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THAILAND

AUTOMOTIVE SUMMIT 2016

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ME MANUFACTURING EXPO 2016

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THAILAND AUTOMOTIVE INSTITUTE
สถาบันยานยนต์

REED TRADEX Reed Tradex

Measuring Hubs – for Tyre Testing with the Highest Precision

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Content

- Intro & Basics
- Motivation
- Comfort Measurements
- Efficiency Measurements
- Trends
- Summary

1959
foundation of Kistler Switzerland

1500
employees worldwide

57
years of technology know-how

70%
of sales to the automotive industry

56
locations worldwide

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Measurable physical variables

Force

Pressure

Torque

Acceleration

Electrical pulse

Displacement

Speed

…

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- Compact design results in a stiff structure with high eigenfrequency
- Sensor located as close to the tire contact patch reduces impacts from machine structure and eliminates parasitic losses

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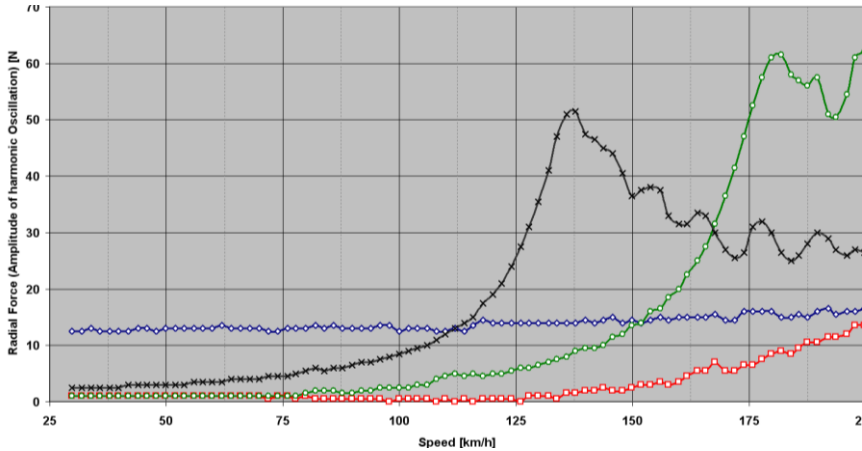
Motivation

- Quality
- Performance / Comfort
- Economic → Lifetime, Rolling Resistance
- Safety → braking/ friction
- Fullfil local and global Regulations
- Verification of Tire Models

Application: Comfort measurements

- High speed uniformity HSU
- Flat spot



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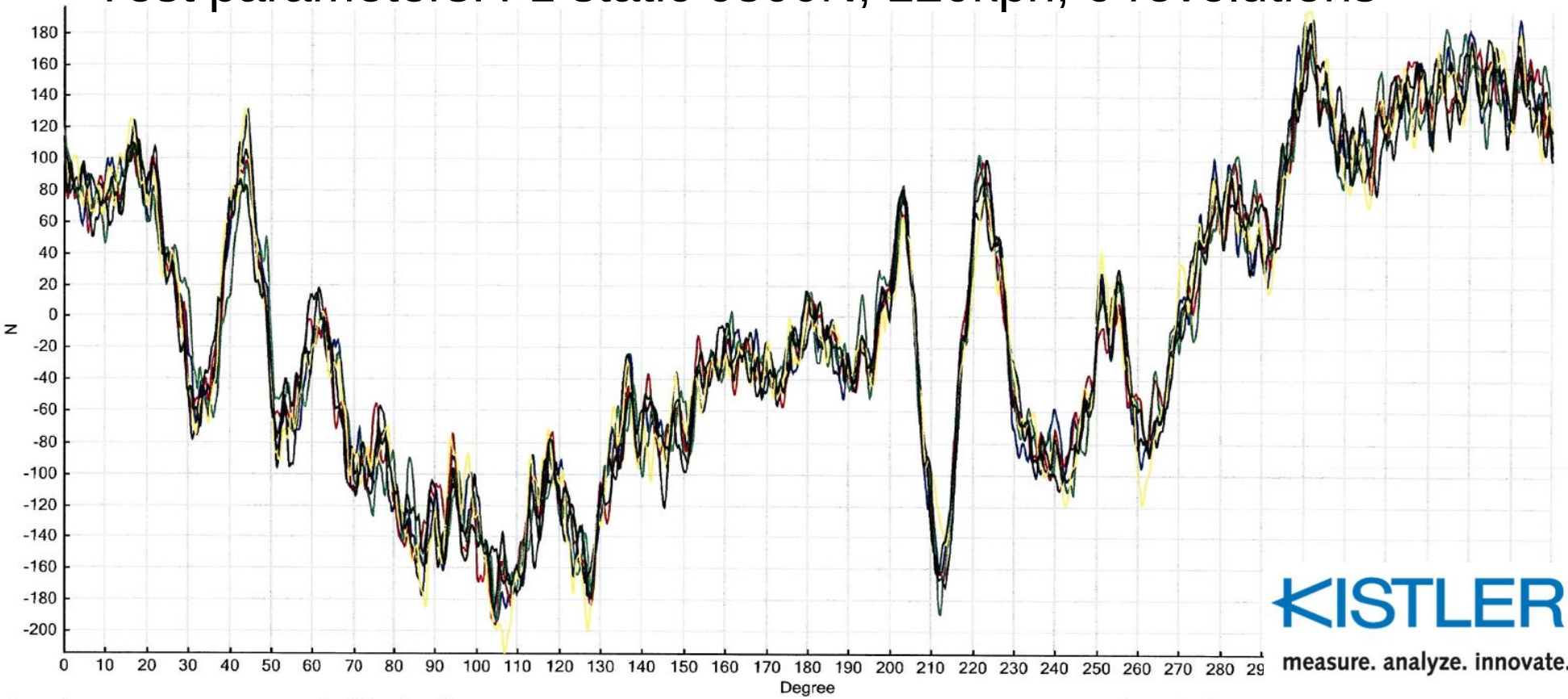
Application: Comfort measurements, HSU, RFV

