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PEA 205N EXHAUST GAS ANALYZER

User Manual PEA-205N-V.01

INDUS *Scientific* Private Limited
11/2B, Hennur Main Road, Hennur Bande, Bangalore 560 043.
T/F: (080) 544 9762 / 544 9764; Fax: + 91 80 544 5573
Email: sales@indusscientific.com, info@indusscientific.com
Website: www.indusscientific.com

Table of Contents

1. INTRODUCTION

INDUS Model PEA205N is a class I Gas Analyzer designed and manufactured for testing the emissions from automotive engines, which run on petrol as well as CNG and LPG. The instrument can measure carbon monoxide (CO), Carbon Dioxide (CO_2) and Oxygen in percentage, and Hydrocarbons [Hexane equivalent (HC)] in ppm and Nitric Oxide (NOx) in ppm. It is generally supplied as a four gas analyzer without the NOx Sensor. When NOx sensor is added PEA205N becomes a 5 Gas analyzer.

PEA205N is built around an NDIR bench and uses a state-of-the-art microcontroller for calculations and to interface with various peripherals.

The analyzer uses the principle of Non-Dispersive Infrared (NDIR) for measurement. The infrared bench used in the analyzer as well as the built-in electronics are based on the latest technology from a world leader in this field. This kind of advanced technology has given PEA 205N its compactness and reliability.

PEA205N has been designed and manufactured to meet international standards (ISO3430) and national standards as per specifications issued by the Ministry of Transport and Highways under MCVR/TAP-115/116. It is certified as a Class I instruments by ARAI.

In compliance with the above standards, PEA205N has the in-built facility for the following self-checks diagnostic.

1. Warm up check: Type P: Permanent & Automatic
2. Low flow check: Type P: Permanent & Automatic
3. HC residue check: Type I: Instrument & Automatic
4. Leak check: Type I: Instrument & Automatic
5. International reference (Auto zero): Type I: Instrument & Automatic

If there is failure in any of these checks, then measurement will be aborted. These features are provided to ensure that measurement takes place under specified conditions only.

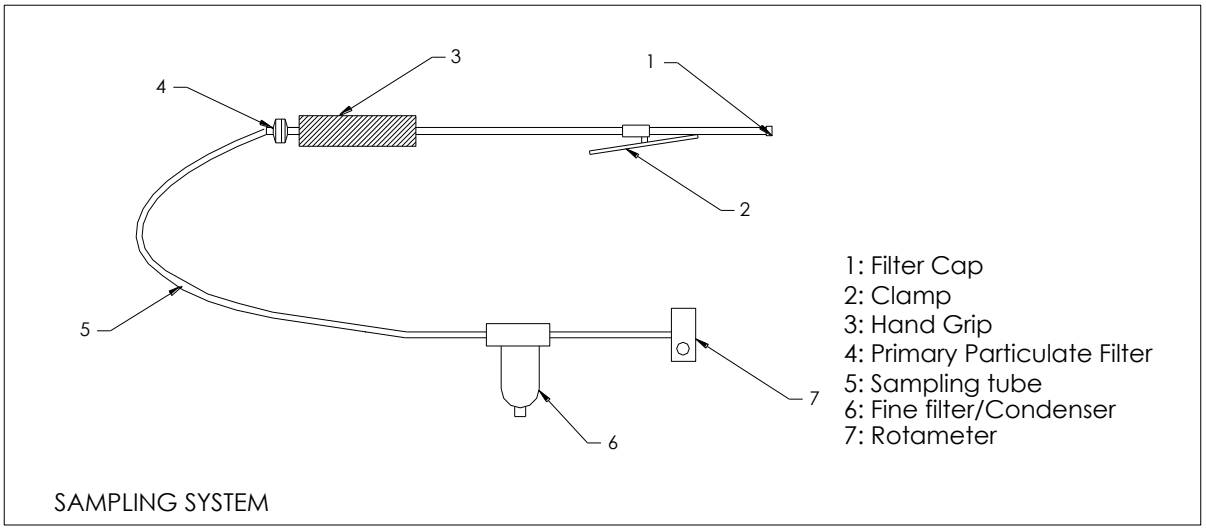
2. SPECIFICATIONS

Gases Measured:	Carbon Monoxide, Hydrocarbon, Carbon Dioxide Oxygen and Nitric Oxide(OPTIONAL)
Principle	Non - Dispersive Infrared for CO, CO_2 and electrochemical sensors for O_2 and NO
Range:	CO : 0 … 15.0% O_2 : 0 … 25.00% CO_2 : 0 ….20.00% NOx : 0…..5000 ppm HC : 0 … 30000 ppm [Propane] 0 … 15000 approx. [Hexane]
Data Resolution:	CO, CO2 and O2: 0.01%, HC, NO: 1 ppm
Accuracy	CO: ±0.06% Vol, CO2: ±0.5% Vol, HC: ±12ppm Vol, O2: ±0.1% Vol
Display:	20-character x 4 -line backlit LCD display (9mm character size), for day and night visibility.
Keyboard:	Membrane keypad, 16 keys.
Start-up Time:	< 2 min. from power ON. Full accuracy in 3min.
Auto Zero:	Every 24 minutes with automatic fresh air intake
Zero Time:	< 25 seconds.
Intrinsic Response Time:	< 5 seconds to 90% final value, for step change in concentration level.
Gas Flow Rate:	500 to 1000 ml/min. (read on a built-in flow meter).
Sample Handling System:	S.S. probe, PU tubing with easily detachable connectors, water separator cum filter, disposable particulate fine filter.
Printer:	24-column dot matrix printer.
Printer Output:	All the Gas concentrations with date and time stamp.
Serial Communications	RS232 output
Operating Conditions:	Temperature: 5 … 45° C, Pressure: 813 to 1060 mbar. Humidity: 0-90% [non condensing]
Power Supply:	12V/3A External Adaptor which will work 110 – 250V AC, 11 – 12V DC (Battery).
Dimensions (WxHxD):	250 x 120 x 220mm.
Weight:	4 kg.
Model & Software version:	PEA205N, Ver. 5G01 - V001

3. INSTALLATION

The PEA205NAnalyzer comes in a single box with a detachable sampling sub-system.

