SGS-1-6

Status of SAE FCV Safety Working Group Activities

Developing Systems-level Performance-based Standards for Hydrogen and Fuel Cell Vehicles (FCVs)

Presented by Phil Horton for
Glenn W. Scheffler, SAE WG Chairman

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FCV Safety Working Group

- **Documents published:**
  - SAE J1766 Post-crash electrical safety
  - SAE J2578 Fuel cell vehicles
  - SAE J2760 Hydrogen system terminology
- **Documents being revised:**
  - SAE J2578 Fuel cell vehicles
- **Documents being developed:**
  - SAE J2579 Vehicular hydrogen systems

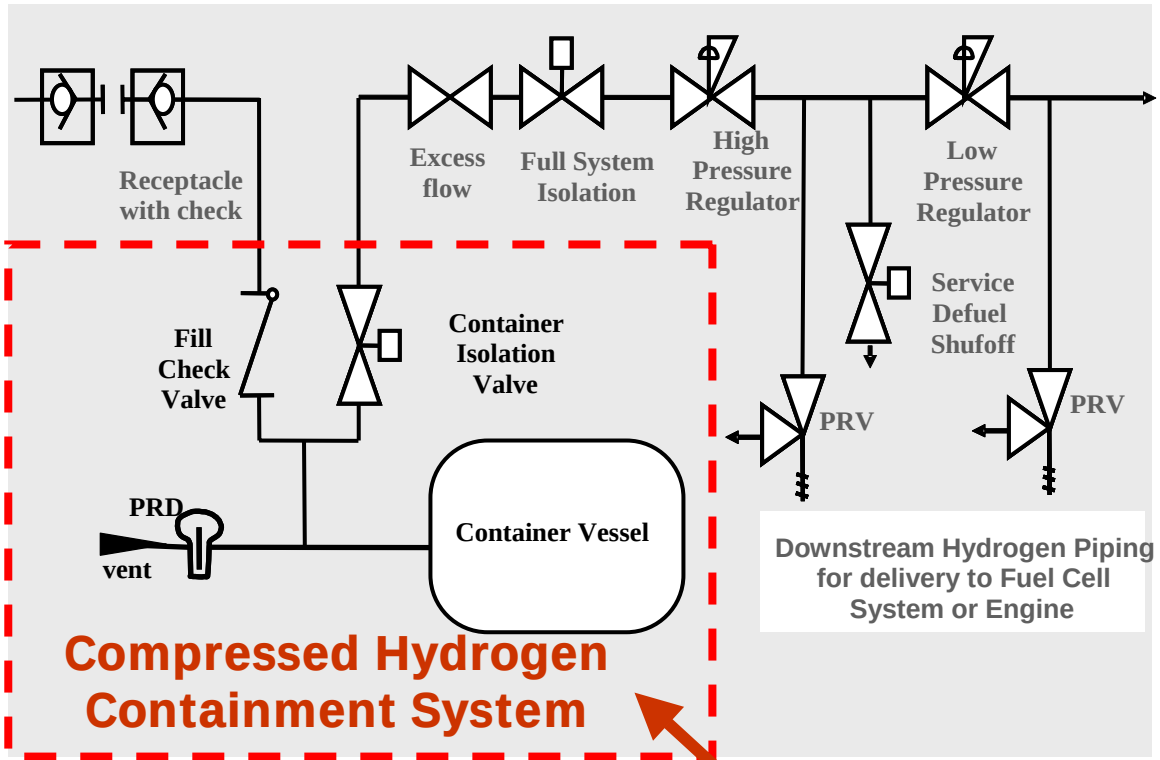
SAE J2578 and J2579

Principle of “Design for Safety”

- **No single failure should cause unreasonable safety risk to persons or uncontrolled vehicle behavior**
  - Fail-safe design
  - Isolation and separation of hazards to prevent cascading of events
  - Fault Management with staged-warning and shutdowns
- **Isolation and containment of stored hydrogen is required to practice fault management on hydrogen and fuel cell vehicles.**

SAE J2579: Vehicular Hydrogen Systems

Typical Vehicular Compressed Hydrogen System Addressed in SAE J2579



Includes all components and parts that form the primary pressure boundary for stored hydrogen

Isolates stored hydrogen from --

- the remainder of the fuel system
- the surrounding environment

SAE J2579: Vehicular Hydrogen Systems

Why the Focus on Systems-level Performance-based Requirements?

