

MetroHyVe 2

Online Workshop on the harmonization of verification periods for Hydrogen Refuelling Station in Europe

Oct. 11, 2023

## **Experience with field verification of hydrogen dispensers in Japan**

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# Introduction

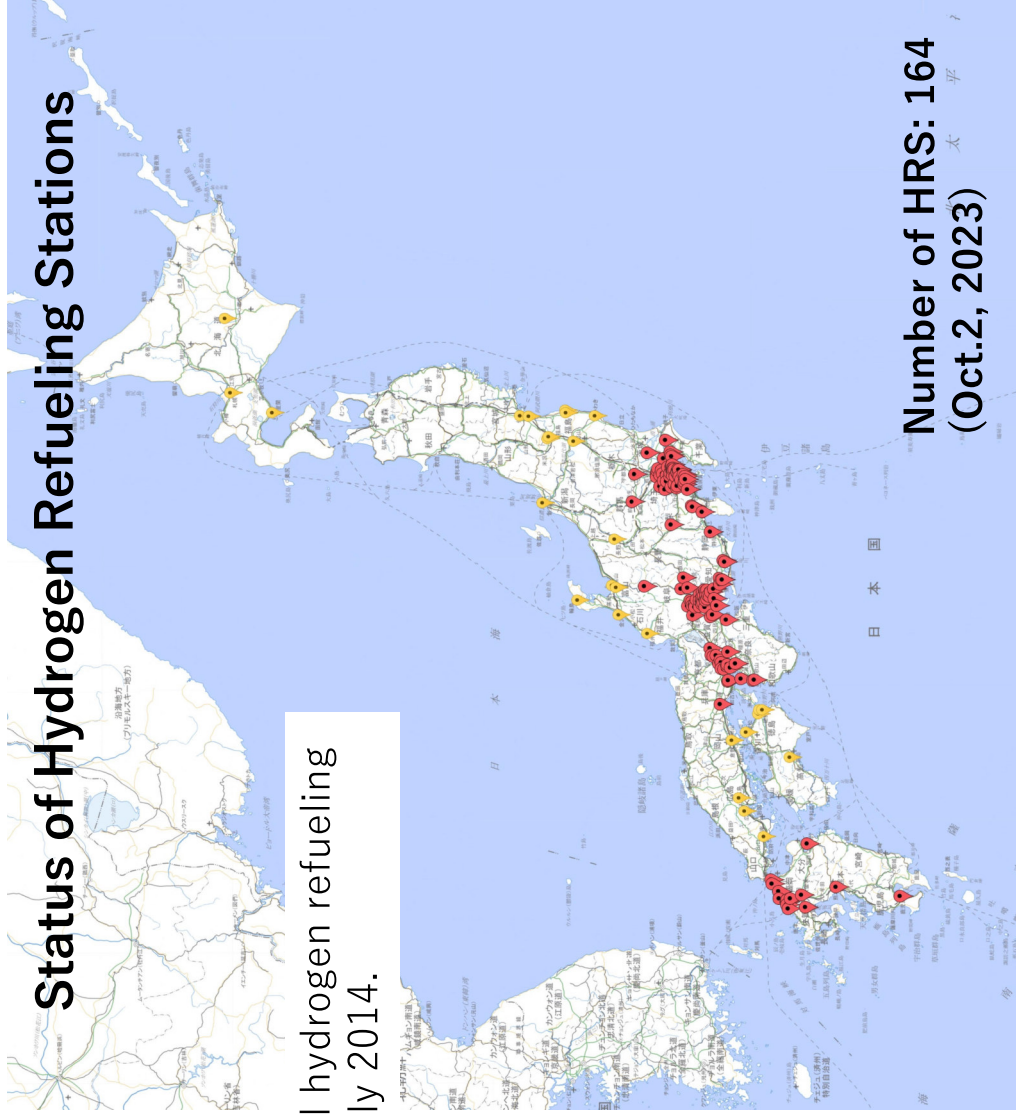
## Hydrogen and Fuel Cells Strategic Roadmap by METI



# Introduction

## Status of Hydrogen Refueling Stations

The first commercial hydrogen refueling station opened in July 2014.



**Number of HRS: 164**  
(Oct.2, 2023)

[https://www.cev-pc.or.jp/suiso\\_station/index.html](https://www.cev-pc.or.jp/suiso_station/index.html)  
(in Japanese)

# Introduction

## Metering Accuracy Verification of Dispensers at HRS

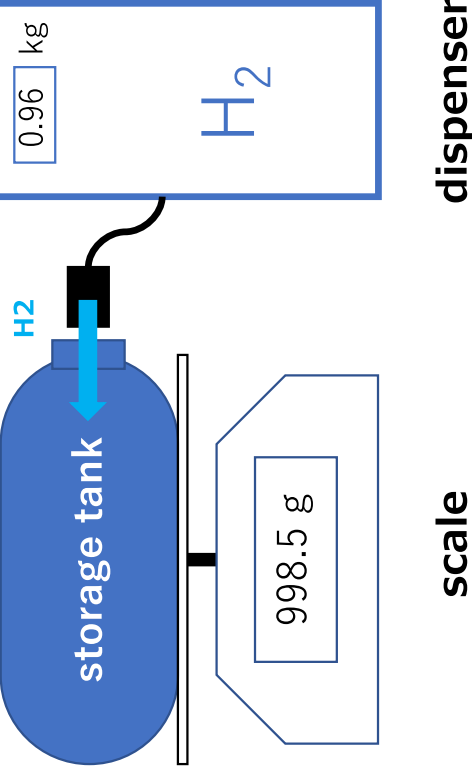


The source : Iwatani, Toyota

# Development of Metering Accuracy Verification Devices

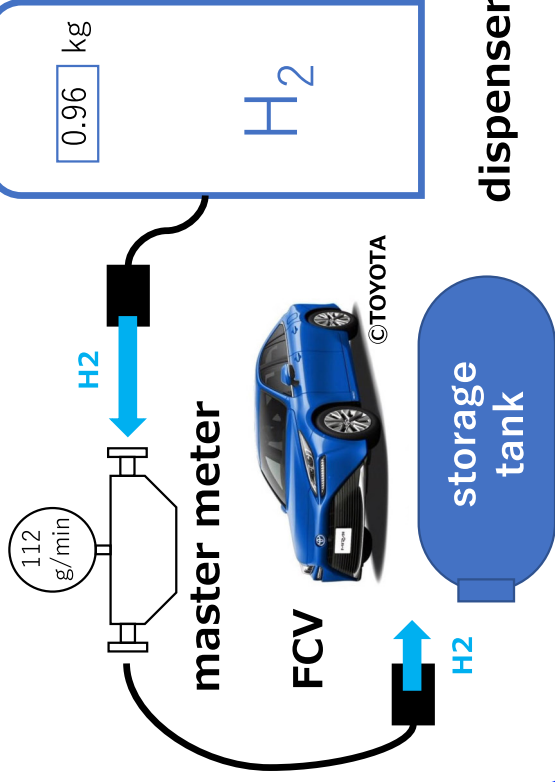
## Gravimetric Method

tank unit weight : approx.300 kg  
scale resolution : 1 g  
H2 filling amount : max.5 kg



