

## Model 408 NO Calibration Source™

Calibrate any NO Monitor



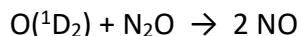
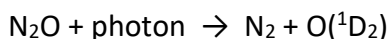
The Model 408 Nitric Oxide Calibration Source is a portable source of nitric oxide (NO) that allows one to calibrate any nitric oxide monitor. The instrument scrubs NO from ambient air and produces either zero air or air having a mixing ratio of NO in the range 20-1,000 parts-per-billion by volume (ppbv). The desired NO concentration is chosen from the easy-to-use menu using a rotary select switch. The instrument can be programmed to output up to 10 individual NO step concentrations over a chosen time interval. The total output volumetric flow rate is 3.0 L/min, and the NO mixing ratio is controlled so as to be independent of ambient temperature, pressure and humidity.

You can attach the NO Calibration Source output directly to the inlet of any nitric oxide monitor (providing that its sampling rate is less than 3.0 L/min), with the excess flow vented through an external overflow tee. Besides portability, an important advantage of the Model NO Calibration Source is that it provides a known concentration of NO in ambient air containing the same level of humidity as the air sample to be measured. Important to the calibration of NO<sub>x</sub> analyzers, the NO Calibration Source provides a known concentration of NO in absence of any significant concentration of NO<sub>2</sub>.

The NO Calibration Source is factory calibrated against a NIST-traceable standard. However, the calibration parameters may be changed in the menu in case the user wants to recalibrate the NO Calibration Source against a separately maintained standard; i.e., the NO Calibration Source can be used as a transfer standard. The NO Calibration Source may be used, for example, for maintaining the calibration of a large number of NO monitors in the field relative to a highly stable laboratory standard. In this case, a huge advantage of the NO Calibration Source is its portability.

## Theory of Operation

The Nitric Oxide Calibration Source makes use of a low pressure mercury lamp to photolyze nitrous oxide ( $\text{N}_2\text{O}$ ) and produce NO in a patent-pending process. The vacuum UV emission lines of mercury near 185 nm are absorbed by  $\text{N}_2\text{O}$  to produce electronically excited oxygen atoms,  $\text{O}(^1\text{D}_2)$ . A large fraction of these highly energetic oxygen atoms react with  $\text{N}_2\text{O}$  to form NO:



Other reactions produce a small amount of molecular nitrogen and oxygen as well. The concentration of NO produced in a flowing stream of air depends on the intensity of the photolysis lamp, the concentration of  $\text{N}_2\text{O}$  (determined by pressure and temperature), and the residence time in the photolysis cell (determined by volumetric flow rate and cell volume). By holding these parameters constant, it is possible to produce a flow of air containing a constant concentration of NO, and the concentration of NO produced can be varied most conveniently by varying the lamp intensity. Figure 1 is a schematic diagram of the NO Calibration Source.