The figure below shows the various parts of the sampling sub-system.



1. The probe consists of a ¼" S.S. pipe (anti-corrosive) with a spring-loaded clamp to fix it to the tail pipe. (In case of a bent exhaust pipe, a flexible probe can be used). In the flexible probe, the sampling end is made of flexible steel tube lined with a Teflon tube. Otherwise it is similar to the straight probe.
2. Clamp to prevent the probe from slipping out of the exhaust pipe.
3. A convenient handle for the easy handling of the probe.
4. Primary particle pre-filter (operator replaceable): This consists of a double disk filter, which removes particulate load and passes the filtered gas to the water separator.
5. Required length of sample tube (Standard length of 4 meters).
6. A fine filter-cum-moisture eliminator is fitted to the back panel to filter out fine particles and to remove any moisture that condenses.
7. Flow meter or Rota meter*:* To measure the flow (in cc/min.) through the analyzer.

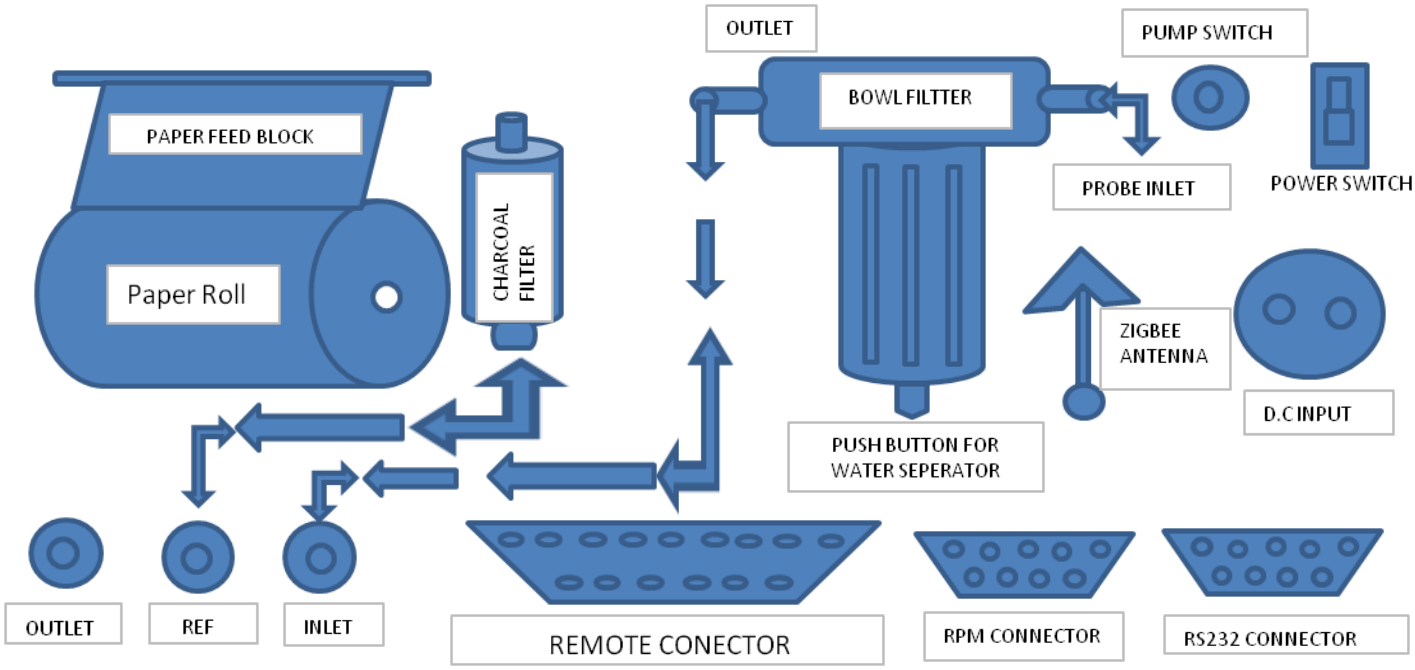
The analyzer needs to be placed on a flat surface and plugged to a DC 12V/3A External adaptor outlet [alternatively a 12VDC battery can be used] using the power chord provided. For easy viewing, it is recommended that the analyzer be placed at a convenient height.

Caution:

1) Before plugging in the unit to an electrical outlet, please ensure that it is a 3-pin socket with the proper ground connection. Failure to do this may damage the unit.

2) In case the power supply from a generator, it is essential to use a voltage stabilizer.

Rear Base Accessories:



The exhaust gas sucked by the pump through the analyzer is released to the atmosphere, after measurement, through a tube at the back of the analyzer marked as **OUTLET.**

The paper roll should be in the correct position and its leading edge threaded in through the paper inlet slot. The procedure for paper loading is described in section 7.

