

This is not an ADB material. The views expressed in this document are the views of the author/s and/or their organizations and do not necessarily reflect the views or policies of the Asian Development Bank, or its Board of Governors, or the governments they represent. ADB does not guarantee the accuracy and/or completeness of the material's contents, and accepts no responsibility for any direct or indirect consequence of their use or reliance, whether wholly or partially. Please feel free to contact the authors directly should you have queries.

**BAQ 2023**  
BETTER AIR QUALITY  
CONFERENCE 15-17 NOV • MANILA



## Pathways to Sustainable Transport in Asia - Vehicle Inspection and Maintenance

MAHA Maschinenbau Haldenwang GmbH & Co. KG

CHRISTIAN VOLLMAR

Haldenwang, 15 NOVEMBER 2023



BEST SOLUTIONS.  
FOR MAXIMUM SAFETY.  
WORLDWIDE.





- technical defects on vehicles can relate to 8 to 15% of death accidents in high income countries and can be even higher at 15 to 25% in middle income countries \*
- over 3500 people die every day on the roads, translate to nearly 1.3 million preventable deaths and an estimated 50 million injuries each year  
⇒ 13 million deaths and 500 million injuries during the next decade \*\*
- Road traffic crashes and accidents have remained a major cause of death globally, making it the leading killer of children and young people worldwide, even though every one of those deaths and injuries is preventable

\* according to United Nations Economic Commission for Europe (UNECE)

\*\* <https://www.who.int/news-room/fact-sheets/detail/road-traffic-injuries>

- The vehicle Inspection and Maintenance program in Europe started more than 60 years ago
- In the EU the program was termed as Periodic Technical Inspections (PTI)
- European Legislation established minimum requirements for a regime of periodic roadworthiness tests of vehicles used on public roads.
- Each member state must ensure that vehicles registered in its territory are periodically tested by testing centers authorized by the member state in which those vehicles are registered





- Member states may introduce national requirements concerning roadworthiness tests for vehicles registered in their territory, in which an existing European PTI control point is tested according to a better test method
- This program is also adopted in many Asian countries with similar guidelines to meet each individual country national policies guidelines and regulations

# The Benefits and Challenges



## The Benefits

- Ensure and Improved Road Safety
- Reducing Vehicle Emissions
- Improved Air Quality
- Create Employment

## The Challenges

- High investment cost to implement

Countries in which MAHA has installed nationwide vehicle testing systems or a significant amount of testing equipment:

- USA
- Costa Rica
- Ecuador
- Chile
- Northern Ireland
- Ireland
- France
- Germany
- Belarus
- Slovakia
- Bosnia and Herzegovina
- Austria
- Rome
- Portugal
- Spain
- Algeria
- Guinea

# The TÜV TÜRK PTI Project



Vehicle inspections in Turkey with technology from Bavaria, has been initiated in 2008  
Planned nationwide mandatory vehicle inspection according to the German model



MAHA equips Turkey with test stations

- **189 Test Stations with over 489 Test Lanes in 18 months**

Always one idea ahead – Globally leading  
MAHA guarantees the customer successful cooperation even after project completion

## Less Road Death people in Turkey



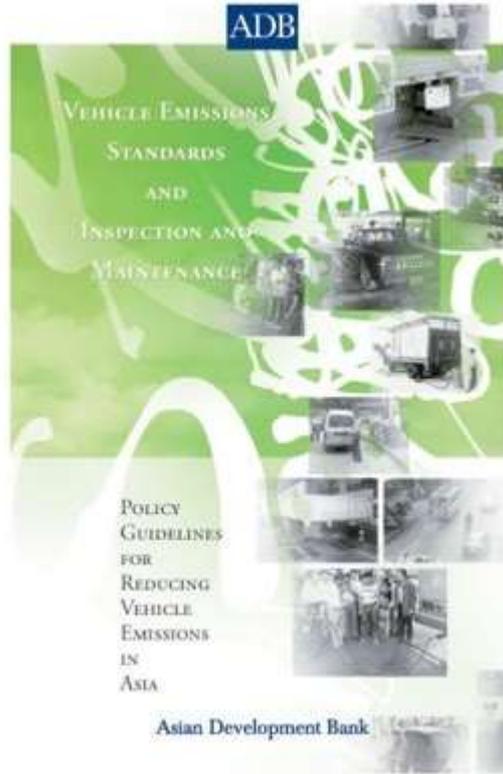
The latest implementation of PTI has increased the traffic safety on Turkey roads dramatically. Minister Binali Yildirim of MOT announced that the **number of people died in Turkey by road traffic has decreased 40% during the last three years**, since TÜV TURK a member of German based TÜV SÜD group started the countrywide PTI in accordance to the long experienced German PTI. TÜV SÜD

*"It is a perfect demonstration for the PTI system that after such a short period the result shows this success"* said Horst Schneider, Member of the board of Directors TÜV Süd AG. The dramatically reduced number of road death fatalities is the evidence how important PTI projects are for the overall traffic safety.

