



# Trimble Beena Vision Solutions

TRIMBLE. INTELLIGENCE IN RAIL.

  
**BeenaVision**  
A TRIMBLE COMPANY

 **Trimble**

TRANSFORMING THE WAY THE WORLD WORKS





TRANSFORMING THE WAY THE WORLD WORKS





# Changing Perspective

Wayside and Track  
Monitoring  
Measurement  
Inspection





## Staying ahead of the curve

Beena Vision—A Trimble Company, is the leading manufacturer of automated vision-based wayside inspection systems for the railroad industry. Over the last twenty years, Beena Vision has pioneered and developed a number of innovative products using sophisticated machine vision and non-contact measurement technologies. These products are specifically designed to provide valuable information to effectively assess railcar components and track safety conditions.

The Trimble® Beena Vision® product line focuses on automatic wayside train inspection systems combined with sophisticated software applications for detector data visualizations and analysis. In addition, it also offers on-board rail and track measurement and inspection systems.



Trimble Beena Vision wayside train condition monitoring systems are designed and manufactured for the most demanding applications with high levels of system accuracy, reliability, and availability. Beena Vision systems have a reputation for being tough and durable even in the heavy haul railway environment, as a result of years of design, testing, and field experience with close to 200 installed and operational systems worldwide.

Beena Vision has installed numerous systems at all major North American Class 1 railroads, including BNSF, Norfolk Southern, CSXT, Canadian National, Union Pacific, and has worked closely with several rail operators and organizations to develop new products. Many Beena Vision systems are successfully deployed with major operators in Australia, such as Aurizon, BHP, Rio Tinto, FMG, and with multiple operators in Europe, China, South America, and the Middle East.

At the technology facility in Norcross, GA, USA, Beena Vision pursues its extensive R&D program to develop advanced systems for automatic monitoring of critical components of freight and passenger cars, bogies, locomotives, and track components.

In February 2017, Trimble Inc. acquired Beena Vision and the addition of Beena Vision's solutions to Trimble's portfolio extends Trimble's ability to deliver more powerful and robust rail solutions. In addition, Beena Vision can leverage Trimble's broad portfolio of technology to even further strengthen solutions.

As part of Trimble, Beena Vision's commitment to customers remains unchanged and Beena Vision will continue to deliver best-in-class solutions and services.

Kambiz Nayebi, Ph.D.  
General Manager



# Vision Technology Pioneer in the Railroad Industry



## Automatic Train Inspection & Measurement Systems

WheelView	Wheel Profile Measurement
TreadView	Wheel Surface Measurement and Inspection
BrakeView-Shoe	Brake Shoe (Block) Measurement and Inspection
BrakeView-Pad	Brake Pad Measurement
BrakeView-Disc	Brake Disc Measurement and Inspection
TruckView	Truck (Bogie) Inspection and Measurement
AHView	Air Hose Arrangement Inspection
CouplerView-Pin	F-Type Coupler Securement Inspection
CouplerView-CrossKey	E-Type Coupler Securement Inspection
CSCView	Car (Wagon) Structural Component and Undercarriage Inspection
TrainView	Full Train Imaging, Inspection, and Measurement
PantoView	Pantograph Measurement and Inspection
AOAView	Angle of Attack and Back-to-Back Measurement
ShoeView	Third Rail Contact Shoe Measurement
SlideView	Sliding Wheel Detection
TempView	High Speed Train Thermal Imaging

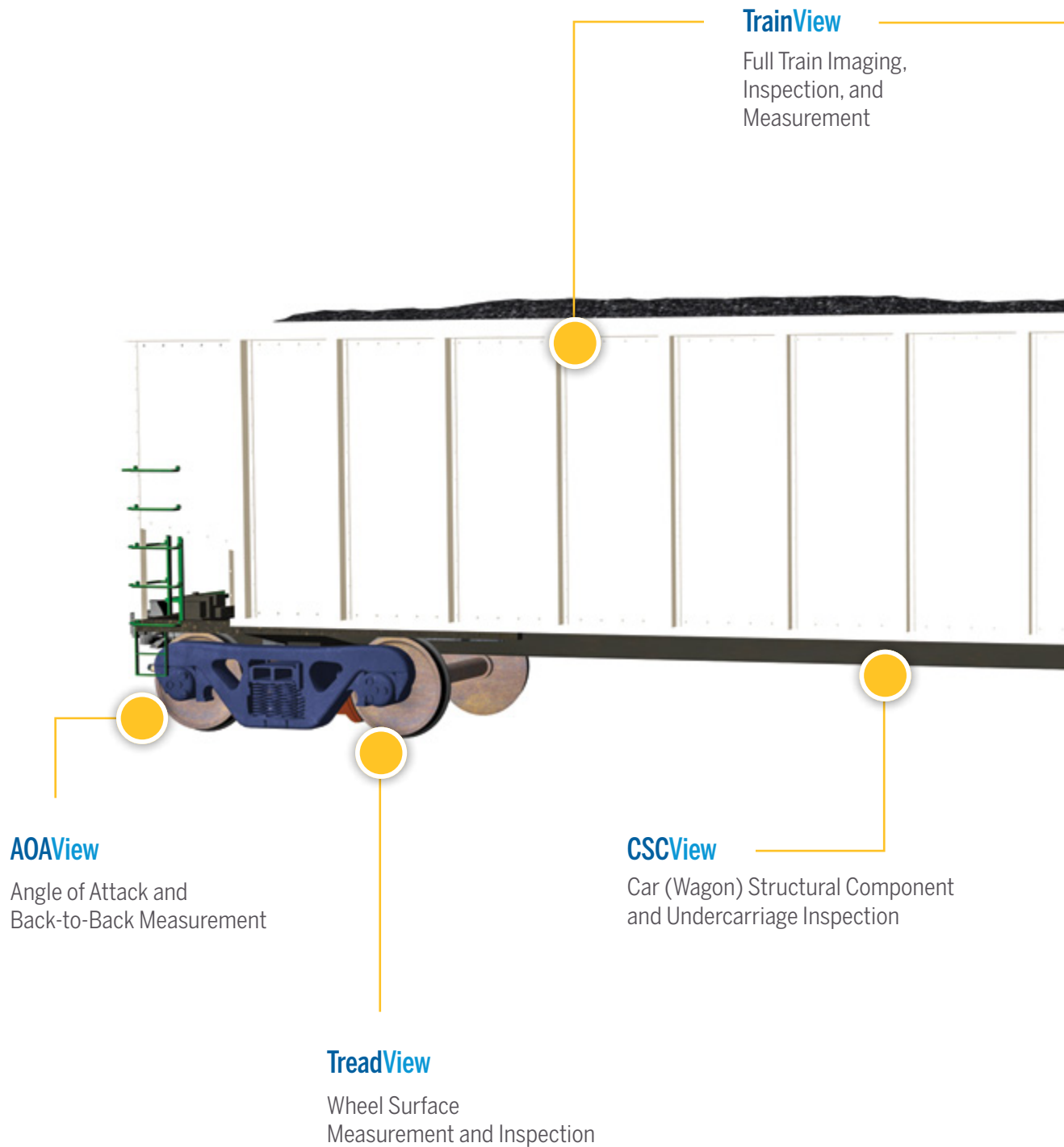
## Rail & Track Inspection Products

TrackView	Track Geometry, Rail, and Track Measurement and Inspection
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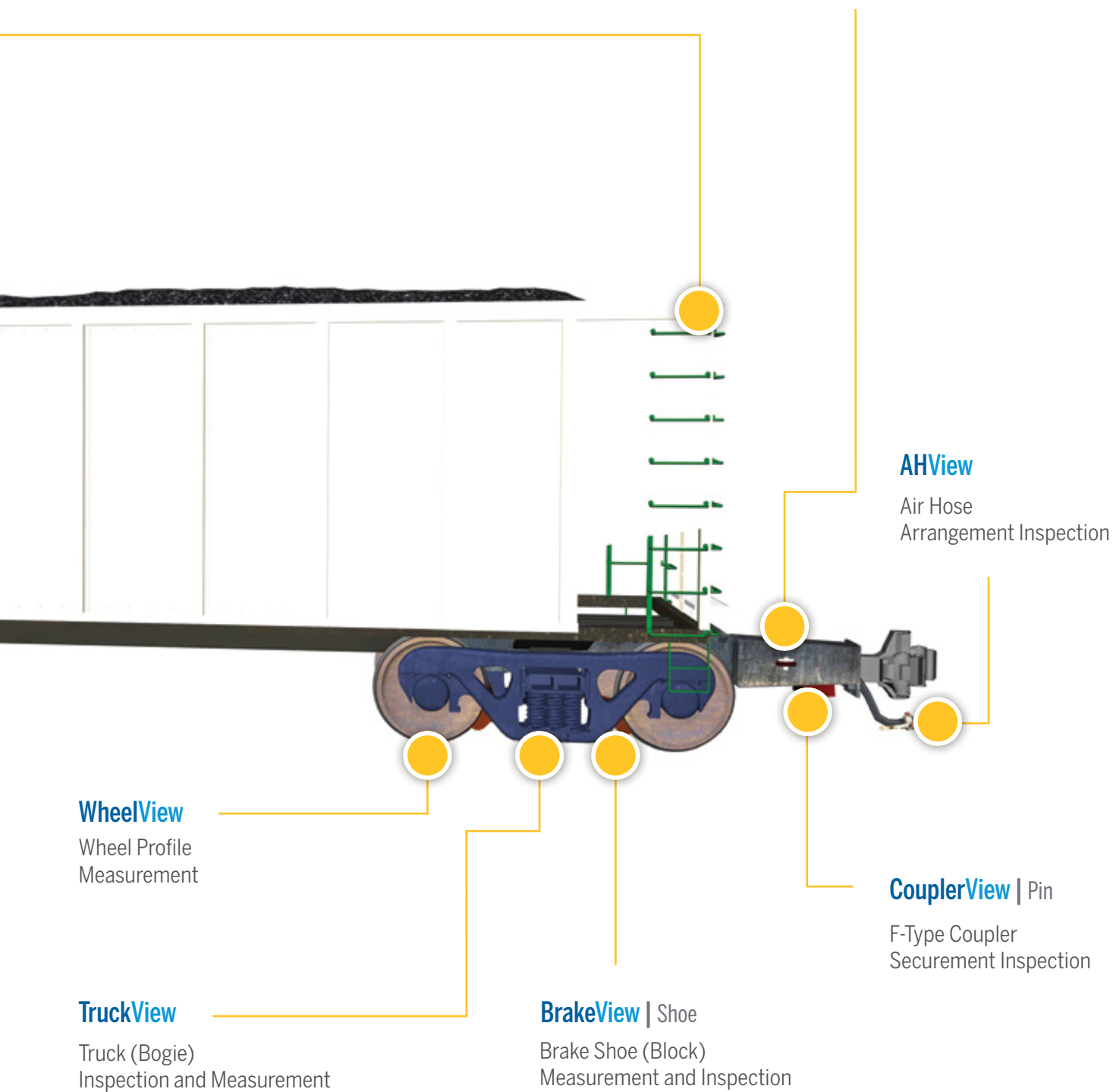
## Software Products

WISE	Complete Wayside Detector Data Solution
TrainWatch	Virtual Train Inspection Software

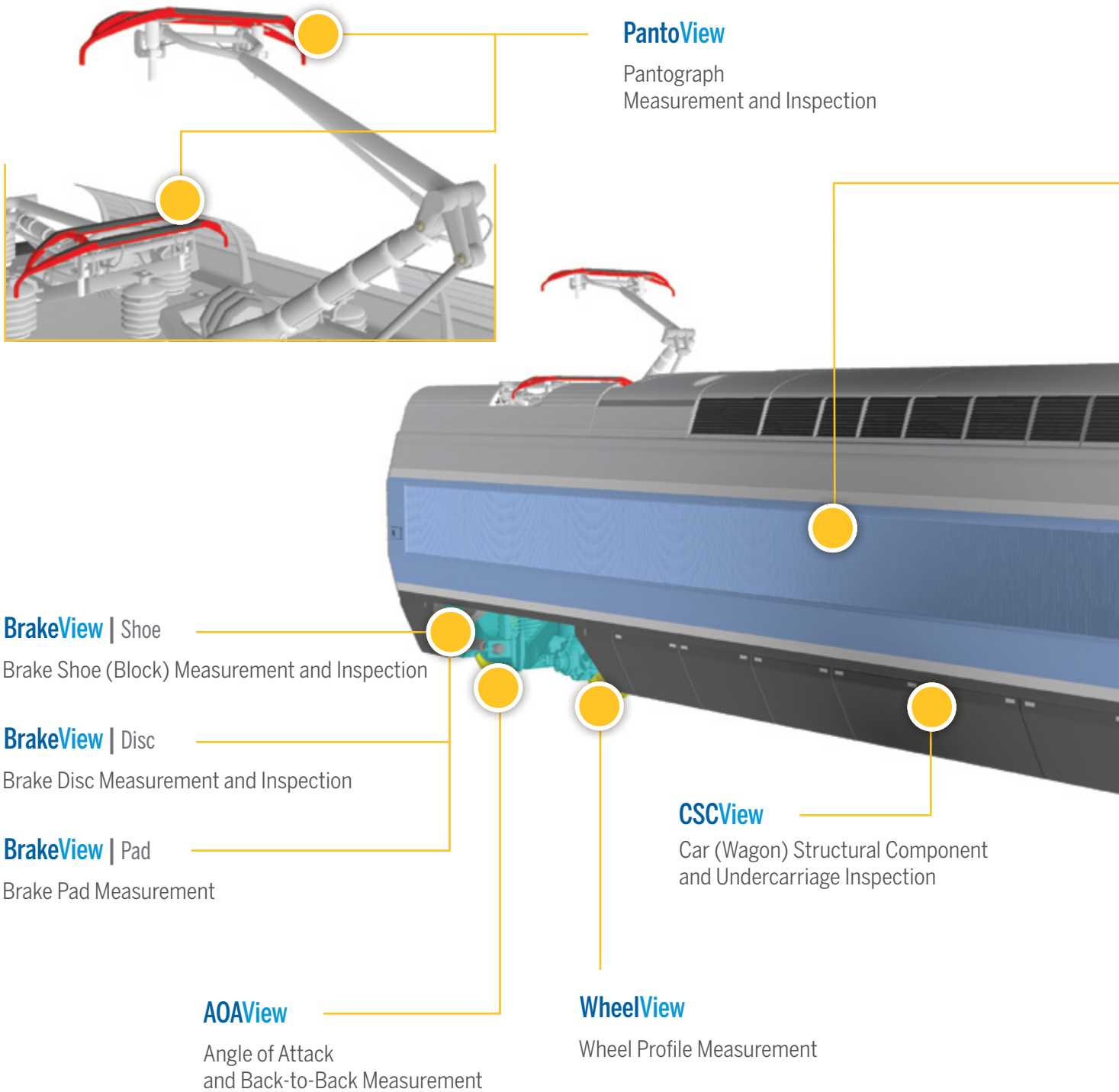
## Freight Train Inspection Technologies



