BMW GROUP

R134 WORST CASE APPROACH FOR SURFACE DAMAGE AND CHEMICAL EXPOSURE TEST.

BMW PROPOSAL AND EXAMPLES.

EA-610, EG-823

DEFINITION IN CURRENT REVISION DOCUMENT.

Annex 3, Paragraphs 3.3 to 3.4., amend to read:

"3.3. Surface damage test (unpressurized)

The surface damage tests and the chemical exposure tests (Annex 3, paragraph 3.4.) shall be conducted on the surface

....

Otherwise, the tests shall be conducted on the surface of the container attachments as indicated in Figure 2.

Note: In case, the CHSS contains more than one chamber design (e.g. different size or material) the Technical Service shall determine whether to conduct the test on each design or whether to use the worst-case approach. ~~**Examples of worst case situations are as follows: location where the wall thickness is smallest. Location where the cover is made of a different type of material (in this case a defect in any material), location where a different resin material is present. Location where the lowest strength of the windings can be expected. Etc.**~~

[e.g worst case based on chamber material, and/or geometric characteristics differentiation affecting the burst pressure performance.]

3.4. Chemical exposure and ambient-temperature pressure cycling test

Each of the 5 areas of the unpressurized container

...

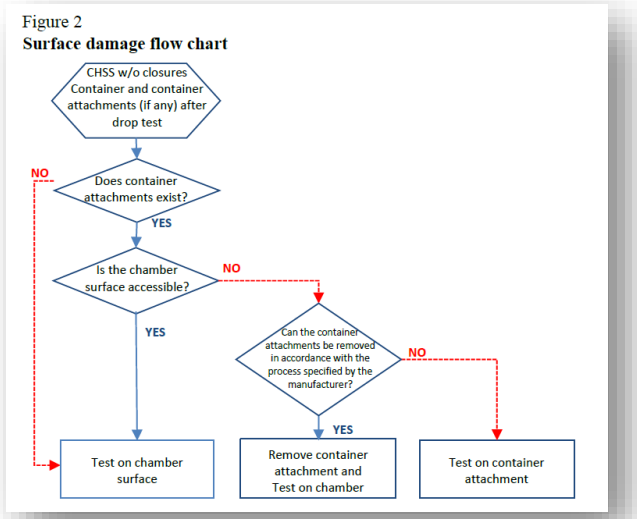
Table 3
Pressure cycles and conditions - chemical exposure and ambient temperature pressure cycling test

Purpose	*Number of cycles*	*Target Pressure*	*Temperature*	*Rate*
Chemical exposure and ambient temperature pressure cycling test (paragraph 5.2.4.)	60 per cent the specified number of cycles determined in paragraph 5.1.2.	≥ 125 per cent NWP	Environment: 20 ± 15 °C Hydraulic fluid: 20 ± 15 °C	≤ 10 cycles per minute
	of which the last 10 cycles	≥ 150 per cent NWP		

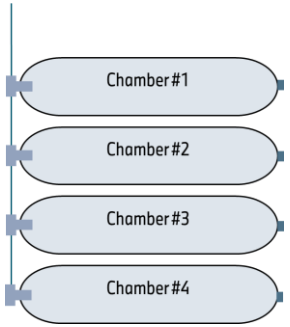
Note: In case, the CHSS contains more than one chamber design (e.g. different size or material) the Technical Service shall determine whether to conduct the test on each design or whether to use the worst-case approach." ~~**Examples of worst case situations are as follows: location where the wall thickness is smallest. Location where the cover is made of a different type of material (in this case a defect in any material), location where a different resin material is present. Location where the lowest strength of the windings can be expected. Etc.**~~ **or [e.g worst case based on chamber material, and/or geometric characteristics differentiation affecting the burst pressure performance.]**

→ The following slides will provide examples and explanations for worst case condition.

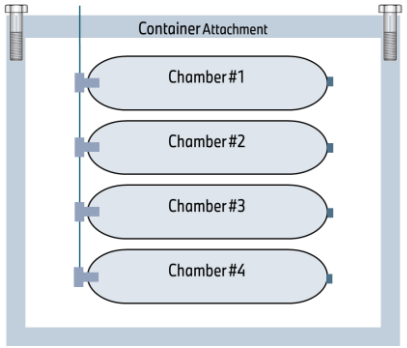
SURFACE DAMAGE FLOW CHART CONSIDERING CONTAINER ATTACHMENTS.



