Explanation of Japan proposal for Pass/Fail criteria of smoke

Acceptance of Alternative Safety Validation Method to “visual inspection”

SIG Meeting in January, 2024

JPN9	380	(6.15.3.4) Add a statement implying the following intention: 'Other appropriate safety proofs may be applied where small amounts of smoke ingress into the cabin are visually observed or anticipated.'	Add text below. **In the case that smoke is observed inside a passenger compartment, The manufacturer will provide the authority responsible for approval with information there is not the presence of a hazardous situation inside the passenger compartment caused by smoke.** **The requirements are deemed to be satisfied, if the Type Approval Authority accept this.**	Issue 10: "smoke assessment" JP to provide further input.

6.15.3.4 Pass/fail criteria for physical thermal propagation test

During the egress or 5 minutes after the activation of the warning indication, there shall be no evidence of:

(a) Fire

(b) Explosion

(c) **Smoke** inside the passenger compartment

- - -

The evidence of hazardous condition inside the occupant compartment shall be verified by **visual inspection** without disassembling any part of the Tested-Device or the vehicle.

[In the case that smoke is observed inside a passenger compartment, the manufacturer will provide the authority responsible for approval with ***information there is not the presence of a hazardous situation*** inside the passenger compartment caused by smoke. The requirements are deemed to be satisfied, if the Type Approval Authority accept this.]

Japan's Homework: Providing further explanation.

- Specific criteria of “visual inspection” are below.
  - No smoke is observed in the cabin. → “Pass”
  - Smoke even if it is only a little is observed in the cabin. → Fail

Issue

“Smoke” can be observed when the cabin is still no hazardous.
- A safe vehicle that was certified “Pass” with UNR100-3’s documentation approach may end up being judged “fail” with the criteria of “visual smoke”.

- In terms of “Technology Neutral”, appropriate safety validation methods other than “visual inspection” should also be accepted.

- Validation methods should not be limited considering technology advancement. Any appropriate methods, if any, are covered by the text proposed by Japan.

- As the flexibility of methods is also important. There is no need to specify the details of each method in UNR100.

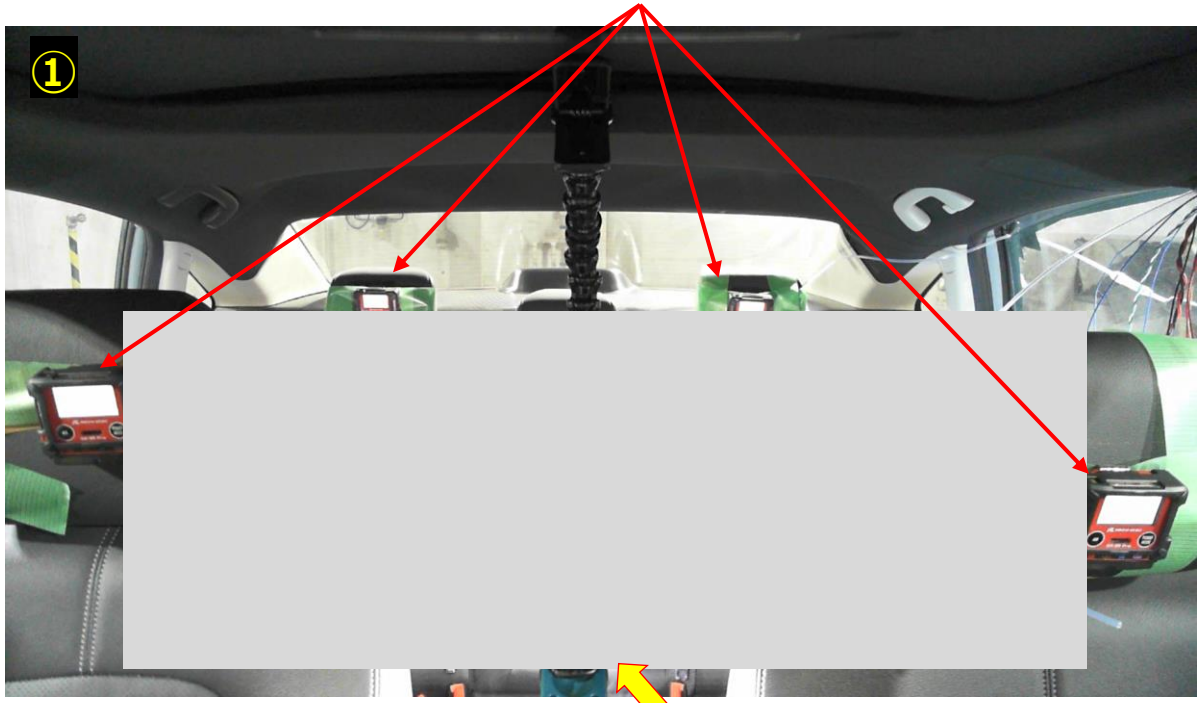
Example of Validation Method instead of “Visual Inspection”