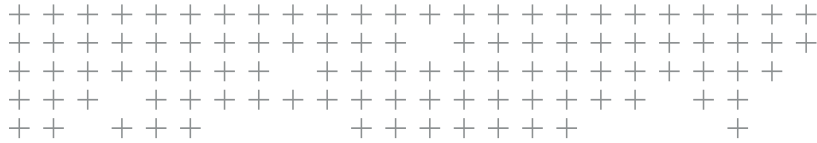




## Passenger Train Inspection Technologies

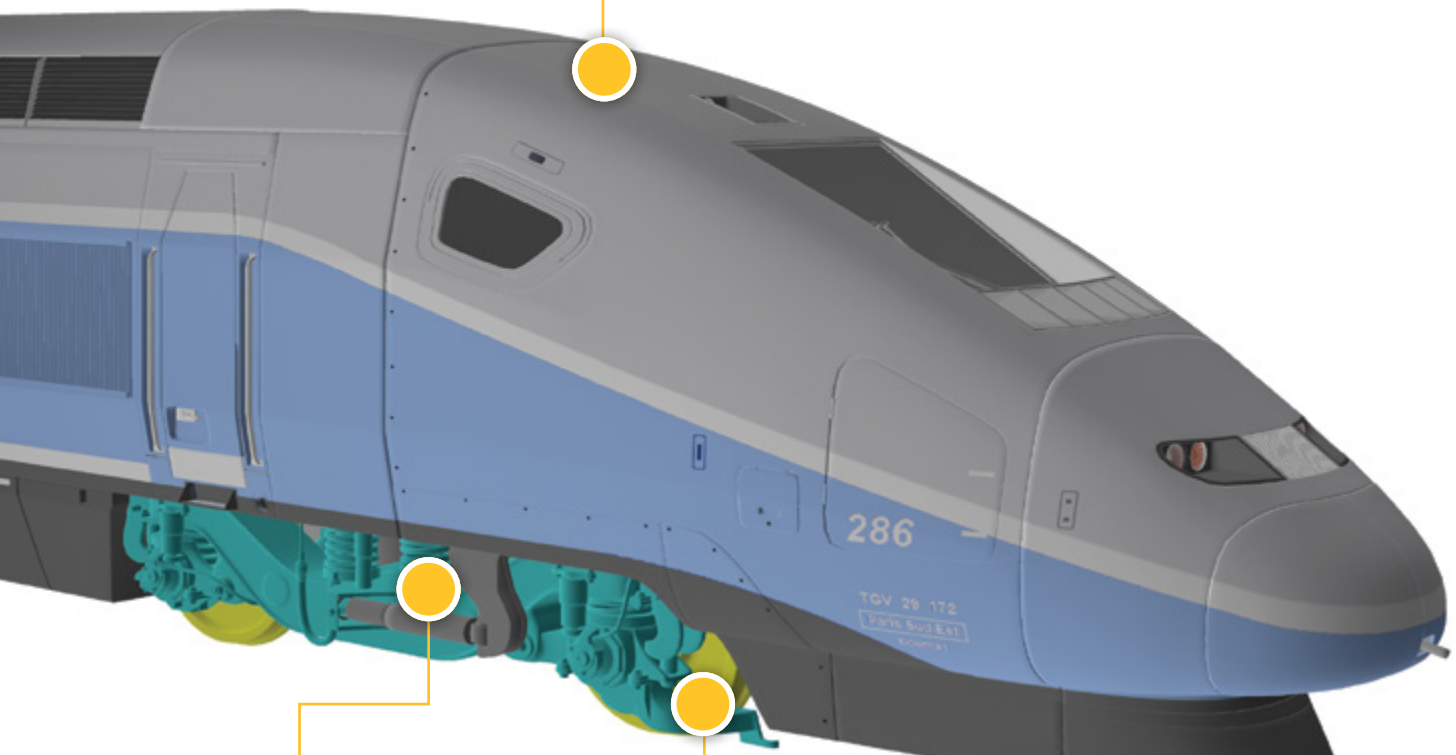






### TrainView

Full Train Imaging,  
Inspection, and  
Measurement



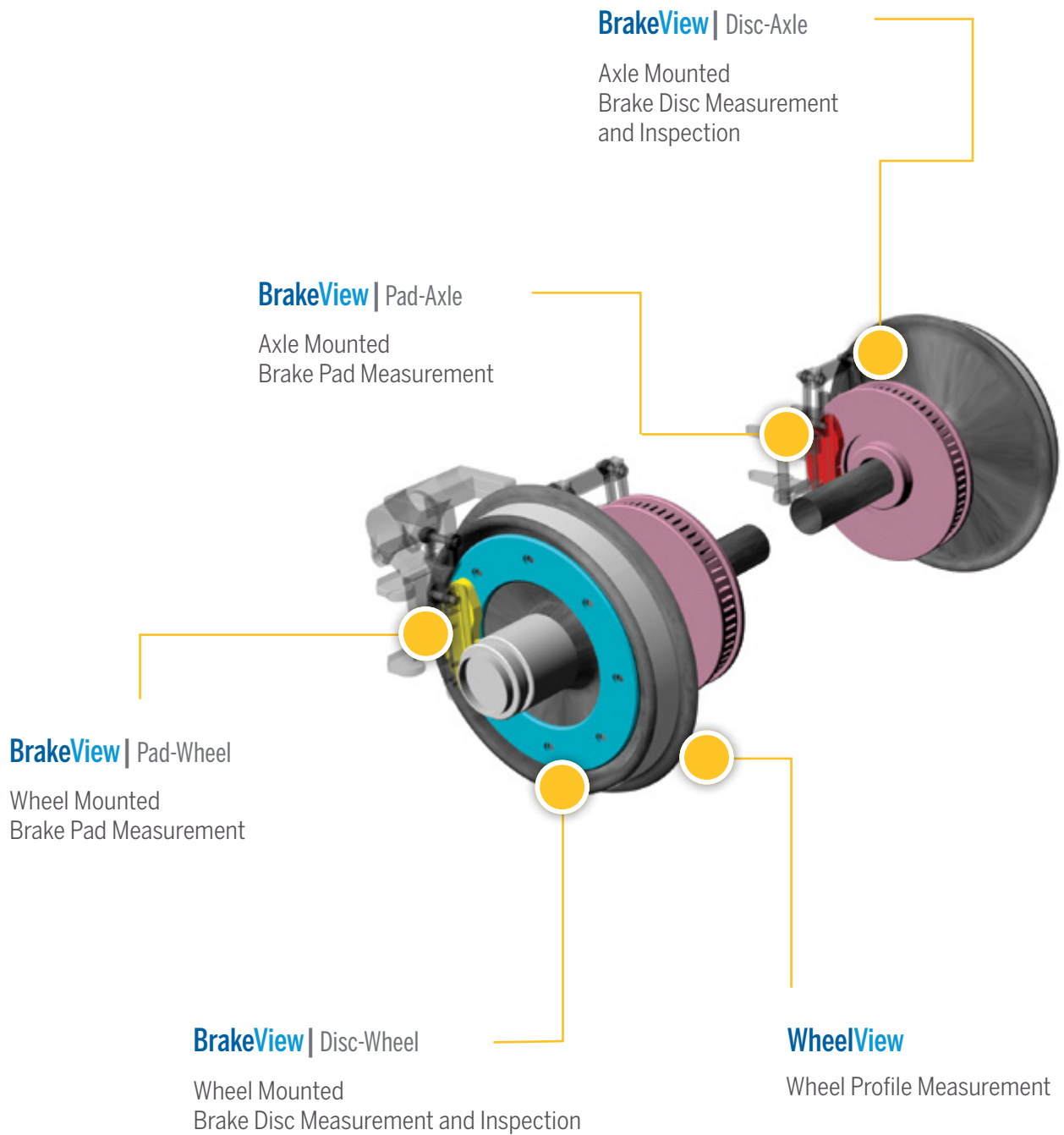
### TruckView

Truck (Bogie)  
Inspection and Measurement

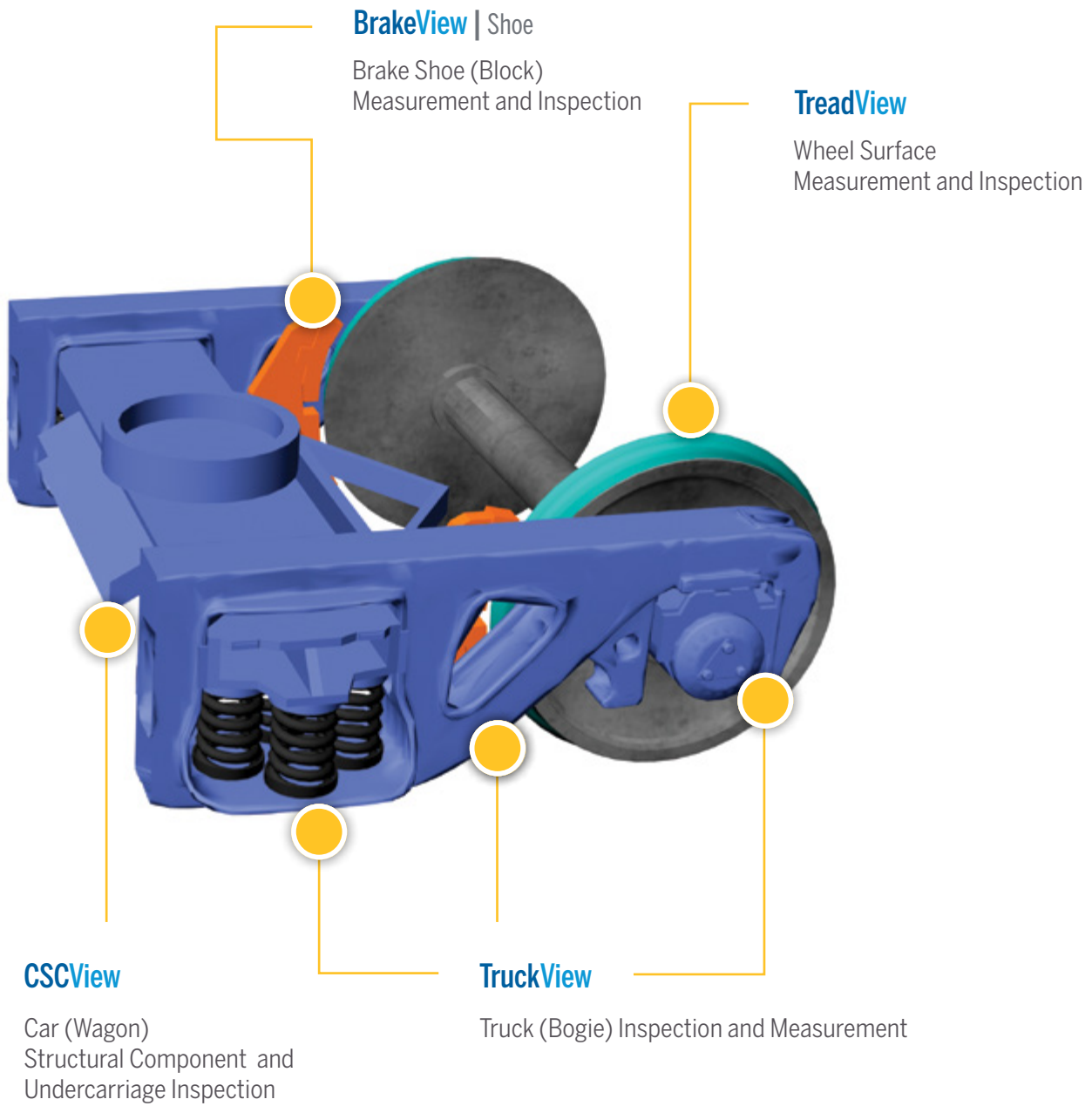
### TreadView

Wheel Surface  
Measurement and Inspection

## Bogie and Axle Inspection Technologies







## System Specifications

### Train | Wagon (Car) | Bogie (Truck) | Wheel Inspection Systems

	WheelView F / I	TreadView	BrakeView   Shoe	BrakeView   Pad	BrakeView   Disc	TruckView	AHView
	page 16	page 18	page 20	page 22	page 24	page 26	page 28
Function	Wheel Profile Measurement	Wheel Surface Inspection	Brake Shoe (Block) Measurement	Brake Pad Measurement	Brake Disc Measurement	Truck (Bogie) Inspection	Air Hose Inspection System
Application	<ul style="list-style-type: none"> <li>• Freight (F)</li> <li>• High Speed (F)</li> <li>• Metro (F, I)</li> <li>• Tram (I)</li> <li>• Indoors (I)</li> </ul>	<ul style="list-style-type: none"> <li>• Freight</li> <li>• High Speed</li> <li>• Metro</li> <li>• Tram</li> <li>• Locomotive</li> </ul>	<ul style="list-style-type: none"> <li>• Freight</li> <li>• High Speed</li> <li>• Passenger</li> <li>• Metro</li> <li>• Locomotive</li> </ul>	<ul style="list-style-type: none"> <li>• High Speed</li> <li>• Passenger</li> <li>• Metro</li> <li>• Tram</li> <li>• Locomotive</li> </ul>	<ul style="list-style-type: none"> <li>• High Speed</li> <li>• Passenger</li> <li>• Metro</li> <li>• Tram</li> <li>• Locomotive</li> </ul>	<ul style="list-style-type: none"> <li>• Freight</li> <li>• High Speed</li> <li>• Passenger</li> <li>• Locomotive</li> </ul>	<ul style="list-style-type: none"> <li>• Freight</li> <li>• Passenger</li> </ul>
Installation Location	<ul style="list-style-type: none"> <li>• Mainline (F)</li> <li>• Depot (F)</li> <li>• Yard (F)</li> <li>• Indoors (I)</li> <li>• Tunnel (F)</li> </ul>	<ul style="list-style-type: none"> <li>• Mainline</li> <li>• Depot</li> <li>• Yard</li> <li>• Indoors</li> </ul>	<ul style="list-style-type: none"> <li>• Mainline</li> <li>• Depot</li> <li>• Yard</li> <li>• Indoors</li> </ul>	<ul style="list-style-type: none"> <li>• Mainline</li> <li>• Depot</li> <li>• Yard</li> <li>• Indoors</li> </ul>	<ul style="list-style-type: none"> <li>• Mainline</li> <li>• Depot</li> <li>• Yard</li> <li>• Indoors</li> </ul>	<ul style="list-style-type: none"> <li>• Mainline</li> <li>• Depot</li> <li>• Yard</li> <li>• Indoors</li> </ul>	<ul style="list-style-type: none"> <li>• Mainline</li> <li>• Depot</li> <li>• Yard</li> </ul>
Standard Operating System	<ul style="list-style-type: none"> <li>• F: 0–140 km/h</li> <li>• I: 0–30 km/h</li> </ul>	0–100 km/h	0–140 km/h	0–140 km/h	0–140 km/h	0–100 km/h	0–100 km/h
Parameters Measured/Inspected	<ul style="list-style-type: none"> <li>• Wheel Profile</li> <li>• Flange H &amp; W</li> <li>• Tread Hollow</li> <li>• Back to Back</li> <li>• Wheel Diameter</li> </ul>	<ul style="list-style-type: none"> <li>• Wheel Surface Condition</li> <li>• Shelling</li> <li>• Broken Wheels</li> <li>• Flats</li> <li>• Out of Round</li> </ul>	<ul style="list-style-type: none"> <li>• Shoe Thickness</li> <li>• Key Condition</li> <li>• Wear Condition</li> </ul>	<ul style="list-style-type: none"> <li>• Pad Thickness</li> <li>• Wear Trend</li> </ul>	<ul style="list-style-type: none"> <li>• Brake Disc Profile</li> <li>• Brake Disc Thickness</li> <li>• Disc Surface Condition (optional)</li> </ul>	<ul style="list-style-type: none"> <li>• Truck (Bogie)</li> <li>• Springs</li> <li>• Friction Wedge</li> <li>• Bolster</li> <li>• Side Frame</li> <li>• Bearings Cap</li> <li>• Bolts and Nuts</li> </ul>	<ul style="list-style-type: none"> <li>• Air Hose</li> <li>• Coupling</li> <li>• Arrangements</li> <li>• Securement</li> <li>• Acoustic (optional)</li> </ul>
Standard Operating Temperature	<ul style="list-style-type: none"> <li>• F: -40 to 55°C</li> <li>• I: -20 to 55°C</li> </ul>	-40°C to 55°C	-40°C to 55°C	-40°C to 55°C	-40°C to 55°C	-40°C to 55°C	-40°C to 55°C
Standard Power Requirements	120/240VAC–24VDC/5kW	120/240VAC–24VDC/20kW	120/240VAC–24VDC/2kW	120/240VAC–24VDC/2kW	120/240VAC–24VDC/2kW	120/240VAC–24VDC/2kW	120/240VAC–24VDC/2kW
Periodic Maintenance	<ul style="list-style-type: none"> <li>• Yearly Calibration</li> <li>• Yearly Service</li> <li>• Semi-Annual Clean Up</li> </ul>	<ul style="list-style-type: none"> <li>• Yearly Calibration</li> <li>• Yearly Service</li> <li>• Semi-Annual Clean Up</li> </ul>	<ul style="list-style-type: none"> <li>• Yearly Calibration</li> <li>• Yearly Service</li> <li>• Semi-Annual Clean Up</li> </ul>	<ul style="list-style-type: none"> <li>• Yearly Calibration</li> <li>• Yearly Service</li> <li>• Semi-Annual Clean Up</li> </ul>	<ul style="list-style-type: none"> <li>• Yearly Calibration</li> <li>• Yearly Service</li> <li>• Semi-Annual Clean Up</li> </ul>	<ul style="list-style-type: none"> <li>• Yearly Calibration</li> <li>• Yearly Service</li> <li>• Semi-Annual Clean Up</li> </ul>	<ul style="list-style-type: none"> <li>• Yearly Calibration</li> <li>• Yearly Service</li> <li>• Semi-Annual Clean Up</li> </ul>
Installation Position and Base	<ul style="list-style-type: none"> <li>• F: In Track/Steel Sleeper (Tie)</li> <li>• I: Steel Base</li> </ul>	Off Track/Concrete or Steel Base	Off Track/Tower or Pole on Concrete or Steel Base	In Track/Steel Sleeper (Tie)	In Track/Steel Sleeper (Tie)	Off Track/Tower or Pole on Concrete or Steel Base	Off Track/Tower or Pole on Concrete or Steel Base
Remote Diagnosis	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Automated Health Reporting	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AEI / RFID Integration	Yes	Yes	Yes	Yes	Yes	Yes	Yes





## Train | Wagon (Car) | Bogie (Truck) | Wheel Inspection Systems

## Rail & Track

CouplerView   Pin	CouplerView   CrossKey	CSCView	TrainView	PantoView	AOAView	TrackView
page 30	page 32	page 34	page 36	page 38	page 40	page 42
F-Type Coupler Securement Inspection	E-Type Coupler Securement Inspection	Undercarriage Inspection	Full Train Imaging & Inspection	Pantograph Inspection	Angle of Attack & B2B Measurement	Track Geometry & Inspection
<ul style="list-style-type: none"> <li>• Freight</li> <li>• Passenger</li> </ul>	<ul style="list-style-type: none"> <li>• Freight</li> </ul>	<ul style="list-style-type: none"> <li>• Freight</li> <li>• High Speed</li> <li>• Passenger</li> <li>• Metro</li> <li>• Locomotive</li> </ul>	<ul style="list-style-type: none"> <li>• Freight</li> <li>• High Speed</li> <li>• Passenger</li> <li>• Metro</li> <li>• Locomotive</li> </ul>	<ul style="list-style-type: none"> <li>• Freight</li> <li>• High Speed</li> <li>• Passenger</li> <li>• Metro</li> <li>• Tram</li> <li>• Locomotive</li> </ul>	<ul style="list-style-type: none"> <li>• Freight</li> <li>• High Speed</li> <li>• Passenger</li> <li>• Metro</li> <li>• Tram</li> <li>• Locomotive</li> </ul>	<ul style="list-style-type: none"> <li>• All Track Types</li> </ul>