Test parameters: Fz static 6300N, 120kph, 6 revolutions



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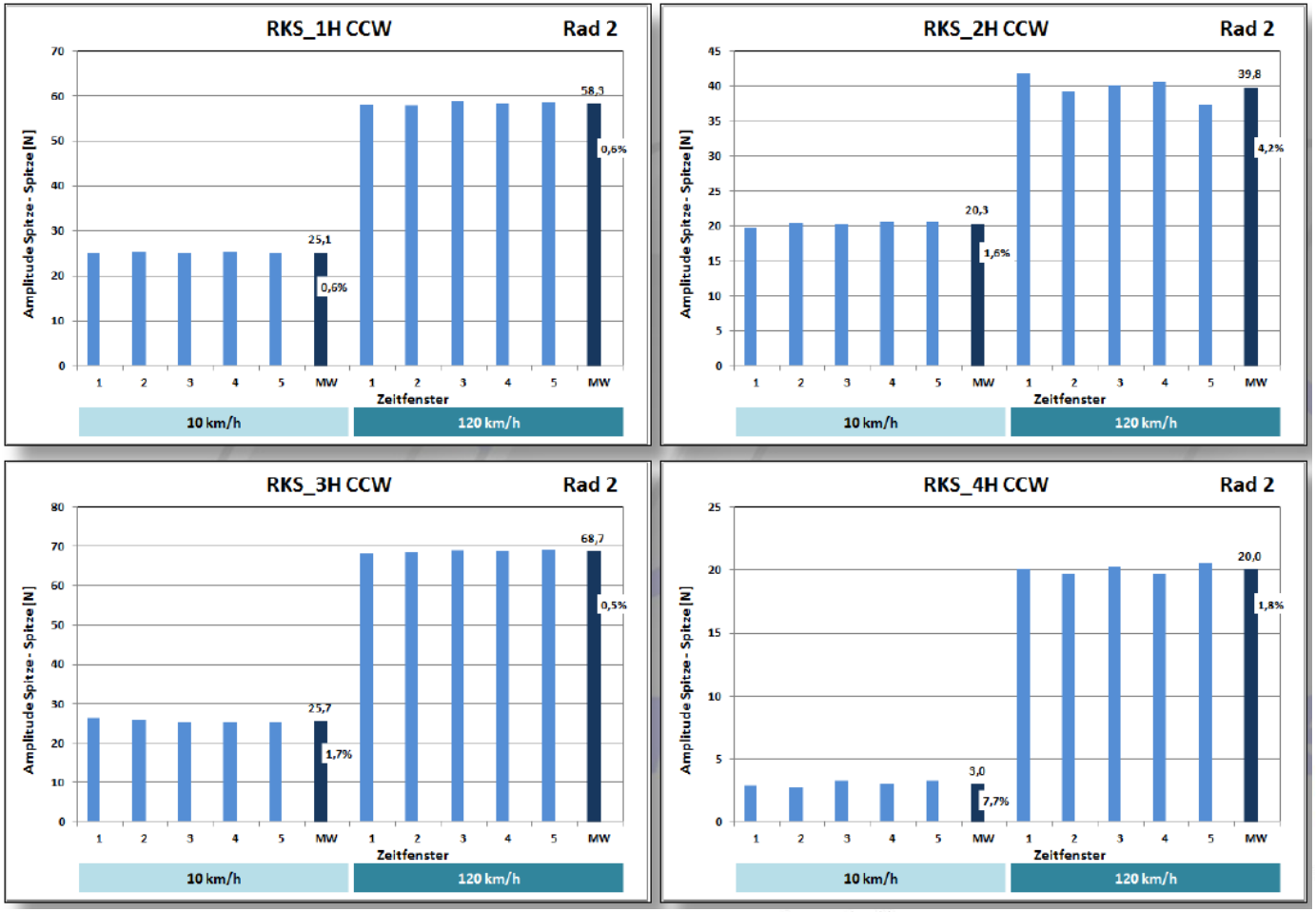
Application: Comfort measurements, HSU, LFV