Concept

Gas concentration in the cabin is measured during vehicle tests. If the cabin can be proved not hazardous, the vehicle can pass the thermal propagation test even when a little smoke is observed.

Step 1:Vehicle test

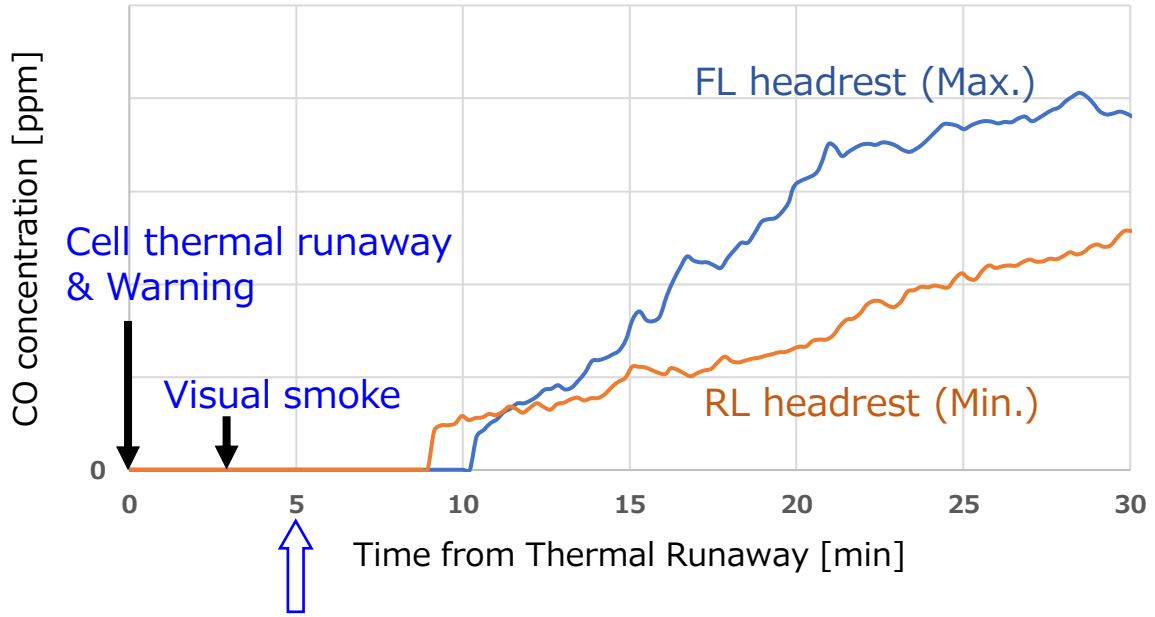
Four CO Gas sensors are installed on headrests



Trigger method: External heater

Visual smoke

CO concentration



No CO concentration (almost 0ppm)

Smoke can be observed, but CO concentration is almost 0ppm at 5 min after the warning.

