

C1 test result further analysis

working with TFTA subgroup on data assessment

39th TF TA
4th and 5th Dec 2025



JAPAN AUTOMOBILE STANDARDS INTERNATIONALIZATION CENTER

1. Analysis of COVA Test/Market Assessment Test Results

- Results from the COVA/market assessment tests conducted in 2024-2025 confirmed a good correlation between the drum test method and the vehicle test method. However, outliers were observed in the market assessment tests, where test results differed between the two methods. Furthermore, in some cases, the correlation between laboratories was poor for both the drum test method and the vehicle test method.
- Regarding the outliers in the market assessment tests, we have been investigating factors from the drum test method side. Since additional vehicle test method data was shared from ETRTO, we proceed with investigating factors from the vehicle test method side.
- Regarding the correlation of inter-drums, we are focusing our investigation on the following items:
 - SRTT abrasion rate
 - Amount of 3rd body sprayed
 - Combination of 3rd body and drum surface
- At the previous TF TA meeting, ETRTO presented the results of their drum tests (TA-37-17v1) and reported differences in test outcomes between ETRTO's drum testing facilities. However, since the test conditions used by ETRTO differ significantly from those of the drum test method previously discussed, we have requested ETRTO to disclose the details.

Progress on Sharing Test Data Needed for Analysis

- ✓ Drum test information: Shared from Japan to ETRTO (initial: May 21, additional: October 22)
- ✓ Actual vehicle test information: Shared from ETRTO to Japan (October 20)
- ✓ ETRTO's own drum test information: Shared from ETRTO to Japan (7th November)

1. Status of Test Data Analysis

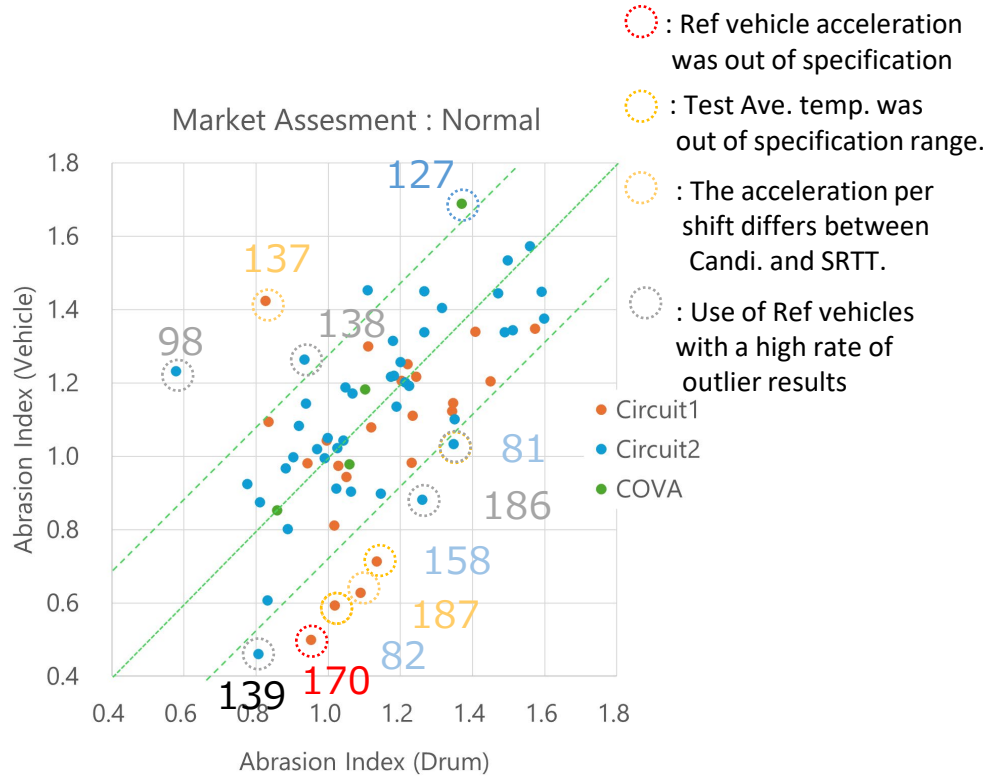
Analysis of MA test results, COVA test results, and ETRTO proprietary drum test results

- Vehicle test: Analysis of factors affecting outliers. Primarily three factors were identified:
 - ✓ Average temperature outside test temperature specification
 - ✓ The acceleration per shift differs
 - ✓ Ref vehicles with a high rate of outlier
- Drum test: Confirming the effects of previous studies on accuracy improvement and conducting further studies for enhanced accuracy.
 - ✓ Correlation improves when excluding data outside the latest test conditions and outliers for which factors have been identified.
 - ✓ Analysis is ongoing to enhance test accuracy, focusing on SRTT abrasion level. To stabilize SRTT abrasion level, factors such as the spray volume of 3rd body are also being studied.
- ETRTO drum test: Consideration of differences from *GRBP-82-29 and factors causing variation.
 - ✓ There are many differences between the test conditions specified in GRBP-82-29.
 - ✓ Test conditions vary between laboratories, such as inflation pressure conditions and test temp.
 - ✓ The input mode for the ETRTO drum test involves short-period changes in longitudinal and lateral forces, concurrent with short-period variations in load, speed, and camber angle. There is concern that the testing machine's response capability to these inputs may be a problem.
 - ✓ The driving severity is approximately twice as high as that of the GRBP-82-29 test method, resulting in a greater average abrasion level for the SRTT.

* Informal document submitted to 82nd GRBP, contains update for drum test condition

2. Vehicle test: Examination of Outlier Factors in MA Tests

Analysis of factors in vehicle test concerning outliers in Normal tyre MA tests

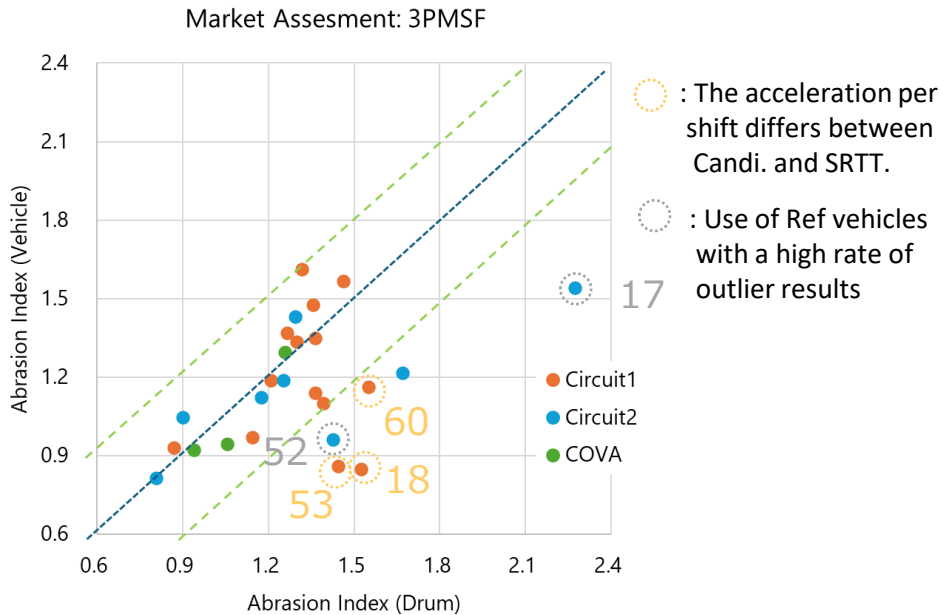


Tyre Code	Size	Estimated factors/Drum	Estimated factors/Vehicle
81	225/45R17 91Y	Flow Rate Control	①Ave. temp. out of specification ③Ref vehicles with a high rate of outlier
82	205/55R16 91V	Under assessment	①Ave. temp. out of specification ②The acceleration per shift differs
94	245/45R18 100Y	Under assessment	Under assessment
98	205/55R16 91H	Flow Rate Control	③Ref vehicles with a high rate of outlier
127	245/45R18 100Y	Under assessment	Temperature
137	155/65R14 75H	Flow Rate Control	②The acceleration per shift differs
138	205/55R16 91V	Under assessment	③Ref vehicles with a high rate of outlier
139	195/65R15 91S	Rim width difference Flow Rate Control	Rim width difference
158	205/55R16 91V	Flow Rate Control	①Ave. temp. out of specification
170	195/65R15 91S	Under assessment	Ref vehicle acceleration out of specification(Std. Dev. X) (The same convoy Tyre73 also has an index difference of 0.20)
186	195/65R15 91S	Rim width difference	Rim width difference ③Ref vehicles with a high rate of outlier
187	205/55R16 91V	Flow Rate Control	②The acceleration per shift differs

- ✓ Regarding Tyre170, the acceleration of the reference vehicle was outside the specified range, so it was excluded from analysis.
- ✓ It was found that there were primarily three other factors:
 - ① Test Ave. temp. was out of specification range
 - ② The acceleration per shift differs between Candi. and SRTT
 - ③ Use of Ref vehicles with a high rate of outlier results

