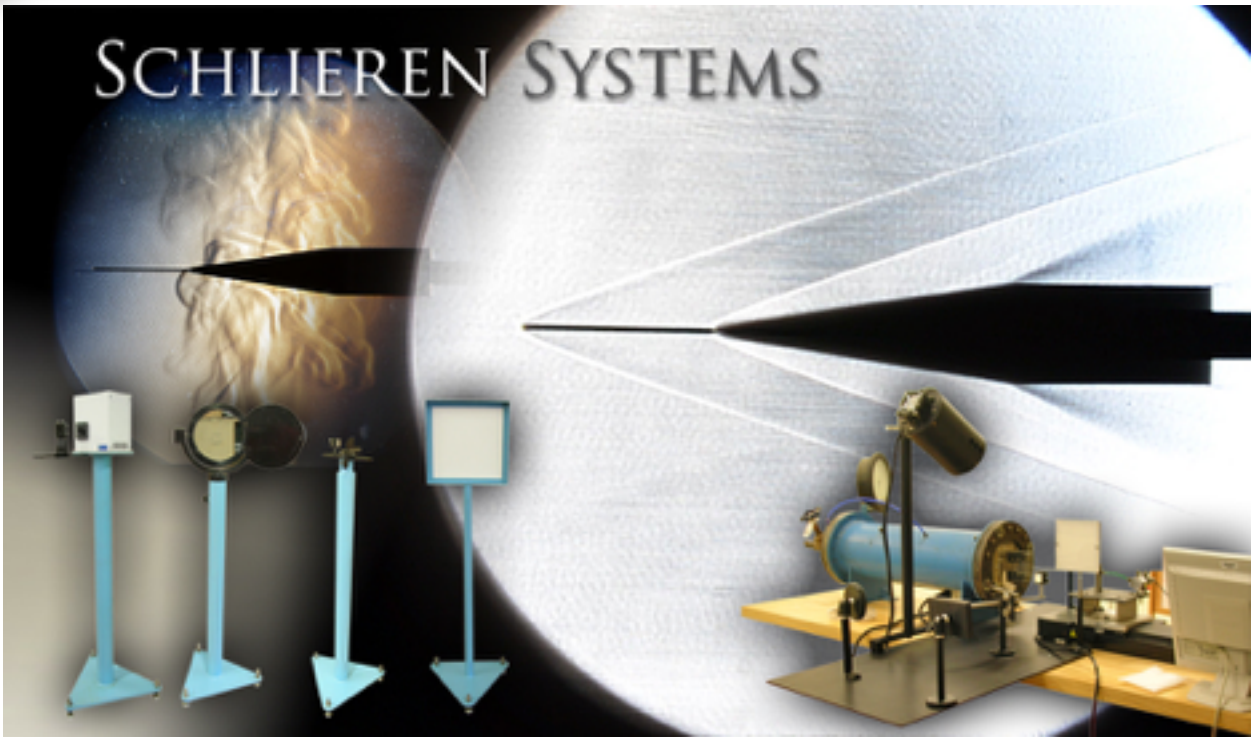


SCHLIEREN SYSTEMS

V1

AEROLAB LLC
8291 Patuxent Range Road
Suite 1200
Jessup, MD 20794

Phone: 301.776.6585
Fax: 301.776.2892
contact@aerolab.com
www.aerolab.com

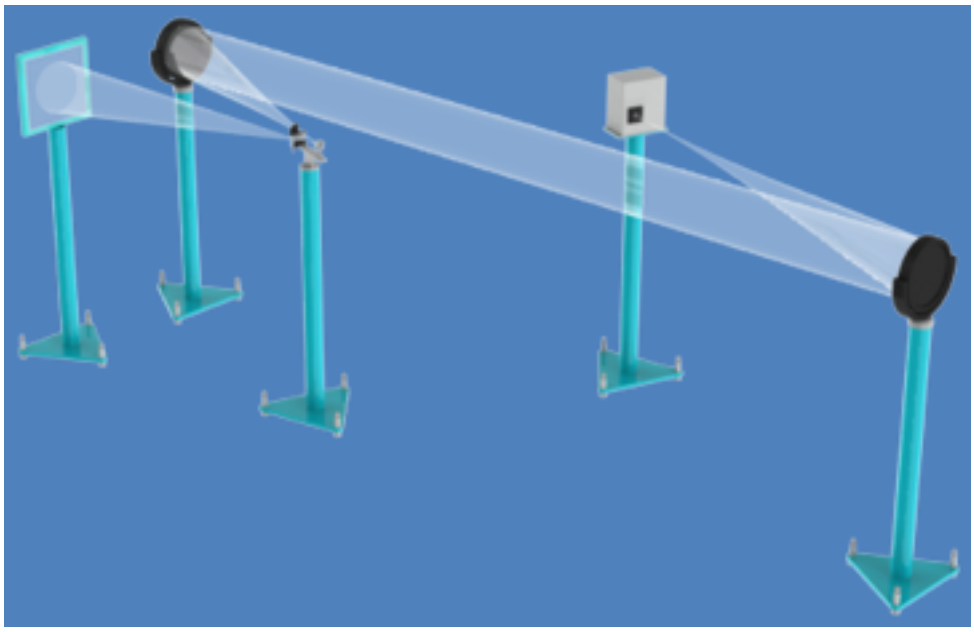
TABLE OF CONTENTS

INTRODUCTION

This introduction serves to give the user a basic introduction to the AEROLAB schlieren system. For a thorough explanation of schlieren systems, see "Schlieren and Shadowgraph Techniques" by Professor G.S. Settles (ISBN 10 3-540-66155-7, ISBN 13 978-3-540-66155-9) of Penn State University.

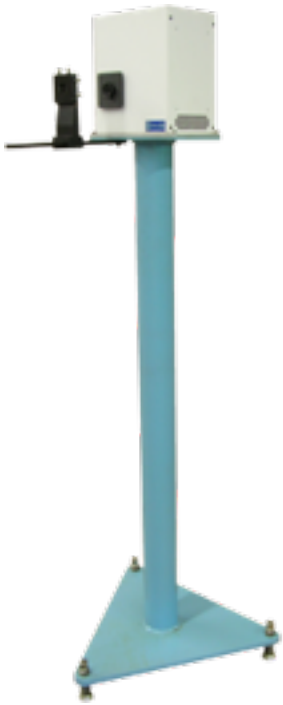
The index of refraction of air is a function of its density. In the case of high speed flow, as air passes through a supersonic shock wave its density undergoes major changes. Schlieren systems use the change in index of refraction to visualize these shock waves. To do this, light from the high-intensity light source is collimated and directed through the test section (test volume). Although the test section windows (glass) have a different index of refraction than air, they do not affect the collimated light because they are perpendicular to the light's path. (AEROLAB supersonic wind tunnel test section windows are chosen for their superior optical performance.) As the light passes through the test section, most of it is unaffected and passes straight through to be collected by the second parabolic mirror. Some, however, is bent (refracted) by the relative change in index of refraction by the shock waves. This light, too, passes through the test section and is collected by the second parabolic mirror. Because the bent light approaches the collecting mirror at a slightly different angle than the light that passed straight through, its focus point is slightly offset. The collecting mirror reflects light to the knife edge assembly. The adjustable knife edge is positioned at the focal length of the collecting mirror and is used to chop off (block) the light that was affected (bent) by the shock waves – the only light allowed to pass is the light unaffected by the shock waves. Finally, this light is reflected by the small flat mirror to a viewing screen.

