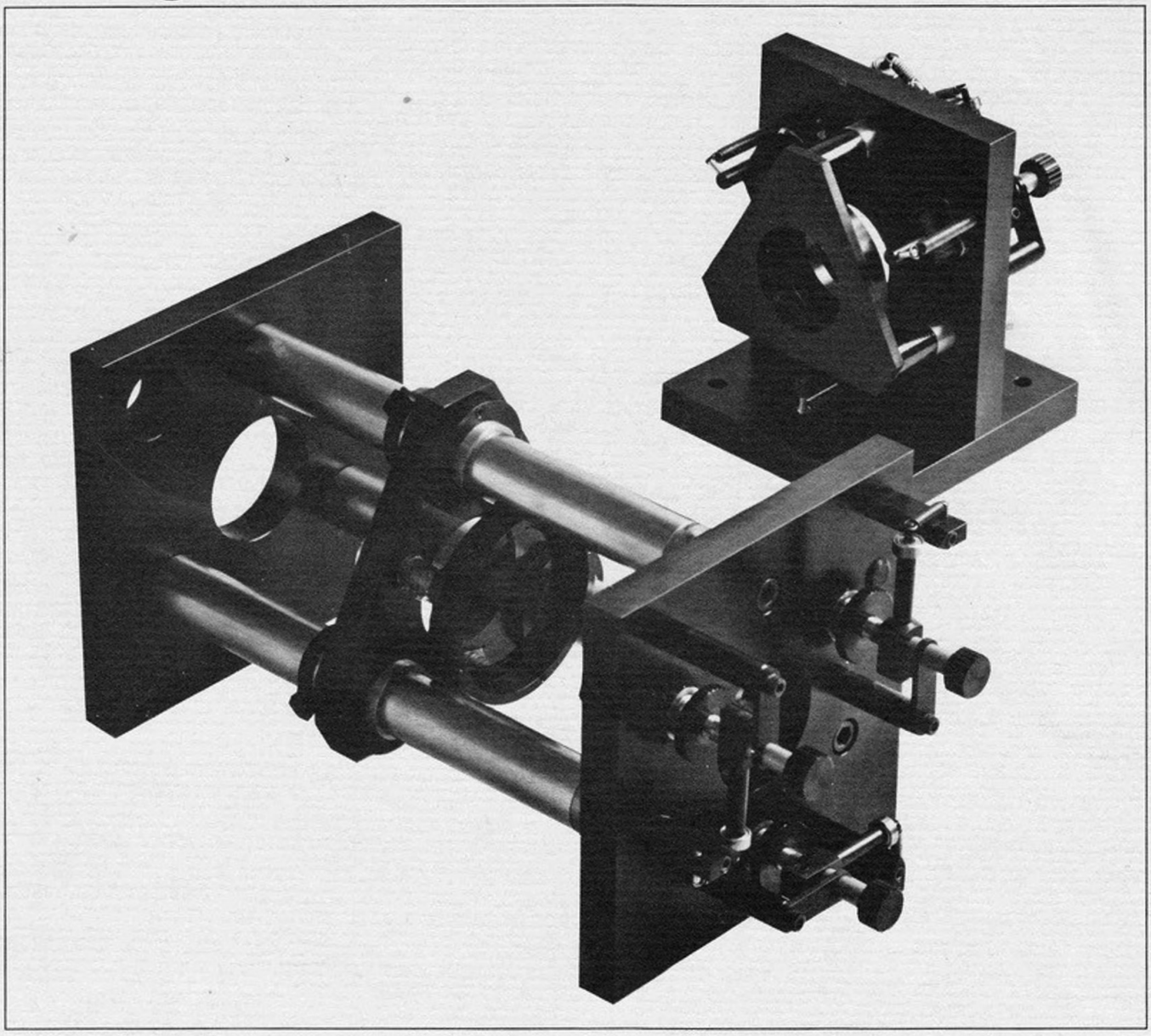
burleigh



FEATURES:

- ☐ High finesse
- ☐ Thermal and mechanical stability
- ☐ Remote PZT alignment to λ/250
- ☐ Variable cavity spacing
- ☐ Large aperture
- ☐ Fast alignment
- ☐ Pre-mounted mirrors
- ☐ Tilt-free PZT scanning
- ☐ Integral collimator
- ☐ Visible, UV and IR models

