DEFORMATION MEASUREMENTS ON RAILWAYS

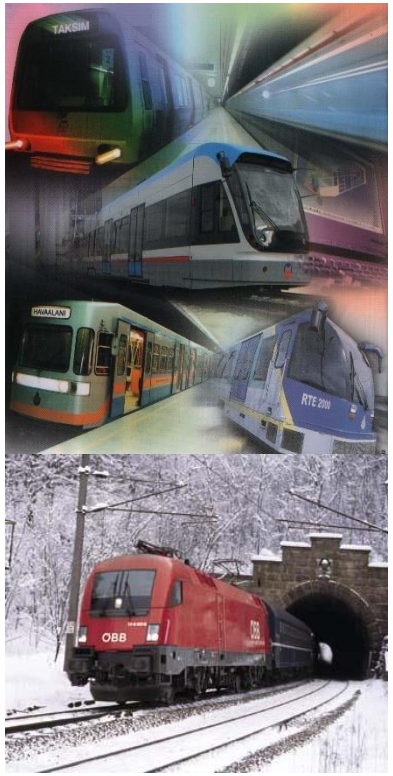
Importance of Railways

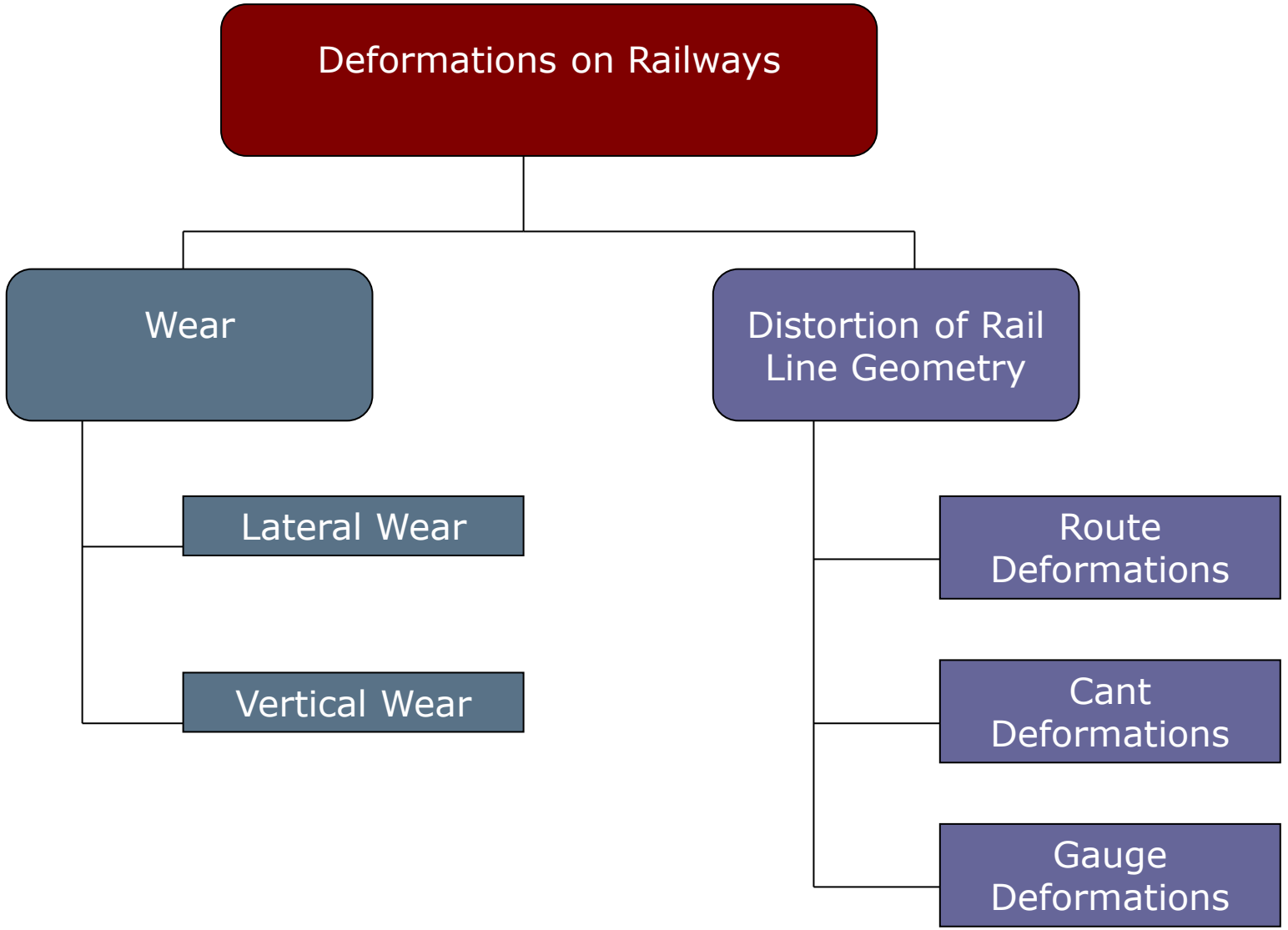
- ***Fast, economical, safe, environmentally friendly and contemporary systems.***
- ***Low energy consumption.***
- ***High Speed***