<ul style="list-style-type: none"> <li>• Mainline</li> <li>• Depot</li> <li>• Yard</li> <li>• Indoors</li> </ul>	<ul style="list-style-type: none"> <li>• Mainline</li> <li>• Depot</li> <li>• Yard</li> <li>• Indoors</li> </ul>	<ul style="list-style-type: none"> <li>• Mainline</li> <li>• Depot</li> <li>• Yard</li> <li>• Indoors</li> </ul>	<ul style="list-style-type: none"> <li>• Mainline</li> <li>• Depot</li> <li>• Yard</li> <li>• Indoors</li> </ul>	<ul style="list-style-type: none"> <li>• Mainline</li> <li>• Depot</li> <li>• Yard</li> <li>• Indoors</li> </ul>	<ul style="list-style-type: none"> <li>• Mainline</li> </ul>	<ul style="list-style-type: none"> <li>• Locomotive</li> <li>• Wagon</li> <li>• Hi-Rail</li> </ul>
0–100 km/h	0–140 km/h	0–100 km/h	0–100 km/h	0–100 km/h	0–140 km/h	0–200 km/h
<ul style="list-style-type: none"> <li>• F-Type Coupler Securement</li> <li>• Coupler Pin Plate</li> <li>• Plate Bolts</li> <li>• Plate Condition</li> </ul>	<ul style="list-style-type: none"> <li>• E-Type Coupler Securement</li> <li>• Cross (Draft) Key</li> <li>• Cutter Pin</li> <li>• T-Pin and Lock</li> </ul>	<ul style="list-style-type: none"> <li>• Brake Rigging</li> <li>• Structural Components</li> <li>• Undercarriage Components</li> </ul>	<ul style="list-style-type: none"> <li>• Car Body</li> <li>• Car Number</li> <li>• Safety Appliances</li> <li>• Reflectors</li> <li>• Doors</li> <li>• Side and Roof Components</li> <li>• Clearance Gauge</li> <li>• Leaning Cars</li> <li>• Load Carryback</li> <li>• Full car 3D</li> </ul>	<ul style="list-style-type: none"> <li>• Carbon Wear</li> <li>• Chips</li> <li>• Cracks</li> <li>• Missing</li> <li>• Misaligned Pantograph</li> <li>• Uplift</li> </ul>	<ul style="list-style-type: none"> <li>• Angle of Attack</li> <li>• Back to Back</li> <li>• Hunting</li> </ul>	<ul style="list-style-type: none"> <li>• Track Geometry</li> <li>• Rail Profile</li> <li>• Track/Ballast Profile</li> <li>• Rail Condition</li> <li>• Track Condition</li> <li>• Sleeper Condition</li> <li>• Joint Condition</li> </ul>
-40°C to 55°C	-40°C to 55°C	-40°C to 55°C	-40°C to 55°C	-40°C to 55°C	-40°C to 55°C	-20°C to 55°C
120/240VAC–24VDC/5kW	120/240VAC–24VDC/5kW	120/240VAC–24VDC/5kW	120/240VAC–24VDC/5kW	120/240VAC–24VDC/5kW	120/240VAC–24VDC/2kW	120/240VAC–24VDC/2kW
<ul style="list-style-type: none"> <li>• Yearly Calibration</li> <li>• Yearly Service</li> <li>• Semi-Annual Clean Up</li> </ul>	<ul style="list-style-type: none"> <li>• Yearly Calibration</li> <li>• Yearly Service</li> <li>• Semi-Annual Clean Up</li> </ul>	<ul style="list-style-type: none"> <li>• Yearly Calibration</li> <li>• Yearly Service</li> <li>• Semi-Annual Clean Up</li> </ul>	<ul style="list-style-type: none"> <li>• Yearly Calibration</li> <li>• Yearly Service</li> <li>• Semi-Annual Clean Up</li> </ul>	<ul style="list-style-type: none"> <li>• Yearly Calibration</li> <li>• Yearly Service</li> <li>• Semi-Annual Clean Up</li> </ul>	<ul style="list-style-type: none"> <li>• Yearly Calibration</li> <li>• Yearly Service</li> <li>• Semi-Annual Clean Up</li> </ul>	<ul style="list-style-type: none"> <li>• Yearly Calibration</li> <li>• Yearly Service</li> <li>• Regular Clean Up</li> </ul>
In Track/ Steel Sleeper (Tie)	In Track/ Steel Sleeper (Tie)	In Track/ Steel Sleeper (Tie)	Off Track/Tower or Pole on Concrete or Steel Base	Above Track/Tower or Bridge on Concrete or Steel Base	In Track/ Steel Sleeper (Tie)	Wagon/Truck Frame
Yes	Yes	Yes	Yes	Yes	Yes	Yes (if remote connection available)
Yes	Yes	Yes	Yes	Yes	Yes	Yes (if remote connection available)
Yes	Yes	Yes	Yes	Yes	Yes	GPS Based

\*Specifications subject to change without notice.

# WheelView — F/I



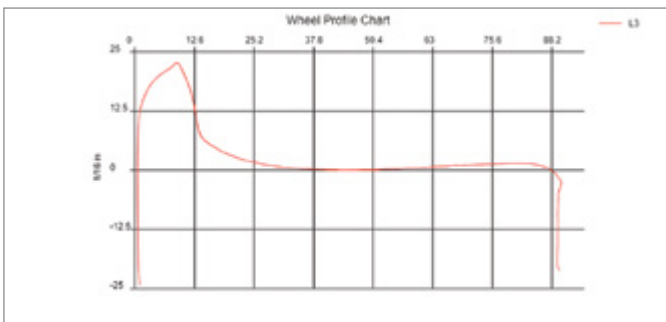
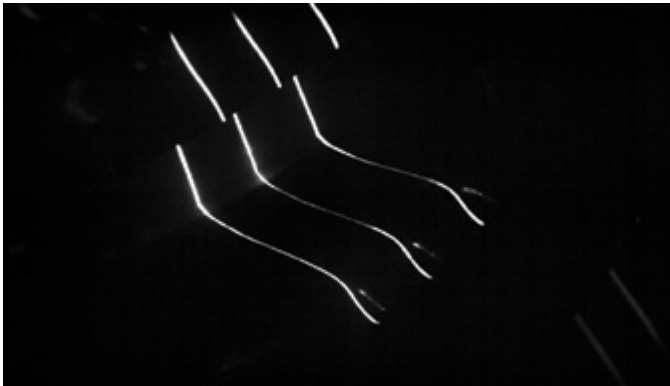
Trimble® WheelView® automatic wayside systems measure the wheel profiles of moving trains. These systems are used to inspect wheels for preventative maintenance, maintenance scheduling, derailment prevention, and to reduce track and rail damage caused by excessively worn wheels.

WheelView-F is a rugged system that operates in harsh environments as well as workshops, depots, and yards. It has an exceptionally robust design capable of operating without human intervention for extended periods. WheelView-F provides wheel diameter measurements at high speeds of up to 85 mph (140 km/h).

The other WheelView variants allow for operation in specific conditions and provide a variety of different measurements. WheelView-I is offered for indoors and low speed operations.



In production since 2000, different versions of WheelView including the standard version (WheelView-S) have been successfully deployed in many countries and is currently operational in some of the busiest freight and passenger corridors in the world, measuring over 50,000 wheels every day per system.



## Inspections & Measurements

- Flange height
- Flange width
- Flange slope
- Tread hollow
- Rim thickness
- Full wheel profile
- Equivalent conicity
- Back-to-back
- Wheel diameter (F, I)
- Flange rollover (arris) and tread rollover
- Wheel diameter based on witness groove

## Features

- Complete wheel profile measurement
- Speeds of 0 to 85 mph (140 km/h)
- Operating temperature: -40°C to 55°C
- Capable of operating in extreme environments
- Installed on custom steel tie (sleeper)
- Easy maintenance
- Air purge system for system cleaning
- Automatic alarm generation

## Software Features

- Remote monitoring/control
- Digital image acquisition/processing
- Web-based database/visualization
- Automated reporting
- AEI (RFID) integration

WheelView is an effective system and quickly pays for itself by improving wheel maintenance practices and eliminating derailments due to worn wheels. It increases the efficiency of wheel maintenance by identifying proactive maintenance practices based on the application of wheel wear rates and early wheel defect detection.



## Wayside Wheel Tread & Surface Inspection System



The Trimble® TreadView® system is a sophisticated automatic non-contact optical wheel surface inspection product that inspects wheel tread surface, flange, and plate areas at mainline operational speeds, even in tough environments, day or night.

This system offers visual inspection of complete wheel tread and flange surface using optical imaging and 3D laser scanning. The objective of the system is to determine any surface abnormalities of the wheel that can be detected using high resolution images of the wheel and high density 3D data of the wheel surface.

TreadView deploys a unique state of art digital imaging and laser scanning technology for maximum data density, accuracy, and efficiency. The product benefits from a series of sophisticated image processing algorithms to assess wheel tread

and flange surface condition from acquired multispectral multi-illumination images.

A major highlight of the system is that it operates at mainline speeds up to 60 mph (100 km/h) for greater utilization by rail operators. Another important advantage is that it can also operate at very low speed, where traditional “contact” impact and force measurement-based systems fall short of detecting wheel surface problems such as flats due to restrictive speed limitations.