## Master Meter Method

master meter : Coriolis flow meter  
standard : CFVN



The source : Report of NEDO project

# Development of Metering Accuracy Verification Devices



self-propelled verification devices



dispenser

nozzle

gtr tanks

scale

hose

The source : Report of NEDO project and TATSUNO

# Development of Metering Accuracy Verification Devices



self-propelled verification device

The source : Report of NEDO project and TOKICO System Solutions



## Regulation and Standardization

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### ☆ Industrial Guideline: HySUT\*-G0002 (2018)

#### “ Operating Guideline for Hydrogen Metering Control ”

- ✓ Purpose :
  - Determine the requisites for hydrogen metering performance at commercial hydrogen stations where hydrogen can be sold to FCV drivers
- ✓ Metering test apparatus & method :
  - 1) Gravimetric method
  - 2) Master-meter method
- ✓ **Maximum permissible errors for metering: 10 %**
- ✓ **Minimum measured quantity: 1 kg**
- ✓ **Measurement times:**
  - **Maximum filling quantity: 1 (pattern A)**
  - **Minimum measured quantity : 1 (at least), usually 3 times (pattern C)**
- ✓ **Measurement frequency: subsequent verification shall be conducted at intervals not exceeding two years.**

\* HySUT: The Association of Hydrogen Supply and Utilization Technology  
The source : Report of NEDO and METI projects

## Regulation and Standardization

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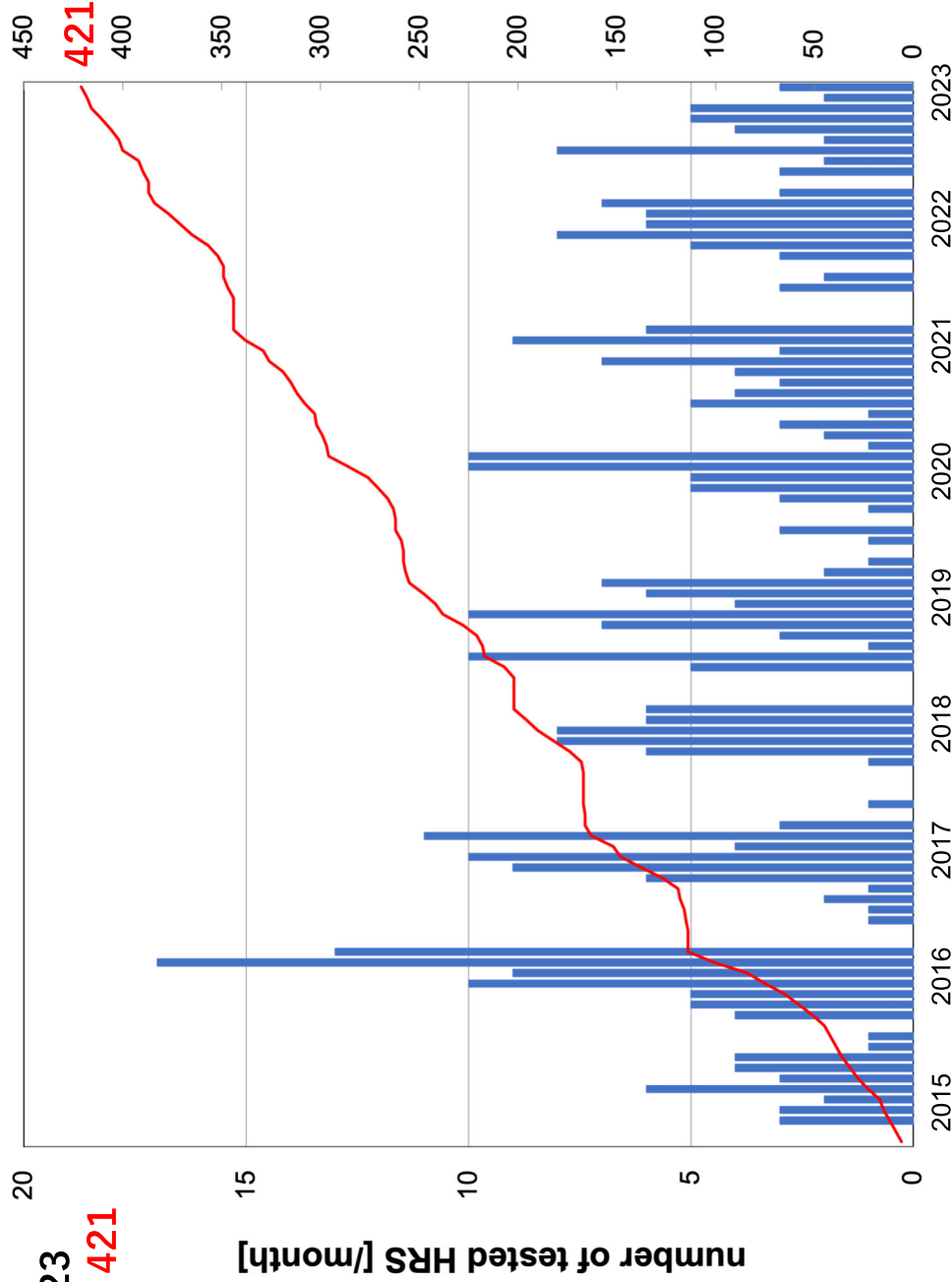
☆ Industrial Guideline: HySUT\*-G0002 (2018)

### “ Operating Guideline for Hydrogen Metering Control ”

<Example of test sequence>

- 1) Fill the storage tank from near empty to the maximum fillable pressure  $P_v$ . (**pattern A**)
- 2) Vent the storage tank to  $0.7^* \times P_v$ .
- 3) Refill the storage tank from  $0.7^* \times P_v$  to  $P_v$ . (**pattern C**)
- 4) Repeat steps 2) to 3).