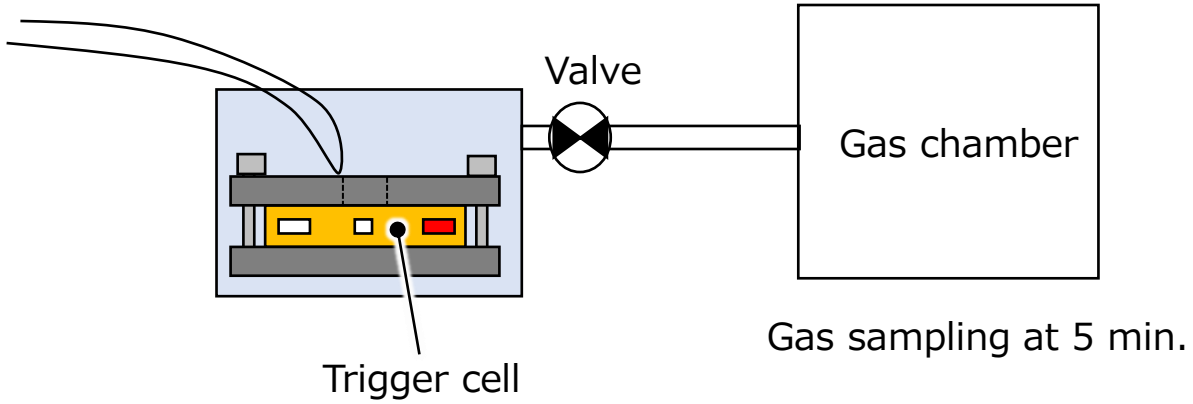
Issue: Is hazardousness of other gases no problem?

Validity of Safety Judgement by CO concentration in the cabin

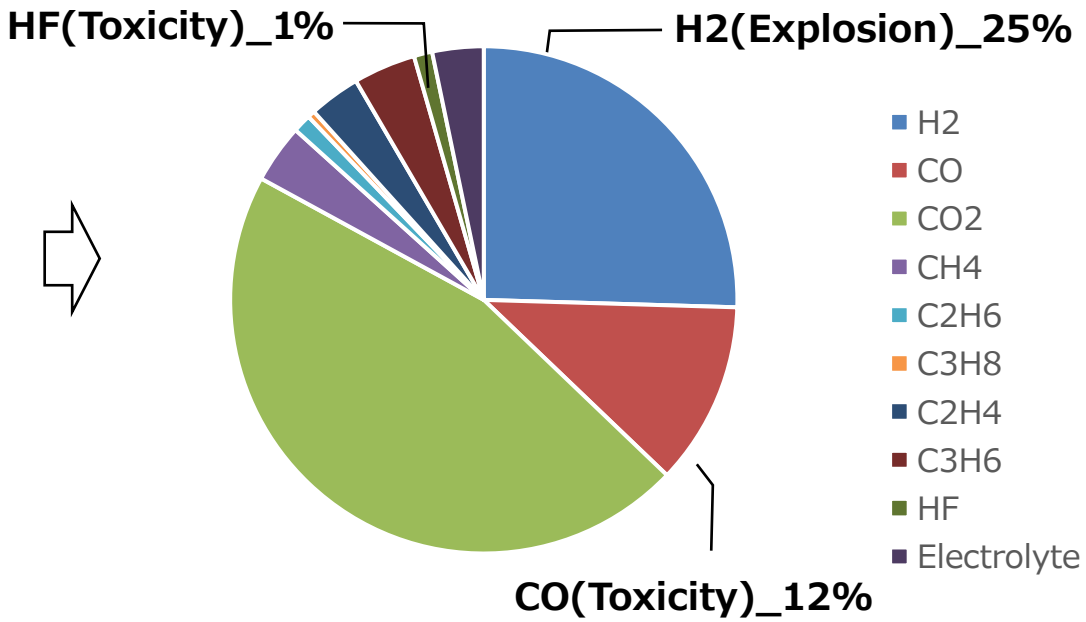
Portion of hazardous gases during thermal runaway can be identified by a cell test.

Step 2: Cell test and gas analysis

Cell thermal runaway with Heater method



Portion of Generated Gas Component



Portion of hazardous gases are clarified.

Safety analysis

Risk level of CO in the generated gas during thermal runaway is higher than HF and H2.
→ When CO in the cabin is not hazardous, HF and H2 are also not hazardous.

Acute Exposure Guideline Level
CO
(12% of total generated gas)

Carbon monoxide 630-08-0 (Final)					
ppm					
	10 min	30 min	60 min	4 hr	8 hr
AEGL 1	NR	NR	NR	NR	NR
AEGL 2	420	150	83	33	27
AEGL 3	1,700	600	330	150	130

Hazard classification of CO concentration in the air.

