

# Development of tyre abrasion test methods by Indoor Drum Method

TF TA

2nd September, 2022



JAPAN AUTOMOBILE STANDARDS INTERNATIONALIZATION CENTER

- ◆ Test machine
- ◆ Running condition
  - Force condition
  - Others
- ◆ Drum Surface
  - Texture & Material
  - Control
- ◆ Environment
- ◆ Sequence
- ◆ Validation
- ◆ Measurement
- ◆ Evaluation

## Test machine :

- ❑ Test Drum: External Drum
- ❑ Drum diameter, width : 1.7m or above, more than tyre width

## Running condition

- ❑ Tyre Load : 80% of the tyre LI
  
- ❑ Tyre inflation pressure :
  - ✓ Standard Load: 210kPa
  - ✓ Reinforced, Extra load: 250kPa
  
- ❑ Force condition : Condition proposed by JARI →Next page
  
- ❑ Running distance : 5000km
  
- ❑ Running velocity : Constant speed (60km/h for mountain/slope, 100km/h for flat road)

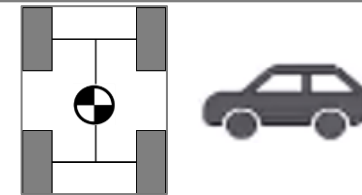
## Force mode Concept

- ◆ Drum running mode based on **WLTC**
- ◆ **“Curve and Slope”** running mode is added as lateral force is a necessary element for tyre wear

### Measurement Vehicle data

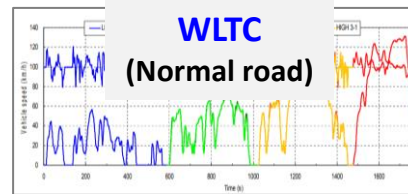
\*selecting representative public road

speed, m/s<sup>2</sup>  
steering angle  
gradient  
...

