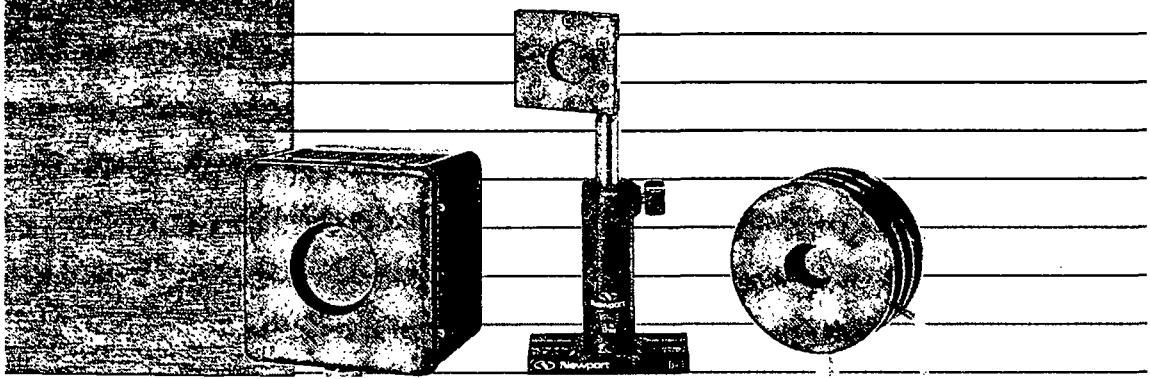
818T Series

High-Power Detectors



Warranty

Newport Corporation warrants this product to be free from defects in material and workmanship for a period of 1 year from the date of shipment. If found to be defective during the warranty period, the product will either be repaired or replaced at Newport's option.

To exercise this warranty, write or call your local Newport representative, or contact Newport headquarters in Irvine, California. You will be given prompt assistance and return instructions. Send the instrument, transportation prepaid, to the indicated service facility. Repairs will be made and the instrument returned, transportation prepaid. Repaired products are warranted for the balance of the original warranty period, or at least 90 days.

Limitation of Warranty

This warranty does not apply to defects resulting from modification or misuse of any product or part. This warranty also does not apply to fuses, batteries, or damage from battery leakage.

This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability or fitness for a particular use. Newport Corporation shall not be liable for any indirect, special, or consequential damages.

Statement of Calibration

These detectors have been inspected and tested in accordance with specifications published by Newport Corporation. The accuracy and calibration of these detectors is traceable to the National Institute for Standards and Technology.

Irvine, CA
P/N 19570-01, Rev. F1
IN-04921 (01-99)

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Safety Symbols and Terms

The following safety terms are used in this manual:

The **CAUTION** heading in this manual explains hazards that could damage the instrument.

The **WARNING** heading explains dangers that could result in personal injury or death.

In addition, a **NOTE** heading gives information to the user that may be beneficial in the use of this instrument.

General Warnings and Cautions

The following general warnings and cautions are applicable to this instrument:

CAUTION

There are no user serviceable parts inside any High-Power Detector. Work performed by persons not authorized by Newport may void the warranty. For instructions on obtaining warranty repair or service please refer to Section 3 of this manual.

