



ISO 28580:

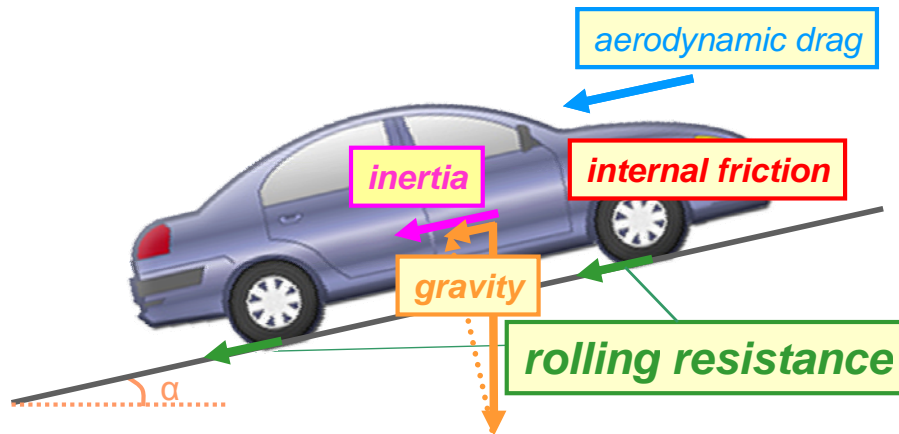
Passenger car, truck and bus tyres - Methods of measuring rolling resistance - Single point test and correlation of measurement results

- Information on Rolling Resistance (RR)
- Why was a new Standard needed ?
- What is new in ISO 28580 ?
- What will be the impact on RR results ?
- ISO 28580 Reference Laboratory
- Technical Aspects ISO 28580

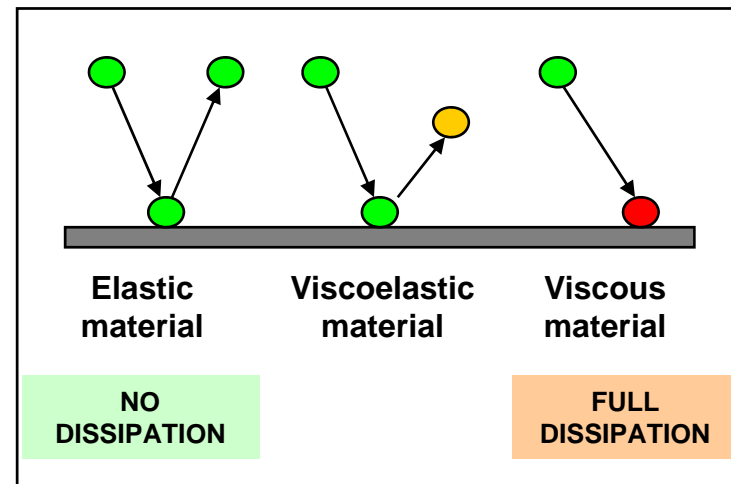


Information on Tyre Rolling Resistance

Rolling Resistance is one of the forces acting on a vehicle:



Rubber compounds are visco-elastic materials. Each time they are deformed they dissipate energy:



RR is a force acting opposite to the travel direction if a tyre is rolling. Due to the vehicle load, the tyre is deformed in the contact area with the road surface.

Pneumatic tyres as we know them today need the rubber materials and deformation to generate the required grip between vehicle and road surface, to give vehicle comfort and generate low rolling noise.



How to measure Tyre Rolling Resistance:

Two measurements are done:

1: Measurement with tyre running under test load

2: Measurement with tyre running at very low load (skimload) or deceleration method.

This second measurement is done to measure parasitic losses like bearing friction or aerodynamic losses that are included in the first measurement.

The difference between measurement # 1 and # 2 gives the RR of a tyre.



Why was a new Standard needed ?

A study done in 2005 by the ETRTO RR workgroup indicated that RR results may vary up to 20% when measuring the identical tire on different machines following the ISO 18164 standard.

Several parameters are not defined in detail in the current ISO 18164:

- Measurement method: Including or not certain machine losses
- Drum surface : Smooth or textured
- Single or multiple speed testing
- Skim load level not specified
-

Currently there is no method to align RR results generated on different machines.