## Inspections & Measurements

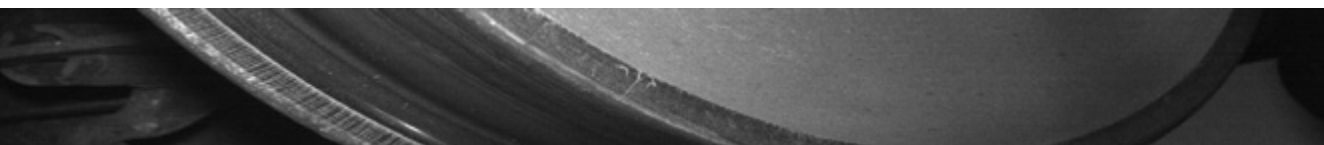
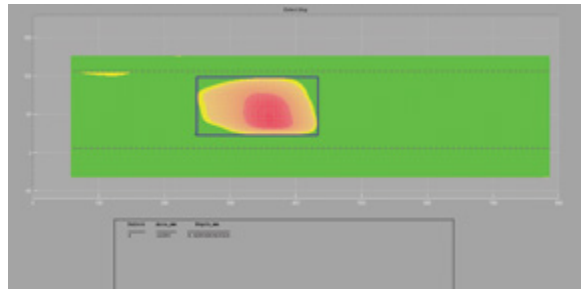
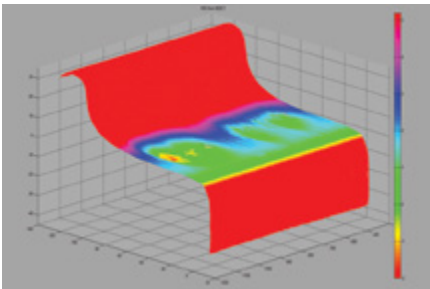
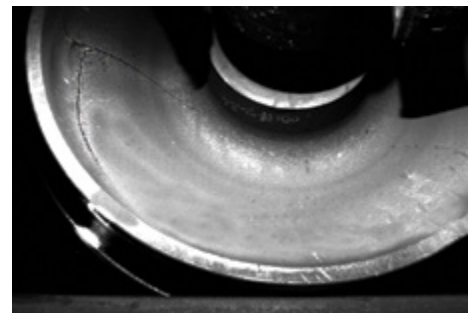
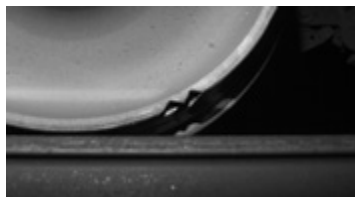
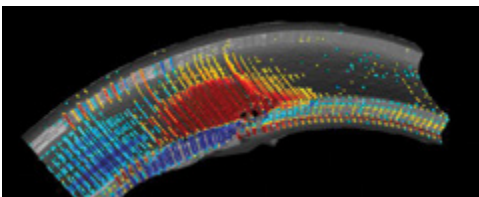
- Flat wheel
- Shelled and spalled tread
- Shell size and depth
- Tread groove
- Shattered rim
- Broken/missing wheel sections
- Broken flange
- Significant spread rim and vertical split rim
- Built-up tread
- Wheel OOR (out-of-round)
- Hunting detection
- Back-to-back (axle wheel pacing)
- Flange height variations around the wheel
- Rim thickness variations around the wheel
- Tread hollow variations around the wheel
- Non-uniform axle wheel wear
- Major scrapes, dents and gouges
- Visible substantial fatigue cracks
- Substantial thermal crack
- Angle of attack

## Features

- Highly sophisticated data collection system
- Speeds of 0 to 60 mph (100 km/h)
- Operating temperature:  $-40^{\circ}\text{C}$  to  $55^{\circ}\text{C}$
- Capable of operating in extreme environments
- Installed on trackside with no track interference
- Automatic alarm generation

## Software Features

- Remote monitoring/control
- Digital image acquisition/processing
- Web-based database/visualization
- Automated reporting
- AEI (RFID) integration



## BrakeView — Shoe

### Wayside Brake Shoe (Block) Measurement System



Trimble® BrakeView™-Shoe wayside measurement system inspects brake shoes (blocks) at mainline operational speeds. This system is vision-based and uses a multi-camera high-speed imaging unit to take multiple images of every brake shoe for inspection and measurement.

BrakeView-Shoe provides a complete and reliable assessment of the brake shoe (block) condition by highlighting obvious shoe defects. The system is fully automated and can operate in extreme conditions—indoors and out. Enclosures are installed on two short towers, one on each side of the track, mounted on two concrete or steel footings. Cameras and illumination systems are installed at a safe distance from the center of the track. Since each brake shoe is viewed by two cameras, a complete and reliable assessment of the brake shoe condition is provided.

Brake shoes are viewed from top and bottom perspectives. Acquired images are processed by a set of sophisticated image processing algorithms. The imaging system and processing algorithms are insensitive to ambient light conditions and can operate day or night.

Brake shoe data is easily integrated into the Trimble WISE data management system which gives web-based access to data including images.





## Inspections & Measurements

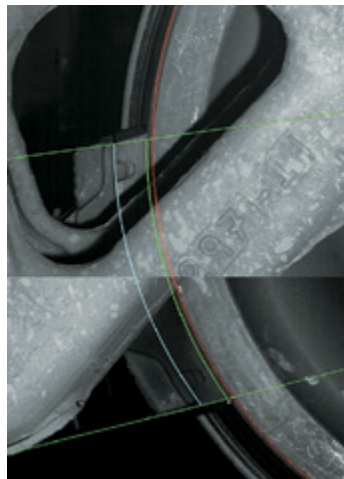
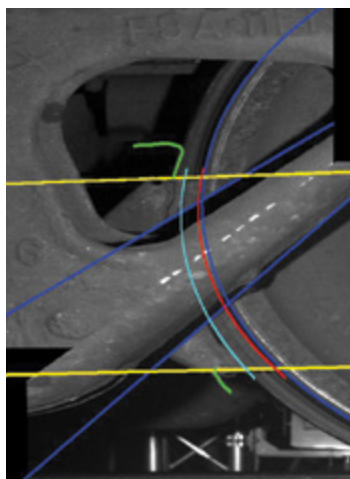
- Shoe detection
- Shoe thickness in top and bottom positions
- Shoe wear profile
- Shoe position with respect to the wheel surface
- Shoe securement such as key inspection
- Obvious shoe breakage
- Brake application status with thermal imaging of brake shoe & wheel contact area (optional)

## Features

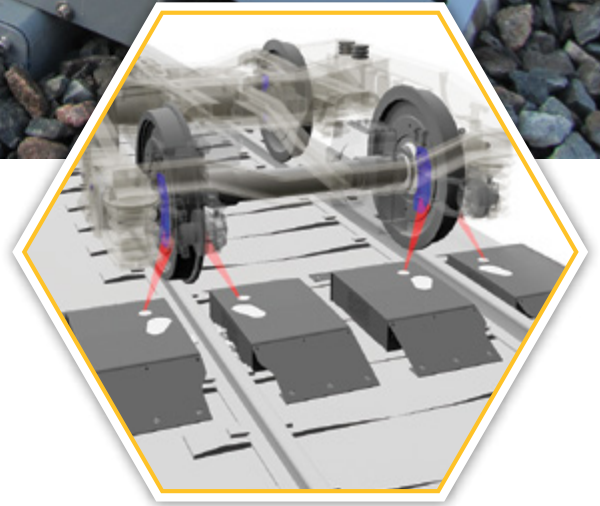
- Speeds of 0 to 85 mph (140 km/h)
- Operating temperature:  $-40^{\circ}\text{C}$  to  $55^{\circ}\text{C}$
- Capable of operating in extreme environments
- Installed on trackside with no track interference
- Easy maintenance
- Automatic alarm generation

## Software Features

- Remote monitoring/control
- Digital image acquisition/processing
- Web-based database/visualization
- Automated reporting
- AEI (RFID) integration



## BrakeView — Pad



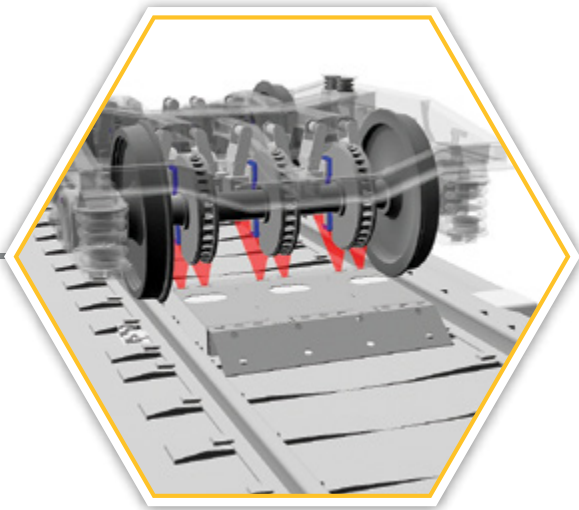
Trimble® BrakeView™-Pad automatic wayside brake pad measurement system operates on passing trains at mainline operational speeds. It is a machine vision system which uses a high-speed digital imaging system to acquire images of every brake pad for inspection and measurement. The system is fully automated and can operate in extreme conditions—indoors and out.

BrakeView-Pad is installed on a steel tie (sleeper) provided by Trimble. Cameras and illumination systems are installed in sealed enclosures installed on the system tie (sleeper).

Brake pads are viewed from the bottom and the acquired images are processed by a set of sophisticated image processing algorithms. The imaging system and processing algorithms are insensitive to ambient light conditions and can operate day or night.

There are two versions of the BrakeView-Pad system—one is designed for axle mounted pads and the other for wheel mounted ones.

The number of cameras and exact design will depend on the rolling stock to be inspected. BrakeView-Pad utilizes both laser based structural light and other illumination to produce several images concurrently for reliable measurements.



## Features

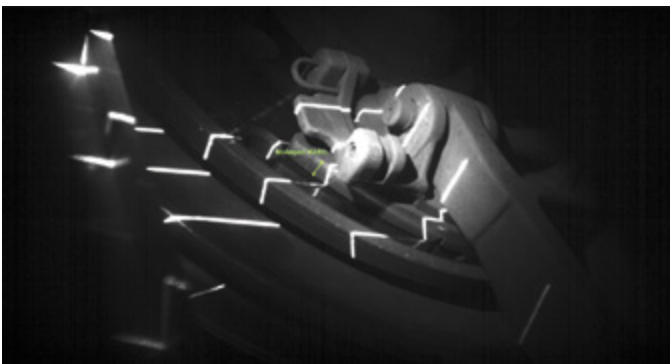
- Speeds of 0 to 85 mph (140 km/h)
- Operating temperature:  $-40^{\circ}\text{C}$  to  $55^{\circ}\text{C}$
- Capable of operating in extreme environments
- Installed on custom steel tie (sleeper)
- Easy maintenance
- Automatic alarm generation

## Inspections & Measurements

- Pad detection
- Pad thickness in up to 3 positions
- Alarm on pad thickness levels
- Alarms on unequal wear of pads
- Visual image of the pad and surrounding area

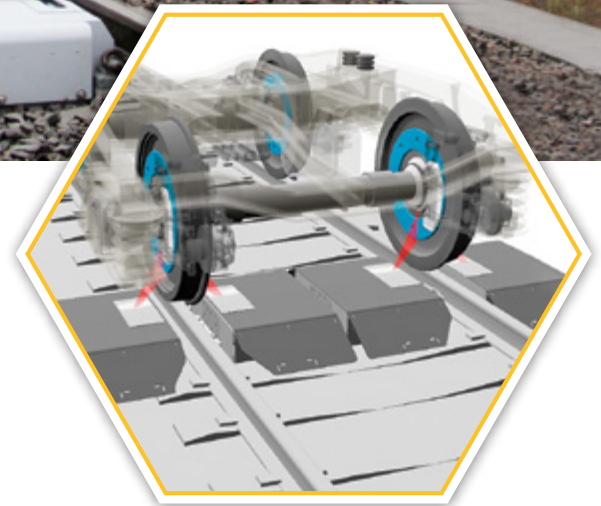
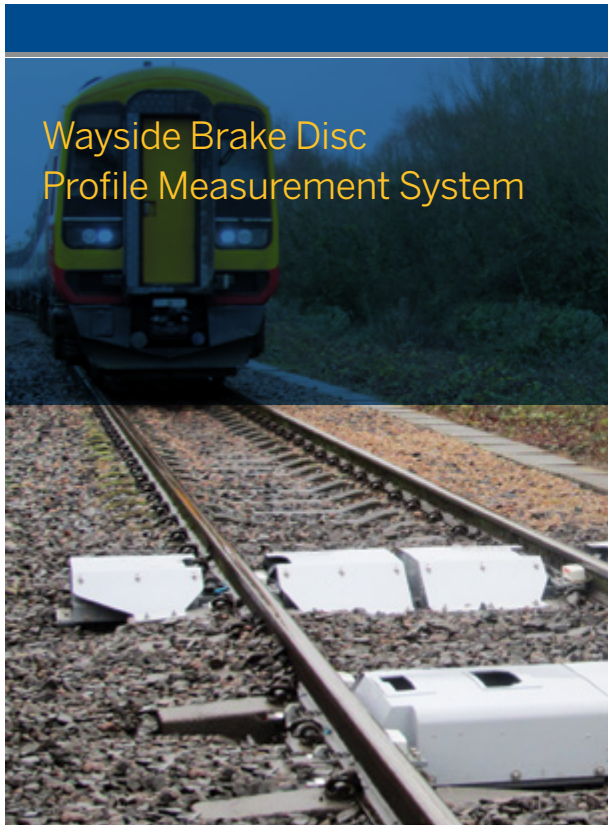
## Software Features

- Remote monitoring/control
- Digital image acquisition/processing
- Web-based database/visualization
- Automated reporting
- AEI (RFID) integration





## BrakeView — Disc



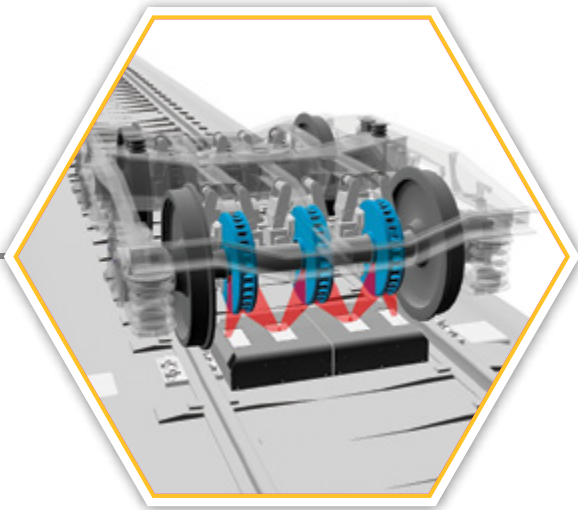
Trimble® BrakeView™-Disc automatic wayside brake disc inspection system operates on passing trains at mainline operational speeds. It is a machine vision system which uses a high-speed digital imaging system to acquire images of every brake disc for inspection and measurement.

