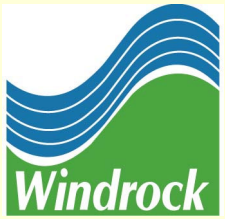
Portable Emission Testing



- Operation Procedures for Performing Emission Test on Natural Gas-Fired Engines

Exhaust Emission Monitoring

- Periodic monitoring of exhaust emission is required to ensure that stationary emission sources are within their specified emission limits. Portable emission analyzers have been shown to provide accurate, cost effective, and timely emission data.

Applicability

- This test procedure is applicable for the measurement of oxides of nitrogen (NO_x), carbon monoxide (CO), and oxygen (O_2) emissions from stationary internal combustion engines and turbine engines. This procedure will measure emissions on a dry basis, without having to dilute the sample.

Principle

- An exhaust sample is collected and drawn into the portable emission analyzer. The analyzer may include several electrochemical sample cells to measure the sample's concentration levels of exhaust constituents such as: NO, NO_2, CO, and O_2. The emission rate for each pollutant is determined by applying the concentration levels obtained with the analyzer, with the mass flow rate of the stack emissions.

Necessary Equipment

Calibration gas NO, NO_2 & CO, O_2 in the right ranges to be samples.

- Calibrate for at least twice the known response time.
- Hazardous Materials Shipping Papers

Portable analyzer with calibration helper and hoses.

Regulator for calibration gas.

Emission limitation for that particular engine (lbs/hr) (gms/BHP-hr) and / or ppmvd.

Extra emission cells as necessary.

- Cell Battery – should read good.

Setup of Portable Emission Analyzer

- Open the instrument lid.
- Remove and check all items contained in the lid unit.
- Items not in lid of unit that need to be checked.
- Water trap and span calibration assembly.

OPTION 1

- Heated hose assembly
  - Screw the heated hose (10’+) on to the stainless tubing probe coming from the source stack.
  - Connect quick connect to gas inlet connector see Diagram (1)

OPTION 2

Pistol grip probe assembly

- Screw the probe extension on to the pistol grip handle.
- Connect the end of the probe into the quick connect.
- Connect the GAS TEMP connector into the marked socket on the gas module.

Power Supply Lead and Battery Charging

- Connect the power lead to the socket on the side of the instrument.
- The full (off load) charging period is 24 hours. A half charge can be achieved in 3-4 hours.
- **NOTE: The instrument always runs off the battery not AC.**

Calibration Helper Setup and Initial Leak Checks

- Mount calibration helper on the case.
- Connect the quick connect to connector on “Gas Inlet”.
- Fill bubbler 2/3 up with clean tap water (only one cylinder).
- Check NO_x and SO_2 filter (*replace as needed when beads turn ashy white*).

Exhaust Stack Sampling Probe Placement

- Place 3/8” stainless tubing through a bored-thru Swagelok fitting located 2 pipe diameters downstream from nearest obstruction and ½ diameter upstream of nearest obstruction.
- Tubing should be inserted exactly ½ the diameter of the exhaust pipe and tightened into place.
- Next, connect flexible stainless shielded Swagelok hose to exhaust probe (need 3/8” to ¼” tube reducer).
- Now connect male end quick connect to female end quick connect on calibration helper.

Sample Port Location

CIRCULAR STACKS

- **Optimum** – 8 diameters downstream of a disturbance; 2 diameters upstream of a disturbance
- **Minimum** – 2 diameters downstream of a disturbance; 0.5 diameters upstream of a disturbance

Sample Port Location

RECTANGULAR STACKS

- Figure the diameter by:

$$D = (2*L*W)/(L+W)$$

Where: D = diameter

L = length

W = width

- Then use the same criteria as for a circular stack.

Sample Port Location

- 2” collars or threadolettes should be used for the test ports. The test ports are to be installed 90 to each other on a circular stack. For a rectangular stack the ports should be installed along the long rectangular wall and following the guidance in 40 CFR 60, Appendix A, Method 1. When the plugs are placed in the collars or threadolettes they must be treated with anti-seize and placed in “finger tight” only.

PRETEST CALIBRATION CHECK

- Manually calibrate NO/CO and NO_2/O_2 sample cells.
- Record calibration information.

Exhaust Emissions Measurement as Specified in Test Protocol

- Verify engine load.
- Input data from emission test worksheet.
- Prepare for emission test.
- Collect field data.
- Disconnect flow to analyzer.

