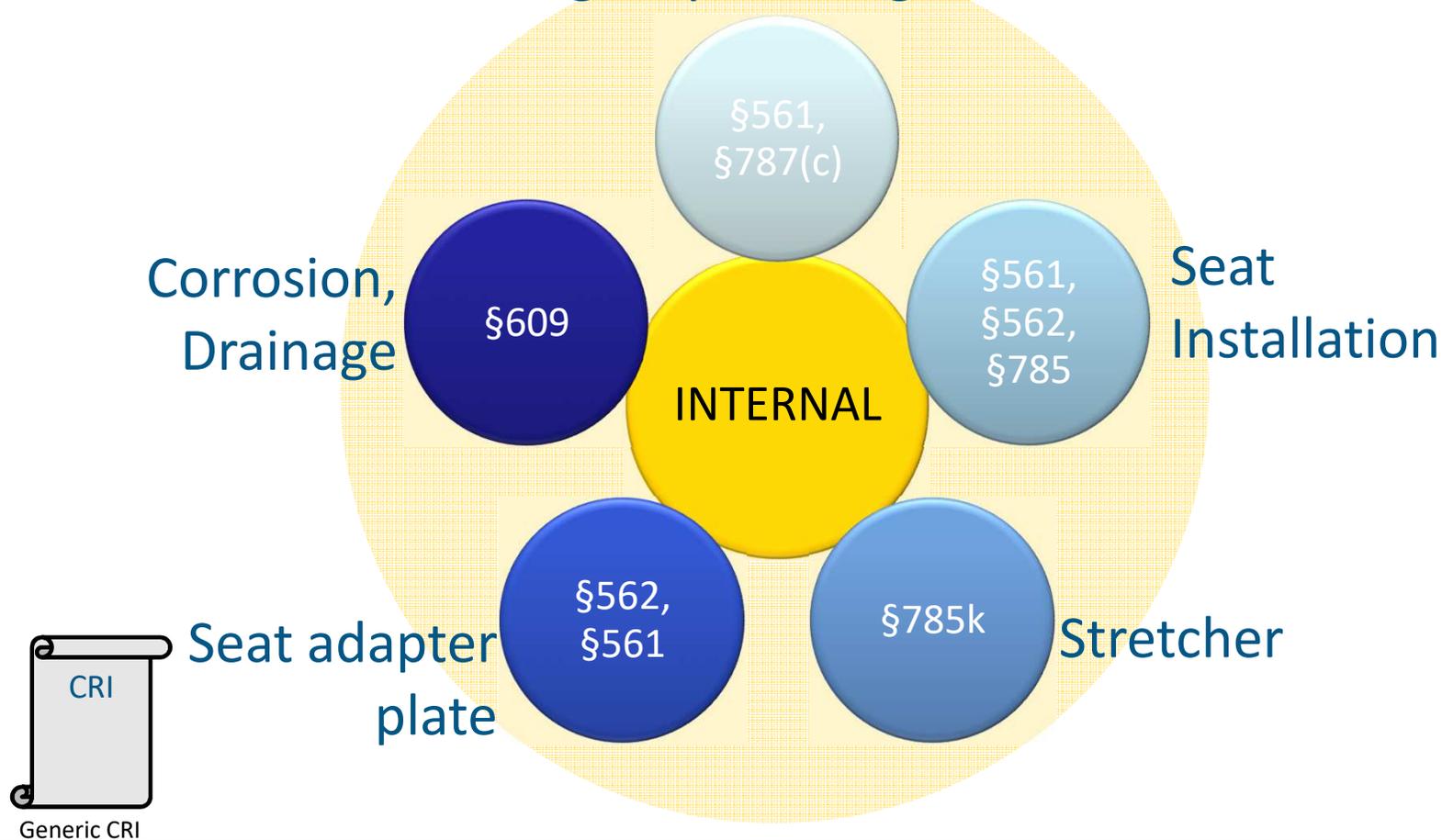
§1529

- Appropriate inspection instructions should be included in the maintenance manual.
- This should cover the STC and the region of the rotorcraft where the external device is attached.