Specifications

Model	818T-02	818T-10	818T-30	818T-150	818T-150X	818T-300	818T-300F
Spectral Range	0.25 to 11 µm	0.25 to 11 µm	0.25 to 11 µm	0.25 to 11 µm	0.19 to 0.35 µm	0.25 to 0.11 µm	0.25 to 0.11 µm
Maximum Power, Continuous	2 W	10 W	30 W	150 W	150 W	300 W	300 W
Maximum Power, Intermittent[1]	3 W	20 W	60 W	300 W	300 W	450 W	600 W
Maximum Average Power Density	26 kW/cm²	26 kW/cm²	26 kW/cm²	26 kW/cm²	26 kW/cm²	26 kW/cm²	20 kW/cm²
Minimum Detectable Power	1 mW	1 mW	10 mW	10 mW	10 mW	100 mW	30 mW
Maximum Pulse Energy Density[2]	0.6 J/cm²	0.5 J/cm²	0.5 J/cm²	0.5 J/cm²	0.5 J/cm²	0.5 J/cm²	0.6 J/cm²
Response Time, 1/e	1 sec	1 sec	1 sec	1 sec	4 sec	1 sec	2 sec
Linearity with Power	±1%	±1%	±1%	±1%	±1%	±2%	±2%
Power Measurement Accuracy[3]	±3%	±3%	±3%	±3%	±5%	±5%	±3%
Uniformity over central 50%[4]	±2%	±2%	±2%	±2%	±2%	±2%	±2%
Uniformity of entire active area	±2%	±2%	±2%	±2%	±2%	±2%	±2%
Active Area	2.84 cm²	2.84 cm²	2.84 cm²	2.84 cm²	19.6 cm²	2.84 cm²	2.84 cm²
Active Diameter	19 mm	19 mm	19 mm	19 mm	50 mm	19 mm	19 mm
Responsivity (approximate)	0.4 mV/W	1.0 mV/W	0.4 mV/W	0.4 mV/W	0.4 mV/W	0.4 mV/W	0.4 mV/W
Dimensions	Rectangular, 5.1 x 4.6 cm	Cylindrical, 6 x 3 cm	Cylindrical, 10 x 8 cm	Cylindrical, 15 x 13 cm	Cylindrical, 15 x 13 cm	Rectangular, 15 x 13 cm	Rectangular 15 x 13 cm
Cooling	Air	Air	Air	Air	Air	Water	Air

[1] Intermittent power assumes low duty cycle use not to exceed 5 minutes.
[2] Pulse energy density determined using a 50-ns pulse.
[3] NIST-traceable calibration assumes 5-mm beam centered on thermal disc.
[4] Assumes a 5 mm diameter beam.