Post-Test Calibration Test

- Manually verify the NO, CO and NO_2 calibration.
- Record calibration information

Prepare Emission Spreadsheet and Report

MANUAL METHOD

- Open computer spreadsheet and record calibration gas concentration.
- Input pre-test calibration check and post-test calibration check data.
- Input data from emission test worksheet.
- Validate span drift and calibration gas ranges.
- Print emission report and make necessary contacts.

Calibration Data Sheet

Engine #:_____ Date: _____ Time: _____

Calibration Gas	Pre-Run Calibration	Post-Run Calibration
O_2 (%)		
NO (ppm)		
NO_2 (ppm)		
CO (ppm)		

Water Trap Span Calibration Assembly

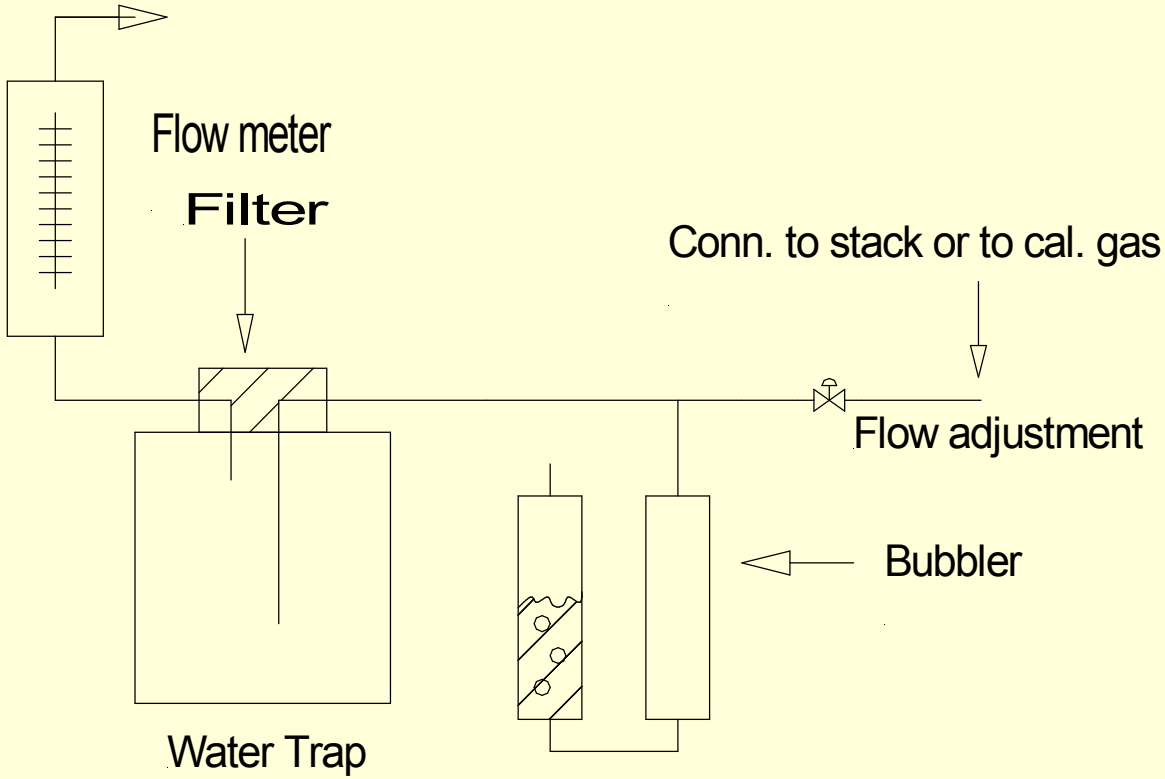


Diagram #1

EPA Reference Methods From 40 CFR 60

- Method 1 – Sample and velocity traverses for stationary sources.
- Method 1A – Sample and velocity traverses for stationary sources with small stacks.
- Method 2 – Determination of stack gas velocity and volumetric flow rate (type S pitot tube).
- Method 2A – Direct measurement of gas volume through pipes and small ducts.
- Method 2C – Determination of stack gas velocity and volumetric flow rate in small stacks or ducts. (standard pitot tube)
- Method 2D – Measurement of gas volumetric flow rate in small pipes and ducts.
- Method 3A – Determination of oxygen and carbon dioxide concentrations in emissions from stationary sources. (instrument analyzer procedure)
- Method 7E – Determination of nitrogen oxides emissions from stationary sources. (instrument analyzer procedure)

EPA Reference Methods From 40 CFR 60

- Method 10 – Determination of carbon monoxide emissions from stationary sources.
- Method 20 – Determination of nitrogen oxides, sulfur dioxide, and diluent emissions from stationary gas turbines.
- Method 21 – Determination of volatile organic compound leaks.
- Method 25 – Determination of total gaseous non methane organic emissions as carbon.
- Method 25A – Determination of total gaseous organic concentration using a flame ionization analyzer.