- Fz 4 kN
- Average of 10 measurements

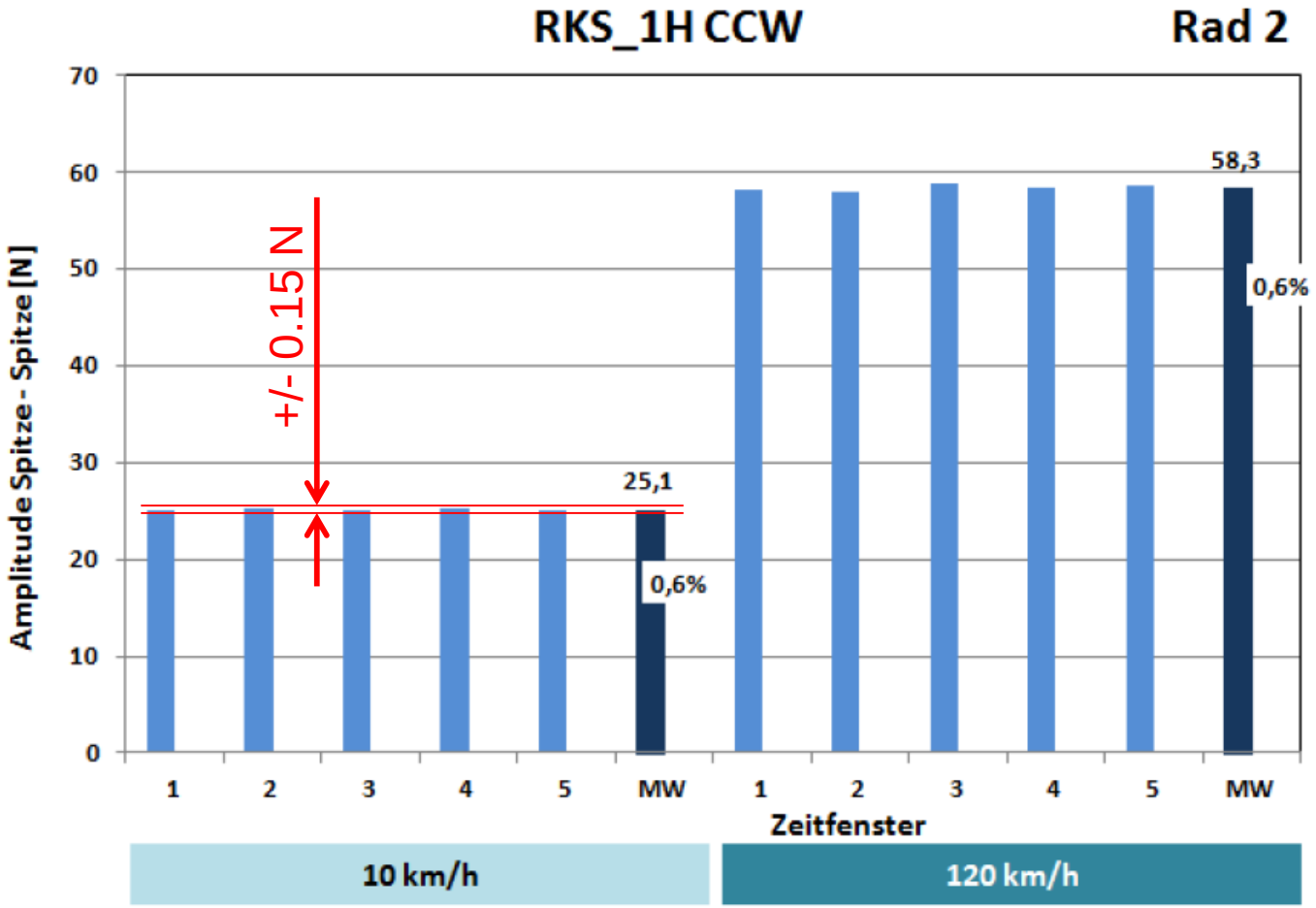


Source: IPW (2014)

Application: Comfort measurements, HSU

- Fz 4 kN
- Average of 10 measurements
- 25,1N / ±0,6% = ± 0.15N

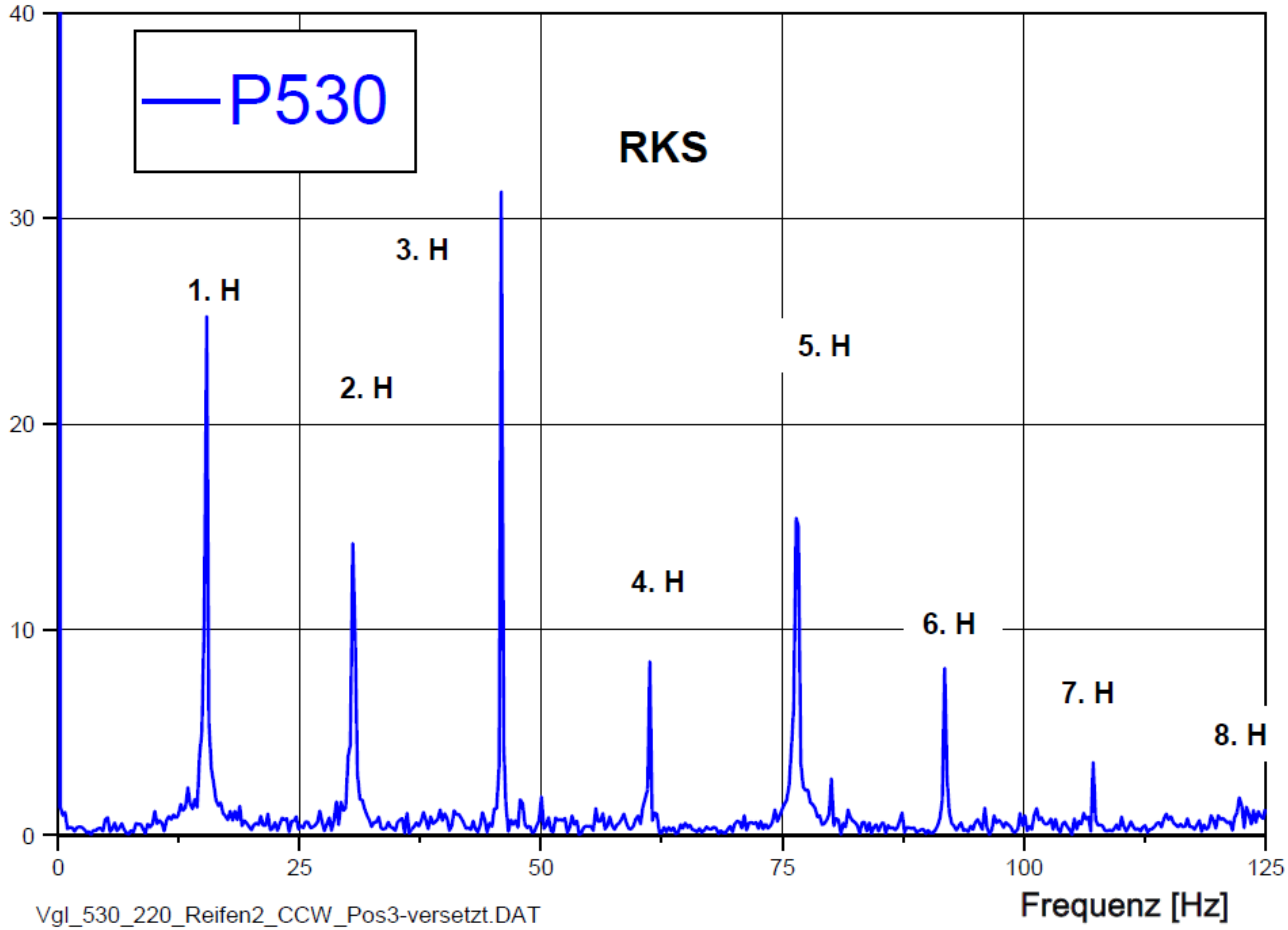
→ ± 0,00375% of 4000N !



