DIGITAL PROFILE MEASURING

by

GREENWOOD ENGINEERING A/S

Full contact - Your way to valid and reliable data
Stay in **full control** of your assets
Choose **full contact** measurements
Why MiniProf BT

The MiniProf BT system is an excellent full contact measurement system with Bluetooth connection for fast, reliable and extremely high quality profile measurements. Combined with a user-friendly and flexible software package which can easily be configured from basic use to in-depth post measurement analysis, MiniProf BT can be used for numerous purposes on all types of wheel, rail and brake profiles. It enables the user to make critical decisions in purchase, maintenance, quality and safety departments etc. and represents a great platform for research and development all over the world.

## Area of use

### Product design & development
- Material and life cycle test
- Lubrication/friction effect
- Design of wheel, rail, brake disk, boogie

### Manufacturing
- Production quality control
- Factory acceptance inspection before shipment
- Verification of production equipment

### Procurement
- On-site field/workshop incoming inspection
- Lifetime/performance monitoring – forecast planning
- Compare quality from different suppliers

### Safety regulation
- Inspection check if assets are within regulation
- Accident and derailment investigation
- Analysis and documentation of work

### Research & universities
- WRI studies, verification of research and principles
- Reduce noise and wear-rates to extend asset lifetime
- Improve safety, speed, load and travel comfort

### Manufacturing
- Production quality control
- Factory acceptance inspection before shipment
- Verification of production equipment

### Management
- Life cycle wear monitoring
- Trend forecast, planning of on-time maintenance intervals
- Life expectancy / improvements / replacements

### Quality control
- Verify accuracy of on-site/build-in laser-based gauges
- Verify accuracy of wheel lathes and rail grinding machines
- Verify accuracy of handheld laser-based gauges

### Quality control
- Verify accuracy of on-site/build-in laser-based gauges
- Verify accuracy of wheel lathes and rail grinding machines
- Verify accuracy of handheld laser-based gauges

### Quality control
- Verify accuracy of on-site/build-in laser-based gauges
- Verify accuracy of wheel lathes and rail grinding machines
- Verify accuracy of handheld laser-based gauges

### Quality control
- Verify accuracy of on-site/build-in laser-based gauges
- Verify accuracy of wheel lathes and rail grinding machines
- Verify accuracy of handheld laser-based gauges
Measuring principles

MiniProf™ is based on secure full-contact measurements and has a knife-shaped full contact point directly to the surface of a given profile. The magnetic full contact point minimizes influences from oil, lubrication, dirt and other substances on the profile as it “cuts” through the layers. It ensures constant contact to the actual profile during the complete measuring process and minimizes operator influence.

The accuracy of a MiniProf™ system is very consistent due to the unique measuring principle with a small magnetic measuring wheel and two rotating optical high resolution encoders which ensure that the measurement is performed perpendicular to the surface of the entire profile.

Due to the unique combination of full contact measurements, consistency and outstanding high-resolution optical encoders, MiniProf™ provides the highest accuracy available on the world market today. 20-30.000 collected individual points in one single profile measurement generate outstanding raw material resulting in excellent profile measurements with extremely high accuracies.
A full contact measuring system measures the exact profile. Concerns about dirt, oil and greasy surfaces are minimized thanks to the MiniProf BT full contact point which cuts through unwanted objects or layers on the profile.

A non-contact measuring system is not in full contact with the actual profile and therefore provides pictures of a given surface including unremoved dirt, oil etc.

Full contact measuring systems are not influenced by reflecting light on the profile surface or by shiny profile surfaces like a newly turned wheel etc.

Non-contact devices may show inconsistency when used on reflecting surfaces, in bright sunlight, frost, fog and moist climates etc. due to the sensibility of the non-contact data collecting method.
A MiniProf BT instrument is a compact and wireless handheld unit, which can enter very narrow places. It weighs only 0.9 kg and is delivered in a special designed transport case providing you with a ready-to-go MiniProf BT kit.

