Product Data – Reflection & Transmission Ultrasound Tortuosity Meter

PRODUCT OFFER

Standard TOR solution comes with TOR-X suite software, two air-coupled ultrasonic transducers (transmitter and receiver), a high voltage amplifier, a USB acquisition system and a reflection test bench. The solution also comes with one of the following (to be selected by the customer): our one-gas or two-gas transmission test bench.

In addition to air, the two-gas model uses helium to extend the measurements to additional parameters. It comes with gas supply system, pneumatic tube assembly and connector. Note that the helium line must be provided by the customer.

TOR can measure the following parameters:

	Reflection test bench	**One-gas transmission test bench**	**Two-gas transmission test bench**
Tortuosity	✓	✓	✓
Equivalent length (m)	✓	✓	✓
Viscous characteristic length (m)			✓
Thermal characteristic length (m)			✓
Parameter requirement	Open Porosity		
Mecanum associated software	Tor-X Reflection	Tor-X 1-Gas Transmission	Tor-X 2-Gas Transmission

Standard Frequency Range

The minimum and maximum limits of the frequency range and the frequency step can be manually set by the user to adjust the test to the response of the sample. A first measurement covering the entire frequency range is suggested to see which will provide the most linear results.

	All TOR test benches
Recommended first measurement frequency range (kHz)	100 to 900 (by step of 50)
Maximal frequency range(kHz)	60 to 1000
Max and min tortuosity	1 to *depends on materials*

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Hardware Specification

Sample Dimension

Sample Holder	
Diameter	100 mm
Maximum thickness	25.4 mm

Wide Band Ultrasound Transducers

Type	Unfocussed planar transducer with circular aperture
Aperture area	10 mm Ø
Ultrasonic bandwidth	40 kHz - 2.25 MHz (emitter), 40 kHz - 1.7 MHz (source)
Connection	Gold SMB

Q-Amp Transimpedance Preamplifier

Sensibility	905 mV/pC nominal
Ultrasonic bandwidth	10 kHz – 5 MHz
Input connection type	Gold SMB
Output connection type	BNC
Input power	12 VAC, 1 A
Dimensions	110 x 30 x 60 mm

V-Pole High-Voltage Polarization Supply

Polarization voltage	2 position (high and low)
Ultrasonic bandwidth	10 kHz – 5 MHz
Input connection type	BNC
Output connection type	BNC
Input power	12 VAC, 1A
Dimensions	110 x 30 x 60 mm

Data Acquisition System

Acquisition card Brand	National Instrument
Model	VirtualBench 8012
Bandwidth	100 MHz
Channels	2 analog inputs, BNC
Sample rate	1 GS/s (single channel) or 500 MS/s/channel
Max frequency generator	20 MHz (sine)
General connectivity	USB 2.0 Type A
Dimensions	305 x 203 x 94 mm

High Frequency High-Voltage Power Amplifier

Brand	Trek
Model	2100HF
Output voltage range	0 to ±150 VDC
Output current range	0 to ±300 mA
Input voltage range	0 to ±3 VDC
Input impedance	50 Ω
DC voltage gain	50 V
Bandwidth	DC to greater than 2.6 MHz
HV connection	BNC
Input power	90 to 127 VAC or 180 to 250 VAC at 48 to 63 Hz
Dimensions	141 x 213 x 336 mm

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REFLECTION SOFTWARE DESCRIPTION

TOR-X Reflection software fully controls the measurement procedure and takes atmospheric conditions into account. With TOR-X Reflection, you'll be able to quickly take accurate measurements in a user-friendly, guided interface designed to make your measurements easy and accurate with just a few steps.

TOR-X Reflection software fully controls the measurement procedure and considers atmospheric conditions. With TOR-X Reflection you will be able to make accurate measurement quickly in a user-friendly and guided interface that is design with the objective to make you measurement easy and sharp just by following some few steps.