2. Vehicle test: Examination of Outlier Factors in MA Tests

Analysis of factors in vehicle test concerning outliers in 3PMSF tyre MA tests



Tyre Code	Size	Estimated factors/Drum	Estimated factors/Vehicle
18	205/55R16 91H	Flow Rate Control	②The acceleration per shift differs
17	205/55R16 91H	Under assessment	③Ref vehicles with a high rate of outlier
48	195/65R15 95T	Flow Rate Control	Under assessment
52	245/45R18 100V	Rim width difference	Rim width difference ③Ref vehicles with a high rate of outlier
53	195/65R15 91H	Under assessment	②The acceleration per shift differs
60	245/45R18 100V	Flow Rate Control	②The acceleration per shift differs

- ✓ Regarding 3PMSF tyre, it was found that the following two factors are common to Normal tyre:
 - ② The acceleration per shift differs between Candi. and SRTT
 - ③ Use of Ref vehicles with a high rate of outlier results

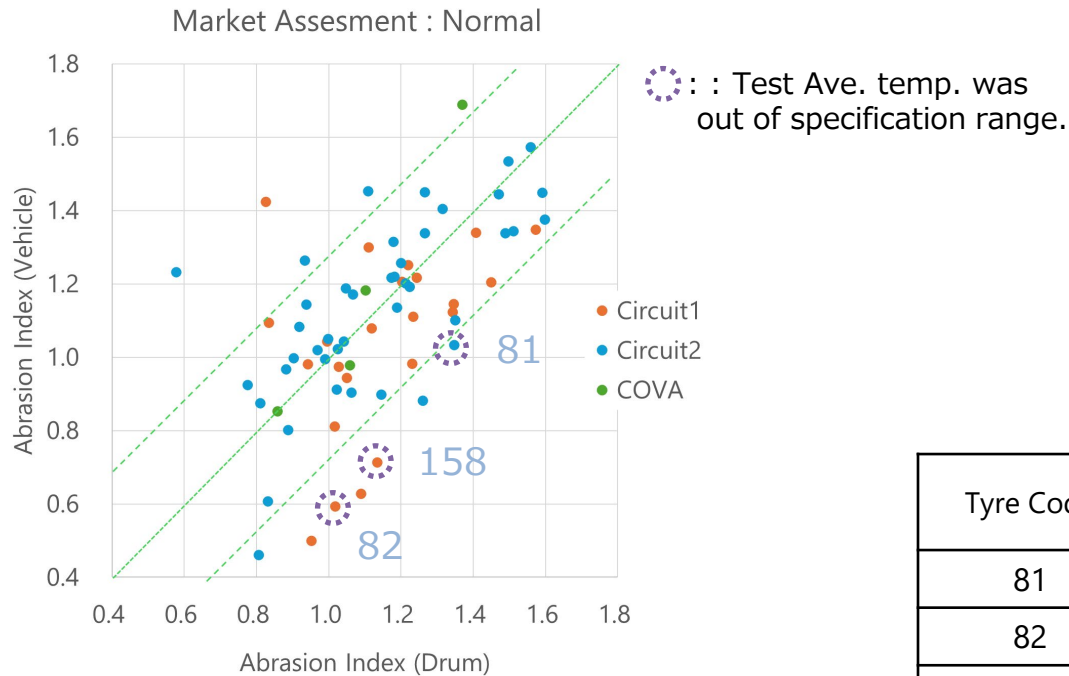
2. Vehicle test: Analysis of Variation Factors in Vehicle Test Methods

① Test Ave. temp. was out of specification range

The updated temperature range proposed by ETRTO

1.7.1. When testing tyres against SRTT17S according to the table in paragraph 1.8. of this Annex, the following weather and climate conditions shall be respected:↵

- (a) The average **ambient** temperature during the test shall be within the following range: from **10⁷ °C** to 35 °C. **However, for tyres designed for maximum speed greater than or equal to 300 km/h, the minimal average ambient temperature during the test shall be greater than or equal to 12 °C;**↵



Normal tyre Temp. range (updated)

Max. Speed ≥ 300km/h : 12°C ~ 35°C

Others : 10°C ~ 35°C

Tyre Code	Size	Required test temperature range	Average test temperature
81	225/45R17 91Y	12°C ~ 35°C	10.6°C
82	205/55R16 91V	10°C ~ 35°C	8.5°C
158	205/55R16 91V	10°C ~ 35°C	9.4°C

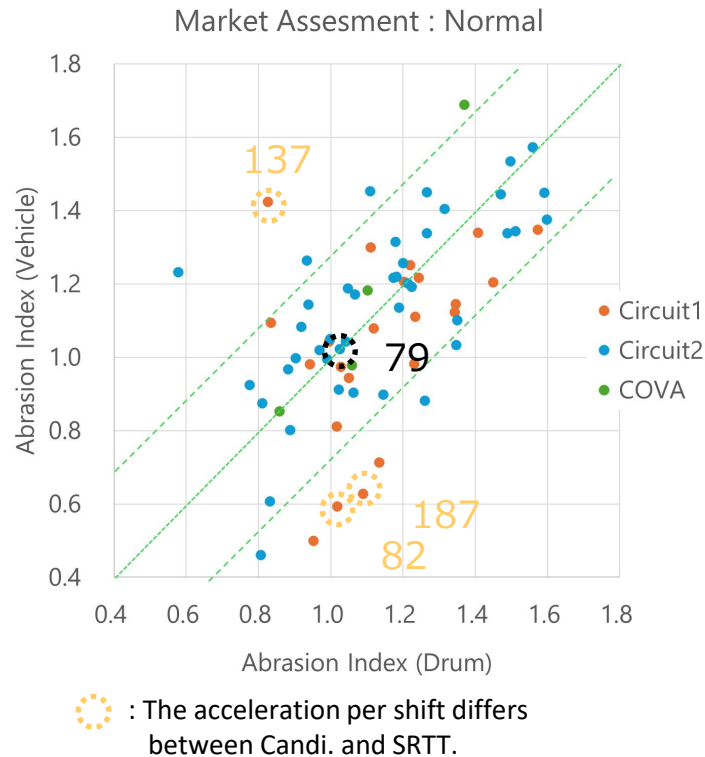
✓ The three SKUs mentioned above were tested at temperatures lower than the updated specified temperature range.

This test temperature may have caused it to become an outlier.

2. Vehicle test: Analysis of Variation Factors in Vehicle Test Methods

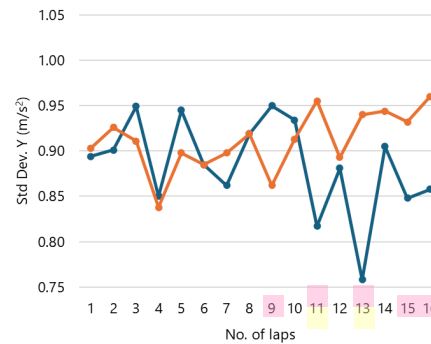
② The acceleration per shift differs between Candi. and SRTT(Normal)

Analysis of the standard deviation of acceleration per shift to confirm the impact of acceleration variation on outliers

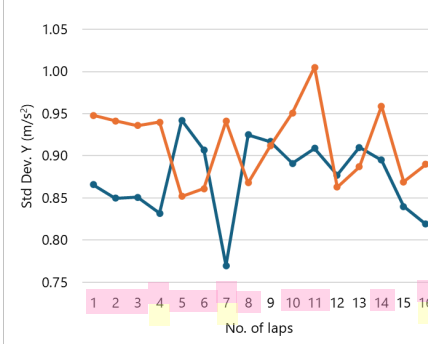


Lateral acceleration per shift

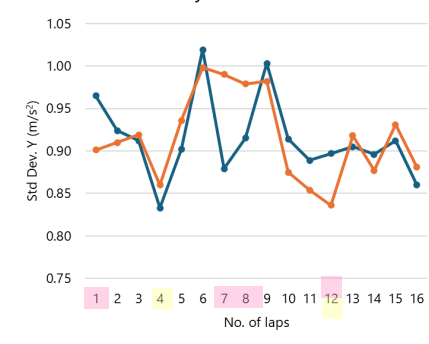
Tyre 82



Tyre 137



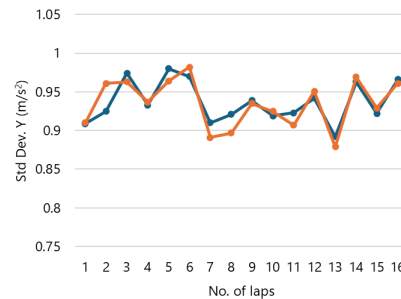
Tyre 187



SRTT
Candidate

Examples of good correlation results

Tyre 79



- Acceleration per shift is stable, and the difference between Ref. and Candi. is small.