**Bluetooth**

MiniProf BT has a strong Bluetooth connection which enables the user to perform wireless measurements. With no cable connected to the measuring unit the measuring process becomes more flexible and efficient. MiniProf BT can also be used with a standard MiniProf cable.

**Highest accuracy**

A MiniProf BT instrument provides the highest accuracy available on the market today. The profile accuracy lies between 9 and 11 microns depending on the MiniProf system configuration.

**Top quality components**

MiniProf BT is made of titanium which makes it very temperature and shock resistant and ensures accuracy, stability and a very long lifetime.

**Consistent accuracy**

The accuracy of a MiniProf BT system is very consistent due to the measuring principle with a small magnetic measuring wheel and two rotating optical high resolution encoders which ensure that the measurement is performed perpendicular to the surface of the entire profile.

**Fast and easy to use**

The MiniProf BT is a fast and easy to use measuring system which enables the user to carry out a single profile measurement in less than 5 seconds.
MiniProf BT is supplied with a full Envision software package for PDA/tablet and computer. The PDA and tablet version is designed for easy data-collection in the field and the computer version for a more advanced data handling and printing.

### Features

**Long battery life**

MiniProf BT is the perfect tool for field work. A new fully charged battery contains approximately 1000 Bluetooth measurements or 10 hours of work, which can be even further extended when using the cable connection option.

**Easy-to-clean design**

The MiniProf BT instrument has an easy-to-clean design, which reduces the accumulation of oil and dirt. The cleaning of the instrument is easily done just by using a mild solvent and a cloth after use of the instrument.

**Warranty - 5 years**

MiniProf BT is founded on 25 years of solid experience and we are therefore pleased to offer up to 5 year warranty for all MiniProf BT instruments.

**Operation temperature**

The MiniProf BT instrument is water resistant and can be used for measuring in many different types of environments and temperatures. The MiniProf BT measures perfectly in temperatures varying from at least -15°C to +35°C.

**Full digital profile**

MiniProf BT uses high resolution optical encoders when measuring a profile. An extreme high amount of data for the total profile is collected and an average of approximately 600 points of the profile is saved digitally for further analysis.

**Full software package**

MiniProf BT is supplied with a full Envision software package for PDA/tablet and computer. The PDA and tablet version is designed for easy data-collection in the field and the computer version for a more advanced data handling and printing.
MiniProf BT Rail is a high precision, lightweight and portable tool for performing cross-sectional rail profile measurements in order to monitor and analyze the wear of rails. It is equipped with Bluetooth as well as cable connection option and can be used on many types of tracks, including grooved rails.

Used with a telescopic rod attached to the opposite rail, it measures the rail profile and track gauge in one single measurement in less than 5 seconds.

Various calculations and alignments for rails are available in the versatile and flexible Envision software package and can easily be added for optimum and customized configuration of the MiniProf BT Rail system.

**Accuracy**
- Better than: ±11 μm
- Repeatability: ±2.5 μm

**Measuring speed**
- Speed: < 5 seconds

**Weight**
- Unit: 0.9 kg
Infrastructure

Rail wear calculations
The MiniProf BT Rail instrument calculates instantly the vertical, horizontal and 45 deg. wear as well as numerous other options. If equipped with the gauge rod it measures the track gauge simultaneously.

Gauge measuring
MiniProf BT Rail is attached magnetically to the top of the railhead using the opposite rail as reference through a telescopic rod. This ensures a stable position, prevents the instrument from tilting and automatic calculates the track gauge.

Super-elevation / Grade
MiniProf BT Rail automatically measures the super elevation and grade when connected to a computer or tablet. The values are stores with the measurement and can be displayed at any time. The range of the measured inclination is ±30 deg.

Rail analysis & grinding
The MiniProf Envision software can visualize and calculate residuals and areas automatically and provides a functionality which is often used for rail grinding analysis. Measurements can be compared in multiple ways and easily exported to various formats. MiniProf Envision offers you a powerful rail analysis tool as well as user friendly measuring software.