Measured Parameters

(1) Tortuosity

Required Parameters

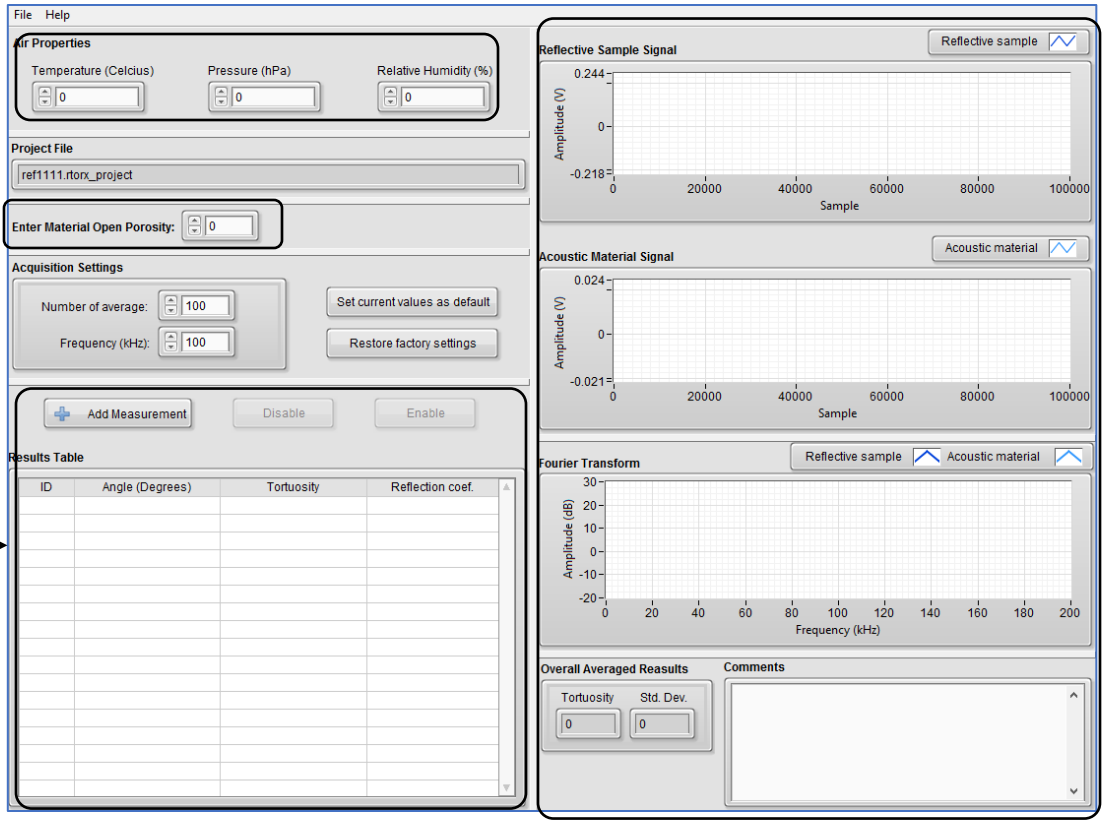
(1) open porosity

Measurement steps

STEP 1 : Enter the environmental conditions

STEP 2 : Enter the open porosity of the tested material.

STEP 3 : Add, edit, or name as many measurements as required.



STEP 4 : Visualize and compare your results. Export your graphics.

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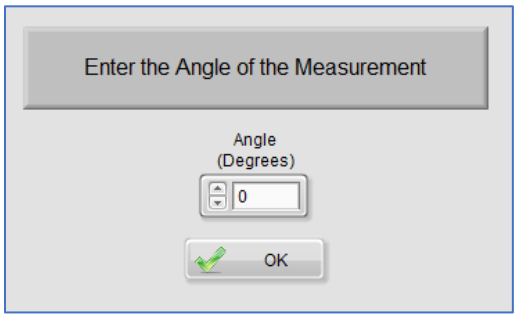
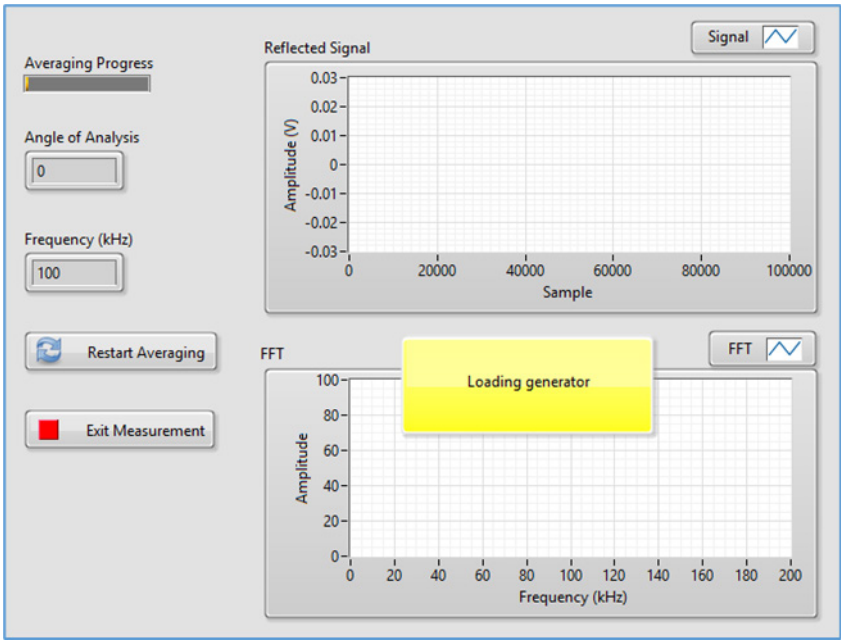
Advanced measurement interface