Circle of Requirements: Internal

Emergency Landing Conditions



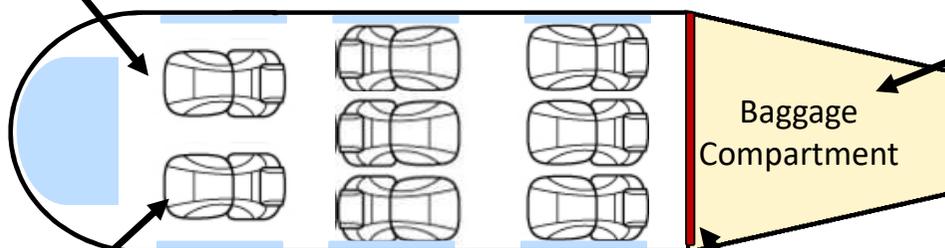


Emergency Landing Conditions

§561,
§787(c)

Occupied Space:

- CS27/29.787
- CS27/29.561(b)
[16g forward]



Baggage Compartment

No Structural Partition:

- CS27/29.787
- CS27/29.561(b)
[16g forward]

With Structural Partition:

- CS27/29.787
- CS27/29.561(c)
[12g forward]

Seats:

- CS27/29.561(b)
- CS27/29.562(b)
[18.4g forward]
[30.0g vertical]

Structural Partition:

- CS27/29.561(c)
[12g forward]

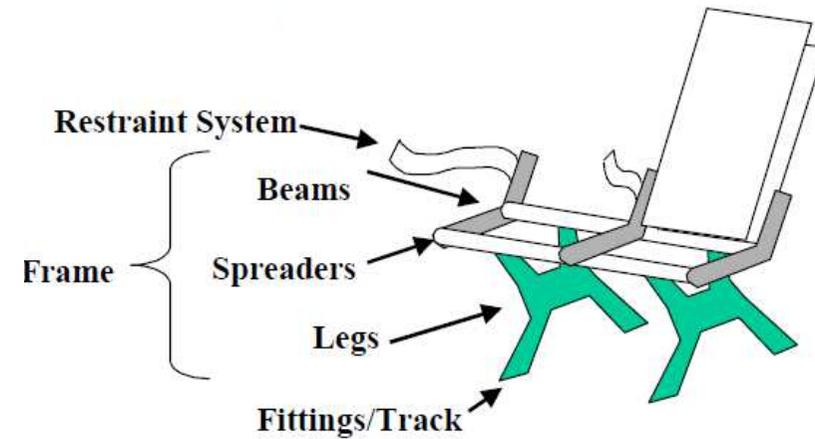
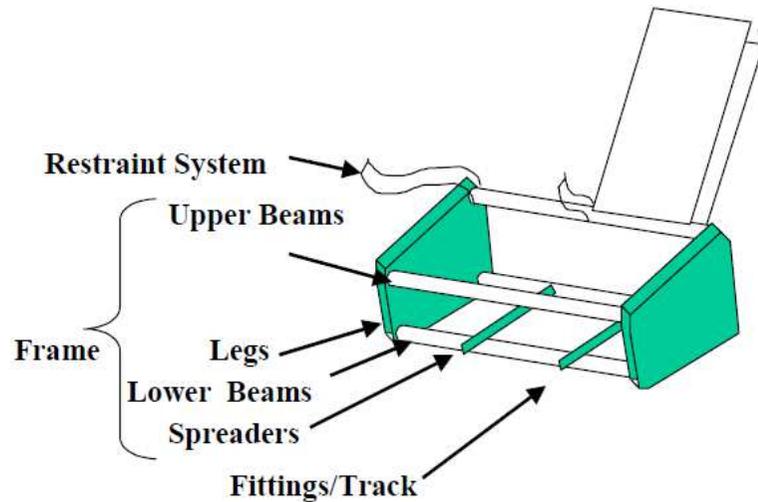
NOTE: For simplicity only forward g factors are quoted. All directions must be considered.



Seat Installation

§561,
§562,
§785

- Emergency landing loads §561 with 1.33 fitting factor
- New Dynamic Seat test:
 - Primary load path modification
Restraint system, Seat frames, Fittings and tracks, Seat back, Bottom cushions, Seat pan
 - Seat Family Definition, see (AC25.562-1B)

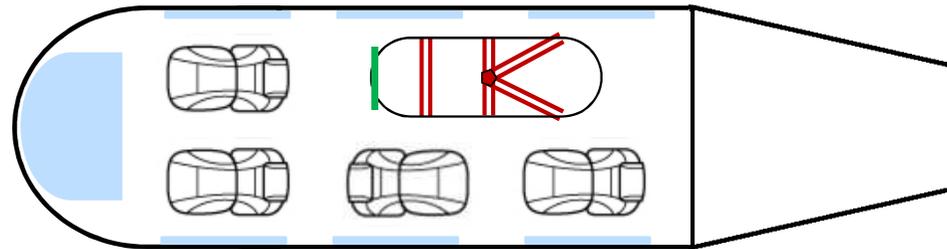




Stretcher

§785k

- §562 not applicable
- §561 stretcher attachments
- §785 harnesses
- 1.33 fitting factor
- Longitudinal orientation → padded end-board, cloth diaphragm or equivalent