Perpendicular device
MiniProf BT Rail is delivered with a small built-in perpendicular device. It ensures correct alignment of the MiniProf BT system to the rail and prevents faulty diagonal measurements.

Suitable for grooved rail
MiniProf BT Rail can be used on grooved rails. The full contact magnetic measuring wheel ensures that the measurement is taken all the way down to the groove. Based on a reference, both the horizontal wear and the side wear are calculated.
MiniProf BT Wheel is a high precision, lightweight and portable tool for performing cross-sectional wheel profile measurements in order to monitor and analyze the wear of wheels. It is equipped with Bluetooth as well as cable connection option and can be used on various types of wheels.

It measures the wheel profile and determines the diameter in one single measurement which takes less than 5 seconds to perform. A complete railroad car can be measured in less than 5 minutes.

Various calculations and alignments for wheel are available in the versatile and flexible Envision software package and can easily be added for optimum and customized configuration of the MiniProf BT Wheel system.

**Accuracy**
- Better than: ±9 μm
- Repeatability: ±2.5 μm
- Diameter: ±0.09 mm

**Measuring speed**
- Speed: < 5 seconds

**Weight**
- Unit: 0.9 kg
The MiniProf BT Wheel instrument calculates instantly the Sd, Sh and qR values as well as numerous other options, including the diameters. The MiniProf BT Wheel instrument is attached magnetically to the backside of the wheel and calculates the flange diameter and the taperline diameter in one single measurement.

**Wheel wear calculations**
The MiniProf BT Wheel instrument calculates instantly the Sd, Sh and qR values as well as numerous other options, including the diameters.

**Diameter measurements**
The MiniProf BT Wheel instrument is attached magnetically to the backside of the wheel and calculates the flange diameter and the taperline diameter in one single measurement.

**Wheel analysis**
The MiniProf Envision software can visualize and calculate residuals and areas automatically. Measurements can be compared in multiple ways and easily exported to various formats. MiniProf Envision offers you a powerful wheel analysis tool as well as user friendly measuring software.

**Measuring scheme**
When measuring multiple profiles, the MiniProf BT measuring scheme is a very strong tool for clear identification of each profile in advance and for simplifying and reducing the measuring process even further.

**Accuracy**
Better than: ±9 μm
Repeatability: ±2.5 μm

**Measuring speed**
Speed: < 5 seconds

**Weight**
Unit: 0.9 kg

The MiniProf BT Lightrail Wheel is a small instrument specially designed for use on tramway vehicles. This small and compact instrument can be mounted on very narrow places and fits all tram wheels.
Rolling stock

MiniProf BT Brake

The MiniProf BT Brake is an excellent tool for measuring the important wear parameters of any brake disc. MiniProf BT Brake provides instant calculations of the brake hollowing and brake thickness. The MiniProf Envision software can visualize and calculate residuals and areas automatically. Measurements can be compared in multiple ways and easily exported to various formats. MiniProf Envision offers you a powerful brake analysis tool as well as user friendly measuring software.

Accuracy
Better than: ±11 μm
Repeatability: ±2.5 μm
Diameter: ±0.09 mm

Measuring speed
Speed: < 5 seconds

Weight
Unit: 0.9 kg

Wheel mounted
The wheel mounted MiniProf BT Brake instrument is attached magnetically to the vertical part of the wheel, either on the backside of the flange or on the outer side of the rim. This part of the wheel is used as a reference for the measurement.

