Introduction to a revision of OIML R139 to accommodate hydrogen metering systems for motor vehicles

National Metrology Institute of Japan (NMIJ)

Toshiyuki Takatsuji

November 2016
Current situation and future plan of FCV and HRS in Japan

The government expects the market of FCV (Fuel Cell Vehicles) to expand with support of a network of HRSs (Hydrogen Refueling Stations). The HRSs utilize renewable energy which also contributes to reducing the total amount of CO$_2$ emission.

Achievements:

- Feb. 2002 The first HRS was demonstrated for operation.
- July 2014 The first commercial HRS became in service.
- Dec. 2014 The first commercial FCV (Toyota MIRAI) was put into the market.
- Mar. 2016 Eighty-two HRSs are running in the four metropolitan areas.
- Mar. 2016 New FCV (Honda CLARITY FUEL CELL) went on sale.
- May 2016 Japan Industrial Standard B8576 (Hydrogen metering system for motor vehicles) was published.

Future:

- by 2025 The industry plans a new scenario to realize a sustainable market of FCV and HRS (320 HRSs and 0.2 million FCVs).
Japan Industrial Standard (JIS) B8576:2016
“Hydrogen metering system for motor vehicles”

Published on May 20, 2016

Scope: Measuring systems
- for refueling of motor vehicles with compressed hydrogen gas
- installed at hydrogen refueling stations
- used for transaction or certification

New technical aspects:
1. Four accuracy classes of MPE from 2% to 10%
2. Compensation of de-pressurization loss
3. On-site inspection
1. Accuracy classes of MPE

<table>
<thead>
<tr>
<th>Accuracy class</th>
<th>MPE</th>
<th>MPE in service</th>
<th>Scale interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1.5 %</td>
<td>2 %</td>
<td>0.001 – 0.005 kg</td>
</tr>
<tr>
<td>3</td>
<td>2 %</td>
<td>3 %</td>
<td>0.005 – 0.01 kg</td>
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<tr>
<td>5</td>
<td>4 %</td>
<td>5 %</td>
<td>0.01 – 0.02 kg</td>
</tr>
<tr>
<td>10</td>
<td>8 %</td>
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<td>0.01 – 0.02 kg</td>
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</tbody>
</table>
New technical aspects in JIS B8576:2016

2. Compensation for hydrogen de-pressurization loss

Where,

\[ C = M \sum \left( \frac{PV}{RF{T}} \right) \]

- \( C \): Amount of hydrogen loss due to de-pressurization (g)
- \( M \): Hydrogen molecular mass (g/mol). In this standard, 2.016 shall be used.
- \( \Sigma \): Summation over the depressurization area
- \( P \): Normal operation pressure of hydrogen (MPa)
- \( V \): Inner volume of the hydrogen conduit in the depressurization area (cm³)
- \( R \): Gas constant (J/K·mol). In this standard, 8.31446 is used.
- \( f \): Compressibility factor (-)
- \( T \): Temperature of hydrogen in the depressurization area (K)
De-pressurization loss

➢ At the end of re-fueling, the pressure in the measuring system reaches up to 82 MPa.
➢ For safety reason, the pressure in “Depressurization area” must be reduced before decoupling the nozzle from the vehicle by releasing the hydrogen to atmosphere.
➢ The amount of the discharged hydrogen is called “de-pressurization loss”. It is already measured by the meter but is not supplied into the vehicle.
➢ In Japan, the typical value of this loss is 10 to 50 g, which is not negligible.
New technical aspects in JIS B8576:2016

3. On-site inspection for complete measuring system

- Measurement method: Gravimetric
- Test sequence
  1. Fill the empty tank to maximum pressure ($P_v$)
  2. Compare the indication with the measured mass
  3. Depressurize the tank down to $0.7P_v$
  4. Fill the tank up to $P_v$
  5. Compare the indication with the measured mass
- Interval: Two years
Proposal for revising R139

Why is current R 139 not sufficient for hydrogen?

• Differences in some physical/technical characteristics between CNG and hydrogen dispensers
  – High pressure up to 82 MPa.
  – Low temperature down to minus 40 deg C.
  – Significant de-pressurization loss

R 139 should be revised adding an annex or an amendment for hydrogen dispensers.
Approved at CIML meeting

• The proposal was approved at the 51st CIML meeting in October 2016 as a new project.

• Japan and Netherlands have indicated to become the co-conveners of this revision project under TC 8 / SC 7.

• A questionnaire has been posted on the OIML TC 8/SC 7 workspace to collect and organize some technical information in advance.
Accuracy classes to be proposed to the revision

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Tentative plan

|-----------|------|------|------|------|------|-----------|------|------|------|-----|------|

- New project proposal
- Approval at CIML meeting
- Establishment of project group (Six P-members)
- Preparation of Frame work
- Meeting in Japan
# OIML TC 8/SC 7: Gas metering

## TC 8/SC 7: Gas metering

### BIML Contact

Mr. Luis Mussio

### Secretariat

**NETHERLANDS**

Mr. George Teunisse

### Participating members (25)

- **AUSTRALIA**
- **AUSTRIA**
- **BELGIUM**
- **CANADA**
- **CZECH REPUBLIC**
- **DENMARK**
- **FRANCE**
- **GERMANY**
- **IRAN**
- **JAPAN**
- **KOREA (R.)**
- **NETHERLANDS**
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- **POLAND**
- **ROMANIA**
- **RUSSIAN FEDERATION**
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- **SLOVAKIA**
- **SOUTH AFRICA**
- **SPAIN**
- **SWEDEN**
- **SWITZERLAND**
- **TURKEY**
- **UNITED KINGDOM**
- **UNITED STATES**

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- **ARGENTINA**
- **CROATIA**
- **CUBA**
- **FINLAND**
- **HUNGARY**
- **IRELAND**
- **LIBERIA**
- **NORWAY**
- **SLOVENIA**
- **TANZANIA**
TC 8/SC 7/p 7 Workspace

Revision of R 139
Proposal phase: Project Approved; project group forming
Comment: Revise OIML R 139 to address fuel dispensers used to provide compressed gaseous hydrogen fuel for motor vehicles. OIML Members have until 3 February 2017 to confirm or request to the BIML a P-member status on this PG.

**BIML Contact**
Mr. Luis Mussio

**Convener**
JAPAN
Toshiyuki Takatsuji
NETHERLANDS
Mr. George Teunisse

- **Current files and documents**
- **Archived files and documents**
- **Information for meetings**

**Add document**  **Add subgroup**  **Send email to the participants**

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Thank you for your attention.