Seat Adapter Plate

§562,
§561

- Objective: Level of safety equal to original seat to floor attachment

Option 1:

adapter = plinth

- Plinth must be tested as part of the seat to §562b

Option 2:

adapter = pallet

- Seat and its attachment to pallet tested to §562b
- Pallet justified to §561 only

Option 3:

adapter ≠ plinth,
adapter ≠ pallet

- Adapter proposed to be classified as part of floor based on (detailed) design review
- Seat and its attachment tested to §562b



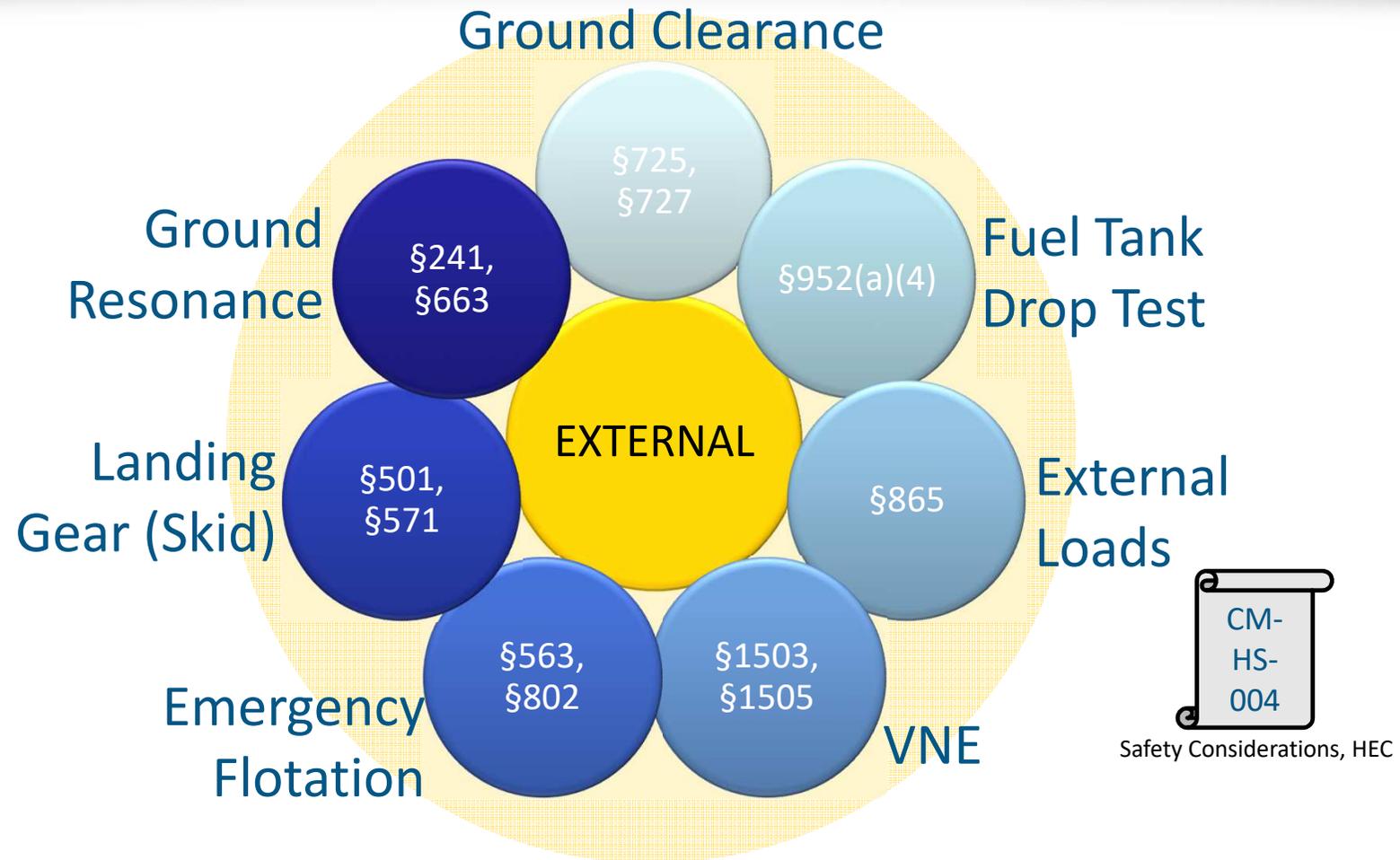
Corrosion, Drainage

§609

- Protection of Structure:
 - Floor protection:
 - Corrosion
 - Drainage



Circle of Requirements: External