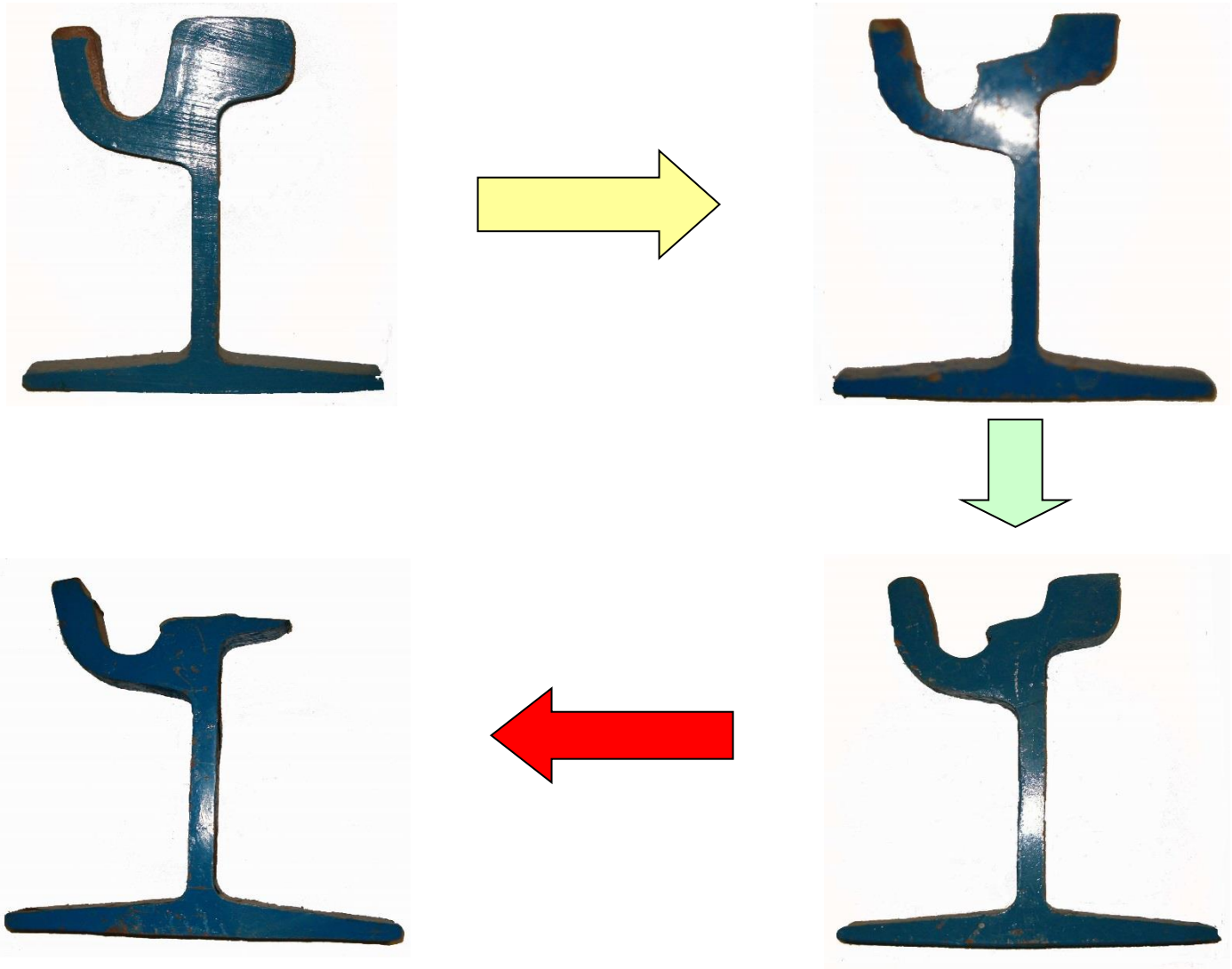
Paris-Lyon:300 km/hour
Tokyo-Osaka: 210 km/ hour
Eskişehir-Ankara: 250 km/ hour