- Results per shift are within the specified average for the following Lateral acceleration test average specification :

Std. Dev. $0.93 \text{ m/s}^2 \pm 10\%$

$0.95 \leq \text{Candidate} / \text{SRTT} \leq 1.05$

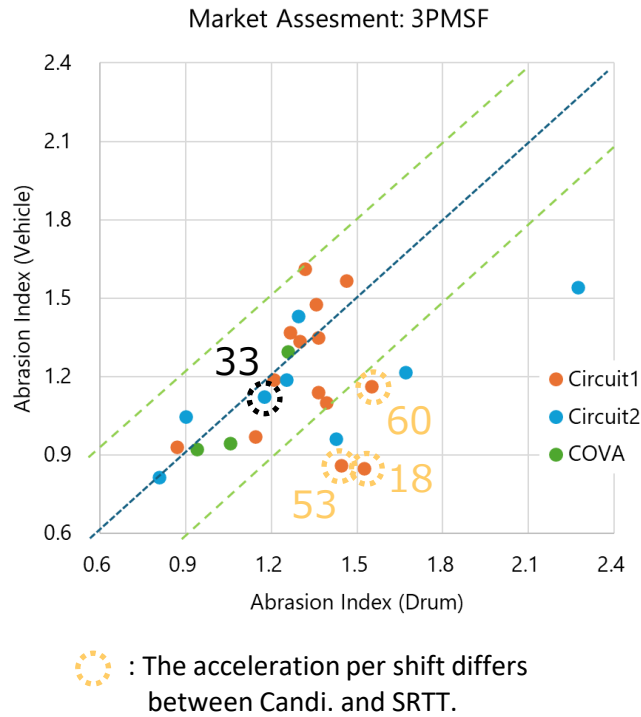
- ✓ The outlier SKUs Tyre82, Tyre137, and Tyre187 exhibit shifts where the SRTT and Candi. values diverge by more than 5%.
- ✓ All these SKUs are Circuit1 tests. Compared to the Circuit2 Tyre79 test, which demonstrates good test method correlation, they show greater variation in Std Dev per shift and some results exceed the test average specification.

These acceleration variations are thought to be the cause of the outliers.

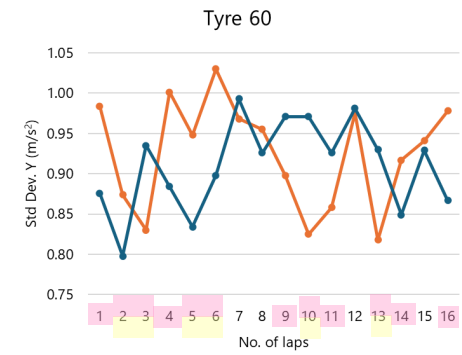
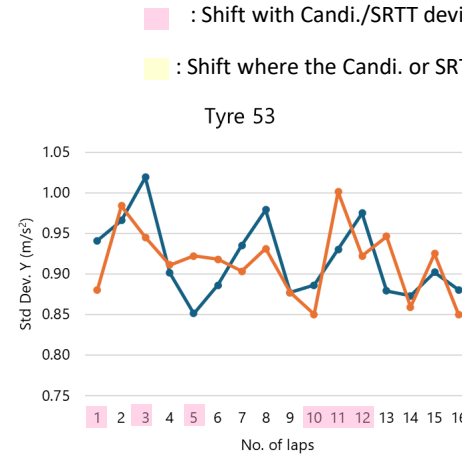
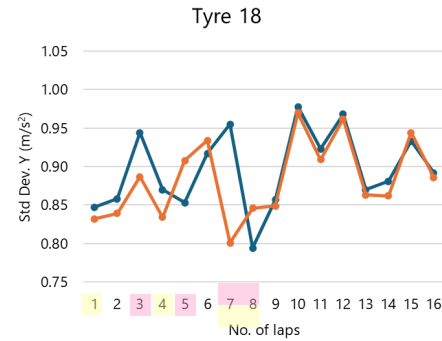
2. Vehicle test: Analysis of Variation Factors in Vehicle Test Methods

② The acceleration per shift differs between Candi. and SRTT(3PMSF)

Analysis of the standard deviation of acceleration for each shift.

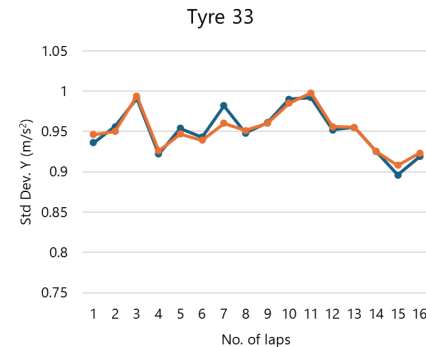


Lateral acceleration per shift



SRTT
Candidate

Examples of good correlation results



- Acceleration per shift is stable, and the difference between Ref. and Candi. is small.
- Results per shift are within the specified average for the following Lateral acceleration test average specification :
 $\text{Std. Dev. } 0.93 \text{ m/s}^2 \pm 10\%$
 $0.95 \leq \text{Candidate} / \text{SRTT} \leq 1.05$

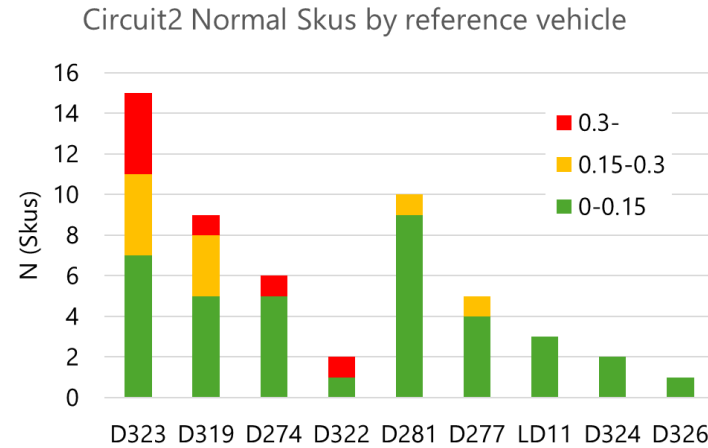
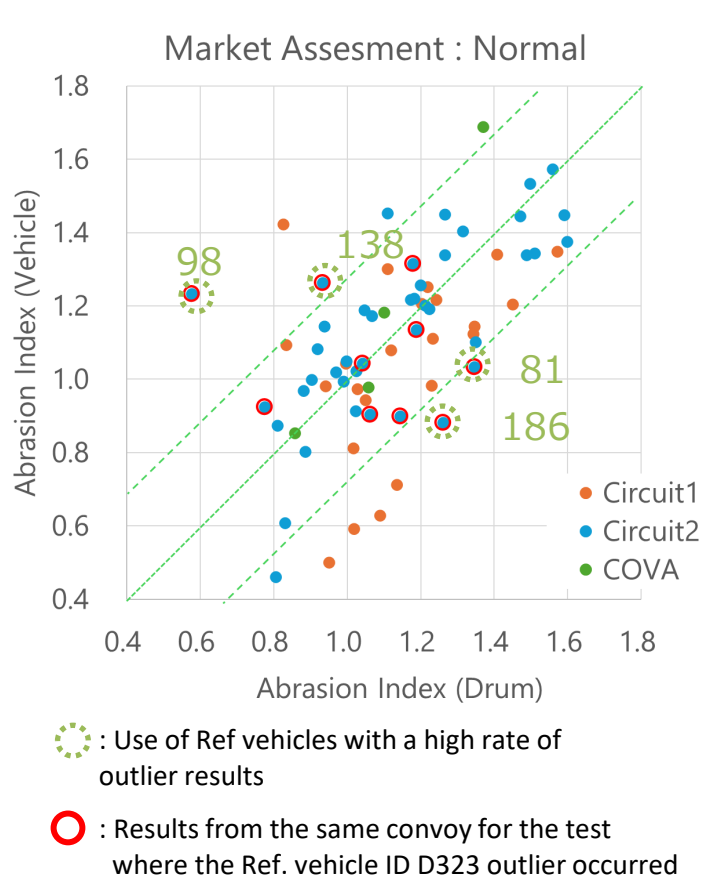
- ✓ The outlier SKUs Tyre18, Tyre53, and Tyre60 exhibit shifts where the SRTT and Candidate values diverge by more than 5%.
- ✓ All these SKUs are Circuit1 tests. Compared to the Circuit2 Tyre33 test, which demonstrates good test method correlation, they show greater variation in Std Dev per shift and some results exceed the test average specification.

As with Normal tyre, these acceleration variations are thought to be the cause of the outliers.

2. Vehicle test: Analysis of Variation Factors in Vehicle Test Methods

③ Use of Ref vehicles with a high rate of outlier results (Normal)

Regarding Circuit2, to verify the impact of vehicles on test results, we analyzed the presence of outliers for each reference vehicle ID.



Tyre Code	Size	Ref. Vehicle ID
81	225/45R17 91Y	D323
98	205/55R16 91H	D323
138	205/55R16 91V	D323
186	195/65R15 91S	D323

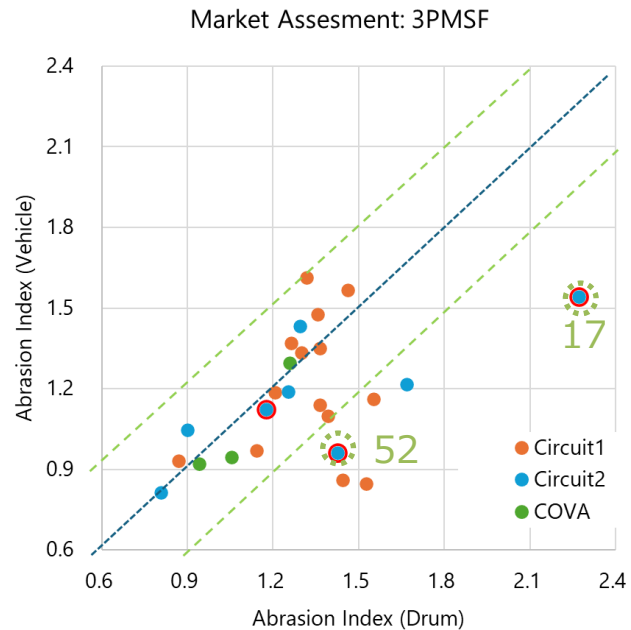
- ✓ Some vehicles produce many outliers, while others produce none.
- ✓ Ref. vehicle ID D323 has a high number of outliers and a higher probability than other vehicles (4/15).

