

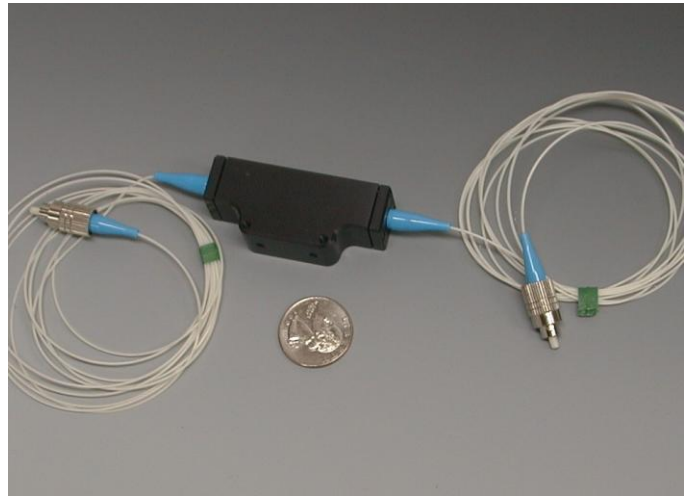
1300nm band/Sensing System Calibrator: Hydrogen Fluoride Gas Cell

A gas cell is a precision filter whose absorption lines are determined by molecular energy levels. These lines have unparalleled stability and accuracy. Hydrogen Fluoride gas absorption has been widely researched and identified by national standards bodies as a wavelength reference in the wavelength range from 1260nm to 1350nm. Other wavelength ranges from various overtone bands, useful in various sensing system applications, are accessible using the bare tube.

The OFHC copper gas tube is sealed for long life and features advanced optical design with wedged sapphire windows for very low level of interference artifacts. The cells are offered in pressures that are suitable for the particular user application.

The cells are offered in two configurations:

1. A bare absorption tube for use in free space applications. The sapphire windows allow operation to >4 micron wavelength
2. With fiber input and output for applications needing optical output or desiring the flexibility of this configuration, or optionally with a built in photodetector.



Specifications¹

Gas Lines:

Wavelength Range		1255nm to 1351nm 865nm to 895nm 2.34 microns to 2.82 microns
Wavelength Accuracy	pm	±0.3 (50 Torr) pm ±0.1 (10 Torr)
Temperature dependence	pm	<0.01/°C
Atmospheric pressure or humidity dependence		not detectable
Linewidth (-3dB)	pm	16 typical (50Torr) pm 5 typical (10 Torr)
HF Pressure (25 °C)	Torr	0.3 to 200 ±10% (custom)
Absorption line depth (P5) ²	dB	6 typical (50 Torr) dB 4 typical (10 Torr)
Interference artifacts	dB	<0.1
Cell Lifetime	years	>10

Photodiode:

Net responsivity	A/W	>0.5
Capacitance (0V)	pf	50 typical
Shunt resistance	MΩ	>5

1. Specifications subject to change without notice
2. For instruments that have resolution better than the line width. When probed with lower resolution devices contrast is reduced

Features

- **Reliable long life (>10 years) tube; compression seal of sapphire against OFHC copper**
- **AR coated optics and wedged sapphire windows for low level of spectral artifacts**
- **Rugged miniaturized package**
- **Custom pressure and connectors**
- **Free space tube available in several path lengths**

Applications

- **Embedded calibrator for tunable laser or OSA**
- **Sensing systems**
- **Wavelength locker**
- **Laboratory Calibration source**

Ordering Information (example)

HF	-	C	-	50	-	None
				Pressure:		Connector(s):
				Torr		FCPC
						FCAPC
						SCPC
						SCAPC
						None
		Type:				
		Cell with pigtails: C				
		Photodiode output: CP				
		Tube only: T				

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Line	Wavelength ¹ (nm)	Pressure Shift ² (pm/Torr)
R(8)	253.84373	+0.0038
R(7)	255.29999	0.0043
R(6)	257.75174	+0.0048
R(5)	260.74150	+0.005
R(4)	264.27199	+0.0048
R(3)	268.34679	+0.0032
R(2)	272.97030	+0.0
R(1)	278.14782	-0.0008
R(0)	283.88556	-0.0056
P(1)	297.07004	0.0045
P(2)	304.53367	0.0008
P(3)	312.59085	0.0016
P(4)	321.25235	0.0016
P(5)	330.52989	0.0016
P(6)	340.43632	-0.0020
P(7)	350.98564	-0.0027
P(8)	362.19301	-0.0032