# Field verification results

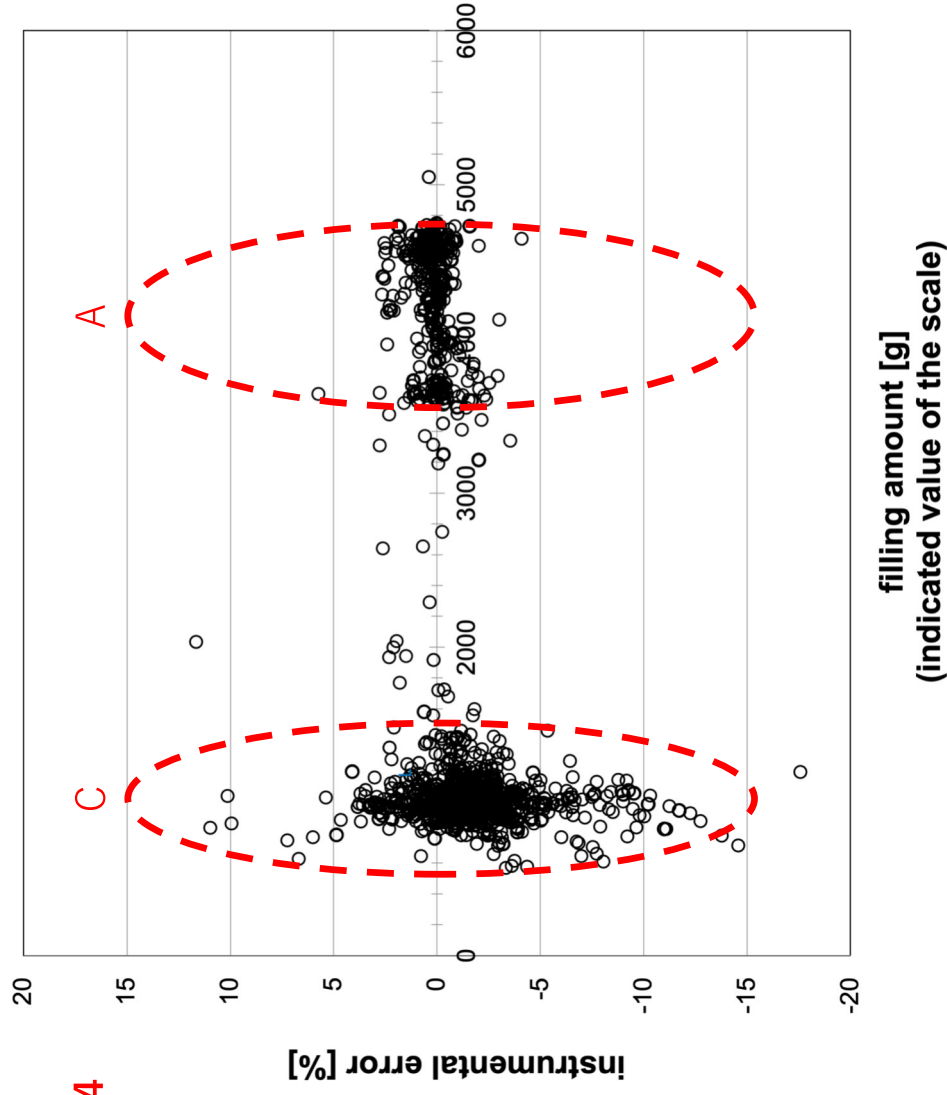


The source : TATSUNO

# Field verification results

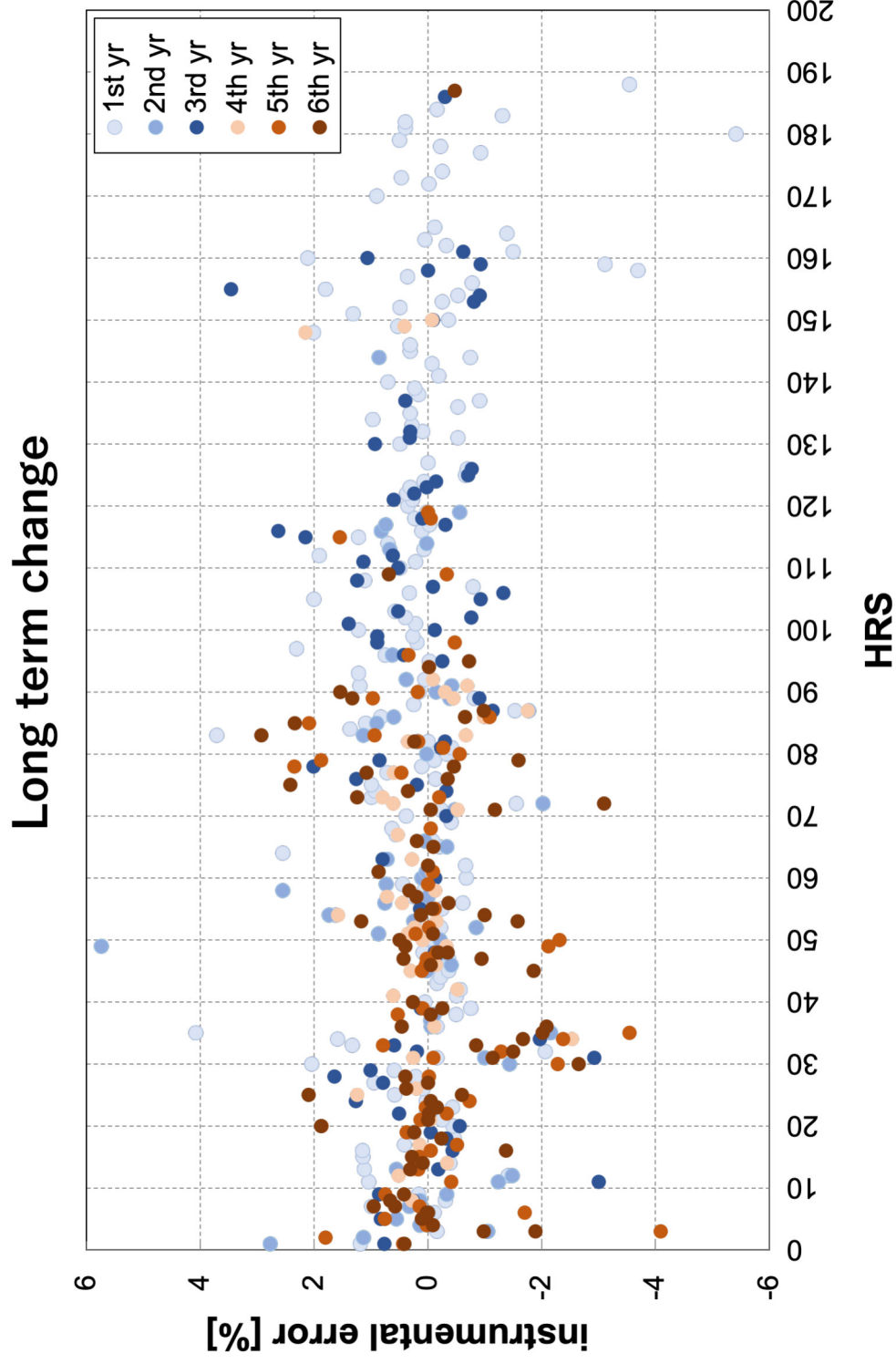
Period: 2014-2023

Number of data: 1684



The source : TATSUNO

# Field verification results

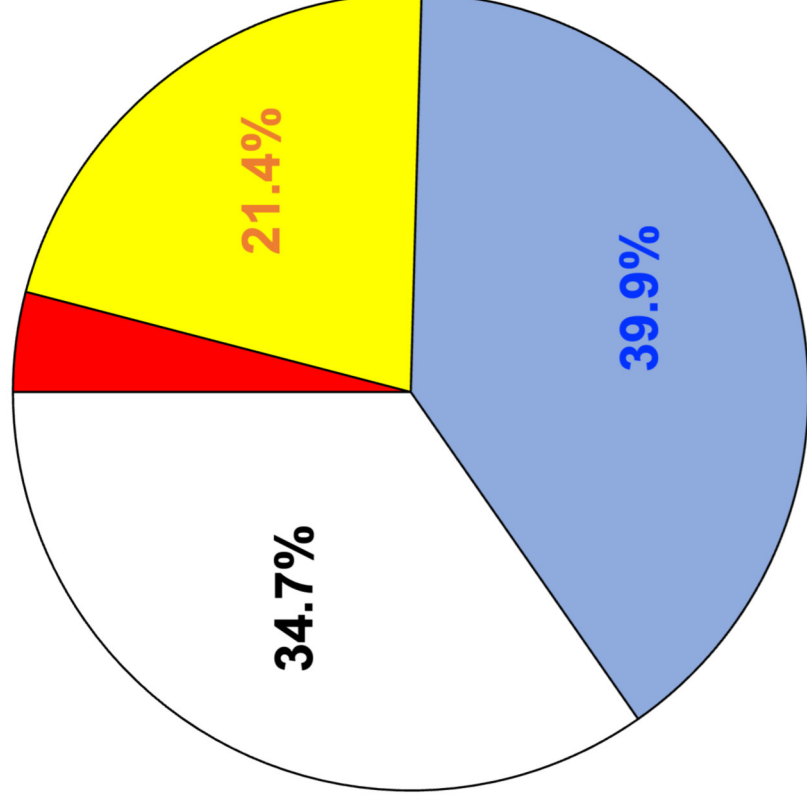


