

THE DIRECT MEASUREMENT OF SYSTEM MODULATION  
TRANSFER FUNCTION (MTF) FOR AN AN/AVS-6 AVIATOR'S  
NIGHT VISION IMAGING SYSTEM (ANVIS)

by

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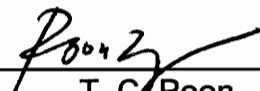
IN

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(ABSTRACT)

Despite the widespread use of night vision imaging systems in today's military, the problem of directly measuring the spatial frequency response of these systems has been ignored. Modulation Transfer Function (MTF) performance specifications have been extensively researched for the components of night vision imaging systems such as the lenses and the image intensifier tube. The current method for calculating the system MTF is to combine the MTFs of all the components of the imaging system. Little research has been performed to directly measure the MTF of the entire system. This thesis describes a method to directly measure the modulation transfer function for an AN/AVS-6 Aviator's Night Vision Imaging System (ANVIS). This method is based on the traditional slit technique and uses a Photo Research PR-900 video photometer as the detector. Comparisons between the direct measurement and the component combination calculation demonstrate the accuracy of the direct measurement.

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Hey Charlie, it's Guinness Time!

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## 1.0 Introduction

Over the years, the military has been researching means to increase the performance of their ground troops, their armor troops, and their aviators during night missions. Battles are no longer fought exclusively during the day. Today's military needs to effectively battle during the day or night. Since the 1960s, research has been undertaken to develop image intensifier systems that help create a daytime-looking image of nighttime scenes. An image intensifier is defined as a device that amplifies the available light energy (visible and non-visible) in order to form an intensified visible image. Several iterations of this image intensifier have been developed. The most recent iteration of image intensifier technology is the Generation 3 (3rd Gen) wafer tube. This tube is used in most high performance image intensifier systems in today's military. Its ability to amplify the light of dark scenes outperforms any other means. These tubes are in ground, armor, and aviator systems. Such a system is the AN/AVS-6 Aviator's Night Vision Imaging System (ANVIS). This system consists of two channels (binocular system) each containing an objective lens, image intensifier tube, and an eyepiece lens as seen in Figure 1-1 a.



Figure 1-1 a. ANVIS.



Figure 1-1 b. ANVIS mounted to an aviator's helmet.

The ANVIS easily mounts to the pilot's helmet as illustrated in Figure 1-1 b. The pilot has the ability to flip the ANVIS up or down when he wants to use it. ANVIS allows pilots to operate

more proficiently in conditions that to the unaided eye, could be extremely dangerous. The system provides a forty degree field of view with unity magnification. It provides the pilot with 20/40 vision on the Snellen acuity scale.

ANVIS components have been extensively assessed, but there are few methods for scientifically assessing the system performance. This problem of adequately characterizing the performance of the system is typical in all vision systems including image intensifiers. Often the system has many performance specifications placed upon it to insure that it presents a "good" image to the user. Often, it is difficult to measure these performance parameters. No parameter has been defined as the "one" metric that a system must meet. However, one parameter that many experts believe provides the most utility in assessing visual performance is the modulation transfer function (MTF). MTF has two main advantages. First, it describes what is generally considered to be critical to an image, specifically the effect of spatial frequency on contrast or modulation. Secondly, it provides an analytical tool which permits the common evaluation of the imaging system and the user in the same units which are quantitative and well understood (1,75). MTF also provides the key advantage of the ability to predict in advance the system performance before a device is actually built.

Several methods for measuring MTF have been developed for component level devices such as lenses. These methods include using an object such as a slit or a point and calculating the Fourier transform of the resulting image through the device under test. The normal procedure for measuring system MTF is to measure the MTF for each component and multiply each component MTF together to form the system MTF. This procedure is often time consuming and requires a separate test setup for each component. For many imaging systems, the ability to focus a detector at the output of the imaging system under test is difficult. This is why no method for directly measuring the system MTF for image intensifier systems such as the ANVIS, has been developed. This has created a void in the performance assessment of the ANVIS. The goal of

this research is to develop a measurement system that is capable of directly measuring the modulation transfer function for a completely integrated AN/AVS-6 Aviator's Night Vision Imaging System. This measurement system would not only provide the military with the ability to directly measure system MTF, but also provide insight into the assessment of component level measurements. This measurement system will also serve as a prototype for a measurement system for any sensor/display imaging system.

Chapter 2 discusses the concept of system MTF and its measurement. Chapter 3 discusses the ANVIS by examining image intensifier technology. It looks at all of the components that make up the ANVIS image intensifier. Chapter 4 presents the proposed method for directly measuring system MTF. Chapters 5 and 6 discuss the experimental setups and procedure for the system MTF measurement. Chapters 7 and 8 discuss the results of the measurements.

## 2.0 MTF Theory and Discussion

The goal of any optical system is to provide an accurate image of the object to the user. Ultimately, the information from the image of any optical system will be utilized by a human user. Therefore, most metrics for specifying optical system performance have the human eye in mind as the standard. Metrics must be developed to specify how well the system will provide the visual information to the human user. No one metric has been accepted as the "one" measure that all visual systems must meet. Specifications for optical systems often specify the contrast ratio, the limiting resolution, or the amount of distortion due to aberrations in the optics. Specifications often include performance requirements under certain environmental conditions such as light level. All of these metrics are good standards but sometimes are difficult to assess. The Modulation Transfer Function (MTF) is widely accepted for assessing imaging system performance. By use of the MTF, the limiting resolution, contrast, the amount of perceivable detail, and the sharpness of the image are specified in the entire spatial frequency domain (2,79). The MTF is the response of an imaging system to a variable spatial frequency, constant amplitude, sine-wave input. At a particular spatial frequency, the MTF is defined as

$$MTF = \frac{B_{\max} - B_{\min}}{B_{\max} + B_{\min}}, \quad \text{Eqn 2-1.}$$

where  $B_{\max}$  and  $B_{\min}$  are defined as the maximum and minimum luminance values of the image of a sine wave pattern, as shown in Figure 2-1.

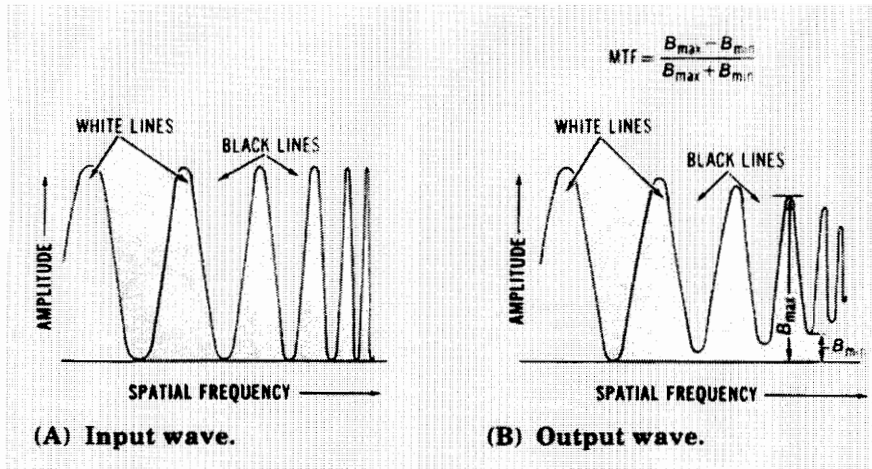


Figure 2-1. An example of MTF  
Source: Image Tubes, Illes Csorba

For the input wave, the modulation is unity. If the modulation of the pattern is less than unity, the modulation transfer function of an imaging system is the ratio of the modulation in the image ( $M_i$ ) to the modulation of the input pattern ( $M_o$ ) (2,79),

$$MTF = \frac{M_i}{M_o} = \frac{\text{Modulation in Image}}{\text{Modulation in Object}} \quad \text{Eqn 2-2.}$$

## 2.1 Optical Transfer Function and the Derivation of the Modulation Transfer Function

The image quality of an electro-optical system can be characterized by either the system impulse response or its Fourier transform. The impulse response  $h(x,y)$  is the two dimensional image formed in response to a delta-function object. A continuous object  $f(x,y)$  can be decomposed into a set of point sources, each with a strength proportional to the brightness of the object at that location. The image  $g(x,y)$  at the output of the system is obtained by superposition of the individually weighted impulse responses. This result is equivalent to the convolution of the object with the impulse response:

$$g(x,y) = f(x,y) \otimes h(x,y) \quad . \quad \text{Eqn 2-3.}$$

Although  $h(x,y)$  is a complete specification of image quality, additional insight is gained by use of the transfer function. Any object can be represented by a combination of its sinusoidal components. Transfer function analysis considers the imaging of sinusoidal objects, rather than point objects. Using the convolution theorem for the Fourier transform, the convolution of  $g(x,y)$  can be rewritten as,

$$G(\xi,\eta) = F(\xi,\eta) * H(\xi,\eta) \quad , \quad \text{Eqn 2-4.}$$

which is simply the multiplication of the corresponding spectra. The uppercase variables  $F$ ,  $H$ , and  $G$  represent the Fourier transform of their corresponding time domain representation  $f$  (object spectrum),  $h$  (impulse response) and  $g$  (image spectrum). The variables  $\xi$  and  $\eta$  are spatial frequencies in the  $x$  and  $y$  directions. Spatial frequency is the reciprocal of the crest to crest distance of a sinusoidal waveform used as a basis function in the Fourier analysis of an object or image. Typical units of spatial frequencies are cycles per millimeter (cy/mm) when describing an image and cycles per milliradian (cy/mrad) when describing an object at a large distance. For objects located at infinity, these spatial frequencies are related by

$$\xi \text{ [cy/mrad]} = \xi \text{ [cy/mm]} * f \text{ [mm]} / 1000 \quad , \quad \text{Eqn 2-5.}$$

where  $f$  is the focal length of the image forming optical system (3,32.3).

The optical transfer function (OTF) is the  $H(\xi,\eta)$  transfer function. The OTF is usually normalized to have a unity value at zero frequency. The OTF is often a complex function with the magnitude of the OTF defined as the MTF and the phase portion defined as the phase transfer function (PTF).

$$\text{OTF}(\xi,\eta) = H(\xi,\eta) = |H(\xi,\eta)| * e^{-j\theta(\xi,\eta)} \quad \text{Eqn 2-6.}$$

$$\text{MTF}(\xi,\eta) = |H(\xi,\eta)| \quad \text{Eqn 2-7.}$$

$$\text{PTF}() = \theta(\xi,\eta) \quad \text{Eqn 2-8.}$$

MTF is the magnitude of the response of an imaging system to sinusoids of different spatial frequencies. The MTF is related to a contrast measurement by Equation 2-1. The MTF at a specific spatial frequency is a measure of contrast for that specific frequency. The limiting resolution (the ability to clearly resolve an object from its background) is the spatial frequency where the value of the MTF drops to a range of 0.05 to 0.02 (1,88). The spatial frequency at which the MTF drops to 3 percent, is widely accepted as the limiting resolution. The 3 percent point is based upon the ability of the human eye to resolve objects from any background.

## 2.2 System MTF

One of the advantages of using transfer function analysis for system measurements is the ability to multiply the responses of each component in the system to form the system transfer function. The MTF of the system

$$MTF(\xi,\eta) = |H(\xi,\eta)| = \frac{|G(\xi,\eta)|}{|F(\xi,\eta)|} \quad , \quad \text{Eqn 2-9.}$$

is found by dividing the magnitude of the output Fourier response by the magnitude of the input Fourier response. Due to the linearity and superposition principles, the MTF for the entire imaging system,

$$MTF_{sys} = MTF_{comp1} * MTF_{comp2} * \dots * MTF_{compN} \quad , \quad \text{Eqn 2-10.}$$

is simply the multiplication of the MTF for each component of the system. Therefore, if the MTFs for all the system components are known, the system MTF can be calculated by Equation 2-10. This relationship is helpful when a direct method for measuring system MTF is not available and it

is possible to measure the MTF of each component. It is also helpfully for predicting which component of the system is degrading the overall system performance.

### 2.3 General Concepts for Measuring System MTF

Several methods for measuring system MTF exist. The major methods use a point, a slit, or a knife edge as the object. The setup is defined in Figure 2-2.

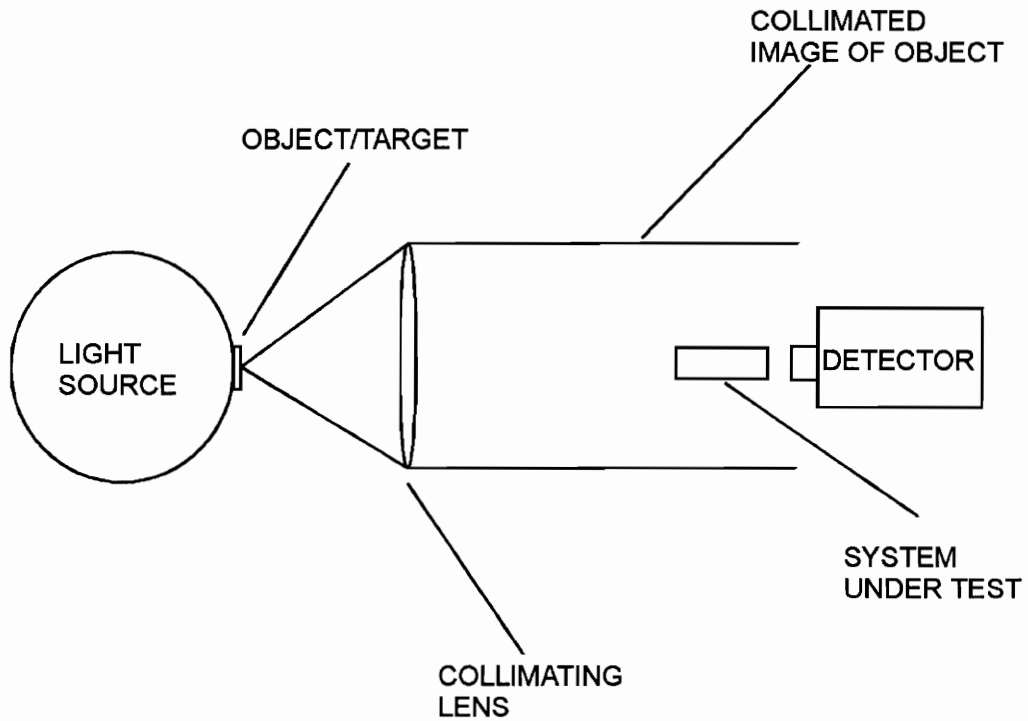


Figure 2-2. General Setup for MTF Measurements.

The light source is used to illuminate the object. The object has a known Fourier transfer function. The collimating lens places the image of the object at infinity so that the measurement is defined for a specific distance. The detector is typically a Charge Coupled Device (CCD), a linear array, or some sort of staring array device. The detector converts the optical image to an electronic



image for Fourier analysis. The MTF analysis for the system must have compensation for the effects of the detector. This compensation is achieved using the relationship,

$$MTF_{\text{system}} = \frac{\text{Measured } MTF_{\text{system using detector}}}{\text{Measured } MTF_{\text{detector}}} \quad \text{Eqn 2-11.}$$

Using the relationship in Equation 2-11, the MTF for the system under test can be obtained.

### 2.4 Slit Method for Measuring System MTF

The setup outlined previously including the light source, object, collimating lens, system under test, and detector is the correct setup for the slit method for system MTF measurements. A convenient method to approximate an ideal line source is to engrave a line through an opaque coating of aluminum on a glass substrate. The system under test is presented with an illuminated line source, which acts as a delta function in one direction and a constant in the other:  $\delta(x)1(y)$ . The system forms an image at the detector, the line response  $l(x)$ , which is a summation of vertically displaced impulse responses. The measured line spread functions  $l(x)$  will resemble Figure 2-3.

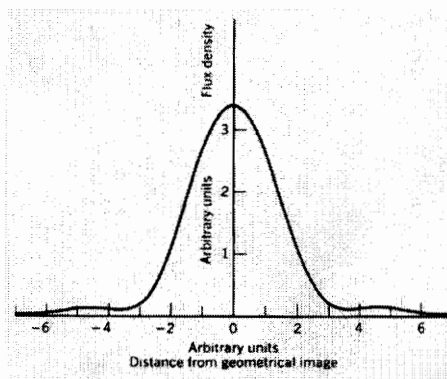


Figure 2-3. Sample Line Spread Response.  
Source: Introduction to the Optical Transfer Functions, Charles Williams

The MTF is the magnitude of the Fourier transform of the line spread function. The slit method only provides the MTF profile for the one dimension Fourier Transform  $[l(x)] = \text{OTF}(\xi, 0)$ . To obtain other profiles of the OTF or MTF, the line source can be reoriented (4,55).

Two other factors also play a key role in the accuracy of the slit measurement method; the focus of the system under test and the slit width. If the system is slightly out of focus, it could create large errors in the MTF measurement. Figure 2-4 illustrates this effect.

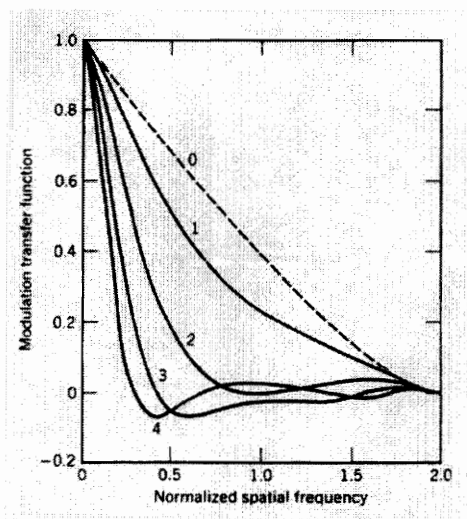


Figure 2-4. Effects of Defocus on the MTF.  
Source: Introduction to the Optical Transfer Functions, Charles Williams

The curve 0 in Figure 2-4, represent the MTF of a system with the correct focus. Curves 1 through 4 (curve 1 slightly out of focus, curve four greatly out of focus) are MTFs for the same system with the effects of defocus applied. Figure 2-4, clearly shows the importance of correctly focusing the system and the detector for accurate measurements.

The second factor to insure accuracy is the slit width. If the width of the slit is too large, the slit will not approximate a delta function. Instead, it will approximate the rectangle function  $f(x) = \text{rect}(x)$ . The Fourier transform of a rectangle function is a Sinc function  $(\text{Sin } \xi / \xi)$ . This will

force the MTF to behave more like a Sinc function. This will artificially increase the MTF as shown in Figure 2-5.

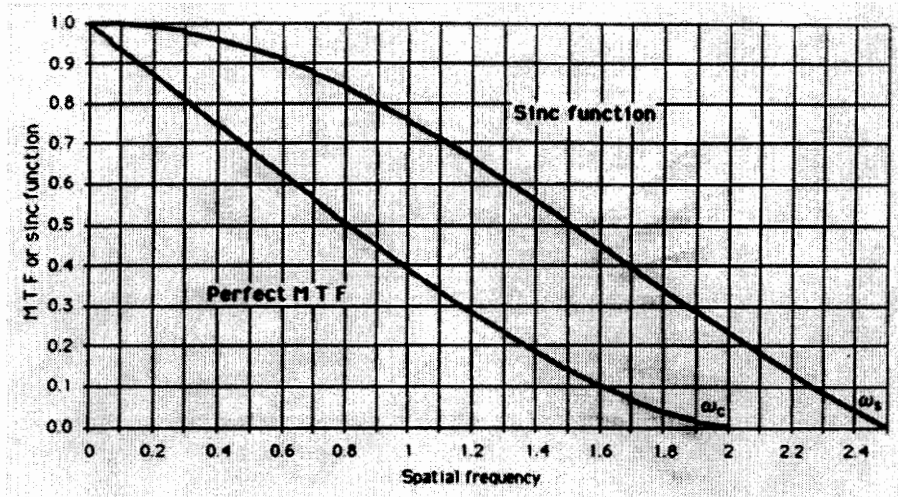


Figure 2-5. Large slit widths will cause MTFs that resemble the Sinc function.  
Source: Introduction to the Optical Transfer Functions, Charles Williams

To preserve the integrity of the measurement, the slit width must be compensated by normalizing the measured MTF with the corresponding Sinc function. A simpler method is to use a slit width that is smaller than the system under test can resolve (4,270). This will create the situation where the slit approximates a delta function and no compensation for the slit width is required.

### 3.0 Discussion of Image Intensifier Technology

In 1905, Albert Einstein theorized the photoelectric effect. His theory stated that when a photocathode, or negatively charged electrode, is exposed to electromagnetic radiation from an image whose wavelength is shorter than a certain critical value, the photocathode will emit a current of electrons that can be collected by a nearby anode or positively charged electrode (5,62). For many metals, this critical wavelength lies in the ultraviolet region of the spectrum, while for some substances it lies in the visible or near infrared region. The rate at which the charge is transferred is proportional to the intensity of the radiation. The concept of the image intensifier is based on the photoelectric effect. An image intensifier uses the photoelectric effect to convert streams of photons in electromagnetic radiation into streams of electrons. Amplification of an image is possible due to the charge on the electrons. In an applied electric field, the electrons are accelerated increasing their kinetic energy. This method increases the total energy available for forming an image by many times (5,62).

A loose definition of an image intensifier is a device that amplifies visible and near visible (near Infrared) light into a brighter visible image (6,21.8). Since the early 1960s, research has been performed to develop image intensifier technology. Several generations of the image intensifier have been developed. To date, the most advanced image intensifier is the third generation (3rd Gen) wafer tube. The 3rd Gen tube is used in nearly every high performance image intensifier system. This tube is the heart of the AN/AVS-6 Aviator's Night Vision Imaging System (ANVIS), which is the focus of this research. The ANVIS is a binocular image intensifier system as illustrated in Figure 3-1, that allows pilots to more effectively operate aircraft during night operations.

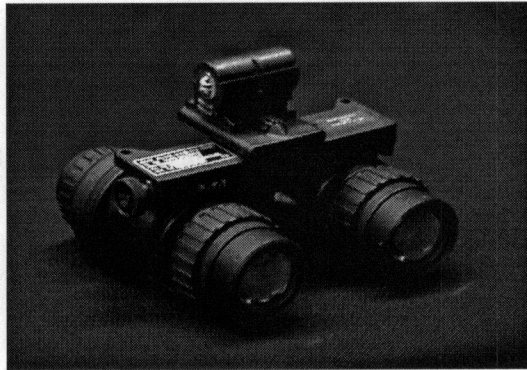


Figure 3-1. Aviator's Night Vision Imaging System (ANVIS).

The ANVIS has the ability to effectively operate in light levels from  $1 \times 10^{-6}$  to  $1 \times 10^{-2}$  foot Lamberts (ft-L) which equates to conditions ranging from overcast to full moon nights. The power consumption is approximately 40 milliWatts which allows for operations on two "AA" batteries for more than 20 hours. The system has a 40 degree field of view with unity magnification. The system can be focused from approximately 10 inches to infinity. The minimum limiting resolution is 0.76 cycles per milliradian (cy/mrad) (7,4). This resolution is approximately 20/40 on the Snellen Acuity scale. This low resolution is primarily caused by the performance of the image intensifier tubes. Newer image intensifier tubes (Improved Resolution Wafer Tube (IRWT) discussed later) can provide system limiting resolutions on the order of 1.4 cy/mrad.

The ANVIS binocular system consists of two channels (monoculars), each containing a 3rd Gen image intensifier wafer tube, an objective lens, and an eyepiece lens as illustrated in the block diagram in Figure 3-2.

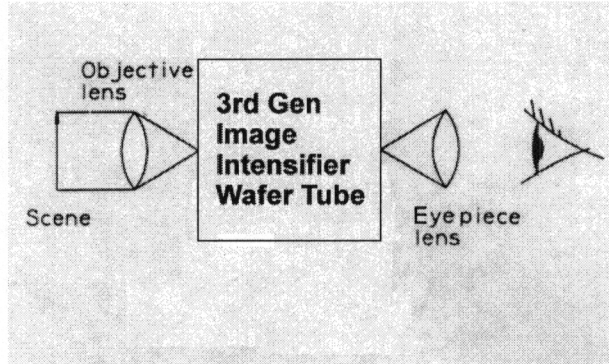


Figure 3-2. Image Intensifier System Concept.  
Source: Electro-Optical Displays, Karim

As shown in the block diagram, the scene is first focused by the objective lens onto the entrance of the 3rd Gen wafer tube. The wafer tube then intensifies the image of the input scene. The eyepiece lens focuses the output of the wafer tube for viewing by the user. To fully grasp the image intensifier system technology, each component should be discussed separately.

### 3.1 3rd Generation Image Intensifier Tube (3rd Gen I<sup>2</sup>)

The 3rd Gen I<sup>2</sup> tube consists of several components including an input window (photocathode faceplate), a photocathode, a microchannel plate (MCP), phosphor screen, and an output window as shown in Figure 3-3.

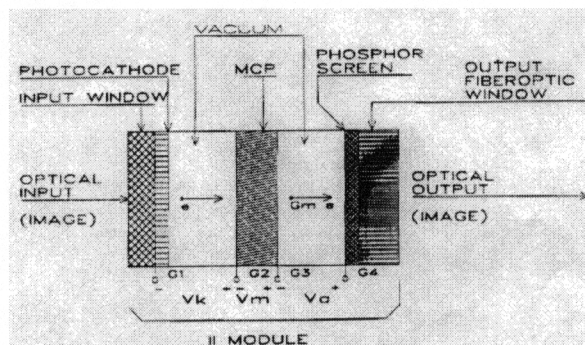


Figure 3-3. Illustrations of 3rd Gen I<sup>2</sup> tube components.  
Source: Handbook of Optics Volume I, Bass

The photocathode on the vacuum side of the input window converts the input optical image into an electronic image by converting photons into electrons. The microchannel plate acts as an amplifier of the electronic image pixel by pixel. The amplification is achieved because each electron exiting the photocathode enters a channel in the MCP and is multiplied several hundred times. This produces an increase in electrons exiting the MCP. The amplified electron image at the output of the MCP is reconverted to a visible image using the phosphor screen on the vacuum side of the output window. The output window is usually a fiber optic. The complete process results in an output image which can be as much as 20,000 to 50,000 times brighter than the input image (6,21.9).

### 3.1.1 Photocathode

The optical spectral range of sensitivity of an image intensifier is determined by the combination of the optical transmission of the photocathode faceplate and the spectral sensitivity of the photocathode. The photocathode faceplate is normally transparent glass that is bonded to the photocathode. Earlier image intensifiers such as the Second Generation (2nd Gen) tubes have photocathodes consisting of multialkali materials. These materials have a luminous sensitivity of approximately 350 micro Amperes per lumen (8,59). The 3rd Gen tubes use GaAs photocathodes with a luminous sensitivity exceeding 1000 micro Amperes per lumen (2,39). Higher luminous sensitivity increases the ability of the photocathode to convert photons to electrons. The combination of a GaAs photocathode bonded to glass such as Corning #7056 has its highest quantum efficiency (approximately 30 percent) and thus sensitivity over the waveband of 600 to 900 nanometers (6,21.12). Therefore, the GaAs photocathode has defined the operating waveband of the 3rd Gen image intensifier system as 600 to 900 nanometers.