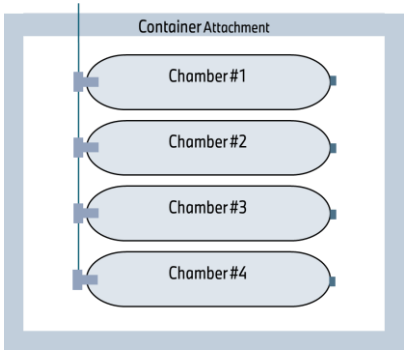
Container without any container attachments



Container with detachable container attachments



Container with undetachable container attachments



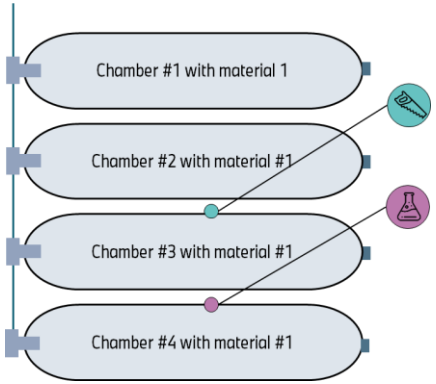
Symbol	Component
	Chamber
	Container Attachment
	T-Piece
	High pressure line
	Screw

CHAMBER CONFIGURATIONS.

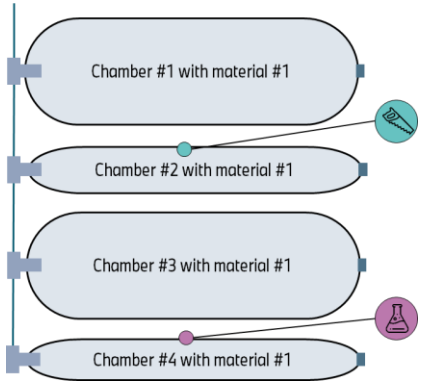
Premises:

- Container consists of several chambers.
- **All chambers are designed for the same burst pressure**
- Container attachments are removable and chamber surfaces are accessible.

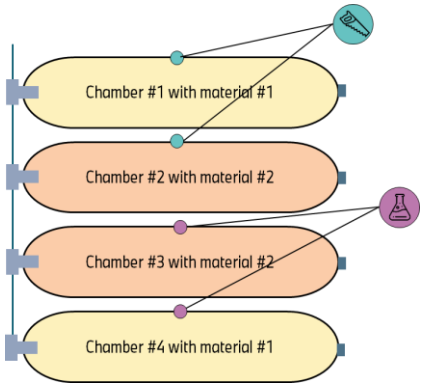
Chambers have same geometry and same material



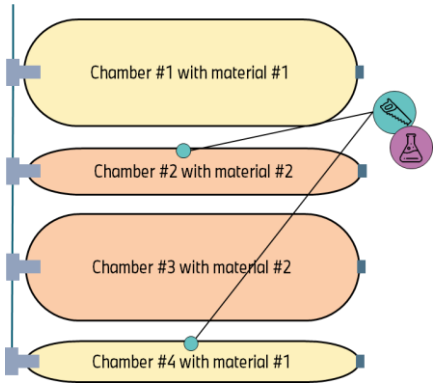
Chambers have different geometry and same material



Chambers have same geometry and different material

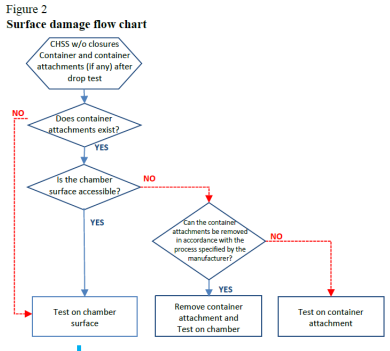


Chambers have different geometry and different material



Symbol	Position of test
	Position of pendulum impacts for chemical exposure
	Position of surface flaw test

FLOW CHART AMENDMENT CONSIDERING CHAMBER MATERIAL AND GEOMETRY.



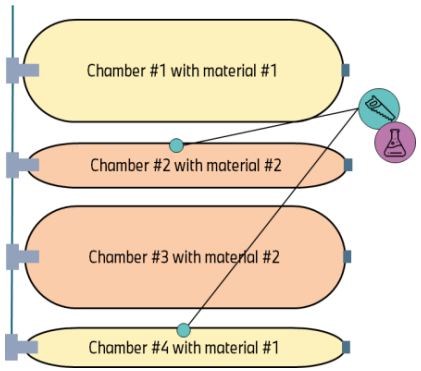
Do the chambers have different materials?

Yes

Do the chambers have different geometry (length>50%, diameter>20%)?

Yes

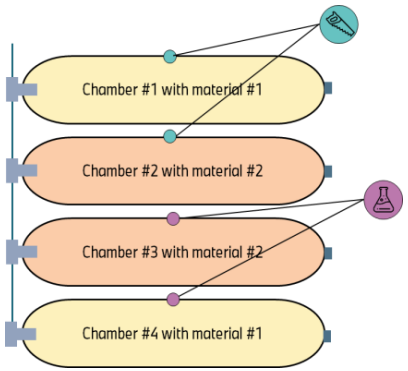
Tests shall be conducted on chambers with smallest diameter and for each material.