Source: IPW (2014)

Application: Comfort measurements, HSU, RFV

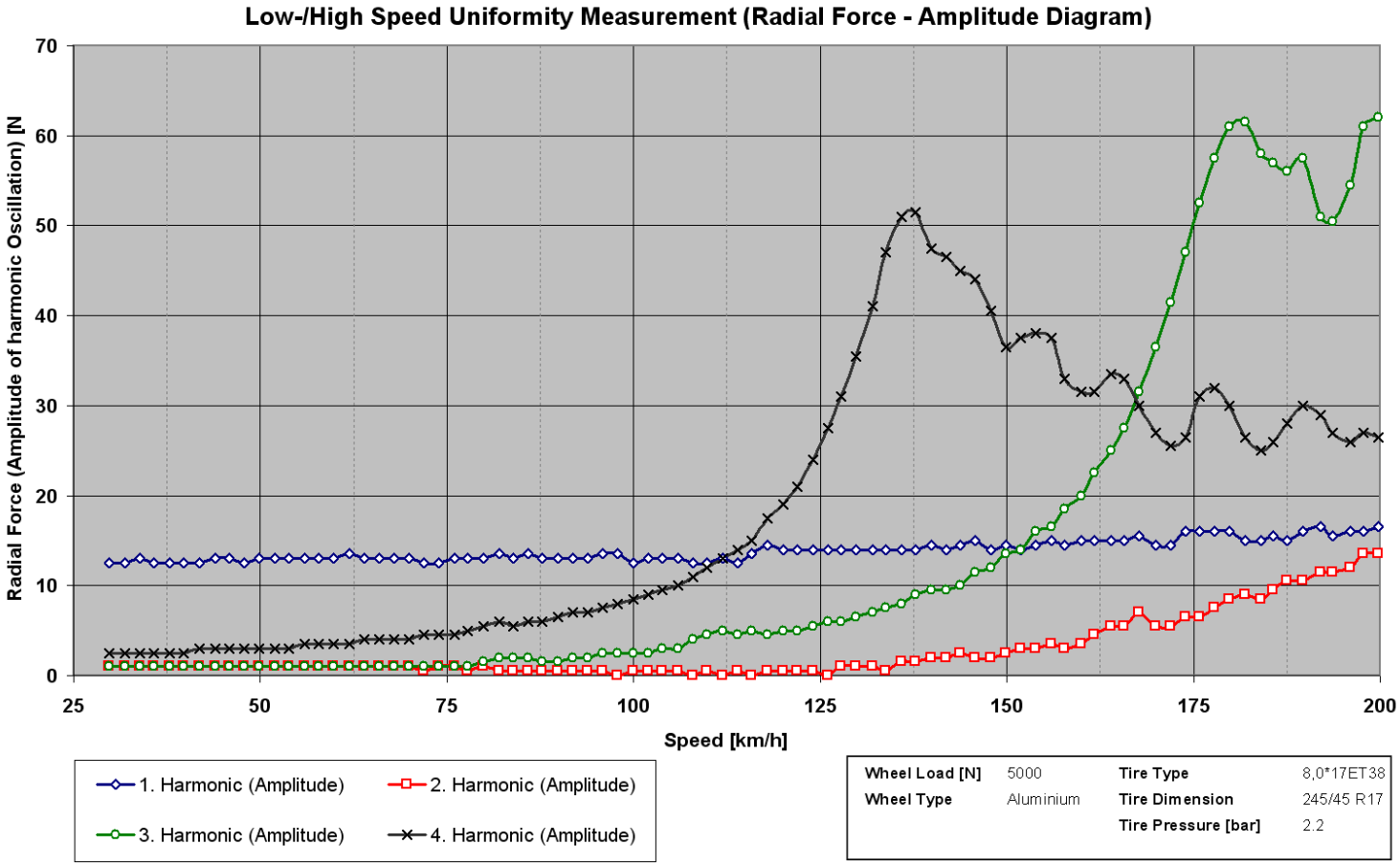
- Fz 4 kN
- 120 kph



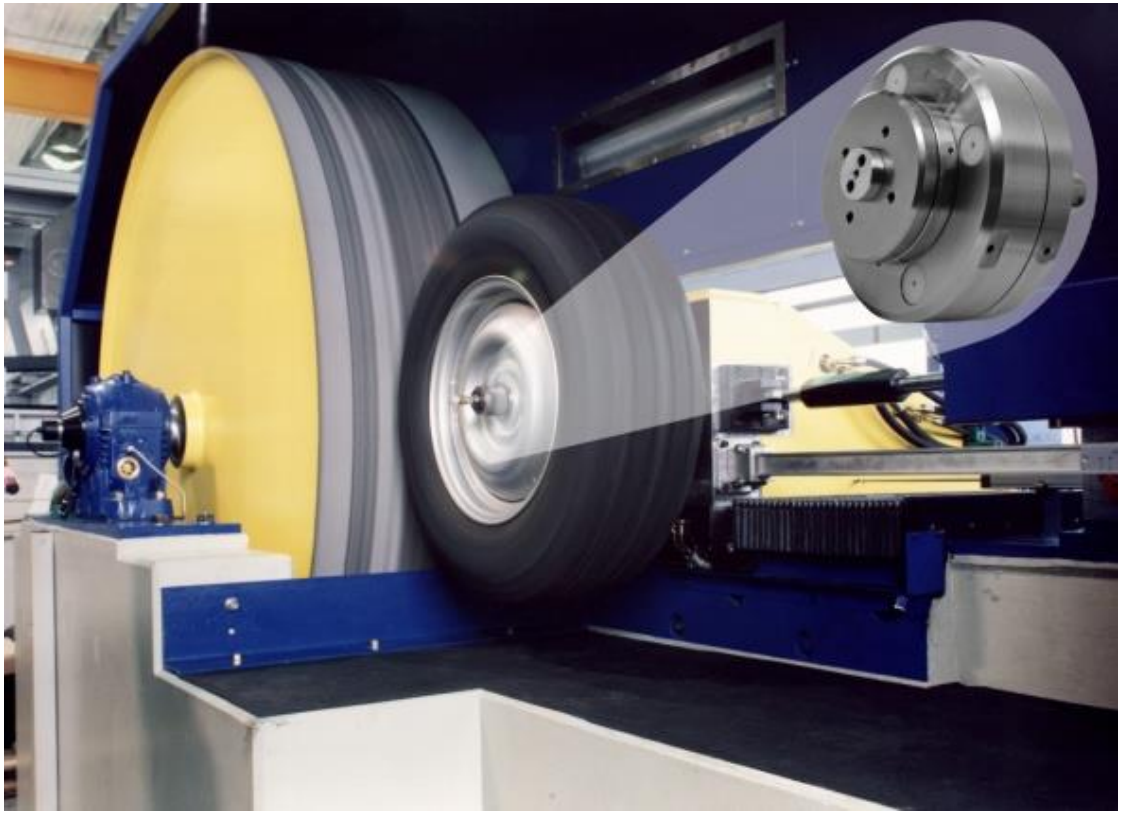
Source: IPW (2014)

Application: Comfort measurements, HSU, RFV

- Fz 4 kN
- 120 kph