- ***High capacity*** for passenger and cargo transportation.
- ***It is the least affected transportation system by weather conditions.***
- Depending on the statistics is the most reliable transportation vehicle.

The risk of death by rail crash under the same traffic by road is less than 8 times, the risk of injury is less than 200 times.




Deformations on Railways
Wear
Distortion of Rail Line Geometry
Lateral Wear
Vertical Wear
Route Deformations
Cant Deformations
Gauge Deformations

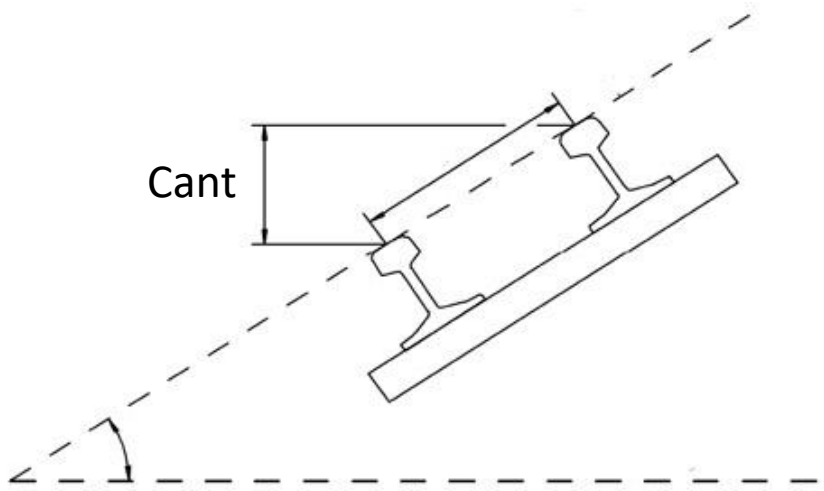


Route Deformations

Especially in ballasted railways, distortions on rail line axes may occur due to traffic load and weather conditions..

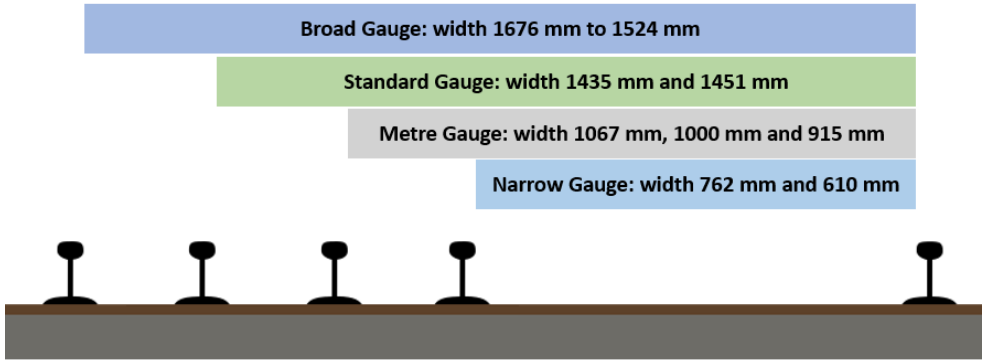
Cant Deformations

In the curves, the amount of cant foreseen in the project is not the same as the amount of real cant, and in alignments it is the difference between the two rail series.



Gauge Deformations

The gauge of a railway track is defined as the clear minimum perpendicular distance between the inner faces of the two rails.



Standard gauge is defined by UIC (1435 mm). Increase or decrease on gauge is named as gauge deformation.

All Railways are constructed according to the criteria set by the International Railway Association, which our country is a member of.

Standards for Rail Line Geometry

Tolerances for horizontal geometry

Ballasted Lines ±25mm Non-Ballasted Lines ±15mm

Tolerances for vertical geometry

Ballasted and Non-Ballasted Lines ±10-15mm

The line geometry should be checked periodically every 3 months!