Dimensions

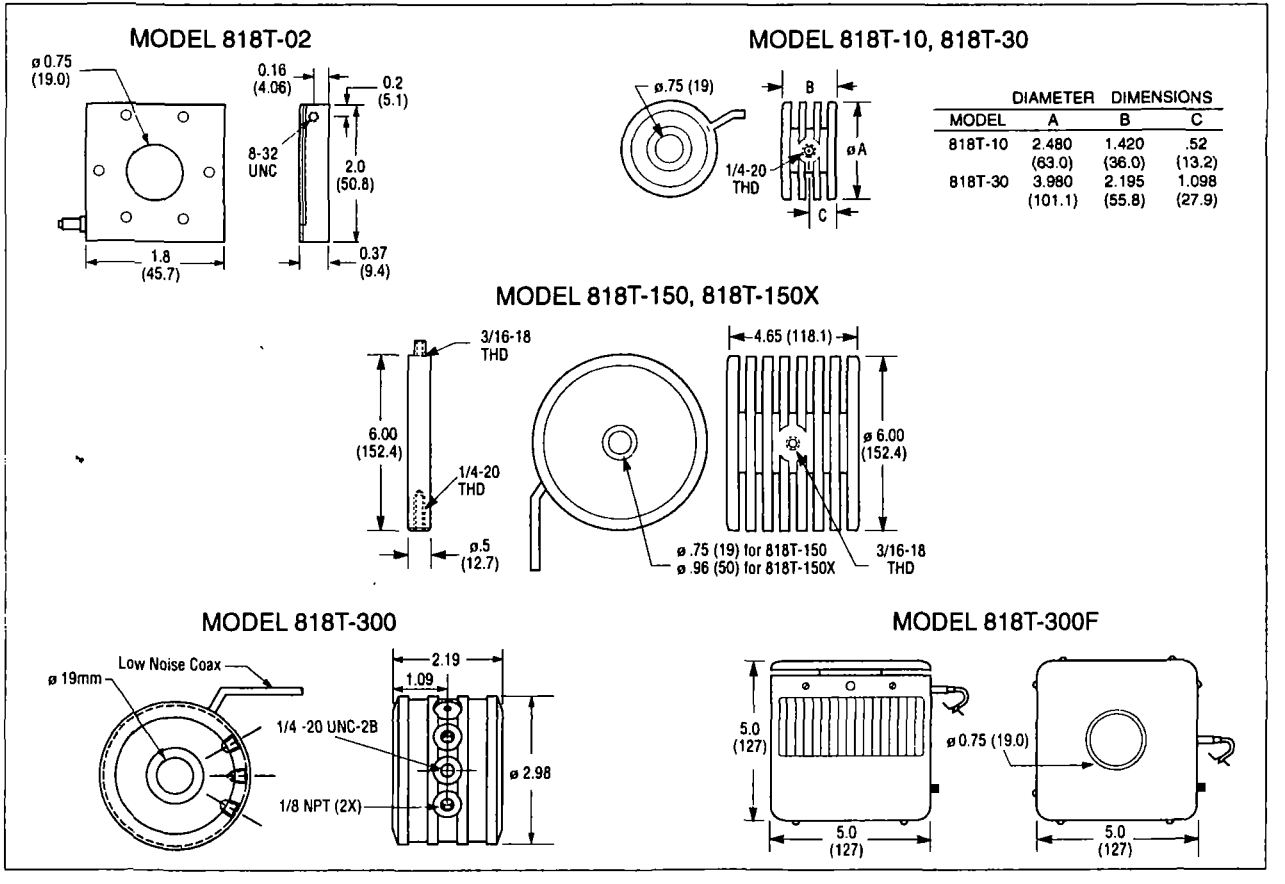


Figure 1.1 – High-Power Detector Dimensions

Section 1 General Information

1.1 Detector Overview

Newport's High-Power Detectors, when used with a compatible Newport Optical Meter, provide accurate power measurements of all types of CW and pulsed sources from the UV to far IR. These detectors can also be used to measure the energy in a pulse when used with certain Newport Optical Meters featured in Newport's Photonics Catalog.

A proprietary high damage threshold surface capable of sustaining 10 times higher power densities than typical "black" thermopiles extends the useful operating range of these detectors. The Model 818T-150X has a large active area "black" absorbing surface that is optimized for excimer laser power measurements. Excepting the 818T-300F, these NIST traceable calibrated disk thermopile detectors are passive air cooled devices and contain no electronic amplification. The 818T-300F features a low-noise, low-vibration fan inside the detector housing, enabling high-power measurements without water cooling. Please refer to the specification section of this manual for detailed information regarding the operating limits of these detectors.

1.2 Scope of this Manual

Please carefully read this instruction manual before using these detectors. Be especially careful to observe the warnings and cautions throughout this manual (see Section 2.3). If any operating instructions are not clear, contact Newport Corporation.

This instruction manual contains the necessary information for operation and maintenance of the Newport High-Power Detectors as well as information for obtaining service if necessary. This information is divided into the following sections:

- Section 1 provides general information about this manual and the detector.
- Section 2 explains the operation of the detectors.
- Section 3 provides instructions for obtaining factory service.

1.3 Unpacking and Inspection

All Newport detectors are carefully assembled, tested, and inspected before shipment. Upon receipt, check for any obvious signs of physical damage that might have occurred during shipment. Report any such damage to the shipping agent immediately. Retain the original packing materials in case reshipment becomes necessary.

The High-Power Detector series come with the following components:

818T-02, 818T-10, and 818T-30

1. Detector head
2. English to Metric thread adaptor
3. Delrin Mounting Post
4. Detector Instruction Manual

818T-150, 818T-150X, 818T-300, and 818T-300F

1. Detector head
2. English to Metric thread adaptor
3. Two 1/8 NPT Fittings (818T-300 only)
4. AC Power Wall Adapter (818T-300F only)
5. Detector Instruction Manual

Section 2 Detector Operation

2.1 Introduction

The High-Power thermopile detectors are primarily designed to measure CW optical power, by observing the thermal effects of incident optical energy on the detector surface. These detectors can also measure the energy in a pulse by time-integrating the power incident on the detector surface.

2.2 Power Signal Behavior

High-Power Detectors respond to a step function of optical power by producing a voltage response as shown in Figure 2.1. The exponential nature of this response also allows one to electronically accelerate the voltage to its final value ahead of the actual detector signal. This is how Newport optical meters deliver readout response risetimes of < 0.1 sec from detectors with natural response time constants of 1 second or more.