APPLICATIONS:

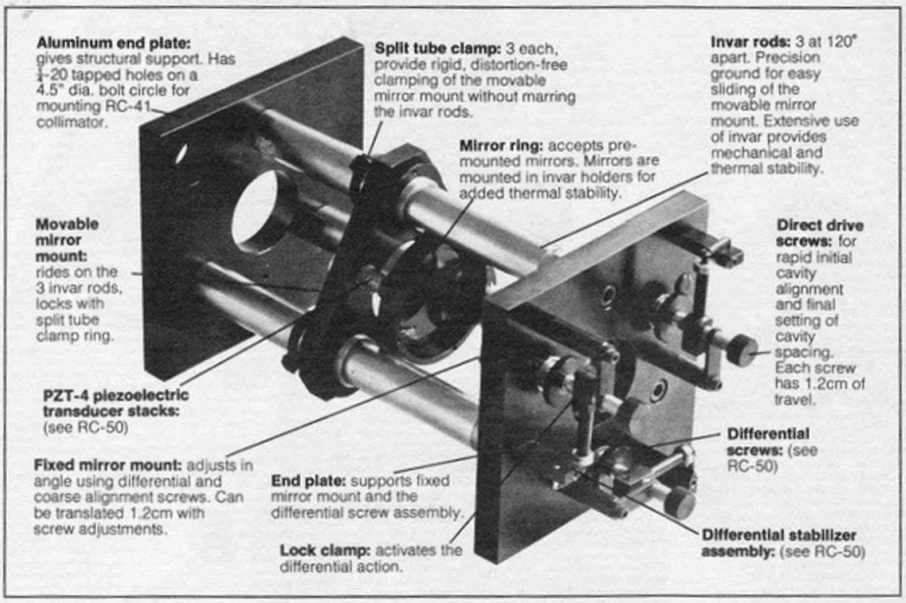
- ☐ Brillouin scattering
- ☐ Multi-pass interferometry
- ☐ High resolution spectroscopy
- ☐ Narrow band, tunable filtering
- ☐ Periodic spectra studies
- ☐ Laser mode analysis

Burleigh's family of Fabry-Perot Interferometers are performance proven instruments. They satisfy your tough spectral analysis problems because they're designed by Fabry-Perot users, not draftsmen. This means you get all the important performance features you need but none of the costly frills. Performance features like mechanical and thermal stability, high finesse, tilt-free and linear PZT scanning, and remote alignment of the interferometer cavity.

Burleigh Instruments Inc., 830 Linden Avenue, PO Box 9108, Rochester, New York 14625 / (716) 586-7930

MODEL RC-40

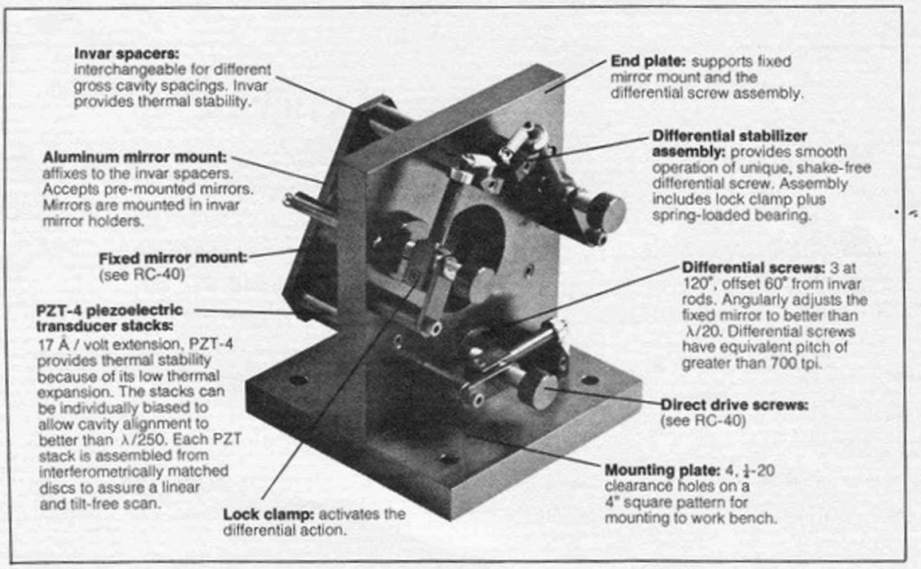
The model RC-40 is a general purpose, piezoelectrically scanned Fabry-Perot interferometer. The gross mirror spacing is continuously variable from 0 to 15cm. This allows an optimum compromise between free spectral range and resolution. Mechanical stability of the RC-40 is greater than other commercially available units because of the solid, massive construction and the rigid structure of the interferometer. All the elements of the instrument move as one solid mass. Thermal stability is achieved by using invar for all components affecting cavity spacing, and by using PZT-4 piezoelectric ceramic material for electronic alignment and for scanning. Both have extremely low thermal expansion coefficients. Where other materials are present, their thermal expansion does not affect the performance of the interferometer. Of course, for the most critical and stringent requirements, it may be necessary to operate the RC-40 on a vibration isolation table and provide some thermal control.