HSU Test Stand with piezo based Measuring Hub RoaDyn P530



Source: ZF

Application: Efficiency measurements

- Rolling resistance RR
- Tire wear

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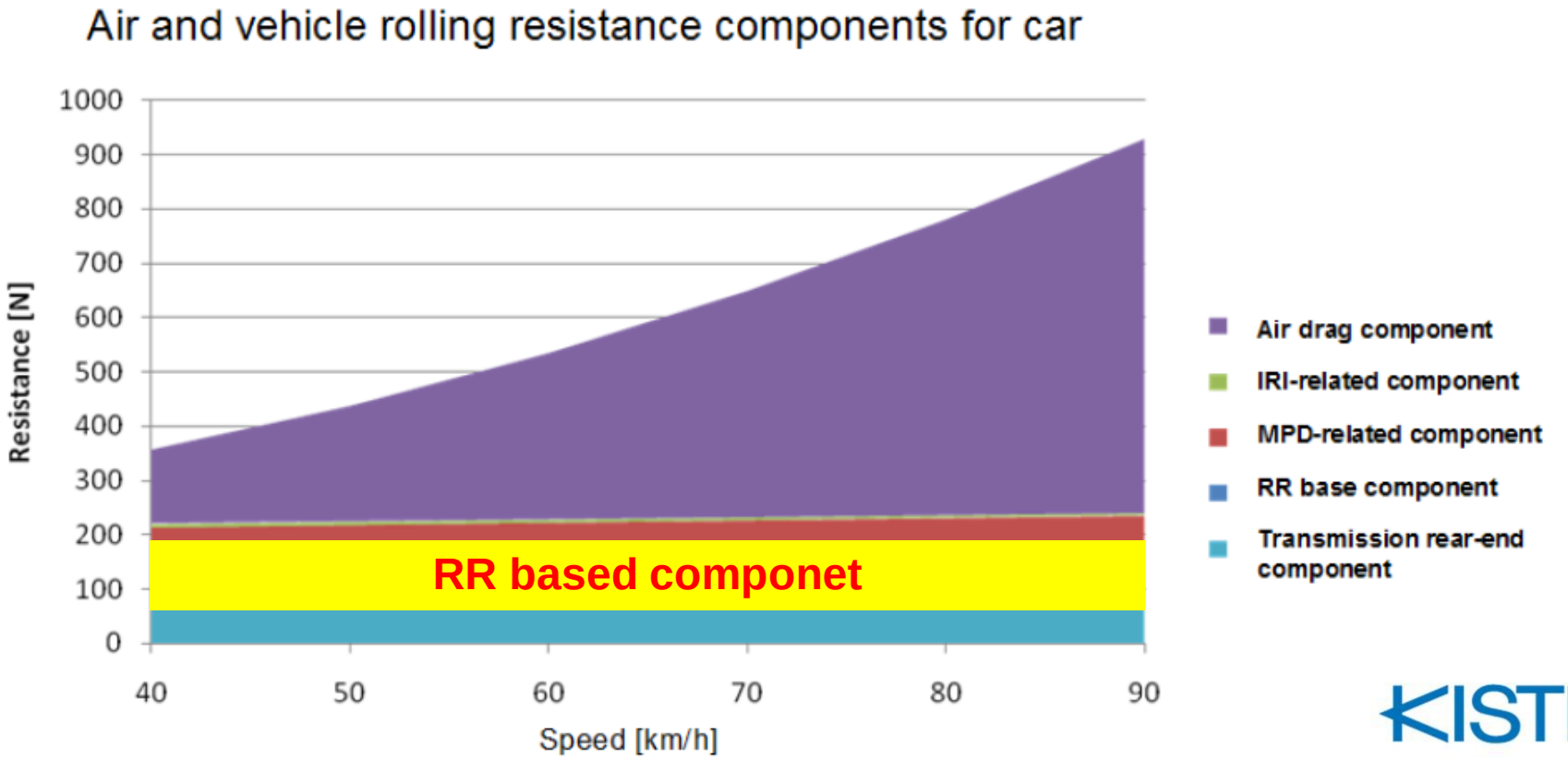
Application: Efficiency measurements