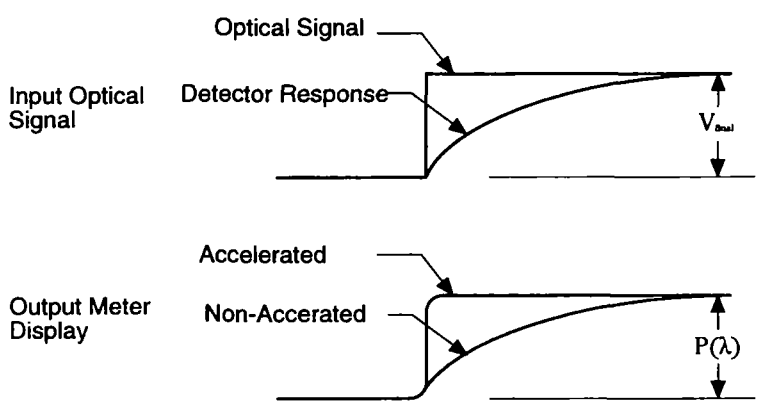


Figure 2.1 – Detector Response to a Step Function

The final value of the voltage response, V_{final}, allows one to calculate the observed optical power, $P(\lambda)$, of the step function. If the responsivity of the detector at the wavelength in use is $R(\lambda)$ then the optical power can be calculated as follows:

$$P(\lambda) = \frac{V_{final}}{R(\lambda)}$$

2.3 Pulse Energy Signal Behavior

One can measure energy with a High-Power Detector by integrating the pulse response of the detector since energy is the time integral of a power signal:

$$E(\lambda) = \int_{t_0}^{t_1} P(\lambda,t)dt = \int_{t_0}^{t_1} \frac{V(t)}{R(\lambda)} dt$$

When doing such an integration, one should measure the effect of single pulses. At higher pulse repetition rates, pulse energy can be measured by observing the average power and dividing by the pulse repetition rate. When a High-Power Detector is subject to a long pulse, the detector response and integrated result behaves as shown in Figure 2.2 below.

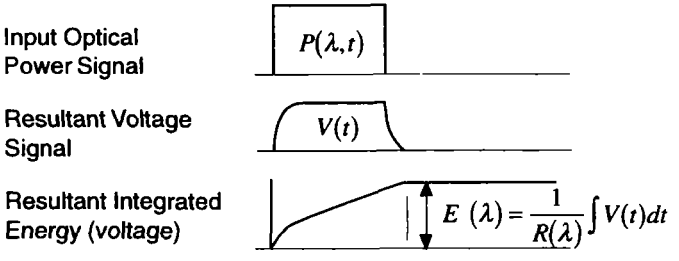


Figure 2.2 – Integrated Energy Behavior of a High-Power Detector

Due to the calorimeter nature of a thermopile detector, the ability to measure energy through the integration of detector signals still holds for short pulses. When a pulse of energy $E(\lambda)$ is incident on its surface, the detector responds with a voltage signal reflecting the thermal effects of the much slower heat pulse that the energy pulse

generates, see Figure 2.3 below. Heat will continue to flow (and be recorded and integrated) until heat energy of the pulse has flowed out of the sensor to the heat sink (thermal reservoir).

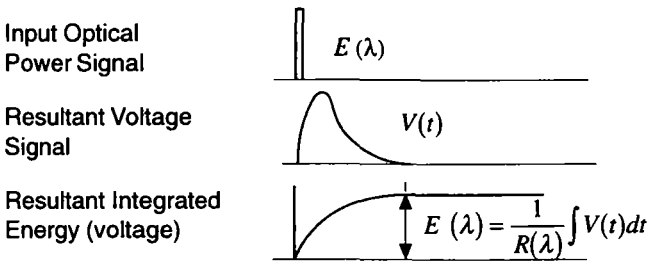


Figure 2.3 – Energy Pulse Behavior of a High-Power Detector

NOTE

The integration method of pulse measurement does limit the frequency of the incoming energy pulses to much lower repetition rates than true pulse energy detectors allow.

NOTE

If one operates the Newport optical meter being used with the detector in an accelerated mode, then faster pulse repetition rates can be observed. Not all Newport meters offer this feature.

2.4 Damage Thresholds

The surface of Newport's High-Power Detectors is a proprietary diffuse reflectance ceramic that can withstand 10 times greater power densities than typical "black" thermal detectors. Even so, before using a High-Power thermopile detector, it is important to check that the expected incident optical power or energy density does not exceed the safe operating limits of the detector. Table 2.1 on page 6 tabulates the maximum allowable safe operating limits.