Chambers have different geometry and different material

No

Tests shall be conducted on the chambers selected by the technical service and for each material.



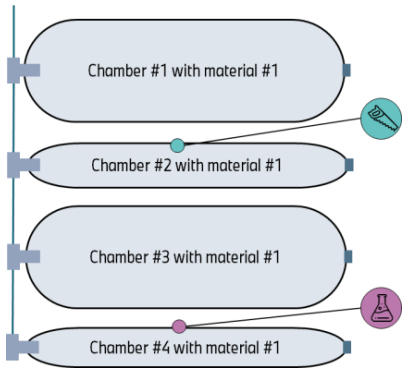
Chambers have same geometry and different material

No

Do the chambers have different geometry (length>50%, diameter>20%)?

Yes

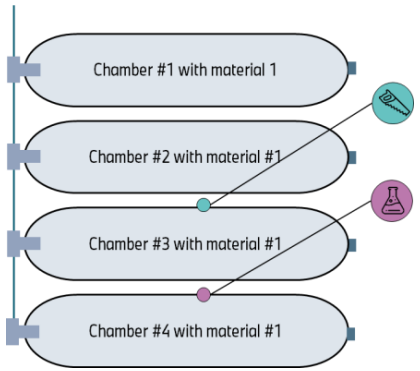
Tests shall be conducted on chambers with smallest diameter.



Chambers have different geometry and same material

No

Tests shall be conducted on one of the chambers selected by the technical service.



Chambers have same geometry and same material

TYPE OF MATERIAL AND GEOMETRY CHANGES.

Material change	Affecting burst pressure performance	Affecting chemical exposure performance	Comment
Fiber material	Yes	Yes	Test shall be conducted for each material.
Resin material	Yes	Yes	Test shall be conducted for each material.
Fire proof protection	No	Yes	Test shall be conducted for each material.
Glass fiber protection	No	Yes	Test shall be conducted for each material.

Geometry change	Affecting burst pressure performance	Affecting chemical exposure performance	Comment
Length ≤ 50%	Not significantly	No	Different geometry, but no significant influence on burst pressure → no additional testing necessary.
Length > 50%	Yes	No	Test shall be conducted for each geometry. See R134 table "change of design".
Diameter ≤ 20%	Not significantly	No	Different geometry, but no significant influence on burst pressure → no additional testing necessary.
Diameter > 20%	Yes	No	Test shall be conducted for each geometry. See R134 table "change of design".

R134 TABLE „CHANGE OF DESIGN“.

"Table 1
Change of Design

Changed Item		*Required Tests*
Metallic container or liner material		- Initial burst, Initial pressure cycle life - Sequential hydraulic tests - Fire test
Plastic liner material		- Initial pressure cycle life - Sequential hydraulic tests - Sequential pneumatic tests - Fire test
Fiber material [1]		- Initial burst, Initial pressure cycle life - Sequential hydraulic tests - Fire test
Resin material		- Initial burst, Initial pressure cycle life - Sequential hydraulic tests - Fire test
Diameter [2]	≤20%	- Initial burst, Initial pressure cycle life
	>20%	- Initial burst, Initial pressure cycle life - Sequential hydraulic tests - Fire test

Notes:

1. Change of fiber type, e.g., glass to carbon is not applicable. Change of design applies only to changes of materials properties or manufacturer within a fiber type.
2. Only when thickness change is proportional to diameter change.
3. Fire test is not required, provided safety relief devices or device configuration passed the required fire test on a container with equal or greater internal water volume.
4. Fire test required if coating affects fire performance.
5. Tests are not required if the stresses in the neck are equal to the original stresses or reduced by the design change (e.g., reducing the diameter of internal threads, or changing the boss length), the liner to boss interface is not affected, and the original materials are used for boss, liner, and seals.
6. Alternative valve shall be approved in accordance with part II.
7. Fire test not required if TPRD design has not been changed, and the mass of the changed valve is +/- 30 per cent of the original valve.

Changed Item		*Required Tests*
Length	≤50%	- Initial burst, Initial pressure cycle life - Fire test [3]
	>50%	- Initial burst, Initial pressure cycle life - Sequential hydraulic tests - Fire test [3]
Coating		- Sequential hydraulic tests - Fire test [4]
Boss [5]	Material, geometry, opening size	- Initial burst, Initial pressure cycle life
	Sealing (liner and/or valve interface)	- Sequential pneumatic tests
Fire protection system		- Fire test
Valve change [6]		- Sequential pneumatic tests - Fire test [7]
Container attachment	Material, geometry	- Sequential hydraulic tests - Fire test [7]