The system is fully automated and can operate in extreme conditions—indoors and out. BrakeView-Disc is installed on a steel tie (sleeper) provided by Trimble. Cameras and illumination systems are installed in sealed enclosures installed on the system tie.

Brake discs are viewed from the bottom and acquired images are processed by a set of sophisticated image processing algorithms. The imaging system and processing algorithms are insensitive to ambient light conditions and can operate day—or night.

There are two versions of the BrakeView-Disc system—one for axle mounted and one for wheel mounted discs. The number of cameras and exact design will depend on the rolling stock to be inspected.

The system utilizes both laser based structural light and other illumination to produce several images concurrently for reliable measurement and inspection.



## Inspections & Measurements

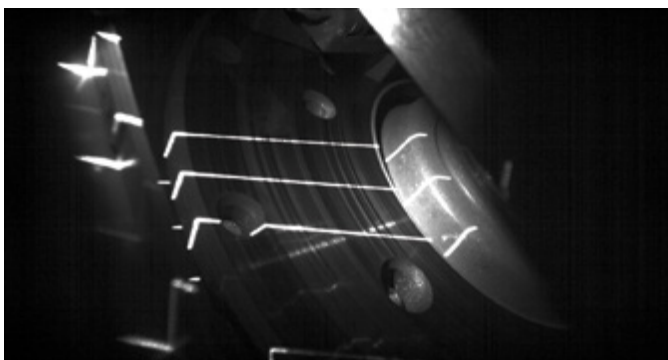
- Disc profile measurement
- Disc thickness for up to 4 discs per axle
- Alarm on disc thickness levels
- Alarms on unequal wear of discs
- Visual image of the disc and surrounding area

## Features

- Speeds of 0 to 85 mph (140 km/h)
- Operating temperature:  $-40^{\circ}\text{C}$  to  $55^{\circ}\text{C}$
- Capable of operating in extreme environments
- Installed on custom steel tie (sleeper)
- Easy maintenance
- Automatic alarm generation

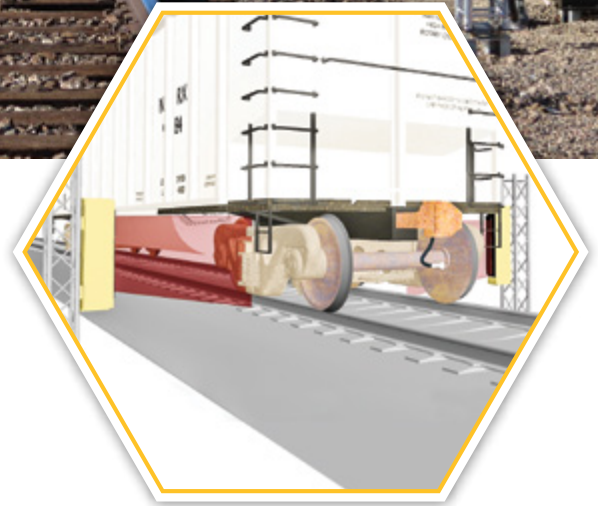
## Software Features

- Remote monitoring/control
- Digital image acquisition/processing
- Web-based database/visualization
- Automated reporting
- AEI (RFID) integration





## Wayside Truck (Bogie) Inspection System



Trimble® TruckView® wayside truck (bogie) inspection system operates on passing trains at mainline operational speeds, even in tough environments, day or night. It is a vision based system which uses high-speed and high-definition imaging to provide high resolution images of every truck for inspection and measurement.

Many truck related defects can cause serious short term and long terms problems and possible derailments. For a reliable and dependable inspection every truck is viewed from at least two angles—top and bottom.

TruckView inspects many features of bogies including fasteners, side frame condition, bearings

and related components, friction wedges, springs, and more. Alarms are generated when issues are detected.

Examples are excessive wedge rise, spring condition to find missing and broken springs, and spring compression to detect imbalanced loads.





## Inspections & Measurements

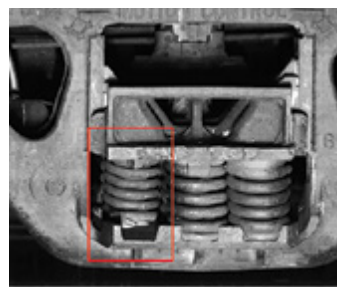
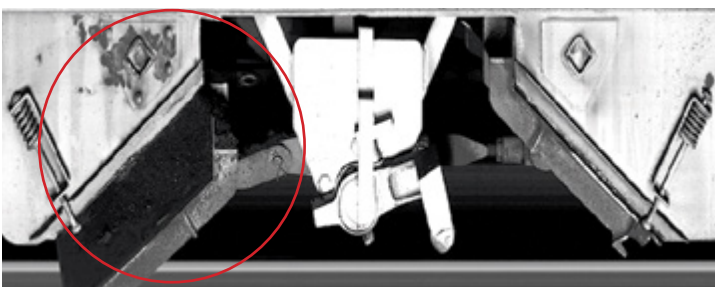
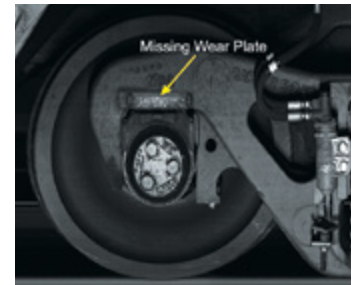
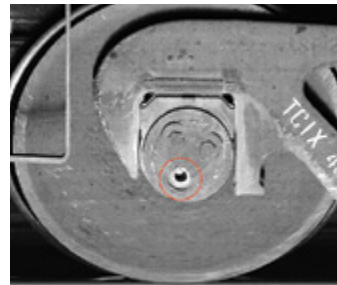
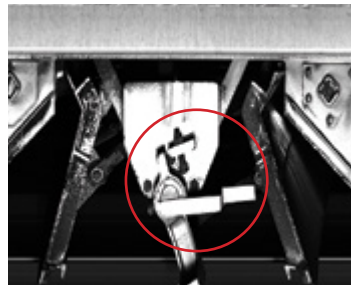
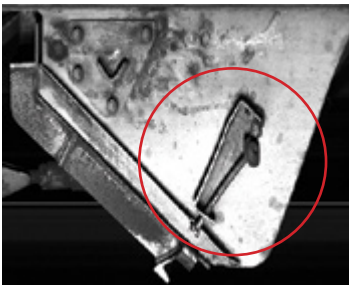
- Fasteners
- Spring inspection to detect broken or missing springs
- Heavy load imbalance
- Bearing cap and cap bolts
- Side frame mismatch
- Bearing adapter
- Bearing adapter wear plate
- Bearing keeps
- Sand hose position and activators
- Wedge detection and height measurement
- Individual and average wedge rise measurement
- Hopper door
- Earth straps
- R-clips
- VTA valves
- Sliding wheel detection (optional)
- Truck type identification (optional)

## Features

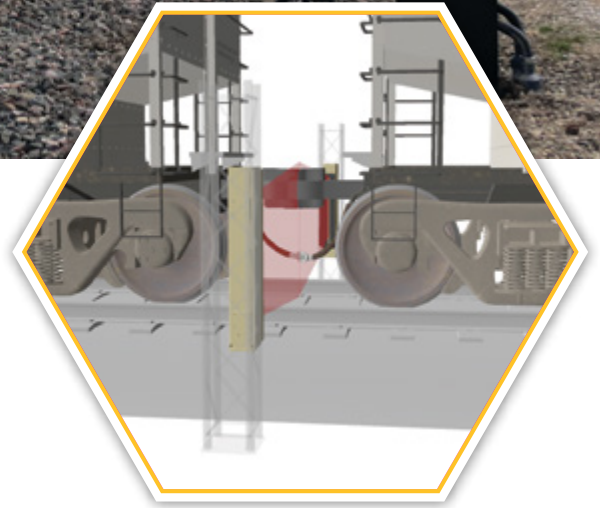
- Speeds of 0 to 60 mph (100 km/h)
- Operating temperature:  $-40^{\circ}\text{C}$  to  $55^{\circ}\text{C}$
- Capable of operating in extreme environments
- Installed on trackside with no track interference
- Easy maintenance
- Automatic alarm generation

## Software Features

- Remote monitoring/control
- Digital image acquisition/processing
- Web-based database/visualization
- Automated reporting
- AEI (RFID) integration



## Wayside Brake Air Hose Inspection System



Trimble® AHView wayside brake air hose inspection system operates on passing trains at mainline operational speeds. A vision based system, it uses a high-speed and high-definition imaging system to provide high resolution images of every air hose arrangement for inspection and measurement.

Air hose arrangements and their diagnosis is complex and an automated system is highly beneficial for rail operators as air hose separation is one of the leading causes of train stoppage in freight operations. AHView provides automated alarms based on the condition of the air hose arrangement and detects the ones that have the highest probability of separation.

AHView is designed to inspect many conditions of the air hose assembly and can detect defects like peaked air hose coupling, air hose height, glad-hand, air hose angle, coupling position, and more.



## Inspections & Measurements

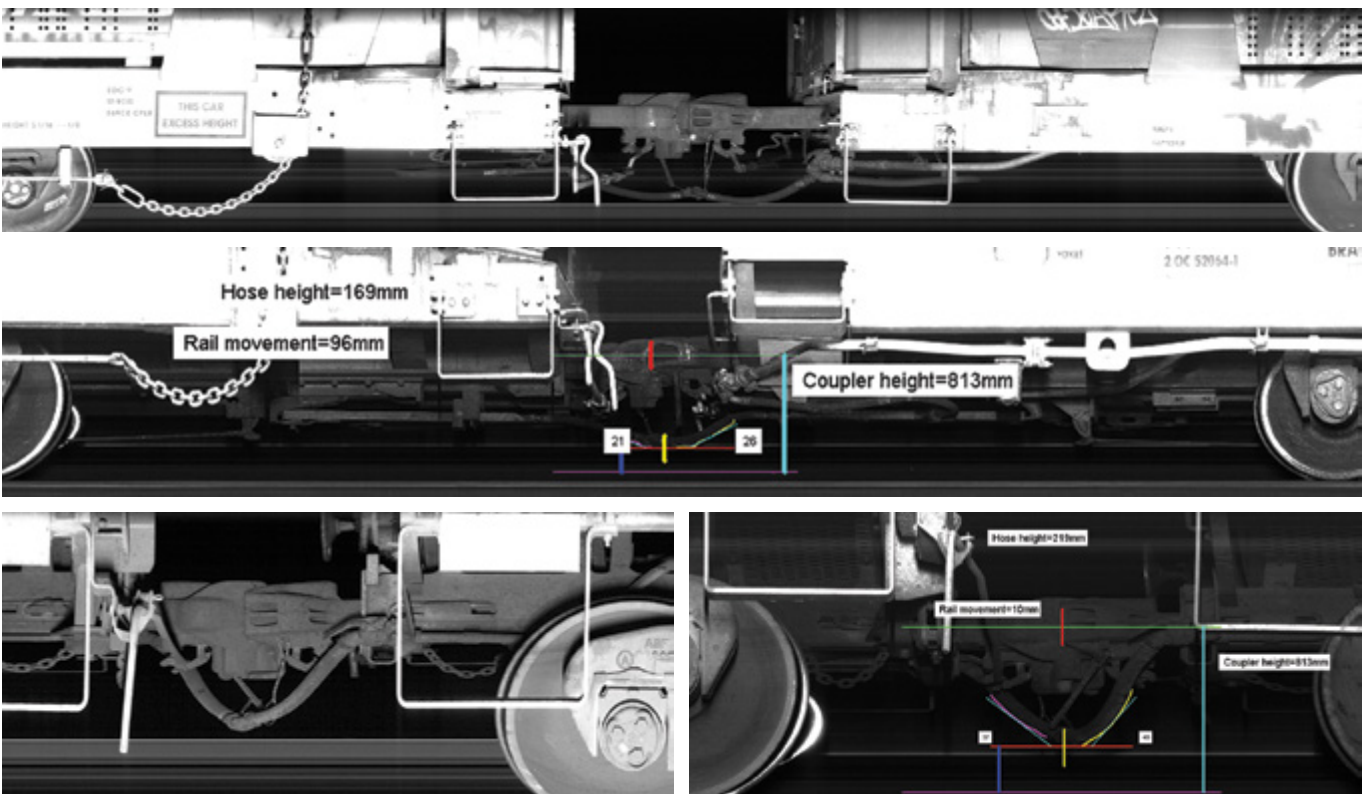
- Air hose orientation
- Air hose angle
- Air hose height from top of rail
- Glad-hand angle
- Coupling: peaked, horizontal, and U-shaped coupling
- Air hose support inspection
- Coupler shank movement
- Coupler height
- Air hose leak (acoustic option)

## Features

- Speeds of 0 to 60 mph (100 km/h)
- Operating temperature:  $-40^{\circ}\text{C}$  to  $55^{\circ}\text{C}$
- Capable of operating in extreme environments
- Installed on trackside with no track interference
- Easy maintenance
- Automatic alarm generation

## Software Features

- Remote monitoring/control
- Digital image acquisition/processing
- Web-based database/visualization
- Automated reporting
- AEI (RFID) integration





## CouplerView — Pin

### Wayside F-Type Coupler Securement Inspection System



Trimble® CouplerView®-Pin is a machine vision wayside detection system that detects defects in F-type coupler securement mechanisms. It utilizes high-speed digital line imaging cameras to acquire multiple images of every coupler pin securement for inspection. The system works at mainline speeds, even in tough environments, day or night.

For F-type couplers, the system inspects the coupler vertical pin carrier plate, securement, and the corresponding fasteners. Different types of F-type securements, including ones with cushioning units, are handled as well.

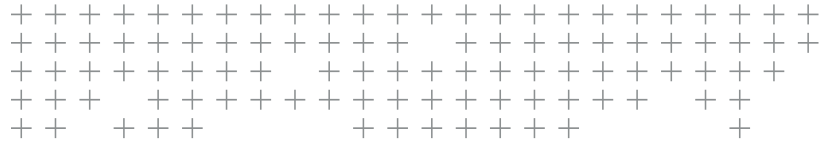
If the coupler securement fails during train operation there is a high probability that the coupler will “pull out” of the car in a draft situation. In most cases this will result in the coupler falling between the cars and into the gauge of the track. If the train is operating at mainline speeds this can result in a derailment.