Source: Sandberg (2011)

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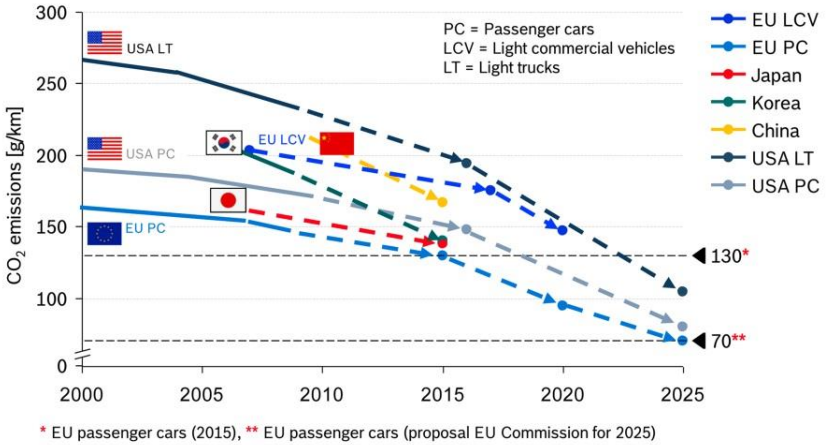
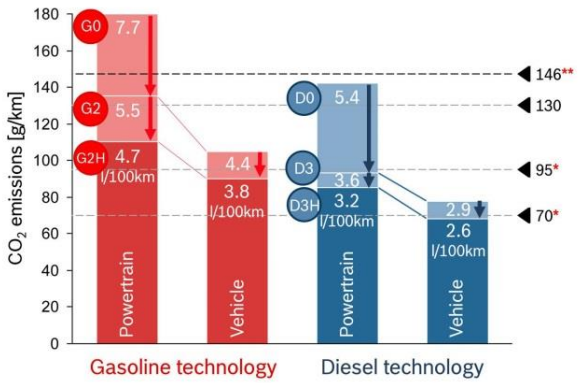
Application: Efficiency measurements

CO_2 emission targets for newly registered light vehicles



* EU passenger cars (2015), ** EU passenger cars (proposal EU Commission for 2025)

Final CO_2 reduction by vehicle technology



Vehicle package include
reduction of
- tire roll resistance (30 %)
- weight (10 %)
- aerodynamic resistance (14 %)

Engine technology
G0 gasoline, port fuel injection
G2 G0 + DI, downsized, 3 cyl., start/stop, turbo, var. valve lifting, thermo management
G2H G2 + hybrid (25 kW el. motor)
D0 diesel, common rail, turbo
D3 D0 + optimizes combustion, downsized, 3 cylinder, start/stop, thermo management NOx exhaust gas treatment
D3H D3 + hybrid (25 kW el. motor)

Vehicle weight 1400 kg, 100 kW, NEDC;

* Targets proposed by European Commission
** EU fleet 2009

FUEL CONSUMPTION OVER THE ENTIRE FLEET HAS TO BE REDUCED FROM 5.8 L TO 5.0 l UNTIL 2020!

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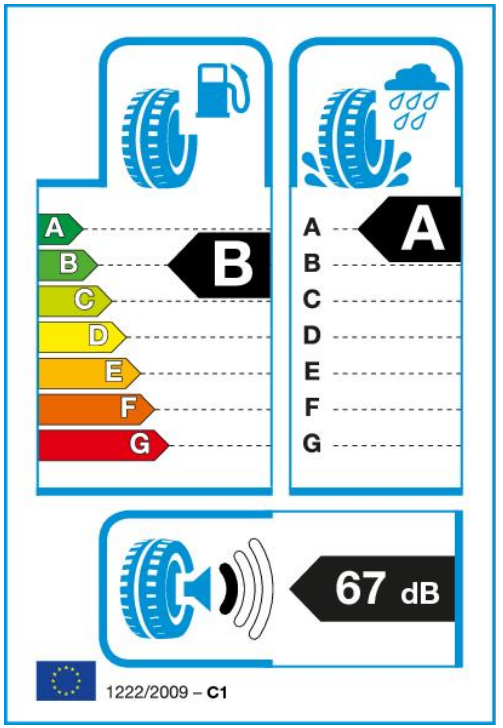
Application: Efficiency measurements

- Wet grip
- Rolling Noise
- Fuel Efficiency

European Commission

C1 tyres

RRC in kg/t	Energy efficiency class
RRC ≤ 6,5	A
6,6 ≤ *RRC* ≤ 7,7	B
7,8 ≤ *RRC* ≤ 9,0	C
Empty	D
9,1 ≤ *RRC* ≤ 10,5	E
10,6 ≤ *RRC* ≤ 12,0	F
RRC ≥ 12,1	G



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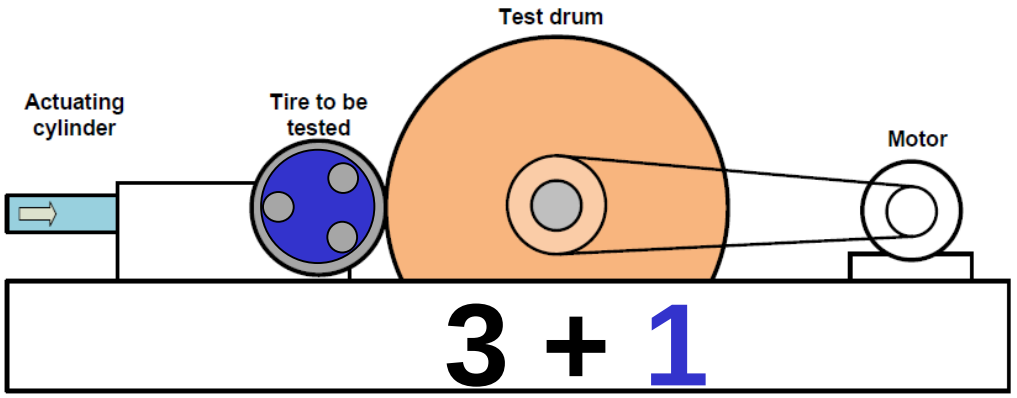
Laboratory methods according ISO 28580