Z-TYPE SCHLIEREN SYSTEM



COMPONENTS

- A "Z-type" Schlieren system consists of the following components:
- 150 Watt Xenon arc lamp light source
- Adjustable light source aperture
- Viewing screen
- Adjustable knife edge
- Adjustable telescope-grade flat mirror
- (2) Telescope-grade parabolic mirrors
  - 6-inch x 48-inch focal length
  - 8-inch x 64-inch focal length
  - 10-inch x 80-inch focal length
  - 12.5-inch x 100-inch focal length
  - Custom sizing available upon request



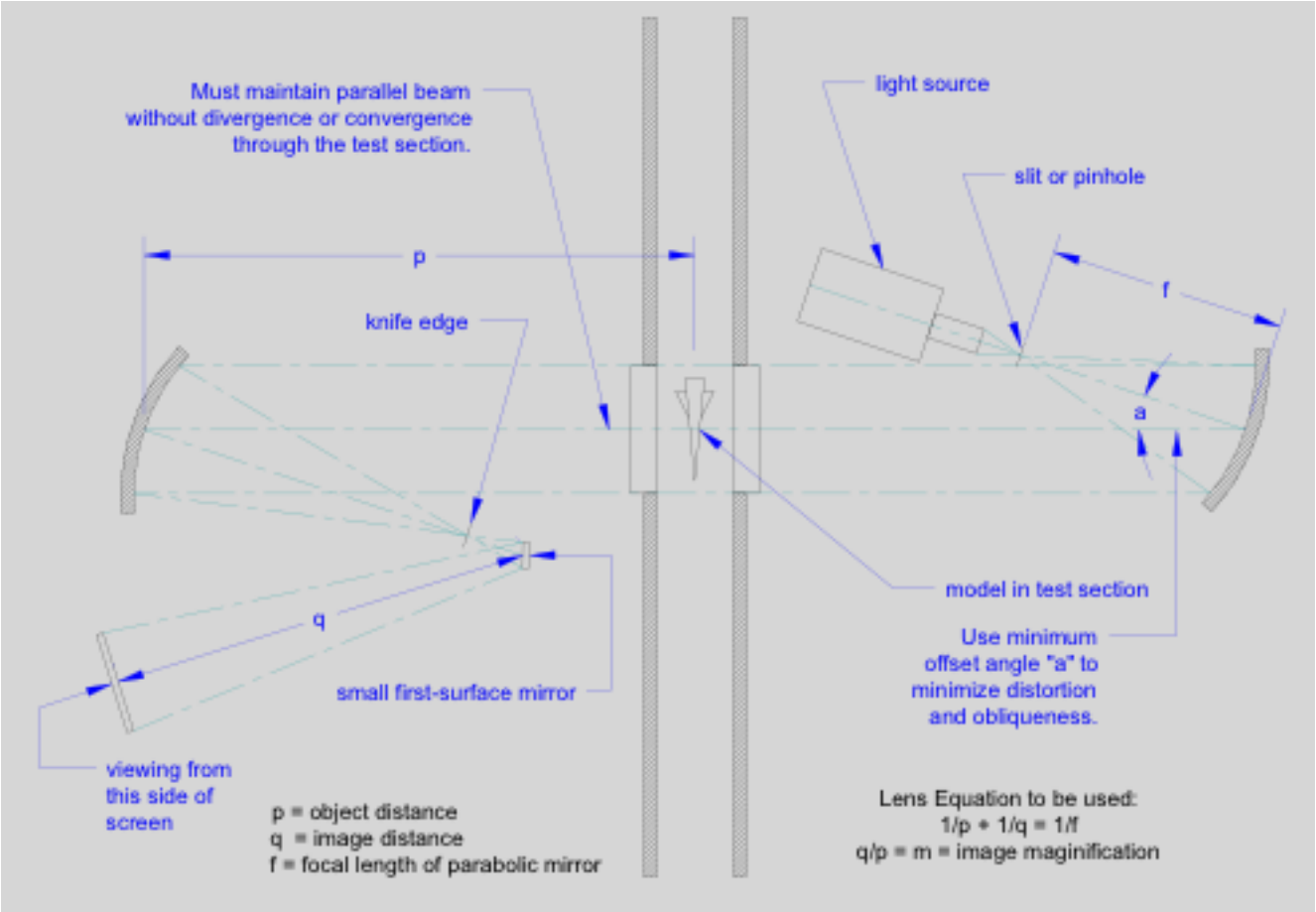
Light Source with Adjustable Aperture

Viewing Screen

Knife Edge with Flat Mirror

(2) Parabolic Mirror

LAYOUT

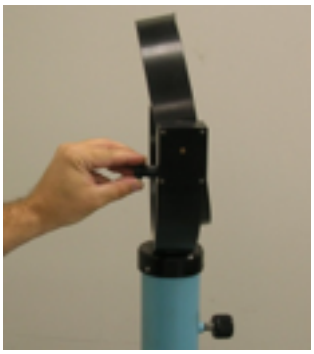


FEATURES

All stands equipped with adjustable footers for aligning centerline of the Schlieren System with the test section centerline. Up to 4" of vertical tuning is possible.