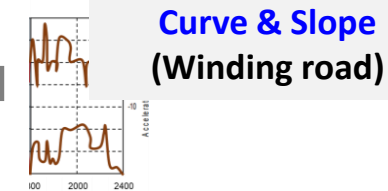


### Conversion to tyre input

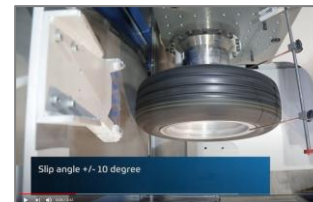
\*using the vehicle models



PLUS

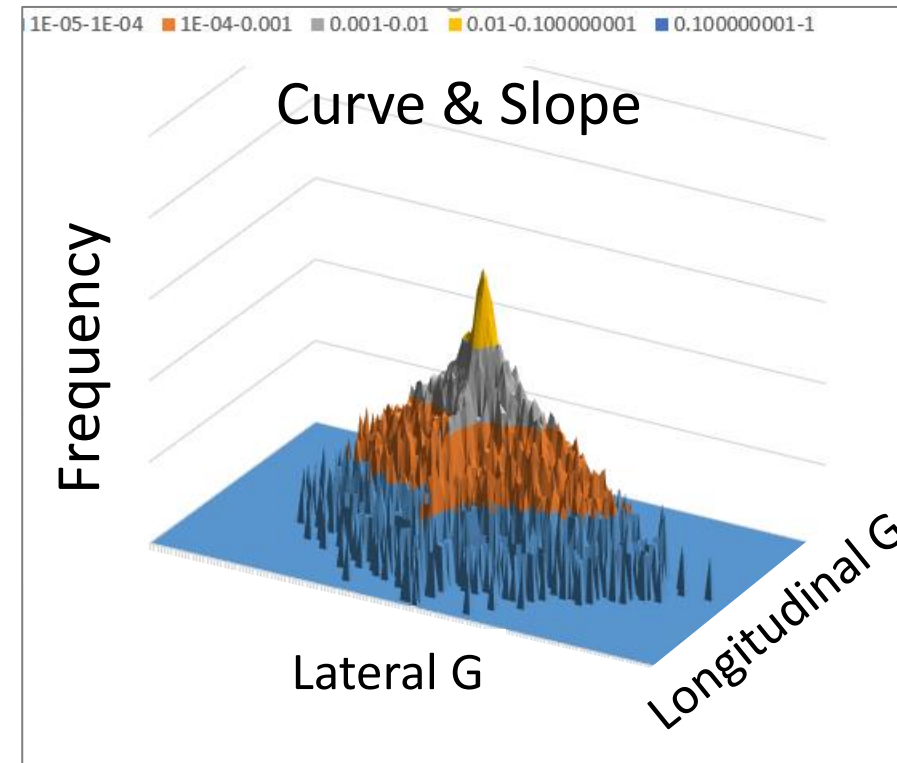
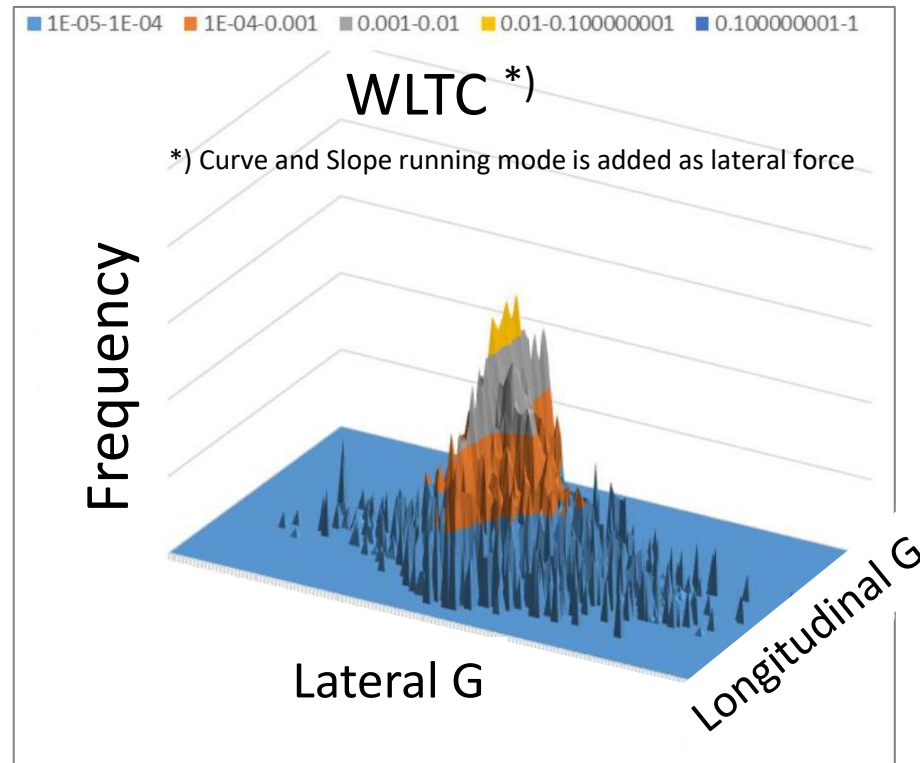


### Conversion to drum testing conditions

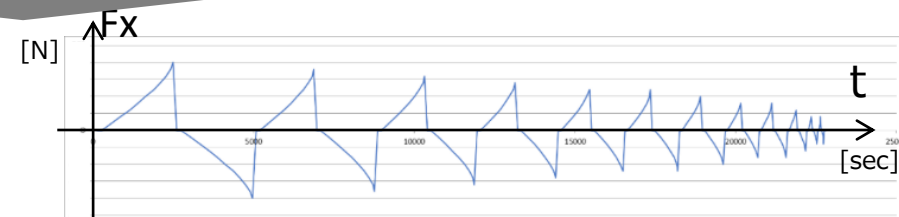
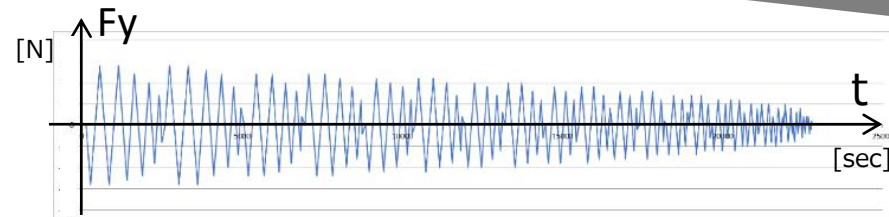


- ✓ Converting the vehicle driving conditions representing the world into the test conditions of indoor drums
- ✓ Drum running mode developed by contract research to JARI, a core member of developing **WLTP / GTR-15**