Standards for Curve and Cant

When determining the radius of horizontal curves, the minimum radius of curves must be taken into account in order for the vehicle to pass safely through the curves.

Minimum Curve Radius

Passenger transported lines : 150m - 200m

Passenger non-transported lines : 125m - 150m

Tolerances for Cant

Ballasted Lines ±10mm Non-Ballasted Lines ±7.5mm

Standards for Track Gauge

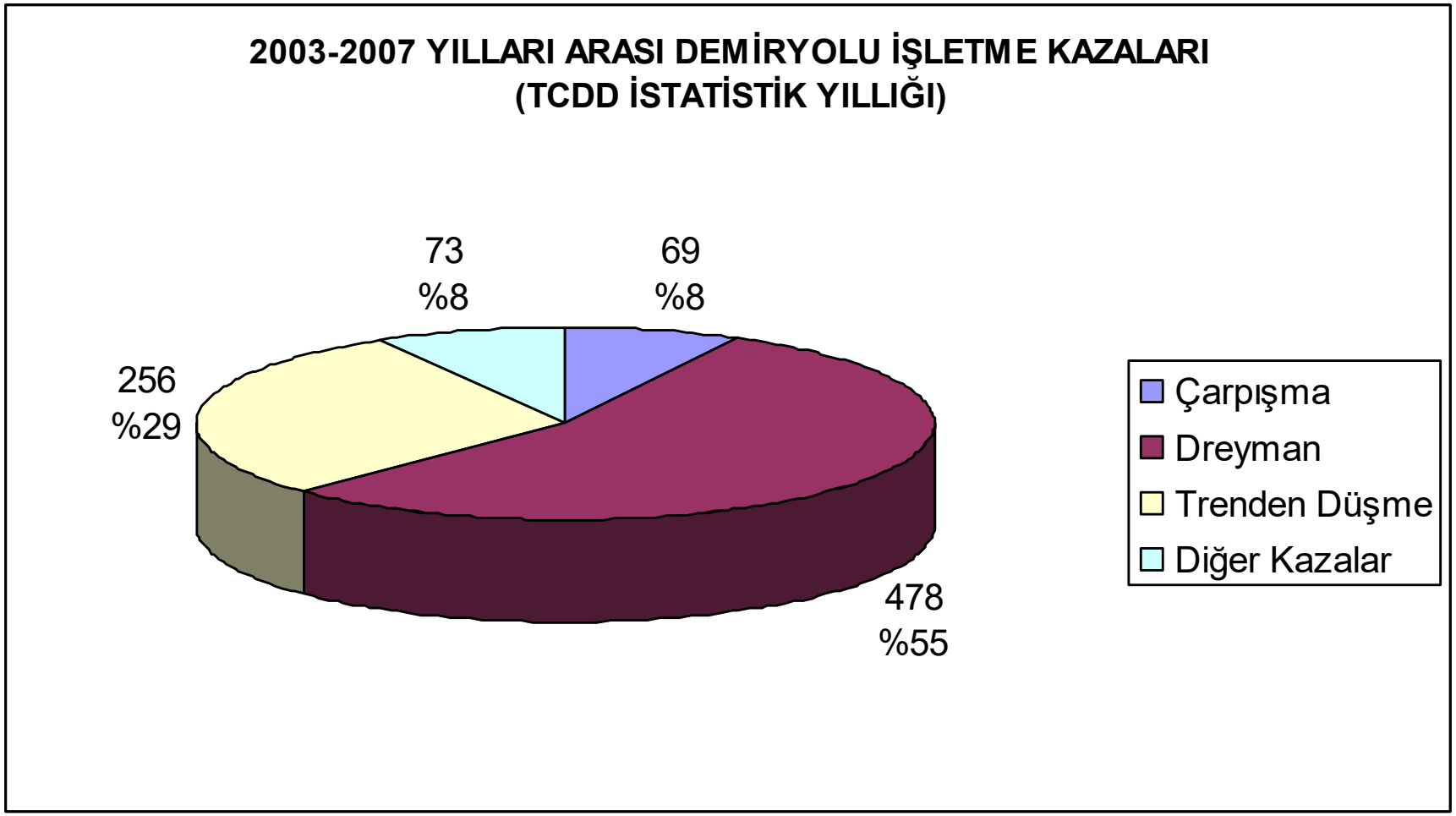
Track Gauge	*Explanation*
1432 mm – 1455 mm	Normal
1426 mm – 1432 mm	Dangerous It needs to be fixed.
1455 mm – 1470 mm	
< 1426 mm	**DANGER OF DERAILMENT !!!**
> 1470 mm	