This is however essential to compare individual data vs. absolute values (RR limits, grading systems..).



What is new in ISO 28580 ?

In ISO 28580, several sources of variation are eliminated and parameters are defined more detailed.

- More precise definition of “new” tyres
- Drum diameter at least 1.7 m
- Parasitic losses include aerodynamic and friction losses of the drum and the tyre/rim/hub assembly. Results will include pure tyre RR only
- Single step test at 80 km/h (60 km/h for CV tires with SS J or lower)
- Thermal conditioning of tyres prior the test is fixed
- Combined Break-in and Warm-up step
- The same physical tyre property will be measured in the same thermodynamic state.



What is new in ISO 28580 ?

- Rolling Resistance results are expressed as rolling resistance coefficient **RRC***
- If needed, the RRC is corrected to a reference ambient temperature of 25°C and a reference drum diameter of 2 m.
- The skimload level is defined:

PC	recommended 100N, not exceeding 200 N
CV with LI ≤ 121	recommended 150 N, not exceeding 200 N or 500 N (depends if machine was designed for passenger or for truck tyres)
CV with LI >121	recommended 400 N, not exceeding 500 N

An inter-laboratory alignment procedure is introduced to allow direct comparison by use of a correlation equation vs. a Reference Machine. To be applicable, ISO 28580 requires the definition of Reference Machines (1 for PC tyres and 1 for TB tyres) within the implementing measures of the concerned regulations.

* **RRC** (Rolling Resistance Coefficient):

The RRC is equal to the RR force (Newton) divided by the load the tyre has to carry.

RRC is a dimensionless parameter that is well suited to compare tyres of different size, load index etc..



What is new in ISO 28580 ?

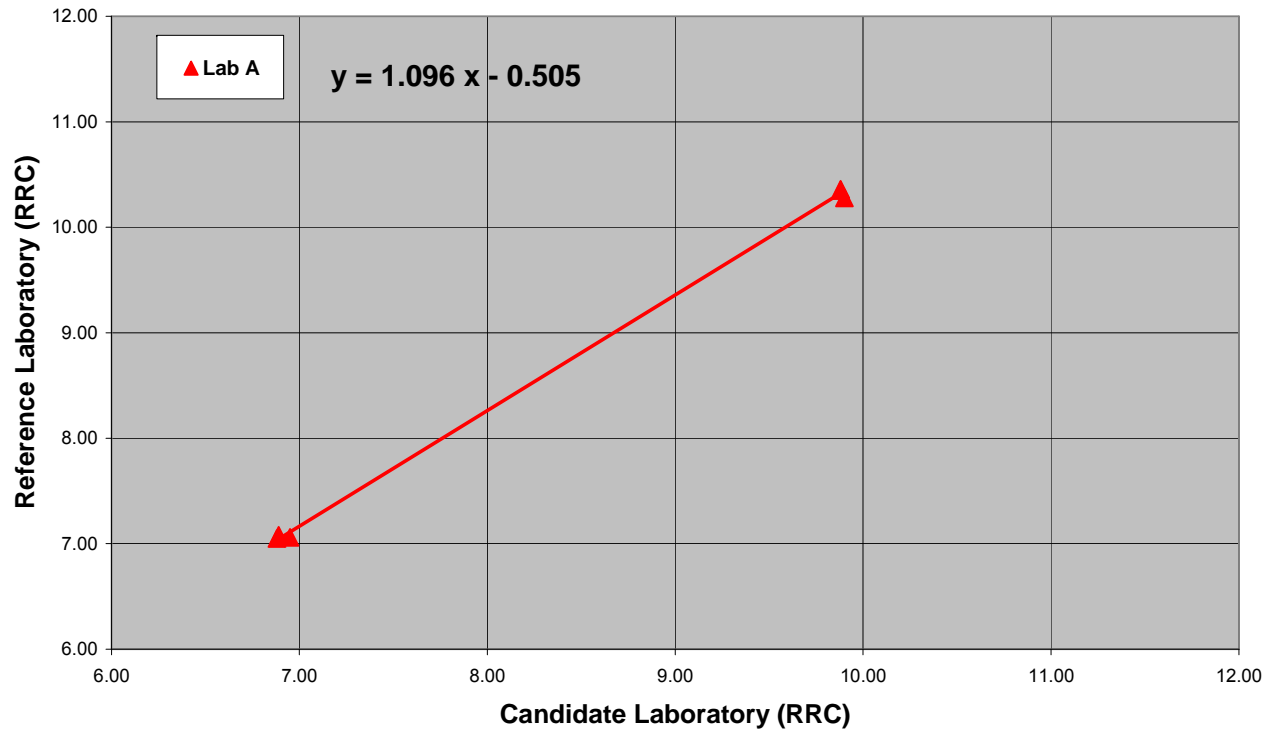
Laboratory Alignment Method:

