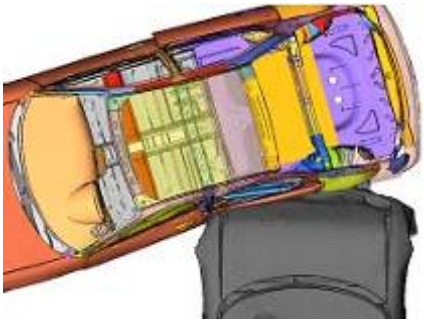
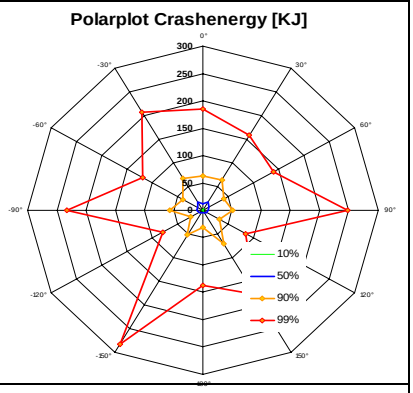
STORHY FINAL EVENT
HYDROGEN STORAGE SYSTEMS FOR AUTOMOTIVE APPLICATION
PSA POISSY, JUNE 3-4, 2008

Safety Assessment:
Crash-related Strength of Hydrogen Containments

Objectives



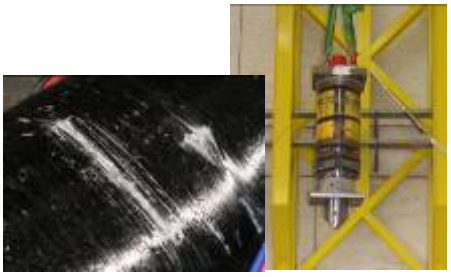
The probability of crash accidents can not be reduced to zero. Crash statistics like the GIDAS data base yield figures (see right) of crash energy depending on relevant parameters, e.g. the energy. Based on this, it is possible to calculate the crash loads on the hydrogen containments interacting with the chassis by finite element method analysis (FEMA).



Test Results

		Rear impact 100% offset	Rear impact 50% offset	Side impact
Crash energy and probability		160KJ 91%	160KJ 97%	150KJ 95%
Parallel	Velocity	6m/s (21.6km/h)	5.35m/s (19.3km/h)	4.3m/s (15.5km/h)
	Force	15KN (rear part)	15KN (rear part)	10KN (rear part)
	Energy	2.56KJ	2.62KJ	69J
Perpend.	Velocity	4m/s (14.4km/h)	5.88m/s (21.2km/h)	2.4m/s (8.6km/h)
	Force	55KN (side part)	45KN (side part)	80KN (side part)
	Energy	1.43KJ	3.3KJ	660J

Based on results of FEMAs (table left), impact tests with a drop mass (see right) on cylinders with hydraulic internal pressure of 50-100 bar peak pressure have been performed.

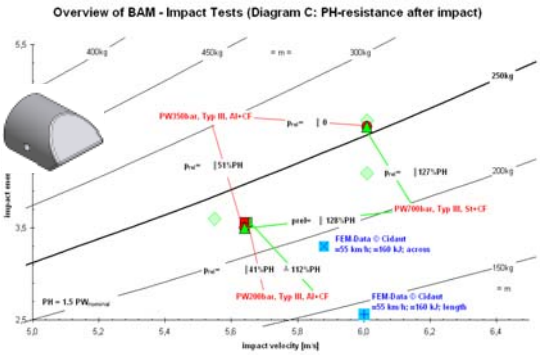


The used impact load parameters are representative for a vehicle speed of about 55 km/h. This speed can be related to the energy of about 95% of crash accidents with injuries in Germany (about 1% of cars per year). This means in total 0.05% of crash accidents are not covered.

The test campaign was finished by performing final burst tests after impact. The results are as follows:

- Specimens tested were Type III cylinders for 200 bar, 350 bar and 700 bar nominal working pressure, as shown in the figure to the right.
- The mandatory test pressure (150% of nominal working pressure) was not met by most of the specimens.
- The tested 700 bar cylinder design was the only Type III cylinder, which resisted the test loads.

This test procedure is relevant for cryogenic and solid storage, too. However, changes in requirements might be necessary due to major differences in the damage potential.



Future Perspectives

- Future regulations will have to explicitly cover the resistance of hydrogen storage containments under crash loads. For this purpose, the properties of the chassis and additional data have to be taken into account.
- It is proposed to perform impact tests on gas filled cylinders at 100% and e. g. 20% of nominal working pressure with a standardised impact mass. Used impact parameters shall be in line with addressed probability level, crash statistics, crash tests and FEMAs.

Partners	cidaut Centro de Investigación y Desarrollo en Automoción; BAM
Website	www.storhy.net
	The project partners wish to thank the European Commission for financial support of the Integrated Project StorHy– Hydrogen Storage Systems for Automotive Application (Contract No.: SES6-CT-2004-502667) within the 6th RTD Framework Programme.