The **number of vehicle failed the test is also reduced since 2008 from 43 to 37 %**, at the same time the **repair volume in the workshops increased by 30 %**. "This number shows the responsibility of the vehicle owner which carry out the necessary repairs after PTI", said Bernhard Horak, Chief Operating Officer von TÜV Turk.

TÜV TURK Organisation is a Consortium managed by TÜV Süd, Dogus Automotive und Bridgepoint and is appointed by the Turkish government as the sole operator for PTI in Turkey. The first test station was opened in February 2008 in Elazig, today the complete network consists of 191 Test stations with mobile test stations. Every year the TÜV carries out over 5 million tests and employees approx. 3000 employees.

# Policy Guidelines for Reducing Vehicle Emissions in Asia



Policy Guidelines for Reducing  
Vehicle Emissions in Asia

Vehicle Emissions  
Standards and  
Inspection and  
Maintenance

Asian Development Bank

*Asian Development Bank 2003  
All rights reserved*

<https://www.adb.org/sites/default/files/publication/171742/inspection-and-maintenance.pdf>

## ASIA PACIFIC REGION

# PERIODIC TECHNICAL INSPECTION (PTI) PROGRAM IN ASIA PACIFIC REGION



Economies	Government owned Inspection Centers	Privately owned Inspection Centers	Inspection by Workshop	Chassis Dynamometer Smoke test for Diesel Vehicle	Nation-wide Inspection Program	Only Certain Province/cities with Inspection Program	Private Passenger Vehicle	Motorcycles 2 & 3 Wheelers	Commercial Vehicle
PR China	X	X		X	X		X	X	X
Japan	X	X	X		X		X		X
South Korea	X	X		XX	X		X		X
Viet Nam	X	X			X		X		X
Philippines	X	X			X	X	*X*	*X*	*X*
Thailand	X	X			X		X	*X*	X
Myanmar	X				X	X		X	X
Malaysia		X			X				X
Brunei	X	X	X		X		X	X	X
Singapore	X			X	X		X	X	X
Indonesia	X	X			X	X	X		X
Cambodia	X	X				X			X
Laos	X	X				X	X		X

# New Emission Regulation in Europe



- In 2016, several Swiss, German and Dutch government organization, metrological institutes, scientists and equipment manufacturers recognized the need for a new PTI emission tests to identify emissions tampering such as removing the Diesel Particulate Filter (DPF) or disabling the Selective Catalytic Reduction (SCR) system or detecting failed after-treatment components.
- The PTI-PN (Particle Number) test should be quick and cost-effective, without the need for a chassis dynamometer.
- Ideally, the test should be conducted through a steady-state, tailpipe measurement at the idle condition.
- As a result, several EU countries have started a mandatory emission test at the PTI, designed to identify high emitting vehicles with Belgium starting the program in July 2022.
- Other European countries that already adopted mandatory PTI-PN particulate filter checks include Germany, Switzerland and Netherlands.

# Legal situation



2021

2022

2023

Belgium



Netherlands



Germany



Switzerland



Additional economies: Spain    Czech Republic    Great Britain    South Korea

 = Date of implementation

# National PTI-PN programs in the European Union



Country	Effective Date	PN TLV	Applicability	Comments
		$cm^{-3}$		
Netherlands	2023.01	1,000,000	All diesel with a wall-flow filter (LD: Euro 3, 4, 5, 6 & HD Euro VI)	Regulation IENW/BSK-2020/125046 [5018]
Belgium	2022.07	1,000,000	Diesel: LD Euro 5b-6	Agreement of the Flemish, Walloon, and Brussels regions <a href="#">announced in 2021.04</a>
Germany	2023.01	250,000	Diesel: LD Euro 6 & HD Euro VI	AU-Richtlinie, Verkehrsblatt Nr. 8 of 30 April 2021 PN counter specification PTB-A 12.16 [5163]
Switzerland	2023.01	250,000 <sup>a</sup>	All diesel with a wall-flow filter	Amendments to SR 741.437 <a href="#">announced in 2022.02</a>

<sup>a</sup> At high idle; alternative standard 100,000  $cm^{-3}$  at low idle.

Source: <https://dieselnet.com/standards/eu/pti.php>

## PTI – Particle Number Counting



- ✓ Particle number measurement is to be seen as a tool in PTI to measure the nanoparticles emitted by an internal combustion engine.
- ✓ This is to make a statement about a well / poorly functioning diesel particle filter and thus exhaust gas after-treatment system.