Equipped with a post-mounted handle for fine swivel adjustments (vertical axis).

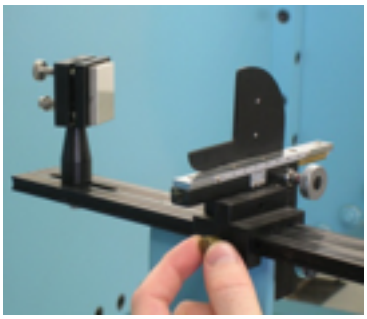
To pitch the mirror (horizontal axis), use the yoke-mounted handle for fine adjustments.



The knife edge/flat mirror assembly has two positional adjustments:

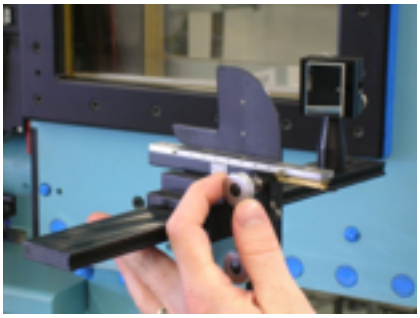
- moving the base stand
- sliding the components individually along the rail

Finer adjustment of the knife edge and flat mirror will follow

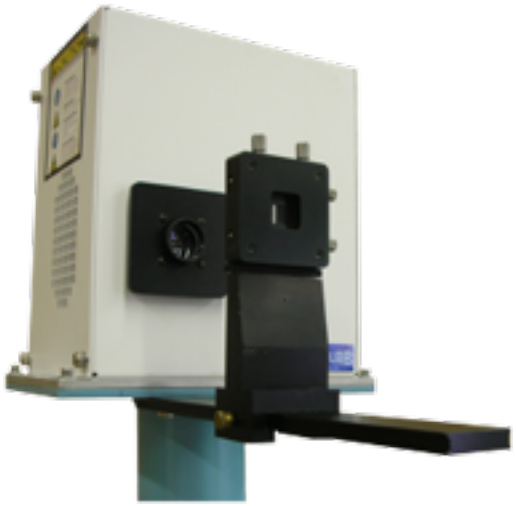


The flat mirror has fine adjustment knobs located on the backing plate - one for pitch and one for swivel. Major alignment changes can be done by swiveling and sliding the mirror post on the rail.

Fine adjustment knobs on the knife edge assembly.