The source : TATSUNO

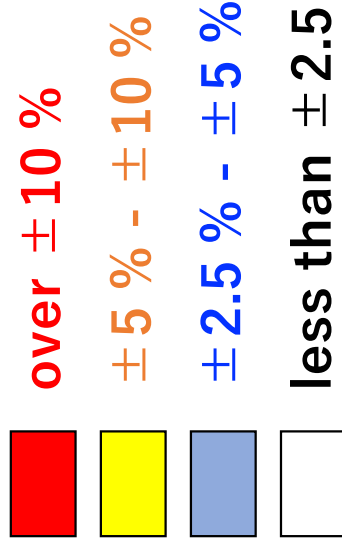
# Field verification results

## Instrumental errors during the entire period (~2022 FY)

**4.0%**



Number of HRS: **174**



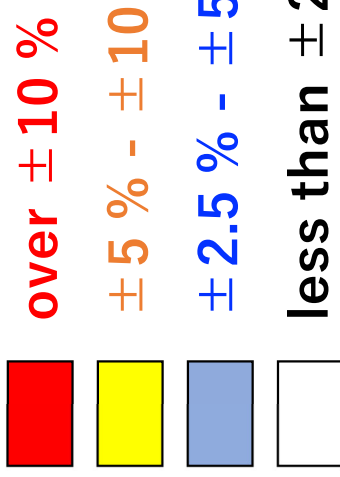
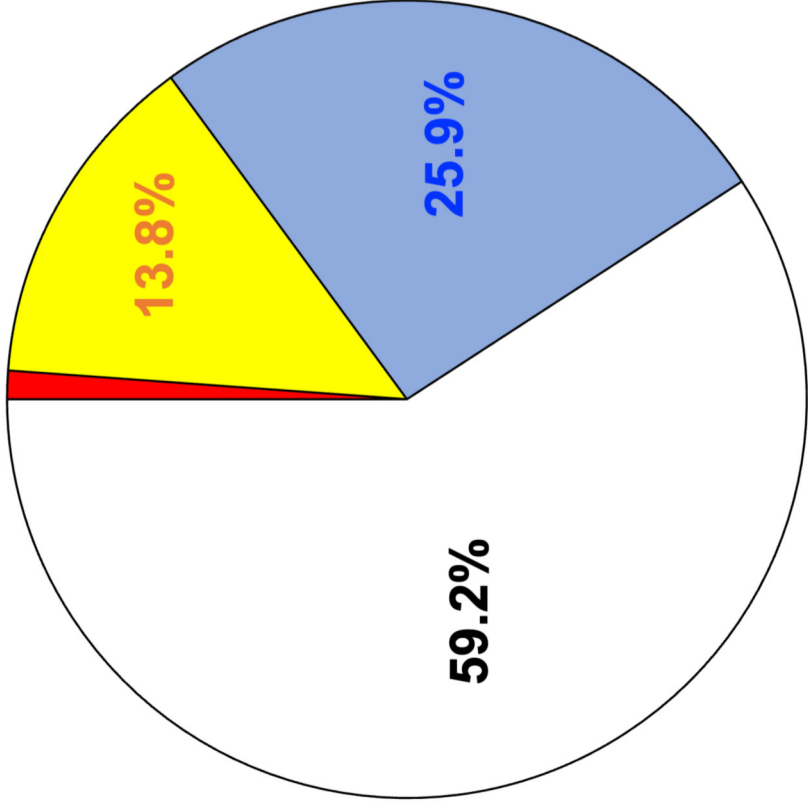
The source : TATSUNO