\*JARI: Japan Automobile Research Institute



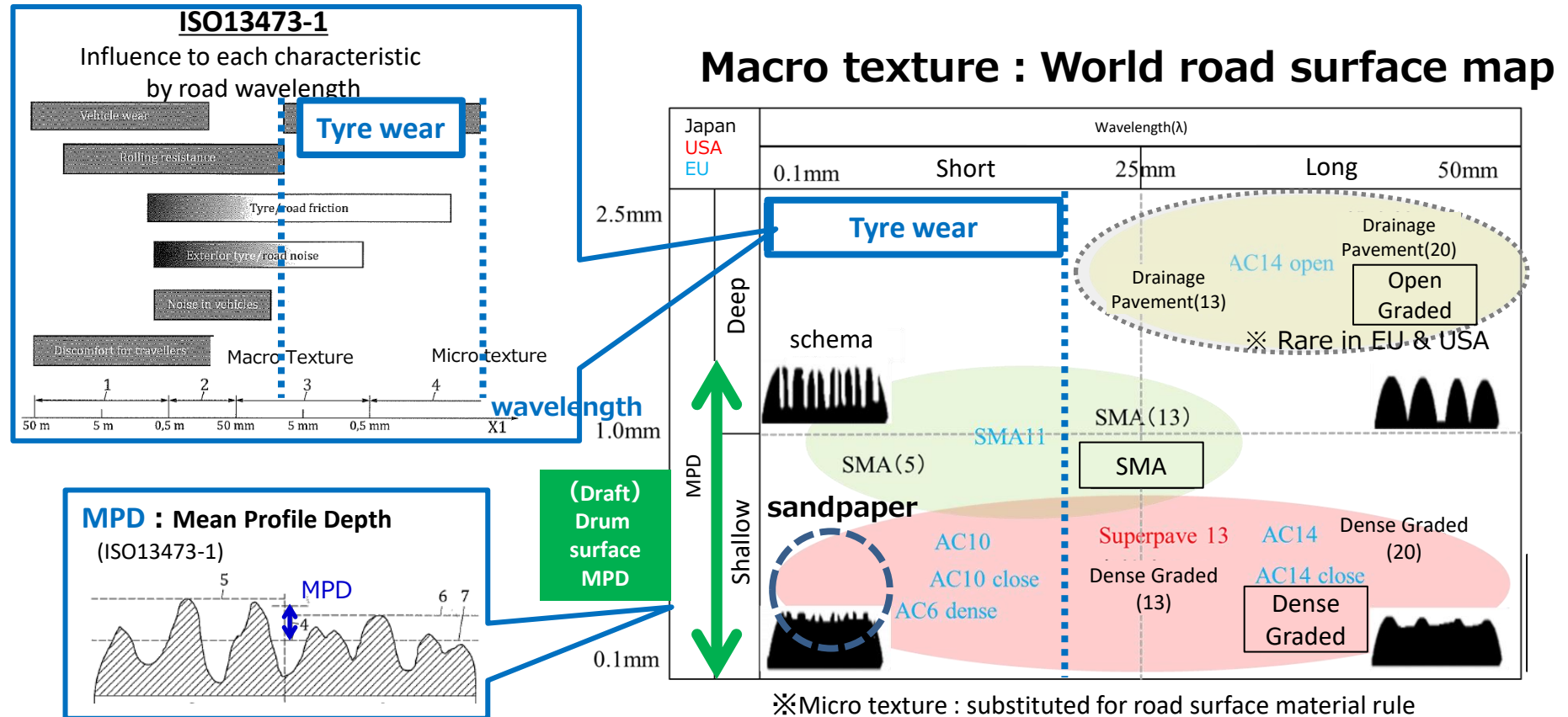
Conversion to Drum testing conditions



## Drum Surface

- ❑ Texture : The range of surface shape [MPD, xx;xx] →Next page
  
- ❑ Material : Sand or stone or substitute materials shall be the constituent elements of a drum surface  
→Next page
  
- ❑ Control : Keep dry and Clean
  - ✓ Measure [MPD] before and after the test

Mapping world road surface by wavelength and MPD to define drum surface shape as tyre wear depends on road surface characteristics



MPD is used in ISO 10844\* as the definition of road surface roughness. (\*Test track for noise)

**Drum surface is defined by road surface shape [MPD]**

## Environment

- ❑ Preparation : 3-hour conditioning
- ❑ Ambient Temperature : 25°C +/- 5°C
- ❑ Prevention of gumming : Gumming shall be prevented by certain method
  - ✓ Accepting any de-gumming devices or methods as already applied to existing indoor abrasion drum

## Sequence

- ❑ 2-position : Test both SRTT and candidate at the same time
- ❑ 1- position : Test SRTT and Candidate tyres alternately
  - ✓ SRTT 1000km → Cand. 2000km → SRTT 2000km → Cand. 2000km → SRTT 2000km → Cand. 1000km



1 Drum 2 Position



1 Drum 1 Position



<https://www.mts.com/jp/products/automotive/tire-test-systems/tire-treadwear>

\* The picture / company is just an example.