TOR-X Reflection is user-friendly software, but it is also extremely powerful. The user will first have to enter the measurement angle. After that, TOR-X Reflection will ask the user to follow a series of steps to complete the measurement. For each measurement, a test with the reflective sample (i.e. the reference value of a perfect reflection) and with the sample will be performed.





Additional features

- **<u>Acoustic penetration depth tool</u>**
  Based on the static air flow resistivity of the material, the software calculates the thickness of the material required to attenuate the amplitude of the acoustic wave by 26 dB.

Tor-X specifications

Compatibilities	Windows 8 and 10 32 or 64 bits
Result file type	.txt
Export graph file type	.txt

ONE-GAS TRANSMISSION SOFTWARE DESCRIPTION

TOR-X One-gas transmission software fully controls the measurement procedure from calibration to measurement itself and takes into account the correction of atmospheric conditions and the selected fluid environment. With the TOR-X One-gas transmission, you'll be able to quickly take accurate measurements in a user-friendly guided interface designed to make measurement easy and accurate for you just by following a few steps.

Measured Parameters

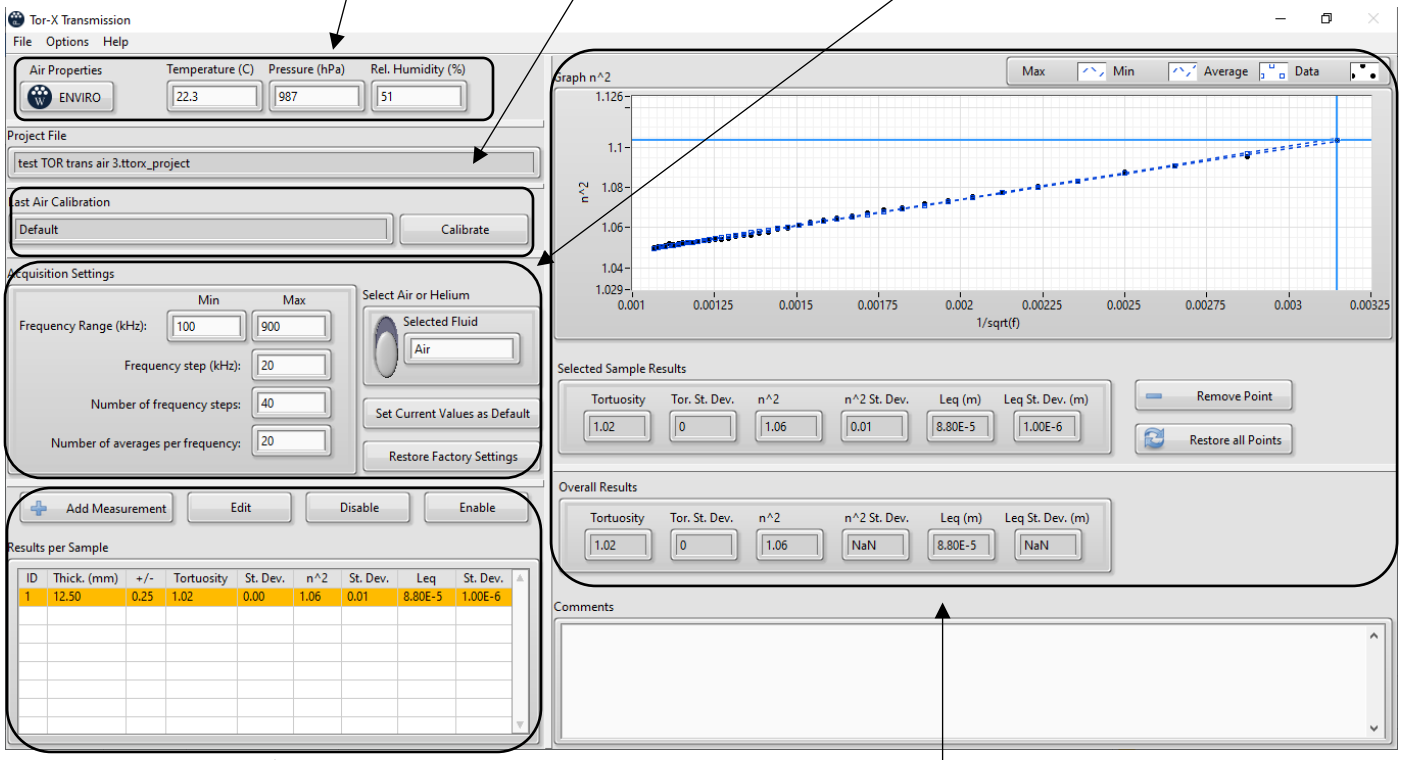
(1) Tortuosity, (2) Equivalent length.