# Field verification results

## Instrumental errors at the opening of each HRS

**1.1%**

Number of HRS: **174**

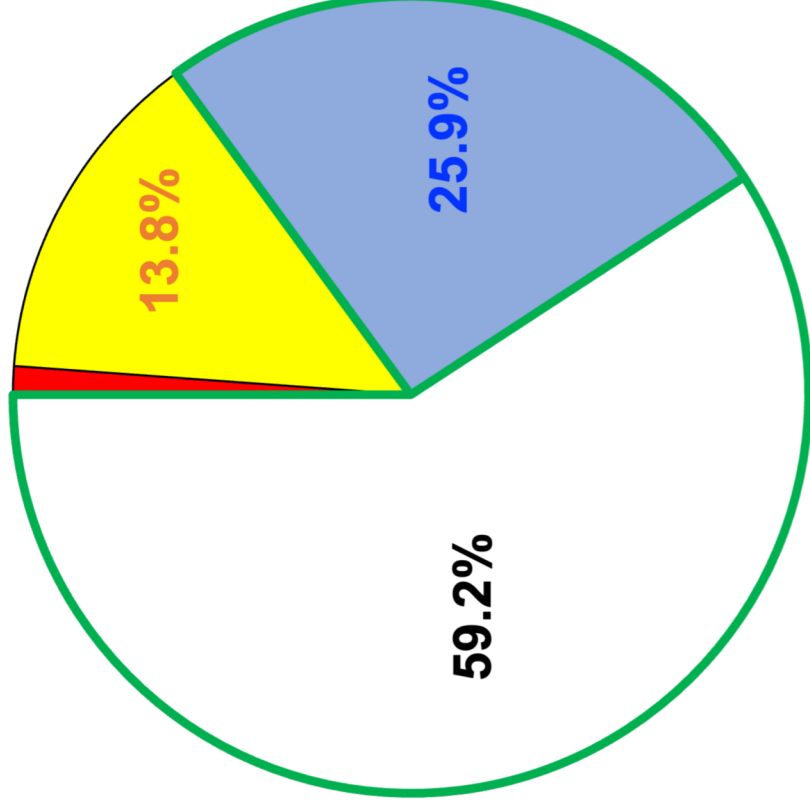


The source : TATSUNO

# Field verification results

## Instrumental errors at the opening of each HRS

1.1%



Number of HRS: 174

- over ±10 %
- ±5 % - ±10 %
- ±2.5 % - ±5 %
- less than ±2.5 %

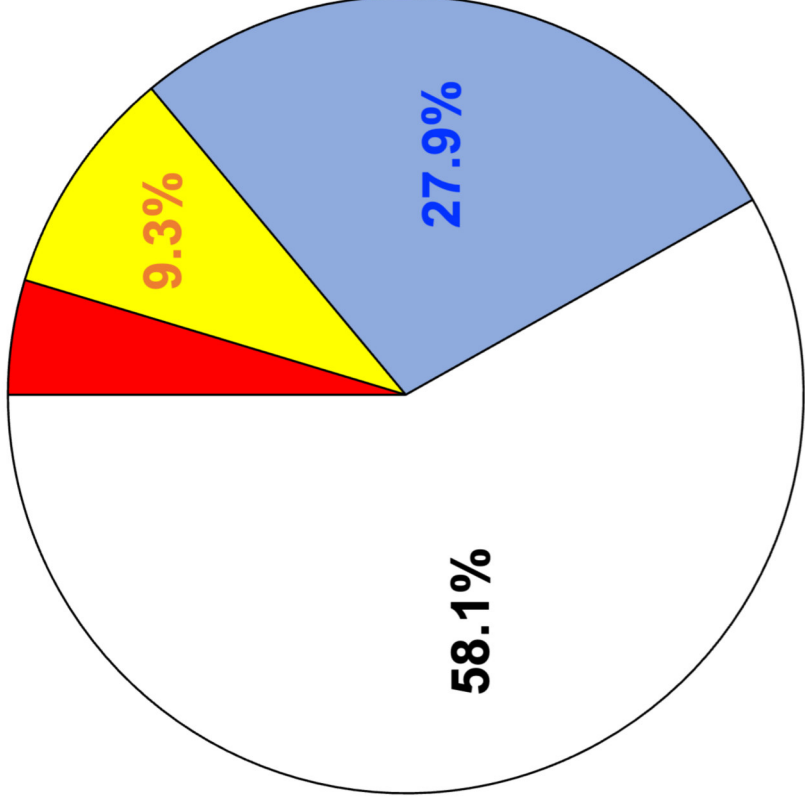
The source : TATSUNO



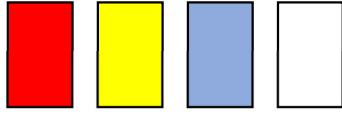
# Field verification results

## Instrumental errors at second verification in HRS passed at the opening

4.7%



Number of HRS: 86



over ±10 %

±5 % - ±10 %

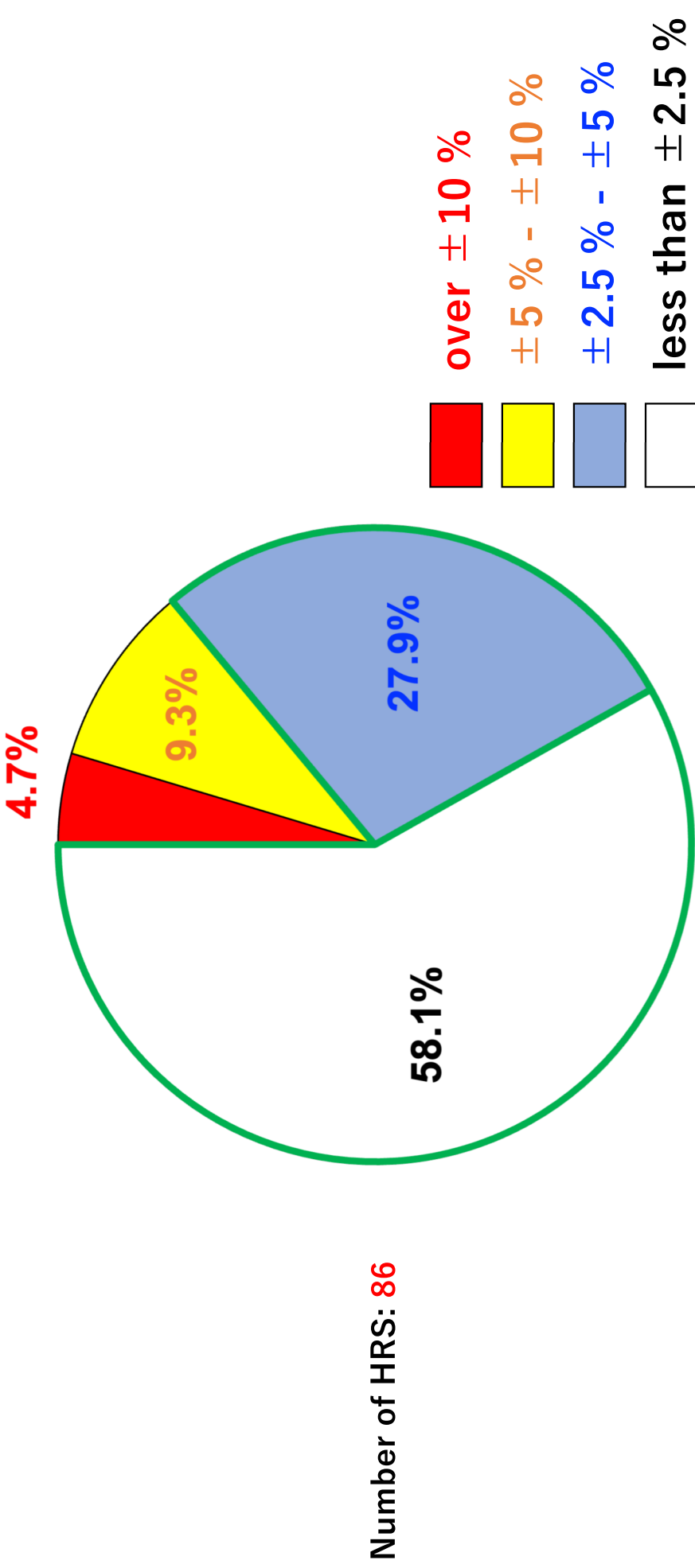
±2.5 % - ±5 %

less than ±2.5 %

The source : TATSUNO

# Field verification results

## Instrumental errors at second verification in HRS passed at the opening

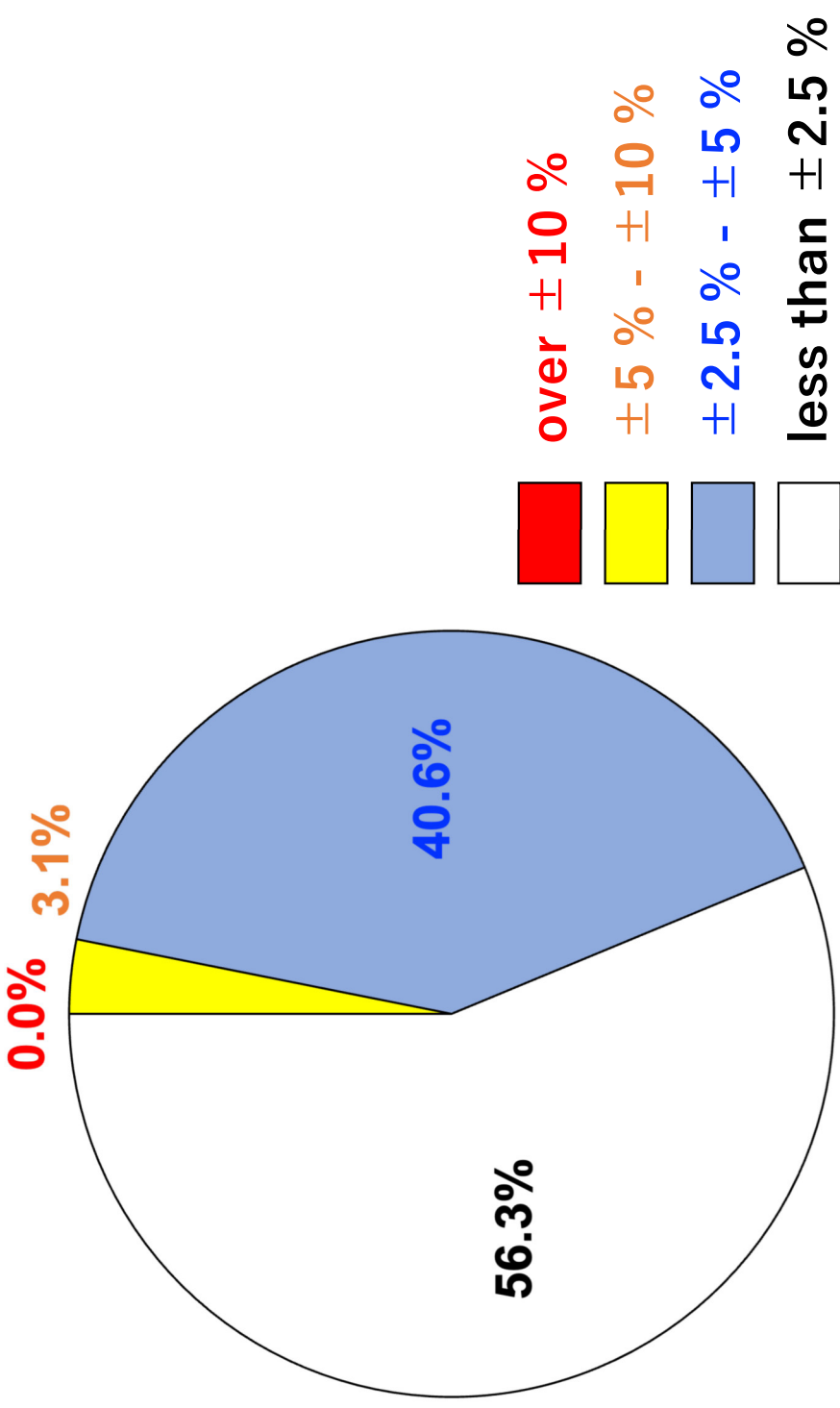