Depending on the reference vehicle, the abrasion index may have varied and potentially become an outlier.

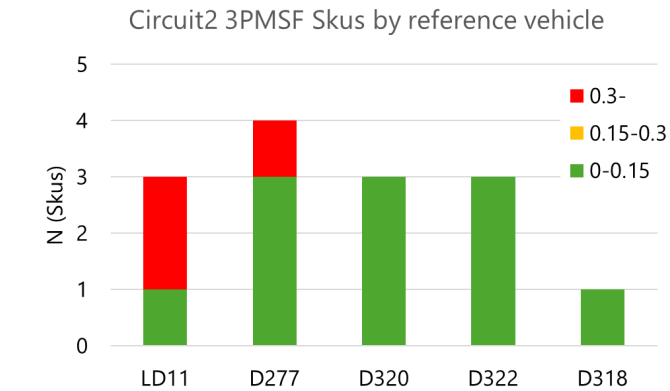
2. Vehicle test: Analysis of Variation Factors in Vehicle Test Methods

③ Use of Ref vehicles with a high rate of outlier results (3PMSF)

For the 3PMSF tyres, to verify the impact on test results by vehicle, we analyzed the presence of outliers for each Circuit 2 reference vehicle ID.



- :Use of Ref vehicles with a high rate of outlier results
- :Results from the same convoy for the test where the Ref. vehicle ID LD11 outlier occurred



Tyre Code	Size	Ref. Vehicle ID
17	205/55R16 91H	LD11
52	245/45R18 100V	LD11

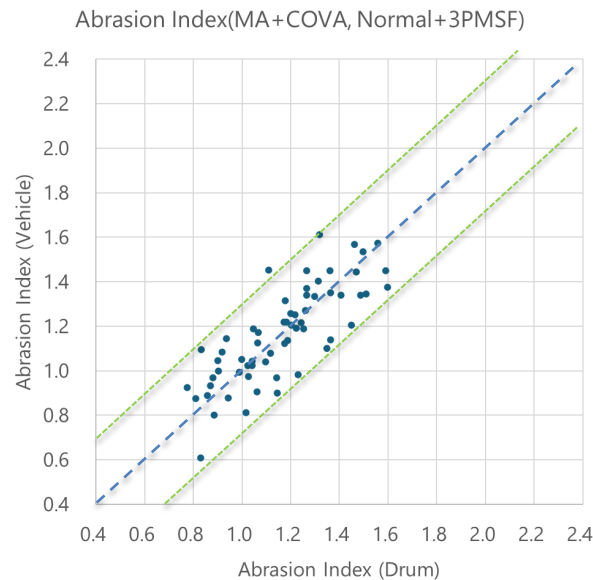
- ✓ Some vehicles produce many outliers, while others produce none.
- ✓ Ref. vehicle ID LD11 has a high number of outliers and a higher probability than other vehicles (2/3).

Depending on the reference vehicle, the abrasion index may have varied and potentially become an outlier.

2. Vehicle test: Examination of Outlier Factors in MA Tests

To investigate the causes of deteriorating test method correlations in MA test, we analyzed the variation factors for each test method concerning outliers.

- ✓ With the exception of 1 sku, outlier factors were identified in both the vehicle test method and the indoor drum test method.
- ✓ Factors causing outliers were present in both the vehicle test method and the indoor drum test method.
- ✓ Plotting the MA test results excluding the identified outlier factors produces the following graph:



- Outliers other than Tyre94 have been removed, though the contributing factors remain unidentified.
- Results from test Tyre73, where SRTT acceleration exceeded specifications, were excluded.
- COVA test results used the temperature-corrected average value
- Data outside the proposed updated temperature range was excluded (Normal)

Our analysis revealed that the apparent lack of correlation in the market assessment results is due to variability in the test results of each method.

By improving the accuracy of both test methods, data that appears to lack correlation should no longer occur.

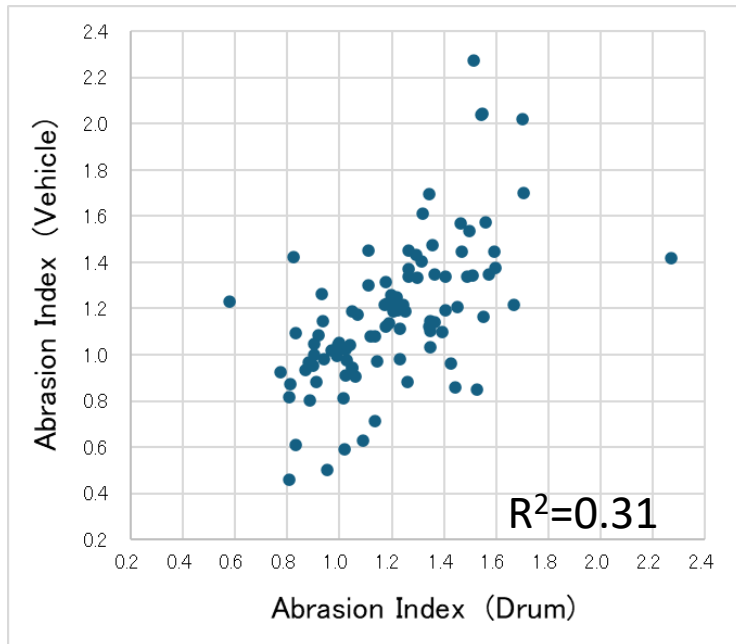
3. Drum test: The transition of the correlation between drum method and vehicle method

The problem was that although correlations were confirmed in correlation tests, there was data in the market assessment results that appeared to show no correlation.

Based on an analysis of test results to date, we have summarized the status of the market assessment test results.

(1) Market assessment

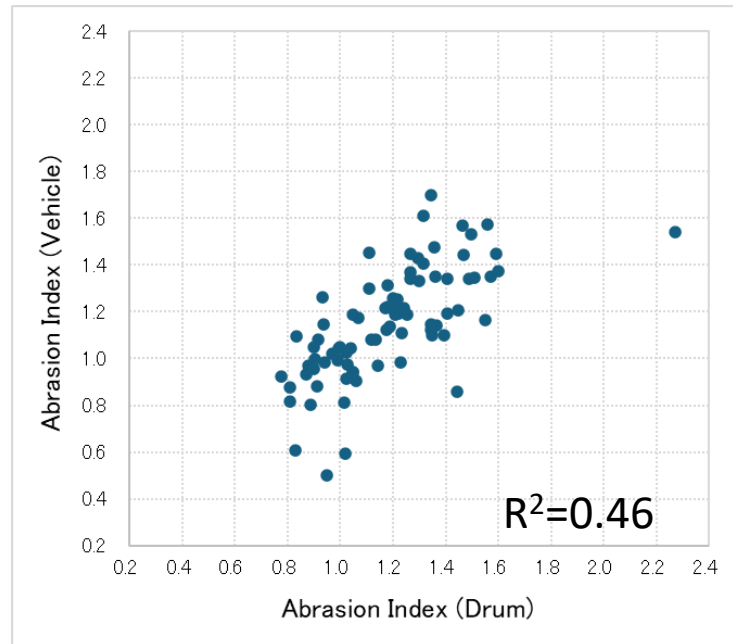
Raw data



(2) Test method improvements GRBP-82-29

Remove:

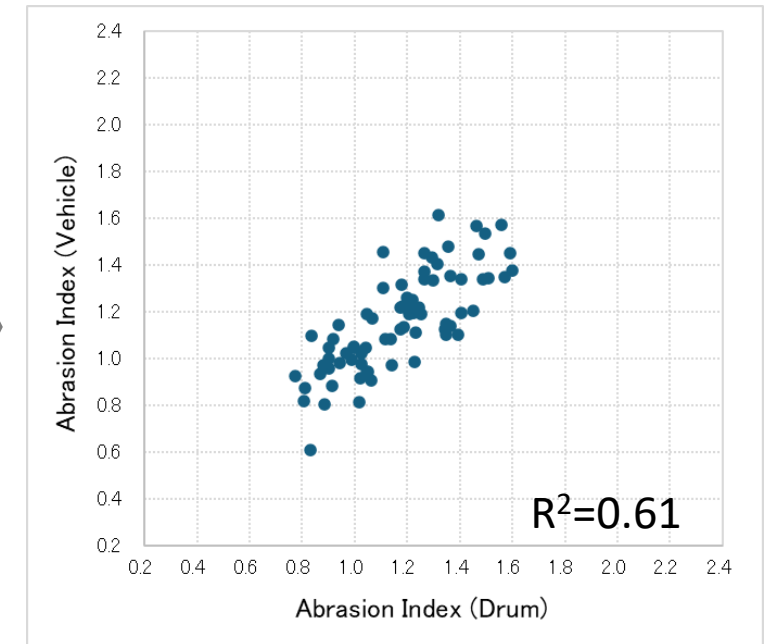
- Outside of new test condition for flowrate
- Rim width difference
- Studdless tyre