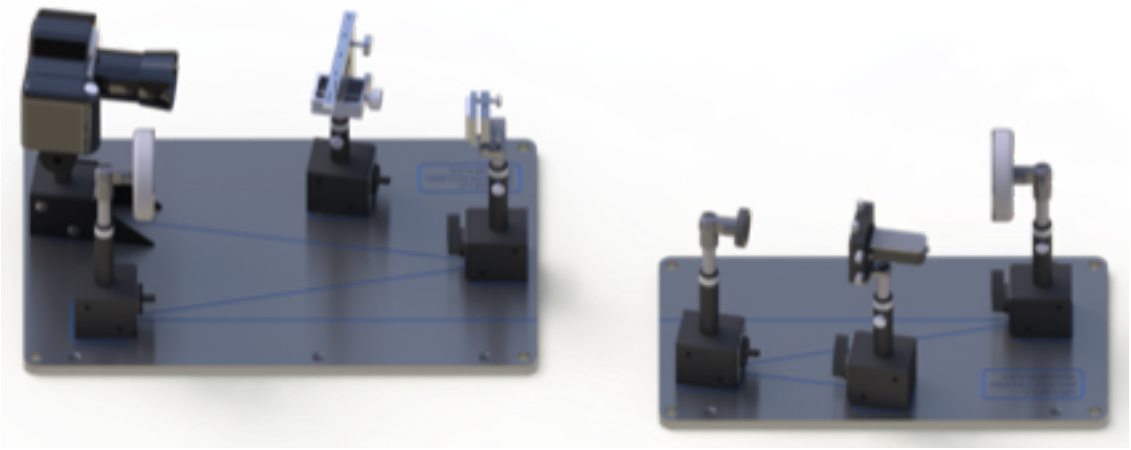
150 Watt Xenon Light Source with rectangular aperture. All four sides of the aperture are independently adjustable. Fine tuning is performed (side-to-side and top-to-bottom) until the image on the viewing screen begins to darken.



The parabolic mirrors have a specific focal length (This varies from size to size. Acquire focal lengths from AEROLAB at time of purchase.). The focusing lens of the light source has a focal length of five (5) inches (1-inch diameter, f/5).

Note: The mismatch of focal lengths is intentional. There will be spillage of light around the first mirror. This spilled light will not adversely affect the final image.

BENCHTOP SCHLIEREN SYSTEM



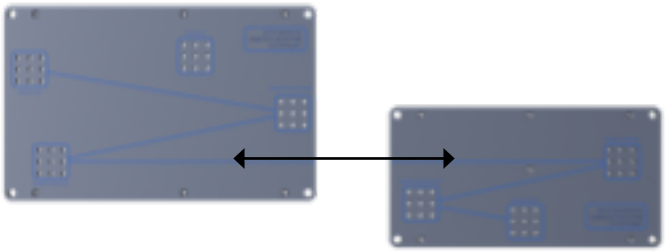
COMPONENTS:

- The benchtop Schlieren System (Z-type) consists of the following components:
- High-intensity LED (light emitting diode) light source
- Adjustable light source aperture
- Viewing Screen with mount (Can be swapped with an SLR camera)
- Adjustable knife edge
- Adjustable telescope-grade flat mirror
- (2) 3-inch (7.62cm) diameter f/6 parabolic mirrors
  - Additional sizing available
- (2) First surface flat mirrors
- Adjustable height Stands with magnetic bases for each component
- Engraved bases (2)

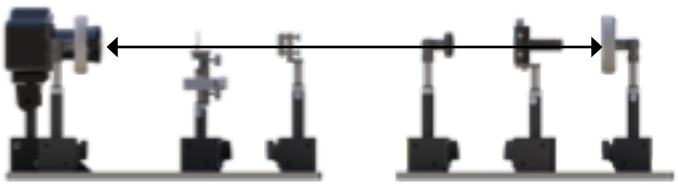
LAYOUT:

Our Benchtop system traditionally uses the Z-Type set-up, however, we do also support Single-Sided Benchtop systems.

