Flat Output Backlit Strobe
Product Requirements Document
University of Rochester, Senior Design

University of Rochester, Institute of Optics
Dare Bodington, Nick Cirucci, Changchen Chen

Sydor Instruments
Bryan Chan, Yoram Fisher, Matthew Zelazny

Advisers
Wayne Knox, Class & Technical Adviser

Document Number 001

Revisions Level	Date
E	10 December 2014

Rev	Description	Date	Authorization
A	Release	25 October 14	DEB
B	Updated Information	9 November 14	DEB
C	Presentation Revision	23 November 14	DEB
D	Addition of Specification Table	1 December 14	DEB
E	Presentation Updates	10 December 14	DEB

Vision:

The product is a high efficiency flat illumination backlit projectile imaging system designed for fast moving projectiles.

Environment:

As an indoor instrument, it needs to operate in the following environment:

Temperature
55-85 °F - safe operation
65-75 °F - meets specifications
Relative Humidity
Non-condensing – safe operation
30% Nominal - meets specifications

The system should not require cooling water, compressed gas or vacuum. Wall power and a computer connection are required. Network connection not required.
During normal operation the system will be protected by plexiglass from projectiles of interest.
The system should be not be damaged by or sensitive to projectiles or their air disturbances.
The system should be placed in a room large enough to accommodate the space requirements mentioned in the “Fitness for use” section below.

Regulatory Issues:

IEC 60825-1 “Safety of Laser Products”

CE, FCC Class A, RoHS (2011/65/EU)

Fitness for use:

The system will:

Be able to image any projectile within a 6”x4.5”x4.5” volume.
Consist of two components, an illumination element and an imaging system; the illumination system will be approximately 12”x12”x12” and will output a monochromatic uniform (>50%) and efficient (>50%) continuous backlit plane within a 90% window of the field of view.
Be scalable to a maximum of 1’x18’x18’ and a minimum of 1’x8’x8’ with 1 discrete step in between.
Be insensitive to $\pm$ 0.02” (0.5mm) translation in any direction.
Contain 4 SPL LL90_3 905nm Osram laser diodes which are capable of firing a 30ns pulse.
Contain optical components for beam homogenization. The homogenizer will consist of either a custom design from RPC Photonics or a NIR design based on an excimer laser homogenizer.
Contain an Allied Vision Technologies GC1380 CCD.
Contain a camera lens system.
Be tested on optical tables.

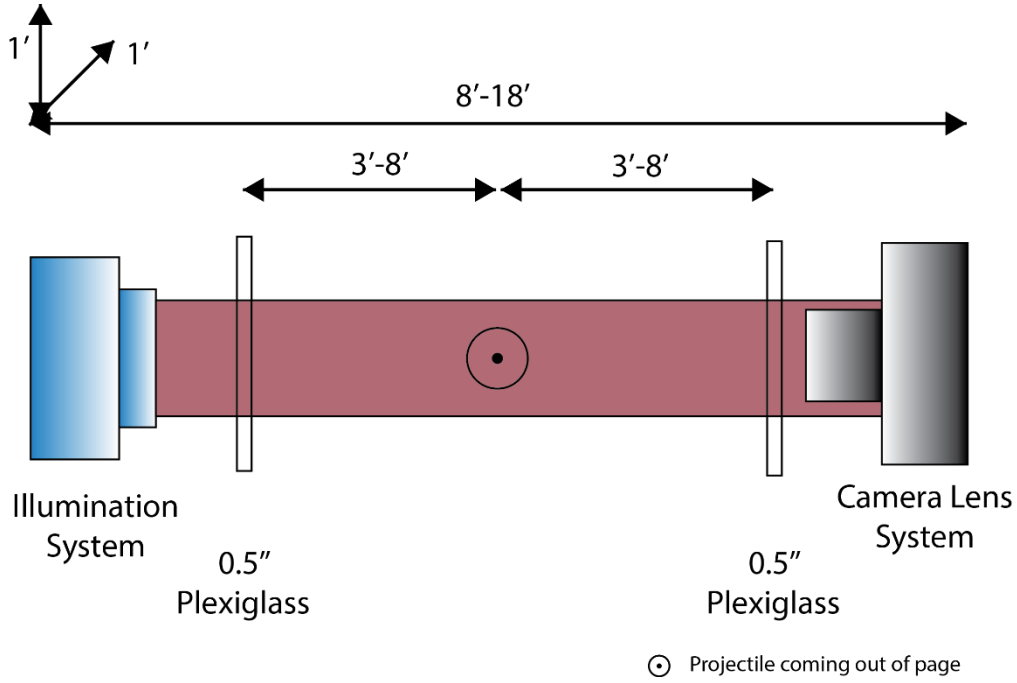
It is desirable that:

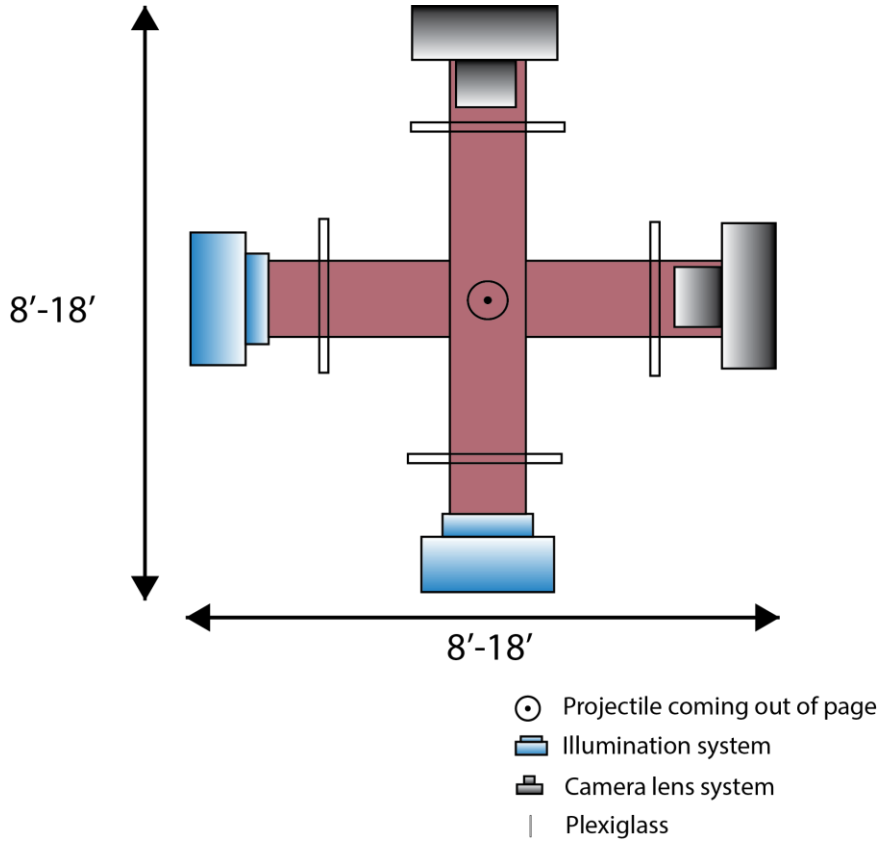
The illumination system has an efficiency as high as possible and uniformity greater than 90% over the 90% field of view.
The illumination system has very little noise fluctuation.
The entire system is telecentric.
The system has adjustable magnification.
The system does not use scattering optics in order to achieve high efficiency.
The system can be scaled to use any number of laser diodes.
The system consists solely of off the shelf components.
The design, build, alignment and results are repeatable.

We are not responsible for:

Custom imaging system designs.
Designs with a number of laser diodes other than 4.
Designing the system’s mechanical housing.
Testing with projectiles.
Testing with a continuous illumination source.
Testing the system with two axes.
Developing software for the system.

Schematic:


1′
1′
8′-18′
3′-8′
3′-8′
Illumination System
0.5″ Plexiglass
0.5″ Plexiglass
Camera Lens System
Projectile coming out of page


8′-18′
8′-18′
Projectile coming out of page
Illumination system
Camera lens system
Plexiglass

Required Specifications:

Property	Specification	Notes
Field of View	6'' x 4.5''	150 x 115 mm
Wavelength	905 ± 10 nm	
Illumination and Imaging System Dimensions	12" x 12" x 12" (DxWxH)	305 x 230 x 305 mm; Shooter Perspective
Total Optical System Throughput	> 50%	
Illumination Uniformity	10% PV	Within 90% FOV
Imaging Lens	Schneider Tele-Xenar 2.2/70 lens	
Imaging Sensor	Allied Vision Technologies GC1380 CCD	
Light Source	SPL LL90_3 Osram laser diode	Source will be 4 laser diodes
Insensitivity to Translational Movement	± 0.02''	± 0.5 mm
Operational Range	8' - 18'	2.44 m – 5.49 m