



OICA

Transmitted by experts of OICA

SIG on Thermal Propagation

Proposed Procedure for the Assessment of
Smoke in the context of Vehicle Type
Approval according to UN ECE R 100 Part I

30 January 2024



Background

UN ECE R100.03, Article 6.15.1

“The REESS or vehicle system shall provide a signal to activate the advance warning indication in the vehicle to allow egress or 5 minutes prior to the presence of a hazardous situation inside the passenger compartment caused by thermal propagation which is triggered by an internal short circuit leading to a single cell thermal runaway such as fire, explosion or smoke.”



UN ECE R 100.03 requires manufacturers to assess the risk of *hazardous situations inside the passenger compartment* caused [...] by smoke.



Smoke Assessment

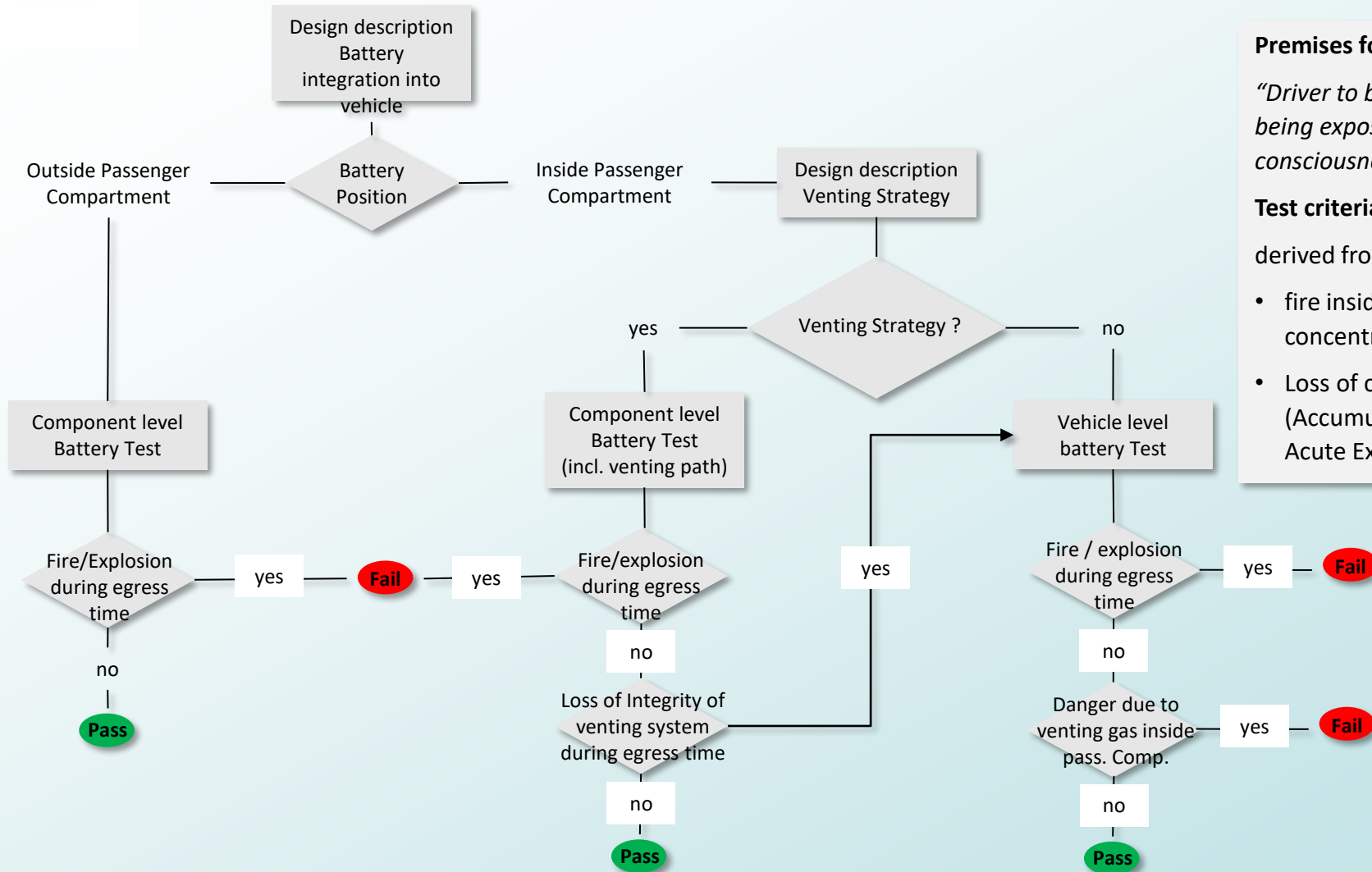
➤ Premises

- Assessment of smoke from the battery directly entering the passenger compartment during egress* time.
(re-entering smoke and smoke from the environment are out of scope)
- Assessment to respect integration of battery into vehicle
(Smoke assessment to be subject of UN R 100 Part 1)
- Neither the presence of smoke nor the visual perception of smoke are fail-criteria.
(Critical substances like CO are invisible)
- Hazards coming from smoke are
 - CO-Concentration (impediment of consciousness, capability to leave the vehicle self-controlled).
 - H₂-Concentration (potential risk of fire or explosion).
 - Other hazards (e.g. opacity) can be controlled or neglected prior to egress.

*Egress means the entire duration of the warning interval; either 5 min or egress time according to manufacturer's risk assessment.



Smoke Assessment Procedure



Premises for smoke testing

“Driver to be able to leave the vehicle during egress time without being exposed to hazards and without impediment of consciousness.”

Test criteria

derived from most prominent hazards during egress time:

- fire inside the passenger compartment due to a hydrogen concentration exceeding the **Lower Flammability Limit LFL[H₂]**.
- Loss of consciousness due to exposure to carbonmonoxid. (Accumulated CO exposure value for egress time according to Acute Exposure Guideline (AEG) Level 2/10 min).

Criterion for integrity of venting system

- Visible smoke escaping the intended venting path outside the intended openings during egress time.