### 3.1.2 Microchannel Plate (MCP)

The development of the microchannel plate has been the single most important advancement in image intensifier technology. The MCP requires low power to operate while providing extremely high gain. The MCP consists of millions of capillary channels arranged in arrays of closed packed hexagonal arrays acting as electron multipliers as shown in Figure 3-4. The channels are in a glass plate with a thickness ( $L_m$ ) of approximately 0.5 millimeters (mm) and a channel diameter on the order of 10 micrometers ( $\mu\text{m}$ ) (9,647).

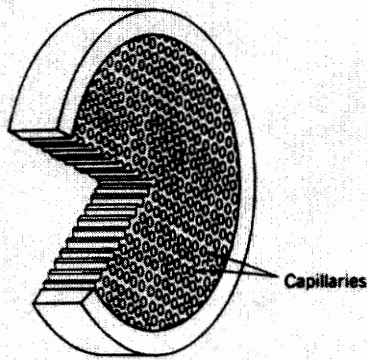


Figure 3-4 a. Microchannel Plate (MCP).

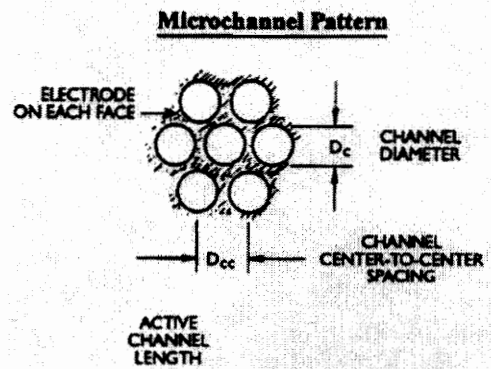


Figure 3-4 b. Geometry of MCP channels.

A voltage is applied across the array of channels producing a gain  $G_m$ . The photocathode produces a current of electrons  $I_{in}$  traveling from the photocathode to the MCP. At the output of the MCP, the current of electrons has been amplified to equal  $G_m I_{in}$ . This result is caused by electrons from the photocathode striking electrons that line the channel walls (electrons created by the applied voltage) of the MCP. The MCP channels are slightly biased in their orientation to localize the first electron strike location to a region close to the input end. This improves the gain of the MCP by maximizing the number of collisions of input electrons to electrons lining the walls of the channels. These collisions produce more electrons traveling down and out the channel and thus more output energy as shown in Figure 3-5 (9,647).



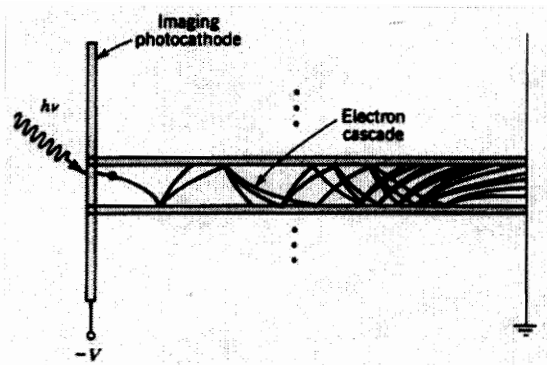


Figure 3-5. The electron path through a MCP.  
 Source: Fundamentals of Photonics, Saleh

In addition to serving as a low noise current amplifier, the MCP retains the current density pattern or "electronic image" from its input to output electrodes. The limiting resolution of the microchannel plate is dependent on the channel spacing. Reduction of the channel spacing increases the limiting resolution for the channel plate. Reduction of the channel diameter increases the MTF of the MCP. Table 3-1 illustrates typical limiting resolutions for MCPs.

Table 3-1. Relationship of Channel Diameter and Spacing to limiting Resolution

Channel Diameter ( $\mu\text{m}$ )	Channel Center-to-Center Spacing ( $\mu\text{m}$ )	Approximate Limiting Res. (cy/mm)
4	6	83
6	8	63
8	10	50
10	12	42
12	15	33

Source: Handbook of Optics Volume I, OSA

Typical MCPs for 3rd Gen tubes have channels with diameters of 10 to 12  $\mu\text{m}$ . Newer 3rd Gen tubes (IRWT tubes discussed later) have channel spacings of approximately 6  $\mu\text{m}$  and thus much higher limiting resolution. Since the MCP has the lowest limiting resolution of the image intensifier tube components, it plays a key role in the limiting resolution of the overall system and the system MTF.

### 3.1.3 Phosphor Screen

An aluminum film electrode is located on the electron input of the phosphor to accelerate the MCP output to a higher energy and to reflect light out the output window. The phosphor screen converts the electrons from the MCP back to photons and the visible image. A typical phosphor screen for 3rd Gen image intensifier tubes is P20, also designated phosphor KA. P20 has a decay time on the order of 0.01 seconds (6,21.16). This short decay time provides for little persistence or smearing of the image. P20 has its peak output at 530 nanometers. The phosphor screen has a typical limiting resolution of 100 to 130 cy/mm (2,81).

### 3.1.4 Fiber Optic Twist

The fiber optic twist acts as the output window for the image intensifier tube. The fiber optic twist is a bundle of smaller fibers with diameters of approximately 6  $\mu\text{m}$ . The bundle diameter is usually the same size as the input window (18mm or 25mm). The phosphor screen is deposited on the input of the fiber optic bundle. The object lens that focuses the input scene on the image intensifier tube inverts the image onto the tube. This inverted image is carried through the imaging tube. The fiber optic has a 180 degree twist to invert the image back to the correct orientation. The limiting resolution of the fiber optic twist is in the range of 80-100 cy/mm (2,81).

### 3.1.5 3rd Gen Image Intensifier Wafer Tube

The heart of ANVIS is the 18mm 3rd Gen I<sup>2</sup> wafer tube. Figure 3-6 illustrates the construction of the tube. The diameter of the output fiber optic twist and the active input window for ANVIS is 18mm.

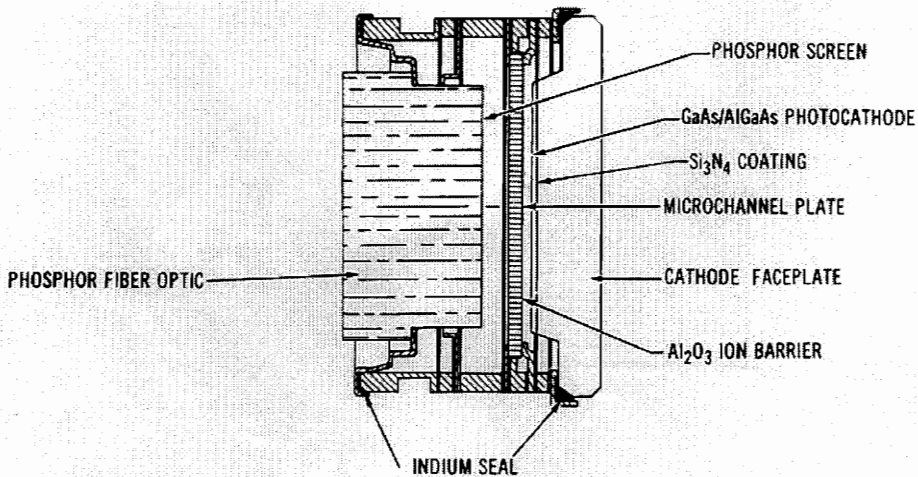


Figure 3-6. Diagram of 3rd Gen Wafer Tube.  
Source: Image Tubes, Illes Csorba

The 3rd Gen wafer tube consists of all the major components discussed previously. It also includes an ion barrier deposited on the MCP input, consisting of Al<sub>2</sub>O<sub>3</sub> to protect the photocathode from positive ions leaking back from the MCP. Typical limiting resolution for the wafer tube is 28-40 cy/mm depending on the MCP channel spacing and the fiber size (2,81). The weight of the tube is 85 grams (10,10). The tube must meet the following MTF specifications outlined in Table 3-2.

Table 3-2. MTF Requirements for 3rd Gen Wafer Tube

Spatial Frequency (cy/mm)	Percent MTF
2.5	86
7.5	65
15.0	35
25.0	16

Source: Omnibus III 18mm Image Intensifier Assembly Specification

### 3.1.6 Improved Resolution Wafer Tube (IRWT)

In December 1993, the Improved Resolution Wafer Tube Program began to advance the state of the art for third generation wafer tubes. The goal of the program was to substantially improve the limiting resolution and the MTF of the wafer tube. The goal for the limiting resolution of the tubes was set at approximately 60 cy/mm. This is achievable by improving several aspects of the wafer tube design as outlined Table 3-3.

Table 3-3. Improvements of the IRWT over the normal 3rd Gen Tube.

<u>CHANGE</u>	<u>ACTION</u>
Photocathode to MCP Spacing	Reduce spacing found in average ANVIS tube by 25%.
MCP Pitch	Reduce pitch found in average ANVIS tube by 50%.
MCP-to Phosphor Screen Spacing	Reduce spacing found in average ANVIS tube by 40%.
Phosphor Particle Size	Reduce particle size found in average ANVIS tube by 30%.
Fiber Optic Twist Fiber Size	Reduce fiber size found in average ANVIS tube by 50%.

Source: IRWT Program Synopsis Dec 93

Two of these tubes were obtained for testing. The data outlining their MTF performance can be found in the appendix (Tube serial numbers: 42000120, 42000112). These tubes have a much improved MTF and limiting resolutions of 64 and 71 cy/mm.

### 3.2 ANVIS Objective Lens

The objective lens of the ANVIS is made to correctly operate with the ANVIS 18mm 3rd GEN image intensifier with a Corning 7056 glass faceplate. The equivalent focal length (EFL) of the lens is 27.03 mm with a T number of 1.35. The field of view of the lens is 40 degrees for an 18mm format (11,4). For cockpit lighting compatibility, the interior surface of the lens is coated with a dielectric film (minus-blue filter). This coating provides the I<sup>2</sup> tube with input light sensitivity at a minimum wavelength of 625 nanometers (12,661). The objective lens must meet the on axis MTF specifications outlined in Table 3-4.

Table 3-4. MTF Requirements for ANVIS Objective Lens

Frequency (cy/mm)	% MTF
0	100
10	94
20	84
30	73
40	61

Source: ANVIS Objective Lens Specification

### 3.3 ANVIS Eyepiece Lens

The eyepiece lens of the ANVIS is made to correctly operate with the ANVIS 18mm 3rd GEN image intensifier tube with an output fiber optic twist. The equivalent focal length (EFL) of the lens is 27.03 mm. The field of view of the eyepiece is 40 degrees for an 18mm format. The eye relief (minimum distance from the eyepiece to eye) is 25 mm (13,3). The eyepiece lens must meet the on axis MTF specifications outlined in Table 3-5.

Table 3-5. MTF Requirements for ANVIS Eyepiece Lens

Frequency (cy/mm)	MTF (%)
10	92
20	83
30	75
40	70

Source: ANVIS Eyepiece Lens Specification

#### 4.0 Present/Proposed System MTF Measurement Methods

Throughout the ANVIS tube and lens performance specifications, references are made to their MTF performance. These specifications provide National Institute of Standards and Technology (NIST) traceable methods for measuring the MTF of all the ANVIS system components (objective lens, image intensifier tube, and eyepiece lens). These methods require individual specialized test setups and often require several people to perform the measurements on all of the components. The ANVIS system specification only specifies an on-axis limiting resolution of 0.76 cy/mrad. There is no performance specification for on-axis system MTF because of the inability to directly measure the system MTF. The system MTF can be calculated by

$$MTF_{sys} = MTF_{obj} * MTF_{tube} * MTF_{eyepiece} \quad \text{Eqn 4-1.}$$

The component level MTFs are functions of linear spatial frequencies cycles per millimeter (cy/mm). Because the system output is collimated light (image focused at infinity), the system MTF is a function of angular spatial frequencies with the units of cycles per milliradian (cy/mrad). The component level spatial frequency must be converted from cy/mm to cy/mrad by use of Equation 4-2 (3,32.3).

$$\begin{aligned} f_{angular} \text{ [cy/mrad]} &= f \text{ [cy/mm]} * f \text{ [mm]} / 1000 \\ f &= \text{focal length for ANVIS eyepiece} = 27.03 \text{ mm} \end{aligned} \quad \text{Eqn 4-2.}$$

Therefore the system MTF can be calculated by measuring the on axis MTF of each component of the ANVIS system, multiplying their MTFs together, and correcting the spatial frequency to an angular scale (cy/mrad).

This method for measuring on-axis system MTF will work, but it is very inconvenient, resource demanding, and time consuming. To incorporate a system MTF requirement into future

specifications and to enhance the assessment of present ANVIS systems, a method to directly measure system MTF is required. A method to measure system MTF would require an object at infinity presented to the system under test and a sensor capable of capturing the collimated image from the eyepiece. The sensor would then have to convert the image data to a MTF measurement. This method is the focus of this research. It is proposed that this setup is achievable by using a slit imaged through a collimating lens to present the object at infinity to the system under test. A sensor such as the Photo Research PR-900 video photometer is capable of capturing the collimated image from the eyepiece of the ANVIS. A slit will be used as the object because the PR-900 has the ability to calculate the line spread function (LSF) of the slit, perform a Fast Fourier Transform (FFT) on the LSF, and produce a MTF curve. To verify that this method works, the on-axis MTF will also be measured for the component parts of the ANVIS system. The process for measuring the MTF of each component is outlined in their corresponding military performance specification. The calculated MTF (derived from the component MTFs) will be used as the standard to assess the accuracy of the directly measured system MTF.

## 5.0 Experimental Setups

### 5.1 Overview of the Setups

There were two basic setups for this experiment. The second was an improvement of the first to add better control of the experimental conditions. Both setups included the use of the Photo Research PR-900 video photometer, a Grayco eight inch collimating lens, a 20 inch uniform light source, and a slit reticle. The method used to measure MTF is the slit method because of the built in capabilities of the PR-900 to calculate the Fast Fourier Transform (FFT) of a line spread function to achieve a MTF measurement. The basic construction of both setups is illustrated in Figure 5-1.

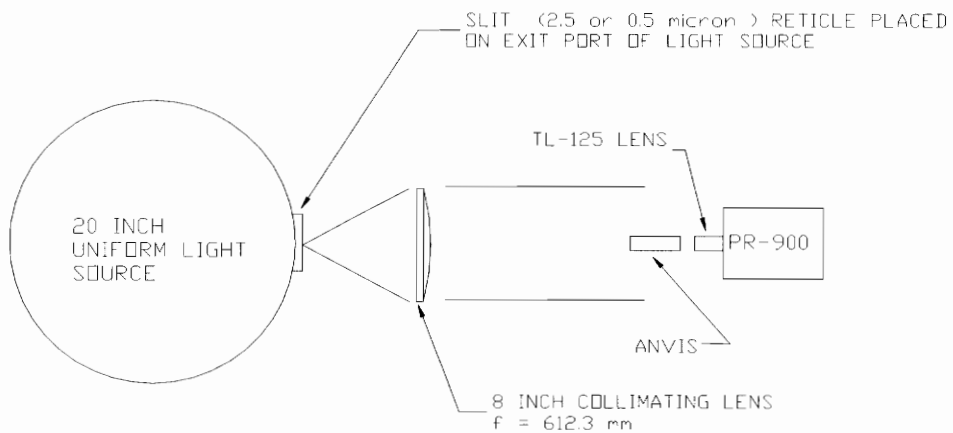


Figure 5-1. Basic setup for system MTF measurement.

Figure 5-1 shows that a slit reticle was attached to the exit port of the 20 inch uniform light source sphere. The 8 inch collimating lens was placed at a distance equal to its focal length of 612.3 mm from the reticle. This condition (distance=612.3 mm) produces a uniform collimated beam of the



image exiting the collimating lens. Next, the PR-900 is placed on axis with the center of the collimating lens to capture the light exiting the center of the collimator. The ANVIS is then placed in front of the lens of the PR-900 at approximately 18 mm (distance from the eyepiece of the ANVIS to the lens of the PR-900 lens). The distances and the heights of the objects have been defined to insure that the light is properly collimated and that all of the measurements will be on axis measurements.

## 5.2 The Photo Research PR-900 Video Photometer

The Photo Research PR-900 Video Photometer is a highly sensitive and highly capable scientific device. It is a PC-based measurement system developed to perform spatial, photometric, and colorimetric inspections of imaging systems. Some of the measurement capabilities of the PR-900 include:

- Line, Character, and Background Luminance,
- Relative Chromaticity,
- Luminance Uniformity,
- Luminance Profiles (2 and 3 Dimensional Representations),
- MTF,
- Line Width,
- Misconvergence,
- Geometric Distortion,
- Character Size, and
- Spot Contour.

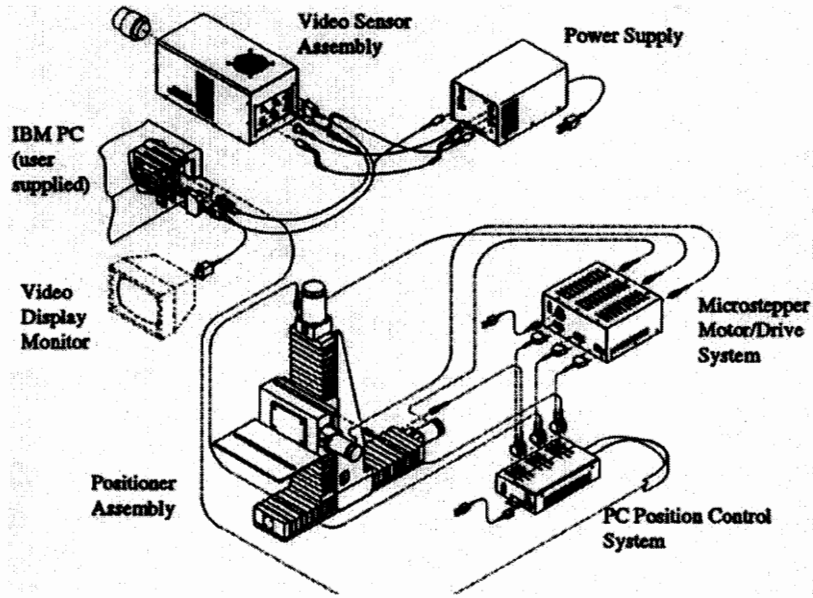


Figure 5-2. PR-900 Components.  
 Source: Photo Research PR-900 Operating Manual

The PR-900 system components are illustrated in Figure 5-2. The heart of the system is the thermo-electrically (TE) cooled CCD Video Sensor Assembly (VSA). This assembly includes a TE cooled 512 x 480 pixel CCD array sensor. The CCD array detector captures light from its target (ANVIS output) and converts it into a video signal. The TE cooler reduces the dark currents and noise across the sensor array and increases its sensitivity. The size of the pixels is approximately 13 x 17  $\mu\text{m}$ . The CCD is capable of measuring light intensities as low as 0.1 ft-L. With the use of its filter wheel (enclosed in the VSA), which includes Neutral Density Filters and Color Filters (Red, Green, and Blue) the CCD can operate with light intensities of 0.1 to  $1 \times 10^4$  ft-L and under any visible color light conditions. The VSA is attached to a 3 axis computer controlled motorized stage with an accuracy of a 10,000th of an inch. This stage allows for an accurate placement of the VSA to insure the accuracy of spatial measurements.

The VSA and stage are connected to a PC. In the PC is a motor control interface board and a frame grabber. The Photo Research software VView, provides for a working environment

that is fairly easy to learn and powerful enough to perform the measurement/control tasks of the system. The software controls the position of the VSA, its integration time, the filter wheel position, and operations of all measurements. The output of the VSA is displayed on a second monitor. The first monitor is used for displaying the control environment.

The PR-900 is capable of using a wide variety of lenses with magnifications ranging from 0.125X to 4X. It is also capable of using the Photo Research TL-125 HUD Lens which provides the capability of focusing on the outputs of devices that produce collimated light (such as the collimating lens or the eyepiece of the ANVIS). The TL-125 lens has a field of view that is approximated 3.22 x 2.42 degrees (Horizontal x Vertical ) and a focal length of 125 mm.

The VDView software is capable of measuring MTF by two methods. The first is by the Contrast Ratio Method, which uses a three bar target spaced at a defined frequency. The PR-900 examines the output of the imaging system under test and measures the contrast, given by

$$\text{Contrast} = \frac{[ (\text{Max Measured Luminance} - \text{Min Measured Luminance}) ]}{[ (\text{Max Measured Luminance} + \text{Min Measured Luminance}) ]} \quad \text{Eqn 5-1.}$$

An MTF curve could be created by taking several measurements with bar patterns at different spatial frequencies.

The second method is the slit method. The PR-900 is capable of examining a vertical or horizontal slit (bright line) as seen in Figure 5-3 a. The PR-900 measures the line spread profile which incurs a DC bias from the CCD sensor as seen in Figure 5-3 b. The PR-900 software subtracts out the DC bias created from the CCD sensor to create the correct line spread function as seen in Figure 5-3 c. Next, the PR-900 performs a FFT transform of the line spread function. The magnitude of this output function is the MTF as seen in Figure 5-3d.

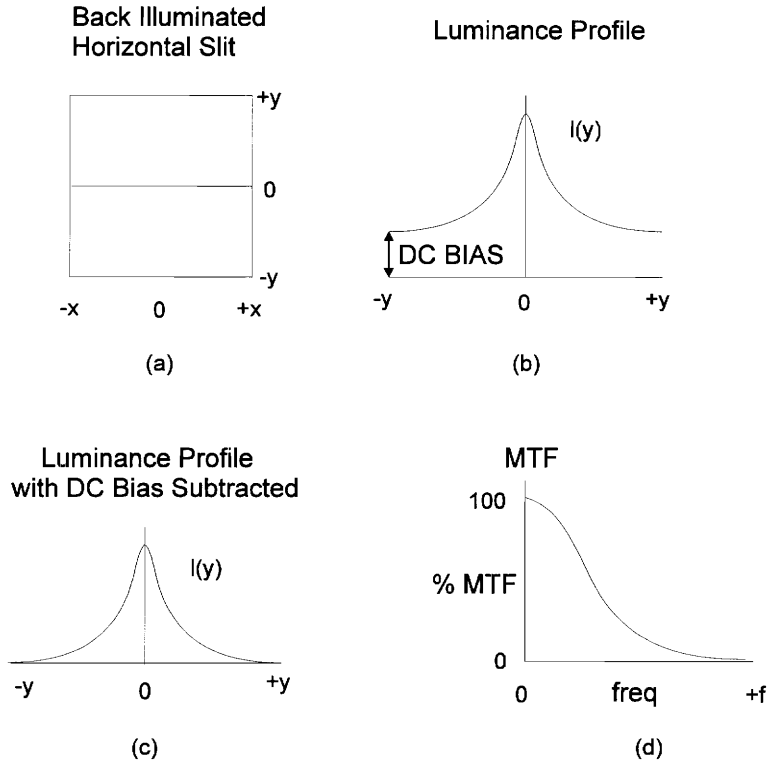


Figure 5-3. PR-900 MTF Measurement Process.

The default spatial frequency of the MTF calculation is cy/inch which applies to the PR-900 lenses with a fixed working distance. Since the PR-900 software does not compensate for the TL-125 lens and its variable working distance (focuses at 4 feet to infinity), the correct conversion from cy/inch to cy/mrad looking through the ANVIS system is given as

$$\frac{\text{freq [cy/inch]} * (\text{Focal Length}_{\text{ANVIS}}/1000)}{25.4 \text{ mm} * (\text{Focal Length}_{\text{PR-900}}/1000)} = X \text{ [cy/mrad]} , \quad \text{Eqn 5-2.}$$

where  $\text{Focal Length}_{\text{ANVIS}}$  is the focal length of the ANVIS eyepiece lens which is equal to 27.03 mm. The  $\text{Focal Length}_{\text{PR-900}}$  is the focal length of the TL-125 lens on the PR-900. The TL-125 has a focal length of 125mm. Since the pixel size of the CCD is  $13 \times 17 \mu\text{m}$ , the PR-900 has

a better response to a horizontal line (better vertical MTF) than a vertical line. Thus, all MTF measurements should be recorded using a horizontal slit.

### 5.3 Grayco 8 inch Collimating Lens

The Grayco 8 inch collimating lens is a thick lens with one flat surface and one rounded surface as shown in Figure 5-4.

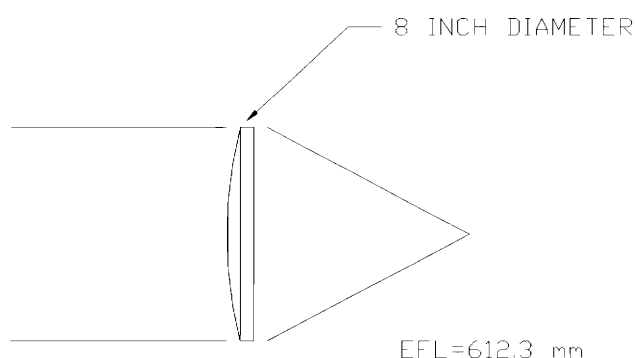


Figure 5-4. Properties of the Grayco 8 inch collimating lens.

The MTF of the collimating lens has been measured by NIST traceable methods and found to be excellent (greater than 95%) for the center two to three inches of the lens and tapered off as the measurements were made towards the edges of the lens. This lens provides ideal collimated light for measurements that are taken on axis and primarily utilize the center of the lens. The collimating lens has been placed in a gimbal mount to insure that the lens orientation is correct. The gimbal is also bolted to a Newport lab jack to provide for the ability to raise and lower the lens. This insured that the lens is on axis with the target reticle. The original setup includes connecting the jack to manually controlled stages to insure that the collimating lens is positioned at the distance equal to its focal length away from the target reticle. The modified final setup

includes a motorized linear stage with an accuracy of  $10\ \mu\text{m}$  to better control the positioning of the collimator lens. Figure 5-5 illustrates the final construction of the collimating lens mount.

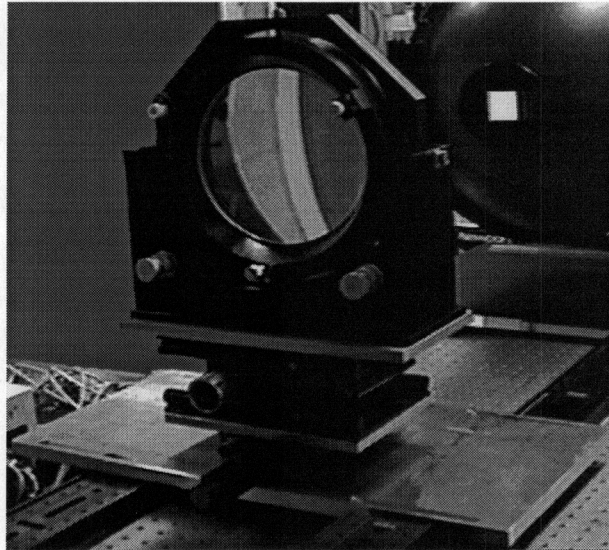


Figure 5-5. 8 Inch collimating lens mounted in a gimbal mount. The gimbal mount is attached to a Newport lab jack for vertical control and a linear stage ( $10\ \mu\text{m}$  accuracy) for positioning.