MODEL RC-50

The model RC-50 is especially designed for those who do not need large cavity separations. The RC-50 is similar to the RC-40. The difference is in the cavity separation scheme employed. The RC-50 uses invar spacers instead of sliding the mirror mount on invar rods.

You can change the gross cavity separation discretely using the optional invar spacers. The PZT-4 stacks simply unscrew from the invar spacers. Spacers are supplied in lengths from 1 to 5 cm, in increments of 1cm. For cavity separations between the fixed values above, the fixed mirror mount can be translated ± .6cm by adjusting the 3 direct drive screws.



HOW IT WORKS

Fabry-Perot Interferometers (FPI's) are high resolution spectrographic instruments. The FPI's are generally two high quality plano mirrors located parallel to each other. While other mirror configurations, like a confocal cavity, are possible, the plano cavity is the most versatile. The adjacent faces of these mirrors are coated with a high reflectance coating. The rear surfaces are antireflection coated. The FPI's can be operated in the scanning mode for real-time spectral analysis. Or in the tunable filter mode for wavelength isolation.

In the scanning mode, one observes the spectral content of incident light by moving one mirror along the interferometer axis without disturbing the parallelism of the mirrors. The The RC-40 and the RC-50 use piezoelectric ceramic transducers attached to one of the mirrors for scanning. The other mirror remains fixed. The PZT transducers expand when a voltage is applied along the poling direction of the ceramic. The voltage applied in the scanning mode is a ramp (sawtooth) waveform and can be conveniently supplied using a Burleigh ramp generator. A detector after the FPI senses the transmitted radiation. The energy can be displayed on a scope or a chart recorder.

In the static or filter mode, the mirrors remain stationary and transmit a selected wavelength. You select (tune) the cavity using the PZT transducers. With a variable dc voltage, the bandpass can be shifted and different wavelengths transmitted. The ability to shift the bandpass allows flexibility not found in fixed cavity etalons.

Transmission through the cavity occurs when: $2nd \cos \theta = m\lambda$. Here n is the refractive index of the space between the two mirrors, d is the mirror separation, θ is the angle the normal to the wavefront makes with the interferometer axis, m is the order of interference (an integer), and λ is the wavelength.

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ALIGNMENT AND SET-UP

The mirrors for the RC-40 and the RC-50 are conveniently mounted in individual invar holders to reduce the danger of handling. These holders allow 0 cavity spacing of the mirrors. These are placed in the interferometer. The gross mirror spacing is set and the split tube clamp locked in place if using the RC-40. For the RC-50, the user selects the proper invar spacers.

If available, an alignment laser will greatly simplify the initial set-up. Using the direct drive screws, the transmitted or reflected multiple beam images of the laser reflected off the mirrors of the interferometer are superimposed. At this point the direct drive screws are locked in place and the differential screws employed to further improve alignment. The differential screws let the user set the mirror alignment to $\lambda/20$.

Now a detector is used if it hasn't been used yet. With a 3 output source of variable voltage, the piezoelectric transducers can be separately activated. Alignment to $\lambda/250$ can be realized on the movable mirror mount with the PZT's. Proper alignment is achieved when the finesse is maximized. The output of the detector can be observed simultaneously scanning the cavity using a ramp voltage waveform and displaying the detector output on a scope.

DEFINITIONS:

Free Spectral Range (FSR); is the range of frequencies (wavelengths or wavenumbers) which can be covered without overlapping of orders of the interferometer.