Detector Model	Maximum Continuous Power	Maximum Intermittent Power	Maximum Average Power Density	Maximum Pulse Energy Density[†]
818T-02	2 W	3 W	26 kW/cm²	0.6 J/cm²
818T-10	10 W	20 W	26 kW/cm²	0.5 J/cm²
818T-30	30 W	60 W	26 kW/cm²	0.5 J/cm²
818T-150	150 W	300 W	26 kW/cm²	0.5 J/cm²
818T-150X	150 W	300 W	26 kW/cm²	0.5 J/cm²
818T-300	300 W	450 W	26 kW/cm²	0.5 J/cm²
818T-300F	300 W	600 W	20 kW/cm²	0.6 J/cm²

[†]This value is a practical upper limit that provides months of service life. Infinite service life is obtained by operating at an energy density level not to exceed 0.3 J/cm².

Table 2.1 – High-Power Detector Operating Limits

In all cases, it is recommended that you not focus your source onto the detector. We recommend instead that you expand the beam to take advantage of the large surface area. If you still expect to encounter power or energy densities above the damage threshold of the detector, we recommend that you use an attenuator.

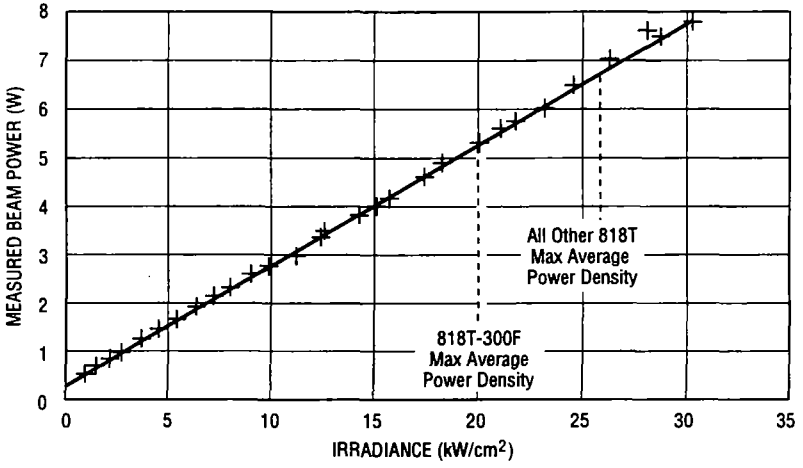
CAUTION

The energy density at the center of a gaussian laser beam is approximately three times higher than the energy density over the two-sigma, 1/e, width.

The symptoms of detector damage are easy to observe with visual inspection. As power densities extend beyond the safe operating threshold, some discoloration will occur. At higher power densities, surface melting occurs. Long service life is still provided at operating levels that are above but still close to the damage threshold.

2.5 Measurement Linearity

The Newport High-Power Detectors exhibit excellent measurement linearity even beyond damage thresholds, see Figure 2.4.



Effective Beam Area: 2.69 x 10^{-4} cm^2; Effective Beam Diameter: 0.185 mm

Figure 2.4 – Detector Linearity and Damage Threshold

2.6 Specular Reflections

Specular reflections from Newport's High-Power Detectors are strongly attenuated by their diffuse reflectance front surfaces. The Newport High-Power Detectors have an 11% diffuse reflectance. It is important to make sure that any reflected beam is directed into an appropriate beam dump.

WARNING

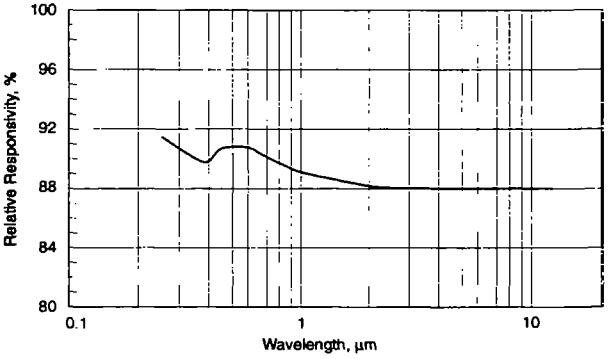
Never look directly into a laser beam or its diffuse or specular reflection, retinal damage and blindness can result. Never allow any part of the body to intercept the laser beam or reflection. Always be sure to take proper safety precautions and wear laser safety goggles appropriate to the laser you are working with.