#### 5.4 Uniform Light Source

The uniform light source serves as the illumination for the slit reticle for all of the measurements. The light source consists of a Labsphere 20 inch sphere with an 8 inch sphere driving the larger sphere. The 20 inch sphere has a 4 inch input and a 4 inch output port. A large 20 inch sphere is used to insure that the 4 inch output port is uniform with 5 percent error across the output plane. The eight inch sphere driving the larger sphere includes a tungsten lamp placed in it. The output light of the lamp exiting the eight inch sphere is approximately uniform across its two inch exit port. It is further attenuated and integrated in the larger sphere to produce greater uniformity at the exit of the larger sphere. The original setup utilizes a Hoffman RS-65 Calibration

Source as the driving light source. The Hoffman includes a manually adjustable variable aperture to adjust its output light level. This double sphere combination provides for a manually controlled operating range of 14.65 ft-L to  $9.5 \times 10^{-5}$  ft-L with a calibrated color temperature of 2856 Kelvin (K). The final light source configuration involves the replacement of the Hoffman source with a Labsphere 8 inch sphere. A computer controlled aperture wheel is placed at the interface between the 20 inch and the eight inch sphere.

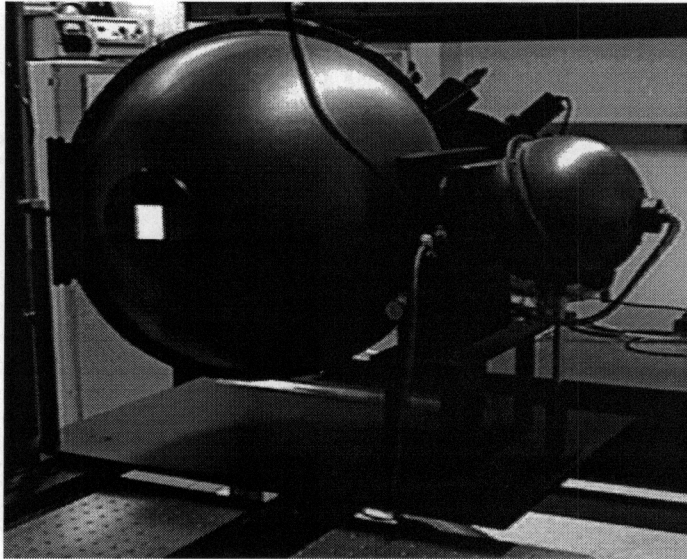


Figure 5-6. 20 inch uniform light source with computer controlled aperture wheel.

This aperture wheel has ten discrete settings to produce light at an operating range of 35 ft-L to  $1 \times 10^{-7}$  ft-L with a calibrated color temperature of 2856K. The computer controlled wheel helps increase the consistency and accuracy of the light source output.

Placed on the output of the 20 inch sphere is a reticle holder. This holder holds two inch square reticles on the center of the four inch exit port. The final sphere configuration is illustrated in Figure 5-6.

## 5.5 Reticles

Three reticles are used during the measurement process. They are an AF-1951 pattern reticle, a 2.5  $\mu\text{m}$  slit reticle and a 0.5  $\mu\text{m}$  slit reticle. The AF-1951 pattern is a standard pattern for assessing the focus and limiting resolution of imaging systems. As seen in Figure 5-7, each set of bar patterns represents a different spatial frequency.

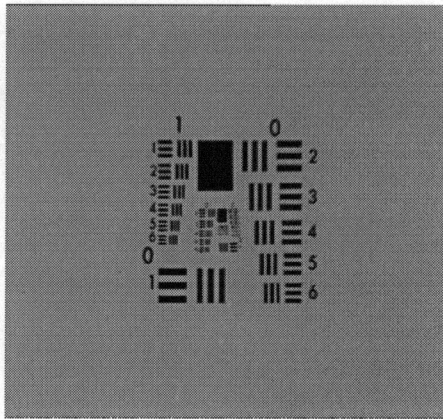


Figure 5-7. AF-1951 pattern reticle.

The bar patterns are arranged into groups of patterns. Figure 5-7 shows four groups (group 0, 1, 2, and 3). Each group has six elements (1 through 6). The resolution of each pattern is defined by

$$\text{Resolution } R = 2^{\exp(n+(k-1)/6)} \text{ [cy/mm]} \quad , \quad \text{Eqn 5-3.}$$

where  $n$  is the group number and  $k$  is the element number. An example pattern would be the pattern 1/3 located on the center left. The 1 is the group number and the 3 is the element number. The resolution of this pattern is  $2^{\exp(1+(3-1)/6)} = 2.52 \text{ cy/mm}$ .

By examining the series of patterns, the user can adjust the focus of the imaging system to insure the best focus. The last pattern for which the imaging system can resolve the bars from spaces is the limiting pattern. This pattern then equates to a limiting resolution. Both



experimental setups use the AF-1951 pattern for focusing the collimating lens, the PR-900, and the ANVIS.

The second reticle is a two inch by two inch quartz slide coated with aluminum that has a 2.5  $\mu\text{m}$  wide slit etched across its center. The third reticle is also a 2 inch x 2 inch slide coated with aluminum, but it has a 0.5  $\mu\text{m}$  wide slit etched across its center. Figure 5-8 illustrates these reticles.

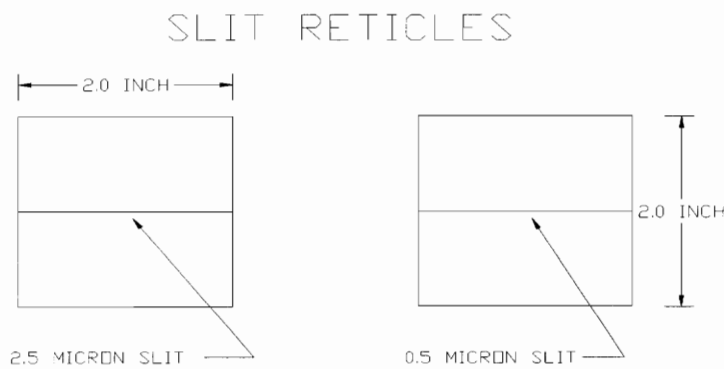


Figure 5-8. Slit Reticles.

### 5.6 Alignment and Focus Procedure

To obtain highly accurate measurements the alignment of the devices in the setup and the focus of the lenses are crucial. First, the eight inch collimating lens is accurately aligned and focused, followed by the PR-900.

The alignment process for the collimating lens begins with setting the height of the lens so that its center is on axis with the center of the slit reticle on the 20 inch sphere. The collimator is approximately positioned 612mm (the focal length of the lens) from the output of the 20 inch sphere. The AF-1951 reticle is placed on the output port of the sphere and back illuminated by

the sphere with a light level of 35.2 ft-L. A K&E millidioptometer is mounted in a holder and placed on a Newport lab jack as seen in Figure 5-9.

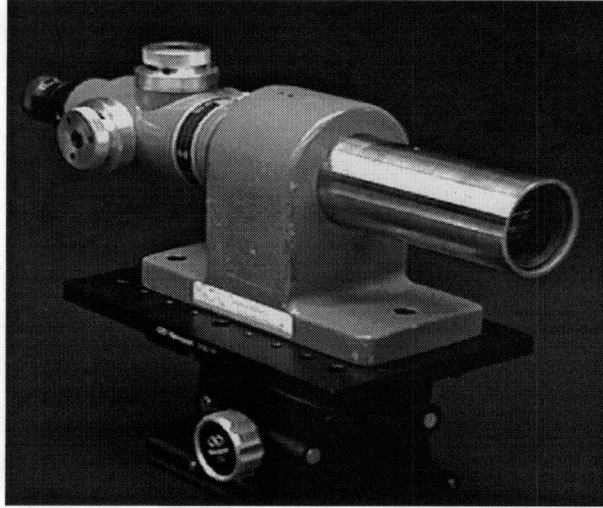


Figure 5-9. K&E Millidioptometer.

The millidioptometer is then raised and centered so that it is on axis with the AF-1951 reticle. The K&E millidioptometer is a unique piece of equipment due to its ability to adjust its focus with an accuracy of a tenth of a millidiopter. The millidioptometer focus is set to infinity (with an error  $\pm 0.1$  millidiopter). The millidioptometer has a limiting resolution much greater than the unaided eye or the PR-900. While viewing the AF-1951 reticle through the millidioptometer, the position of the collimating lens is varied (distance from the collimating lens to the AF-1951 reticle) to achieve accurate placement of the collimating lens at its focal length away from the output port of the 20 inch sphere. Using the first setup, this adjustment was performed manually using manually controlled stages to move the collimator. In the improved experimental setup, the manual adjustment was replaced with a motor controlled linear stage, with an accuracy of  $10 \mu\text{m}$ . This improved setup allows for greater ease of focus setting, the time required to set the focus is greatly minimized, and accuracy is increased. While viewing the AF-1951 reticle through the millidioptometer, the adjustment knobs on the gimbal mount are varied to insure best focus and

the collimating lens is normal to the sphere. After the focus setting process is complete, it is possible to clearly see the 5/3 pattern of the AF-1951 bar pattern using the millidioptometer looking through the collimating lens. The 5/3 pattern equates to a resolution of 40.3 cy/mm.

To double check the collimator focus, a hand held K&E diopterscope focused at infinity is used to look through the collimating lens at the reticle. If the reticle appears at best focus at this setting (focus at infinity) then the collimator lens is correctly focused.

With the collimating lens in the correct alignment/focus, it is now possible to focus the TL-125 lens on the PR-900 to infinity. The TL-125 focus procedure requires the VSA of the PR-900 to be on-axis and center to the collimating lens and the reticle. By viewing the output of the PR-900 on the computer monitor, the focus of the TL-125 lens can be varied to achieve best focus.

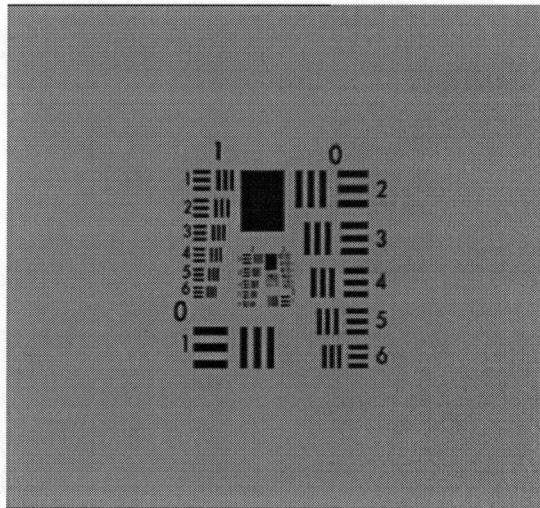


Figure 5-10. View of the AF-1951 reticle through the PR-900.

Figure 5-10 shows the best focus in the vertical (horizontal lines) direction is the pattern 3/2 (may not be seen due to printer resolution) and horizontal (vertical lines) direction is the pattern 1/6.

The difference between the focus in the two directions is caused by the rectangular pixels (13 x 17  $\mu\text{m}$ ) and the support electronics. All measurements are taken in the vertical orientation to take advantage of the better resolution.

## 6.0 Experimental Procedure

The data procedure is designed so that it is relatively easy to execute. It consists of three major sections, focusing the ANVIS monocular channel under test (left or right), acquiring the MTF data, and transforming the data to corrected data. A normal ANVIS system consists of two channels (left and right channel) to create a binocular system. Due to availability, four ANVIS single channels (monoculars) have been assembled from spare components. The same fixturing used for these tests will accommodate testing of ANVIS binocular systems, one channel at a time.

### Initial Conditions

The collimator lens and the PR-900 lens should have already been focused.

Power has been applied to the light source, the PC and the PR-900.

The PR-900 software has been started on the PC.

The PR-900 has been centered on the collimator lens and the reticle on the output of the 20 inch sphere.

The light level of the sphere has been set to 35.2 ft-L.

The AF-1951 reticle has been placed on the exit port of the 20 inch sphere.

Record the channel identification that is under test (ex: mono1\_1).

Record the serial number of the component parts of the ANVIS (lenses, I<sup>2</sup> Tube).

Record the position of the PR-900.

Record the Date.

## 6.1 ANVIS Monocular Focus

### Step 1.

Use the ANVIS test set to approximately focus the eyepiece and object lenses for infinity focus. This procedure is outlined in the ANVIS test-set manual. The test set is a small box with a light source and a reticle pattern. The test set is used for assessing the focus and operations of the ANVIS.

### Step 2.

With the PR-900 looking through the collimator at the AF-1951, capture an image of the reticle. Record the filename, the integration time, and the light level. The image should resemble Figure 6-1.

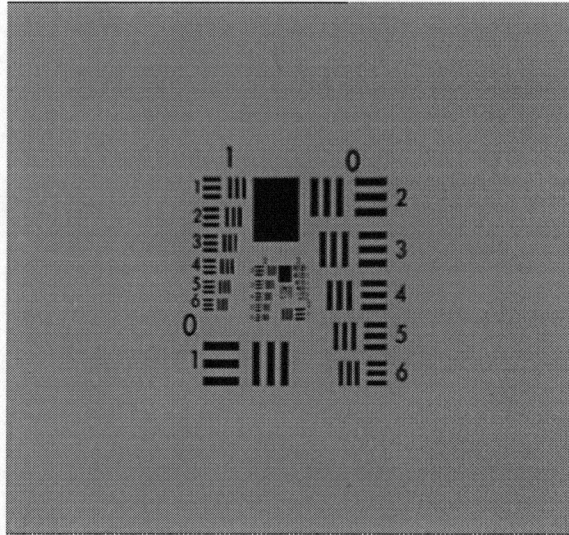
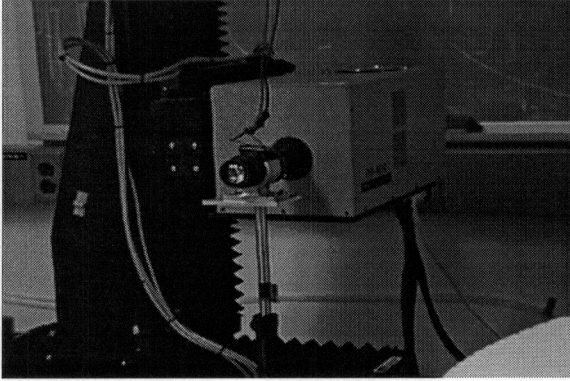


Figure 6-1. View of AF-1951 reticle through collimating lens and PR-900.

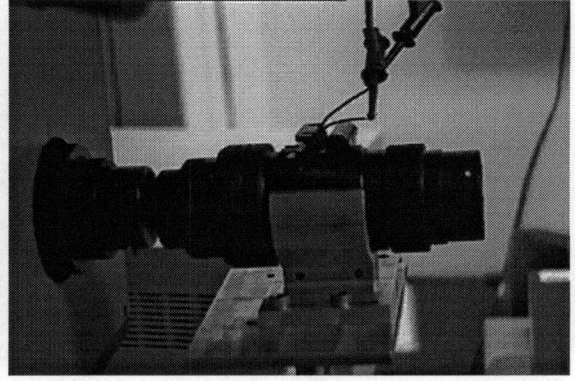
Note that you should clearly see the vertical and horizontal bars of pattern 1/6 and horizontal bars of pattern 3/1 (Note: May not be visible in Figure 6-1 due to printer resolution). This image displays to the user that the system (collimator and PR-900) is correctly in focus.

**Step 3.**

Mount the ANVIS monocular in the ANVIS holder. Mount the ANVIS in front of the PR-900 lens. The ANVIS eyepiece should be centered to the input of the PR-900 and on axis with the collimator lens. The position of the ANVIS should resemble the position of the ANVIS in Figures 6-2 a and 6-2 b.



**Figure 6-2 a. Front view of ANVIS mounted in front of PR-900.**



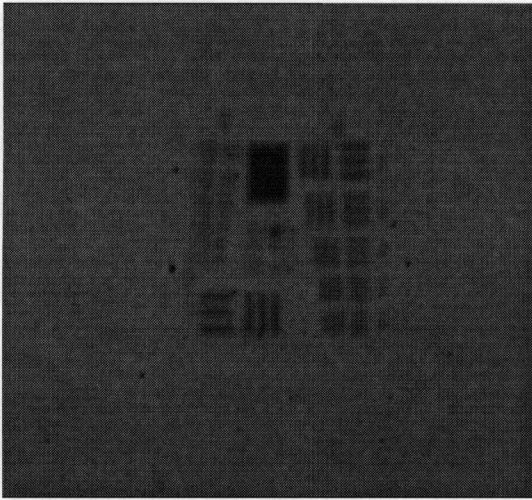
**Figure 6-2 b. Side view of ANVIS mounted in front of PR-900.**

**Step 4.**

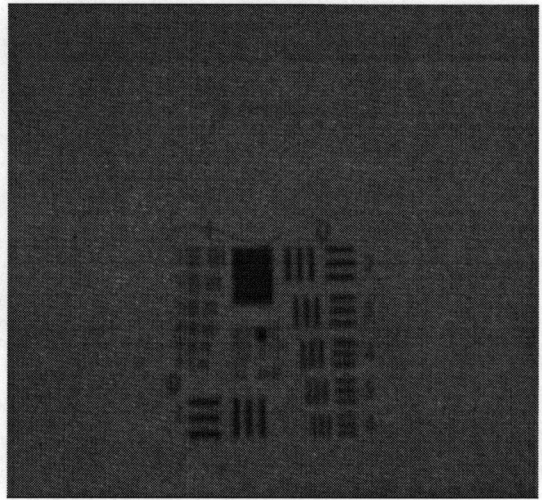
Extinguish the room lights. Set the light level of the 20 inch sphere to  $6.35 \times 10^{-4}$  ft-L using the PC software. Apply power to the ANVIS monocular.

**Step 5.**

Set the integration time of the PR-900 to 1000. Grab an image from the PR-900. The user should see the AF-1951 pattern out of focus. Because the collimator and the PR-900 objective lens are correctly focused, the ANVIS lenses can be adjusted so that both are correctly set for infinity focus. Adjust the ANVIS eyepiece slightly and grab another image. The image should appear more or less fuzzy. Continue to adjust the eyepiece and grab images until you clearly see the construction pattern (hexagonal pattern) of the microchannel plate in the image of the AF-1951 pattern. This insures that the output of the ANVIS is collimated. Next, slightly adjust the objective lens of the ANVIS and grab an image. Continue adjusting the objective lens and grabbing images until the best focus is reached. The output should resemble Figure 6-3 a or 6-3 b.

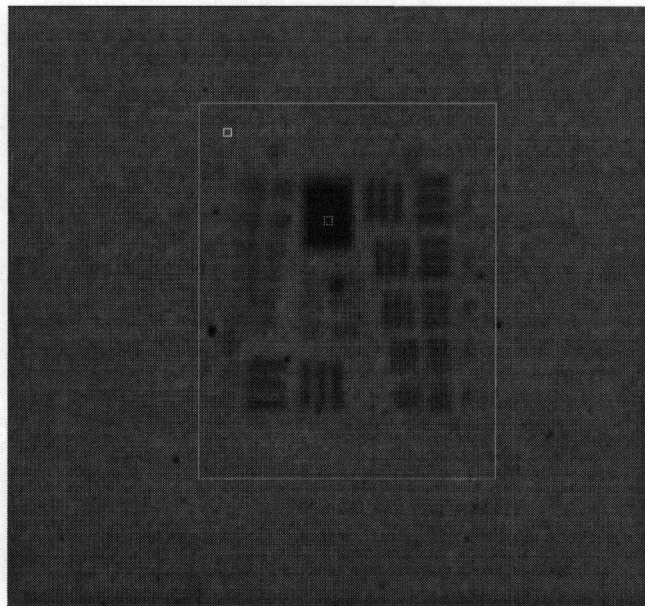


**Figure 6-3 a.** View of AF-1951 through a focused ANVIS with a normal 3rd Gen tube .



**Figure 6-3 b.** View of AF-1951 through a focused ANVIS with a IRWT 3rd Gen tube.

Capture the image to disk. Record the file name, the integration time, and the light level. Perform a luminance measurement. Record the file name, the integration time, light level, the maximum luminance, the minimum luminance, and the average luminance values. The output on the screen (and the saved file) should resemble Figure 6-4.



**Figure 6-4 .** Luminance measurement using an ANVIS w/normal 3rd Gen tube.

## 6.2 Data Acquisition

### Step 1.

Remove power from the ANVIS. Remove the ANVIS in its mount from in front of the PR-900. Increase the light level of the sphere to 35.2 ft-L. Remove the AF-1951 reticle from the 20 inch sphere exit port and replace it with the slit reticle. In the original setup, the 2.5  $\mu\text{m}$  slit is used. In the improved setup, the 0.5  $\mu\text{m}$  slit is used. Orient the slit so that it is approximately horizontal.

### Step 2.

Turn on the integration optimization function of the PR-900 software. Go to the luminance measurement menu on the software. The menu displays a rectangular box as the area of regard (AOR) over the camera image. Increase the box size to the width of the display. The rectangular box is constructed by lines of single pixel width. Move the box to just below the slit on the display. If the slit is not completely horizontal (parallel to the horizontal line of the AOR rectangle), then adjust its orientation and grab another frame. Adjust the orientation of the slit until the slit appears parallel to the horizontal lines of the AOR box and thus is horizontal. The slit should correspond to one row of lit pixels on the display. The image should resemble Figure 6-5.



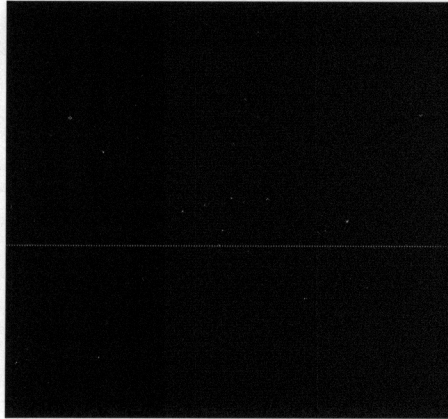


Figure 6-5. View of correctly oriented horizontal slit.

Save the image of the horizontal line to disk. Record the filename, the integration time, and the light level. Note that the AOR box may not save with the image (bug in the software). This step insures that the slit is correctly oriented horizontally.

Step 3.

Go to the setup menu on the PR-900 software. Enable the MTF output and enter a file name. This will output 350 datapoints to file. These points are the MTF measurements vs. cy/inch (1 datapoint per cy/inch). This data will be converted to cy/mrad later. Go to the MTF menu of the PR-900 software. Move the AOR over a segment of the slit. Set the orientation to a horizontal line. Start the MTF measurement. Save the image to disk. Record the file name, the integration time, and the light level. Go to the PR-900 software setup menu and Disable the MTF data output. The image file should resemble the image of Figure 6-6.

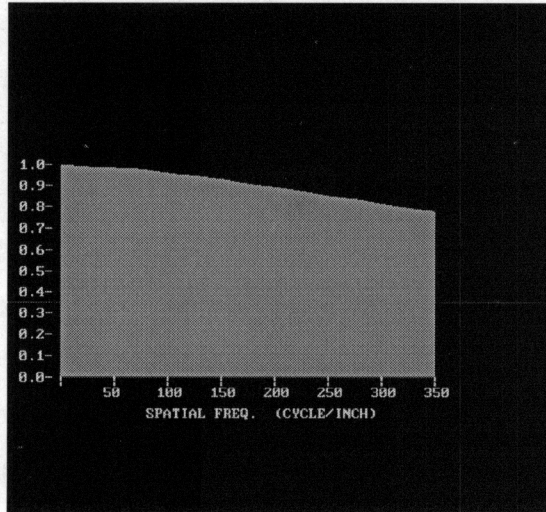


Figure 6-6. Measured MTF for the PR-900 (frequency uncorrected).

Step 4.

Set the light level of the 20 inch sphere to  $6.52 \times 10^{-2}$  ft-L. Mount the ANVIS (in the holder) in front of the PR-900 lens. The ANVIS eyepiece should be centered on the input of the PR-900 and on axis with the collimator lens. Apply power to the monocular. Using the PR-900, grab a frame of the output of the ANVIS looking at the slit. Record the file name, the integration time, and the light level. Go to the setup menu on the PR-900 software. Enable the MTF output and enter a file name. Go to the MTF menu of the PR-900 software. Grab a frame. Move the AOR over a segment of the horizontal line. Start the MTF measurement. Save the image to disk. Record the filename, the integration time and the light level. Record the MTF data file name. Go to the PR-900 software setup menu and Disable the MTF data output. The image file should resemble the image of Figure 6-7 a or 6-7 b.

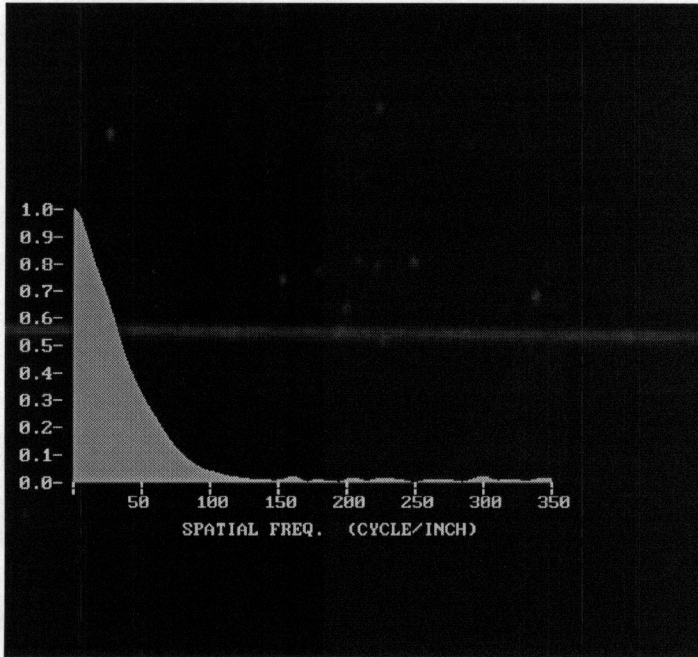


Figure 6-7 a. Sample uncorrected system MTF measurement for ANVIS with a normal 3rd Gen tube.