## Validation

- ❑ Abrasion rate of reference tyre SRTT16 : [xx;xx] mg/km
  
- ❑ Record actual force level
  - ✓ accuracy : +/- [xx ]N or +/- [x]%, whichever is greater
  
- ❑ Abrasion status : record photos of tyres after test

## Measurement

- ❑ Mass loss : Measure mass of the tyre-rim assembly before and after test

## Evaluation

- ❑ Abrasion rate : Mass loss per kilometer (mg/km)
  
- ❑ Abrasion index : Mass loss of candidate compared to mass loss of SRTT

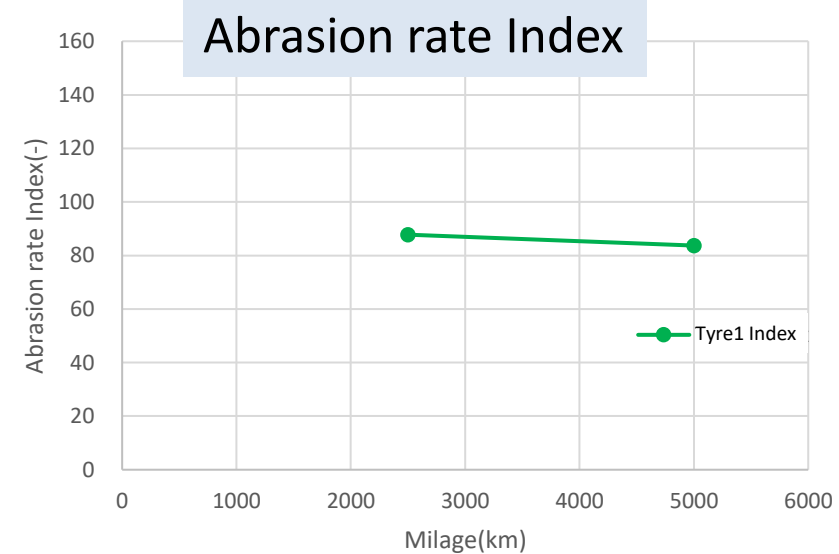
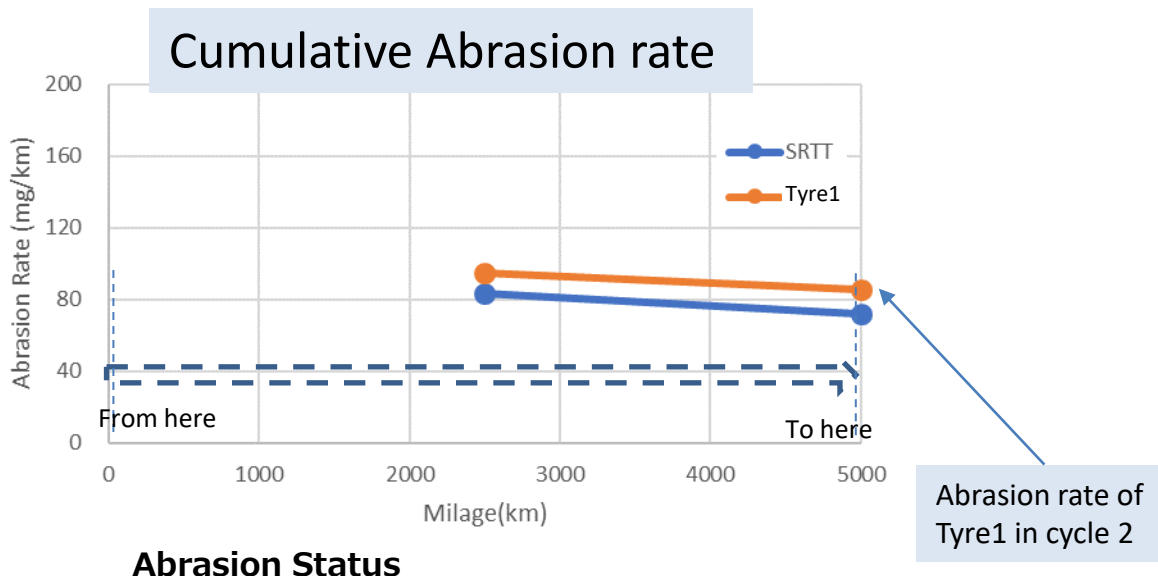
We are proceeding the verification test for indoor testing method.