Minimum Resolvable Bandwidth (MRBW); is the instrumental response to a delta function input.

Finesse (F); is the ratio of the FSR to the MRBW. Or equivalently, the ratio of the spacing of the Fabry-Perot fringes to the fringe width at half-maximum.

Etendue (E); is the light gathering power of the interferometer. The product of the area of the interferometer aperture and the solid angle subtended by the source.

Resolving Power (RP); is tne ratio of the frequency to the MRBW.

	PLANO CAVITY		
	λ units	σ units	ν units
FSR	$\lambda^2/2d$	$1/2d$	$c/2d$
MRBW	$\lambda^2/2dF$	$1/2dF$	$c/2dF$
RP	λ/MRBW	σ/MRBW	ν/MRBW
F	$\pi R^{1/2}/1-R$		
d	cavity spacing		
R	reflectivity		

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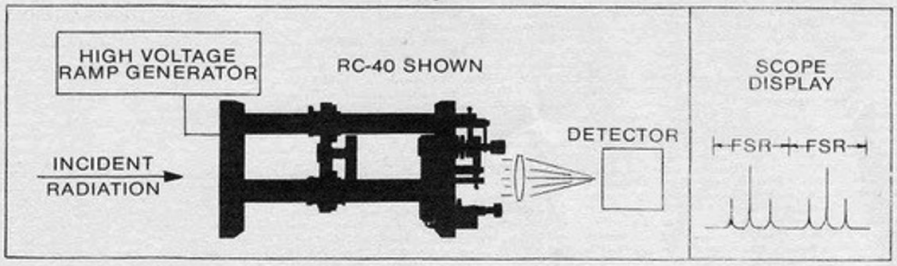
APPLICATIONS:

Scanning: Many experiments require the analysis of a spectrum of electromagnetic radiation. In the scanning mode, the RC-40 and RC-50 use piezoelectric transducers to repetitively vary the cavity spacing as a function of time. Since the cavity is changing, the resonance of the interferometer cavity is changing and different wavelengths are transmitted.

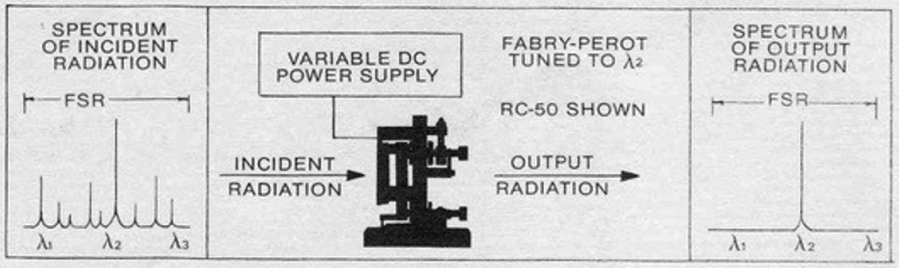
Scanning is accomplished by applying a sawtooth (ramp) voltage waveform. Stable performance requires a linear and regulated voltage source as good as the interferometer. A Burleigh ramp generator satisfies these requirements because it's been specifically designed for the RC-40 and RC-50.

The radiation transmitted through the interferometer is recorded by a suitable detector and displayed as a linear function of the interferometer transmission versus mirror separation. A cavity change of $\lambda/2$ is sufficient to go one full order. Generally one should scan 1.5 to 2 orders, however.



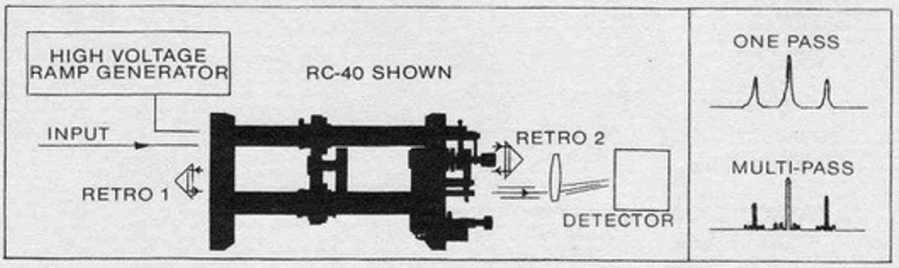
Filtering: The Fabry-Perot in a static mode will transmit a plane wavefront traveling normal to the interferometer axis if the wavelength is within the bandpass of the interferometer.