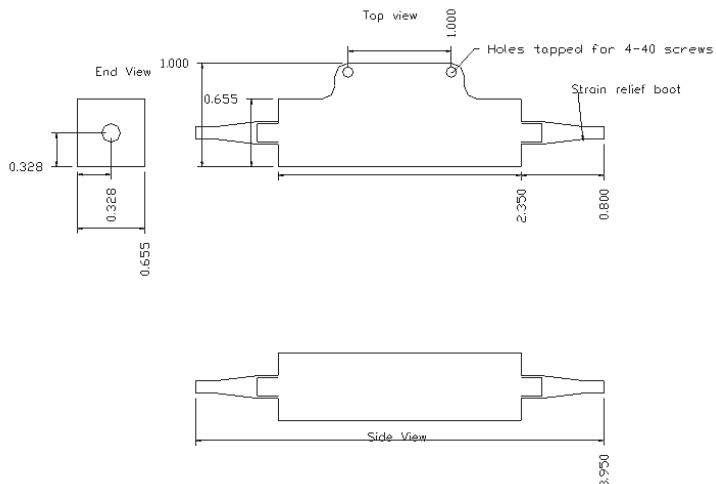
1)Wavelengths stated for low pressures (<10 Torr). Absolute accuracy ±0.05pm (from HITRAN data base)
 2)Shift tolerance ±0.001 pm/Torr

Hydrogen Fluoride absorption spectra vacuum wavelengths and pressure shift. Line data derived from the HITRAN, a spectroscopic database involving research and standards bodies worldwide. It is headquartered at the Harvard Smithsonian Center for Astrophysics and contains the most accurate spectroscopic data in the world. The pressure shift data is from Herget et al "Infrared Spectrum of Hydrogen Fluoride", J Opt Soc America Vol 52 #10 pp1113-19 October 1962.

Note that the dimer H₂F₂ is generally present to varying concentrations depending on gas pressure and temperature. For room temperature (25 degC) at 100 Torr pressure the concentration of dimer will be in the neighborhood of 25%. For pressures below 25 Torr the dimer concentration is generally negligible at room temperature and above. The presence of the dimer effectively reduces the concentration of the monomer but does not change the wavelength of the absorption lines except through the weak dependence on pressure shift. The most evident effect will be the absorption width getting larger at higher temperatures due to the increase in monomer concentration.

Safety Information:

While hydrogen fluoride is a dangerous gas the quantity present in the cell is very small (<100 micrograms). Both OSHA TWA and ACGIH list 3ppm as the maximum exposure limit for a 10 hour shift. During this period the exposed person would inhale approximately 30mg of HF. This is >300 times the amount of HF contained within the cell assuming the entire contents of the cell could somehow be ingested. For this reason the gas within the cell is considered non hazardous and no labels or other warnings are necessary.



HF fiber coupled gas cell

Bare absorption tube is also available in two sizes (or custom please inquire). The bare absorption tube is especially valuable for accessing other wavelength ranges that HF has absorption lines. The cell may also be ordered in an instrument type package with bulkhead connectors. Up to three cells may be configured in one package for a universal calibration instrument.

NIST traceability

The question of NIST traceability often comes up when discussing a piece of calibration equipment. What constitutes traceability is not always clear. Gas cells are referenced to fundamental molecular energy levels. These transition frequencies are remarkably stable to environmental affect such as temperature and are essentially invariant with time. This is what is called a physical standard i.e. a standard whose basic performance is not dependent on a calibration step but rather the fundamental properties of the material itself. To assure quality of the starting material we rely on certificates of lot purity from our material vendors..

Many researchers have measured the precise wavelengths of absorption lines. HITRAN a worldwide database of high-resolution spectroscopy administered at the Harvard-Smithsonian Center for Astrophysics contains a wealth of information. These measurements have been repeated and verified recently at NIST. The remarkable stability and small pressure shift and temperature dependence has been repeatedly verified.

We have at Wavelength References NIST SRM references materials by which we compare the results of our gas cells with the results obtained using the NIST SRM. For gas cells, like hydrogen fluoride, where we do not have a direct NIST SRM available, we develop our traceability chain through comparisons of measurements made on lasers locked to NIST traceable gas cells with lasers locked to these cells. This together with the use of the best available measurements from bodies such as HITRAN ensure that our gas cells and instruments using gas cells deliver traceable measurements.