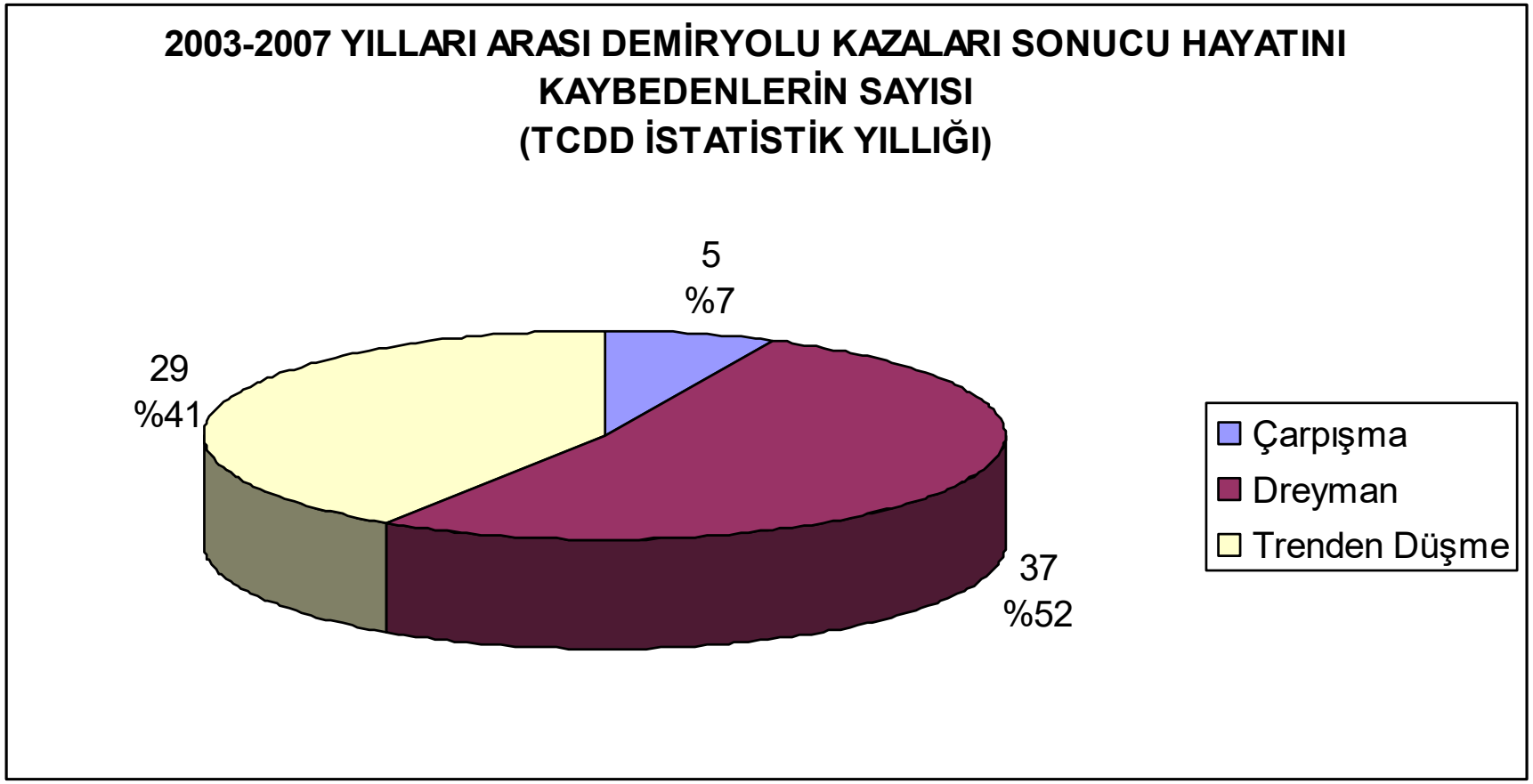
The most reliable value determined by UIC is 1435 mm.

If the 1426 mm – 1432 mm and 1455 mm – 1470 mm values are determined, rail line must be fixed in 24 hours.