The RC-40 and RC-50 are tunable because the application of a variable dc voltage will change the cavity spacing and hence the wavelength at which the interferometer will transmit.

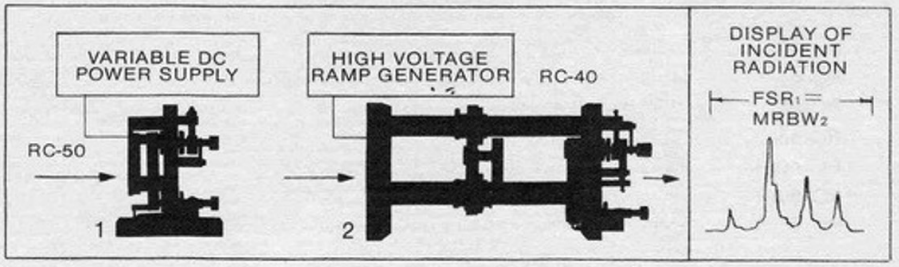


SPECIAL APPLICATIONS:

Work recently described by Sandercock has shown an operational multi-pass Fabry-Perot. The purpose of this type of operation is to enhance the contrast of the transmission profile of the interferometer. For closely spaced spectra, the gain in the signal to noise ratio is significant for work such as in Brillouin scatter studies.



Another type of application is to operate two spectrographs in series. One particular application uses a grating spectrograph and a Fabry-Perot. The series operation allows the high resolution of the Fabry-Perot along with the wide spectral coverage of the grating device. The grating instrument narrows the bandwidth of the radiation incident on the Fabry-Perot. Two Fabry-Perots can also be operated in series.



OTHER UNITS OF SPECIAL INTEREST

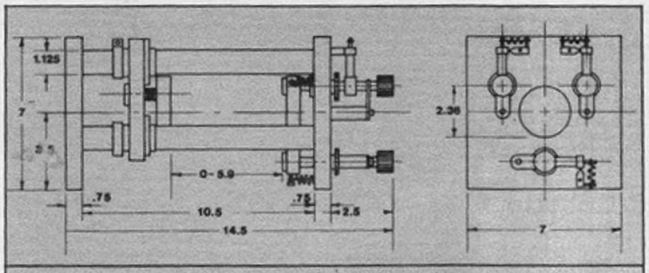
Besides the standard units, Burleigh offers special instruments for those who have special problems. Like an all-invar RC-40 or RC-50. These units, called the models RC-46 and RC-56, are made completely out of invar except, of course, for the PZT material.

Besides the standard units, which use PZT-4 to drive the interferometer cavity one full order at $\lambda = 3.3\mu m$ for a ramp of 1000 volts p-p, we offer optional PZT stacks to drive 1.5 full orders at $10.6\mu m$. See the price list.

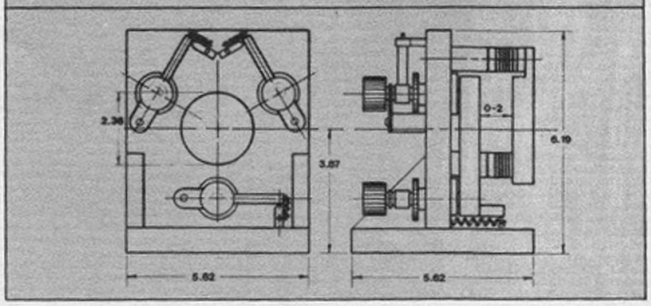
SPECIFICATIONS

FABRY-PEROT	Model RC-40	Model RC-50
aperture	60mm max.	60mm max.
scan method	matched piezoelectric stacks	matched piezoelectric stacks
mirror separation	0-150mm	0-50mm
scan linearity	1%	1%
adjustments		
movable mirror mount	manual sliding for gross cavity spacing	interchangeable invar spacers for gross cavity spacing
	PZT alignment to $\lambda/250$ precision	PZT alignment to $\lambda/250$ precision
fixed mirror mount	direct drive screws, 8.8mm/turn, 1.2cm travel	direct drive screws, 8.8mm/turn, 1.2cm travel
	differential screws, 30μ/turn	differential screws, 30μm/turn
finesse	depends on reflectivity, flatness and alignment	depends on reflectivity, flatness and alignment