CouplerView-Pin is designed to operate on passing trains at mainline operational speeds up to



60 mph (100 km/h). The CouplerView-Pin system's processing algorithm classifies couplers into E and F types before the securement processing and only F-Type couplers are inspected.

CouplerView-Pin systems are installed on steel ties (sleepers) supplied by Trimble. Cameras and the illumination system are enclosed in sealed steel boxes mounted on the gauge side of the supplied steel tie (sleeper). The securement component images are analyzed for possible failure, deformation, and missing fasteners, and plates.



## Inspections & Measurements

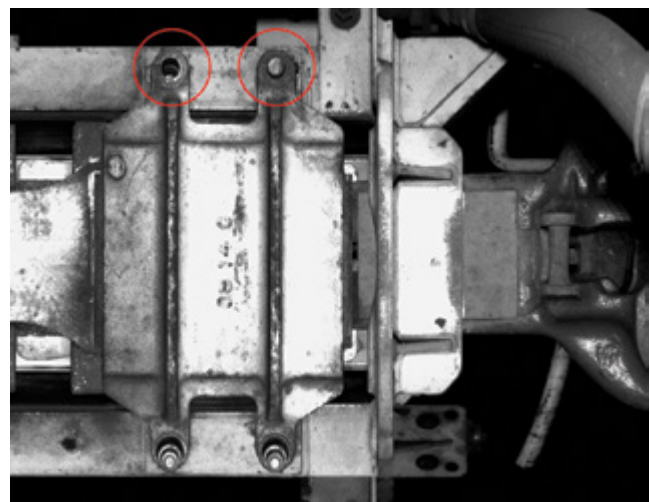
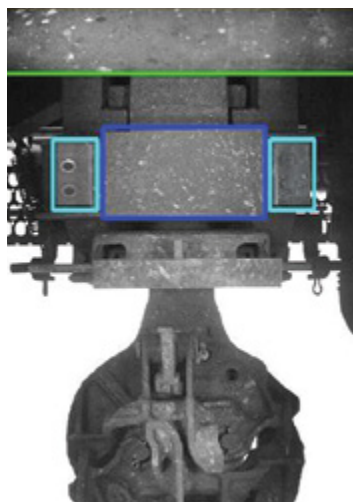
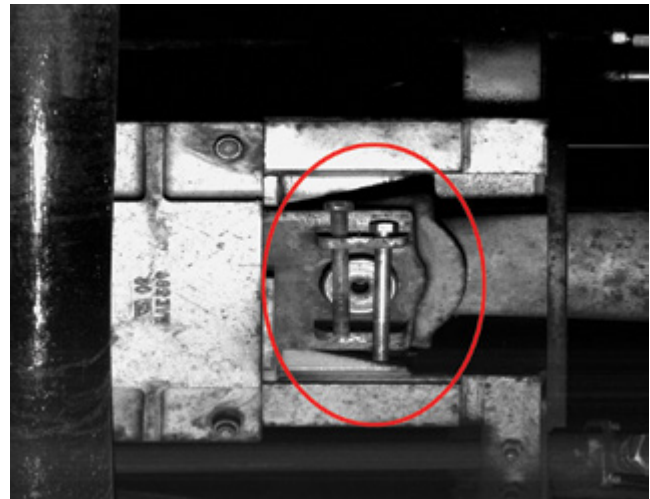
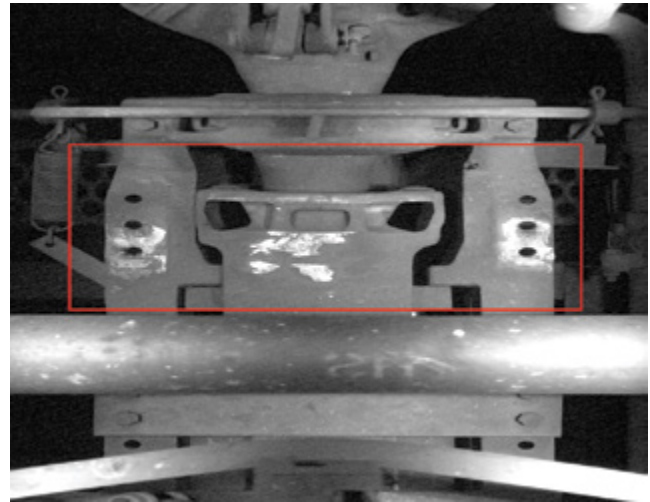
- Missing coupler pin plate
- Missing horizontal securement bolts
- Leaning coupler pin plate
- Damaged, deformed or rotated pin plate, or securement bolts
- Missing fasteners

## Features

- Speeds of 0 to 60 mph (100 km/h)
- Operating temperature:  $-40^{\circ}\text{C}$  to  $55^{\circ}\text{C}$
- Capable of operating in extreme environments
- Installed on custom steel tie (sleeper)
- Easy maintenance
- Automatic alarm generation

## Software Features

- Remote monitoring/control
- Digital image acquisition/processing
- Web-based database/visualization
- Automated reporting
- AEI (RFID) integration



## CouplerView — CrossKey

### Wayside E-Type Coupler Securement Inspection System



Trimble® CouplerView®-CrossKey is an automatic wayside detection system that is designed to inspect E-Type coupler securement components at mainline speeds. It uses a high-speed strobe digital imaging system to acquire multiple images of every cross key (draft key) and the surrounding area for inspection.

The system is used to inspect the cross key and its securement mechanism. Failure of such securement parts is a source of delay and derailments in freight operations. It operates on passing trains at mainline operational speeds up to 85 mph (140 km/h). All cross keys are imaged from both front and back—including the area under the center sill for proper E/F coupler classification.

The system's processing algorithm classifies couplers into E and F types before the plate processing and only E-Type couplers are inspected. CouplerView-CrossKey systems are installed on steel ties (sleepers) supplied by Trimble. Cameras and illumination component are enclosed in sealed boxes mounted on the gauge side of the steel tie (sleeper). Images are analyzed for the existence of the cross key and its securement components.





## Inspections & Measurements

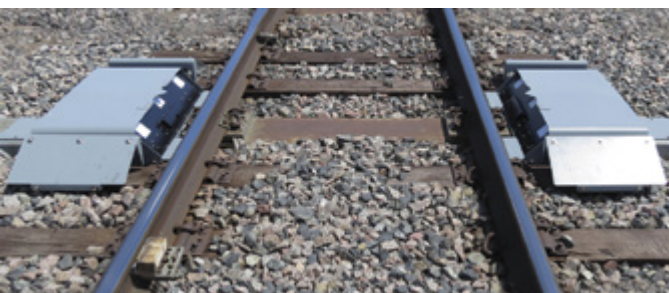
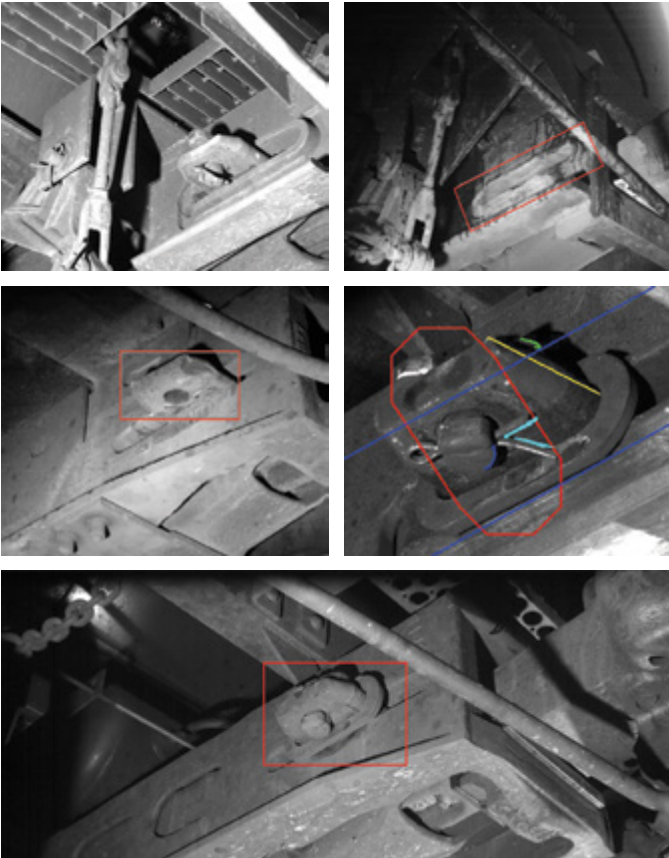
- Classify E-type and F-type couplers
- Detect missing cross (draft) key
- Find missing retainer-pin (t-pin)
- Detect missing cotter key
- Find missing cross key retainer washer

## Features

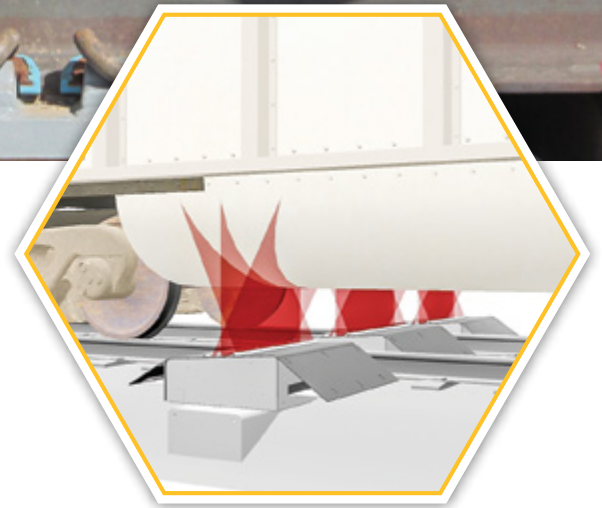
- Speeds of 0 to 85 mph (140 km/h)
- Operating temperature:  $-40^{\circ}\text{C}$  to  $55^{\circ}\text{C}$
- Capable of operating in extreme environments
- Installed on custom steel tie (sleeper)
- Easy maintenance
- Automatic alarm generation

## Software Features

- Remote monitoring/control
- Digital image acquisition/processing
- Web-based database/visualization
- Automated reporting
- AEI (RFID) integration



## Wayside Car Undercarriage Inspection System



Trimble® CSCView® system undercarriage imaging and automated inspection system produces high quality images of the structural components of railcars (wagons) and locomotives at mainline operational speeds. The system is highly effective for the inspection of all undercarriage components for passenger and freight trains.

CSCView automates the inspection of undercarriage components such as brake rigging components, center and side sill, couplers and coupler components, jacking plate, and more. The inspection of car (wagon) components which are only visible from the bottom has always been a challenge for railway operators. The system operates with line scan imaging technology and produces high resolution images of virtually all

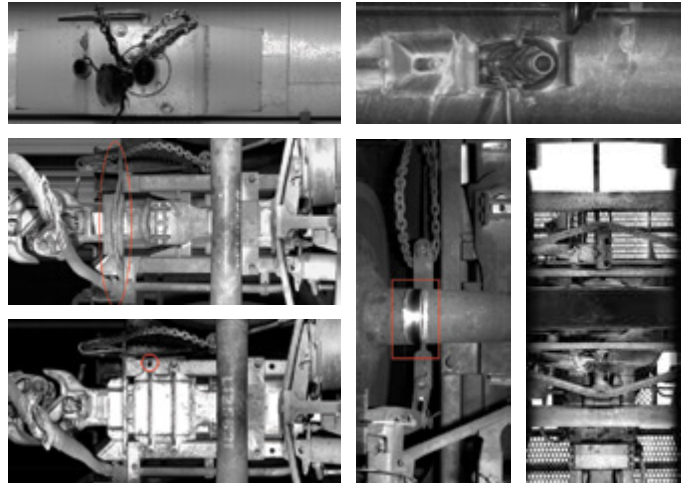
visible components under the car. It is installed under the track and is housed within steel tie (sleeper) structures.

CSCView uses multiple cameras to capture different areas of the car undercarriage with different angles of view. Specially designed lighting systems are deployed with the system to provide ample illumination and withstand the harsh railroad track environment.



## Inspections & Measurements

- Couplers
- Brake hose
- Brake rigging components including brake beam
- Coupler securement
- Draft gear carrier
- Axle surface
- Locomotive gear case
- R-clips
- Hopper doors
- Center sill
- Side sill
- Cross bearers
- Body bolster

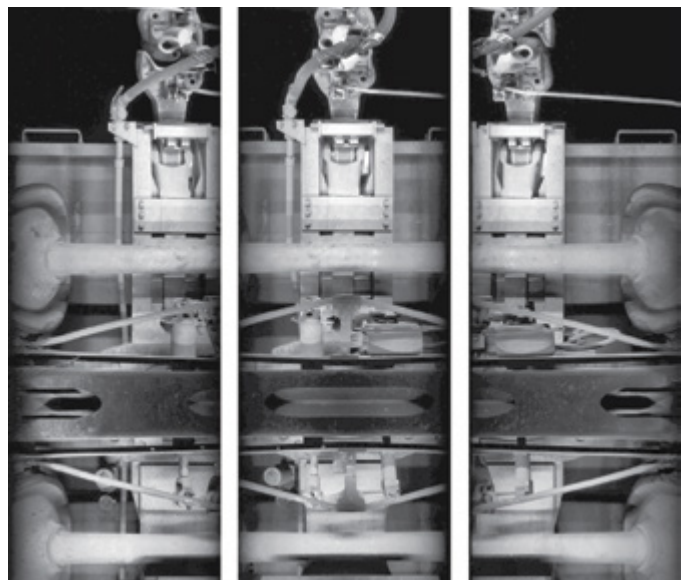


## Features

- Speeds of 0 to 60 mph (100 km/h)
- Operating temperature:  $-40^{\circ}\text{C}$  to  $55^{\circ}\text{C}$
- Capable of operating in extreme environments
- Installed on custom steel tie (sleeper)
- Easy maintenance
- Automatic alarm generation

## Software Features

- Remote monitoring/control
- Digital image acquisition/processing
- Web-based database/visualization
- Automated reporting
- AEI (RFID) integration





# TrainView

## Wayside Full Train Imaging, Inspection, & Measurement System



Trimble® TrainView® full scale train imaging, 3D scanning, and inspection system consists of multiple imaging and scanning units that provide images of the train at mainline speeds with high resolution.

The system is designed to provide data of all externally visible components of a rail vehicle. The images and data are then assigned to individual cars based on the AEI data so that car components are then ready for viewing and analysis.

The system uses multiple sensors and algorithms to pinpoint axle position, car beginning and car end positions, car components such as safety appliances, hand brake wheels, car identifiers, load limit identification, reflectors, car body condition, structural gauge and high-wide load detection, car load profile, load securement conditions, load carry back detection, etc.

Benefits to rail operators includes assisting Carmen's visual inspection process and providing



timely maintenance alerts for defective car components. While most of the inspection process is automated, the Trimble TrainWatch sophisticated train viewing software can be used to perform a complete virtual train visual inspection as well.