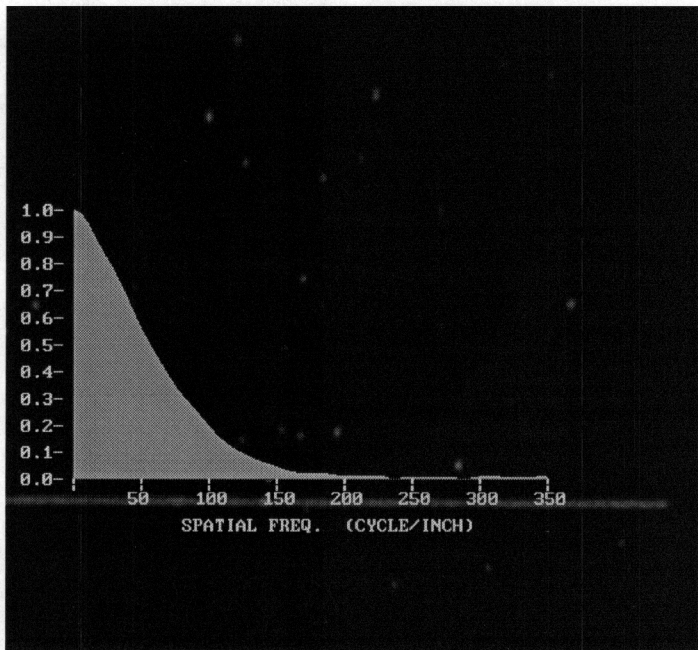


Figure 6-7 b. Sample Uncorrected system MTF measurement for ANVIS with a IRWT 3rd Gen tube.

### 6.3 Correcting/Plotting the Data

The ASCII files containing the MTF data (350 datapoints) store the data in rows with five columns. The data is converted by a small basic file to convert it to one column of data. This makes importing the data to Microsoft Excel much easier. In Excel, the series of numbers 1 through 350 (cy/inch) is inputted into column one. In column two, these values are converted from cy/inch to cy/mrad using

$$\frac{Y \text{ [cy/inch]} * \text{Focal Length}_{\text{ANVIS}}}{25.4 \text{ mm} * \text{Focal Length}_{\text{PR-900}}} = X \text{ [cy/mrad]} \quad \text{Eqn 6-1.}$$

Focal Length<sub>ANVIS</sub> = 27.03 mm  
Focal Length<sub>PR-900</sub> = 125 mm

In column three, the camera (PR-900) MTF values are imported from file. In column four, the monocular MTF values are imported from file. In column five, the corrected MTF is calculated by dividing the measured data from the monocular by the data measured from only the camera. The plot of column six vs. column two produces the corrected MTF of the ANVIS monocular vs. frequency in cy/mrad.

Next, the calculated MTF curve is created. In columns eight, nine, and ten, the formulas for the MTF values of the objective lens, image intensifier, and the eyepiece lens (as a function of cy/mm) are inserted. The multiplication of column eight, nine, and ten produces the calculated MTF curve for the ANVIS monocular. Finally, a plot of the calculated and measured MTF curves vs. spatial frequency (cy/mrad) is created. This plot should resemble Figure 6-8 a or Figure 6-8 b.

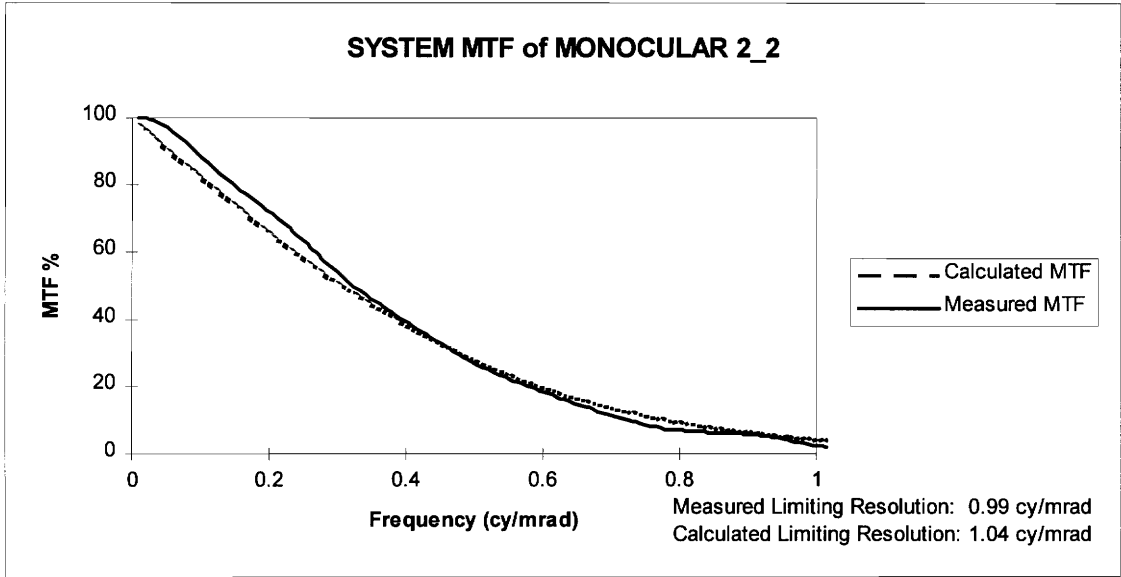


Figure 6-8 a. Sample System MTF measurement for ANVIS with normal 3rd Gen tube.

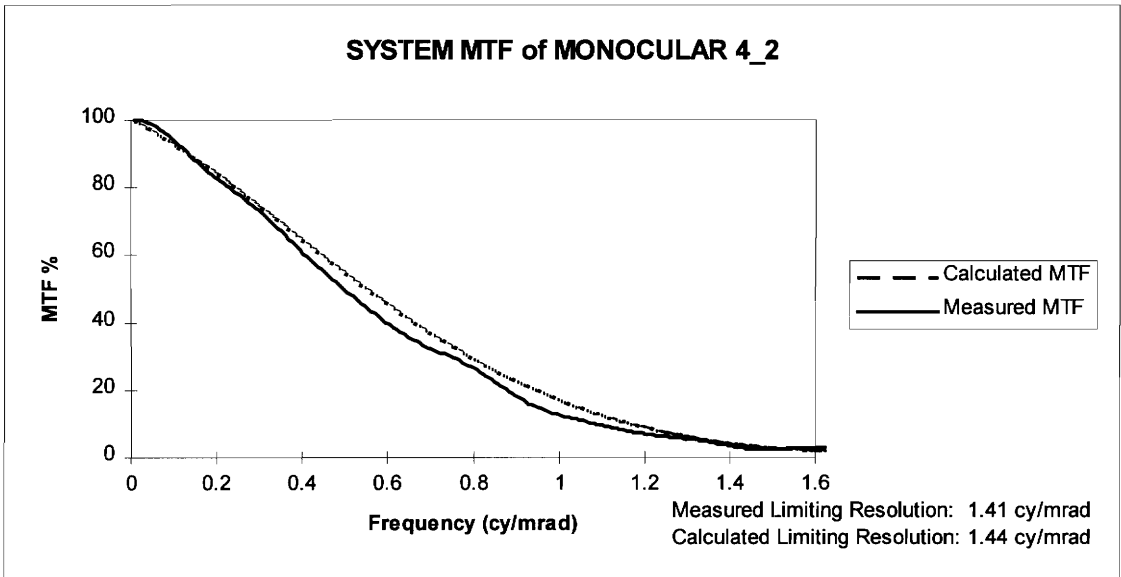


Figure 6-8 b. Sample System MTF measurement for ANVIS with IRWT 3rd Gen tube.

## 7.0 Data Discussion

The system MTF data for this research has been measured by three methods. First, measuring the MTF of each component and calculating the system MTF. This measurement acts as the standard for the direct measurements. The second method utilizes an experimental setup using a manually controlled light source, manual focusing of the collimating lens, and a 2.5  $\mu\text{m}$  wide slit as the object. The third method is an improved setup of the previous method. The improvements involve the automation of the light source control and the focusing of the collimating lens. The improvements also include the reduction of the slit width to 0.5  $\mu\text{m}$ .

### 7.1 System MTF Measurement by the Standard Component Method

Because of the availability of spare component parts, 4 objective lenses, 4 image intensifier tubes, and 3 eyepiece lenses, are used to create 4 ANVIS monocular channels. Two of the image tubes are standard ANVIS 3rd Gen wafer tubes and two are IRWT tubes. The use of these two types of tubes provides a good basis for the usefulness of the direct measurement system for the future. It also serves as an assessment of the improved performance the IRWT tubes possess over the regular ANVIS 3rd Gen wafer tubes.

The measurement of on-axis MTF for the lenses was performed by a U.S. Army Night Vision and Electronics Sensors Directorate (NVESD) electro-optics engineer. The on-axis MTF measurements for the image intensifier tubes were performed by another NVESD engineer and an ITT engineer. The measured MTF data for all the components is located in the appendix. All components were found to meet the specifications outlined in their corresponding performance specification. The IRWT tubes have measured MTF and limiting resolution performances that surpass those of the normal ANVIS image intensifier tubes.

The components are then assembled into four monocular systems. Two systems share eyepiece lens due to the availability of only three eyepiece lenses. Monoculars one and two utilize normal ANVIS image intensifier tubes. Monoculars three and four utilize the IRWT tubes. Mathematica 2.2.1 for Windows is utilized to convert the measured MTF data for each component to fourth order polynomial functions (spatial frequency is cy/mm). This allows easier multiplication of the component MTFs to form the system MTFs.

The component MTF polynomials are multiplied together using Microsoft Excel. The spatial frequency is converted to angular spatial frequencies (cy/mrad). The plots of the calculated (by component measured MTF) MTF vs. spatial frequency (cy/mrad) are used as the standard for all measurements. These plots have been shown to NVESD image intensifier experts for validity of the curves. These curves have been found to be valid and useable as standards. An example of these curves is shown in Figure 7-1.

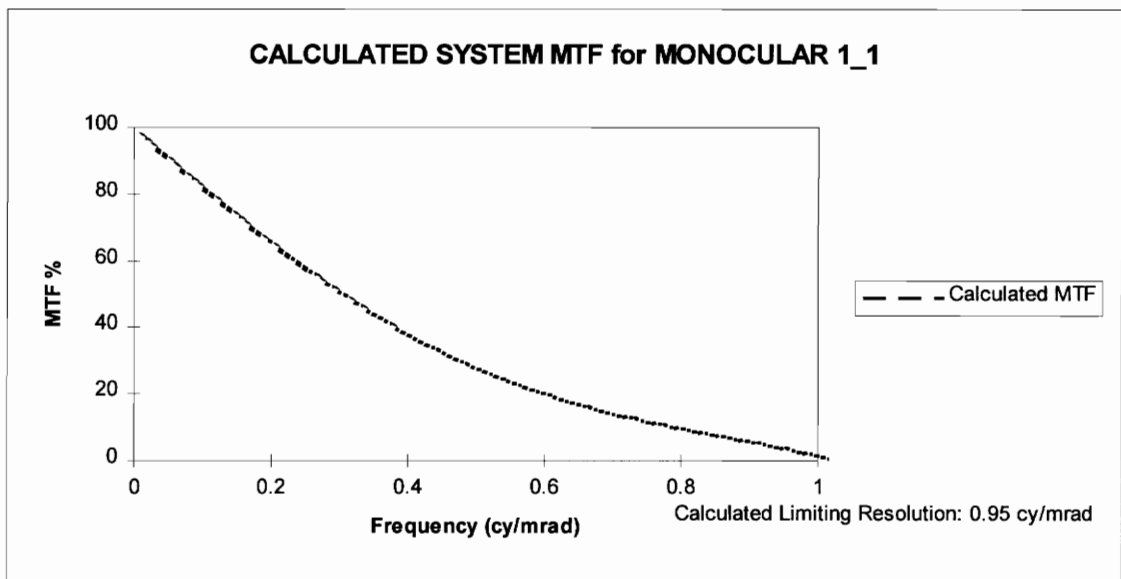


Figure 7-1. Calculated System MTF for Monocular 1\_1

## 7.2 System MTF Measurement by the Setup Using the 2.5 $\mu\text{m}$ Slit

This setup includes the manually controlled light source, manually controlled focusing of the collimating lens, and the use of the 2.5  $\mu\text{m}$  slit. This setup produces the measured system MTFs for the four monoculars as shown in Figures 7-2 (a)-(d).

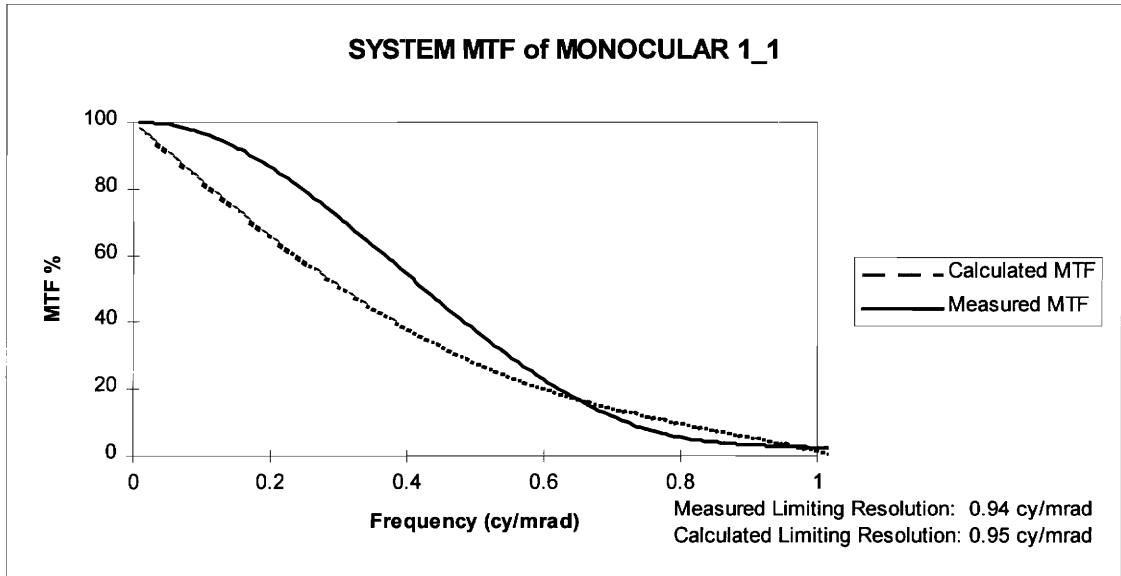


Figure 7-2 a. Measured System MTF for Monocular 1\_1.

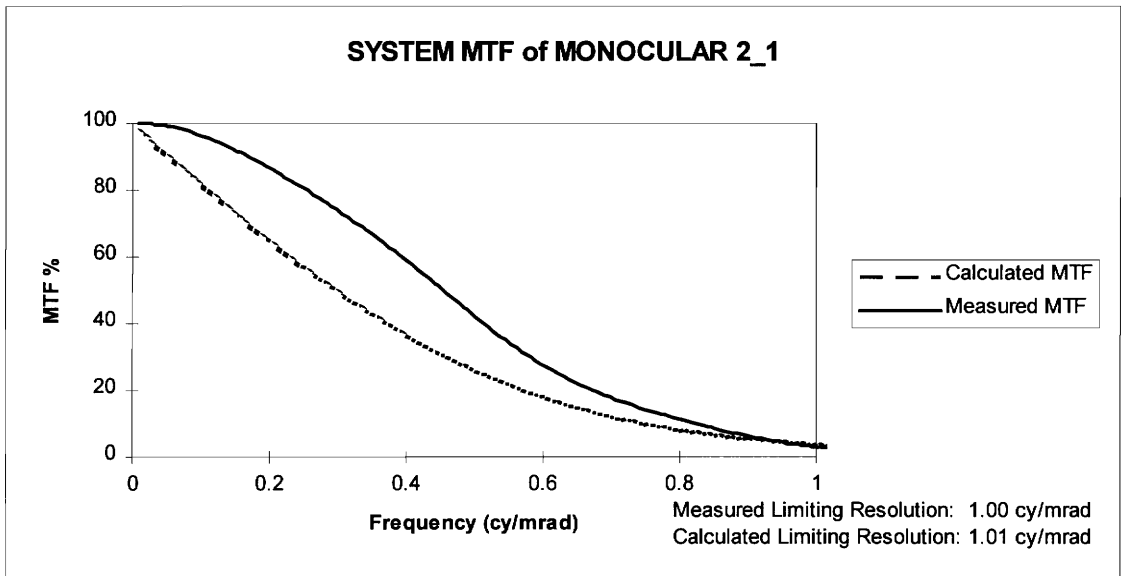


Figure 7-2 b. Measured System MTF for Monocular 2\_1.



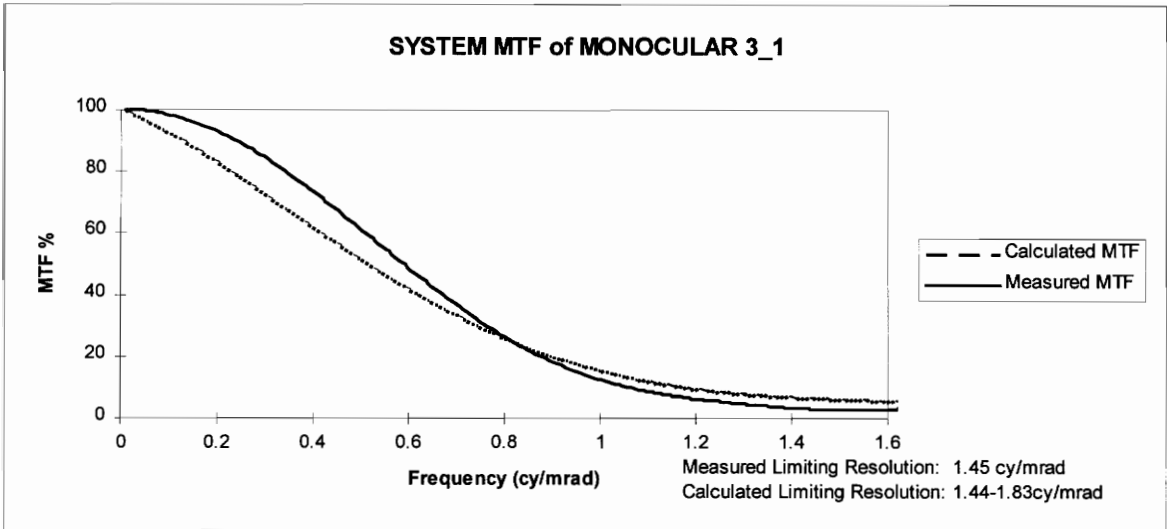


Figure 7-2 c. Measured System MTF for Monocular 3\_1.

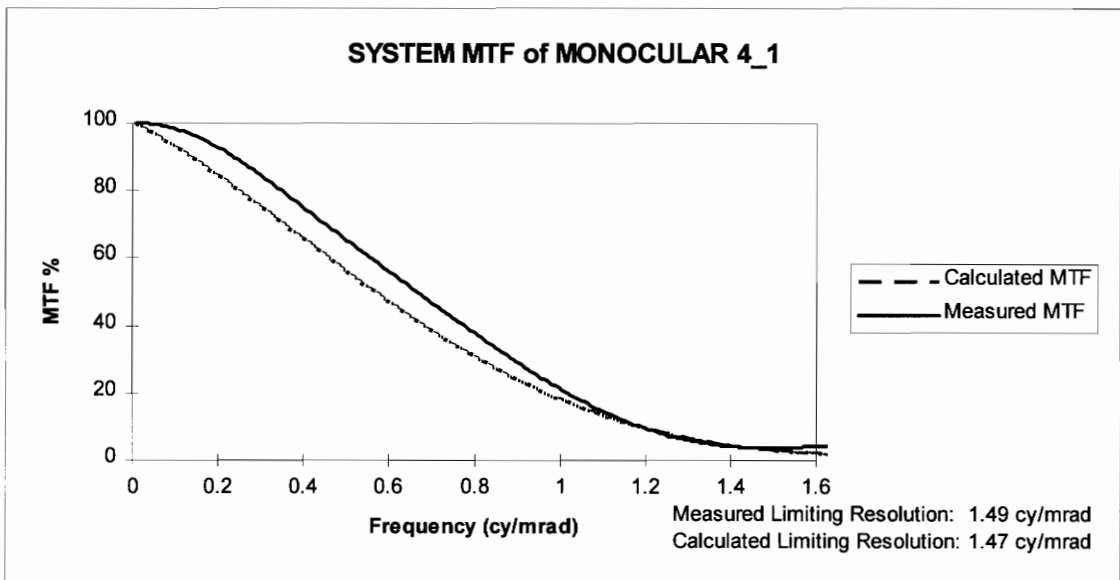


Figure 7-2 d. Measured System MTF for Monocular 4\_1.

Figure 7-2 shows that the measurements made on all the monoculars have a considerable error at the lower frequencies and approximately the correct limiting resolution (within 3%). The measured curves resemble the response of a  $\text{Sinx}/x$  curve. This illustrates that the line width should be reduced or compensated for (too large, cannot assume infinitesimally narrow slit). This

error could also be caused by the defocus of the collimating lens or the control on the light source. The fact that the limiting resolutions are approximately correct gives the impression that a refinement of the setup could reduce the errors.

### 7.3 System MTF Measurement by the Setup Using the 0.5 $\mu\text{m}$ Slit

This improved setup utilizes computer and mechanical control for everything. The manually controlled light source is replaced with a computer/motor controlled light source to provide for an accurate reproduction of the measurement background light level for all measurements. The manually controlled focusing stages for the collimating lens are replaced with a motorized linear stage with an accuracy of 10  $\mu\text{m}$ . This provides a much greater control on the setting of the collimator focus. The 2.5  $\mu\text{m}$  slit is replaced with a 0.5  $\mu\text{m}$  wide slit. The 0.5  $\mu\text{m}$  slit width will approximate an infinitesimally narrow slit and eliminates the need to compensate for the slit width in the measurement. This setup produces the data outlined in Figures 7-3 (a)-(d).

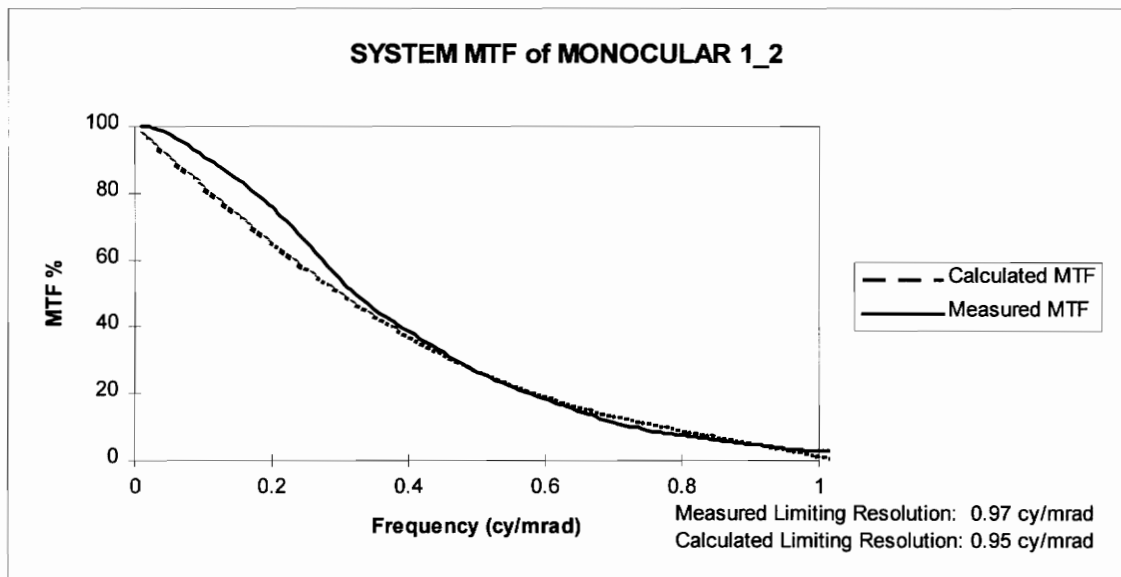


Figure 7-3 a. Measured System MTF for Monocular 1\_2.

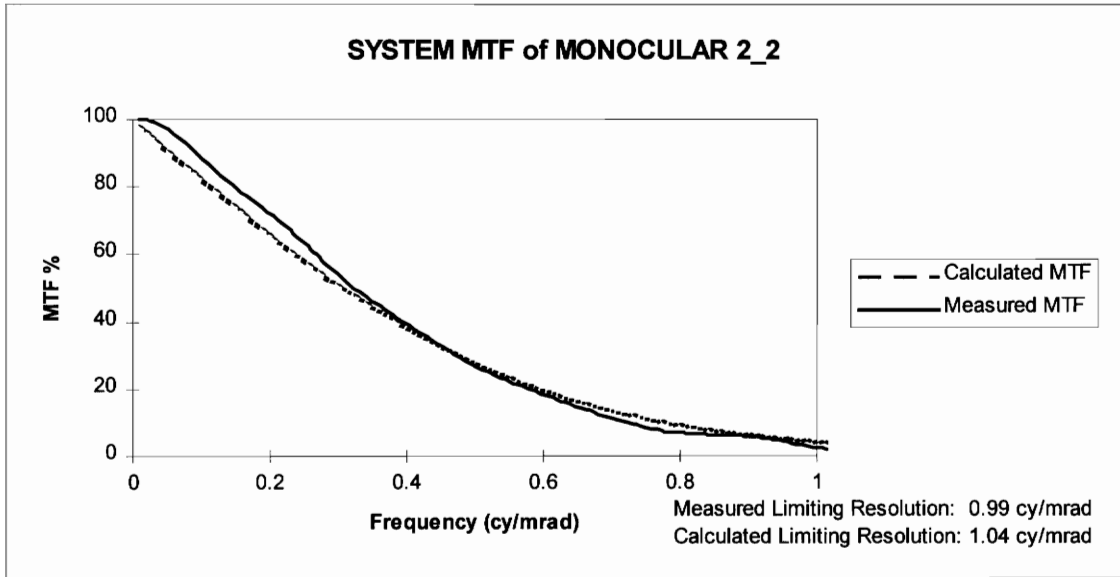


Figure 7-3 b. Measured System MTF for Monocular 2\_2.