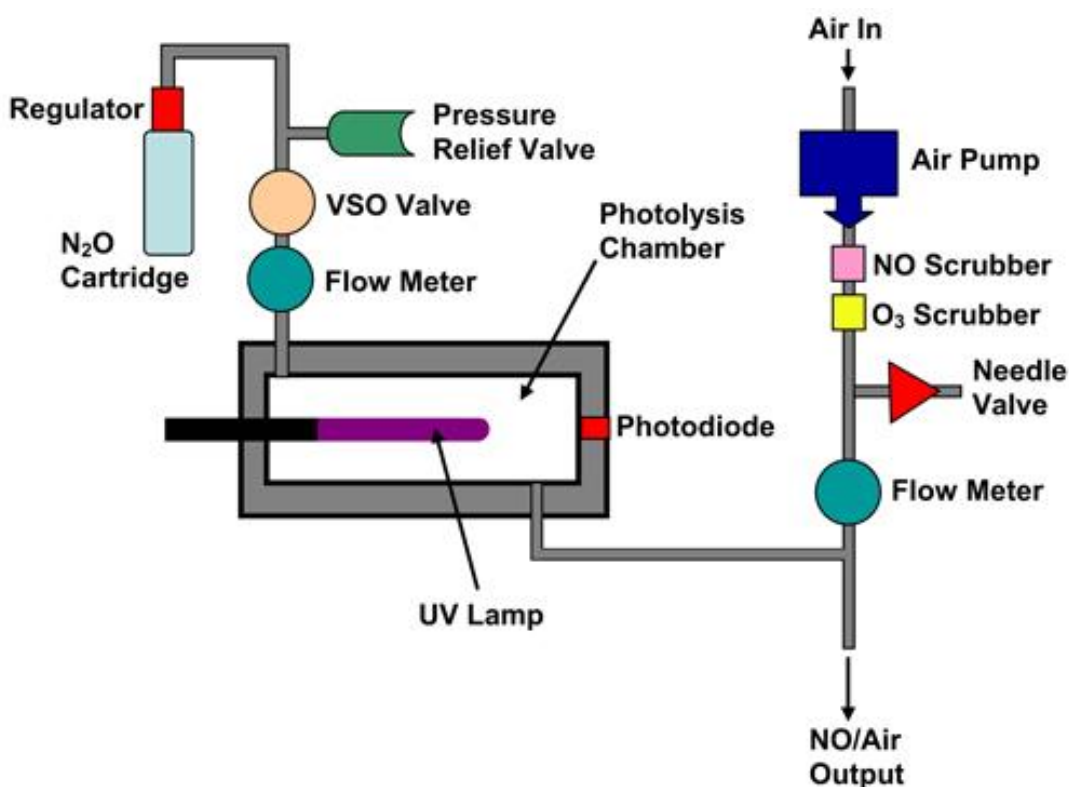


Figure 1. Schematic diagram of the NO Calibration Source.

An air pump forces ambient air through NO and ozone scrubbers to remove any ambient NO and ozone. The air flow rate is controlled by use of restrictors (not shown) and a needle valve that vents part of the flow and is measured by a flow meter. The needle valve is adjusted to produce a total output volumetric flow rate of ~3.0 L/min, as measured by the flow meter. Nitrous oxide is supplied by a cartridge containing liquid N<sub>2</sub>O with a headspace pressure of ~50 atmospheres. Either 8-g or 16-g N<sub>2</sub>O cartridges may be used, providing either 1 hours or 2 hours of continuous operation, respectively. The internal pressure is dropped by a combined cracker/regulator and additional flow restrictor, which also is used to provide coarse adjustment of the flow rate of N<sub>2</sub>O to be in the range 60 ± 10 cc/min. A pressure relief valve inside the instrument housing prevents over pressurization by opening to the atmosphere if the pressure exceeds 25 psig. A Voltage Sensitive Orifice (VSO) valve is used to provide fine control of the N<sub>2</sub>O flow rate to ~60 ± 1 cc/min. Within the photolysis chamber, a very small fraction of the N<sub>2</sub>O is converted to NO and N<sub>2</sub> by absorption of light at wavelengths near 185 nm. Measurements of the output of the photolysis chamber show that no significant concentration of NO<sub>2</sub> is produced. The lamp intensity at 254 nm is monitored by a photodiode and controlled by the microprocessor. The photodiode voltage is calibrated against the output NO concentration. Pressure within the gas stream is measured but not controlled. Instead, the lamp intensity is varied to compensate for changes in pressure and total flow rate using a proprietary algorithm. Air containing nitric oxide at a selected concentration in the range 20-1,000 parts-per-billion by volume exits the instrument.

## Specifications

<b>Method for Producing NO</b>	Photolysis of N <sub>2</sub> O at 185 nm
<b>Output Concentration of NO</b>	0 and 20-1,000 ppbv
<b>Programmable</b>	Yes; up to 10 steps over chosen time interval
<b>Precision and Accuracy of NO Output</b>	Greater of 3 ppbv or 3% of reading
<b>Total Output Flow Rate</b>	3.0 Liter/min
<b>Rise Time</b>	< 30 s to reach 95% of selected concentration
<b>Diagnostic Data Output</b>	RS232
<b>Baud Rate</b>	19200
<b>Operating Temperature Range</b>	10 to 40°C
<b>Power Requirements</b>	12 V dc or 120/240 V ac, 21 watt
<b>Size</b>	3.7 × 8.5 × 9.5 in (9.4 × 21.6 × 24.1 cm)
<b>Weight</b>	5.2 lb (2.4 kg)

## **Features**

- Lightweight, compact, and highly portable source of nitric oxide (NO)
- Generate 0 ppbv NO (zero air) or 20-1000 ppbv of NO in your air stream
- Calibrate any NO monitor in the field or lab
- Patent-pending process uses photolysis of N<sub>2</sub>O to produce NO
- NO is free of any significant concentration of NO<sub>2</sub>
- Uses ambient air, producing NO containing same humidity as air sample to be measured
- Portable N<sub>2</sub>O Source eliminates need for compressed-gas cylinders
- Programmable for up to 10 concentration steps
- Can be used as a transfer standard
- Low power consumption

## **System Includes**

- Model 408 Nitric Oxide Calibration Source
- AC Power Adapter (100-240 VAC to 12 VDC) with Country-Specific Plug
- Portable N<sub>2</sub>O Source (for use with either 8-g or 16-g N<sub>2</sub>O cartridges)
- Mounting Bracket and Extra O-Rings for Portable N<sub>2</sub>O Source
- Connecting Tube with Overflow Tee
- Serial Cable (9PinF-9PinF)
- Operation Manual on USB Stick
- Calibration Data and NIST-Traceable Calibration Certificate
- Instrument Birth Certificate
- One-Year Warranty