Inlet port: It is provided for fresh air intake during zero setting. A charcoal filter module is connected to this port to remove HC present in atmospheric air.

Water condenses in the bowl filter which is provided with a water level indicator. When water level rises above the permissible level, the measurement will abort automatically and shows <**Moisture**> as Error Message.

✍ *Note: Paper roll is optional, and is available with printer model only*

4. OPERATION

When the power switch on the front panel is put ON, the backlit LCD display read as,

INDUS Scientific Bangalore

Then Model and Version

PEA 205N xxxx-xxxx

Warming up for 1 minutes

Warming Up xxx

Startup Zero Setting

Zero Setting Wait

Initialization part includes Leak check, Error checking (HC Residue check with auto fixing) etc.

Initializing

<<Leak Check>> Insert CAP at the Tip of the probe Press CAL when ready

After Pressing 'CAL' key

Leak Check Done/Failed Flow : xxx cts

Wait….....

Initialization Ok

Due Date reminder

Calibrate before xx:xx:xx

Then it will wait in Standby mode

1. 4 Whlr-EIS 2. 4 Whlr-DIS 3. 2/3 Whlr-2 Strk 4. 2/3 Whlr-4 Strk

✍*Note: Use keys '1' to '4' for selecting Vehicle Type. Connect RPM Sensor in Secondary Coil and place near to engine.*

In Standby mode user can perform manual Zero Setting, Pump ON/OFF, etc. Refer Key function of Key '5', Key '6', 'Zero' Key in page 11

After selecting Vehicle Type, equipment will prompt for Vehicle number Entry

Enter Vehicle No ----------

✍ *Note: This facility is available with printer model only*

After selecting this System will enter Measurement mode and user can perform Vehicle test. The display will read as,

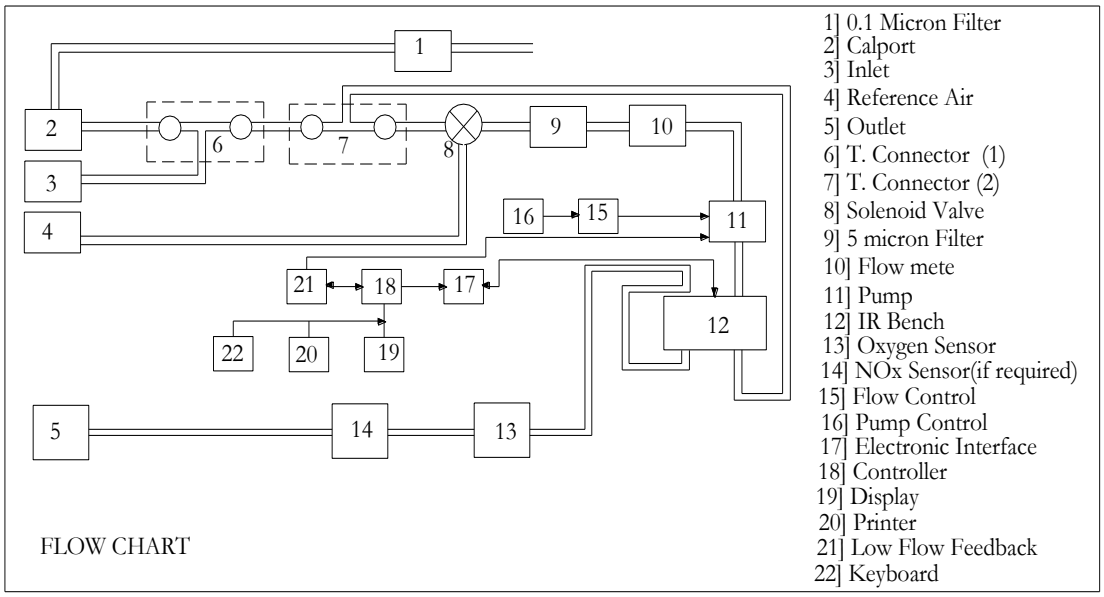
CO : + XX.XXX % HC : + XXXXX ppm CO2: + XX.XX % O2 : + XX.XX %

Or

CO : + XX.XXX % NOx: + XXXX ppm CO2: + XX.XX % O2 : + XX.XX %

✍*Note: To toggle between HC and NOx use Key '1'*

4.1. Front panel with keyboard



On power ON, an internal pump continuously sucks air through the sampling sub-system; the air then passes through the IR chamber and sensors for O_2 and NO_x (where the measurement is done). During this stage, the display values will not be constant but changing.

Before any measurement, Zero set all values by pressing 'ZERO' Key. This will ensure automatic zeroing (Auto zero) with respect to atmospheric air i.e. atmospheric air is considered as 0.0% CO. There is however about 100ppm HC content in atmospheric air which can be removed by putting an activated charcoal filter.. All readings are with respect to this (The difference in CO from time to time or place to place will not vary by more than a few tens of ppm i.e. definitely less than 0.01% CO under normal conditions). During zero operation, the equipment automatically switches the sample intake to fresh air.

On pressing the 'ZERO' key, the display will read:

Zero Setting Wait

Normally a zero setting happens within 25 sec. Otherwise equipment will abort Zero Setting and display will read as.

Zero Setting Failed

In this case the user can retry ZERO setting by pressing **ZERO** key.

On successful execution of zero setting, the display changes to

Zero Setting Done

Then it returns to normal mode of operation displaying the CO & HC values. The instrument does automatic temperature and pressure compensation.