Ground Clearance

§725,
§727

Ground Clearance

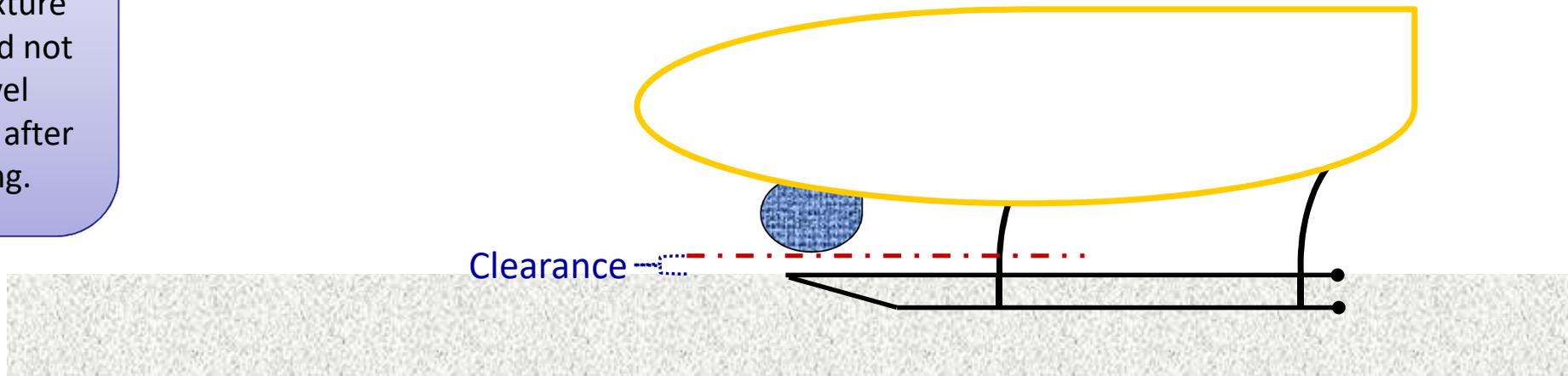
§725 Limit Drop Test

§727 Reserve energy absorption drop test

AC §.727(b)(2), AC§ MG6b.(8) External Devices

Limit landing load deflection:

The external fixture or device should not contact a level landing surface after a limit landing.





Ground Clearance

§725,
§727

Reserve energy absorption drop test deflection:

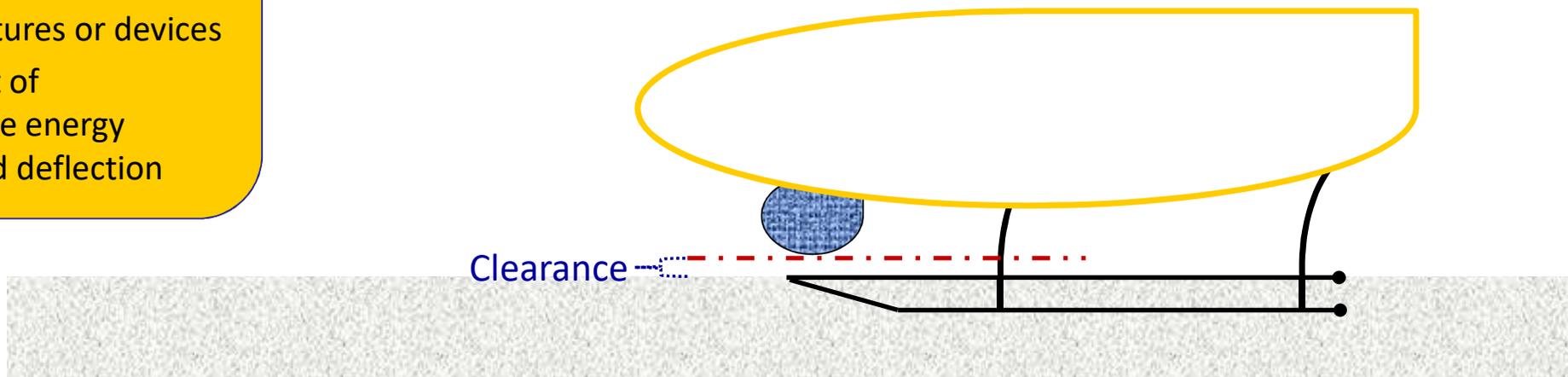
- Devices likely to cause post-landing fires → No Impact
- Electrical connections protection to prevent electrical fires
- Design and/or location to avoid penetration into a critical area