# Diesel Particle Filter (DPF)

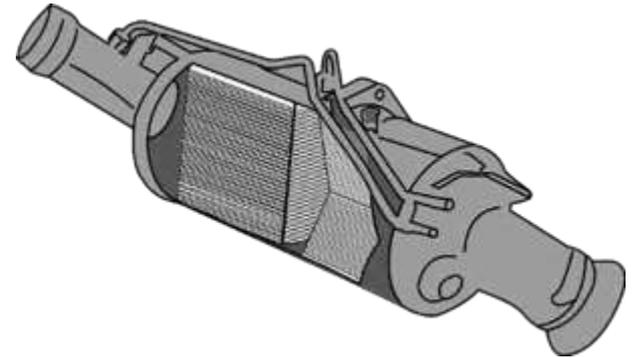


## Advantages:

- Particulate filter reduce the particulates in the range of 20–300 nm (PM<sub>0,1</sub> & PM<sub>1</sub>) by 90–99%

## Disadvantages:

- DPF's require a regeneration.  
In case this is not possible (driving only in cities) the DPF gets damages and needs to be replaced  
→ 1500 - 2000 Euro
- DPF's increase the fuel consumption.
- DPF's reduce the engine power.



**The resulting consequences are manipulation, poor maintenance  
⇒ Increased environmental pollution**

# Possibilities to detect DPF defect or manipulation.



## Thermal



Effectiveness



## Opacity



Effectiveness



## Particle Mass



Effectiveness



## Particle Number



Effectiveness

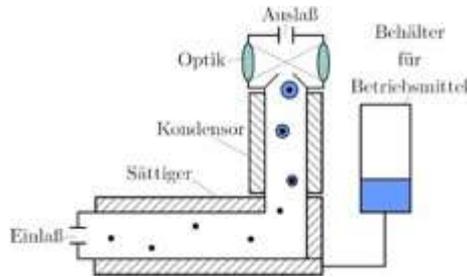


# TECHNOLOGY

CPC vs. DC



## Condensation Particle Counter (CPC)



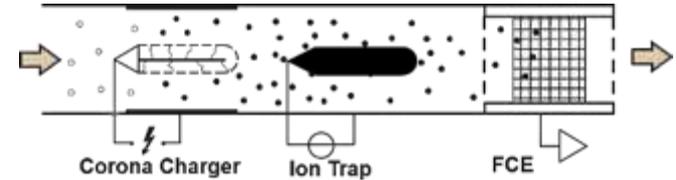
### CPC Pro's

- High accuracy and sensitivity (individual particles can be detected)
- Established procedure for automotive PN measurements

### CPC Con's

- Measuring range limited to the top (typical automotive CPCs up to approx. 30000 cm<sup>-3</sup>)
- Equipment mostly problematic (toxic, not odor-free, special disposal necessary)

## Diffusion Charger (DC)



### DC Pro's

- Measuring range suitable for tailpipe measurements
- Compact, robust and weight-optimized design possible
- Inexpensive
- Short set-up / warm-up times

### DC Con's

- Dependence on the particle size
- High voltage source required
- Dependence on particle morphology

# MAHA Particle Counter





## A HIGHLY PRECISE PN DEVICE FOR EVERY DAY WORKSHOP WORK

- Robust aluminum sheet housing
- Durable materials, solid workmanship
- Stable stand
- IP 54 certified

# MAHA Particle Counter



VARIOUS	
Measuring principle	Advanced Diffusion Charging
Operating temperature	5 ... 40 °C
Humidity	0 ... 90 % non-condensing 0 ... 95 % condensing
POWER SUPPLY	
Power Supply	100 ... 230 V
SIZE & WEIGHT	
Size (L x W x H)	505 x 210 x 310 cm
Weight	Approx. 8,5 kg
MEASURING RANGE	
Particle size	20 ... 300 nm
Measuring Range	1.000 ... 10.000.000 #/cm <sup>3</sup>
Volatile particles	Removing efficiency > 95%
Measuring frequency	1 Hz



## The Future of Mobility

Electrification – Connectivity – Autonomy

- Electric Vehicle
- Autonomous Vehicle
- Hydrogen and Fuel Cell Vehicle
- Big Data



## ADAS Testing

Advance Driver Assistance System

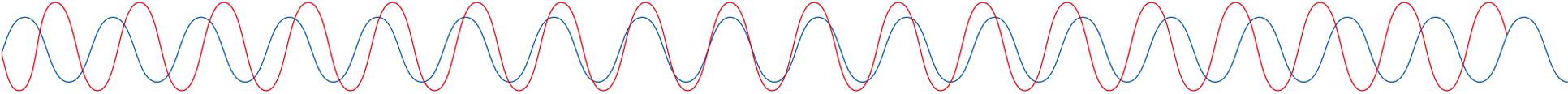
- Lane Departure and Lane Assist Warning
- Anti-collision
- Emergency Braking System
- Blind Spot Detection
- Adaptive Cruise Control



**THE FUTURE OF PTI IS STILL VERY MUCH ALIVE !!**

MAHA. YOUR  
**SAFETY IS OUR BUSINESS.**

# SAFETYFORSUREMAHA



# THANK YOU!

**MAHA Maschinenbau Haldenwang GmbH & Co. KG**  
Hoyen 20 | 87490 Haldenwang | Germany

Christian Vollmar

Sales Manager – Sales Department International

Phone +49 8374 585 171

[www.maha.de](http://www.maha.de)

All rights of use and disposal, such as the right to copy and pass on this presentation are reserved by MAHA Maschinenbau Haldenwang GmbH & Co. KG