< 1426 mm ve > 1470 mm

danger of derailment, the line must be closed to traffic immediately.


2003-2007 YILLARI ARASI DEMİRYOLU İŞLETME KAZALARI
(TCDD İSTATİSTİK YILLIĞI)
73
%8
69
%8
256
%29
478
%55
Çarpışma
Dreyman
Trenden Düşme
Diğer Kazalar



Only the number of casualties in highway accidents in 2008 > 500

In Railways, effective and efficient works cannot be done with classical geodetic measurement methods and equipments which are used in superstructure maintenance.

Distortions in the superstructure are detected by using existing measuring systems but measurement process can take a long time.

Considering the cost of rail systems and especially superstructure maintenance costs (average repair and maintenance costs of ballasted lines is 1.000.000 TL), geodetic measurements should be performed efficiently.

A tamping machine or ballast tamper is a machine used to pack (or tamp) the track ballast under railway tracks to make the tracks more durable.

Prior to the introduction of mechanical tampers, this task was done by manual labour. As well as being faster, more accurate, more efficient and less labour-intensive, tamping machines are essential for the use of concrete sleepers since they are too heavy (usually over 250 kg (551 lb)) to be lifted by hand.

Cant, Longitudinal Slope

Inclination Sensors

Gauge

Precision Length Sensor

Rail Line Location Information

RTK GPS RECEIVER

Rail Line Location Information, (high accuracy and tunnels work)

TOTAL STATION

SENSOR

POSITION SYSTEM

LVDT
(Gauge)

Dual Axes Inclinometer
(Cant, Longitudinal Slope)

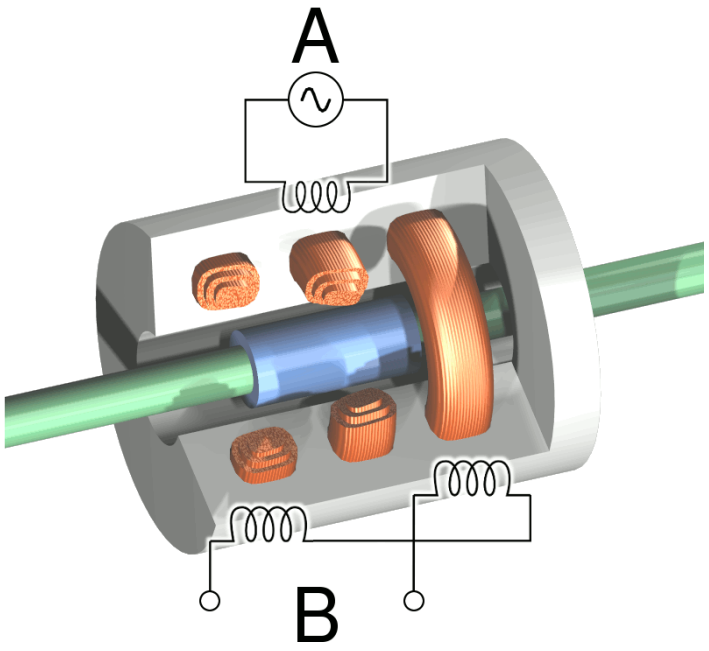
Data Unit

GNSS Receivers
(Rail Line Position)

ATR Total Station and Wireless Radio Modem
(Rail Line Location Information, high accuracy and tunnels work)

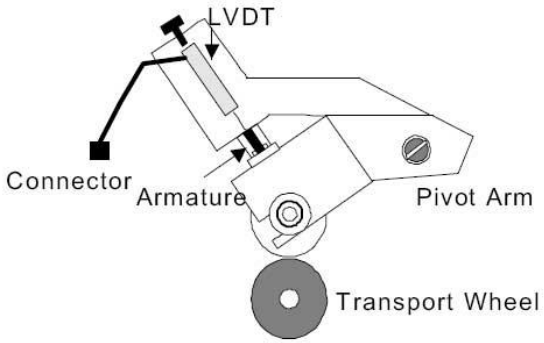
Linear variable differential transformer- LVDT

LVDT is a type of electrical transformer used for measuring linear displacement (position).