Measurement steps

STEP 1 : Enter the environmental conditions (automatic if you use optional Mecanum ENVIRO weather station (sold separately).

STEP 2 : Proceed to the calibration.

STEP 3 : Set measurement parameters and choose the fluid environment



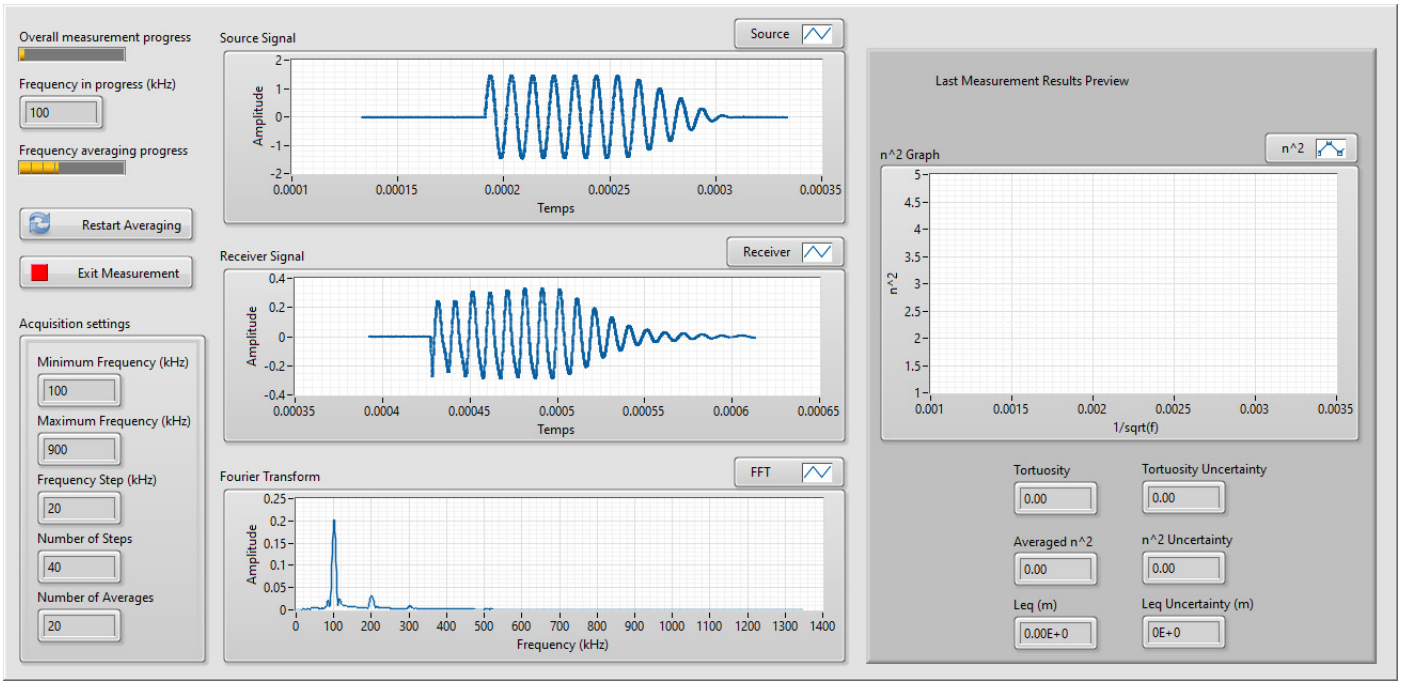
STEP 4 : Add, edit, or name as many measurements as required.