- Establishes clear expectations for the vehicle system based on foreseeable use
- Addresses all parts, connections, and interactions within the system
- Provides flexibility for future development
  - Does not dictate specific component or configurations
  - Avoids arbitrary flow down of requirements to components
- Ensures direct connection to requirements for the targeted vehicle applications
  - Standard
  - Heavy-duty commercial

SAE J2579: Vehicular Hydrogen Systems

Systems-level Performance-based Requirements for the Compressed Hydrogen Containment Systems

- Bridging the gap in different terminology and design practices
  - Hydrogen containers and equipment on the vehicle
  - Pressure vessel and piping codes on filling stations
- Verification tests for foreseeable use
  - Expected Service Performance
  - Durability under Extended Usage and Extreme Conditions
  - Performance under Service-terminating Conditions

SAE J2579: Vehicular Hydrogen Systems

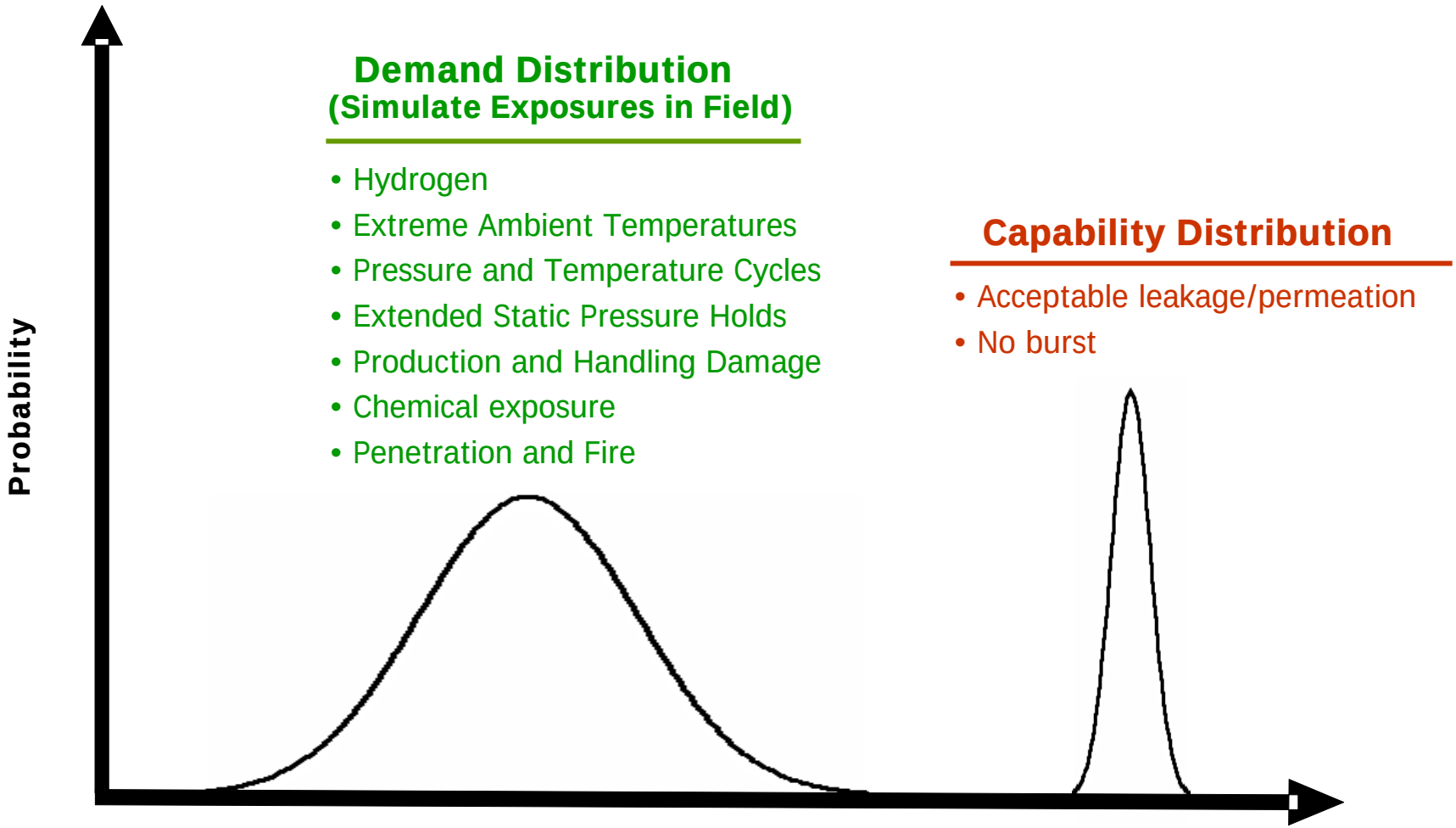
Bridging the Gap in Terminology and Design Practices