- **Deceleration** up to standstill
- Electrical **power** for constant drum rotation
- Breaking **torque** on drum hub
- Resistive **force** at tire spindle



Source: Gent (2005)

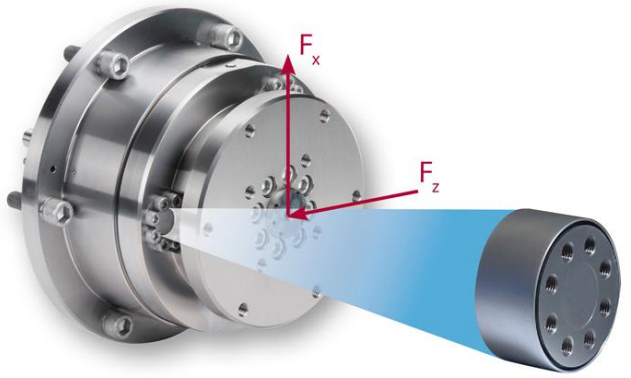
Comparison of the methods

- Reference Machine – e.g. Tire Manufacturer
- Candidate Machine – e.g. OEM
- Round Robin Test
- Min. 10 Tires for Pass. Cars
- > 3 Measurements
- Min. RRC Range 3 N/kN
- Standard Deviation < 0.075 N/kN

Source: BiA (2013)

Used sensors

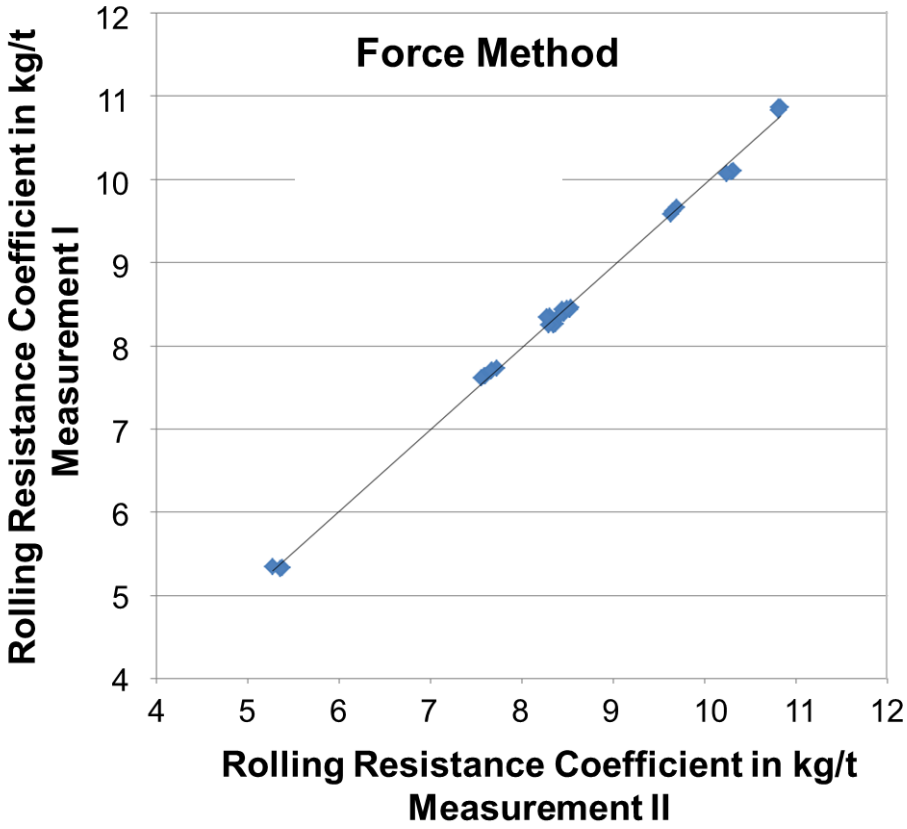
- Torque Method: Non-Contact Torque Meter
  - Loading Range 500 Nm
  - Accuracy 0.01 %
- Speed Controll < 0.1 km/h
- Force Method Measurement: RoaDyn® S220
  - Strain gauge technology
  - Fz 15 kN; Fx ±400 N for, 0,5 N/± 0.5%



Repeatibility Results

Avg. of Standard Deviation

- Deceleration 0.036 N/kN
- Power 0.022 N/kN
- Torque 0.022 N/kN
- Force 0.019 N/kN



Source: BiA (2013)

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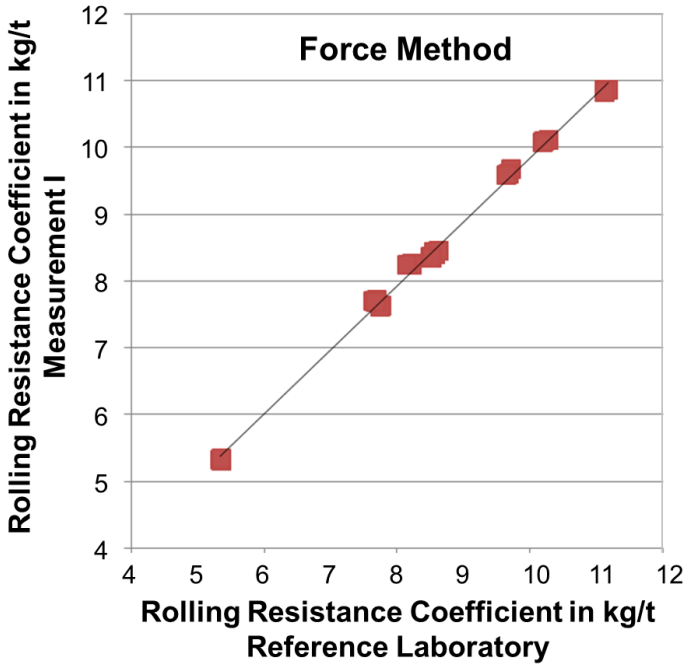
Alignment Results