☞Ensure that the flow rate during zero procedure and during measurement are within 10% of each other for best results i.e. if zero procedure is done at 500 ml/min., then ideally measurements should also be taken at 500 ml/min.

4.2. DATE & TIME

PEA205N has a built-in real time clock, which keeps the date and time updated. Press key '4', display shows the current date and time as follows:

Time: HH:MM:SS Date: DD:MM:YYYY

To change, press the required numeric key. For example, for setting the time as 9.15 AM & date as 02.01.06, press '0' first, then '9' for Hours. The position now automatically goes to "MM". Press '1' and '5' for minutes. Then press '0' and '2' for the date, '0' and '1' for the month. The first two digits of the year are already programmed as ''20'', hence press '0' and '6' for making the year as 2006. Press any numeric Key when finished to store the data entered.

4.3. RPM INDICATION

A provision to measure the RPM of the engine is incorporated in PEA205N. The RPM reading can be viewed by pressing key '2'.

✍*Note: This facility is not available in the standard model but is provided as an option.*

4.4. ENGINE OIL TEMPERATURE

A provision to measure the Engine Oil Temperature is incorporated in PEA205N.

✍*Note: This feature is not available in the standard model but is provided as an option*.

4.5. VEHICLE TYPE SELECTION

In Standby mode or After Pressing Key '8' equipment will prompt for Vehicle Type selection,

1. 4 Whlr-EIS 2. 4 Whlr-DIS 3. 2/3 Whlr-2 Strk 4. 2/3 Whlr-4 Strk

4.6. VEHICLE NUMBER ENTRY

After Vehicle Type Selection (In the case of Equipment with Printer) equipment will prompt for Vehicle number Entry

Enter Vehicle No ----------

- **a.** Use 'AUX' and 'ZERO' keys for scrolling through 0, 1, 2, 3,…, "Space", A,B, ….,Z
- **b.** For Next position use 'PRN' Key
- **c.** Numeric Keys can be used for entering Numbers.
- **d.** For skipping Vehicle number entry use 'VEH NO.' Key
- **e.** Up to 14 Characters can be entered (All formats).

✍*Note: This facility is available with printer model only.*

5. OPERATING MODES

Provision exists to operate the analyzer in two modes - Normal mode and Field calibration mode.

5.1. NORMAL MODE

This is the power ON default mode. It is in this mode that the analyzer will be used most of the time, in which it is assumed to be measuring real exhaust gas.

In this mode the analyzer LCD display indicates:

i. CO in %, as by default the exhaust going into the analyzer contains CO & CO_2.
ii. HC as Hexane in ppm / NOx in ppm (by pressing Key '1' its Toggle)
iii. CO2 in %
iv. O2 in %

The equipment will also measure the RPM in the background. This reading also included among the printed details.

Key-1 Key-1	Page 1 - Default **CO : + XX.XXX %** **HC : + XXXXX ppm** **CO2 : + XX.XX % FUEL** **O2 : + XX.XX %** **Page 2** **CO : + XX.XXX %** **NOx : + XXXX ppm FUEL** **SOX : + XXXX ppm** **O2 : + XX.XX %** ***FUEL** is Selected Fuel*
Key-2 Key-2	Page 1 Menu **RPM : XXXXX** **Temp : XXX.X °C** **Pres : XX.XX Kpa** **Flow : XXX cts** **Page 2** **CO Crt : + X.XXX %** **Oil Tp : XXX.X °C** **Lambda: XXXX** **A.F.R. : XXXXXX**
Key-3	PEF Display Menu **PEF : X.XXX**
Key-4	Set Time and Date **Time: HH:MM:SS** **Date : DD:MM:YYYY**
Key-5	Toggle between User and Service Mode *(Hold Key for 6 Sec)*
Key-6	Pump ON/OFF control
Key-7	No Function
Key-8	For Vehicle type selection **1. 4 Whlr - EIS** **2. 4 Whlr - DIS** **3. 2/3 Whlr - 2 Strk** **4. 2/3 Whlr - 4 Strk**
Key-9	Fuel Selection Menu Select Fuel Type **Petrol <0>** **L.P.G <1>** **C.N.G <2>**
Key-0	No Function
VEH NO.	Quitting from Menus
PRN	Print Test Report (Optional)
CAL	No Function
AUX	Leak Check
ZERO	Zero Set
LF	Line Feed (Optional)

5.2. SERVICE MODE or FIELD CALIBRATION MODE

Operation in Service Mode or Field Calibration Mode is advised to be performed only by a trained service person or a person authorized by the Company. For this reason, keys used for this functioning are disabled; hence preventing keyboard tampering/ unauthorized use/ invalid calibration entries.

For calibration method refers our calibration procedure

Key-1 Key-1	Page 1 - Default **CO : + XX.XXX %** **HC : + XXXXX ppm FUEL** **CO2 : + XX.XX % S** **O2 : + XX.XX %** Page 2 **CO : + XX.XXX %** **NOx : + XXXX ppm** **SOx : + XXXX ppm FUEL** **O2 : + XX.XX %** ***FUEL** is Selected Fuel* ***S** is Service Mode*
Key-2 Key-2	Page 1 Menu **RPM : XXXXX** **Temp : XXX.X °C** **Pres : XX.XX Kpa S** **Flow : XXX cts** Page 2 **CO Crt : + X.XXX %** **Oil Tp : XXX.X °C** **Lambda : XXXX S** **A.F.R. : XXXXXX**
Key-3	PEF and Error Menu **PEF : X.XXX** **<Measurement Errors>**
Key-4	Set Time and Date **Time: HR:MN:SC** **Date : DD:MM:YYYY**
Key-5	Toggle between User and Service Mode *(Hold Key for 6 Sec)*
Key-6	Pump ON/OFF control
Key-7	Clear Oxygen Error
Key-8	Clear Oxygen Channel
Key-9	Zero Flow Channel
Key-0	Sensor Sl.No. and Status **Serial Number : XXXXXXX** **xxxxxxxx** ***xxxxxxxx** is Sensor Error status*
VEH NO.	No Function