Pressure Vessel Terminology	Terminology Used in J2579 to "Bridge the Gap"	Container Terminology
Ultimate Strength (Greater than 3-5 X MAWP)	← **Ultimate Strength** →	Burst Pressure (Greater than 1.8 X NWP or SP)
Secondary Relief Fault Management (less than 1.2 x MAWP)	← **Maximum Developed Pressure (MDP)**	
Primary Relief Fault Management (less than 1.1 x MAWP)	***MDP*** ***for Filling Station Faults*** →	1.5 X NWP (or SP)
Maximum Allowable Working Pressure (MAWP)	← **Maximum Allowable Working Pressure (MAWP)**	
Relief Device Setpoint	← **Initiation of Fault Management by Relief Device(s)** (Relief Device Setpoint) →	1.38 X NWP (or SP) (Fill station fueling relief valve setpoint)
	Initiation of Fault Management by Dispenser →	1.25 X NWP (or SP) (Principal fault protection during fueling)
Maximum Operating Pressure (MOP)	← **Maximum Operating Pressure (MOP)** **or** **Maximum Fill Pressure** →	1.25 X NWP (or SP)
	Nominal Working Pressure (NWP) →	Service Pressure (SP) or Working Pressure

Information on this page is still under development by the SAE FCV Safety Working Group and should not be used until officially approved and published.

SAE J2579: Vehicular Hydrogen Systems

Verification of Compressed Hydrogen Containment Systems



SAE J2579 Development Plan

- **4Q 2007: Complete TIR J2579 and have ready for ballot.**
  - Reference-able document of system-level, performance-based verification
  - Provide appropriate guidance for system design and installation
  - Baseline for verification testing during 2007-2009 Demonstration Phase

- **2007 - 2009: Develop and confirm test methodologies**
  - Gain experience with tests and demonstrate effectiveness
  - Develop options for reduced or decoupled testing
  - Investigate localized fire requirements and methods

- **4Q 2009: Revise J2579 and re-ballot as a Recommended Practice *or* a Standard**
  - Include findings and results of activities conducted in 2007-2009
  - Provide a basis for national and global requirements

SAE J2578: Fuel Cell Vehicles (FCVs)

Key Updates for Upcoming Revision

- Improving methods to measure post-crash hydrogen loss
  - Allowable based on FMVSS 301 (gasoline)
  - Approach based on FMVSS 303 (CNG)
- Harmonizing electrical system safety with ISO TC22/SC21
- Expanding and improving methods to evaluate hydrogen discharges

SAE J2578: Management of Electrical Issues

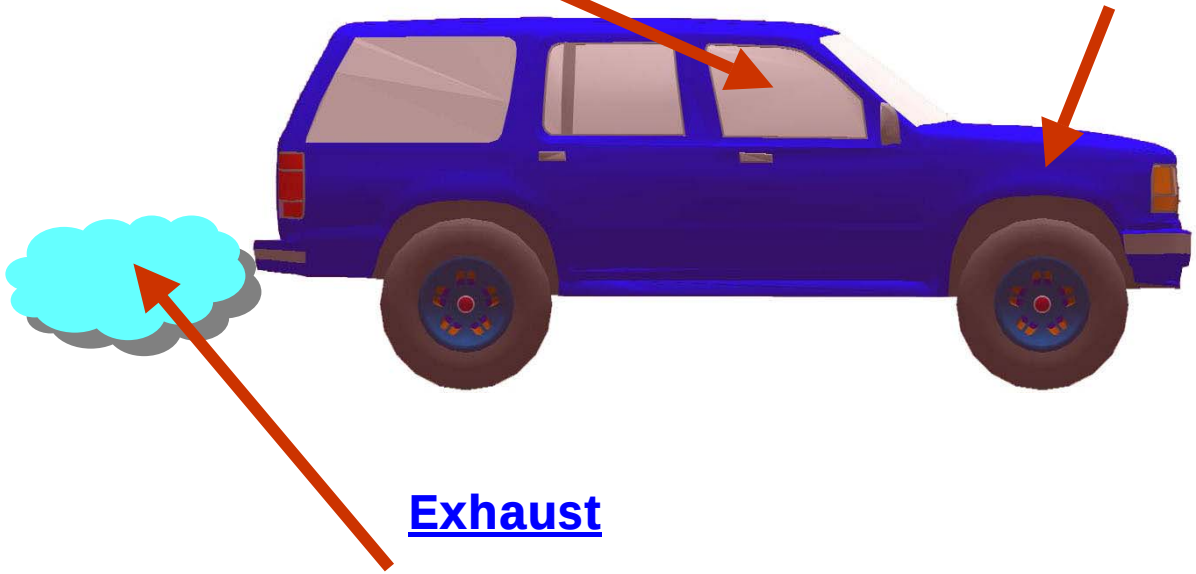
Based on Existing Electric Vehicle (EV) Standards and on-going harmonization activities with ISO TC22/SC21