Data Input

Data input

Station:	XYZ	**Manfct:**	Dresser Rand	**Enter Field data in all cells that are blue**	
Engine #:	1	**Model:**	TLAD-8		
HP:	3010	**Rated Speed:**	300		**hrs:min:sec**
Run #:	1	**Date:**	9/11/2007	**Set time intervals**	0:05:00

Data Collected by:	Stobbe
2 or 4 Stroke	2
Bore (in)	17
Stroke (in)	19
# Cylinders	8
Exh Port Close BTDC	110
Rod Length (in)	34.375

Calibration Data	Cal.Bottle	Pre-test	Post-test	Pre-test zero	Post-test zero
O2 span (%)	15.00	14.98	15.08	0.00	0.00
NO span (ppm)	500.00	500.00	507.00	0.00	0.00
NO2 span (ppm)	45.00	45.00	49.00	0.00	0.00
CO span (ppm)	100.00	100.00	92.00	0.00	0.00

Engine Data

Date	Time	SAMPLE #	RPM	HP	Ign. Timing	AMT degF	AMP "Hg	FFR (mscfh)	FFR (scfm)
11-Sep-07	7:28:00	1	300	2956	7.5	110	27	22.38	373
11-Sep-07	7:33:00	2	299	2956	7.5	110	27	22.44	374
11-Sep-07	7:38:00	3	302	2956	7.5	110	27	22.44	374
11-Sep-07	7:43:00	4	300	2956	7.5	110	27	22.44	374
11-Sep-07	7:48:00	5	302	2956	7.5	110	27	22.44	374
11-Sep-07	7:53:00	6	301	2956	7.5	110	27	22.38	373

Analyzer

Date	Time	1 CO	2 NO	3 NO2	4 O2
11-Sep-07	7:28:00	239.00	93.00	29.00	15.42
11-Sep-07	7:33:00	236.00	90.00	28.00	15.53
11-Sep-07	7:38:00	235.00	94.00	30.00	15.38
11-Sep-07	7:43:00	234.00	93.00	30.00	15.42
11-Sep-07	7:48:00	234.00	93.00	29.00	15.46
11-Sep-07	7:53:00	233.00	92.00	28.00	15.51

Weather

Rel.Hum	Amb.Temp	Bar.Press
66.81	27.15	29.06
66.81	27.15	29.06
66.81	27.15	29.06
66.81	27.15	29.06
66.81	27.15	29.06
66.81	27.15	29.06

Data Report

Emission Summary for XYZ Engine # 1

Station:	XYZ	Manfct:	Dresser Rand
Engine #:	1	Model:	TLAD-8
HP:	3010	Rated Speed:	300
Data Collected by:	Stobbe	Date:	9/11/2007

Run #	1
Date	11-Sep-07
Time	7:53:00 AM
Ambient Conditions	
Rel Hum %	66.8
Ambient Air Temp	27.2
Barametric Pressure ("Hg)	29.06
Engine Operating Conditions	
RPM	300.7
% Load	98.0%
Ignition Timing	7.5
Air Man. Temp.	110.0
Air Man Pressure ("Hg)	27.00
Fuel Volume (MSCFH)	22.42
BTU Content HHV	1027.0
BTU Content LHV	934.6
Fuel Flow (MillionBTU/hr)	23.03
BHP	2956.0
Exhaust Gas Conditions (Corrected for drift)	
O2 %	15.42
CO2 %	3.11
CO ppmvd	245.0
NO ppmvd	91.9
NO2 ppmvd	27.8
NOx ppmvd	119.6
CO ppmvd @15%	263.9
NO ppmvd @15%	98.9
NO2 ppmvd @ 15%	29.9
NOX ppmvd @15%	128.8
Exhaust Emission	
BSFC	7088
NOx lbs/hr	10.99
CO lbs/hr	13.70
NOx gms/BHP-hr	1.69
CO gms/BHP-hr	2.10
Fo Factor	1.75
%H2O	6.0
FF (SCFM)	373.7
FF(lb/hr)	1013.3
A/F Ratio	53.6
A/F (ADJ)	58.7
Calc. Air Flow (WSCFM)	12501
Exh Flow (SCFM)	13292
Exh. Flow (lb/hr)	49782