PRN	Print Calibration Report
CAL	Calibration Menu **Select Gas** **CO2 <0> Hexane <1>** **CO <2> Propane <3>** **NOx <4> Print <5>**
AUX	Leak Fix
ZERO	Zero Set
LF	Line Feed

✍*Note: If any parameter is invalid display will show -------*

6. OUTPUT

6.1. PRINTER

PEA205N is provided with a built-in printer, which consists of a print head (Epson, 24 columns) and a printer driver. The paper roll is fitted at the back and is let into the inlet slot at the back of the analyzer. The print out comes out through the slot at the top of the instrument case.

PAPER LOADING

1. Ensure that the paper is loaded into the printer.
2. Inserting the paper through the slit provided at the Back panel of the analyzer into the printer and then Pressing the LF key can load paper.

In case a printout is required the '**PRN**' key may be pressed.
This will give a hard copy.
A typical printout is shown here:

✍*Note: This facility is available with printer model only.*

****
INDUS *Scientific* Pvt Ltd
Bengaluru – 43
India
Date: 01/09/20xx
Time: 11:23:30

Veh. No : ----------
Veh. Type: 2/3 Whlr - 4 Strk
Fuel : Petrol

CO : + xx.xxx %
HC : + xxxxx ppm
CO2 : + xxxxx %
O2 : + xxxxx %
NOx : + xxxxx ppm

RPM : xxxxx
Pressure : xx.xxKPa
PEF : x.xxx

Oil Temp : xxx.xDegC
Cell Temp: xxx.xDegC

CO Crtd : + x.xxx %
Lambda : xxxxx
A.F.R : xxxxxx

Permissible Limits:

WhlrStrk CO (%) HC(ppm)

Mfd on/bfr 31st Mar'00
2/3 2/4 4.5 9000

Mfd after 31st Mar' 00
2/3 2 3.5 6000
2/3 4 3.5 4500

Bharath stage II
4 0.5 750

(Others)
4 3.0 1500

Sign:
****

6.2. RS-232 OUTPUT

The 232 output is compatible with INDUS PetrX 1.30V onwards only

7. TEMPERATURES AND PRESSURE COMPENSATION

All the temperature and pressure drifts are compensated in the PEA205NAnalyzer system, the temperature of the sensor and the ambient pressure can be seen on the display by pressing the key '**2**'.

PEA205Nanalyzer constantly measures the temperature and corrects for its effects according to Charles law.

The IR detector sensitivity also varies with temperature. As the temperature increases, the IR detector produces less output with the same incident light from the IR source. This effect is corrected whenever the analyzer is zeroed. The PEA 205N also has a built-in compensation to correct for this effect between zeroes - called warm-up drift compensation, as this is when the effect is most pronounced. However it is actually active at all times and compensates for detector temperature changes, by performing a zero setting periodically.

8. SELF-CHECKING FACILITIES

PEA205N is provided with a following built in features of self-checking.

Warm up check and Initialization:

During this, the system reads the IR bench and checks for concentration out of range, specification violation and system error if any. It stops the further operations if any one of the above occurs. Measurement can be done only after initialization is over successfully.

Leak check:

It checks for leak in the gas flow system. Leak in the gas flow system may affect the CO corrected values measured. Leak check is automatically initiated on power on or manually by pressing Key '**6**'. Refer Page 5 for procedure. This takes about 5 sec. In case of a leak the following error message will appear:

Leak check Failed Flow: xxx cts

Again it will prompt for Leak Check. In order to fix leak, enter Service mode and Press '**AUX**' Key.

8.1. Low Flow Check:

The low flow checks monitors whether the flow through the bench is adequate to give reliable measurement. It is based on the measurement of the differential pressure between the inlet and outlet of the bench, which is calibrated for minimum flow requirement. The optimum flow through the bench is 500 to 1000 ml/min. Outside these limits, measurement will abort with following message.

Measurement Aborted <Low Flow>

8.2. Auto zero:

The instrument automatically performs AUTO ZERO periodically (default timing: once every 24 minutes) or when there is a temperature drift of more than 2 °C. When the unit prepares to do the zero setting it indicates it, <**Z**> in the LCD as Zero request, 20 sec in advance by an intermittent (this time will vary depends on current status of equipment). This is to avoid the chance of auto zero setting during measurement. The PEA 205N automation system takes care of sampling in fresh air through a solenoid valve built into it. The auto zero setting is done in the same way as of manual zero setting. This operation is necessary to give accurate values even under changing temperature conditions.

8.2. Error Checking:

The PEA205N is having a facility of checking HC residual value presence in the IR Bench. During Error Checking it checks for the HC residual value. The system reads "HC residue error" if HC residue value is more than 20 ppm. If HC Residue is present, the system will fix it automatically through Auto Zero Setting. If HC Residue Error is coming continuously you need to change charcoal filter

So it is necessary to ensure that HC value should be '00000' before each and every test. This can be achieved by pressing '**Zero**' Key (for Zero Setting).