(3) Potential condition

Remove:

- Outliers identified variation cause



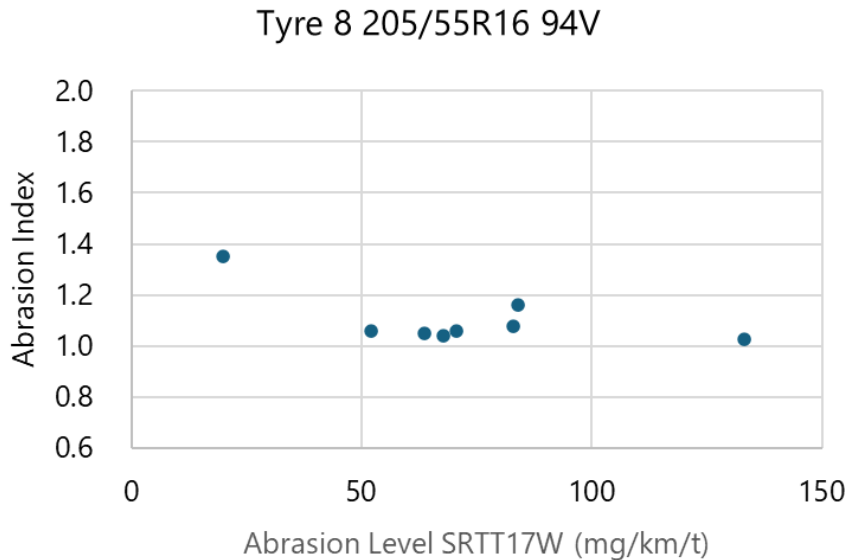
It has been confirmed that there is a correlation between the drum method and the vehicle method.

3. Drum test: Study on Improving the Accuracy of Indoor Drum Test Methods

The relationship between the SRTT abrasion level as the reference tyre and the Abrasion Index was investigated

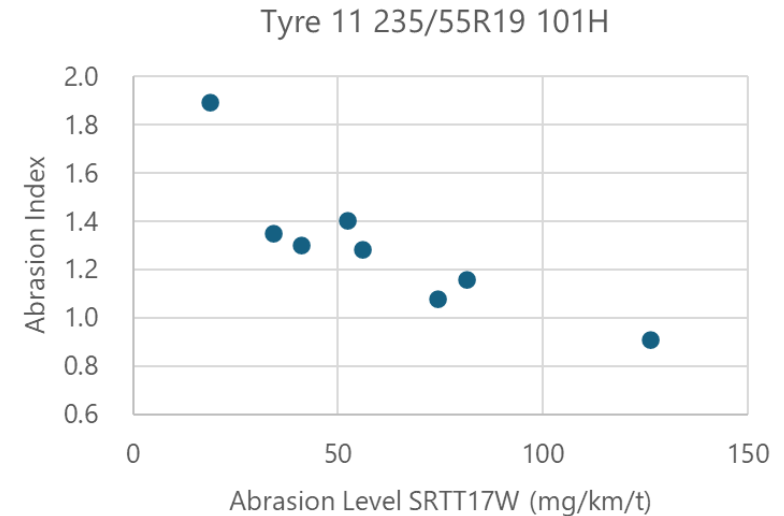
Majority

The AI remains stable regardless of SRTT abrasion level



Tyre code 8 205/55R16 94V : COVA Inter-testing facility variation Max 0.04

The SRTT abrasion level has an impact on the AI



Tyre code 11 235/55R19 101H : COVA Inter-testing facility variation Max 0.33

The results of the COVA test show that the Abrasion Index is generally not dependent on the SRTT abrasion level, but it was confirmed that there are tyres for which it is dependent. While there are not many such tyres, it was found that verifying a reference tyre could improve test accuracy.

It has been found that test accuracy can be improved by narrowing the range of SRTT abrasion level.

4. ETRTO drum test: Test conditions for drum test method

- The indoor drum test method proposed by JASIC aims to establish test conditions that represent global markets and to set necessary and sufficient parameters for drum testing, based on our accumulated knowledge and experience with tyre abrasion characteristics and drum tests.
- Technical analyses of test campaign results, COVA tests, and market assessment tests have been conducted to improve test accuracy.
- On the other hand, the drum test results reported by ETRTO in TFTA #37 differed in both test conditions and outcomes from the drum tests previously conducted in Japan (see TA-37-17 v1 for reference).
- As we prepare to propose further improvements to test accuracy at the GRBP meeting in September 2026, we believe it is necessary to not only analyze COVA tests and market assessment tests, but also to fully understand and analyze the test conditions used in the drum tests conducted by ETRTO. To this end, we have requested ETRTO to provide detailed information on their test condition settings and actual test data.
- At this stage, we would like to share an overview of the factors considered likely to affect test results.
- JASIC received data from ETRTO. Study on ETRTO drum test is ongoing.

Background and Purpose

At the last GRBP meeting, a presentation was given on the test results of the ETRTO drum method independently developed by ETRTO.

According to the presentation, the test results showed variation between TCs, yielding results different from the GRBP-82-29* drum method, and demonstrated poor correlation with the vehicle method.

Therefore, we analyzed the test conditions of the ETRTO drum method to identify the causes of variation in the ETRTO drum test and the reasons for the differing results compared to the GRBP-82-29 drum method.

* Informal document submitted to 82nd GRBP, contains update for drum test condition

reference: TA-37-17 v1 ETRTO Drum results for TFTA 20250826.pptx

ETRTO drum measurement preliminary results

- High variability of ETRTO drum results
- However identical parameters (same surface (with same brand), same schema for surface change, same 3rd body (with same brand) , same 3rd body flow, same animation, same tyre order, same (3/4) drum brand...)
- What is(are) the missing parameter(s)?

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Correlation ETRTO drum to Vehicle method

- Correlation drum to vehicle method is not convincing

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SRTT abrasion level variation, on drums and IFV circuit

- Strong variation for abrasion level for SRTT tyres on ETRTO drums, to be investigated.

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4. ETRTO drum test: Inflation pressure and load conditions

Inflation pressure conditions of ETRTO drum test varied by Test Centers.

Furthermore, the inflation pressure and load at each TC differed from the GRBP-82-29 drum method.

These differences are considered a contributing factor to the variation in the ETRTO drum test and to the results differing from the GRBP-82-29 drum method.

Test method			GRBP-82-29 Drum method	ETRTO drum test (○/× : Conformity with the GRBP-82-29 drum method)				
				E-Drum4	E-Drum5	E-Drum6	E-Drum7	E-Drum8
Inflation pressure (kPa)	Reference tyre	XL	250	290	250	290	250	290
				×	○	×	○	×
	Candidate tyre	SL	210	250				
				×				
		XL	250	290	250	290	250	290
				×	○	×	○	×
Load (% of max load capacity)	Reference tyre & Candidate tyre		80	74*				
				×				

*Only the TyreCode24 of the E-Drum4 was tested at 68% of its maximum load capacity.

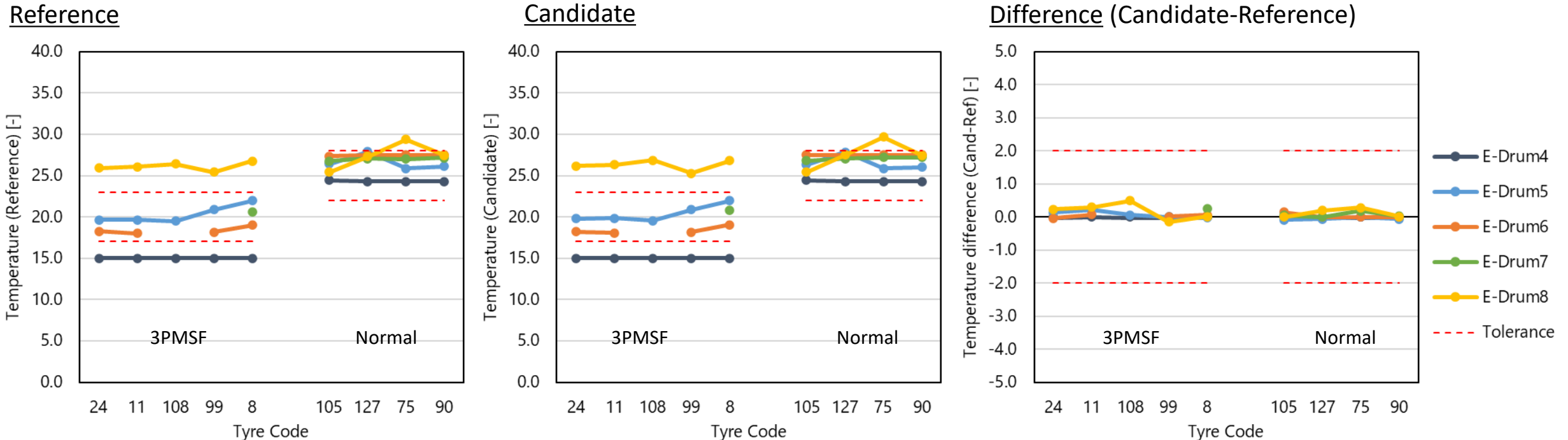
To accurately evaluate tyre abrasion performance, reference tyres must be tested at the same inflation pressure at all TCs. Furthermore, candidate tyres must be tested at appropriate inflation pressure conditions, not at the same pressure for SL and XL.