Axle mounted
The axle mounted MiniProf BT Brake instrument is mounted on the outer diameter of the brake disc and is attached using magnetic rollers. These also align with the wear marker on the disc which act as reference points for the measurement.
All MiniProf BT variations are delivered in a ready-to-go transport case special designed and configured for safe storage and transportation of the measuring tool and accessories. The transport cases offer the ultimate grade of protection of any MiniProf system as they are extremely impact resistant, water proof and impervious to dust. They are lightweight and come in a variety of sizes and configurations depending on the specification of the MiniProf BT system and requested accessories.
MiniProf BT is supplied with a full software package usable for all variations of our MiniProf BT instruments. It is highly flexible and customizable to the individual customer requirements and can be used to perform measurements as well as in-depth post measurement analysis. The software package includes measurement schemes, trending and a lot of other analysing possibilities.
User-friendly design
A MiniProf Envision system is supplied with modern and user-friendly software package MiniProf Envision. Its smart configuration wizard makes setup process easy and provides a simplified user learning curve.

Measuring scheme
MiniProf Envision features a measuring scheme system to perform large sequences of wheel, rail and brake profiles efficiently. An intelligent scheme wizard, enables the user to make customized scheme solutions.

More than a profile
MiniProf Envision has features such as logging of GPS locations and attachment of photographs to measurements. It can also measure temperature, super-elevation and grade with relevant MiniProf instrument.

Examine trends
You can perform trend analysis on your data which can show alarm and failure warning levels and estimates. These are imperative for safety requirements and decision making for your company.

Printing & reporting
The software has a number of printing templates, which can be saved as an Adobe PDF, a Windows Metafile or printed on paper. MiniProf Envision offers data exportation to formats like Microsoft Excel and text files.

Intelligent cursors
Profile cursor runs smoothly through the data points which allow readings between the points. The advanced functionality also gives instant residuals and area results to the user by highlighting the area between the profiles.
### Calculations

#### Common calculations

<table>
<thead>
<tr>
<th>Calculation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angles</td>
<td>Calculates the tangent angle, measured in degrees, at each point of the selected profile. The angles for a reference profile are calculated and displayed along with the angles of the measured profile if a reference is selected.</td>
</tr>
<tr>
<td>Vertical residuals</td>
<td>Calculates the vertical distance (D) to a measured profile at each point of the reference profile. The calculation assumes that the points in the measured profile can be connected with straight lines.</td>
</tr>
<tr>
<td>Curvature</td>
<td>Calculates the curvature in every point of a profile by fitting a 2nd degree polynomial to a small part around each point. If a reference profile is available, the curvature will also be calculated for this and the result displayed as a reference for the curvature of the measurement.</td>
</tr>
<tr>
<td>Horizontal residuals</td>
<td>Calculates the horizontal distance (D) to a measured profile at each point of the reference profile. The calculation assumes that the points in the measured profile can be connected with straight lines.</td>
</tr>
<tr>
<td>Residuals</td>
<td>Calculates the distance (D) to a measured profile perpendicular to a reference profile at each point of the reference profile. The calculation assumes that the points in the measured profile can be connected with straight lines.</td>
</tr>
<tr>
<td>Rail wear</td>
<td>This function will calculate the vertical (W1), horizontal (W2) and 45° (W3) wear. The wear is calculated as the difference between a measured profile and a reference profile.</td>
</tr>
<tr>
<td>Maximum residuals</td>
<td>Calculates the maximum, minimum and average residual between the reference profile and the measured profile in a given area. This area is defined independently for wheel, rail and brake profiles as illustrated below.</td>
</tr>
<tr>
<td>Rail gauge angle maximum</td>
<td>Calculates the maximum gauge angle (A) and position (Y) for the selected profile. The calculation determines the angles either as the tangent angle in each point, as the angle between two points on each side or as the average of the tangent angles in a certain area (D).</td>
</tr>
<tr>
<td>Rail gauge angle maximum</td>
<td>Calculates the maximum gauge angle (A) and position (Y) for the selected profile. The calculation determines the angles either as the tangent angle in each point, as the angle between two points on each side or as the average of the tangent angles in a certain area (D).</td>
</tr>
<tr>
<td>Rail head width</td>
<td>The rail head width (W) is the distance from the field side of the rail head to the gauge side measured at 1 millimeters from the highest point of the rail profile. Setting the L parameter to 0 makes the calculation return the largest width.</td>
</tr>
<tr>
<td>Rail gauge angle</td>
<td>Calculates the gauge angle (A) at a given point defined from the top of the railhead (L). The angle is determined either from the tangent in the point, the angle between two points on each side or as the average of the tangent angles in a certain area (D).</td>
</tr>
<tr>
<td>Align rail</td>
<td>Aligns a measured rail profile against a reference by using the field side face and the lower corner. The alignment can optionally use the gauge side face if desired.</td>
</tr>
<tr>
<td>Align rail centered</td>
<td>Aligns a measured rail profile against a reference by using both sides of the profiles and the top point. This alignment is particularly useful for aligning measurements of new rails for quality control.</td>
</tr>
</tbody>
</table>