TrainView is also of relevance in the security industry where the detection of foreign objects on trains is becoming a critical issue for the rail transportation industry.



## Features

- Speeds of 0 to 60 mph (100 km/h)
- Operating temperature:  $-40^{\circ}\text{C}$  to  $55^{\circ}\text{C}$
- Capable of operating in extreme environments
- Installed on trackside tower with no track interference
- Easy maintenance
- Automatic alarm generation

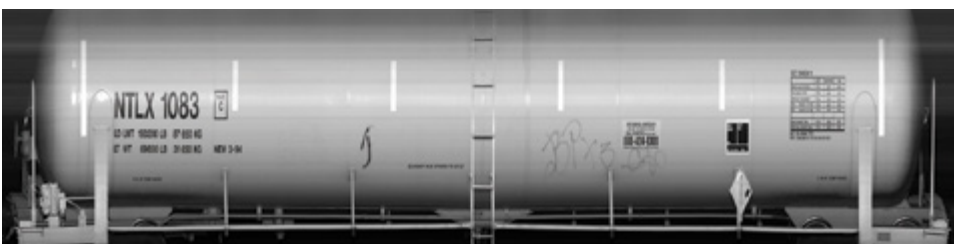
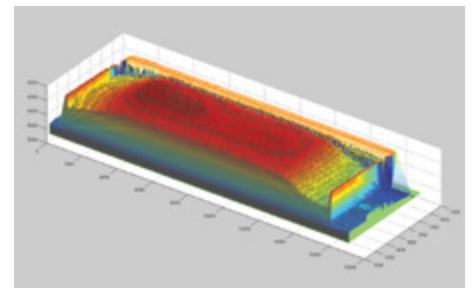
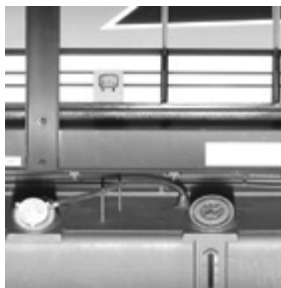
## Inspections & Measurements

Automated condition monitoring of many train components:

- Side walls condition
- Car ID and OCR
- Car load limit identification
- Reflector conditions
- Car structural gauge and profile
- High-wide detection
- Car load profile
- Load securement
- Gauge reading
- Load profile
- Load carry back
- Foreign object detection

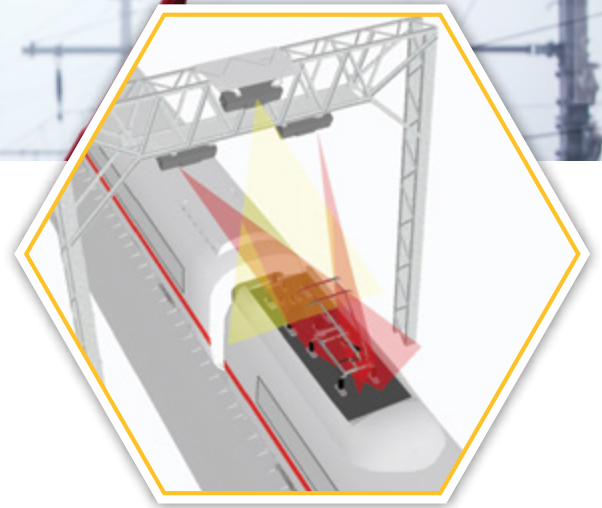
Safety appliances such as:

- Hand brake wheel
- Running boards (long and latitudinal)
- Roof hatches
- Ladders and handholds
- End platforms
- Sill steps



# PantoView

## Pantograph Measurement & Inspection System



The Trimble® PantoView™ is an automatic inspection system for pantograph carbon strips and head that can be deployed in depots as well as the mainline. The system can handle pantographs with up to four strips and there is a provision to inspect both raised and lowered pantographs.

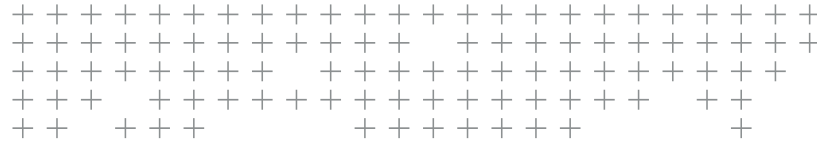
Pantograph contact strips are made from carbon and are very susceptible to damage. The system uses both imaging and 3D data from the pantograph head to inspect its condition. This provides a comprehensive data set to reliably assess the strip condition.

PantoView is also designed to measure the OLE (Overhead Line Equipment) uplift. From the measurement of uplift the condition of the pantograph can be ascertained. This means that

the correct contact force is applied and it is aerodynamically balanced. Uplift trending also provides a measure of frictional hysteresis in the pantograph.

PantoView is unique in providing the complete 3D shape of the head as it is traveling through the inspection site. It is also capable of measuring the pantograph at speed of up to 60 mph (100 km/h).





## Inspections & Measurements

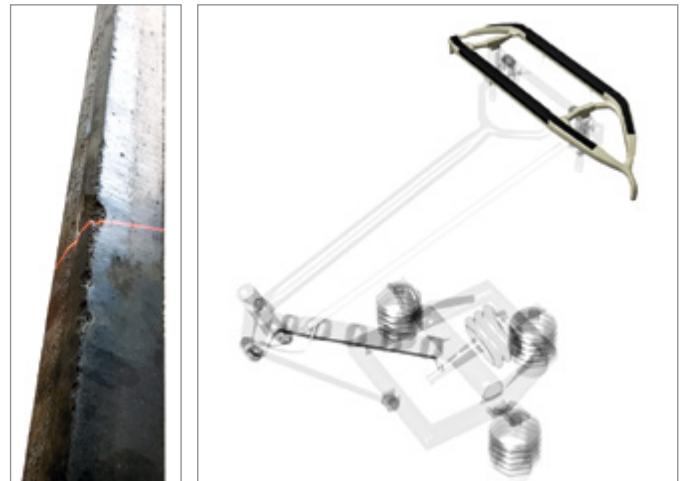
- Carbon wear profile along the carbon length
- Carbon surface roughness
- Measure gap between the strip and the end horn
- Poor contact wire condition
- Broken carbons
- Missing carbons
- Carbon grooves, cracks (lengthwise and widthwise)
- Misaligned pantograph head
- Horn condition
- OLE uplift

## Features

- Speeds of 0 to 60 mph (100 km/h)
- Operating temperature:  $-40^{\circ}\text{C}$  to  $55^{\circ}\text{C}$
- Capable of operating in extreme environments
- Installed on trackside tower/bridge with no track interference
- Automatic alarm generation

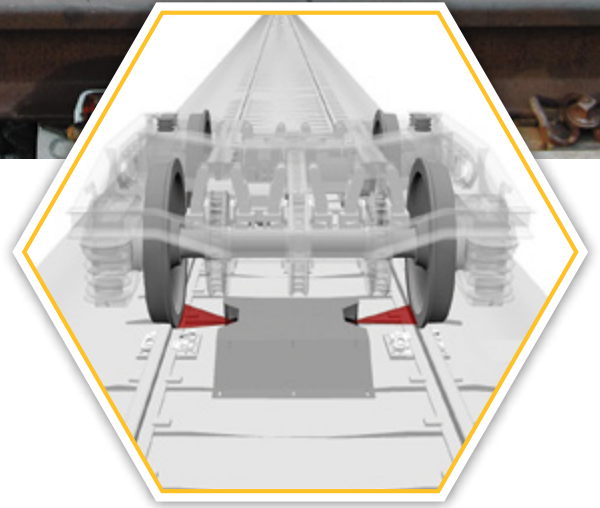
## Software Features

- Remote monitoring/control
- Digital image acquisition/processing
- Web-based database/visualization
- Automated reporting
- AEI (RFID) integration



# AOAView

## Wayside Angle of Attack & B2B Measurement System



Trimble® AOAView is a wayside angle-of-attack (AOA) measurement system that is designed to measure AOA on both wheels of a wheelset simultaneously. Since AOAView is installed on a tie (sleeper) between the rails, it provides a reliable AOA measurement as track fluctuations due to dynamic loads do not affect where the measurements are performed. Also, AOAView provides extremely accurate measurements of back-to-back distance of wheel sets with multiple measurements from both wheels of an axle.

AOAView is also capable of measuring tracking position and axle back-to-back dimension. The system is installed between the rails and has sufficient clearance with respect to the rail for most rail grinding machines and other track maintenance equipment to pass through the location without interference.



## Inspections & Measurements

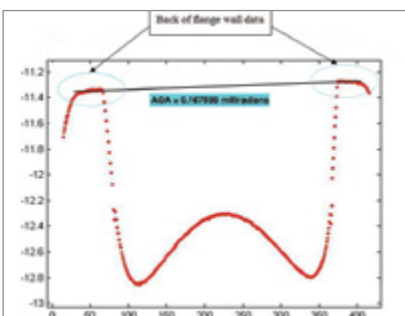
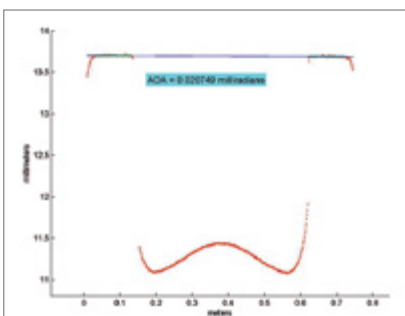
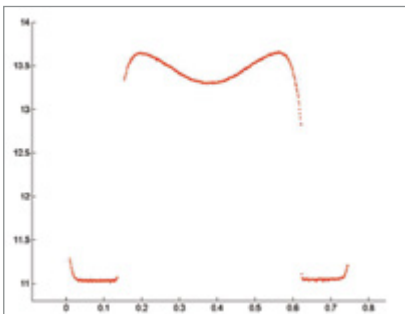
- Measure AOA on both wheels of an axle
- Measure B2B in two sections of the wheel
- Axle lateral position Identify warped trucks
- Detect hunting railcars (if three units are installed)
- Wheel plate type recognition (if applicable)

## Features

- Speeds of 0 to 85 mph (140 km/h)
- Operating temperature:  $-40^{\circ}\text{C}$  to  $55^{\circ}\text{C}$
- Capable of operating in extreme environments
- Installed on custom steel tie (sleeper)
- Easy maintenance
- Automatic alarm generation

## Software Features

- Remote monitoring/control
- Digital image acquisition/processing
- Web-based database/visualization
- Automated reporting
- AEI (RFID) integration





# TrackView

## Vehicle-Mounted Track Geometry, Rail, & Track Measurement & Inspection System



Trimble® TrackView vehicle-based track geometry, rail profile, and track inspection system can be installed on various types of rail vehicles including locomotives, passenger rail cars, freight cars, and hi-rail trucks. TrackView uses accurate IMU and GPS units along with 3D laser scanning and imaging systems in a compact package for effective track condition monitoring that works at mainline speeds.

The main advantage of the system is that when installed on locomotives or regular rail cars, it provides track measurements with high frequency. Track measurement in short intervals creates the opportunity to trend small changes to the track condition and take quick action to repair the track before it becomes costly.

The system provides a comprehensive track geometry including track gauge, alignment, and twist at very good accuracy. In addition, rail profile condition is also assessed in short intervals and

the rail wear can also be trended over time as well. The combination of rail profile, track geometry, and wheel profile (measured by the Trimble WheelView system) provides all the data needed for efficient track maintenance planning.

The track inspection section of the TrackView system provides a laser generated track profile and images to evaluate the rail, tie, and ballast condition on the track. This data can be combined with the track geometry to obtain a complete status of the track condition.



## Track Profile & Condition

- Ballast condition
- Tie (sleeper) spacing and condition
- Vegetation detection
- Rail surface condition
- Joint bar inspection and counting
- Missing or broken rail fasteners

## Track Geometry

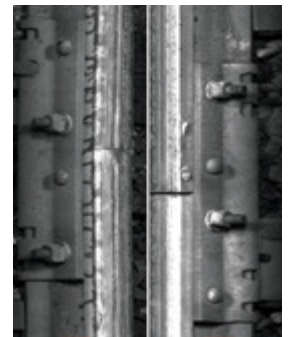
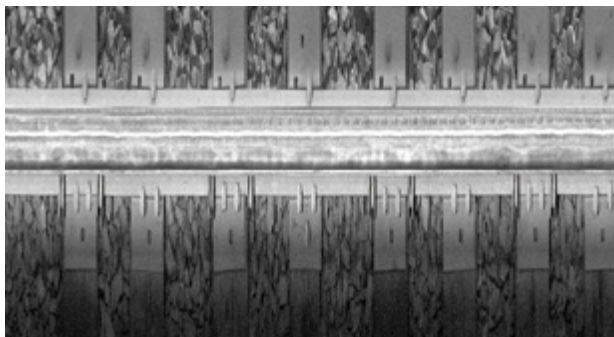
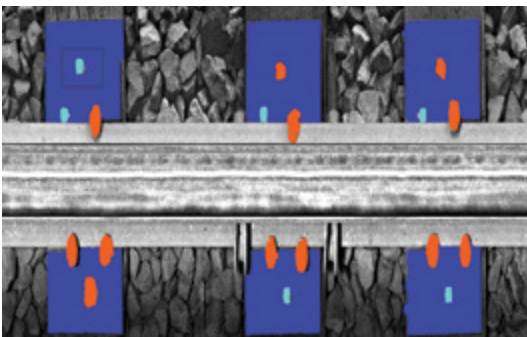
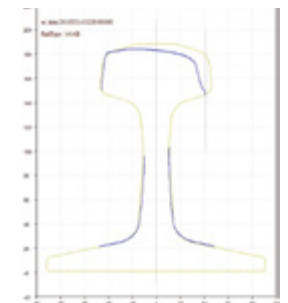
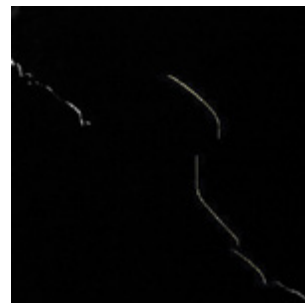
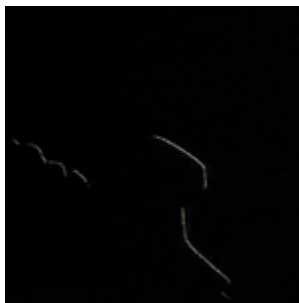
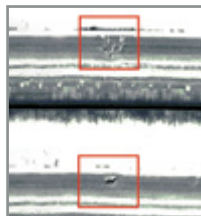
- Track gauge
- Superelevation
- Curvature
- Twist
- Alignment
- Grade

## Rail Profile

- Rail profile
- Rail height
- Head width
- Gauge and field lip
- Percent head loss
- Gauge, vertical wear, and 45° wear
- Gauge face width and angle

## Features

- Speeds of 0 to 185 mph (300 km/h) for track geometry
- Speeds of 0 to 85 mph (140 km/h) for track condition
- Real-time processing of critical parameters
- Installed on locomotive, railcar, or a high-rail truck
- On-board display
- Off-line display for detailed post processing
- Operation under severe environmental conditions
- Report and alarm on geometry and other conditions
- Supplied complete with all hardware and software
- Storing data locally for post viewing and processing
- Requires custom brackets for different vehicles





## Complete Wayside Detector Data Solution



Data generated by wayside detection and monitoring systems is highly beneficial for prioritizing train maintenance and derailment prevention. As more systems are deployed, the management and effective use of gathered detector data becomes more challenging. Also, the correlation between data generated by different detectors provides additional opportunities to analyze and understand the condition of any individual rolling stock or the whole fleet.