Same risk level

Calculated HF concentration in the air.

HF
(1% of total generated gas)

35.0	12.5	6.9	2.8	2.3
141.7	50.0	27.5	12.5	10.8

HF concentration does not reach the same risk level of CO.

Risk level: CO > HF

Hydrogen fluoride 7664-39-3 (Final)					
ppm					
	10 min	30 min	60 min	4 hr	8 hr
AEGL 1	1	1	1	1	1
AEGL 2	95	34	24	12	12
AEGL 3	170	62	44	22	22

Calculated H2 concentration in the air.

H2
(25% of total generated gas)

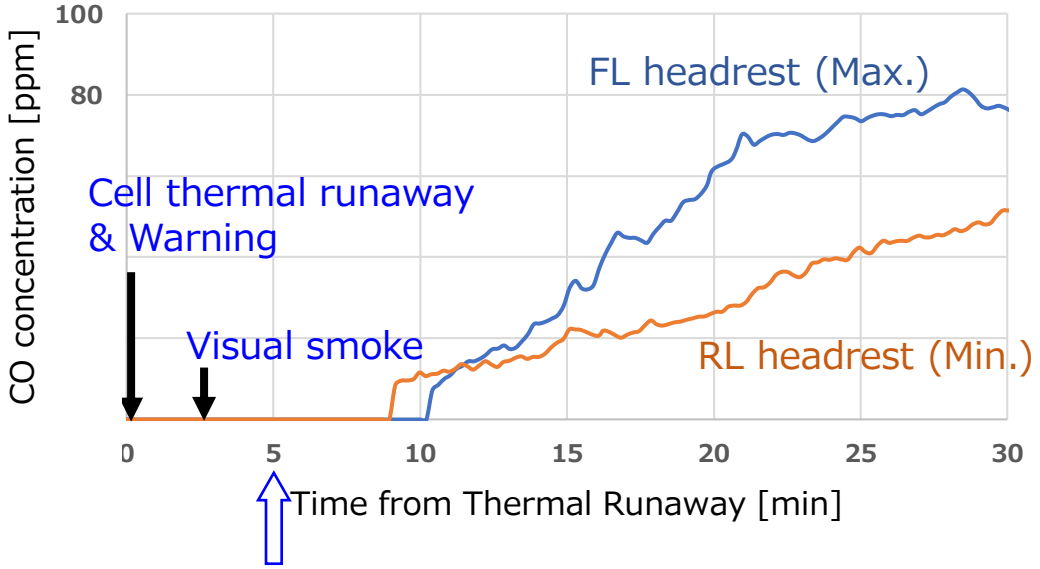
875.0	312.5	172.9	68.8	56.3
3541.7	1250.0	687.5	312.5	270.8

H2 concentration is much less than lower explosion limit of 4% (40000ppm).