#### Rail calculations & alignments

<table>
<thead>
<tr>
<th>Calculation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail crown radius</td>
<td>The rail crown radius (R) is calculated as the radius of the circle that gives the best fit at the top of the rail head in an area determined by the distance parameter (Dist).</td>
</tr>
<tr>
<td>Railhead angle</td>
<td>Calculates the angle of the rail head (A) for the selected profile.</td>
</tr>
<tr>
<td>Rail height</td>
<td>Calculates the remaining height of the rail head (H) for the selected profile.</td>
</tr>
<tr>
<td>Grooved rail geometry</td>
<td>This function calculates a number of geometrical features for a grooved rail profile: Groove width (W), groove height (H), crown radius (RC) and radiiuses for the different parts of the groove (R1, R2, R3 and R4).</td>
</tr>
<tr>
<td>Grooved rail wear</td>
<td>This function will calculate the vertical (W1) and horizontal (W2, W4) wear for a grooved rail. The wear is found as the distance between the measurement and the reference.</td>
</tr>
</tbody>
</table>

Graphs and illustrations are not included in this text representation.
Calculations

Wheel calculations & alignments

Align rail (CEN)
Aligns a measured rail profile against a reference by minimizing the wear parameters W1 and W3. No rotation is performed on the measured profile.

Align rail for grinding (High)
Aligns a measured rail profile against a reference according to the CEN grinding standard for the high rail in curves. No rotation is performed on the measured profile.

Align rail for grinding (Low)
Aligns a measured rail profile according to the CEN grinding standard for tangent track and the low rail in curves. No rotation is performed on the measured profile.

Align rail on top
Aligns a measured rail profile so the profile intersects the horizontal axis at the top point. This alignment only moves the profile in the vertical direction. No rotation is performed.

Align rail on wear
Aligns a measured rail profile against a reference by moving the measurement so it intersects the reference at the top and in a point on the gauge side. No rotation is performed on the measured profile.

Align grooved rail (Flat)
Aligns a grooved rail measurement using the bottom parts of the groove, either gauge part or check part.

Align grooved rail
Aligns a measured grooved rail profile against a reference using a point on the inner side of the check part and the bottom of the groove.

Wheel wear
Calculates the flange thickness (Sd), flange height (Sh) and the flange gradient (qR) for a wheel profile.

Wheel wear
Calculates the radius of the wheel flange (R) for a wheel profile.

Wheel flange radius
Calculates the width of the flange (D) for a wheel profile.

Wheel flange back wear
Calculates the flange back wear (W) for the selected profile.

Wheel flange angle maximum
Calculates the maximum flange angle (A) and the position (X) for a wheel profile.

Wheel flange width
Calculates the width of the flange (W) for a wheel profile at a specific distance (L) from the top of the flange.

Wheel flange width (Tram)
Calculates the width of the flange (D) for a wheel profile.

Wheel flange width (Tram)
Calculates the flange back wear (D) for the selected profile.

Wheel flange crown thickness
Calculates the thickness of the flange crown (D) for the selected profile.