Purpose	Test machine	Drum surface	Mileage	Tyre Size	Note
Wear rate investigation(Summer)	A,B	Sandpaper #80	5000	P225/60R16 97S 225/60R16 98H	Including below comparison; -Testing location -Sequence -temperature control -repeatability
Wear rate investigation(Winter)	A,B			P225/60R16 97S 205/55R16 91H	

Indoor testing method can control testing condition so no need to evaluate factor dependence.  
 → Short term development of testing method can be expected.

# Indoor Test result: Abrasion Rate (1 drum 2 position)

JASIC is conducting Round Robin Test of indoor drum method in JATMA members by draft test condition.  
 Purpose : Results comparison among testing machine type / tyre category difference



### Abrasion Status

SRTT P225/60R16 97S	Tyre1 225/60R16 98H

	Size	LISS	comment
SRTT	P225/60R16	97S	As Reference
Tyre1	225/60R16	98H	Summer

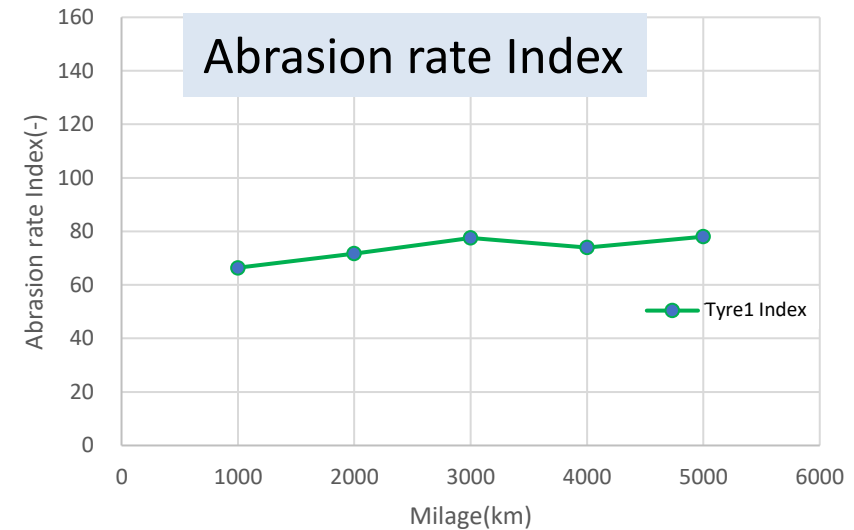
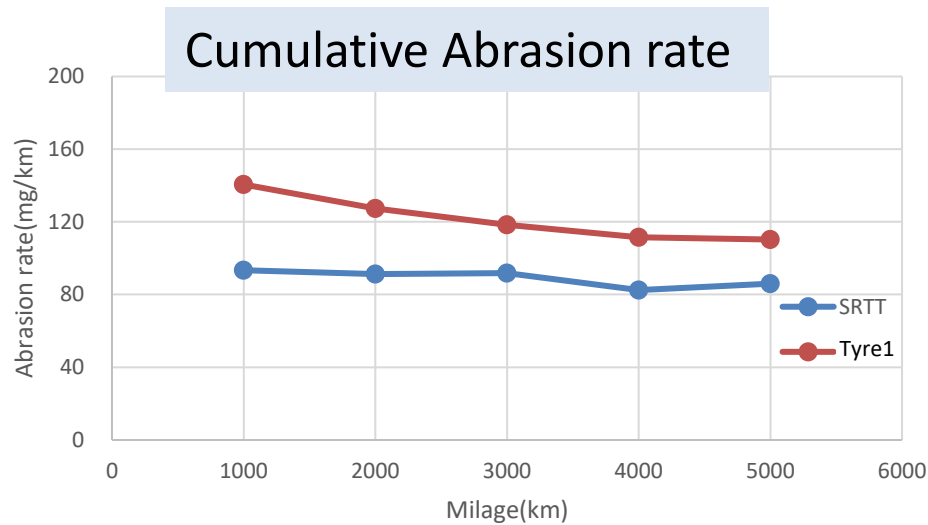
$$\text{✱ Abrasion rate Index} = \text{SRTT} / \text{Tyre1} \times 100$$