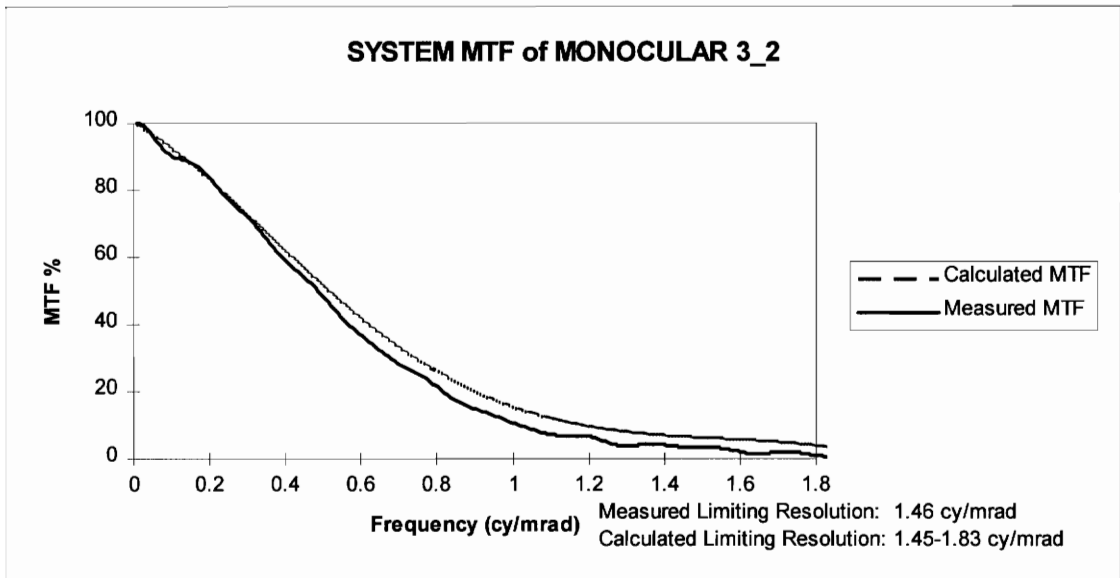


Figure 7-3 c. Measured System MTF for Monocular 3\_2.

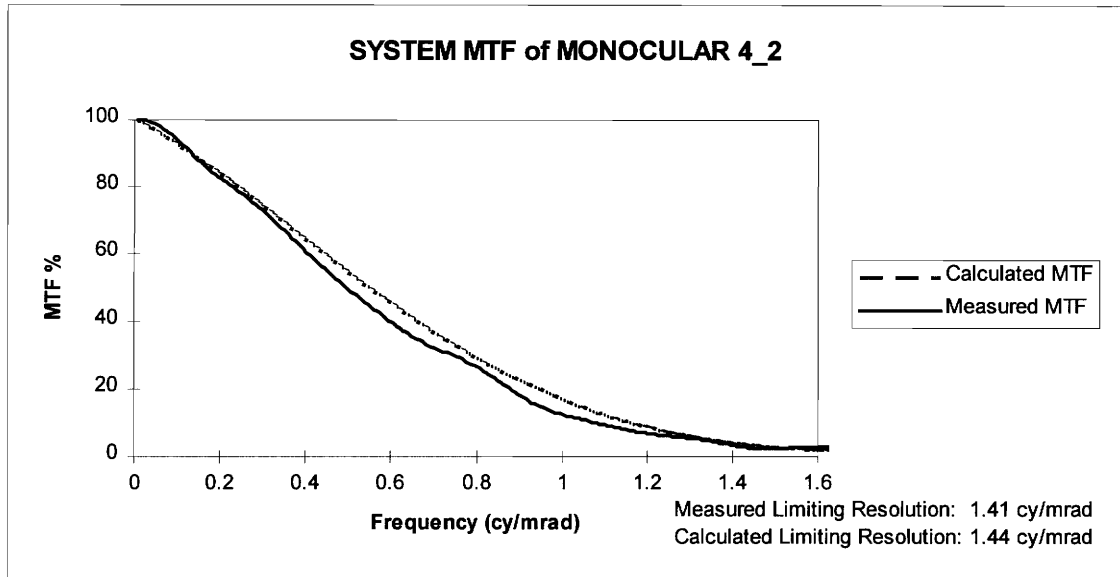


Figure 7-3 d. Measured System MTF for Monocular 4\_2.

Figure 7-3, shows that the error for all the monoculars has been greatly reduced. The curves approximately resemble the calculated curves over the entire frequency range. Monoculars two and four track extremely well with their corresponding calculated values. Monocular four, which uses an IRWT tube, shows an approximately 40% increase in the limiting resolution and an overall better MTF response over monocular two which uses a normal ANVIS I<sup>2</sup> tube.

Monocular one still has a considerable error at the lower frequencies, but the error is reduced to within 5 to 8% for the majority of the curve. The remaining error is probably due to aberrations in the optics of the monocular. Figure 7-4 illustrates the reduction in error between the measurement using the two setups.

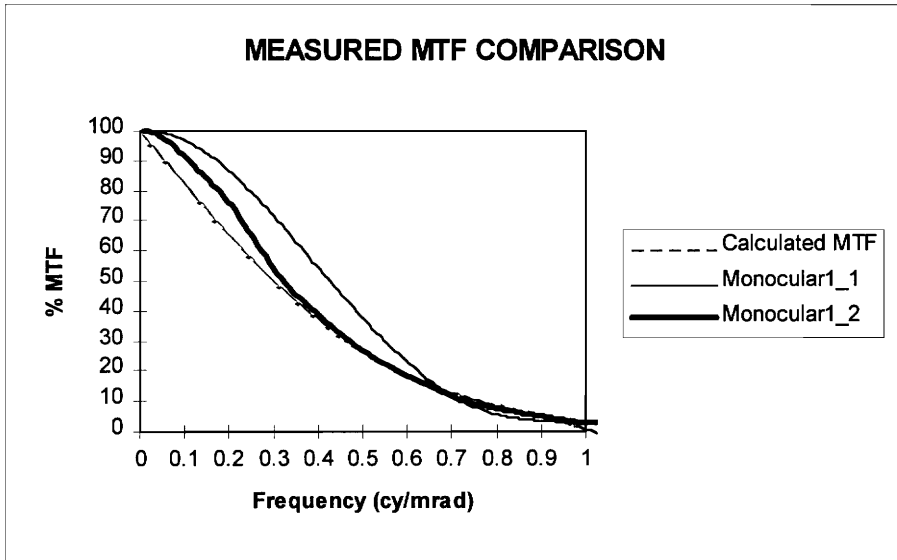


Figure 7-4. Comparison between measurements Monocular1\_1 and Monocular 1\_2. This shows the error greatly reduced.

Monocular three has a much better measurement for the lower frequencies as illustrated in Figure 7-5.

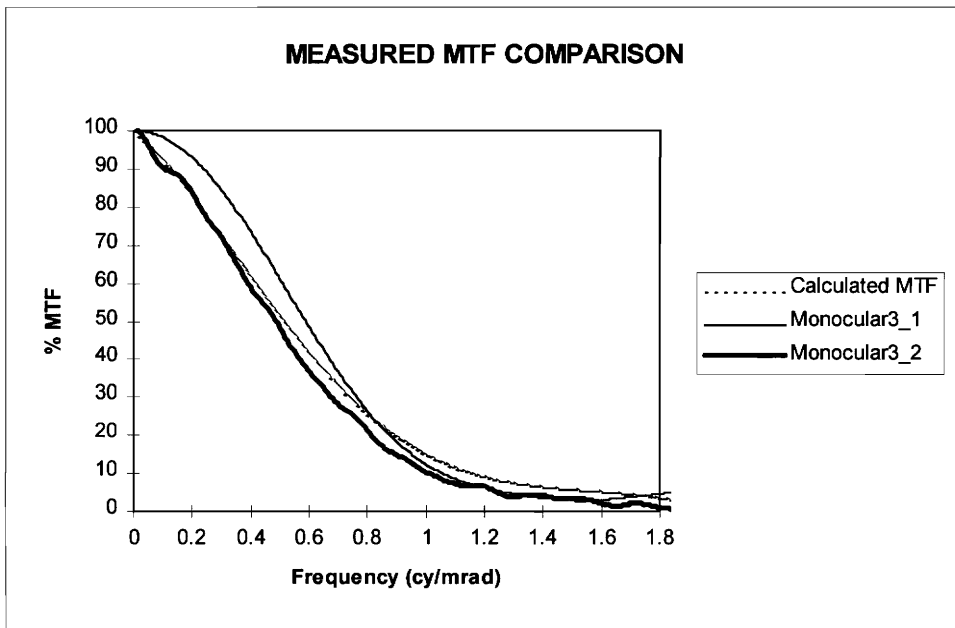


Figure 7-5. Comparison between measurements Monocular3\_1 and Monocular 3\_2. This shows the error greatly reduced.

However, at the higher spatial frequencies, the measured curve still exhibits an error from the calculated curve. This could be caused by slightly high measurements of the tube data by the manufacturer. It also could be caused by the definition of the calculated system MTF. For systems that have the same approximate performance as the eye, (eye limiting resolution 1.72 cy/mrad, while monocular three has 1.83 cy/mrad) the limiting resolution data may need the effects of the eye's MTF factored in. This would slightly reduce the calculated MTF for monocular three and reduce the error significantly. Even with the error present, this measurement still compares well to the calculated data and shows that the IRWT tube technology greatly outperforms that of a normal ANVIS wafer tube.

## 8.0 Conclusions

This research has successfully created a new test bed for the ANVIS image intensifier technology. The data reveals that the computer/motor controlled setup provides a system MTF measurement that falls within a 5 to 8 percent error of the calculated data. The importance of slit width and experimental control (light and focus) is demonstrated by the improved performance of the more controlled experimental setup.

This research has also helped to provide an assessment of the IRWT tubes. The IRWT tubes have been shown to enhance system performance with a 40 percent increase in their limiting resolution and a better overall MTF performance over the entire operating spatial frequency range.

Future research for this experimental setup has already begun. This setup has already been used to measure an experimental 60 degree field of view ANVIS. Future plans are to modify the fixturing to work with any image intensifier system and any sensor/display imaging system. This system may also be used for examining the effects on system MTF when subcomponents such as the MCP, phosphor screen, fiber optic twist, or coating on optics are altered.

This setup will play a significant role in the assessment of present and future military imaging systems. It will serve as the prototype for a standard method for the system MTF measurement of image intensifier systems and all other imaging systems.

## References

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12. Karim, Mohammad, Electro-Optical Displays, Marcel Dekker, Inc., New York, New York, 1992.
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14. Photo Research, PR-900 Operating Manual, Photo Research Corporation, Chatsworth, California, 1995.
15. Improved Resolution Wafer Tube Program Synopsis, December 1993.



## APPENDIX

## A.1 COMPONENT DATA REQUIRED FOR THE SYSTEM MTF CALCULATION

## A.1.1 ANVIS EYEPiece LENSES

## Component Data

All data measured by NIST Traceable Methods

Component: Eyepiece Lens

Serial Number: 18159A

Date: 2 March 95

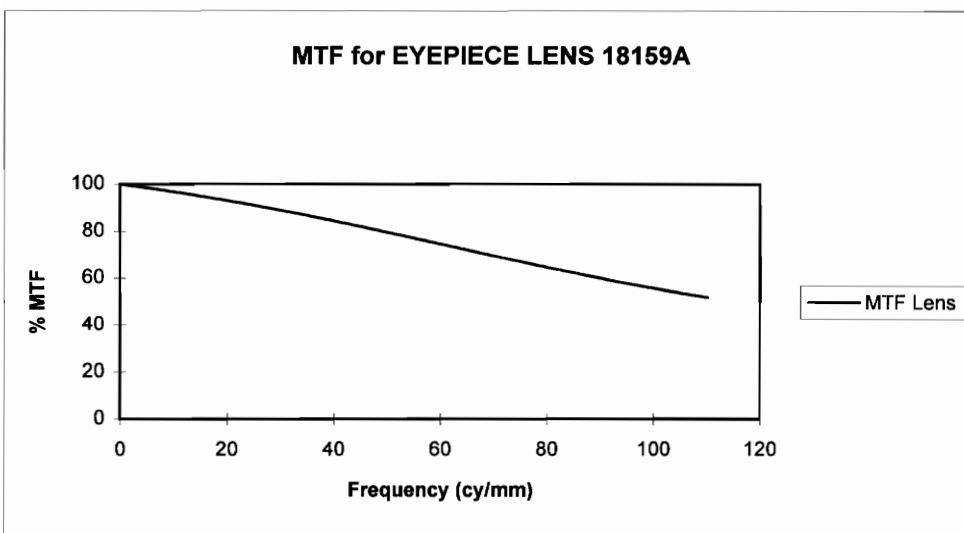
On Axis MTF Measurement

Frequency cy/mm	MTF %
0.0	100.00
11.0	96.91
22.0	92.36
33.0	87.55
44.0	82.30
55.0	77.53
66.0	71.55
77.0	66.43
88.0	61.57
99.0	55.41
110.0	52.33

Measurement Source: Robert Spande

Formula for MTF created by Mathematica 2.2.1 using fourth order polynomial line fitting

$$\text{MTF}(x) = 100.167 - 0.299618*x - 0.00263914*x^2 + 5.85815E-6*x^3 + 6.12961E-8*x^4$$



## Component Data

All data measured by NIST Traceable Methods

Component: Eyepiece Lens

Serial Number: 18229A

Date: 8 March 95

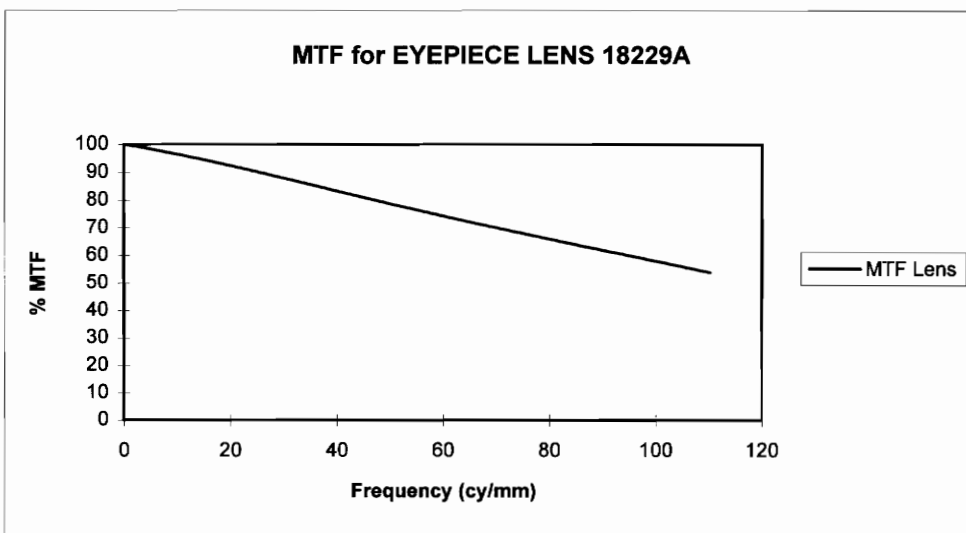
### On Axis MTF Measurement

Frequency cy/mm	MTF %
0.0	100.00
11.0	96.39
22.0	91.99
33.0	86.32
44.0	82.12
55.0	75.88
66.0	71.71
77.0	66.94
88.0	63.70
99.0	57.42
110.0	54.20

Measurement Source: Robert Spande

Formula for MTF created by Mathematica 2.2.1 using fourth order polynomial line fitting

$$\text{MTF}(x) = 100.084 - 0.313373x - 0.00455253x^2 + 0.0000563749x^3 - 2.16128E-7x^4$$



## Component Data

All data measured by NIST Traceable Methods

Component: Eyepiece Lens

Serial Number: 18258A

Date: 2 March 95

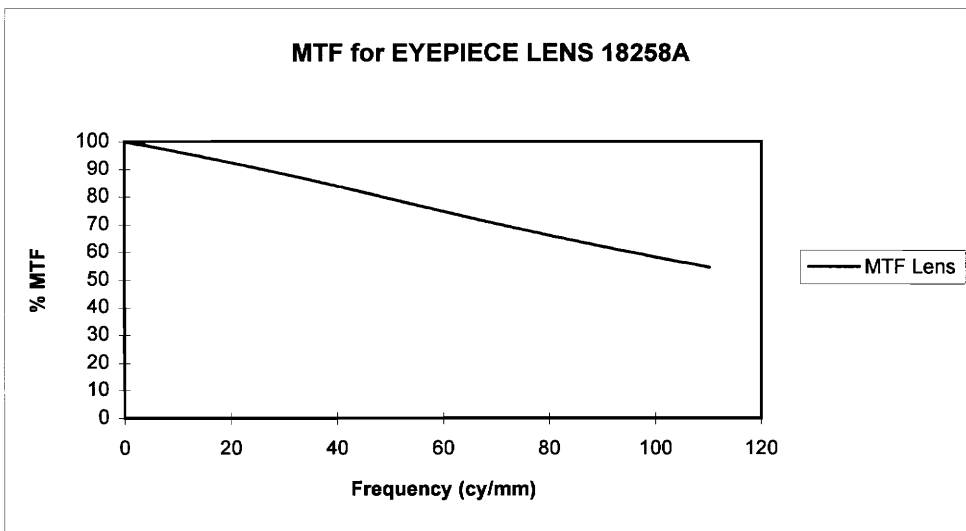
### On Axis MTF Measurement

Frequency cy/mm	MTF %
0.0	100.00
11.0	96.69
22.0	92.26
33.0	86.62
44.0	81.53
55.0	77.13
66.0	73.44
77.0	67.31
88.0	62.93
99.0	58.13
110.0	54.97

Measurement Source: Robert Spande

Formula for MTF created by Mathematica 2.2.1 using fourth order polynomial line fitting

$$\text{MTF}(x) = 100.271 - 0.340105*x - 0.00237235*x^2 + 0.0000187405*x^3 - 3.0051E-8*x^4$$



## A.1.2 ANVIS OBJECTIVE LENSES

## Component Data

All data measured by NIST Traceable Methods

Component: Objective Lens

Serial Number: 2329

Date: 2 March 95

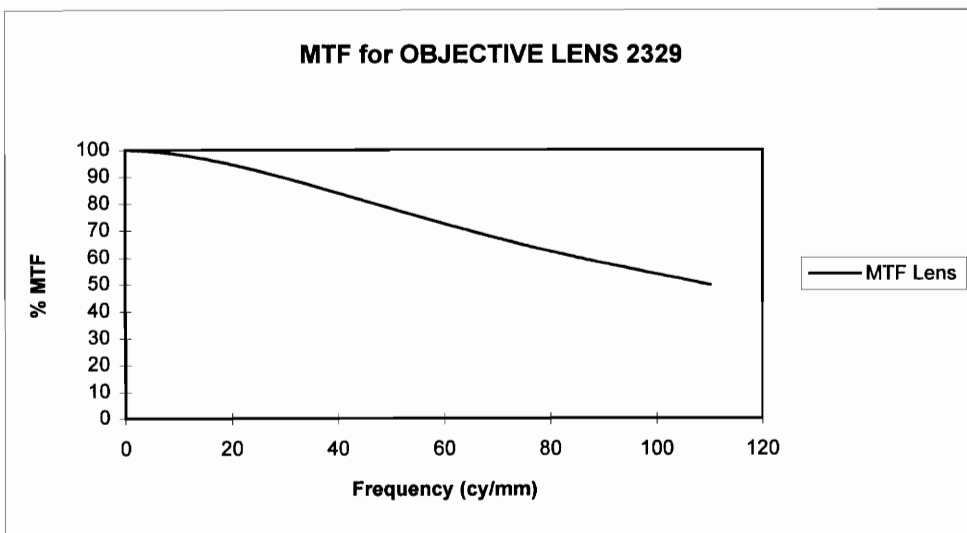
On Axis MTF Measurement

Frequency cy/mm	MTF %
0.0	100.00
11.0	98.03
22.0	93.72
33.0	87.85
44.0	82.02
55.0	75.02
66.0	69.59
77.0	63.51
88.0	58.81
99.0	54.38
110.0	49.64

Measurement Source: Robert Spande

Formula for MTF created by Mathematica 2.2.1 using fourth order polynomial line fitting

$$\text{MTF}(x) = 99.9959 - 0.040498*x - 0.0142554*x^2 + 0.00015338*x^3 - 5.29375E-7*x^4$$





## Component Data

All data measured by NIST Traceable Methods

Component: Objective Lens

Serial Number: 2360

Date: 2 March 95

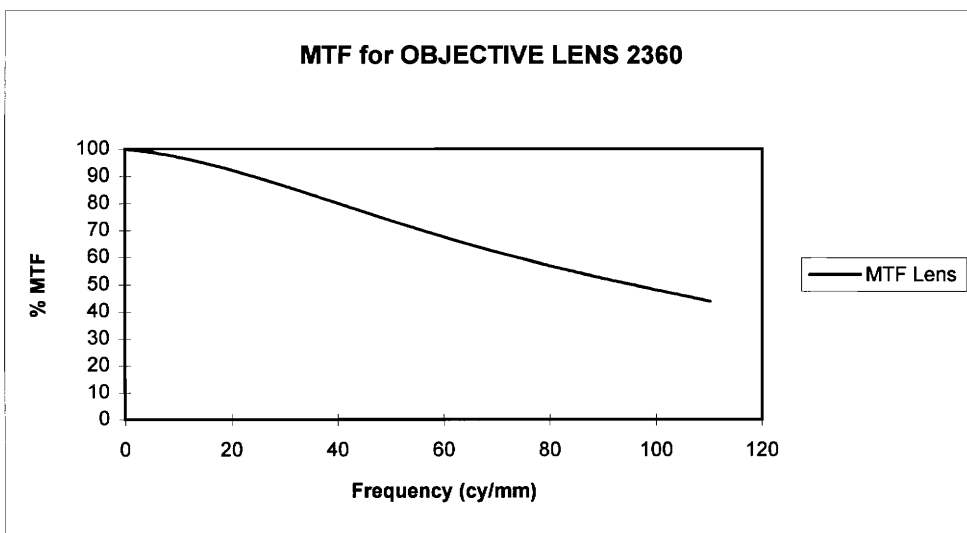
On Axis MTF Measurement

Frequency cy/mm	MTF %
0.0	100.00
11.0	97.12
22.0	91.15
33.0	84.75
44.0	77.01
55.0	70.76
66.0	64.64
77.0	58.52
88.0	52.78
99.0	48.70
110.0	43.96

Measurement Source: Robert Spande

Formula for MTF created by Mathematica 2.2.1 using fourth order polynomial line fitting

$$\text{MTF}(x) = 100.155 - 0.181487x - 0.0131535x^2 + 0.000151114x^3 - 5.34351E-7x^4$$



## Component Data

All data measured by NIST Traceable Methods

Component: Objective Lens

Serial Number: 2397

Date: 2 March 95

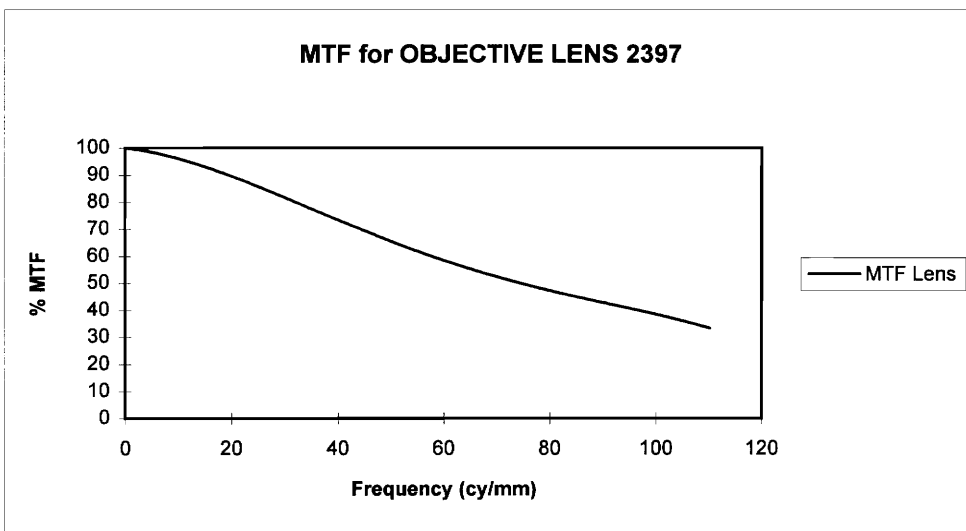
On Axis MTF Measurement

Frequency cy/mm	MTF %
0.0	100.00
11.0	96.57
22.0	88.37
33.0	79.21
44.0	70.23
55.0	61.90
66.0	55.80
77.0	49.19
88.0	44.25
99.0	38.80
110.0	34.19

Measurement Source: Robert Spande

Formula for MTF created by Mathematica 2.2.1 using fourth order polynomial line fitting

$$\text{MTF}(x) = 100.317 - 0.206141*x - 0.0208039*x^2 + 0.000278144*x^3 - 1.10811E-6*x^4$$



## Component Data

All data measured by NIST Traceable Methods

Component: Objective Lens

Serial Number: 26340A

Date: 2 March 95

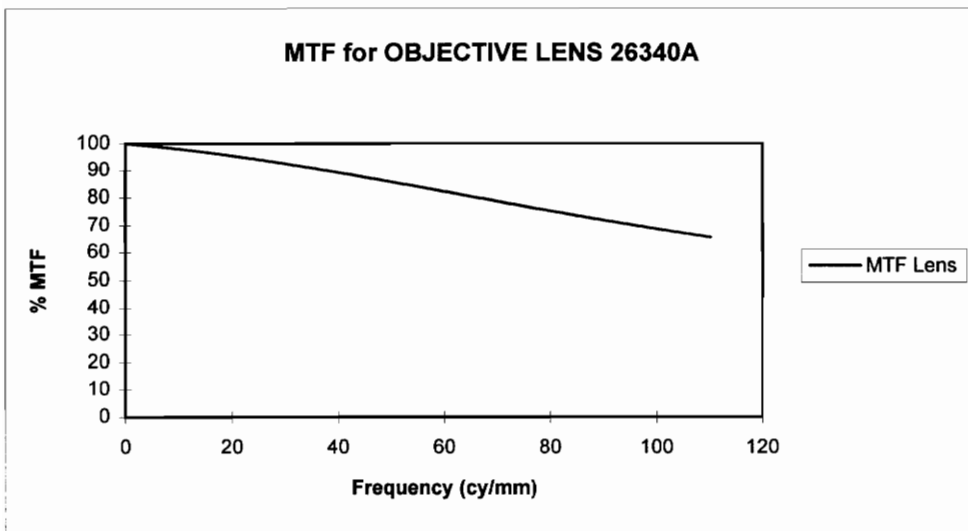
### On Axis MTF Measurement

Frequency cy/mm	MTF %
0.0	100.00
11.0	98.12
22.0	94.82
33.0	91.58
44.0	88.01
55.0	84.01
66.0	80.12
77.0	76.36
88.0	72.82
99.0	68.82
110.0	65.66

Measurement Source: Robert Spande

Formula for MTF created by Mathematica 2.2.1 using fourth order polynomial line fitting

$$\text{MTF}(x) = 100.173 - 0.157125*x - 0.00404371*x^2 + 0.0000345184*x^3 - 9.71185E-8*x^4$$