Smoke Test on Vehicle Level

➤ Premises

- Vehicle-off/no active ventilation (worst case)
- Sampling Position:
 - H₂ according to R134
 - CO at the seating position of the driver and at one rear passenger position.
- Analyser: standard mobile electrochemical gas-sensors
(standard devices for rescue forces, several products available on the market)
- Measurement criteria:
 - $\Sigma[\text{CO}]/10\text{min} = 252.000 \text{ ppms}$
(according to Acute Exposure Guideline (AEGl), AEGl-Level 2 for CO)
 - LFL [H₂] = 4 vol. %
(Lower Explosion Limit of Hydrogen)



Acute Exposure Guideline

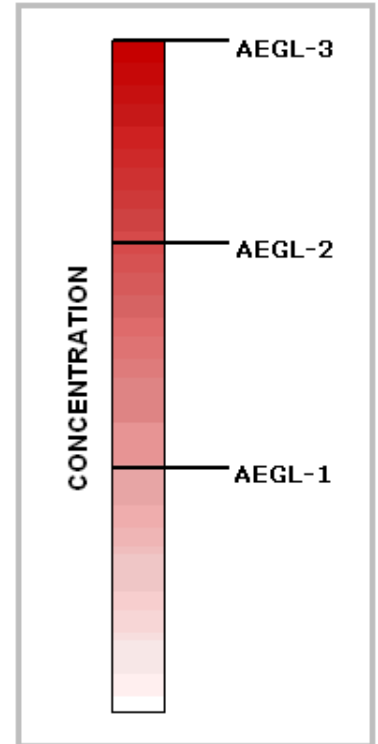
➤ Exposure Levels (AEGL)

What are AEGLs?

AEGLs estimate the concentrations at which most people—including sensitive individuals such as old, sick, or very young people—will begin to experience health effects if they are exposed to a hazardous chemical for a specific length of time (duration). For a given exposure duration, a chemical may have up to three AEGL values, each of which corresponds to a specific tier of health effects. The three AEGL tiers are defined as follows:

- **AEGL-3** is the airborne concentration, expressed as parts per million (ppm) or milligrams per cubic meter (mg/m^3), of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.
- **AEGL-2** is the airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.
- **AEGL-1** is the airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.

All three tiers (AEGL-1, AEGL-2, and AEGL-3) are developed for five exposure periods: 10 minutes, 30 minutes, 60 minutes, 4 hours, and 8 hours. The table below shows how the chlorine AEGL values vary with exposure duration.





Test Criterion CO

➤ Airborn Concentration over 10 min Exposure Interval

- With respect to toxicity one of the most prominent components in venting gas.
- Assumption: other critical substances (*according to ISO 13571 ("Life-threatening components of fire")*) are represented by the lead-parameter CO-Concentration.
- Unlike other critical substances CO cannot be sensorially perceived by man.
- CO does have a strong effect on human consciousness.
- CO-Measurement is simple and precise.

Pass-Fail Criterion

- Accumulated CO-Concentration over egress time < AEGL-2-10min accumulated exposure Value
(AEGL-2-10min. = 420 ppm * 10 min = 252.000 ppms)