8.3. Power Supply Limits:

PEA205N operates with external 12V/3A power supply which will operate over a wide range of mains voltage from 110 – 250V AC.

The instrument also operates on a battery within the voltage limits of 10.8 VDC to 16.5 VDC. When the voltage falls to 10.8V, the system will be put off. No measurement is possible.

9. LAMBDA / AFR MEASUREMENT

Based on the measurement of CO2, CO, HC and O2, the analyzer computes **λ**(Lambda) which is the air-to-fuel ratio as a dimension-less quantity. **AFR** (Air to Fuel ratio) has air pressure built into it and hence is not dimension-less.
λand **AFR** are displayed and printed out. Lambda value is meaningful only in the range of 0.8 to 1.2. Our analyzer displays or prints this value in the range of 0.5 to 1.5.

A quick check of why lambda value is not displayed can be made by looking the O2 concentration. If O2 is more than 5 %, it means there is some leakage of air. It is essential to use a tail pipe extension to ensure that Oxygen values are correct. A **Universal Tail Pipe** extension system applicable to most vehicles can be supplied with the instrument on request at reasonable cost.

10. STANDARD ACCESSORIES

1. Sampling Probe with 4 meters of tubing and convenient handle.
2. Primary Particulate Filter.
3. Bowl filter & Moisture Eliminator.
4. Connectors for leak tight connections of the above.

SAMPLING SYSTEM COMPONENTS

1. Probe	- Stainless Steel with hand grip for straight probe
	- Flexible Steel with Teflon lining for flexible probes
2. Particulate Pre-filter	- PP Pad Filter
3. Moisture cum Filter Eliminator	- Headline Filter
4. Tubing	- Polyurethane
5. Connectors	- Aluminium
6. Internal Tubing	- Silicone
7. Final Filter	- 5-micron filter
8. Flow meter	- Acrylic
9. Charcoal Filter	- ABS Plastic

All the sample-handling materials have been chosen so as not to contaminate the gases being analyzed and are corrosion resistant to motor vehicle exhaust gases.

11. MAINTENANCE

The PEA205NAnalyzer has been designed for easy maintenance.
If the flow level in the Flow meter goes below 200 ml/min. it indicates that the PP-Pad Filters may be chocked in the probe or 25 micron filter element may be chocked.
Check the bowl filter by unscrewing its case and replace the filter element if necessary.
The primary particulate filter is a replaceable disc type filter, mainly meant for removing larger particulates. In case the disc is completely coated with black particles, then it clearly indicates clogging. Replace the disc with a new one and check the flow level in the Flow meter. The general guideline is to replace this after every 50 measurements.
Oxygen sensor has a life of about 2 years. When it fails, the display will indicate it. To change the oxygen sensor, open the cover of the instrument case, disconnect the electrical connector to the sensor and unscrew the sensor from its base. Now a new sensor can be screwed into the base and the electrical connection put back in place.

12.TROUBLE SHOOTING

1. In case the CO% indicated is changing and does not remain constant to within ±0.2%, remove the probe from the exhaust pipe and zero the instrument as described in the Calibration section.
2. In case the CO% indicated seems to be much lower than the actual value, ensure that all connectors are properly fixed and make sure that there are no leaks by using Teflon tape at tube connectors. User can check leak by closing the probe inlet using the CAP provided with Probe. The Flow meter will indicate zero flow in case of no leak. If zero flow is not indicated, then there is leak in the equipment.
3. In case the flow falls below 200ml/min., the filter(s) need to be replaced /cleaned as explained in the Maintenance section.
4. In case there is no flow at all and no error is displayed on the LCD Display, then first check whether the probe cap is fitted at the tip. This has to be removed during measurement. If this is not the problem check whether the pump has failed. Kindly contact the nearest dealer/manufacturer for replacement.
5. In case of no display, check if AC power is connected to the back panel in the right socket. Also check if the backlight of the LCD is ON. It is not ON; check the connection to the LCD Display. Otherwise contact the nearest dealer/manufacturer for assistance.
6. In case of any other problem contact the manufacturer/dea

Sensor Status or Error's

Error Code	Error Description	Remedy
0	Concentration Error	Zero set in fresh air. If Error Still remains, Switch off the equipment and Switch ON after 1 minute.
1/Z	Zero request	Wait for Auto zero Setting
2	Command Error	Problem in internal connection. Equipment requires Service.
3	Check Sum Error	Problem in internal connection. Equipment requires Service.
4	Specification Error	Ensure no block in the Probe. Zero set in fresh air. If error still remains Call INDUS Technical Support Team.
5	EEPROM Error	Equipment requires Service.
6	IR Low	Equipment requires Service.
7	System Error	Switch OFF the Equipment. It requires Service.

✍*Note: LCD line-1 last three positions display the Sensor status error.*
Detailed Sensor status or error report is available in service mode key ***'0'***

Measurement Error

Error Message	Cause	Remedy
Pump OFF	Auto OFF (after 5 minutes) or Manual OFF (Key '**6**')	Press Key '**8**' for Start measurement
Low Flow	Probe tip is closed with cap or blocked.	Ensure no block in the Probe. Zero set in fresh air. If error still remains Call INDUS Technical Support Team.
Moisture	Water content in 0.1-micron bowl filter.	Clean 0.1 micron filter
Oxygen Sensor Fail	Check Oxygen sensor connection or Oxygen sensor Life span is over.	Zero Set in fresh air. If error still remains, the Equipment requires Service.
System Error	Hardware Failure	Switch OFF the Equipment. It requires Service.
MZ *This will come in 4th line right corner of LCD*	Request for Manual Zero setting.	Zero set equipment in fresh air.