How to determine clearance:

- ✓ TC Holder Data
- ✓ Comparison with TC Holder external fixtures or devices
- ✓ Assessment of limit/reserve energy landing load deflection

Flight Test:

Slope landing envelope: Check no problem exists within the TCH certified envelope





Fuel System Crash Resistance: Drop Test

§952(a)(4)

- Installation of equipment in the vicinity of the fuel tanks may invalidate the §952(a)(4) fuel tank drop test compliance

Option 1

Demonstrate added structure is not a contributing hazard to fuel tank

- **Dynamic Drop Test**
 - Direct Compliance
 - High Cost

Option 2

Demonstrate added structure is not a contributing hazard to fuel tank

- **Dynamic Analysis**
 - Correlation of model with a fully instrumented drop test
 - Only valid with close similarity to the reference drop test

Option 3

Remove interaction between installation and fuel tank

- **By Design**
 - Locate installation away from the fuel tank



External Loads / PCDS

§865

§865 is not applicable to External Fixtures:

- NO true jettison capability
- NO true payload capability

Cameras

Searchlights

Equipment box with fixed mass/cg

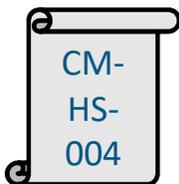


HUMAN EXTERNAL CARGO (HEC)

- 3.5g load factor, 30° angle to vertical
- Safety Factor ≥ 3 (if no static test)
- Fatigue evaluation §571 §573

NON HUMAN EXTERNAL CARGO (NHEC)

- 2.5g load factor, 30° angle to vertical
- Safety Factor ≥ 1.5
- Fatigue evaluation §571 §573 (hazard to rotorcraft)



Simple PCDS

AMC §865 Simplified method

Complex PCDS

§571 §573 Fatigue evaluation



Reverse Engineering:

HEC STC on a NHEC rotorcraft can be challenging

Safety Considerations, HEC



Never-exceed speed (VNE)

§1503,
§1505

- The operational never-exceed speed VNE should be not more than:
 - 0.9 times the VD speed analysed for structural strength
 - 0.9 times the speed flown for the vibration flight test
- Any restrictions should be clearly defined in the RFMS



Emergency Flotation

§563,
§802

§802 Emergency Flotation and AMC§802

Introduced at CS27/29 Amendment 5, Replaces AC 29 MG 10

Compliance to **§563 Structural Ditching and emergency flotation provisions** is necessary for emergency flotation

CS27 and CS29 \leq 9 passenger capacity:

Flotation units and attachments only

CS29 \geq 10 passenger capacity:

Rotorcraft

Resist capsize in sea conditions selected by applicant:

- Scale Model Testing with irregular waves
- Sea conditions defined by significant wave height and mean wave period

CS29: Rotorcraft will not sink following functional loss of any single complete flotation unit



Landing Gear (Skid)

§501,
§571

- Attachment of the device to landing gear cross-tube:
 - Static and fatigue consideration of flight loads introduced on the skid landing gear
 - Behaviour of the landing gear may be modified in the landing phase
 - Ground resonance mode may be modified (§241, §663)
 - Protection of cross-tube against degradation at attachment point (§609)



Additional Considerations – All STCs

- Influence on Global Rotorcraft:
 - Evacuation (Internal Installations)
 - Flammability (Internal Installations)
 - Interference
 - Compatibility with optional kits
 - Global loading on aircraft:
 - Impact on global fatigue
 - Aerodynamic influence on horizontal stabiliser, TR, fin from external installations
 - Check current ADs on variant



Conclusions

- Classification of change:
 - External Installations typically major
 - Internal Installations major if evacuation affected

- Requirement checklist → should be reviewed for each project

- External installation → location is important
(fuel tank drop test, loading, ground clearance, skid landing gear...)

- Impact on rotorcraft should not be forgotten



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Thank you for your attention!

Any questions....?

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An agency of the European Union