4. ETRTO drum test: Temperature conditions

Normal: Conducted within the range of 25°C +/- 3°C as specified by the GRBP-82-29 drum method(Except for E-Drum8 #166)

3PMSF: Testing on E-Drum5, 6, and 7 was conducted within the range of 25°C +/- 3°C as specified by the GRBP-82-29 drum method.

In contrast, Testing on E-Drum4 was conducted at approximately 15°C, and testing on E-Drum8 was conducted at approximately 25°C, almost same as the Normal tyre condition.



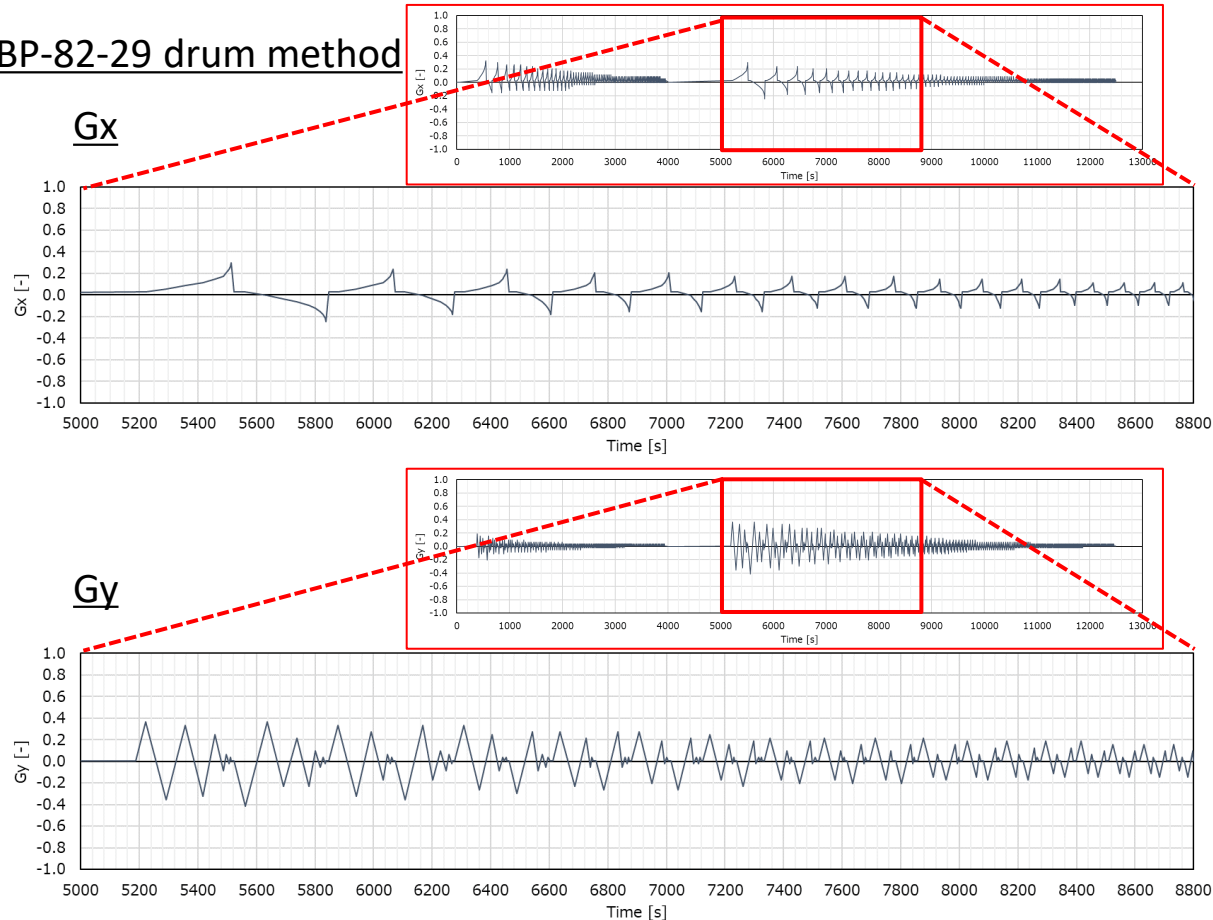
ETRTO proposes a test temperature of 15–20°C for 3PMSF, but many tyres actually tested by ETRTO were found to fall outside this 15–20°C range.

4. ETRTO drum test: Input conditions

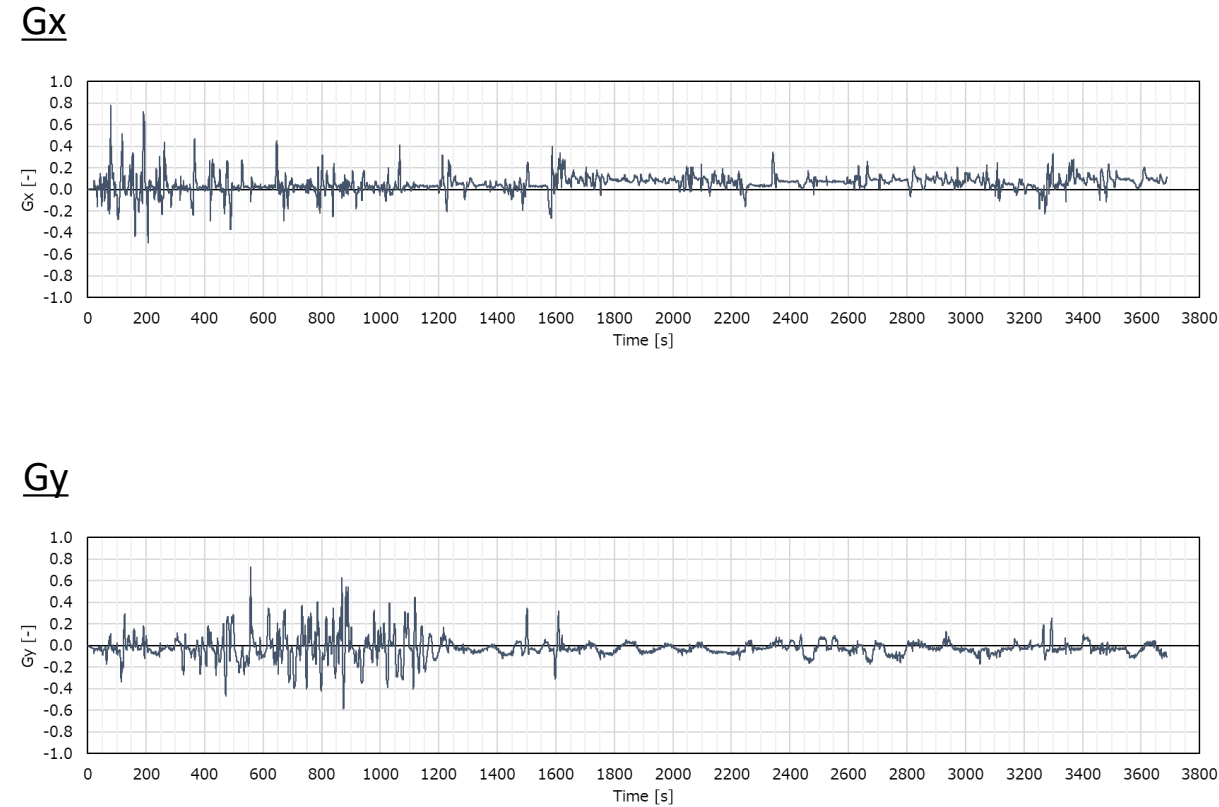
The Gx and Gy values in the ETRTO drum test exhibit rapid changes and higher peak values compared to the GRBP-82-29 drum method based on WLTC.

Such abrupt and large inputs raise concerns about the testing machine's ability to accurately follow the input, potentially contributing to RMSG values deviating from specifications. Furthermore, large input and high driving severity may lead to excessive wear severity.