Sequence: 1 drum 2 position

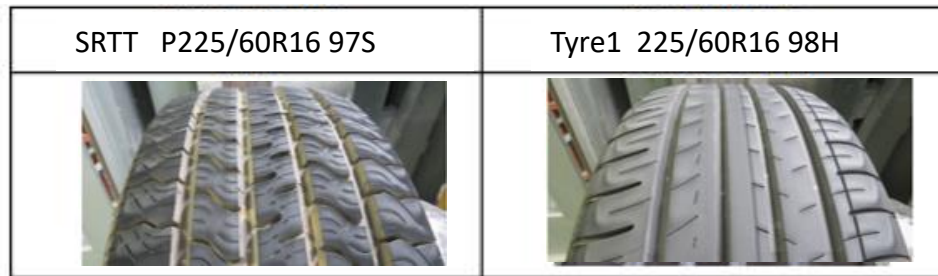
Conducted at the same time of different tyres (Tyres were mounted different position of one drum)

# Indoor Test result: Abrasion Rate(1 drum 1 position)

JASIC is conducting Round Robin Test of indoor drum method in JATMA members by draft test condition.  
 Purpose : Results comparison among testing machine type / tyre category difference



### Abrasion Status



	Size	LISS	comment
SRTT	P225/60R16	97S	As Reference
tyre1	225/60R16	98H	Summer

Sequence: 1 drum 1 position

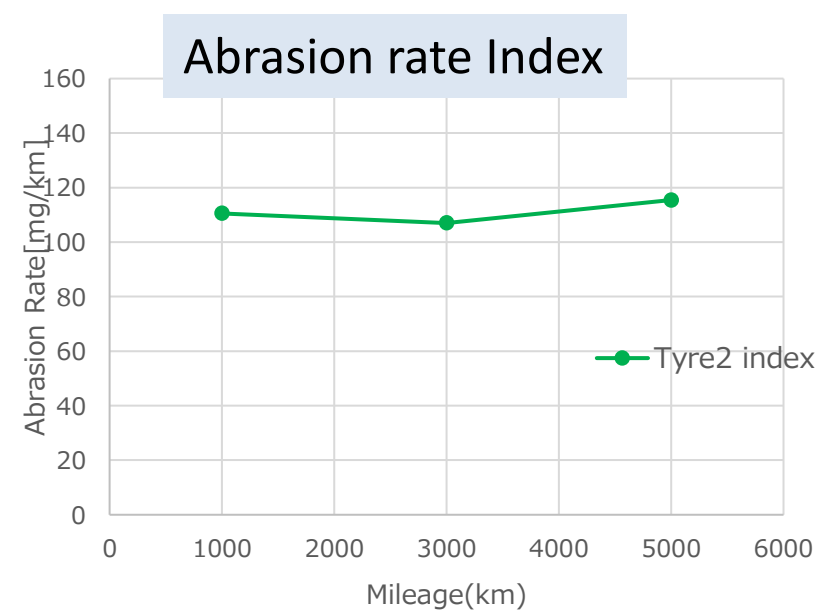
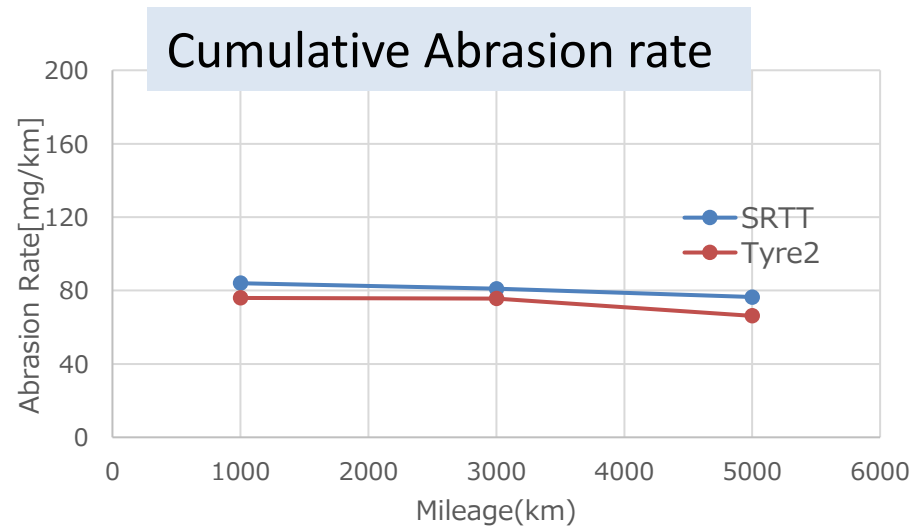
Test SRTT and Candidate tyres alternately