Reference Laboratory

- Deceleration method only

Alignment Target

- Average deviation < 0.5 N/kN
- Correlation coefficient > 0.95



Source: BiA (2013)

Method	Average Deviation	Correlation Coefficient
Force	0.10 kg/T	0.997
Torque	0.21 kg/T	0,998
Power	0.20 kg/T	0.997
Deceleration	0.15 kg/T	0.998

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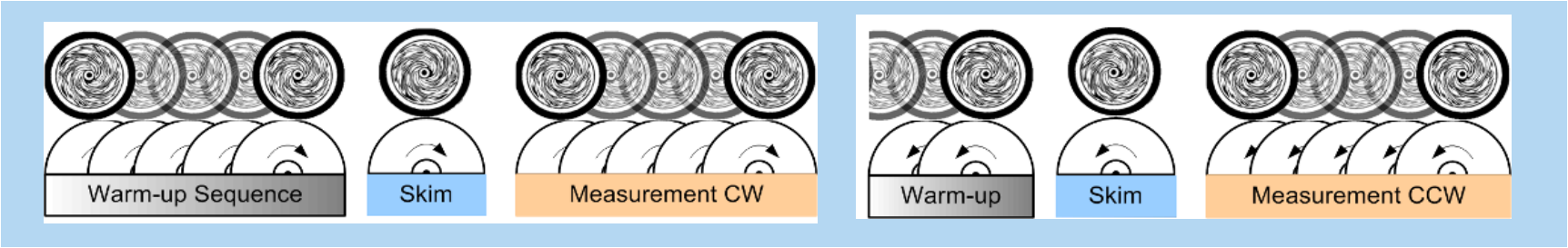
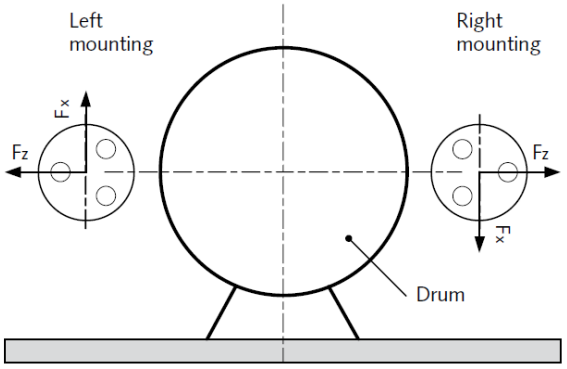
Performance and repeatabillity check with two position RR test stand (force)

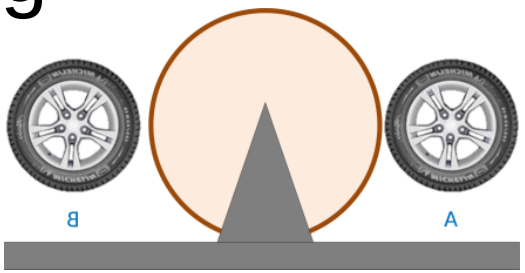


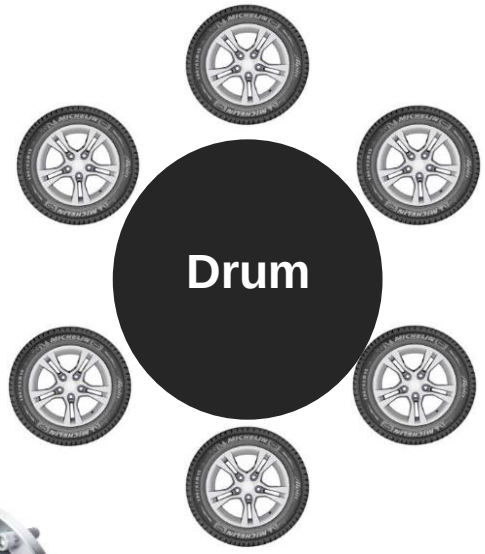
STEP	Direction	Time [sec]	Speed [km/h]	Load [kgf]	Station A Tractive [kgf]	Station A Value-skim [kgf]	Station B Tractive [kgf]	Station B [Value-skim] [kgf]
Warm-Up	CW	1200	80	411.5				
Skim	CW	60	80	9.6	1.09		1.35	
1	CW	300	80	411.4	5.32	**4.23**	5.38	**4.03**
2	CW	60	80	411.5	5.21	**4.12**	5.31	**3.96**
3	CW	60	80	411.4	5.27	**4.18**	5.28	**3.93**
Warm-Up	CCW	300	80	411.6				
Skim	CCW	60	80	9.7	-2.00		-1.53	
				411.5	-6.25	**-4.25**	-5.98	**-4.45**
				411.6	-6.20	**-4.20**	-5.99	**-4.46**
				411.6	-6.32	**-4.32**	-5.97	**-4.44**
					Ave. RR	4.22		4.21
					Ave. load	401.85		401.52
					RR/%	**1.049%**		**1.049%**



Trends in Tire Testing

- Tire wear





- Increased demand of measuring equipment for RR according force method

- Truck and bus more and more in focus of wear and RR

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Summary

- HSU measurement requires a stiff machine structure
- Measuring equipment with a high eigenfrequency is a must to receive truthfull results from highest quality when performing HSU measurements
- Due to low impact of parasitic losses, the force method is an appropriate test method for RR not only for candidate but also for reference machines
- As the RRC ist calculated Fx/Fz, also the repeatibility of Fz is from highest importance
- Kistler provides experienced solutions in the form of measuring hubs, to support automotive industry in the daily tire testing challanges

Thank You

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