GRBP-82-29 drum method



ETRTO drum test



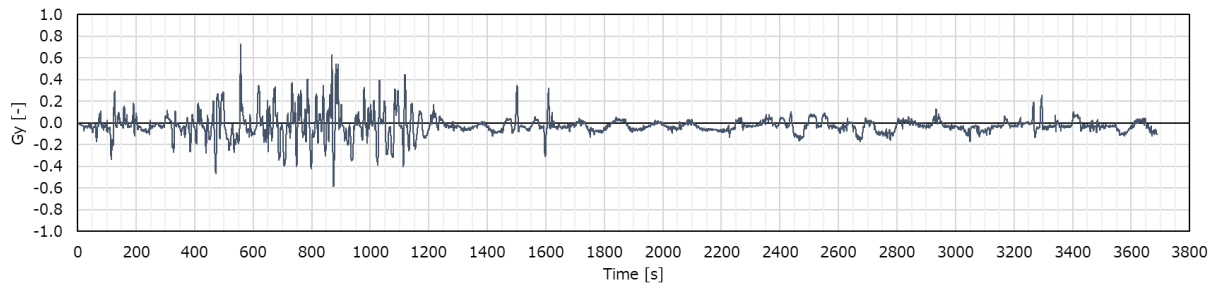
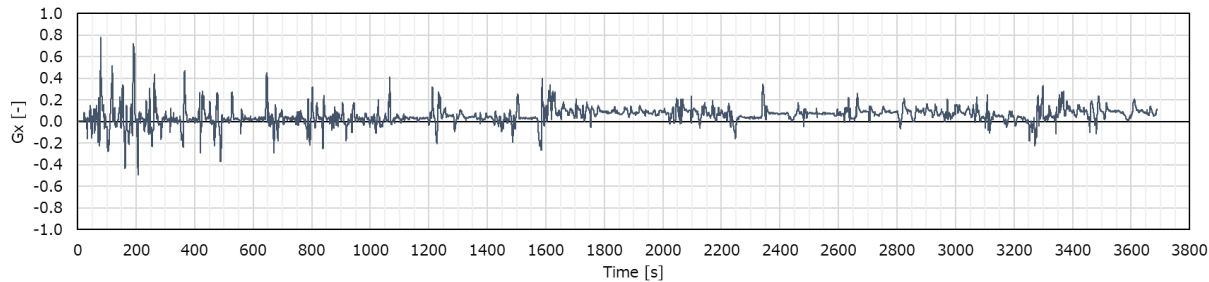
* Enlarge the red-framed area to match the horizontal axis of the ETRTO drum method.

4. ETRTO drum test: Input conditions

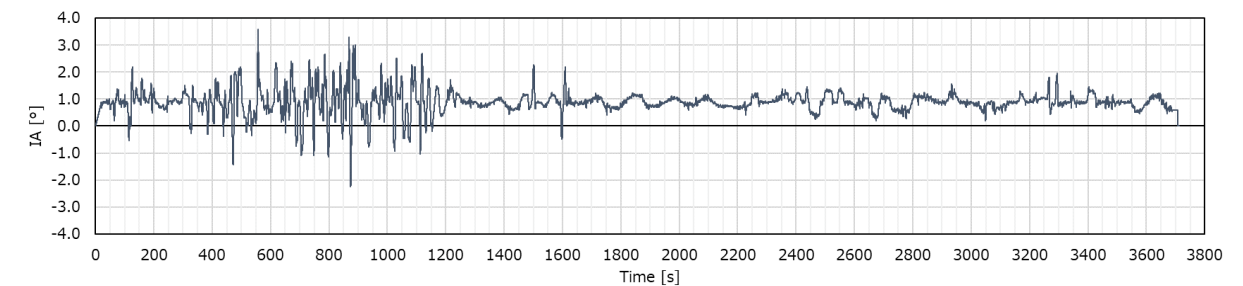
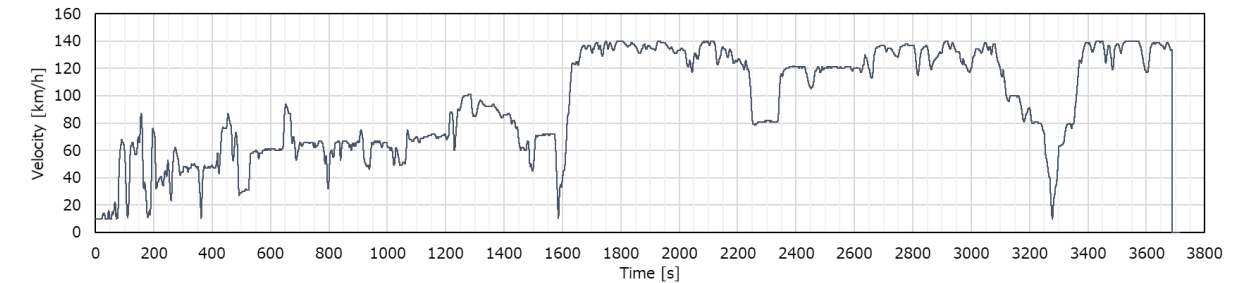
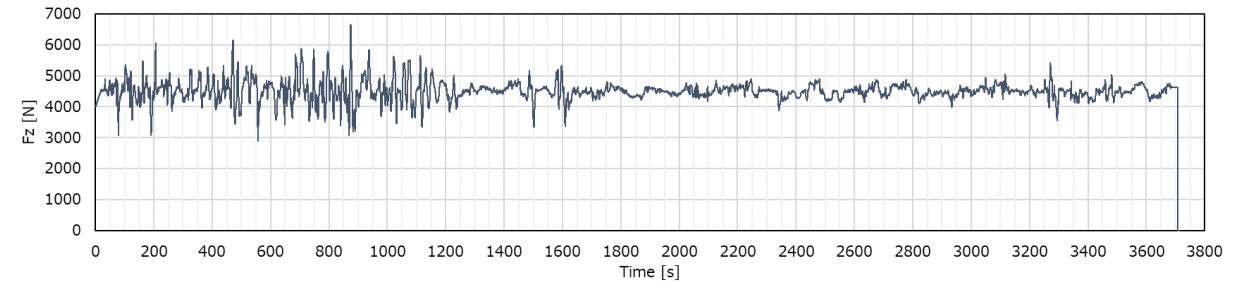
In the input mode of the ETRTO drum test, longitudinal and lateral forces change rapidly, while load, speed, and camber angle also change rapidly.

This raises concerns about the testing machine's ability to accurately follow the input, potentially contributing to RMS_G deviations from specifications.

Gx, Gy



Load, Speed, Camber angle



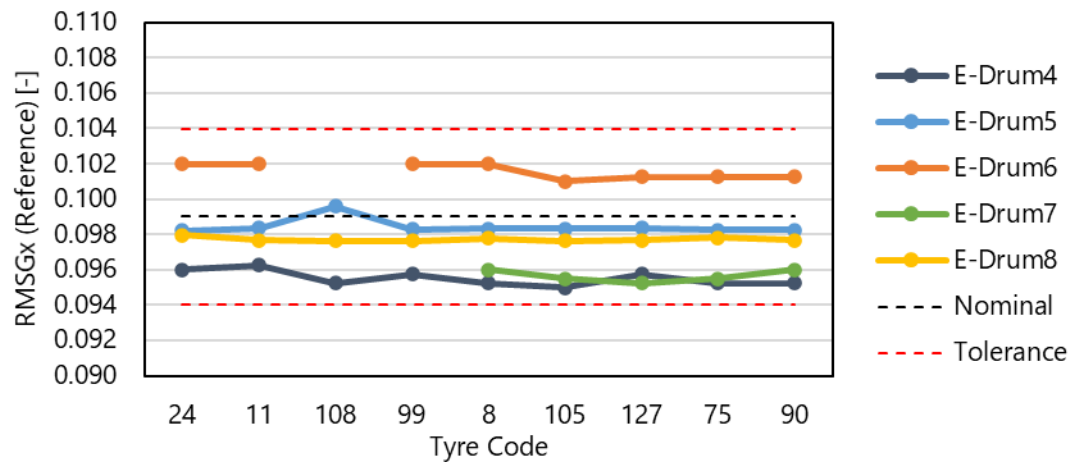
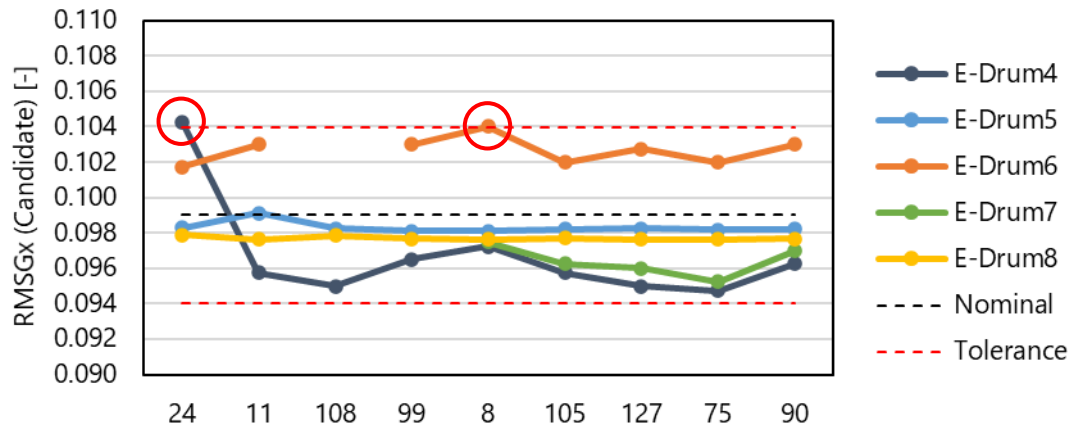
4. ETRTO drum test: RMS_G

The RMS_G values for the ETRTO drum test generally fall within the +/-5% tolerance range specified by the GRBP-82-29 drum method, though some data points deviate. (○)

In particular, RMS_{Gy} shows data points significantly outside the tolerance range, and these are considered to be the cause of variation.