✓ SRTT 1000km → Cand. 2000km → SRTT 2000km → Cand. 2000km → SRTT 2000km → Cand. 1000km

$$\text{✱ Abrasion rate Index} = \text{SRTT} / \text{Tyre1} \times 100$$

# Indoor Test result: Abrasion Rate (1 drum 2 position)

JASIC is conducting Round Robin Test of indoor drum method in JATMA members by draft test condition.  
 Purpose : Results comparison among testing machine type / tyre category difference

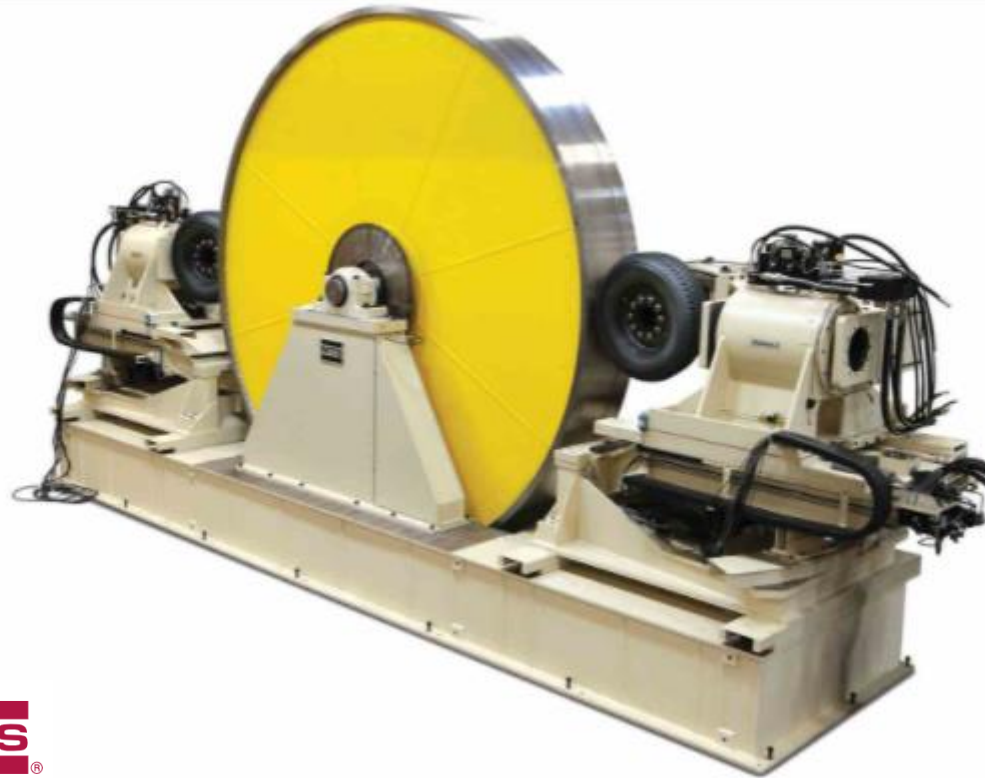


	Size	LISS	comment
SRTT	P225/60R16	97S	As Reference
Tyre2	205/55R16	91H	Winter

※ Abrasion rate Index =  $\frac{\text{SRTT}}{\text{Tyre2}} \times 100$

Conducted at the same time of different tyres (Tyres were mounted different position of one drum)

Wear drum testers are available in general, commonly sold by testing machine manufacturer.



<https://www.mts.com/en/products/automotive/tire-test-systems/tire-treadwear>



<https://www.youtube.com/watch?v=Ve8Kwv6UB9s>

Anyone can test under the same conditions anywhere in the world using indoor wear testing method.