✍*Note: Detailed Measurement error report is available in service mode by pressing Key* ***'3'***

13.CALIBRATION PROCEDURE

[This section is given only for specially trained personnel]

The instrument sets the zero point whenever the '**ZERO'** key is pressed. This is one calibration point. A second calibration point is realized through the use of a calibration mixture. However, depending on the usage and changes in environmental conditions the frequency of calibration may be changed.

To perform field calibration on PEA 205N, go through the following steps.

1. Enter service mode.
2. Zero set the equipment.
3. Switch off the PUMP by pressing Key '**6**'.
4. Pass the calibration gas into the device at a constant flow rate [normally, 500-1000ml/min]. Check this on the Flow meter. Please note that error <**4**> will appear on LCD below and above these limits.
5. Wait for a while until the unit displays constant value.
6. Press '**CAL**' Key for calibration menu.
7. Now the unit offers choice to select the gas to be calibrated:

Select Gas	
CO2 <**0**>	Hexane <**1**>
CO <**2**>	Propane <**3**>
NO <**4**>	Print <**5**>

8. After selecting gas the Equipment prompt for tag value.
   E.g.: For Hexane Press '**3**'. Then display will read as,

Enter Propane Tag
xxxxx ppm

9. Enter the calibration gas tag value through the numeric keys. After entering all characters, Press any numeric key to start calibration.
10. At the end of this, the device performs calibration and comes out with the reports, either calibration success full or failure with error codes.
11. Press '**CAL**' to enter the calibration mode for the next gas and repeat procedure for the other gases
12. Calibration of oxygen is done using fresh air [Oxygen-20.9%]. This can be done by passing fresh air to the equipment and pressing the '**ZERO**' key.

> ✍*Note: If Propane is used for calibration instead of Hexane, the instrument calculates the propane equivalence factor (PEF) and Displays corresponding Hexane Tag value.*

Calibration Message

Calibrating Wait

This indicates that the tag values entered during the calibration procedure are being sent to the bench

Calibration Done

Comes when calibration takes place successfully

Calibration Failed Spec. Limit Exceeds

This usually occurs due to any one of the following:

1. Zero Set requests from IR Bench (<Z> on LCD) during calibration.

In this case, quit from calibration menu, remove calibration gas from inlet and then Zero set the bench by pressing 'ZERO' key and redo the calibration procedure to avoid this problem.

2. Wrong tag value.

When the tag values entered does not match with the gas sensed by the bench. So enter the correct tag value as per the calibration gas manufacturer to avoid this.

Printout of Calibration Report

****
INDUS *Scientific* Pvt Ltd
Bengaluru – 43
India
Date: 02/01/20xx
Time: 12:03:52

-----Calibration Report-----

Eq Ser No. : P xxxx
Sensor No. : xxxxxxx
Version No. : xxxx-xxxx
Eq. Status : xxxxxxxx

Veh. Type: 2/3 Whlr - 4 Strk
Fuel : Petrol

CO : + xx.xxx %
HC : + xxxxx ppm
CO2 : + xxxxx %
O2 : + xxxxx %
NOx : + xxxxx ppm

RPM : xxxxx
Pressure : xx.xxKPa
PEF : x.xxx

Oil Temp : xxx.xDegC
Cell Temp: xxx.xDegC

CO Crtd : + x.xxx %
Lambda : xxxxx
A.F.R : xxxxxx

--Calibration Tag Values—
Hexane : xxxx ppm
Propane : xxxxx ppm
CO : x.xxx %
CO2 : xx.xx %
NOx : xxxx ppm
Calibrated by: ……..
****

APPENDIX A.

MOST/CMVR/TAP-115/116	**STANDARDS AND TEST PROCEDURES FOR IDLING**	
ISSUE NO.1		**PART 1**

DETAILS OF STANDARDS AND TEST PROCEDURES FOR CARBON MONOXIDE EMISSIONS AT IDLING FOR IN-SERVICE VEHICLES FITTED WITH PETROL ENGINES

1 Scope & Field of application:

1.1 This part applies to the emissions of carbon monoxide at idling from In-service vehicles fitted with spark ignition engines (petrol), as referred in CMVR-115(2) (a) & (b) and for issue of "Pollution under control "certificate to be issued by authorized agencies under CMVR-115(7).

1.2 This part specifies standards and test procedures for the determination of the concentration of exhaust carbon monoxide (CO) emissions from road vehicles equipped with spark ignition engines running at idle speed. This is based on ISO 3929 - 1979 (E) - "Road vehicles - determination of exhaust carbon monoxide concentration at idle speed".

1.3 This also lays down the technical specifications for the analyzer equipment used for the determination of concentration of exhaust carbon monoxide (CO) emission from road vehicles equipped with spark ignition engines and is based on ISO 3930 - "Road vehicles - carbon monoxide analyzer equipment - technical specifications".

2 Definitions**:**

2.1 Spark Ignition Engine: Means an internal combustion engine in which the combustion of the air/fuel mixture is initiated at given instants by a hot spot, usually an electric spark.

2.2 Idle Speed: Means the engine rate, in revolution per minute, with fuel system controls (accelerator and choke) in the rest position, transmission in neutral and clutch engaged in the case of vehicles with manual or semi-automatic transmission or with selector in park or neutral position when an automatic transmission is installed, as recommended by the manufacturer.