- The alignment will be done between a “Reference Laboratory” and a “Candidate Laboratory” by use of pre-determined alignment tyres: 2 tyres for Passenger/Light Truck and 2 tyres for Truck.
- A global (NA, Asia & Europe) study including various Passenger and Truck RR machines was done to validate the concept and proposed alignment tyres.
- Candidate Laboratories will purchase alignment tyres. The RRC of those tyres will be measured both by themselves and on the Reference Machine. The machine alignment with the Reference Machine will be done using a linear regression (see next page).



Principle of the Lab Alignment Method:

RRC Correlation based on 2 predetermined ISO 28580 PC Alignment Tires



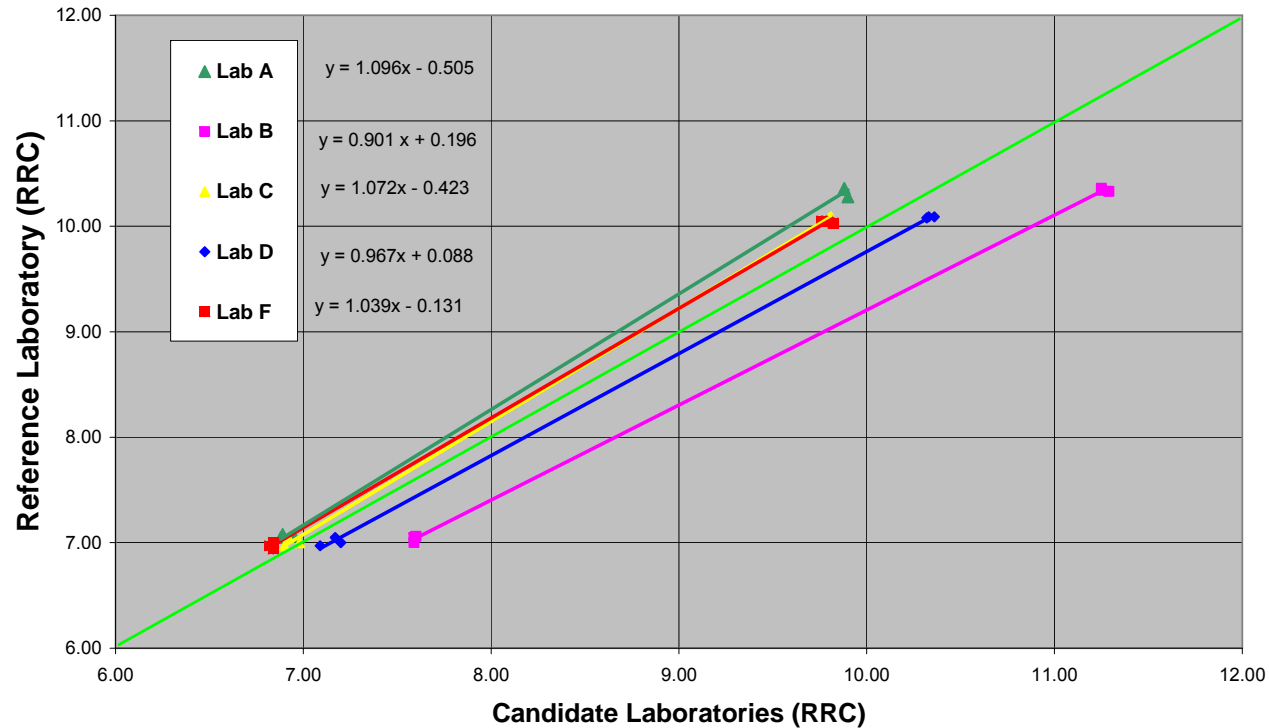
In this example, Lab A would need to transform its measured RRC as follows into aligned ISO 28580 RRC:

$$\text{Lab A (ISO 28580)} = 1.096 \times \text{Lab A} - 0.505$$



Principle of the Lab Alignment Method:

RRC Correlation based on 2 predetermined ISO 28580 PC Alignment Tires



For different Candidate Laboratories, different correlation equations to the Reference Laboratory will exist.



