PATRAM 2007, Miami

Drop Testing of the NCS 45

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Topics

1. Design of the NCS 45
2. Drop test program
3. Shock absorber design and puncture test
4. Horizontal drop and slap-down
5. Shear-off test
6. Delayed impact of content
7. Lead slump
Design of the NCS 45
Drop test program

- In total 19 drop tests in 8 sequences
- 9 m vertical flat onto each packaging end
- 9 m vertical oblique onto each packaging end
- 9 m horizontal and slap-down
- 9 m onto lid side at operating temperature
- 1 m onto the bar onto each packaging end
- 1 m onto the bar onto the side
- 1 m shear-off test
Drop test program

- 1:3 scale model
- Safety relevant parts scaled down accurately
- Conservative approach if not possible
- Damaged parts replaced (shock absorbers)
- Or repaired (load dummy)
- Tests carried out by BAM at drop test facility Berlin
- Instrumentation, measurements and drop test report by BAM
Puncture test

- Severe test for lids and openings
- Especially oblique orientations
- Drop height for scale models
- Sequence: before or after 9 m drop?
Shock absorber design and puncture

Penetration

No penetration
Horizontal and slap-down

Horizontal drop:  max. deceleration at center of gravity
Slap-down drop:  smaller deceleration at center of gravity
but larger deceleration at secondary impact
Horizontal and slap-down
Shear-off test
Shear-off test
Delayed impact of content

- Content hits inner side of packaging later than the packaging hits the target
- Reason: gap between content and inner side of packaging
- Important during oblique vertical drop test
- Might cause high stresses in closure system
- High deceleration of content
Delayed impact of content

![Graph showing elongation lid bolt and acceleration packaging body over time.](image-url)
Lead slump

Lead height: 4500 mm
Temperature: 100°C
Drop height: 9 m
Acceleration: 100 g
Impact side: lid
Result: no lead slump
Conclusions

- The shock absorbers protect the containment system against the bar
- The package design is adequate for all drop orientations
- The shear-off test does not cause unacceptable damage
- Delayed impact of the content is accounted for
- There is no lead slump