### A.1.3 ANVIS IMAGE INTENSIFIER TUBES

## Component Data

All data measured by NIST Traceable Methods

Component: GEN III Image Intensifier Tube

Serial Number: 42115CC

Date: 27 Sept 94

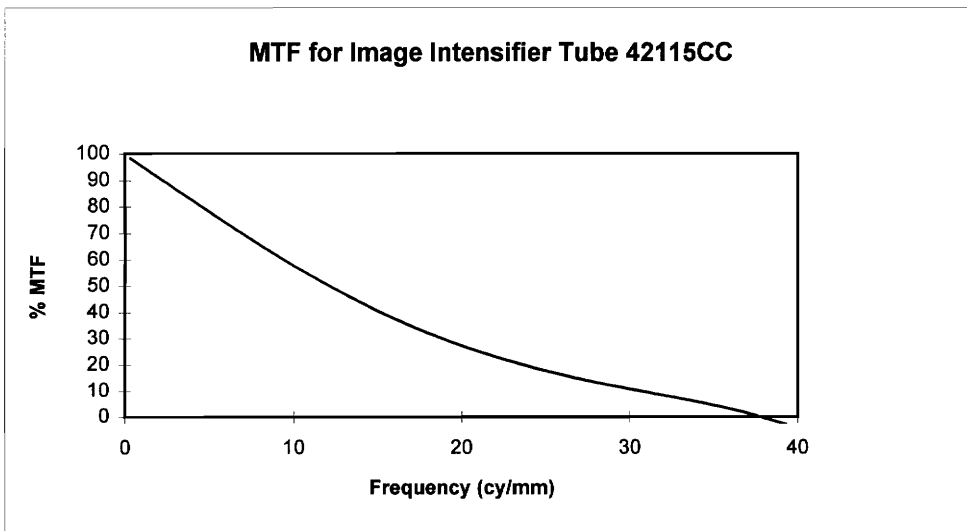
On Axis MTF Measurement

Frequency cy/mm	MTF %
0.0	100.00
2.5	88.20
7.5	68.30
15.0	40.30
25.0	17.80
36.0	3.00

Measurement Source: Richard Burnett

Formula for MTF created by Mathematica 2.2.1 using fourth order polynomial line fitting

$MTF(x) = 99.6683 - 4.25064*x - 0.03136*x^2 + 0.00447379*x^3 - 0.000066516*x^4$



## Component Data

All data measured by NIST Traceable Methods

Component: GEN III Image Intensifier Tube

Serial Number: 63585CC

Date: 27 Sept 94

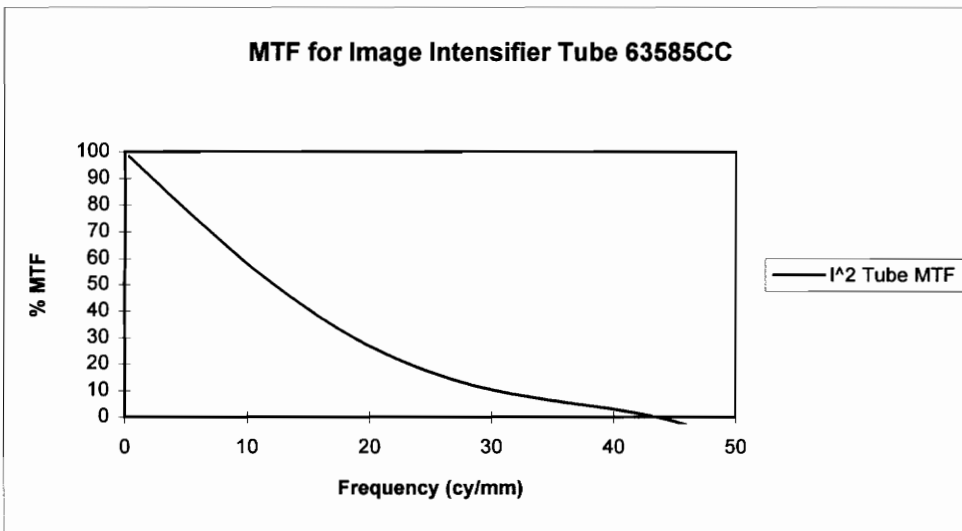
### On Axis MTF Measurement

Frequency cy/mm	MTF %
0.0	100.00
2.5	88.10
7.5	68.50
15.0	40.40
25.0	17.00
40.0	3.00

Measurement Source: Richard Burnett

Formula for MTF created by Mathematica 2.2.1 using fourth order polynomial line fitting

$$\text{MTF}(x) = 99.6389 - 4.29146*x - 0.0140253*x^2 + 0.00315266*x^3 - 0.0000407439*x^4$$



## Component Data

All data measured by NIST Traceable Methods

Component: IRWT GEN III Image Intensifier Tube

Serial Number: 2400112

Date: 25 March 94

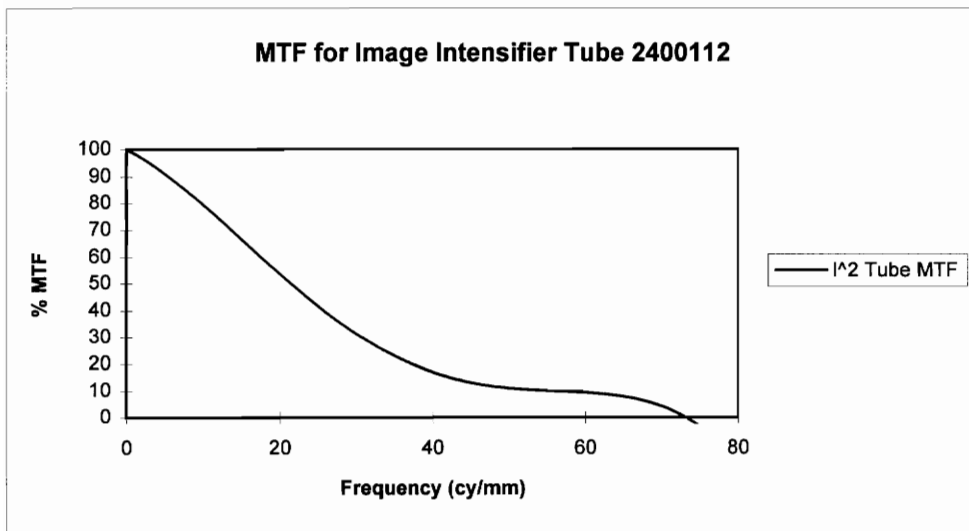
### On Axis MTF Measurement

Frequency cy/mm	MTF %
0.0	100.00
2.5	96.00
7.5	86.00
15.0	66.00
25.0	42.00
40.0	17.00
71.0	3.00

Measurement Source: ITT

Formula for MTF created by Mathematica 2.2.1 using fourth order polynomial line fitting

$$\text{MTF}(x) = 100.088 - 1.41125*x - 0.0882796*x^2 + 0.00248797*x^3 - 0.0000174072*x^4$$



## Component Data

All data measured by NIST Traceable Methods

Component: IRWT GEN III Image Intensifier Tube

Serial Number: 2400120

Date: 18 Feb 94

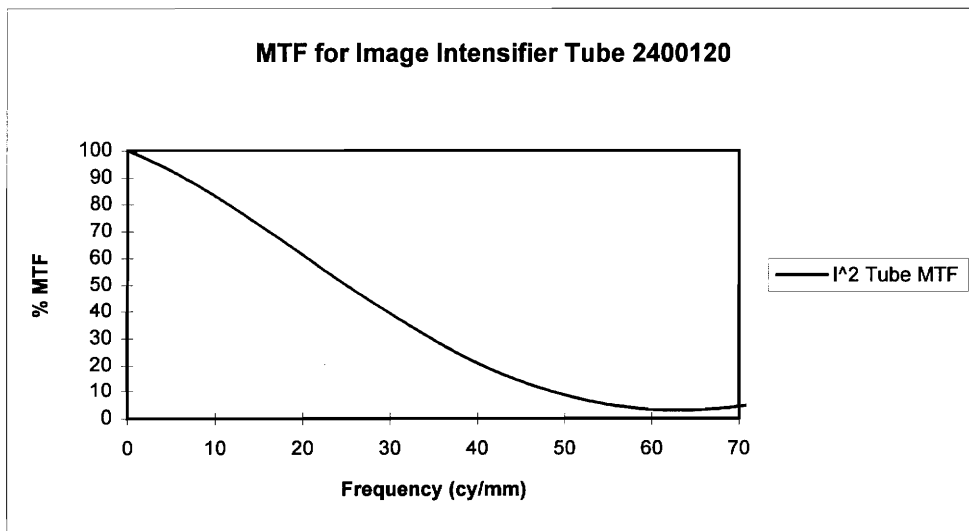
On Axis MTF Measurement

Frequency cy/mm	MTF %
0.0	100.00
2.5	98.00
7.5	89.00
15.0	72.00
25.0	51.00
40.0	21.00
64.0	3.00

Measurement Source: ITT

Formula for MTF created by Mathematica 2.2.1 using fourth order polynomial line fitting

$$\text{MTF}(x) = 100.618 - 1.22658*x - 0.0576181*x^2 + 0.00119534*x^3 - 5.75033E-6*x^4$$





**A.2 SYSTEM MTF DATA MEASURED USING THE SETUP WITH  
THE 2.5  $\mu\text{m}$  SLIT**

## A.2.1 SYSTEM MTF DATA

Monocular 1\_1

Objective Lens S/N: 18159A

Eyepiece Lens S/N: 26340A

Image Intensifier Tube S/N: 42115CC

## System MTF Measurement for a Complete ANVIS System

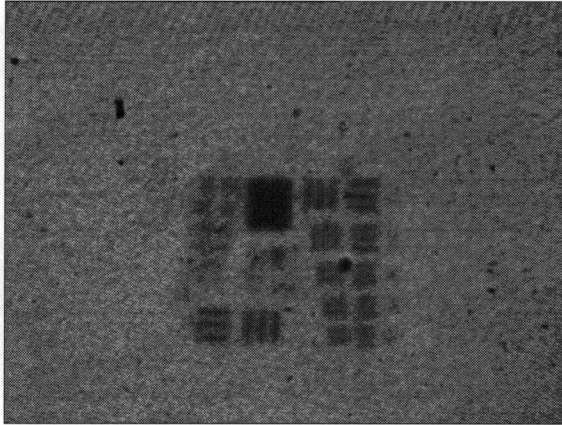
Data Identification: Mono1\_1  
Date: 22 Feb 95  
Excel Filename: Mono1\_1.xls  
Mono1\_1a.xls

Slit Used: 2.5 micron

Monocular Components:  
Eye Piece S/N: 18159A  
Objective S/N: 26340A  
Tube S/N: 42115CC

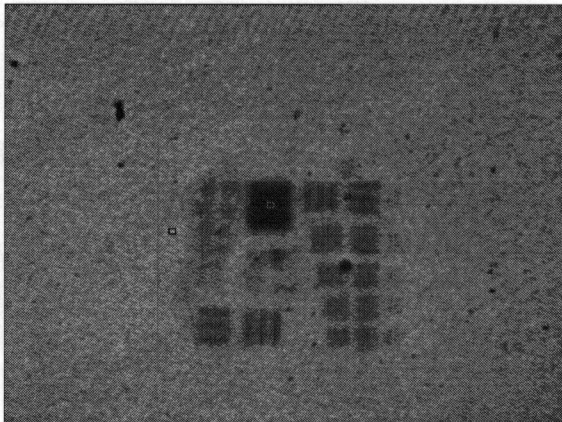
Camera Focus Data:  
File Name: None  
Integration Time:  
Light Level:

Monocular Focus Data:  
File Name: mon1foc1.tif  
Integration Time: 1000  
Light Level: 9.5E-5 ft-L



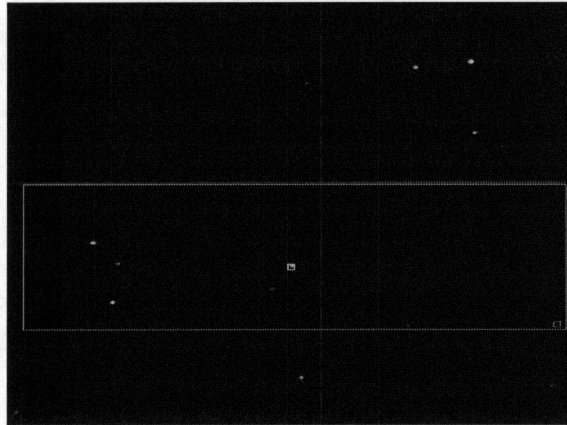
### Monocular Luminance Measurement

File Name: mon1lm1.tif  
Integration Time: 1000  
Light Level: 9.5E-5 ft-L  
Max. Luminance (ft-L) 0.529  
Min. Luminance (ft-L) 0.132  
Ave. Luminance (ft-L) 0.415



Horizontal Line Setting

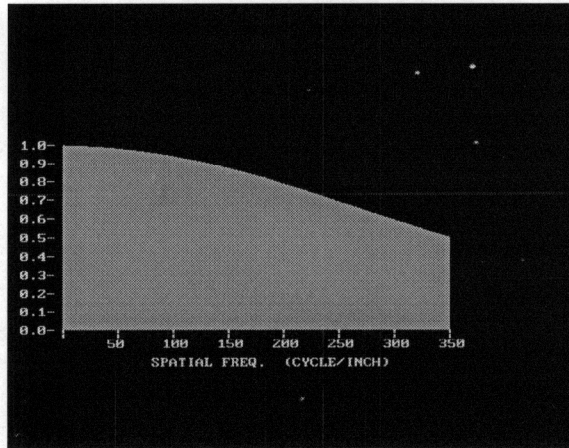
File Name: Cam1hslt.tif  
Integration Time: 1000  
Light Level: 14.39 ft-L  
Slit Size: 2.5 micron



Camera MTF Measurement

Image File Name: cam1h.tif  
Data File Name: cam1h.dat  
Integration Time: 1000  
Light Level: 14.39 ft-L

cam1h.tif

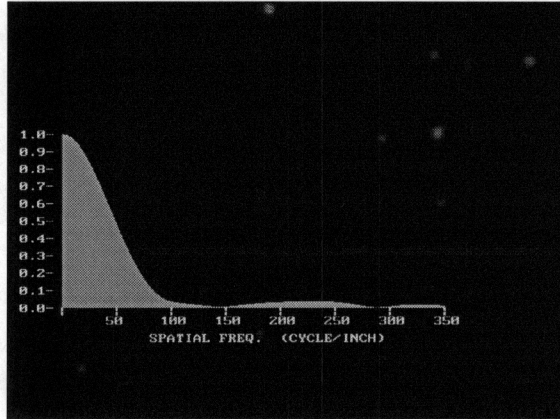


Monocular Image of Horizontal Slit

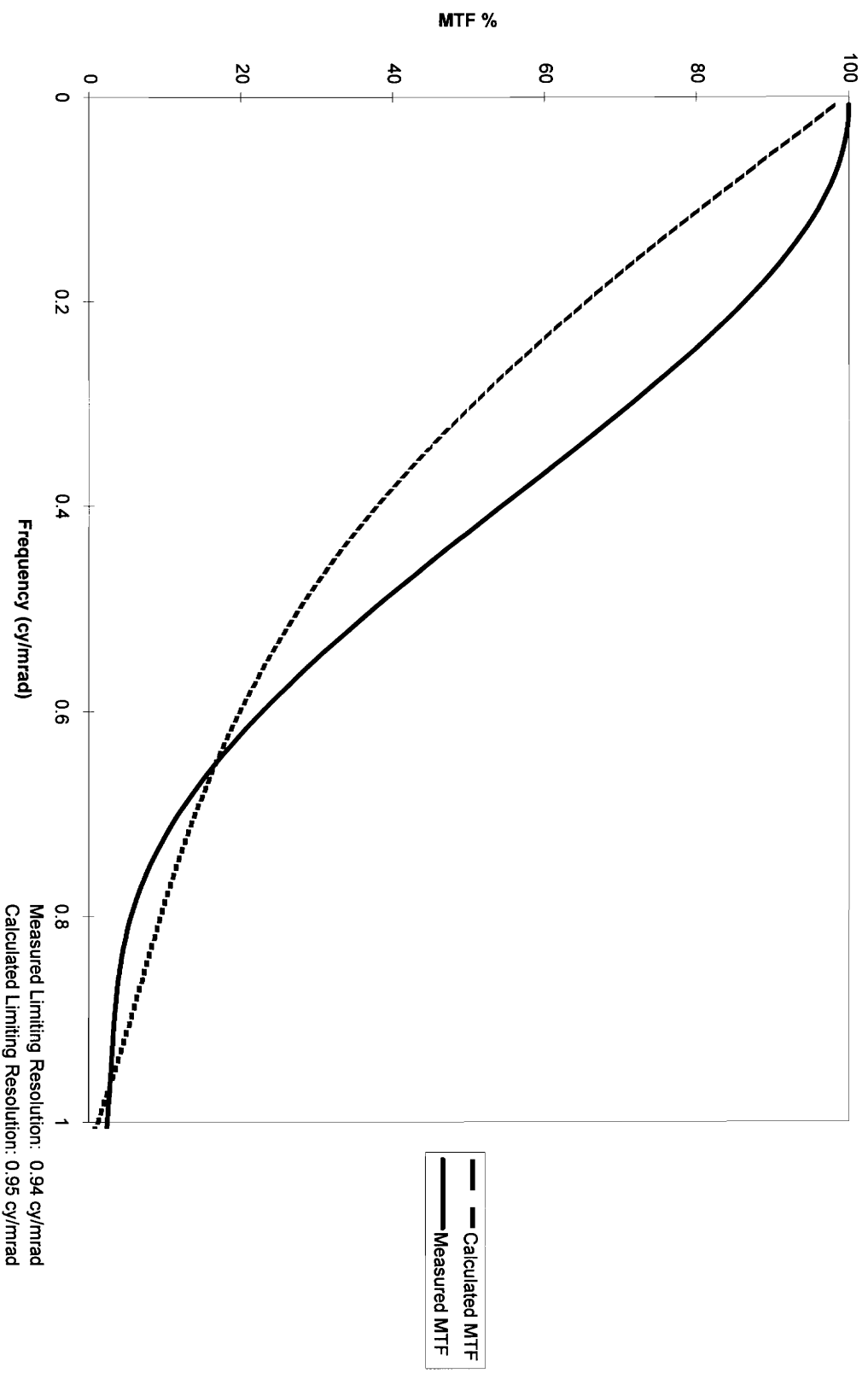
File Name: None  
Integration Time:  
Light Level:

Monocular MTF Measurement Using Horizontal Slit

Image File Name: mon1h1.tif  
Data File Name: mon1h1.dat  
Integration Time: 1000  
Light Level: 1.504 ft-L



# SYSTEM MTF of MONOCULAR 1\_1



MTF Data

Monocular:  
Date:

Mono1\_1  
22 Feb 95

Monocular Components:

Eye Piece S/N: 18159A  
Objective S/N: 26340A  
Tube S/N: 42115CC

Measured Data

Table with 5 columns: Raw Frequency (cy/inch), Corrected Frequnc (cy/mrad), Measured Camera MTF, Measured Monocula MTF Data, Actual Measured Monocular MTF (mono/camera). Rows 1-88.

Calculated Data

Table with 7 columns: Frequency (cy/mm) f1, Objective Lens MT, Tube MTF, Eyepiece Lens MT, Frequency (cy/mrad) (f1\*27.03/1000), Calculated Monocular MTF (obj\*tube\*eye). Rows 1-88.

Measured Data

Calculated Data

Raw Frequency (cy/inch)	Corrected Frequency (cy/mm)	Measured Camera MTF	Measured Monocula MTF Data	Actual Measured Monocular MTF (mono/camera)
89	0.75769	95.19644	7.24453	7.61008
90	0.76920	95.08957	6.77941	7.12893
91	0.77472	94.99849	6.34826	6.65249
92	0.78323	94.89592	5.95052	6.27058
93	0.79174	94.79101	5.58545	5.92338
94	0.80026	94.68364	5.25214	5.54703
95	0.80877	94.57452	4.94946	5.23340
96	0.81729	94.46319	4.67608	4.95016
97	0.82580	94.34999	4.43042	4.69573
98	0.83431	94.23511	4.21066	4.46828
99	0.84283	94.11873	4.01491	4.26579
100	0.85134	94.00107	3.84091	4.09603
101	0.85985	93.88232	3.68642	3.92664
102	0.86837	93.76272	3.54910	3.78519
103	0.87688	93.64246	3.42662	3.65926
104	0.88539	93.52177	3.31669	3.54644
105	0.89391	93.40085	3.21716	3.44447
106	0.90242	93.27988	3.12602	3.35123
107	0.91093	93.15903	3.04149	3.26484
108	0.91945	93.03846	2.96195	3.18358
109	0.92796	92.91829	2.88605	3.10601
110	0.93647	92.79862	2.81265	3.03092
111	0.94499	92.67953	2.74080	2.95729
112	0.95350	92.56105	2.66976	2.88432
113	0.96201	92.44320	2.59968	2.81143
114	0.97053	92.32597	2.52806	2.73819
115	0.97904	92.20930	2.45672	2.66429
116	0.98755	92.09310	2.38482	2.58958
117	0.99607	91.97728	2.31231	2.51400
118	1.00458	91.86171	2.23923	2.43761
119	1.01309	91.74622	2.16566	2.36049
120	1.02161	91.63066	2.09177	2.28283
121	1.03012	91.51476	2.01773	2.20481
122	1.03863	91.39840	1.94375	2.12668
123	1.04715	91.28133	1.87007	2.04869
124	1.05566	91.16334	1.79691	1.97109
125	1.06417	91.04420	1.72453	1.89417
126	1.07269	90.92370	1.65316	1.81818
127	1.08120	90.80164	1.58301	1.74337
128	1.08971	90.67783	1.51432	1.67000
129	1.09823	90.55208	1.44730	1.59831
130	1.10674	90.42424	1.38213	1.52850
131	1.11525	90.29418	1.31901	1.46079
132	1.12377	90.16179	1.25814	1.39542
133	1.13228	90.02699	1.19968	1.33256
134	1.14079	89.88974	1.14386	1.27251
135	1.14931	89.75001	1.09007	1.21545
136	1.15782	89.60783	1.04096	1.16168
137	1.16633	89.46322	0.99441	1.11153
138	1.17485	89.31628	0.95154	1.06536
139	1.18336	89.16709	0.91272	1.02361
140	1.19187	89.01579	0.87839	0.98678
141	1.20039	88.86294	0.84901	0.95442
142	1.20890	88.70750	0.82508	0.92611
143	1.21741	88.55087	0.80712	0.90148
144	1.22593	88.39366	0.79560	0.88007
145	1.23444	88.23368	0.79001	0.86338
146	1.24295	88.07355	0.79333	0.85076
147	1.25147	87.91270	0.80295	0.84135
148	1.25998	87.75134	0.81871	0.83413
149	1.26849	87.58969	0.84337	0.82896
150	1.27700	87.42794	0.87357	0.82619
151	1.28552	87.26629	0.90981	0.82457
152	1.29403	87.10490	0.95155	0.82402
153	1.30255	86.94391	0.99822	0.82451
154	1.31106	86.78344	1.04924	0.82603
155	1.31957	86.62358	1.10406	0.82767
156	1.32809	86.46438	1.16214	0.82940
157	1.33660	86.30589	1.22300	0.83120
158	1.34511	86.14809	1.28618	0.83307
159	1.35363	85.99097	1.35127	0.83501
160	1.36214	85.83444	1.41788	0.83701
161	1.37066	85.67844	1.48566	0.83907
162	1.37917	85.52283	1.55429	0.84117
163	1.38768	85.36747	1.62349	0.84330
164	1.39620	85.21221	1.69297	0.84544
165	1.40471	85.05685	1.76251	0.84761
166	1.41322	84.90121	1.83187	0.84979
167	1.42174	84.74509	1.90097	0.85198
168	1.43025	84.58825	1.96932	0.85417
169	1.43876	84.43051	2.03706	0.85636
170	1.44728	84.27164	2.10395	0.85855
171	1.45579	84.11144	2.16986	0.86074
172	1.46430	83.94973	2.23470	0.86293
173	1.47282	83.78631	2.29836	0.86512
174	1.48133	83.62105	2.36076	0.86731
175	1.48984	83.45381	2.42184	0.86950
176	1.49835	83.28446	2.48154	0.87169
177	1.50687	83.11294	2.53982	0.87388
178	1.51538	82.93920	2.59664	0.87607
179	1.52390	82.76320	2.65196	0.87826
180	1.53241	82.58496	2.70577	0.88045
181	1.54092	82.40451	2.75805	0.88264
182	1.54944	82.22194	2.80877	0.88483
183	1.55795	82.03733	2.85792	0.88702
184	1.56646	81.85082	2.90550	0.88921

Frequency (cy/mm)	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mm)	Calculated Monocular MTF (obj/tube*eye)
28.0315	93.1235	13.3466	89.7116	0.75769	11.15010
28.34846	93.0255	12.9329	89.5767	0.76920	10.77687
28.66142	92.9271	12.5248	89.4415	0.77472	10.41004
28.97638	92.8284	12.1218	89.3058	0.78323	10.04910
29.29134	92.7295	11.7232	89.1699	0.79174	9.69354
29.60630	92.6302	11.3285	89.0336	0.80026	9.34280
29.92126	92.5306	10.9369	88.8969	0.80877	8.99637
30.23622	92.4308	10.5488	88.7598	0.81729	8.65398
30.55118	92.3307	10.1609	88.6225	0.82580	8.31422
30.86614	92.2302	9.77504	88.4847	0.83431	7.97738
31.18110	92.1295	9.38772	88.3466	0.84283	7.64261
31.49606	92.0286	9.00423	88.2082	0.85134	7.30934
31.81102	91.9273	8.61783	88.0695	0.85985	6.97699
32.12598	91.8258	8.22979	87.9304	0.86837	6.64496
32.44094	91.724	7.83935	87.7909	0.87688	6.31267
32.75591	91.622	7.44573	87.6512	0.88539	5.97950
33.07087	91.5197	7.04817	87.511	0.89391	5.64487
33.38583	91.4172	6.64584	87.3706	0.90242	5.30815
33.70079	91.3144	6.23793	87.2299	0.91093	4.96873
34.01575	91.2114	5.82361	87.0888	0.91945	4.62598
34.33071	91.1082	5.40203	86.9474	0.92796	4.27928
34.64567	91.0047	4.97232	86.8057	0.93647	3.92799
34.96063	90.901	4.53359	86.6637	0.94499	3.57148
35.27559	90.797	4.08496	86.5213	0.95350	3.20909
35.59055	90.6928	3.62551	86.3787	0.96201	2.84020
35.90551	90.5885	3.1543	86.2357	0.97053	2.46413
36.22047	90.4839	2.67041	86.0924	0.97904	2.08224
36.53543	90.3791	2.17286	85.9489	0.98755	1.68787
36.8504	90.2741	1.66066	85.805	0.99607	1.28334
37.16536	90.1689	1.13286	85.6609	1.00458	0.87501
37.48032	90.0634	0.58842	85.5164	1.01309	0.45320
37.79528	89.9578	0.02634	85.3717	1.02161	0.02023
38.11024	89.8521	-0.55443	85.2267	1.03012	-0.42457
38.4252	89.7461	-1.15496	85.0813	1.03863	-0.88189
38.74016	89.6399	-1.77628	84.9358	1.04715	-1.35239
39.05512	89.5336	-2.41951	84.7899	1.05566	-1.83678
39.37008	89.427	-3.08574	84.6437	1.06417	-2.33574
39.68504	89.3204	-3.7761	84.4973	1.07269	-2.84994
40	89.2135	-4.4917	84.3506	1.08120	-3.38010
40.31496	89.1065	-5.2337	84.2037	1.08971	-3.92690
40.62992	88.9993	-6.00327	84.0565	1.09823	-4.49103
40.94488	88.8919	-6.80158	83.909	1.10674	-5.07319
41.25984	88.7844	-7.62984	83.7612	1.11525	-5.67408
41.5748	88.6768	-8.48924	83.6132	1.12377	-6.29379
41.88976	88.569	-9.38102	83.465	1.13228	-6.93484
42.20472	88.461	-10.3064	83.3165	1.14079	-7.59611
42.51968	88.3529	-11.2667	83.1678	1.14931	-8.27891
42.83465	88.2447	-12.2632	83.0188	1.15782	-8.98397
43.14961	88.1364	-13.2971	82.8696	1.16633	-9.71194
43.46457	88.0279	-14.3697	82.7201	1.17485	-10.46355
43.77953	87.9193	-15.4824	82.5704	1.18336	-11.23849
44.09449	87.8105	-16.6365	82.4205	1.19187	-12.04049
44.40945	87.7017	-17.8334	82.2703	1.20039	-12.86723
44.72441	87.5927	-19.0744	82.1199	1.20890	-13.72041
45.03937	87.4836	-20.3609	81.9694	1.21741	-14.60075
45.35433	87.3744	-21.6943	81.8185	1.22593	-15.50995
45.66929	87.2651	-23.0761	81.6675	1.23444	-16.44569
45.98425	87.1557	-24.5076	81.5163	1.24295	-17.41169
46.29921	87.0461	-25.9904	81.3648	1.25147	-18.40496
46.61417	86.9365	-27.5258	81.2132	1.25998	-19.43225
46.92913	86.8268	-29.1163	81.0613	1.26849	-20.49220
47.24409	86.717	-30.7605	80.9092	1.27700	-21.58219
47.55906	86.6071	-32.4629	80.757	1.28552	-22.70496
47.87402	86.4971	-34.2239	80.6045	1.29403	-23.86111
48.18898	86.387	-36.0452	80.4519	1.30255	-25.05139
48.50394	86.2769	-37.9282	80.2991	1.31106	-26.27647
48.81890	86.1667	-39.8746	80.1461	1.31957	-27.53705
49.13386	86.0564	-41.8859	79.9929	1.32809	-28.83380
49.44882	85.946	-43.9637	79.8395	1.33660	-30.16741
49.76378	85.8356	-46.1097	79.686	1.34511	-31.53855
50.07874	85.7251	-48.3255	79.5323	1.35363	-32.94792
50.3937	85.6145	-50.6128	79.3784	1.36214	-34.39617
50.70866	85.5039	-52.9732	79.2244	1.37066	-35.88398
51.02362	85.3932	-55.4083	79.0702	1.37917	-37.41202
51.33858	85.2824	-57.92	78.9159	1.38768	-38.98096
51.65355	85.1716	-60.51	78.7614	1.39620	-40.59151
51.96851	85.0608	-63.1798	78.6067	1.40471	-42.24423
52.28347	84.9499	-65.9313	78.4519	1.41322	-43.93982
52.59843	84.8389	-68.			