STEP 5 : Visualize and compare your results. Export your graphics.

Product Data – Reflection & Transmission Ultrasound Tortuosity Meter

Advanced measurement interface

TOR-X One-gas transmission is a user-friendly software, but it is also extremely powerful. It will ask the user to follow a series of steps to complete the measurement. For each measurement, a test with and without the sample will be performed.



Additional features

- **<u>Acoustic penetration depth tool</u>** Based on the static air flow resistivity of the material, the software calculates the thickness of the material required to attenuate the amplitude of the acoustic wave by 26 dB.

Tor-X specifications

Compatibilities	Windows 8 and 10 32 or 64 bits
Result file type	.txt
Export graph fils type	.txt

TWO-GAS TRANSMISSION COMBINER SOFTWARE DESCRIPTION

TOR-X Two-gas transmission combiner software is a utility software designed to combine transmission tortuosity meter results from the same material in two different gases to recover viscous and thermal characteristic lengths.

Measured Parameters

(1) Tortuosity, (2) Equivalent length, (3) Viscous characteristic length, (4) Thermal characteristic length.

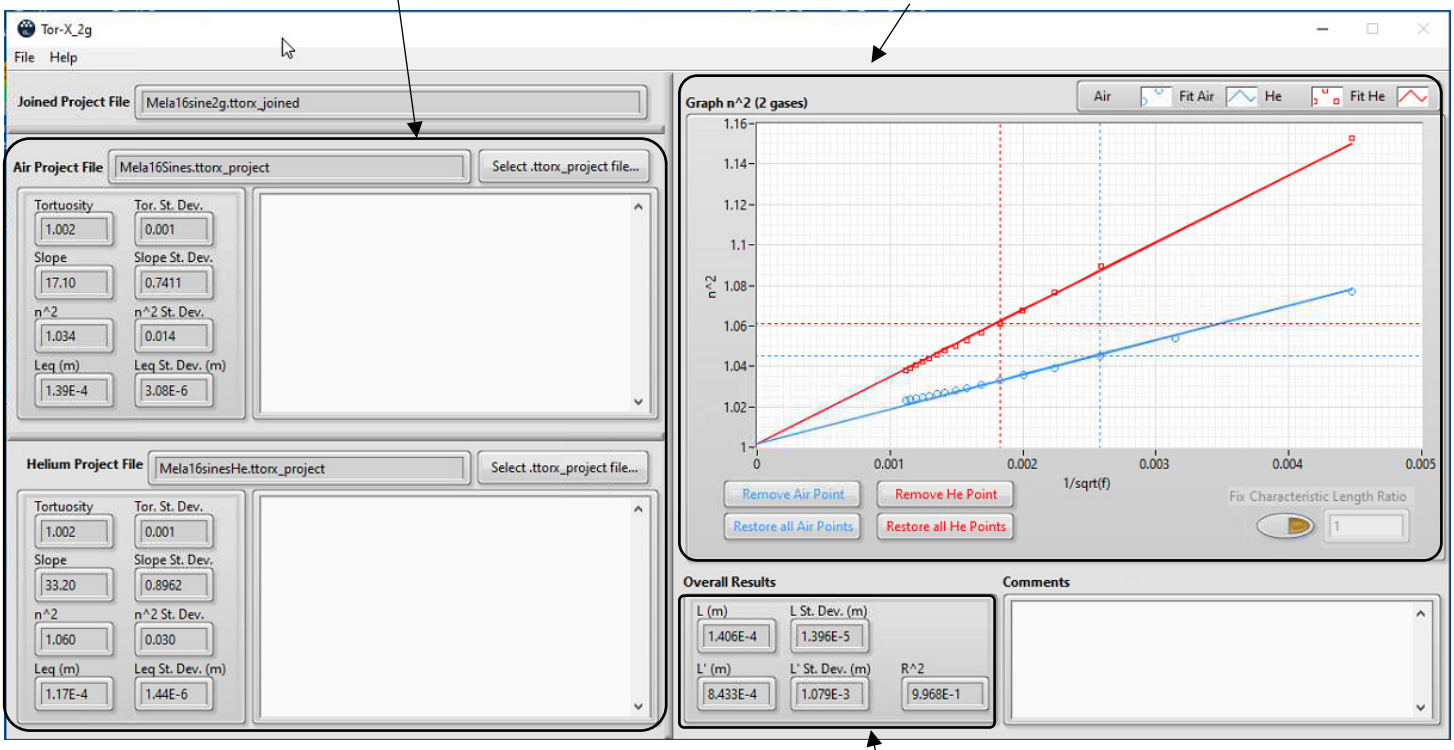
Requirement

Two transmission measurements in different fluids (air and helium) of the same material in an instrumented gas-tight enclosure.