Wheel flange angle
Calculates the angle of the flange (A) for a wheel profile.
Calculations

Wheel calculations & alignments (continued)

**Maximum residuals**
Calculates the maximum, minimum and average residual between the reference profile and the measured profile in a given area. This area is defined independently for wheel, rail and brake profiles as illustrated below.

**Wheel taperline angle**
Calculates the taperline angle (A) using the average for a distance (L2, L3) around the taperline (L1) for a wheel profile.

**Wheel hollowing**
Calculates the wheel hollowing (H) and position (X) for a wheel profile.

**Wheel thread wear maximum**
Calculates the maximum thread wear (W) and position (X) between the measurement and the reference in an area set from the flange backside (L1) to the outer thread (L2).

**Wheel gauge flange**
Calculates a number of wheel dimensions and gauge values given two measured wheel profiles.

**Align wheel on taperline**
Aligns a measured wheel profile on a given taperline. This alignment only moves the profile in the vertical direction (dy). No rotation is performed.

**Wheel flange root radius**
Calculates the wheel flange root radius (R) at a given point defined from the taperline (L1). The radius is determined from the curvature of a 2nd order polynomial fitted to a specified area (D).

**Wheel wear difference**
Calculates the difference between the wheel wear on a measured profile and a reference profile.

**Wheel hollowing maximum**
Calculates the highest wheel hollowing (H) and position (X) for the selected profile.

**Wheel volume loss**
Calculates the volume between the measurement and a reference. This is done using either the measured diameter (if available) or the diameter entered as a parameter for the calculation.

**Align wheel**
Aligns a measured wheel profile to the reference profile at the top of the flange. This alignment only moves the profile in the vertical direction (dy). No rotation is performed.

**Align wheel on flange back**
Aligns a measured wheel profile to the reference profile at the flange back. No rotation is performed.

**Align wheel on outer thread**
Aligns a measured wheel profile to the reference profile at the top of the flange. This alignment only moves the profile in the vertical direction. No rotation is performed.

**Wheel diameter difference**
Calculates the difference between the diameters on wheels in a bogie.

**Wheel diameter from tyre**
Determines the wheel diameter using the inner diameter and a field containing the tyre height, measured separately.

**Align wheel on flange top**
Aligns a measured wheel profile to the reference profile at the top of the flange. This alignment only moves the profile in the vertical direction. No rotation is performed.

**Align wheel on outer thread**
Aligns a measured wheel profile to the reference profile on the outer thread. This alignment only moves the profile. No rotation is performed.
Align wheel on diameter
Aligns a measured wheel profile using the diameter information stored with the profile.

Align wheel on tyre
Aligns a measured wheel profile using the tyre height information if present.

Brake wear
Calculates the brake-disc hollowing (W) and the remaining thickness (T).

Brake wear (No reference)
Calculates the brake-disc wear (W) and the remaining thickness (T).

Maximum residuals
Calculates the maximum, minimum and average residual between the reference profile and the measured profile in a given area. This area is defined independently for wheel, rail and brake profiles as illustrated below.

Brake volume loss
Calculates the volume between the measurement and a reference. This is done using either the measured diameter (if available) or the diameter entered as a parameter for the calculation.

Brake debending
Calculates a debended brake disc profile using either a circular or parabolic method. The parameters L1 and L2 defines the origin of the bend, where the bolt attaches the disc to the wheel. The calculation uses the top and/or the bottom edge of the disc to determine the amount of debending required.

Align brake on top edge
Aligns a measured brake profile on the top edge so this edge overlays the horizontal axis.