ISO 28580 test conditions are similar to those of the current ISO 18164:

Load and Inflation Pressure:

Table 2 — Test Loads and Inflation Pressures

Tyre Type	Passenger Car ^a		Truck and Bus
	Standard Load	Reinforced or Extra Load	σ
Load- % of maximum load capacity	80	80	85 ^b (% of single load)
Inflation Pressure kPa	210	250	Corresponding to maximum load capacity for single application ^c

NOTE 1 The inflation pressure shall be capped with the accuracy specified in A.4.1.

Speed:

Table 1 — Test Speeds (in km/h)

Tyre Type	Passenger Car	Truck and Bus		
		LI 121 and below	LI 122 and above	
Load Index	All	LI 121 and below	LI 122 and above	
Speed Symbol	All	All	J [100 kph] and lower or tyres not marked with speed symbol	K [110 kph] and higher
Speed	80	80	60	80

Warm-Up Duration:

Table 3 — Warm Up Durations

Tyre Type	Passenger Car	Truck and Bus Tyres L ≤ 121	Truck and Bus Tyres LI > 121	
			< 22.5	≥ 22.5
Nominal Rim Diameter	All	All	< 22.5	≥ 22.5
Warm up duration	30 min	50 min	150 min	180 min



What will be the impact of ISO 28580 on RR results ?

- Different thermal conditioning and the integrated tyre break-in will have only minor impact on RR results. Detailed definition of test parameters will help reducing the result dispersion.
- The alignment process vs. a Reference Laboratory may shift data of the individual Candidate Labs up or down. This shift depends on the absolute RR level as measured in the Reference Laboratory.
- **The choice of the Reference Laboratory is very important.**



ISO 28580 Reference Laboratory:

- ISO 28580 will be the reference RR test method in UNECE R117 (also in other European regulations like R692_2008, motor vehicle emissions Euro5/6).
- ISO 28580 will probably be used on a global basis (EU, JP, US) and may support different regulatory applications.
- The Reference Laboratory could be every organization operating a Rolling Resistance Test Machine.
- An appropriate Reference Laboratory needs to be defined.
- The Lab alignment method of ISO 28580 was designed in a way that the workload can be handled by one single global Reference Laboratory.
- The Reference Laboratory question is under discussion in the ISO TC31 WG6.
- It is mandatory that the Reference Laboratory complies with all requirements of 28580.



ISO 28580 Reference Laboratory:

Items to be considered when choosing a Reference Laboratory:

- Technical compliance of the Reference Laboratory
- Logistics
- Complexity of the process
- Consistency of data (one, multiple Laboratories)
- Potential issues / break-down of a Reference Laboratory machine
- Global approach
- Cost
- Reliability and availability
- Turn-around-time, Candidate Laboratories should not wait too long
- Reference Laboratory machine should represent technical state-of-the-art and should not significantly deviate from other RR machines



ISO 28580 Reference Laboratory technical aspects:

The test time to measure a passenger tyre according to ISO 28580 is 30 minutes warm-up + measurement phase + mounting/dismounting of the tyre/rim assembly. In total, this represents roughly 45 minutes. The corresponding duration for truck tyres is 200 minutes.

For the Inter-laboratory alignment, the alignment tyres need to be measured 3 times to determine the repeatability σ_m . For the Reference Laboratory, the requirement is: $\sigma_m \leq 0.05$ N/kN

If a Candidate Laboratory does not meet the σ_m requirement of 0.075 for passenger and 0.060 for truck tyres, ISO 28580 defines a process it has to follow to be conform with the standard (more measurements will be required for every tyre).

The correlation to the Reference Laboratory needs to be refreshed every second year.

The pre-determined ISO 28580 alignment tyres cover a defined range of RRC and RR force, their load index covers a representative range and their dimensions are chosen that they fit on most test machines.