Measured Data

Raw Frequency (cy/inch)	Corrected Frequency (cy/mrad)	Measured Camera MTF	Measured Monocula MTF Data	Actual Measured Monocular MTF (mono/camera)
185	1.57498	81.66255	2.95148	3.61424
186	1.58349	81.47271	2.99586	3.67713
187	1.59200	81.28149	3.03861	3.73838
188	1.60052	81.09099	3.07974	3.79787
189	1.60903	80.89573	3.11921	3.85564
190	1.61754	80.70165	3.15702	3.91196
191	1.62605	80.50707	3.19314	3.96626
192	1.63457	80.31222	3.22756	4.01877
193	1.64308	80.11733	3.26028	4.06936
194	1.65160	79.92260	3.29123	4.11802
195	1.66011	79.72825	3.32045	4.16471
196	1.66862	79.53444	3.34792	4.20940
197	1.67714	79.34134	3.37364	4.25206
198	1.68565	79.14908	3.39760	4.29266
199	1.69416	78.95777	3.41983	4.33121
200	1.70268	78.76749	3.44033	4.36770
201	1.71119	78.57830	3.45914	4.40216
202	1.71970	78.39021	3.47631	4.43462
203	1.72822	78.20320	3.49188	4.46514
204	1.73673	78.01724	3.50591	4.49376
205	1.74524	77.83226	3.51849	4.52061
206	1.75376	77.64815	3.52970	4.54576
207	1.76227	77.46480	3.53965	4.56937
208	1.77078	77.28204	3.54844	4.59155
209	1.77930	77.09973	3.55620	4.61247
210	1.78781	76.91768	3.56307	4.63232
211	1.79632	76.73568	3.56917	4.65122
212	1.80484	76.55355	3.57466	4.66949
213	1.81335	76.37108	3.57968	4.68722
214	1.82186	76.18806	3.58438	4.70465
215	1.83038	76.00430	3.58891	4.72198
216	1.83889	75.81961	3.59340	4.73941
217	1.84740	75.63381	3.59798	4.75711
218	1.85592	75.44675	3.60277	4.77525
219	1.86443	75.25829	3.60788	4.79400
220	1.87294	75.06831	3.61339	4.81347
221	1.88146	74.87674	3.61936	4.83376
222	1.88997	74.68351	3.62584	4.85494
223	1.89848	74.48860	3.63284	4.87704
224	1.90700	74.29200	3.64035	4.90006
225	1.91551	74.09376	3.64832	4.92392
226	1.92403	73.89392	3.65686	4.94857
227	1.93254	73.69259	3.66537	4.97387
228	1.94105	73.48988	3.67422	4.99987
229	1.94957	73.28593	3.68310	5.02666
230	1.95808	73.08093	3.69184	5.05411
231	1.96659	72.87504	3.70023	5.07750
232	1.97511	72.66849	3.70807	5.10272
233	1.98362	72.46147	3.71511	5.12701
234	1.99213	72.25423	3.72111	5.15002
235	2.00065	72.04698	3.72811	5.17136
236	2.00916	71.83996	3.72896	5.19065
237	2.01767	71.63339	3.73027	5.20745
238	2.02619	71.42748	3.72950	5.22138
239	2.03470	71.22244	3.72837	5.23202
240	2.04321	71.01846	3.72663	5.23986
241	2.05173	70.81569	3.72424	5.24483
242	2.06024	70.61427	3.72035	5.24602
243	2.06875	70.41434	3.68535	5.23381
244	2.07727	70.21596	3.66884	5.22223
245	2.08578	70.01920	3.64464	5.20520
246	2.09429	69.82407	3.61859	5.18244
247	2.10281	69.63059	3.58854	5.15368
248	2.11132	69.43870	3.55438	5.11873
249	2.11983	69.24834	3.51603	5.07742
250	2.12835	69.05941	3.47343	5.02963
251	2.13686	68.87190	3.42653	4.97523
252	2.14537	68.68534	3.37532	4.91418
253	2.15389	68.49988	3.31983	4.84648
254	2.16240	68.31523	3.26010	4.77214
255	2.17091	68.13119	3.19620	4.69124
256	2.17943	67.94754	3.12823	4.60389
257	2.18794	67.76407	3.05631	4.51022
258	2.19645	67.58057	2.98059	4.41042
259	2.20497	67.39682	2.90124	4.30471
260	2.21348	67.21282	2.81846	4.19335
261	2.22199	67.02878	2.73247	4.07662
262	2.23051	66.84410	2.64349	3.95483
263	2.23902	66.65544	2.55180	3.82834
264	2.24753	66.46766	2.45764	3.69750
265	2.25605	66.27964	2.36133	3.56273
266	2.26456	66.08830	2.26315	3.42443
267	2.27307	65.89659	2.16342	3.28305
268	2.28159	65.70348	2.06246	3.13904
269	2.29010	65.50896	1.96061	2.99289
270	2.29861	65.31309	1.85819	2.84505
271	2.30713	65.11591	1.75577	2.69607
272	2.31564	64.91754	1.65308	2.54643
273	2.32415	64.71807	1.55109	2.39699
274	2.33267	64.51766	1.44997	2.24740
275	2.34118	64.31648	1.35008	2.09812
276	2.34969	64.11470	1.25182	1.95247
277	2.35821	63.91253	1.15560	1.80810
278	2.36672	63.71016	1.06186	1.66670
279	2.37523	63.50782	0.97110	1.52910
280	2.38375	63.30573	0.88388	1.39621

Calculated Data

Frequency (cy/mm)	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mrad) (1/2.03/1000)	Calculated Monocular MTF (obj*tube*eye)
58.26772	82.8375	-136.167	75.4881	1.57498	-85.14862
58.58268	82.7262	-140.943	75.3312	1.58349	-87.83377
58.89764	82.6148	-145.841	75.1742	1.59200	-90.57467
59.2126	82.5036	-150.863	75.0171	1.60052	-93.37190
59.52756	82.3923	-156.011	74.86	1.60903	-96.22600
59.84252	82.2811	-161.288	74.7028	1.61754	-99.13753
60.15748	82.1698	-166.695	74.5455	1.62605	-102.10705
60.47244	82.0586	-172.234	74.3882	1.63457	-105.13508
60.7874	81.9474	-177.908	74.2309	1.64308	-108.22218
61.10236	81.8362	-183.72	74.0735	1.65160	-111.36888
61.41732	81.725	-189.67	73.9161	1.66011	-114.57570
61.73228	81.6138	-195.762	73.7586	1.66862	-117.84316
62.04725	81.5027	-201.997	73.6011	1.67714	-121.17190
62.36221	81.3916	-208.378	73.4436	1.68565	-124.56220
62.67717	81.2805	-214.908	73.2861	1.69416	-128.01469
62.99213	81.1695	-221.587	73.1285	1.70268	-131.52986
63.30709	81.0585	-228.419	72.971	1.71119	-135.10621
63.62205	80.9475	-235.400	72.8134	1.71970	-138.75023
63.93701	80.8366	-242.551	72.6558	1.72822	-142.46540
64.25197	80.7257	-249.856	72.4982	1.73673	-146.22721
64.56693	80.6148	-257.322	72.3407	1.74524	-150.06312
64.88189	80.504	-264.953	72.1831	1.75376	-153.96480
65.19685	80.3932	-272.75	72.0255	1.76227	-157.93212
65.51181	80.2825	-280.717	71.868	1.77078	-161.96504
65.82677	80.1718	-288.855	71.7104	1.77930	-166.06710
66.14173	80.0612	-297.167	71.5529	1.78781	-170.23545
66.4567	79.9506	-305.656	71.3954	1.79632	-174.47177
66.77165	79.8401	-314.324	71.238	1.80484	-178.77608
67.08662	79.7296	-323.173	71.0805	1.81335	-183.14936
67.40157	79.6192	-332.208	70.9231	1.82186	-187.59148
67.71654	79.5088	-341.426	70.7658	1.83038	-192.10342
68.03149	79.3986	-350.834	70.6085	1.83889	-196.68502
68.34646	79.2883	-360.434	70.4513	1.84740	-201.33727
68.66142	79.1781	-370.229	70.2941	1.85592	-206.06013
68.97638	79.068	-380.22	70.1369	1.86443	-210.85413
69.29134	78.958	-390.41	69.9799	1.87294	-215.71968
69.6063	78.848	-400.802	69.8229	1.88146	-220.65715
69.92126	78.7381	-411.396	69.666	1.88997	-225.66693
70.23622	78.6282	-422.202	69.5091	1.89848	-230.74938
70.55119	78.5185	-433.216	69.3523	1.90700	-235.90504
70.86614	78.4088	-444.442	69.1957	1.91551	-241.13378
71.18111	78.2991	-455.883	69.0391	1.92403	-246.43662
71.49606	78.1896	-467.542	68.8826	1.93254	-251.81324
71.81103	78.0801	-479.422	68.7262	1.94105	-257.26466
72.12598	77.9707	-491.524	68.5699	1.94957	-262.79054
72.44095	77.8614	-503.854	68.4137	1.95808	-268.39191
72.75591	77.7521	-516.412	68.2576	1.96659	-274.06857
73.07087	77.6428	-529.201	68.1017	1.97511	-279.82103
73.38583	77.5339	-542.225	67.9458	1.98362	-285.64960
73.70079	77.4249	-555.486	67.7901	1.99213	-291.55461
74.01575	77.3159	-568.987	67.6345	2.00065	-297.53635
74.33071	77.2071	-582.731	67.4791	2.00916	-303.59514
74.64567	77.0984	-596.721	67.3238	2.01767	-309.73128
74.96063	76.9897	-610.96	67.1686	2.02619	-315.94505
75.27559	76.8811	-625.45	67.0136	2.03470	-322.23678
75.59055	76.7726	-640.185	66.8587	2.04321	-328.60668
75.90551	76.6643	-655.186	66.704	2.05173	-335.05100
76.22047	76.556	-670.459	66.5494	2.06024	-341.58229
76.53543	76.4477	-685.984	66.395	2.06875	-348.19863
76.8504	76.3396	-701.776	66.2408	2.07727	-354.87429
77.16535	76.2316	-717.837	66.0868	2.08578	-361.63919
77.4803	76.1237	-734.171	65.9329	2.09429	-368.48436
77.79528	76.0158	-750.778	65.7792	2.10281	-375.40940
78.11024	75.9081	-767.666	65.6258	2.11132	-382.41478
78.4252	75.8005	-784.834	65.4725	2.11983	-389.50023
78.74016	75.6929	-802.286	65.3194	2.12835	-396.66751
79.05512	75.5855	-820.026	65.1665	2.13686	-403.91534
79.37008	75.4781	-838.057	65.0138	2.14537	-411.24447
79.68504	75.3709	-856.381	64.8613	2.15389	-418.65511
80	75.2638	-875.002	64.7091	2.16240	-426.14750
80.31496	75.1567	-893.923	64.557	2.17091	-433.72186
80.62992	75.0498	-913.147	64.4052	2.17943	-441.37841
80.94489	74.9429	-932.678	64.2536	2.18794	-449.11760
81.25984	74.8362	-952.517	64.1023	2.19645	-456.93892
81.57481	74.7296	-972.67	63.9512	2.20497	-464.84355
81.88976	74.6231	-993.138	63.8004	2.21348	-472.83071
82.20473	74.5166	-1013.93	63.6497		

Measured Data

Raw Frequency (cy/mch)	Corrected Freq (cy/mrad)	Measured Camera MTF	Measured Monocula MTF Data	Actual Measured Monocular MTF (mono/camera)
281	2.39226	63.10408	0.80088	1.28914
282	2.40077	62.90310	0.72285	1.14831
283	2.40929	62.70288	0.65115	1.03847
284	2.41780	62.50380	0.58683	0.93887
285	2.42631	62.30602	0.53167	0.85332
286	2.43483	62.10948	0.48769	0.78519
287	2.44334	61.91441	0.45688	0.73792
288	2.45186	61.72088	0.44084	0.71425
289	2.46037	61.52897	0.44006	0.71521
290	2.46888	61.33870	0.45359	0.73948
291	2.47740	61.15008	0.47933	0.78396
292	2.48591	60.96307	0.51472	0.84431
293	2.49442	60.77761	0.55733	0.91700
294	2.50294	60.59361	0.60514	0.99869
295	2.51145	60.41096	0.65665	1.08697
296	2.51996	60.22952	0.71075	1.18007
297	2.52848	60.04913	0.76666	1.27672
298	2.53699	59.86959	0.8238	1.37599
299	2.54550	59.69073	0.88178	1.47725
300	2.55402	59.51233	0.94029	1.57999
301	2.56253	59.33418	0.99808	1.68382
302	2.57104	59.15606	1.05795	1.78841
303	2.57956	58.97776	1.11673	1.89348
304	2.58807	58.79908	1.17523	1.99872
305	2.59658	58.61982	1.23329	2.10388
306	2.60510	58.43980	1.29071	2.20881
307	2.61361	58.25886	1.34731	2.31263
308	2.62212	58.07685	1.40289	2.41556
309	2.63064	57.89366	1.45724	2.51710
310	2.63915	57.70920	1.51013	2.61679
311	2.64766	57.52340	1.56134	2.71427
312	2.65618	57.33625	1.61064	2.80911
313	2.66469	57.14773	1.6578	2.90090
314	2.67320	56.95788	1.70257	2.98917
315	2.68172	56.76677	1.74475	3.07354
316	2.69023	56.57448	1.78409	3.15352
317	2.69874	56.38113	1.8204	3.22874
318	2.70726	56.18686	1.85347	3.29976
319	2.71577	55.99186	1.88314	3.36324
320	2.72428	55.79629	1.90924	3.42180
321	2.73280	55.60037	1.93163	3.47413
322	2.74131	55.40432	1.9502	3.51994
323	2.74982	55.20835	1.96487	3.55901
324	2.75834	55.01270	1.97559	3.59115
325	2.76685	54.81761	1.98234	3.61625
326	2.77536	54.62328	1.98511	3.63418
327	2.78388	54.42994	1.98396	3.64488
328	2.79239	54.23780	1.97896	3.64857
329	2.80090	54.04703	1.97022	3.64538
330	2.80942	53.85781	1.95789	3.63520
331	2.81793	53.67028	1.94215	3.61867
332	2.82644	53.48465	1.92323	3.59586
333	2.83496	53.30072	1.90135	3.56721
334	2.84347	53.11885	1.87682	3.53325
335	2.85198	52.93895	1.84994	3.49448
336	2.86050	52.76105	1.82104	3.45149
337	2.86901	52.58509	1.7905	3.40496
338	2.87752	52.41102	1.7587	3.35559
339	2.88604	52.23874	1.72603	3.30412
340	2.89455	52.06816	1.69291	3.25133
341	2.90306	51.89911	1.65977	3.19807
342	2.91158	51.73146	1.62701	3.14511
343	2.92009	51.56501	1.59506	3.09330
344	2.92860	51.39958	1.5643	3.04341
345	2.93712	51.23598	1.53512	2.99623
346	2.94563	51.07099	1.50784	2.95244
347	2.95414	50.90742	1.48278	2.91270
348	2.96266	50.74407	1.46018	2.87754
349	2.97117	50.58074	1.44027	2.84747
350	2.97969	50.41726	1.4232	2.82284

Calculated Data

Frequency (cy/mm)	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mrad)	Calculated Monocular MTF (obj*tube*eye)
88.50384	72.4108	-1501.82	69.698	2.39226	-860.08093
88.8189	72.3067	-1530.09	60.5538	2.40077	-869.94182
89.13386	72.2027	-1568.75	60.41	2.40929	-879.88952
89.44882	72.0988	-1587.81	60.2665	2.41780	-889.92471
89.76378	71.995	-1617.27	60.1234	2.42631	-899.94735
90.07874	71.8913	-1647.13	59.9807	2.43483	-909.95760
90.3937	71.7877	-1677.4	59.8384	2.44334	-919.95562
90.70866	71.6842	-1708.09	59.6964	2.45186	-929.94157
91.02362	71.5808	-1739.19	59.5549	2.46037	-939.91564
91.33858	71.4776	-1770.71	59.4137	2.46888	-949.87797
91.65354	71.3744	-1802.66	59.273	2.47740	-959.82874
91.96851	71.2714	-1835.03	59.1326	2.48591	-969.76845
92.28346	71.1685	-1867.84	58.9927	2.49442	-979.69625
92.59843	71.0656	-1901.08	58.8532	2.50294	-989.61368
92.91338	70.9629	-1934.75	58.7141	2.51145	-999.52115
93.22835	70.8603	-1968.87	58.5754	2.51996	-1009.41937
93.54331	70.7578	-2003.44	58.4372	2.52848	-1019.30932
93.85827	70.6554	-2038.46	58.2994	2.53699	-1029.19141
94.17323	70.5532	-2073.93	58.1621	2.54550	-1039.06593
94.48819	70.4511	-2109.85	58.0252	2.55402	-1048.93330
94.80315	70.3489	-2146.24	57.8888	2.56253	-1058.79333
95.11811	70.247	-2183.1	57.7528	2.57104	-1068.64630
95.43307	70.1451	-2220.42	57.6173	2.57956	-1078.49284
95.74803	70.0434	-2258.22	57.4823	2.58807	-1088.33345
96.063	69.9417	-2296.49	57.3477	2.59658	-1098.16861
96.37795	69.8402	-2335.25	57.2137	2.60510	-1108.00000
96.69292	69.7387	-2374.49	57.0801	2.61361	-1117.82824
97.00787	69.6374	-2414.22	56.947	2.62212	-1127.65398
97.32284	69.5362	-2454.44	56.8145	2.63064	-1137.47771
97.63779	69.4351	-2495.16	56.6824	2.63915	-1147.29993
97.95276	69.334	-2536.38	56.5508	2.64766	-1157.12015
98.26772	69.2331	-2578.1	56.4198	2.65618	-1166.93888
98.58268	69.1323	-2620.34	56.2893	2.66469	-1176.75661
98.89764	69.0316	-2663.09	56.1593	2.67320	-1186.57284
99.2126	68.9309	-2706.35	56.0298	2.68172	-1196.38807
99.52756	68.8304	-2750.14	55.9009	2.69023	-1206.20280
99.84252	68.73	-2794.45	55.7725	2.69874	-1216.01663
100.1575	68.6297	-2839.29	55.6447	2.70726	-1225.82997
100.4724	68.5294	-2884.67	55.5174	2.71577	-1235.64330
100.7874	68.4293	-2930.56	55.3907	2.72428	-1245.45603
101.1024	68.3292	-2977.04	55.2646	2.73280	-1255.26876
101.4173	68.2293	-3024.04	55.139	2.74131	-1265.08149
101.7323	68.1294	-3071.59	55.014	2.74982	-1274.89422
102.0473	68.0296	-3119.7	54.8896	2.75834	-1284.70695
102.3622	67.93	-3168.37	54.7658	2.76685	-1294.51968
102.6772	67.8304	-3217.6	54.6426	2.77536	-1304.33241
102.9921	67.7308	-3267.4	54.52	2.78388	-1314.14514
103.3071	67.6314	-3317.77	54.398	2.79239	-1323.95787
103.6221	67.5321	-3368.71	54.2766	2.80090	-1333.77060
103.937	67.4329	-3420.24	54.1559	2.80942	-1343.58333
104.252	67.3337	-3472.35	54.0357	2.81793	-1353.39606
104.5669	67.2346	-3525.05	53.9162	2.82644	-1363.20879
104.8819	67.1356	-3578.34	53.7974	2.83496	-1373.02152
105.1969	67.0367	-3632.24	53.6791	2.84347	-1382.83425
105.5118	66.9379	-3686.73	53.5616	2.85198	-1392.64698
105.8268	66.8391	-3741.83	53.4446	2.86050	-1402.45971
106.1417	66.7405	-3797.54	53.3284	2.86901	-1412.27244
106.4567	66.6418	-3853.87	53.2128	2.87752	-1422.08517
106.7717	66.5433	-3910.82	53.0979	2.88604	-1431.89790
107.0866	66.4449	-3968.39	52.9836	2.89455	-1441.71063
107.4016	66.3465	-4026.59	52.8701	2.90306	-1451.52336
107.7165	66.2482	-4085.43	52.7572	2.91158	-1461.33609
108.0315	66.1499	-4144.9	52.6451	2.92009	-1471.14882
108.3465	66.0518	-4205.02	52.5336	2.92860	-1480.96155
108.6614	65.9536	-4265.78	52.4228	2.93712	-1490.77428
108.9764	65.8556	-4327.2	52.3128	2.94563	-1500.58701
109.2913	65.7576	-4389.27	52.2035	2.95414	-1510.40000
109.6063	65.6597	-4452	52.0949	2.96266	-1520.21333
109.9213	65.5618	-4515.4	51.9871	2.97117	-1530.02666
110.2362	65.464	-4579.47	51.8799	2.97969	-1539.84000

## A.2.2 SYSTEM MTF DATA

Monocular 2\_1

Objective Lens S/N: 2397

Eyepiece Lens S/N: 18258A

Image Intensifier Tube S/N: 63585CC

## System MTF Measurement for a Complete ANVIS System

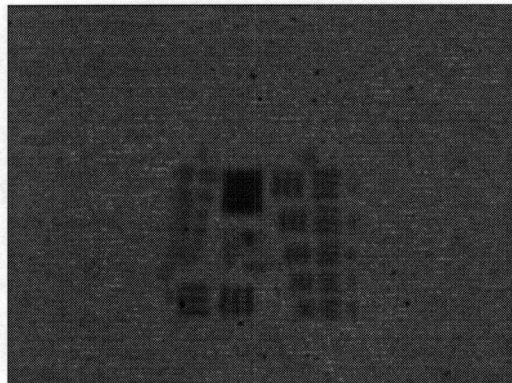
Data Identification: Mono2\_1  
Date: 22 Feb 95  
Excel Filename: mon2\_1.xls  
mon2\_1a.xls

Slit Used: 2.5 micron

Monocular Components:  
Eyepiece S/N: 18258A  
Objective S/N: 2397  
Tube S/N: 63585CC

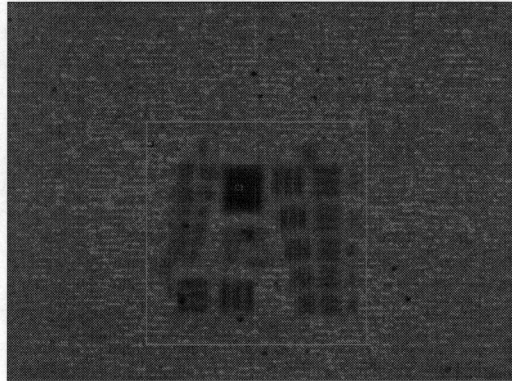
Camera Focus Data  
Filename: None  
Integration Time:  
Light Level:

Monocular Focus Data  
Filename: mon2foc1.tif  
Integration Time: 1000  
Light Level: 9.5E-5 ft-L