RC-40



RC-50



COLLIMATOR	Model RC-41
construction	aluminum
length	325mm
pinholes	50, 100, 200, 500 μm
adjustments	orthogonal micrometer location of pinholes
lens focal length	300mm
mounting	
Model RC-40	3, $\frac{1}{4}$-20 clearance holes located on a 4.5" dia. bolt circle. Affixes to end plate of RC-40.
Model RC-40 or Model RC-50	mounting brackets to affix collimator to work bench, 4 $\frac{1}{4}$-20 clearance holes on a 4" square hole pattern.

RC SERIES MIRRORS

Mirror sets, price includes invar RC-80 mirror holders to achieve 0 cavity separation. Mirrors are high reflectance coated surface 1 and AR coated surface 2 with low loss multilayer dielectric coatings. Material is fused silica. Surface 1 flatness to your order. Surface 2 flatness $\lambda/20$. Wedge angle is 30'.

PRICE INFORMATION

Model No.	Description	Price
RC-40	Fabry-Perot Interferometer	
RC-50	Fabry-Perot Interferometer includes one set of invar spacers	
RC-41	Collimator	
RC-41-1	Mounting brackets to attach RC-41 to work bench	
RC-46	All invar RC-40	
RC-56	All invar RC-50	
RC-40IR	RC-40 with PZT stacks for 10.6μm operation	
RC-50IR	RC-50 with PZT stacks for 10.6μm operation	
RC-50-A	Extra invar spacers for RC-50. Available in lengths to give cavity spacings of 0-1cm, .5-1.5cm, 1.5-2.5cm, 2.5-3.5cm, 3.5-4.5cm, 4.5-5.5cm. Specify the range when ordering by substituting for "A" on your order form.	
RC-620-X	25mm dia., $\lambda/100$, R_1 = 96%, R_2 = .5%	
RC-630-X	25mm dia., $\lambda/200$, R_1 = 98.5%, R_2 = .5%	
RC-640-X	37.5mm dia., $\lambda/100$, R_1 = 96%, R_2 = .5%	
RC-650-X	37.5mm dia., $\lambda/200$, R_1 = 98.5%, R_2 = .5%	
RC-660-X	50mm dia., $\lambda/100$, R_1 = 96%, R_2 = .5%	
RC-670-X	50mm dia., $\lambda/200$, R_1 = 98.5%, R_2 = .5%	
RC-80	Invar mirror holders for RC-40 and RC-50, 1 pair. Designed to give 0 cavity spacing when used with RC series mirrors.	

COATING CODE

Select coating "X" for specified wavelength region. For coating type 7, the reflectivity is 96%.

X	Wavelength
1	420nm-460nm
2	450nm-550nm
3	400nm-500nm
4	550nm-650nm
5	600nm-700nm
6	1.05μm-1.15μm
7	450nm-650nm*

*$125 additional

ORDERING NOTES

The RC-41 collimator must be mounted in the RC-41-1 mounting bracket when used with the RC-50 Fabry-Perot Interferometer. The RC-41 can be attached directly to the RC-40 Fabry-Perot without using the RC-41-1. However, we recommend that the RC-41 be mounted in the RC-41-1 for optimum stability.

When ordering the RC-50 Fabry-Perot Interferometer please specify the set of invar spacers desired. One set is included in the price of the RC-50.

When ordering mirror sets, specify the model number and the coating region from the code: eg. RC-630-2 is a set of mounted mirrors in our special invar holders allowing 0mm cavity separation, 25mm dia., $\lambda/200$, R_1 = 98.5%, R_2 = .5% for 450-550 nm wavelength range.

DELIVERY INFORMATION

The products are in most cases off-the-shelf. The mirrors are stocked to meet anticipated demand. However, Burleigh's large number of mirror sets offered means that sometimes demand exceeds the supply. In these cases, delivery is 2-3 weeks. For special mirror sets the delivery is generally 5-7 weeks.

Burleigh products are warranted to be free from defects in material and workmanship for a period of one year after date of delivery and the return of Burleigh's warranty card.

Prices are quoted FOB Rochester, N.Y. and are subject to change without notice. Outside Canada and the Continental USA prices are slightly higher.

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