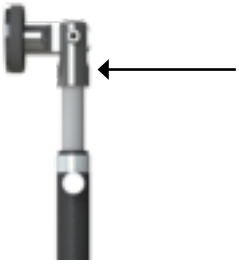
The base plates include etched lines to assist in set-up of the Schlieren System. The etched lines running between the parabolic mirrors must be co-linear



Each component is independently adjustable. This permits centerline height configuration to be customized for various test section objects.



Knuckle permits vertical tilt of the cameras and mirrors.

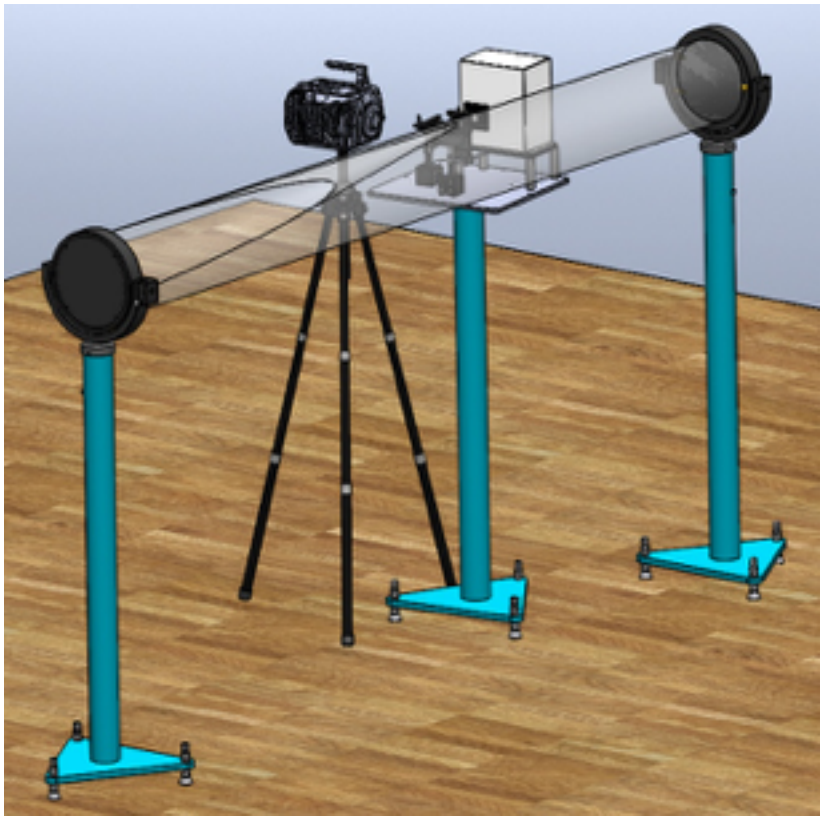


Knuckle for adjusting the tilt of a component

3mm x 3mm light source aperture.

Custom sizes available.

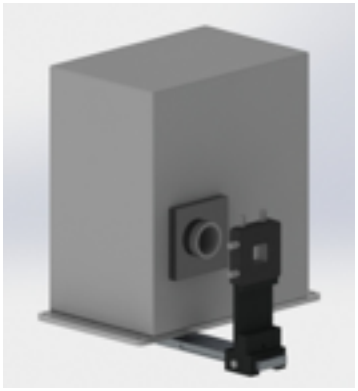
ONE-SIDED SCHLIEREN SYSTEM



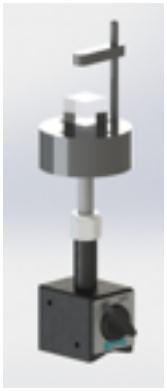
COMPONENTS:

The One-Sided Schlieren System consists of the following components:

- 150 Watt Xenon arc lamp light source or SuperBright LED source
- Adjustable light source aperture
- Beam Splitter
- Digital SLR camera with zoom lens
- Adjustable knife edge
- Adjustable telescope-grade flat mirror
- Adjustable telescope-grade parabolic mirror
    - 6-inch x 48-inch focal length
    - 8-inch x 64-inch focal length
    - 10-inch x 80-inch focal length
    - 12.5-inch x 100-inch focal length
    - Custom sizing available upon request