Align brake on scale
Aligns a measured brake profile against the reference by stretching the measured profile vertically so the height of the measurement (Hm) matches the height of the reference (Hr).
References

Globally used by thousands of MiniProf users
References

Hindu
Alstom
Bombardier
Siemens
Stadler
Bussnang
Stran Szechenyi University

India
Bangalore
Metro Rail
Bharat
Steel Plant
BSP
Delhi
Metro
Rail Corporation Ltd.
Indian
Railway
Northern
Railway
RDSO
Rotem
Hyundai
Sherrin
Industries
UN
Development

Iran
Farvardeh
Chemine
Co.
Ltd.
Iranian
Islamic
Republic
Railways

Ireland
Alstom
Ireland
Ltd.
Iarnród
Erneam
Irish
Rail

Israel
Citadis
Alstom

Italy
AAE
Alstom
Alonso
Breda
ATM
Milano
BaanCom
Bombardier
BTW
Connex
Ferromarramia
Spa
Ferrone
Emilia
Romagna
Ferrone
Nord
Milano
FS
GTT
Tunin
Lenard
SRL
Lucchini
Plant
Metro
Service
Metrotubus
Brescia
Metro
Napoli
Metropolitana
Roma
Metro
Roma
RPM
SAD
Transporto
Locale
Santragina
Trambus
SPA
Trentina
SpA
Trento

Japan
Akebono
Brake
Industry
BTTMG
Central
Japan
Railway
Daiichi
Kinsetu
Industries
East
Japan
Railway
Company
Hankei
Hanwha
Railway
Technology
Hanwha
Electric
Railway,
Ltd.
Hitachi
JFE
JR
Kokaido
JR
Kryo
Kawasaki
Heavy
Industries
Keihan
Electric
Railway
Koito
Motor
Kokusai
Transport
Construction
Kyoto
Municipal
Transportation
Bureau
Nabiteko
Nihon
Sennen
Gi
jyousu
Nippon
Kiakai
Honse
K.
Nippon
Speno
Nippon
Steel
Corporation
Yawata
Works
NKK
Trading
Nissan
Osaka
City
Osaka
Municipal
Transportation
Bureau
Rail
Tech
Railway
Technical
Research
Institute
Samurana
Metal
Tokyo
Electric
Railway
Tokyo
Metro
Tokyo
Metropolitan
Government
Transport
Ministry
Toyo
Transport
Tosetzu
Kogyo
TT
Ueda
Brake
Ltd.
West
Japan
Railway
Company
Yamatodo
Traffic
Yokahama
Municipal
Transportation
Bureau

Malaysia
Rapid
Sistem
Transit
Aliran
Rangka
SDN
BHD
Star
Point

Mauritania
SNIM,
Société
Nationale
Industrielle
&
Minière

Mexico
Ferronex

Morocco
Alstom

Netherlands
AEAO
Technology
Rail
BV
Arriva
BAM
Raj
Connex
GVB
Amsterdam
GVB
Amsterdam
andres
til
GVB
Holland
Railconsult
HTM
Lloyd’s
Register
Rail
Europe
BV
Mopars
Netdtrain
Consulting
HSE
Techno
Service
Nederland
Tibao
Rail
and
Road
Vehicle

New
Zealand
John
Holland
Rail
OnTrack

Norway
BIS
Production
Jernbaneverket
Ofotbanen
Mantena
NSB
Oslo
Sponsor

Peru
Gym
Fernovias

Poland
SPAW
TORT

Portugal
Caminhos
de
Ferro
Metropolitano
de
Lisboa
REFER

Puerto
Rico
ACI
Puerto
Rico

Romania
S.C.
Alstom
Transport
S.A.
Spectromals
R

Russia
Russian
Railways,
RZD

Saudi
Arabia
Ethal
Rail

Serbia
GSP
Belgrade

Singapore
ESO
Services
(Singapore)
Ltd.
SBS
Transit
Singapore
MRT
Ltd

Slovakia
Zilina
University

South
Africa
Bombardier
Cape
Motorail
LRS
Lennings
Rail
Services
Metro
Rail
CT
GORE
PRAA
Spoornet
Transnet

Switzerland
Bader
Verkehrsbetriebe
BLS
AG
Bombardier
Zürich
Furka
Oberalp
Bahn
Maltis
Meisterhorn
Gotthard
Bahn
Metro
Lausanne
Regionalverkehr
Mittelland
SBB
CFF
FFS