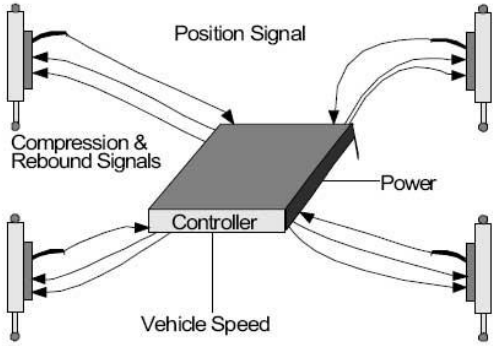


Linear variable differential transformer- LVDT

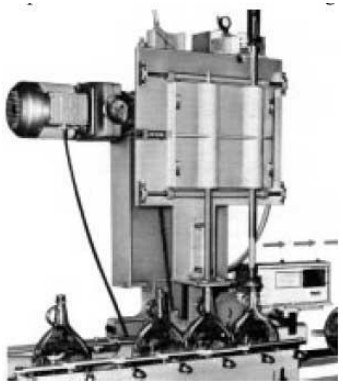
LVDT Usage Areas



Money Counting
ATM Machines



Automobile Suspension Systems
Automatic Stability Control



Bottle Factories
Checking Bottle Sizes

Linear variable differential transformer- LVDT

Schaevitz Sensors GCD-SE-2000 LVDT Teknik Özellikleri

Input Voltage	8.5 – 28 VDC
Input Current	6 mA
Operating temperature	-25°C - 85°C
Storage Temperature	-55°C - 95°C
Outout Voltage	0-5 VDC (4 wires) 1-6 VDC (3 wires)
Output Impedance	< 1 Ω
Noise	<10 mV
Linearity	<0.25 % Full Scales
Repeatability	0.0006 mm
Stability	0.1 % Full Scales