2.3 Normal Thermal Conditions: Means the thermal conditions attained by an engine and its drive line after a run of at least 15 min. on a variable course, under normal traffic conditions.

3 Specifications & Tests:

3.1 The vehicle when subjected to the tests described in para 3.2 below, shall meet the following limits.

3.1.1 The CO emission at idling for all four-wheeled petrol driven vehicles shall not exceed 3% by volume. The CO emission at idling for all two and three-wheeled petrol driven vehicles shall not exceed 4.5% by volume.

3.2 Description of Test

3.2.1 Instrument

3.2.1.1 The instrument used for the measurement of CO should be a type approved instrument as given in CMVR-116(3) and the tachometer to measure idling speed should have an accuracy of ± 50 rpm.

3.2.1.2 The instrument should be prepared, used and maintained following the directions given in the instrument manufacturer's operation manual, and it should be serviced and calibrated at such intervals as to ensure accuracy.

3.2.1.3 Within a period of 4 hours before the instrument is first used, and each time the instrument is moved or transferred to a new environment, a *span & zero* calibration should be carried out using calibration gas. The calibration shall be performed well away from the exhaust of motor vehicles whose engines are running.

3.2.1.4 If the sample handling system is not integral with the analyzer, the effectiveness of the condensate traps and all connections of the gas sampling system should be checked. It should be checked that filters are clean; that filter holders are fitted with their gaskets and that these are in good conditions.

3.2.1.5 If the instrument is not self-compensated for non-standard conditions of altitude and ambient temperature or not equipped within a manually controlled system of compensation, the scale calibration should be performed with calibration gas.

3.2.1.6 It should be ensured that the sample handling line and probe are free from contaminants and condensates.

3.2.2 Vehicle Preparation

3.2.2.1 It should be checked that the road vehicle exhaust system leak-proof and that the manual choke control has been returned to the rest position.

3.2.2.2 It should be checked that the gas-sampling probe can be inserted into the exhaust pipe to a depth of at least 300mm. If this proves impossible owing to the exhaust pipe configuration, a suitable extension to the exhaust pipe(s), making sure that the connection is leak-proof, should be provided.

3.2.2.3 The vehicle shall have attained normal thermal conditions as defined in 2.3, immediately prior to the measurement.

3.2.2.4 The vehicle idling speed should be checked and set as per 2.2, as prescribed by the manufacturer, with all the accessories switched off.

3.2.3 Measurement

3.2.3.1 Immediately preceding the measurement, the engine is to be accelerated to a moderate speed with no load, maintained for at least 15 sec, then returned to idle speed as set in 3.2.2.4.

3.2.3.2 While the engine idles, the sampling probe should be inserted into the exhaust pipe to a depth not less than 300 mm.

3.2.3.3 After the engine speed stabilizes, the reading should be taken.

3.2.3.4 The value of CO concentration reading should be recorded.

3.2.3.5 In cases where gadgets or devices are incorporated in the exhaust system, for dilution of the exhaust, both CO & CO_2 should be measured using an instrument having facility to measure both CO & CO_2. If the total of the measured values of CO & CO_2 (T. CO & T. CO_2) concentration exceed 15% for four stroke engines and 10% for two stroke engines, the measured value of CO should be taken as carbon monoxide emissions from the vehicle. If it does not, the corrected value (T corrected) should be taken as given below.

T corrected = T CO x 15/ (TCO + T CO_2)
for 4 stroke engines
= T CO x 10/ (T CO + T CO_2)
for 2 stroke engines.

3.2.3.6 Multiple exhaust outlets should be connected to a manifold arrangement terminating in a single outlet. If a suitable adopter is not available, the arithmetic average of the concentrations from the multiple pipes may be used.

3.2.3.7 If the measurement is to be repeated, the entire procedure of para 3.2 shall be repeated. For the purpose of PUC (Pollution Under Control) certification, if the idling CO is not within limits, the vehicle shall be adjusted as recommended by the manufacturer to bring the CO values within limits.

APPENDIX B.

Version Information:

Display format

PEA 205N XXXX-YYYY

XXXX - Hardware and Firmware version
YYYY - Configuration code
E.g.:
PEA 205N
5G01-V001

CALIBRATION REPORT/ CERTIFICATE

INDUS *Scientific* Private Limited
11/2B, Hennur Bande, Hennur Road, Bengaluru – 560 043
T/F: (080) 2544 9762/ 64, Fax: + 91 80 2544 5573
Email: info@indusscientific.com,
sales@indusscientific.com
Website: www.indusscientific.com

No.: ISPL/CC// Date: / /

1.0	Component:	
2.0	PUCCenter Registration No.:	
3.0	Objective of the test: To carry out Physical and calibration of Gas Analyzer as per the test procedure specified in Annexure 1 of CMVR / TAP 115-116 Part-8.	
4.0	Detailed Observations	
4.1	Checking of supply / earthing	
4.2	Checking of accessories:	
4.3	Span Calibration 2. Details of span gas concentration _____ % 3. Calibration gas cylinder No.: _____ 4. Calibration gas cylinder make: M/s. Bhoruka Gases Ltd 5. Calibration gas validity date: _____ **OR** 1. Details of Natural Density filters used for midpoint calibration	
4.4	Electrical Calibration OK / Not OK	
4.5	Leak test:	Passed / Failed
5.0	One no. of Petrol vehicle checked for idling Emission / Free acceleration. Measurement	
6.0	Conclusion:	
7.0	Next Calibration Due Date:	

For INDUS *Scientific* Private Limited

Authorized Signatory.