Measurement steps

STEP 1 : Select and load the two measurements files performed in different gases

STEP 2 : Display the results



STEP 3 : Visualize final results.

RELATED ACCESSORIES AND OPTIONS

Enviro - Environmental weather station that communicate with Mecanum software

Software compatibilities	Windows 8 and 10 32 or 64 bits
Connection	USB 2.0 Type A
Measured parameters	Temperature (Celsius) Humidity (%) Pressure (Pa)

Circular cutter

Available diameters (mm)*	29, 44.44, 100
Maximum sample thickness (mm)	75 mm
Material	Stainless steel

*Custom diameter available on demand.

Sample slicer

Available diameters (mm)*	29, 44.44, 100
Maximum sample thickness (mm)	100 mm
Also include	Acoustic material knife

*Custom diameter available on demand.

Foam-X software

Based on the sound absorption coefficient measured in impedance tube (ASTM E1050, ISO 10534-2), Foam-X computes all the acoustic parameters (e.g. equivalent fluid or poroelastic Biot) you need to model a single or an equivalent acoustic material.

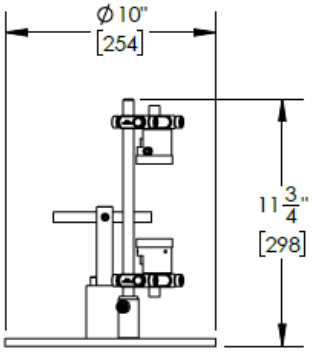
Nova software

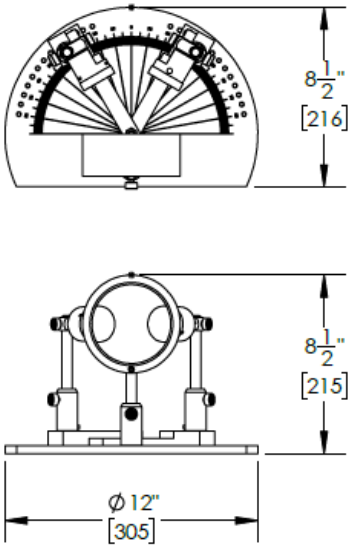
Nova predicts sound absorption and transmission loss (and more) of single or multilayer materials. Simulation is based on the acoustic parameters you determined with Foam–X or direct characterisation apparatuses such as a airflow resistance meter (SIGMA), a porosity meter (PHI), a tortuosity meter (TOR), and a mechanical analyzer (QMA) or using directly the measured transfer matrix obtain using our transmission tube.

ANNEX 1 – REFLECTION AND ONE-GAS TRANSMISSION TORTUOSITY METER

One-Gas Transmission Test Bench

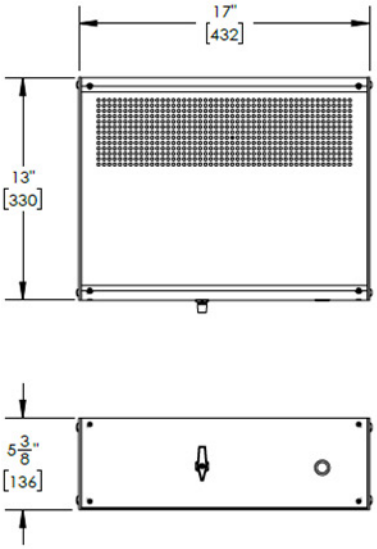
Reflection Test Bench



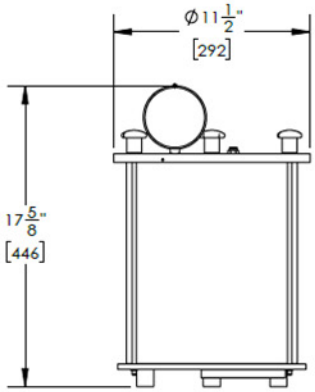


ANNEX 2 – REFLECTION AND TWO-GAS TRANSMISSION TORTUOSITY METER

Gas Feed Unit



Two-Gas Transmission Test Bench



Reflection Test Bench