Trimble® WISE (Wayside Inspection System Environment) software is a condition monitoring data management platform. It provides a comprehensive unified web-based interface to all

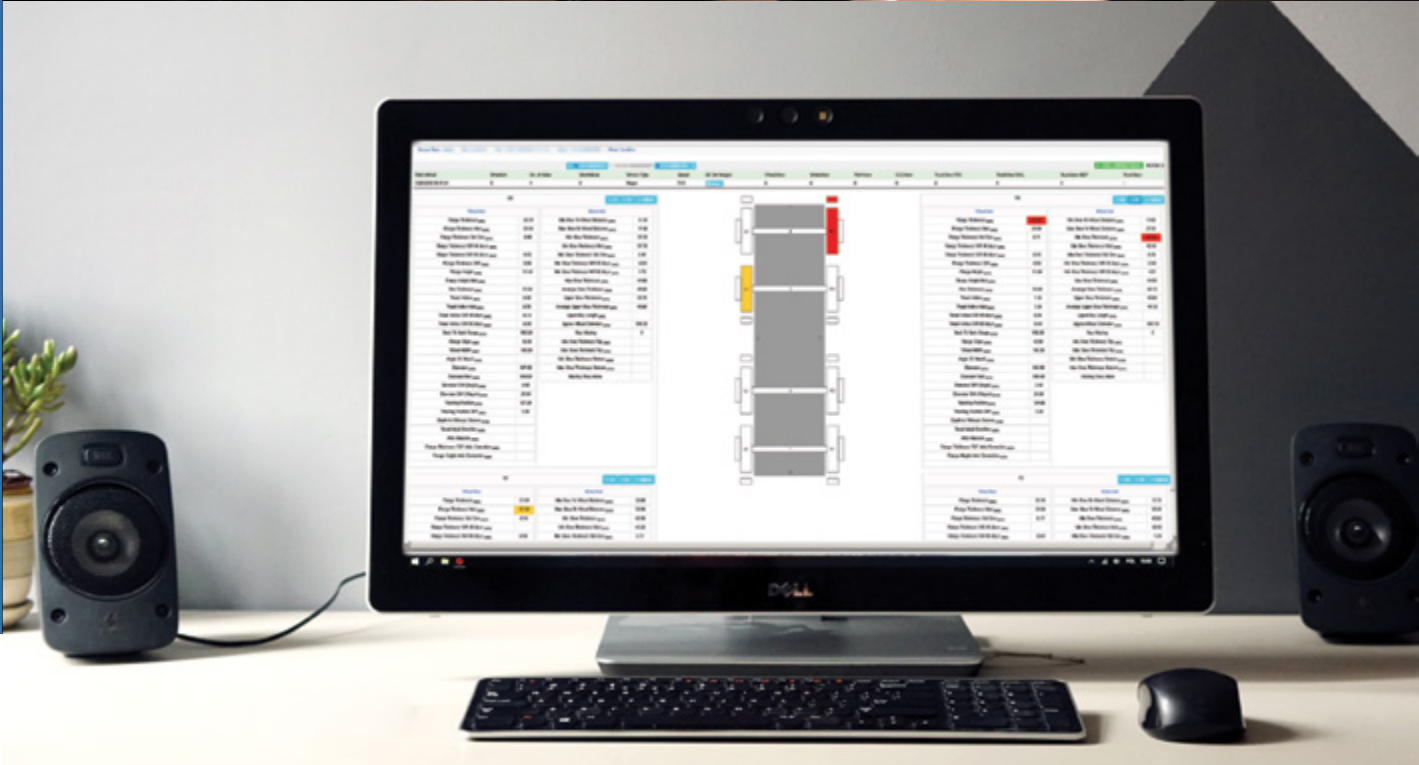
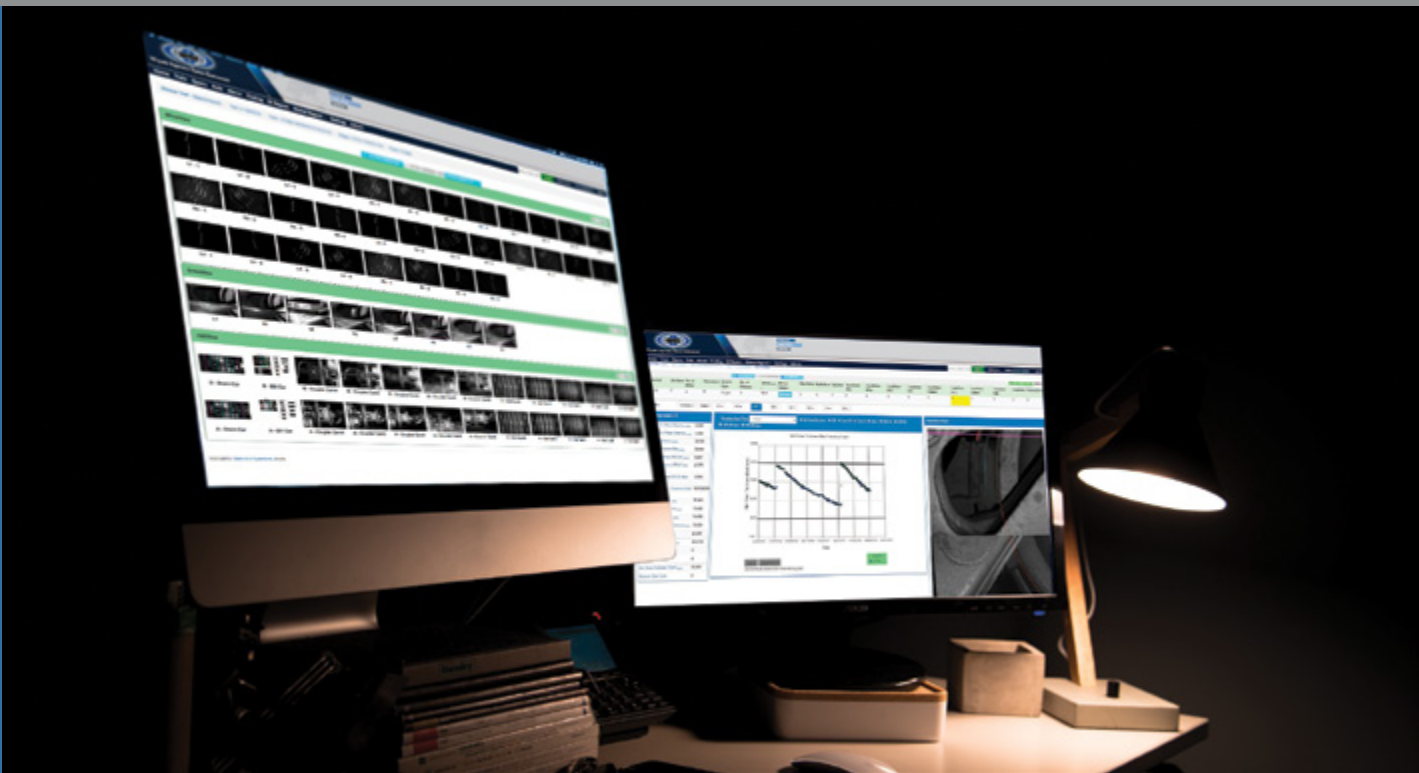
wayside data that has been produced. Data from all types of wayside detectors including systems provided by Trimble and systems from other suppliers can be seamlessly integrated within WISE. Current system data streams that can be integrated include wheel profile and brake shoe measurements, wheel impact detectors, hot bearing detectors, and acoustic bearing detectors.





# WISE

## Complete Wayside Detector Data Solution





WISE is a single point of access to all condition monitoring data with the advantage of a customizable search functionality across the entire database. WISE consolidates all vehicle exceptions across installed monitoring systems to facilitate the analysis and efficient planning of required maintenance activities for a train.

WISE also integrates to SAP and other enterprise resource planning systems to create maintenance notifications. It is based on a SQL backend that houses all the data from all detector systems.

### Software Features

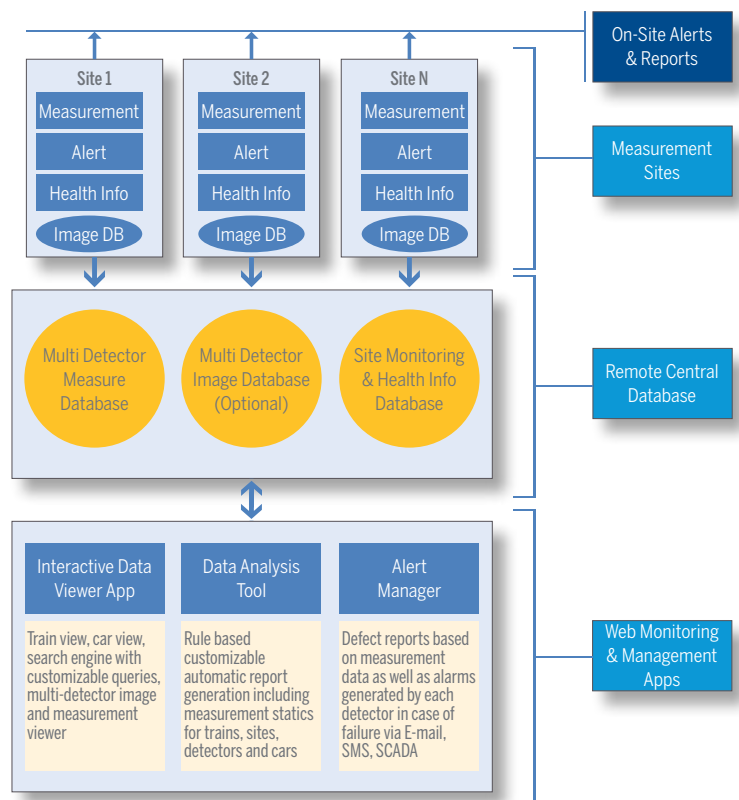
- **Detector Status:** Status display for real time indication of wayside detector health
- **Train Listing:** Trains listed by detector site and number of alarms
- **Wagon History:** Historical data and images for all wagon history
- **Query Generator:** Generic query generation tool capable of simple through to complex composite queries
- **Alert Generator:** User customizable alarming tool based on predefined conditions such as trended or absolute measurements
- **Reporting Functionality:** Customizable reports for consist alarm notifications

### General Features

- Capable of importing all wayside detector data
- Can be hosted either within a customer IT infrastructure or in the cloud
- Integration with Windows Active Directory to manage user access control
- Backend SQL database can be replicated to interface with other customer business systems
- Can be integrated with enterprise resource planning software (e.g. SAP, Maximo etc.)
- Automated defect reporting via email, SMS, SNMP etc

### Support for Complicated Composite Queries

Immediate defect reporting using e-mail, SMS, etc.





# TrainWatch



Trimble® TrainWatch software is a powerful virtual train inspection portal. It provides a comprehensive environment where a train inspector can inspect a full train using data gathered by wayside equipment.

The environment is designed to provide different modes of inspection like animation, car based and/or component based.

The advanced technology utilized in TrainWatch works with one operator with multiple monitors where the content of each monitor can be customized by the user according to the inspection routine to be followed by the inspector.

TrainWatch users benefit from automated car component detection and segmentation algorithms running in the background to help simplify and speed up the inspection process.



# TrainWatch

## Virtual Train Inspection Portal



Existing Trimble automated inspection algorithms are also supported within the TrainWatch environment. This allows required inspections to be managed using automated algorithms making the virtual inspection process even faster.

TrainWatch provides versatile reporting capabilities to facilitate train condition reporting, including cropping images of relevant sections directly into the report, adding comments, automatic identification of the car (wagon) that components belong to, and more. This innovative technology can link directly to Trimble WISE software for data display.

TrainWatch supports image data from all Trimble wayside detectors including the Trimble TrainView, TruckView, and CSCView systems, together with data display from other detector technologies such as impact detectors, hot box detectors, and acoustic bearing detectors.





## Software Features

### Inspections Mode

- **Animation:** Train motion is simulated at a desired speed
- **Car Mode:** Car by car data access with AEI identification attached
- **Component Mode:** Access and navigate through certain components
- **Mixed Mode:** Mix different modes of operation in a predefined form

### Display Mode

- **Synchronous:** All displayed data are synchronized in time and location
- **Asynchronous:** Different customized cameras/cars/components display

### Navigation Guide

- Graphical interface to view the camera orientation
- Assign cameras to display windows
- Navigation bar to show the current car position within the train
- Car list available for inspection

### General Functions

- Customize all displays
- Audio support
- Image cropping for reporting purposes
- Adding comment windows throughout markers and tags on the train, car, components, etc.
- Excel report generation for train/car/component
- AEI (RFID) integration
- E-mail generation



# About Trimble

TRIMBLE. INTELLIGENCE IN RAIL.

Trimble's rail solutions combine the latest in sensors and monitoring technologies with customized software and wireless communications to quickly and accurately capture the data needed to maintain and construct rail infrastructure or to manage rail transport assets.

Trimble's rail asset lifecycle management products manage the lifecycle of rail transport assets from operation through maintenance and repair. In 2014, Trimble acquired Nexala of Dublin, Ireland, providers of data aggregation and analytics tools for engineering and operations of rolling stock. In 2017, Trimble acquired Beena Vision of Atlanta, Georgia, a manufacturer of vision-based automatic wayside rail inspection systems. Using this comprehensive portfolio of

on-board and wayside condition monitoring solutions, rail companies can improve operational efficiencies, manage service levels and reduce costs, while ensuring that service is maintained to the highest level. Customers using Trimble solutions include major freight operators such as BNSF, Aurizon, Norfolk Southern, and Canadian National as well as many passenger operators such as South Western Railway, Eurostar, SNCF, Irish Rail, the Go-Ahead group, Arriva, and Greater Anglia among others.

For more information, visit:

[rail.trimble.com](http://rail.trimble.com)

[www.trimble.com/hexala](http://www.trimble.com/hexala)

[www.trimble.com/beenavision](http://www.trimble.com/beenavision)



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