2.7 Spectral Response

The typical response curve for the 818T-02, 818T-10, 818T-30, 818T-150, 818T-300 and 818T-300F detectors is shown in Figure 2.5. This curve reflects relative responsivity as a function of wavelength rather than the absolute responsivity. To calculate the absolute responsivity, $R(\lambda)$, at a wavelength different than the calibration wavelength, use the following formula:

$$R(\lambda_{new}) = R(\lambda_{Cal}) \frac{\text{Relative Response at } \lambda_{new}}{\text{Relative Response at } \lambda_{Cal}}$$

Where: $R(\lambda_{Cal})$ = Responsivity at the calibration wavelength



Lambda (µm)	Response (%)	Lambda (µm)	Response (%)	Lambda (µm)	Response (%)	Lambda (µm)	Response (%)
0.25	91.4	0.75	90.1	1.30	88.7	1.90	88.1
0.30	92.6	0.80	89.9	1.35	88.7	1.95	88.1
0.35	90.8	0.85	89.6	1.40	88.6	2.00	88.0
0.38	89.8	0.90	89.4	1.45	88.6	3.00	88.0
0.40	90.0	0.95	89.2	1.50	88.5	4.00	88.0
0.45	90.6	0.97	89.1	1.55	88.5	5.00	88.0
0.50	90.6	1.00	89.1	1.60	88.4	6.00	88.0
0.55	90.6	1.05	89.0	1.65	88.4	7.00	88.0
0.60	90.6	1.10	89.0	1.70	88.3	8.00	88.0
0.63	90.6	1.15	88.9	1.75	88.3	9.00	88.0
0.65	90.5	1.20	88.9	1.80	88.2	10.00	88.0
0.70	90.3	1.25	88.8	1.85	88.2	11.00	88.0

Figure 2.5 – Relative Spectral Responsivity
(applies to 818T-02, 818T-10, 818T-30, 818T-150, 818T-300, and 818T-300F)

2.8 Care for High-Power Detectors

The best way to remove dust or other foreign material from a High-Power Detector is to blow the surface off using compressed dry air or CO_2. When necessary, the detector may be cleaned gently by washing the detector surface off using alcohol and a foam wipe. If your wipe leaves a residue, blow the surface clean of particulate using dry air or CO_2. The front surface of Newport's High-Power Detectors is very abrasive and will cause common wipes or cotton swabs to leave particulate residues.

The black anodized aluminum surfaces of the detector may be wiped clean using any common wipe with alcohol or acetone.

2.9 Detector Recalibration

Newport Corporation recommends that you have your detector recalibrated annually. Newport certifies that the calibration is performed using standards that are traceable to the National Institute of Standards and Technology (NIST), other recognized national standards laboratories, using natural physical constants, or ratio calibration techniques. The calibration complies with ANSI/NCSLZ540-1-1994 as well as ISO-9002. Please refer to the Detector Calibration Services Section of the Newport Photonics Catalog for more details and ordering information.

Section 3 Factory Service

3.1 Introduction

This section contains information regarding obtaining factory service for the Newport High-Power Detectors. The user should not attempt any maintenance or service of this detector.

All Newport High-Power Detectors contain no user serviceable parts. Each detector's calibration accuracy is warranted for a period of 1 year. After 1 year, the detector should be returned to Newport Corporation for recalibration. For recalibration ordering information, refer to the Detector Calibration Services Section of Newport's Photonics Catalog. Contact Newport Corporation or your Newport representative for assistance.

3.2 Obtaining Service

To obtain information concerning factory service, contact Newport Corporation or your Newport representative. Please have the following information available:

1. Detector model number. (Found on label.)
2. Detector serial number. (Found on label.)
3. Description of the problem.

If the instrument is to be returned to Newport Corporation, you will be given a Return Number (RMA number), which you should reference in your shipping documents.

Please fill out the service form, located on page 13, and have the information ready when contacting Newport Corporation. Return the completed service form with the instrument.

Service Form

Newport Corporation
U.S.A. Office: 714/863-3144
FAX: 714/253-1800

Name _____ **Return Authorization #** _____

Company _____ (Please obtain prior to return of item)

Address _____

Country _____ Date _____

P.O. Number _____ Phone Number _____

Item(s) Being Returned:

Model # _____ Serial # _____

Description: _____

Reason for return of goods (please list any specific problems)

_____

_____

_____

Please Describe the Problem:

_____

_____

_____

_____

_____ (Attach additional sheets as necessary)

Where is the Equipment Installed?

(factory, controlled laboratory, out-of-doors, etc.) _____

Maximum Air Pressure available? _____ Regulated? _____

Any additional information. (If special modifications have been made by the user, please describe below).

_____

_____

_____

_____

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