2.5277 VDC = 1 inch

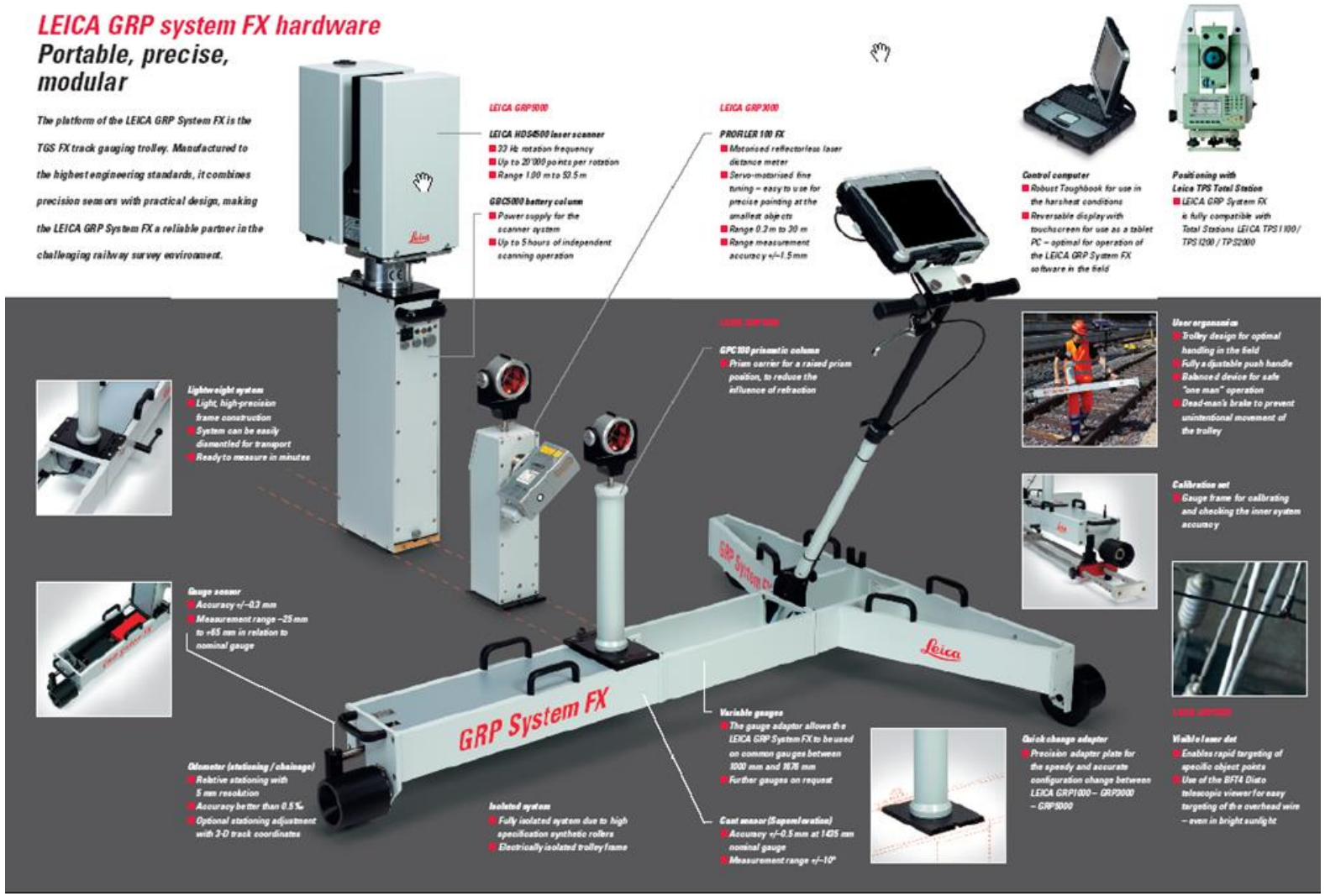
1 VDC = 10.0487 mm

Dual Axes Inclinometer

HLPlanar Technik NS-15/V2

Operating Range	**±15°**
Precision	**-3° - +3° ---- 0.03°** **-10° - +10° ---- 0.08°**
Resolution	**0.001°**
Analog Output	**-2V(-15°) - +2V(+15°)**
Supply voltage	**+12 - +24 VDC**
Operating temperature	**0°C - +70°C**
Storage Temperature	**-40°C - +85°C**


GRP System FX
AMBERG


LEICA GRP system FX hardware
Portable, precise, modular
The platform of the LEICA GRP System FX is the TGS FX track gauging trolley. Manufactured to the highest engineering standards, it combines precision sensors with practical design, making the LEICA GRP System FX a reliable partner in the challenging railway survey environment.
LEICA GRP1000
LEICA HDS6500 laser scanner
33 Hz rotation frequency
Up to 20'000 points per rotation
Range 1.00 m to 52.5 m
GDC5000 battery column
Power supply for the scanner system
Up to 5 hours of independent scanning operation
LEICA GRP3000
PRORLER 100 FX
Motorised reflectorless laser distance meter
Servo-motorised fine tuning – easy to use for precise pointing at the smallest objects
Range 0.2 m to 30 m
Range measurement accuracy +/–1.5 mm
GPC100 prism/tie column
Prism carrier for a raised prism position, to reduce the influence of refraction
Control computer
Robust Toughbook for use in the harshest conditions
Reversable display with touchscreen for use as a tablet PC – optimal for operation of the LEICA GRP System FX software in the field
Positioning with Leica TPS Total Station
LEICA GRP System FX is fully compatible with Total Stations LEICA TPS1100 / TPS1200 / TPS2000
User ergonomics
Trolley design for optimal handling in the field
Fully adjustable push handle
Balanced device for safe "one man" operation
Dead-man's brake to prevent unintentional movement of the trolley
Calibration set
Gauge frame for calibrating and checking the inner system accuracy
Lightweight system
Light, high-precision frame construction
System can be easily dismantled for transport
Ready to measure in minutes
Gauge sensor
Accuracy +/–0.2 mm
Measurement range –25 mm to +65 mm in relation to nominal gauge
Odometer (stationing / chainage)
Relative stationing with 5 mm resolution
Accuracy better than 0.5‰
Optional stationing adjustment with 3-D track coordinates
Isolated system
Fully isolated system due to high specification synthetic rollers
Electrically isolated trolley frame
Variable gauges
The gauge adaptor allows the LEICA GRP System FX to be used on common gauges between 1000 mm and 1676 mm
Further gauges on request
Cant sensor (Superelevation)
Accuracy +/–0.5 mm at 1435 mm nominal gauge
Measurement range +/–10°
Quick change adapter
Precision adapter plate for the speedy and accurate configuration change between LEICA GRP1000 – GRP3000 – GRP5000
Visible laser dot
Enables rapid targeting of specific object points
Use of the BFT4 Disto telescopic viewer for easy targeting of the overhead wire – even in bright sunlight
GRP System FX
Leica


TRAGEOS