The source : TATSUNO

# Field verification results

## Instrumental errors at third verification in HRS passed at the second

Number of HRS: **32**

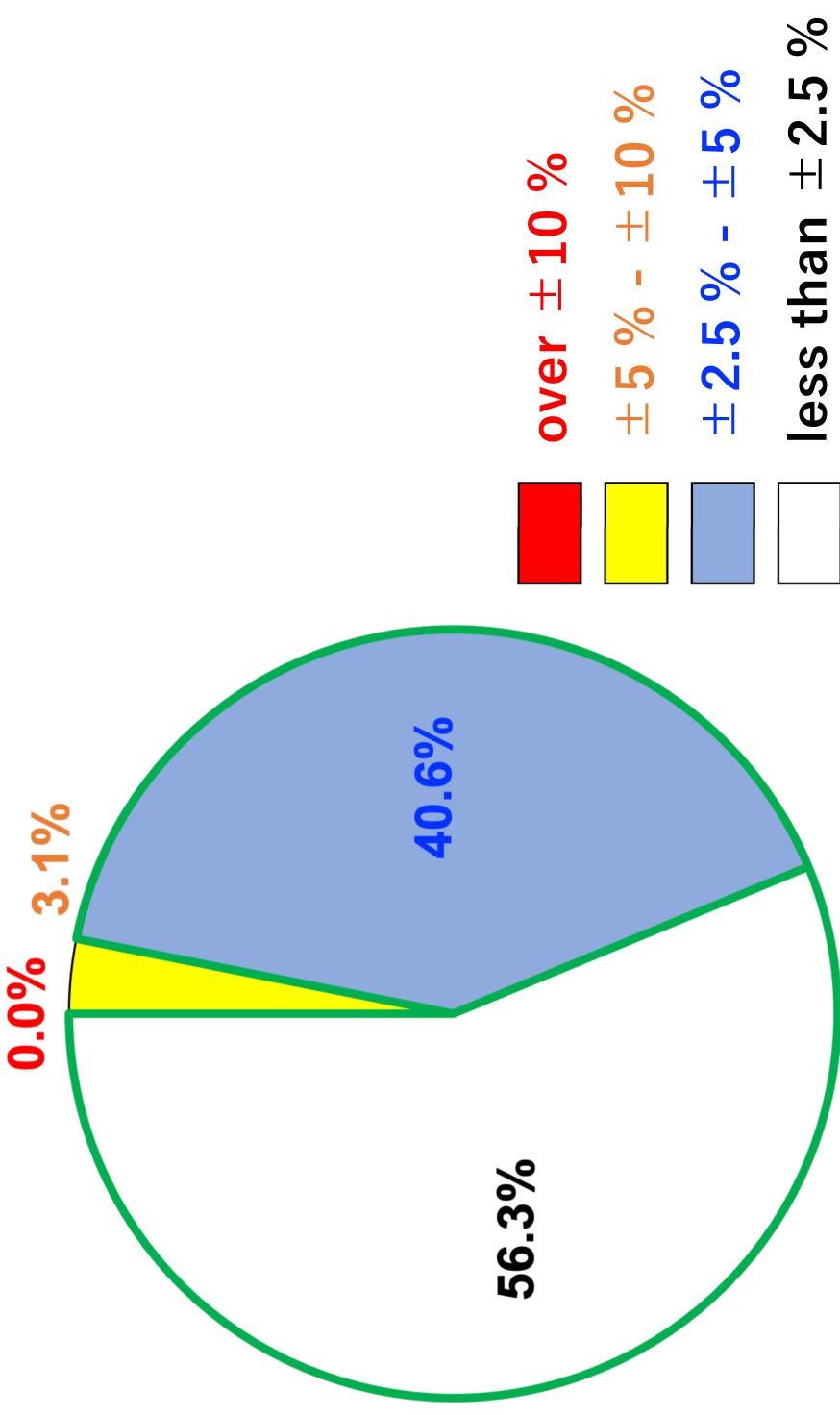


The source : TATSUNO

# Field verification results

## Instrumental errors at third verification in HRS passed at the second

Number of HRS: **32**

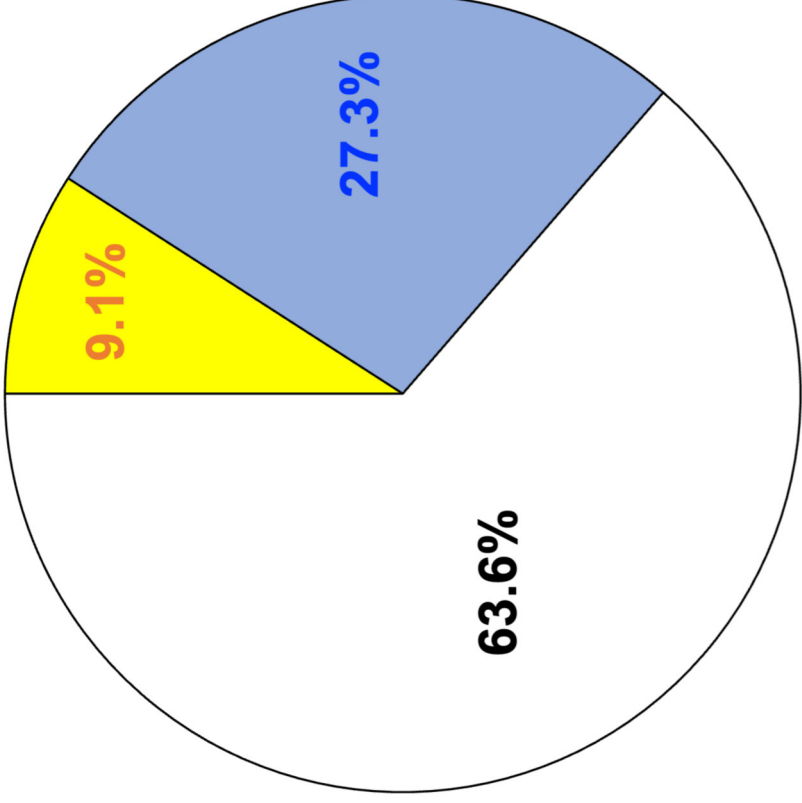


The source : TATSUNO

# Field verification results

## Instrumental errors at fourth verification in HRS passed at the third

**0.0%**



Number of HRS: **22**

**over ±10 %**

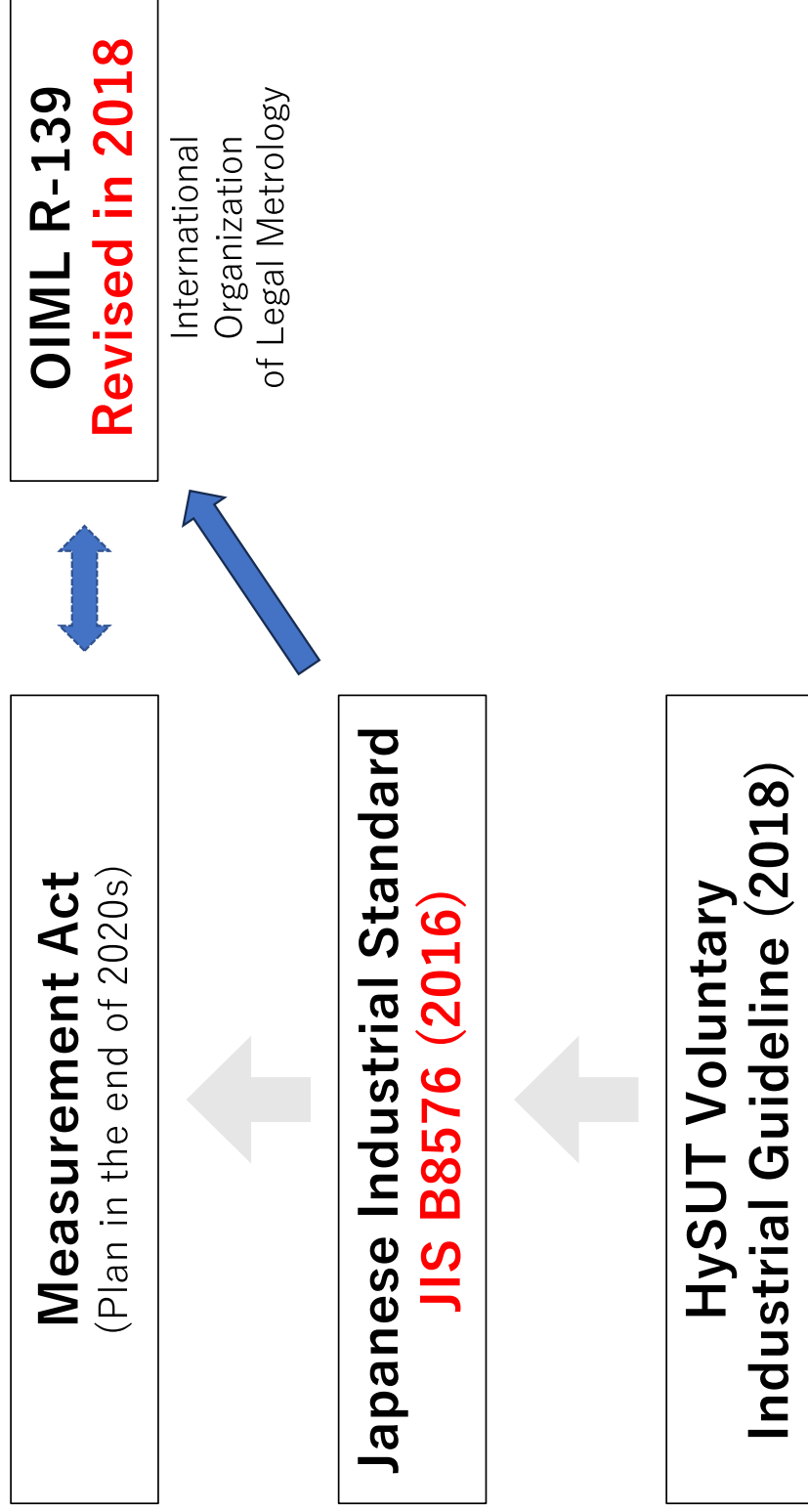
**±5 % - ±10 %**

**±2.5 % - ±5 %**

**less than ±2.5 %**

The source : TATSUNO

# Regulation and Standardization



The source : Report of NEDO and METI projects

# Regulation and Standardization

## MPE

HySUT-G0002 :2018 (under revision)

type test	tolerance	in use
-	± 10.0%	± 10.0%