Risk level: CO > H2

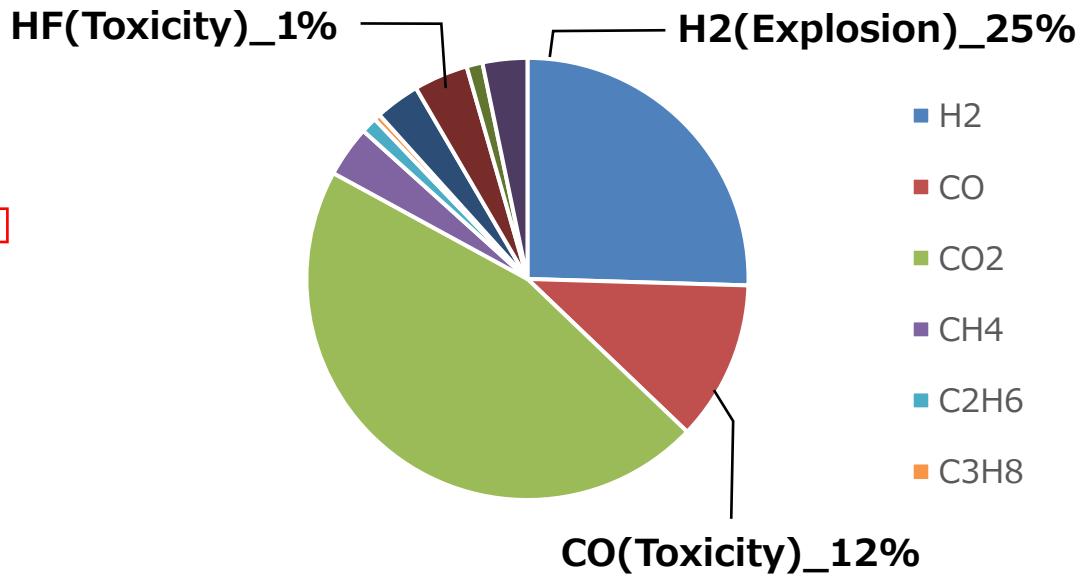
Summary

Vehicle Test



No CO concentration (almost 0ppm)

Cell Test



Conclusion

Though a little smoke is observed, gases in the cabin are not hazardous within 5 min after the warning.

Gas measurement is mentioned with [ ] in the current draft.

* It is not a Japan proposal.

Annex 9K Thermal propagation test

4.1. The following information shall be recorded during the test and during the observation period. All data measurement systems shall be referenced to the same starting time.

(a) Identification of the test method, including the trigger method, and a description of the test set-up;

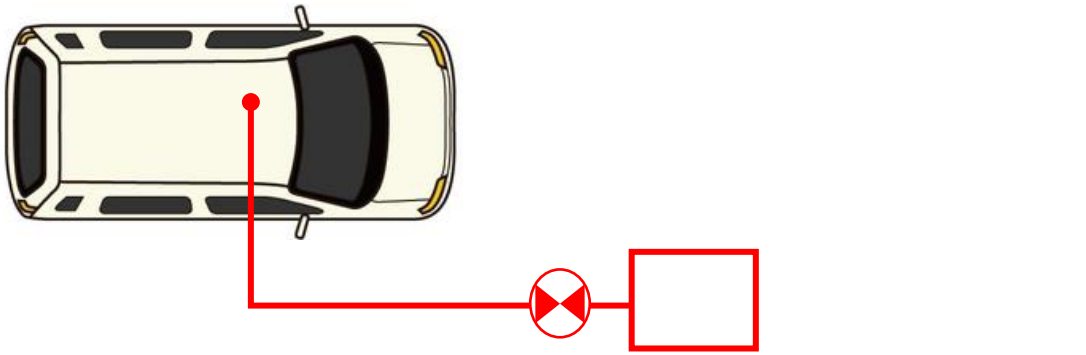
(b) - - -

(j) If the test is performed on vehicle level, the time stamp of warning indications or alarms to occupants.

[e.g. battery management system live-data, additional temperature measurement with distributed sensors at the battery surface and at the venting port, infrared temperature video, weight loss of target cell, **multi-gas measurement inside the vehicle** for relevant flammable and toxic gases e.g. CO, H2, CH4 and VOCs.]

Option 1: Direct gas analysis at vehicle test

Gas in the cabin during the vehicle test is collected, and then, analyzed.



Option 2: Test without alternative validation methods

If a manufacturer has a confidence about “No Visual Smoke” during a vehicle test, “Visual Inspection” can be a sole validation method for the vehicle test.

Overview

Acute Exposure Level Guidelines (AEGLs) are used by emergency planners and responders worldwide as guidance in dealing with rare, usually accidental, releases of chemicals into the air. AEGLS are expressed as specific concentrations of airborne chemicals at which health effects may occur. They are designed to protect the elderly and children, and other individuals who may be susceptible.

AEGLs assigned 1, 2 or 3 according to severity of effects

AEGLs are calculated for five relatively short exposure periods – 10 minutes, 30 minutes, 1 hour, 4 hours, and 8 hours – as differentiated from air standards based on longer or repeated exposures. AEGL “levels” are dictated by the severity of the toxic effects caused by the exposure, with Level 1 being the least and Level 3 being the most severe.

All levels are expressed as parts per million or milligrams per cubic meter (ppm or mg/m^3) of a substance above which it is predicted that the general population could experience, including susceptible individuals:

Level 1

•Notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.

Level 2

•Irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

Level 3

•Life-threatening health effects or death.