Indoor testing method has already been proposed to ISO by Japan.  
 Development schedule of ISO standard matches below TF TA schedule.

TF TA		ISO TC31 WG13	
Apr 2022	Kicked off	Jun 2022	New Work Item Proposal
		Sep 2022	Working Draft
		Mar 2023	Committee Draft
Sep 2023	<b>Informal document (78<sup>th</sup> GRBP)</b>	Sep 2023	<b>Draft International Standard</b>
Jan 2024	<b>Working document (79<sup>th</sup> GRBP)</b>	Jun 2024	Publication



Indoor testing method also should be discussed in TF TA with vehicle testing method.

Japan believes that Indoor Drum Method will benefit all stakeholders

- Indoor Drum Method has an advantage to control variation factors.
- Wear drum testers are available in general, commonly sold by testing machine manufacturer.
- Anyone can test under the same conditions anywhere in the world using indoor wear testing method.
- Test condition of Indoor Drum Method is based on the WLTC that is representing the driving condition of the world.



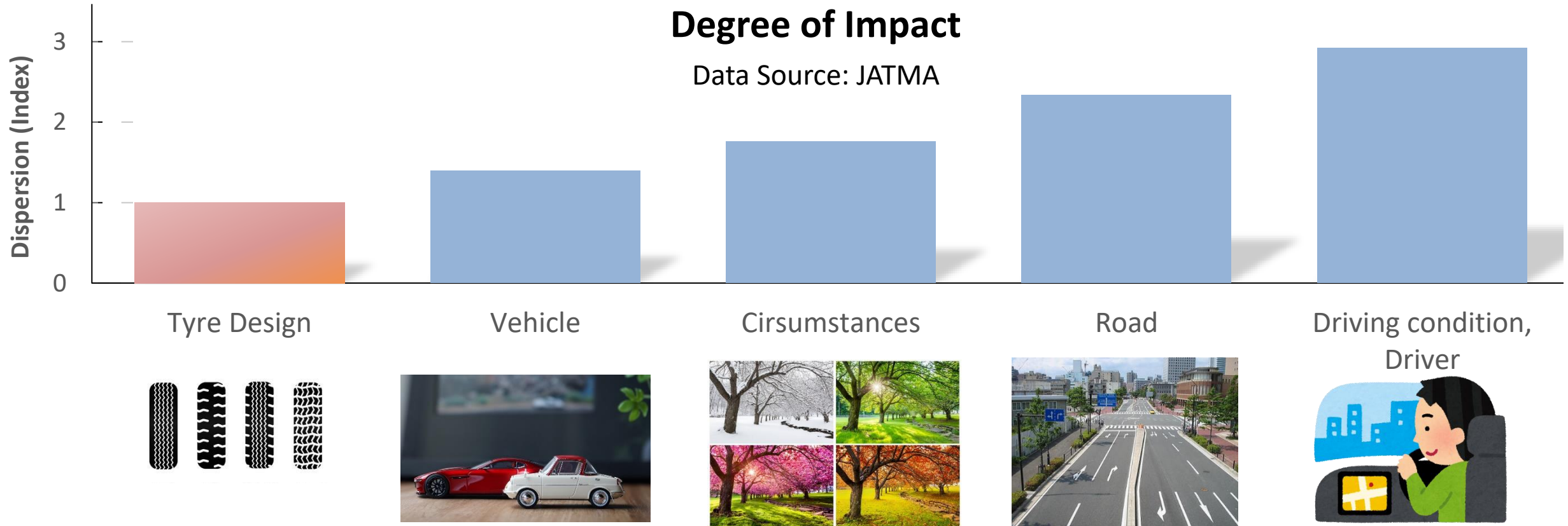
Requirements for a tyre abrasion test method could be considered as follows

- The driving mode must be representative of the world
- Factors other than tyres should be controlled since evaluation of tyre performance is the purpose of the test
- The test precision should be sufficiently high
- The test must be fair and can be conducted anywhere by anyone

**Japan proposes that the TF TA discuss tyre abrasion test methods taking these requirements into account**

# APPENDIX

Vehicle, Circumstance (weather, climate...) , Road and Driving conditions and Driver are known as factors affecting tyre wear



- These 4 factors affect tyre wear greater than tyre design
- Test methods need to control these 4 factors