JIS B 8576 :2016 (under revision)

accuracy class	MPE	in use
2.0	± 1.5%	± 2.0%
3.0	± 2.0%	± 3.0%
5.0	± 4.0%	± 5.0%
10.0	± 8.0%	± 10.0%



OIML R139 :2018

accuracy class	MPE for meter	MPE for system	in use for system
1.5	± 1.0%	± 1.5%	± 2.0%
2	± 1.5%	± 2.0%	± 3.0%
4	± 2.0%	± 4.0%	± 5.0%



Verification period (interval): 2 yr



3 yr (If two consecutive verification clear ±5 %)

Gravimetric method



Master-meter method

## Summary

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- ✓ **Current number of HRSs is 164 in Japan.**
- ✓ **Two types of metering accuracy verification devices for hydrogen dispenser were developed, i.e., the gravimetric method and the master-meter method.**
- ✓ **Industry guideline has been established and are in operation.**
- ✓ **Instrumental error data from field verifications are being accumulated and the verification period for the guidelines is being revised.**
- ✓ **Improvements of the metering accuracy of the hydrogen dispensers themselves as well as the inspection devices and methods are needed for independence of HRSs.**



## Acknowledgement

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This research was funded by the New Energy and Industrial Technology Development Organization (NEDO), under the “Research and Development Project for Hydrogen Utilization Technology / Research and Development on Low-Cost Devices and Systems for Fuel Cell Vehicles and Hydrogen Refueling Stations / Research and Development on Hydrogen Metering Management Methods at Hydrogen Refueling Stations”.

In addition, I received a lot of cooperation from co-investigators, especially **TATSUNO** Corporation, in carrying out the research. I would like to express my gratitude by adding a note here.