Light Source with Aperture



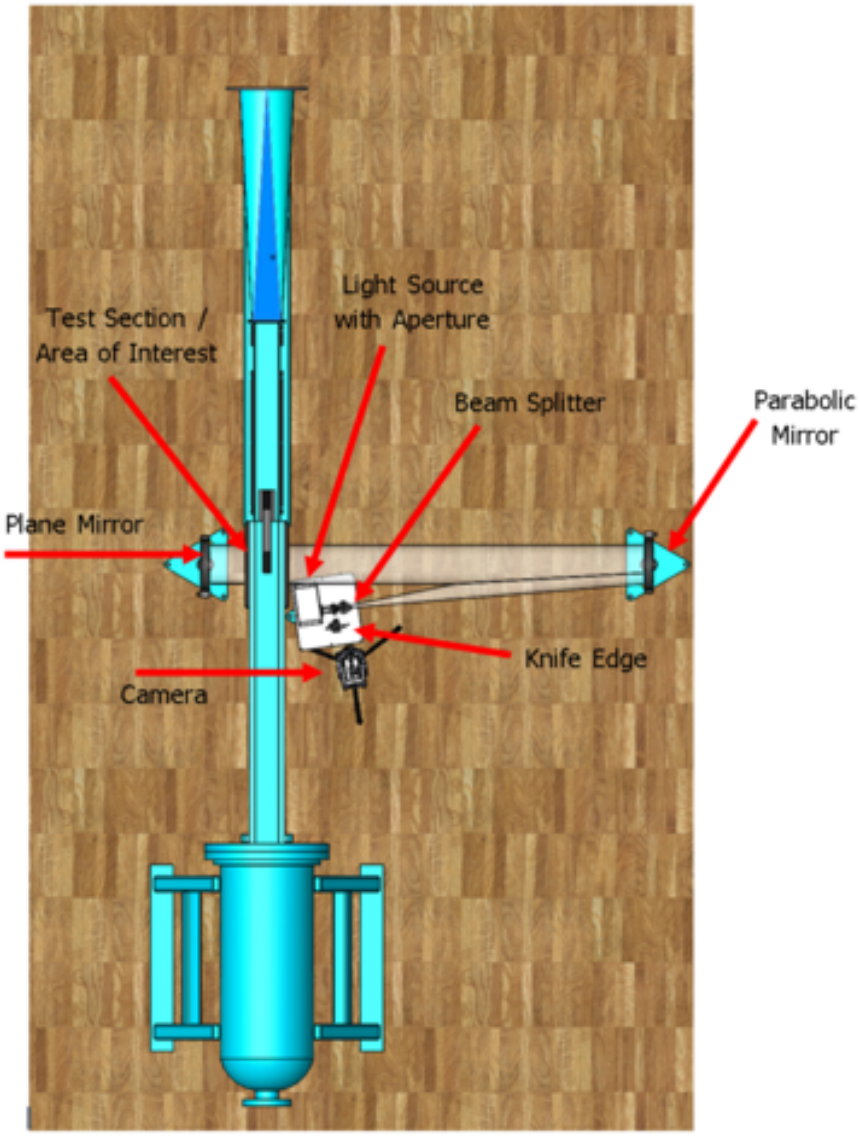
Beam Splitter With Stand

Parablic Mirror

Plane Mirror

Knife Edge With Stand

LAYOUT



FEATURES:

The One-Side Schlieren system is ideal for test-set ups with limited space. As opposed to the Z-Type Schlieren System, which uses a pair of parabolic mirrors in addition to a flat mirror, the One-Sided system employs only 1 parabolic mirror and 1 flat mirror. The flat mirror is the only component on the "other side" of the set up as you can see in the above layout figure, thus permitting a more efficient Schlieren set-up.