Spano
International
S.A.
Stadler
Switzerland
Tranz
Transports
Verkehrs
betriebe
Zürich

Taiwan
Kaohsiung
Rapid
Transit
Corporation
(KRTC)
Ming
Yu
Machinery
Co.
Ltd.
San
Lien
Technology
Corp.
SST
Taiwan
Ltd.
Taiwan
Railway
Administration
THSRC

Thailand
Siemens

Turkey
Burlanas
Istanbul
Ulasim
A.S.
Turkish
State
Railways

United
Kingdom
4-Rail
Services
Aftans2
AEA
Technology
Rail
Alstom
Train
Services
Babcock
International
Bakerlite
Ballow
Beatty
Rail
Beacon
Bombardier
Prorail
Ltd.
Bombardier
Transportation
UK
Carillion
Rail
Collinson
Dutton
Ltd.
Corin
Corus
(Monks
&
Crane)
Corus
Rail
Docklands
Light
Railway
Ltd
DRS
East
Coast
Main
Edmundson
Eurostar
Eurotunnel
EWS
Federal
Mogul
First
Scot
Rail
Hansen
Rail
Heathrow
Express
InfraCo
BCV
Ltd.
Infranet
Interfleet
Technology
Knorr-bremse
Rail
Systems
LB
Forster
London
Tramlink
London
Underground
Ltd.
Lucent
UK
Ltd.
Manchester
Metropolitan
University
Merseyrail
Metro
Rail
BCV
MIRC
Network
Rail
Newcastle
University

Nottingham
Tram
NTL
World
NVBC
Trains
Ltd
Portec
Rail
RailMeasurements
Ltd.
Railtrack
Schweerbau
(UK)
Ltd
Seno
Docklands
Ltd
Seno
Railtrack
Ltd
Siemens
South
Eastern
Rails
Ltd
South
Eastern
Trains
Ltd
South
West
Trains
SPT
Underground
Railway
Tata
Steel
Rail
TMR
Freight
Ltd.
Tube
Lines
Ltd.
West
Coast
Traincare

United
States
of
America
ABC
NACD
American
Steel
Foundries
Amsted
Rail
Amtrak
Anchor
Brake
AJR
Best
BART
BC-
Rail
Birmingham
Steel
Corporation
BNSF
City
of
Charlotte
Delta
Manufacturing
Hansco
Rail
LB
Forster
National
Transportation
Safety
Board
Woolin
America
TTCI
TTX
Union
Pacific
Railroad
Company
Utah
Transit
Authorities
VAE
North
America,
Inc.
Valleyn
Transportation
Authority
Viola
Transportation
Webtec
WMATA

Venezuela
Caracas
Metro
The MiniProf systems are used globally in various combinations by thousands of users, and are distributed and supported locally by a vast agent network covering more than 50 countries. A complete list of MiniProf agents and users can be found on www.miniprof.dk.
Greenwood Engineering A/S

With almost 25 years of international experience, a representative office in China and local agents in more than 50 countries, Greenwood Engineering is the leading manufacturer of highly specialised measuring equipment for monitoring and condition surveys in the global road and railway sector.

The wide product range spreads from the handheld and lightweight MiniProf units for measuring and analysing the cross sectional profile of train wheels, rails and brakes to the big-size Traffic SpeedDeflectometers (TSD) for network level bearing capacity measurements on roads while driving at normal traffic speed.

Since the establishment of Greenwood Engineering in 1992 by Leif Grønskov, the basic premise for all marketed products has been an uncompromising high technological level, a wish to be at the frontier in the business and to present top of the range solutions operating with the least disturbance to environment and traffic and with the highest safety to the user of the equipment.

With thousands of various measuring systems distributed and used all over the world, Greenwood Engineering has a strong position on the market with continuous focus on maintaining a close relation to the customers and developing the products in an on going process to keep and always strive to reach an even higher technological level.