- Electrical isolation
- High voltage dielectric withstand
- High voltage wire and connectors
- Over-current protection
- Labeling and access to live parts
- Automatic disconnects
- Manual disconnect functions

SAE J2578: Management of Hydrogen Discharges

Passenger Compartment
Less than 25% LFL

Other Compartments
Non-Flammable



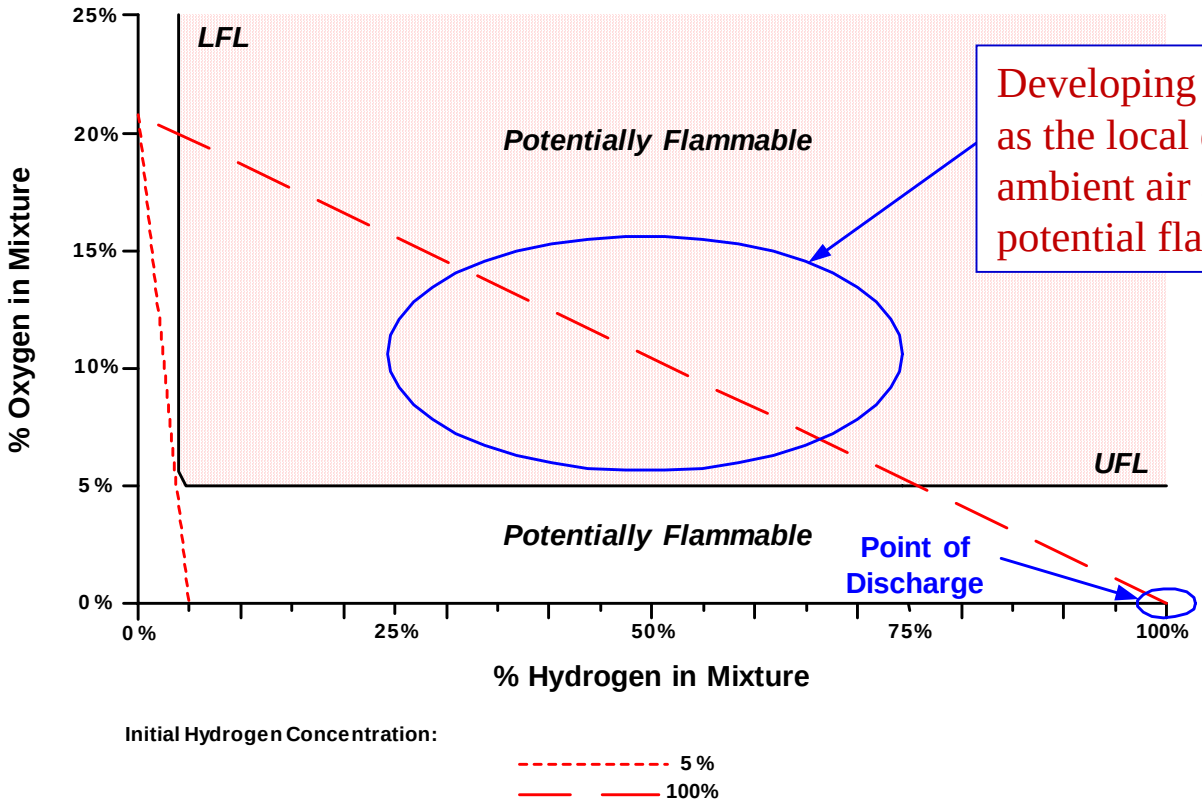
Exhaust

1) Locally non-hazardous *and*

2) Less than 25% LFL in general surroundings

SAE J2578: Management of Hydrogen Discharges

Evaluation of Local Region as Discharge Disperses into Ambient Air



Developing method to evaluate ignitability as the local discharge disperses into ambient air and passes through region of potential flammability

SAE J2578: Management of Hydrogen Discharges in General Surroundings

Situations Being Addressed

	Condition Being Simulated		
Vehicle Operating State	**Minimally-ventilated Residential Garage**	**Mechanically-Ventilated Structure**	**Outdoor on a Still Day**
Parked	●	●	***Not Necessary***
Idling	***Being Developed***	●	●