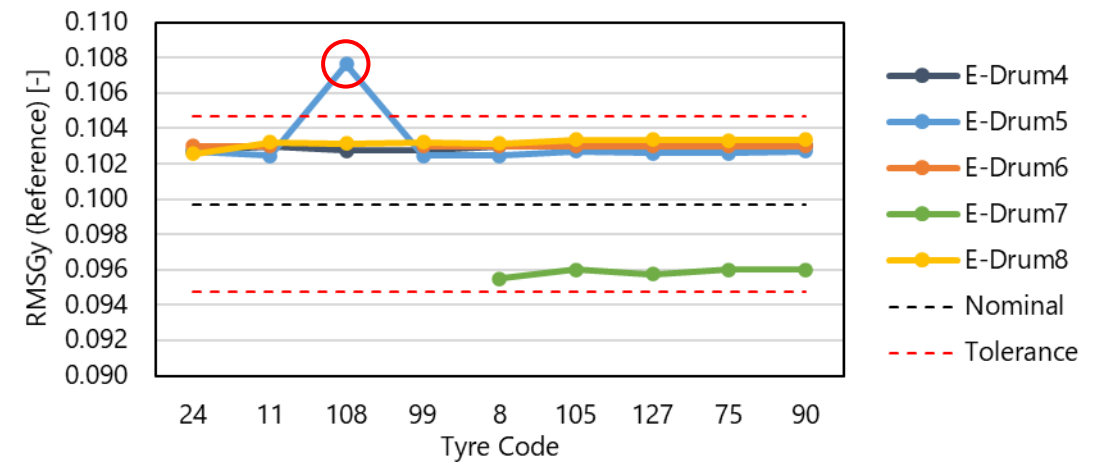
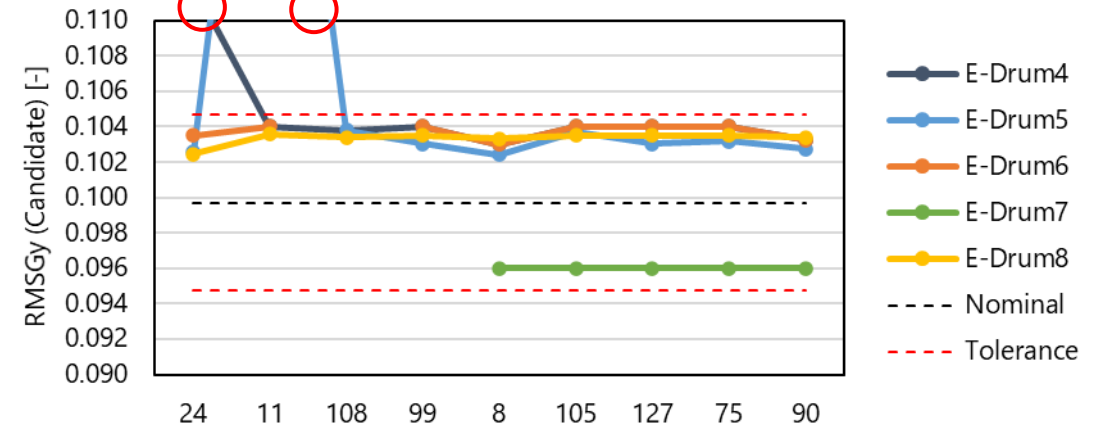
RMS_{Gx}

$$RMS_{Gx} = \sqrt{\frac{1}{N} \sum_{i=1}^N \left(\frac{Fx_i}{Fz_i} \right)^2}$$



RMS_{Gy}

$$RMS_{Gy} = \sqrt{\frac{1}{N} \sum_{i=1}^N \left(\frac{Fy_i}{Fz_i} \right)^2}$$



4. ETRTO drum test: Abrasion level of the reference tyre

The ETRTO drum method has a driving severity level approximately twice that of the GRBP-82-29 drum method, resulting in a higher average abrasion level for the reference tyre.

Excessive conditions may lead to reduced test accuracy; therefore, the abrasion level of the reference tyre must be kept at or below an appropriate value.

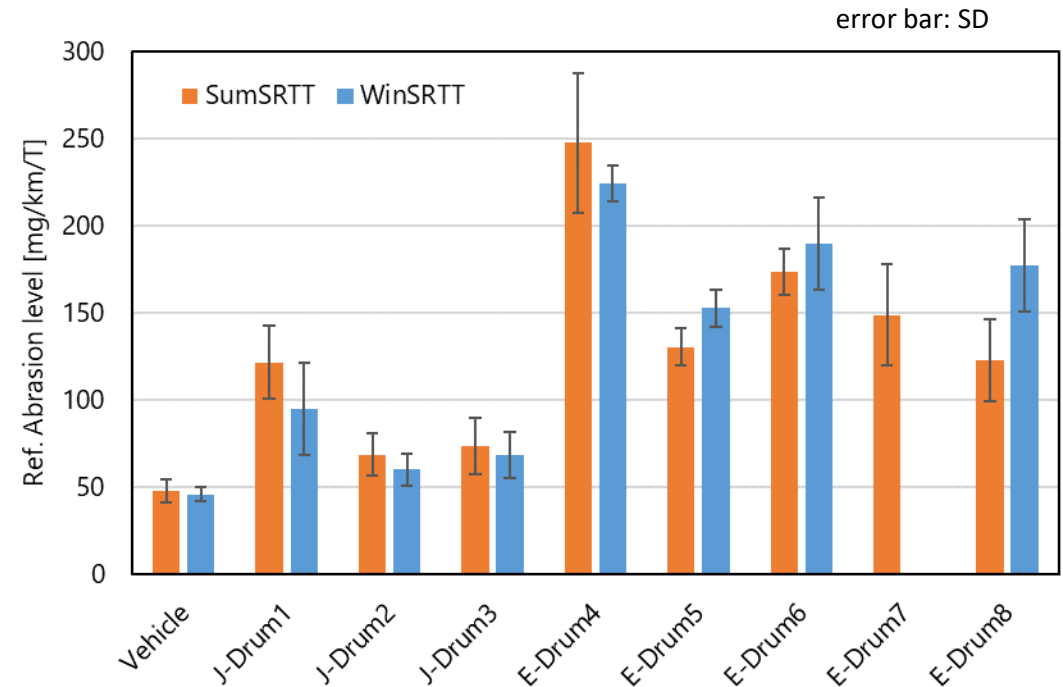
Comparison of nominal $RMS_{\underline{G}}$

	GRBP-82-29 Drum method	ETRTO drum test
RMS_{G_x}	0.059	0.099
RMS_{G_y}	0.074	0.100

Ref) Driving severity ratio

	$(ETRTO/GRBP-82-29)^2$
RMS_{G_x}	2.82
RMS_{G_y}	1.83

Average abrasion level of SRTT



JASIC is currently reviewing the flow rate of the third-body to optimize the wear level of the reference tyre.

Additionally, JASIC is considering revising the upper limit for the specified abrasion level of the reference tyre.

4. ETRTO drum test: Summary

Inflation pressure and load

Inflation pressure for the ETRTO drum test varied between TCs.

Furthermore, Inflation pressure and load conditions also differed from the GRBP-82-29 drum test method.

These differences are considered a contributing factor to the variation in the ETRTO drum test and to the results differing from the GRBP-82-29 drum method.

Temperature

Temperature for the ETRTO drum test was within the range of $25^{\circ}\text{C} \pm 3^{\circ}\text{C}$ specified by the GRBP-82-29 drum method for Normal tyres.

For 3PMSF tyres, ETRTO recommends a temperature of $15\text{--}20^{\circ}\text{C}$. However, some TCs conducted tests within the $25^{\circ}\text{C} \pm 3^{\circ}\text{C}$ range specified by GRBP-82-29, others conducted tests at approximately 15°C , and still others conducted tests at approximately 25°C , similar to Normal tyre condition.

4. ETRTO drum test: Summary

Input mode

In the ETRTO drum test, longitudinal force, lateral force, load, speed, and camber angle change simultaneously over a short period. Additionally, peak values for G_x and G_y are large. Such abrupt and complex inputs raise concerns about the testing machine's ability to follow the input, potentially contributing to RMS_G values deviating from specifications. Furthermore, the high driving severity may lead to excessive wear severity.

RMS_G

The RMS_G data from the ETRTO drum test showed values outside the 5% tolerance specified by the GRBP-82-29 drum method, with RMS_{G_y} in particular exhibiting significant deviations. These deviations are the cause of test variability, and to achieve a precise test, it is necessary to keep the RMS_G within the specified range.

Abrasion level of SRTT

The ETRTO drum method has a driving severity level approximately twice that of the GRBP-82-29 drum method, resulting in a higher average abrasion level for the reference tyre.

Excessive conditions may lead to reduced test accuracy; therefore, the abrasion level of the reference tyre must be kept at or below an appropriate value.

JASIC is currently reviewing the flow rate of the third-body to optimize the wear level of the reference tyre.

Additionally, JASIC is considering revising the upper limit for the specified abrasion level of the reference tyre.

- JASIC is working together with ETRTO and JRC to enhance the accuracy of both test methods.

- Overall Summary
 - ✓ Several factors causing variation in vehicle test have been identified.
 - ✓ It has been determined that outliers in market assessments can be mitigated by controlling these testing variation factors.
 - ✓ Direction for improving the accuracy of the drum test method.

- By enhancing test accuracy, it is anticipated that consistent test results will be obtained.

- The drum tests conducted by ETRTO differed in test conditions from the GRBP-82-29 test method, and test conditions also varied between Test Centers. Different test conditions may result in different test results.