**Monocular Luminance Measurement**

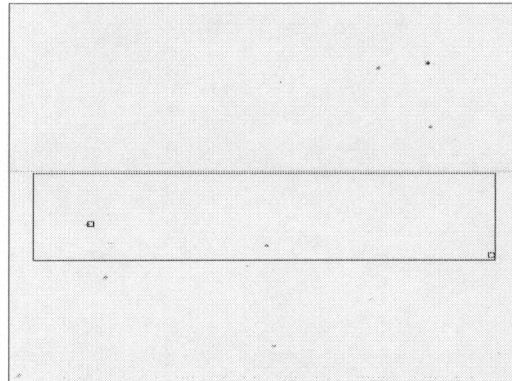
Filename: mon2lm1.tif  
Integration Time: 1000  
Light Level: 9.5E-5 ft-L  
Max. Luminance (ft-L): 0.423  
Min. Luminance (ft-L): 0.108  
Ave. Luminance (ft-L): 0.332



**Horizontal Line Setting**

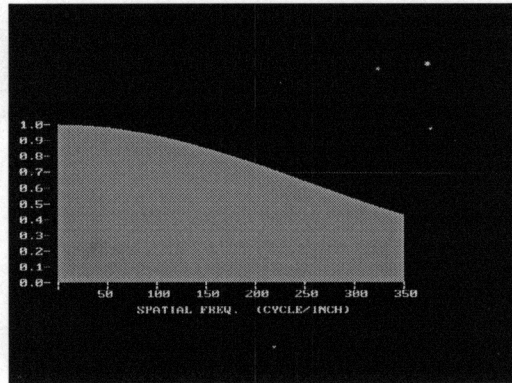
Filename: cam2hslt.tif  
Integration Time: 375  
Light Level: 14.39 ft-L  
Slit Size: 2.5 micron

Negative Print for  
Easier Viewing



**Camera MTF Measurement**

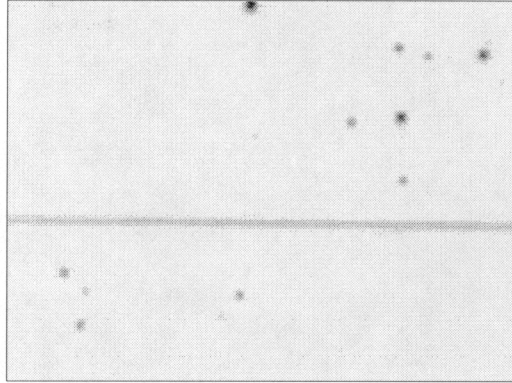
Image Filename: cam2h.tif  
Data Filename: cam2h.dat  
Integration Time: 1000  
Light Level: 14.39 ft-L



Monocular Image of Horizontal Slit

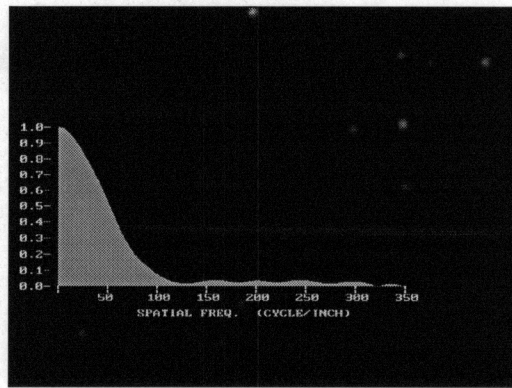
Filename: mon2slt1.tif  
Integration Time: 1000  
Light Level: 1.504 ft-L

Negative Print for  
Easier Viewing

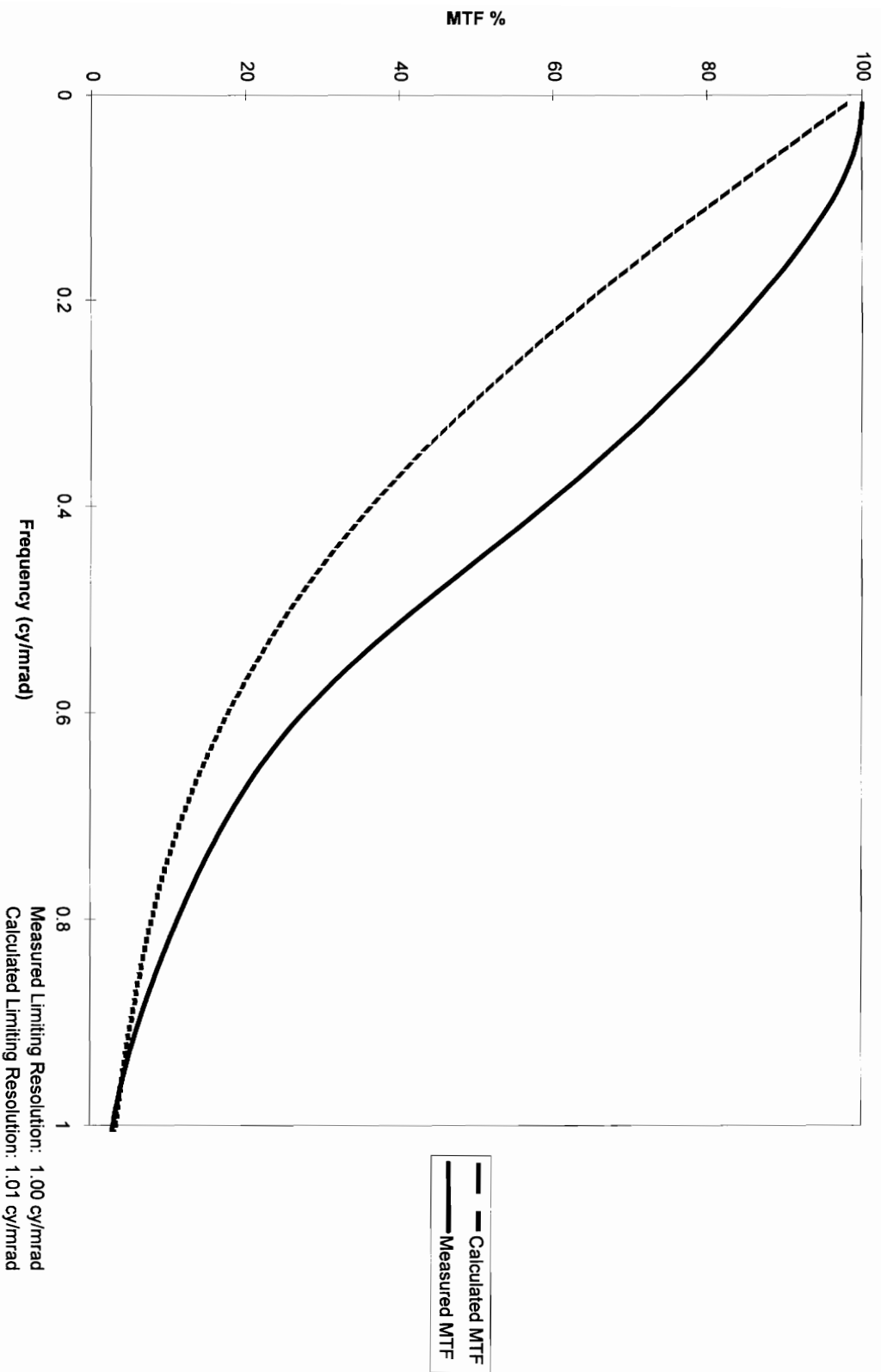


Monocular MTF Measurement Using Horizontal Slit

Image Filename: mon2h1.tif  
Data Filename: mon2h1.dat  
Integration Time: 1000  
Light Level: 1.504 ft-L



# SYSTEM MTF of MONOCULAR 2\_1



**MTF Data**

Monocular: Mono2\_1  
Date: 22 Feb 95

Monocular Components:  
Eye Piece S/N: 18258A  
Objective S/N: 2397  
Tube S/N: 63585CC

**Measured Data**

Raw Frequency (cy/inch)	Corrected Frequency (cy/mrad)	Measured Camera MTF	Measured Monocula MTF Data	Actual Measured Monocular MTF (mono/camera)
1	0.00851	100.00000	100.00000	100.00000
2	0.01703	99.99887	99.99802	99.96715
3	0.02554	99.99550	99.98429	99.86878
4	0.03405	99.98991	99.69540	99.70546
5	0.04257	99.98210	99.46034	99.47815
6	0.05108	99.97213	99.16048	99.18812
7	0.05959	99.96003	98.79753	98.83704
8	0.06811	99.94587	98.37354	98.42682
9	0.07662	99.92969	97.89085	97.95973
10	0.08513	99.91158	97.35207	97.43322
11	0.09365	99.89160	96.76001	96.86501
12	0.10216	99.86983	96.11768	96.24296
13	0.11067	99.84636	95.42822	95.57506
14	0.11919	99.82128	94.69483	94.86437
15	0.12770	99.79468	93.92079	94.11402
16	0.13621	99.76665	93.10932	93.32710
17	0.14473	99.73727	92.26361	92.50665
18	0.15324	99.70664	91.38672	91.65560
19	0.16175	99.67485	90.48158	90.77674
20	0.17027	99.64197	89.55090	89.87267
21	0.17878	99.60808	88.59718	88.94578
22	0.18729	99.57326	87.62265	88.00000
23	0.19581	99.53756	86.62928	87.03175
24	0.20432	99.50106	85.61871	86.04804
25	0.21283	99.46379	84.59228	85.04832
26	0.22135	99.42579	83.55104	84.03357
27	0.22986	99.38710	82.49570	83.00443
28	0.23837	99.34774	81.42670	81.96322
29	0.24688	99.30772	80.34419	80.90427
30	0.25540	99.26703	79.24807	79.83322
31	0.26391	99.22567	78.13804	78.74781
32	0.27243	99.18362	77.01359	77.64749
33	0.28094	99.14085	75.87409	76.53161
34	0.28946	99.09732	74.71880	75.39942
35	0.29797	99.05298	73.54693	74.25009
36	0.30648	99.00777	72.35768	73.08222
37	0.31500	98.96165	71.15028	71.89682
38	0.32351	98.91452	69.92404	70.69138
39	0.33202	98.86633	68.67840	69.46891
40	0.34054	98.81700	67.41293	68.21997
41	0.34905	98.76643	66.12741	66.95333
42	0.35756	98.71456	64.82182	65.66592
43	0.36608	98.66129	63.49640	64.35797
44	0.37459	98.60653	62.15162	63.02992
45	0.38310	98.55022	60.78823	61.68249
46	0.39162	98.49226	59.40729	60.31671
47	0.40013	98.43257	58.01069	58.93384
48	0.40864	98.37110	56.59823	57.53642
49	0.41716	98.30777	55.17356	56.12330
50	0.42567	98.24252	53.73819	54.69662
51	0.43418	98.17530	52.29448	53.25643
52	0.44270	98.10606	50.84487	51.82653
53	0.45121	98.03478	49.39243	50.39856
54	0.45973	97.96142	47.93676	48.97339
55	0.46824	97.88598	46.48000	47.54903
56	0.47675	97.80843	45.04627	46.12561
57	0.48526	97.72880	43.61177	44.70322
58	0.49378	97.64708	42.18970	43.28183
59	0.50229	97.56332	40.78325	41.86143
60	0.51080	97.47753	39.39554	40.44200
61	0.51932	97.38977	38.02961	39.02358
62	0.52783	97.30008	36.68835	37.60639
63	0.53634	97.20853	35.37449	36.19031
64	0.54486	97.11517	34.08054	34.77532
65	0.55337	97.02010	32.83875	33.36137
66	0.56188	96.92337	31.62114	31.94848
67	0.57040	96.82508	30.43939	30.53664
68	0.57891	96.72532	29.29489	29.12593
69	0.58742	96.62416	28.18865	27.71730
70	0.59594	96.52171	27.12138	26.31074
71	0.60445	96.41805	26.09341	24.90729
72	0.61296	96.31327	25.10471	23.50698
73	0.62148	96.20746	24.15492	22.10972
74	0.62999	96.10070	23.24336	20.71551
75	0.63850	95.99306	22.36905	19.32435
76	0.64702	95.88463	21.53072	17.93624
77	0.65553	95.77546	20.72688	16.55112
78	0.66404	95.66563	19.95586	15.16801
79	0.67256	95.55517	19.21581	13.78690
80	0.68107	95.44413	18.50481	12.40779
81	0.68958	95.33255	17.82085	11.03068
82	0.69810	95.22045	17.16192	9.65557
83	0.70661	95.10784	16.52605	8.28246
84	0.71512	94.99472	15.91133	6.91035
85	0.72364	94.88111	15.31595	5.53924
86	0.73215	94.76896	14.73822	4.16913
87	0.74066	94.65227	14.17661	2.80002
88	0.74918	94.53700	13.62977	1.43091

**Calculated Data**

Frequency (cy/mm)	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mrad) ((1*27.03/1000))	Calculated Monocular MTF (obj*tube*eye)
0.31496	99.9332	98.286	99.8929	0.00851	98.11518
0.62992	99.8624	96.9308	98.7854	0.01703	96.58974
0.94488	99.7876	95.5741	98.6774	0.02554	95.06339
1.25984	99.7088	94.2163	98.5699	0.03405	93.53696
1.5748	99.626	92.858	98.4601	0.04257	92.01123
1.88976	99.5395	91.4997	98.3507	0.05108	90.48698
2.20472	99.4491	90.1421	98.2409	0.05959	88.96498
2.51969	99.355	88.7855	98.1306	0.06811	87.44590
2.83465	99.2571	87.4306	98.0199	0.07662	85.93058
3.14961	99.1556	86.0778	98.9088	0.08513	84.41967
3.46457	99.0505	84.7277	98.7972	0.09365	82.91385
3.77953	98.9418	83.3807	98.6852	0.10216	81.41380
4.09449	98.8297	82.0374	98.5728	0.11067	79.92016
4.40945	98.714	80.6981	98.46	0.11919	78.43357
4.72441	98.595	79.3634	98.3467	0.12770	76.95464
5.03937	98.4726	78.0337	98.233	0.13621	75.48397
5.35433	98.3469	76.7094	98.1189	0.14473	74.02213
5.66929	98.2179	75.391	98.0044	0.15324	72.56969
5.98425	98.0856	74.0788	97.8895	0.16175	71.12718
6.29921	97.9503	72.7734	97.7741	0.17027	69.69513
6.61417	97.8117	71.4751	97.6584	0.17878	68.26404
6.92913	97.6701	70.1843	97.5423	0.18729	66.83411
7.24409	97.5255	68.9014	97.4258	0.19581	65.40469
7.55906	97.3779	67.6268	97.3089	0.20432	64.08130
7.87402	97.2273	66.3608	97.1916	0.21283	62.76876
8.18898	97.0739	65.1037	97.0739	0.22135	61.46495
8.50394	96.9175	63.8561	96.9558	0.22986	60.17075
8.8189	96.7584	62.618	96.8374	0.23837	58.87205
9.13386	96.5965	61.39	96.7186	0.24688	57.57471
9.44882	96.432	60.1723	96.5994	0.25540	56.28029
9.76378	96.2647	58.9652	96.4798	0.26391	54.98760
10.07874	96.0948	57.769	96.3599	0.27243	53.69627
10.3937	95.9223	56.584	96.2397	0.28094	52.40668
10.70866	95.7473	55.4105	96.119	0.28946	51.11902
11.02362	95.5698	54.2487	95.998	0.29797	49.83329
11.33858	95.3898	53.089	95.8767	0.30648	48.54964
11.65354	95.2074	51.9615	95.755	0.31500	47.26801
11.9685	95.0228	50.8365	95.633	0.32351	46.08833
12.28346	94.8356	49.7242	95.5106	0.33202	44.91069
12.59842	94.6462	48.6249	95.3879	0.34054	43.73504
12.91339	94.4546	47.5387	95.2648	0.34905	42.56141
13.22835	94.2608	46.4659	95.1415	0.35756	41.38978
13.54331	94.0648	45.4066	95.0178	0.36608	40.22016
13.85827	93.8667	44.3611	94.8937	0.37459	39.05254
14.17323	93.6665	43.3295	94.7694	0.38310	37.88692
14.48819	93.4643	42.312	94.6447	0.39162	36.72329
14.80315	93.2601	41.3087	94.5197	0.40013	35.56166
15.11811	93.0539	40.3197	94.3944	0.40864	34.40204
15.43307	92.8458	39.3453	94.2688	0.41716	33.24441
15.74803	92.6358	38.3854	94.1429	0.42567	32.08879
16.06299	92.424	37.4403	94.0167	0.43418	30.93516
16.37795	92.2104	36.5101	93.8902	0.44270	29.78354
16.69291	91.995	35.5948	93.7633	0.45121	28.63391
17.00787	91.7778	34.6945	93.6362	0.45973	27.48628
17.32283	91.559	33.8093	93.5088	0.46824	26.34065
17.63778	91.3386	32.9393	93.3811	0.47675	25.19702
17.95274	91.1165	32.0845	93.2532	0.48526	24.05539
18.26772	90.8929	31.245	93.1249	0.49378	22.91576
18.58268	90.6677	30.4208	92.9964	0.50229	21.77813
18.89764	90.441	29.6119	92.8676	0.51080	20.64250
19.2126	90.2129	28.8184	92.7385	0.51932	19.50887
19.52756	89.9833	28.0402	92.6091	0.52783	18.37724
19.84252	89.7523	27.2775	92.4795	0.53634	17.24761
20.15748	89.52	26.53	92.3497	0.54486	16.11998
20.47244	89.2863	25.7979	92.2195	0.55337	15.00435
20.7874	89.0514	25.0812	92.0891	0.56188	13.89072
21.10236	88.8152	24.3796	91.9585	0.57040	12.77909
21.41732	88.5778	23.6933	91.8276	0.57891	11.66946
21.73228	88.3392	23.0222	91.6965	0.58742	10.56183
22.04725	88.0995	22.3661	91.5651	0.59594	9.45620
22.36221	87.8586	21.725	91.4334	0.60445	8.35257
22.67717	87.6167	21.0989	91.3016	0.61296	7.25094
22.99213	87.3737	20.4876	91.1695	0.62148	6.15131
23.30709	87.1297	19.891	91.0371	0.62999	5.05368
23.62205	86.8847	19.3091	90.9046	0.63850	3.95805
23.93701	86.6388	18.7416	90.7718	0.64702	2.86442
24.25197	86.3919	18.1884	90.6388	0.65553	1.77279
24.56693	86.1442	17.6495	90.5055	0.66404	0.68316
24.88189	85.8956	17.1246	90.3721	0.67256	0.58953
25.19685	85.6462	16.6135	90.2384	0.68107	0.49590
25.51181	85.396	16.1162	90.1045	0.68958	0.40227
25.					



Measured Data

Raw Frequency (cy/inch)	Corrected Frequency (cy/mrad)	Measured Camera MTF	Measured Monocular MTF Data	Actual Measured Monocular MTF (mono/camera)
89	0.75769	94.42111	13.09649	13.87030
90	0.76620	94.30454	12.57578	13.33529
91	0.77472	94.18725	12.06680	12.81150
92	0.78323	94.06916	11.56890	12.29829
93	0.79174	93.95021	11.08160	11.79518
94	0.80026	93.83032	10.60456	11.30185
95	0.80877	93.70942	10.13759	10.81811
96	0.81729	93.58744	9.68061	10.34392
97	0.82580	93.46428	9.23396	9.87935
98	0.83431	93.33988	8.79688	9.42557
99	0.84283	93.21415	8.37046	8.97982
100	0.85134	93.08703	7.95466	8.54540
101	0.85985	92.95843	7.54978	8.12167
102	0.86837	92.82830	7.15614	7.70901
103	0.87688	92.69657	6.77410	7.30782
104	0.88539	92.56318	6.40398	6.91850
105	0.89391	92.42810	6.04613	6.54144
106	0.90242	92.29128	5.70087	6.17704
107	0.91093	92.15268	5.36849	5.82565
108	0.91945	92.01230	5.04926	5.48759
109	0.92796	91.87011	4.74341	5.16317
110	0.93647	91.72612	4.45114	4.85284
111	0.94498	91.58034	4.17261	4.55623
112	0.95350	91.43278	3.90794	4.27411
113	0.96201	91.28347	3.65722	4.00644
114	0.97053	91.13245	3.42049	3.75332
115	0.97904	90.97976	3.19777	3.51481
116	0.98755	90.82547	2.98904	3.29087
117	0.99607	90.66963	2.79427	3.08181
118	1.00458	90.51232	2.61341	2.88735
119	1.01309	90.35361	2.44638	2.70756
120	1.02161	90.19359	2.29313	2.54245
121	1.03012	90.03234	2.15381	2.39204
122	1.03863	89.86995	2.02780	2.25637
123	1.04715	89.70651	1.91573	2.13555
124	1.05566	89.54213	1.81748	2.02975
125	1.06417	89.37689	1.73318	1.93918
126	1.07268	89.21088	1.66302	1.86414
127	1.08120	89.04420	1.60726	1.80501
128	1.08971	88.87692	1.56613	1.76213
129	1.09823	88.70914	1.53986	1.73585
130	1.10674	88.54093	1.52857	1.72640
131	1.11525	88.37238	1.53227	1.73388
132	1.12377	88.20348	1.55075	1.75815
133	1.13228	88.03436	1.58363	1.79888
134	1.14079	87.86504	1.63029	1.85545
135	1.14931	87.69556	1.68995	1.92706
136	1.15782	87.52593	1.76166	2.01273
137	1.16633	87.35619	1.84437	2.11332
138	1.17485	87.18632	1.93892	2.22159
139	1.18336	87.01634	2.03613	2.34224
140	1.19187	86.84621	2.14676	2.47691
141	1.20039	86.67593	2.26156	2.62612
142	1.20890	86.50546	2.38128	2.79257
143	1.21741	86.33475	2.50643	2.96710
144	1.22593	86.16375	2.63034	3.05272
145	1.23444	85.99242	2.75713	3.20625
146	1.24295	85.82067	2.88374	3.36019
147	1.25146	85.64844	3.00888	3.51306
148	1.25998	85.47566	3.13131	3.66339
149	1.26849	85.30225	3.24979	3.80974
150	1.27701	85.12813	3.36313	3.96078
151	1.28552	84.95322	3.47015	4.08478
152	1.29403	84.77743	3.56972	4.21070
153	1.30255	84.60058	3.66080	4.32715
154	1.31106	84.42290	3.74236	4.43287
155	1.31957	84.24432	3.81348	4.52621
156	1.32809	84.06395	3.87332	4.60759
157	1.33660	83.88264	3.92113	4.67454
158	1.34511	83.70003	3.95625	4.72670
159	1.35363	83.51606	3.97814	4.76332
160	1.36214	83.33070	3.98639	4.78382
161	1.37066	83.14392	3.98070	4.78772
162	1.37917	82.95567	3.96091	4.77473
163	1.38768	82.76596	3.92701	4.74472
164	1.39620	82.57478	3.87913	4.69772
165	1.40471	82.38213	3.81757	4.63398
166	1.41322	82.18803	3.74278	4.55392
167	1.42174	81.99250	3.65542	4.45824
168	1.43025	81.79559	3.55631	4.34780
169	1.43876	81.59733	3.44650	4.22379
170	1.44728	81.39779	3.32726	4.08765
171	1.45579	81.19701	3.20009	3.94114
172	1.46430	80.99509	3.06681	3.78441
173	1.47282	80.79208	2.92652	3.62800
174	1.48133	80.58809	2.79069	3.46291
175	1.48984	80.38319	2.65319	3.30068
176	1.49836	80.17747	2.52030	3.14340
177	1.50687	79.97105	2.39572	2.99573
178	1.51538	79.76400	2.28354	2.86287
179	1.52390	79.55643	2.18804	2.75030
180	1.53241	79.34843	2.11341	2.66346
181	1.54092	79.14010	2.06330	2.60715
182	1.54944	78.93154	2.04027	2.58486
183	1.55795	78.72282	2.04535	2.59817
184	1.56646	78.51404	2.07781	2.64642

Calculated Data

Frequency (cy/mm) f1	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mrad) (f1*27.03/1000)	Calculated Monocular MTF (obj*tube*eye)
28.0315	83.3696	12.6069	89.0262	0.75769	9.35695
28.34646	83.1136	12.2235	88.8905	0.76620	9.93075
28.66142	82.8572	11.8515	88.7547	0.77472	8.71558
28.97638	82.6002	11.4907	88.6187	0.78323	8.41113
28.29134	82.3428	11.1408	88.4825	0.79174	8.11708
29.6063	82.0851	10.8014	88.3461	0.80026	7.83339
29.92126	81.8277	10.4723	88.2096	0.80877	7.55883
30.23622	81.5685	10.1531	88.0729	0.81729	7.29398
30.55118	81.3097	9.84356	87.936	0.82580	7.03819
30.86614	81.0505	9.54327	87.799	0.83431	6.79114
31.1811	80.7911	9.25191	87.6618	0.84283	6.55248
31.49606	80.5315	8.96912	87.5244	0.85134	6.32186
31.81102	80.2716	8.69453	87.3869	0.85985	6.09895
32.12598	80.0116	8.42777	87.2493	0.86837	5.88339
32.44094	79.7513	8.16846	87.1114	0.87688	5.67483
32.75591	79.4911	7.91618	86.9735	0.88539	5.47294
33.07087	79.2305	7.67055	86.8354	0.89391	5.27735
33.38583	78.9699	7.43115	86.6972	0.90242	5.09271
33.70079	78.7092	7.19756	86.5588	0.91093	4.93088
34.01575	78.4485	6.96933	86.4203	0.91945	4.72488
34.33071	78.1878	6.74603	86.2816	0.92796	4.55098
34.64567	77.9277	6.5272	86.1428	0.93647	4.38162
34.96063	77.6663	6.31238	86.0039	0.94498	4.21643
35.27559	77.4057	6.1011	85.8649	0.95350	4.05506
35.59055	77.1451	5.89288	85.7258	0.96201	3.89715
35.90551	76.8846	5.68722	85.5865	0.97053	3.74236
36.22047	76.6242	5.48363	85.4471	0.97904	3.59031
36.53543	76.364	5.28159	85.3078	0.98755	3.44085
36.85039	76.1036	5.08057	85.168	0.99607	3.29303
37.16536	75.844	4.88060	85.0283	1.00458	3.14710
37.48032	75.5843	4.67952	84.8885	1.01309	3.00249
37.79528	75.3248	4.47839	84.7486	1.02161	2.85866
38.11024	75.0656	4.27811	84.6086	1.03012	2.71584
38.4252	74.8067	4.07212	84.4684	1.03863	2.57309
38.74016	74.548	3.86583	84.3282	1.04715	2.43026
39.05512	74.2896	3.65687	84.1879	1.05566	2.28899
39.37008	74.0316	3.44403	84.0475	1.06417	2.14933
39.68504	73.7739	3.2273	83.9071	1.07268	1.99775
40	73.5165	3.00588	83.7665	1.08120	1.85109
40.31496	73.2596	2.77912	83.6258	1.08971	1.70280
40.62992	73.003	2.5484	83.4851	1.09823	1.55195
40.94488	72.7469	2.30708	83.3443	1.10674	1.39878
41.25984	72.4912	2.06049	83.2034	1.11525	1.24279
41.5748	72.236	1.80597	83.0625	1.12377	1.08360
41.88976	71.9812	1.54285	82.9215	1.13228	0.92089
42.20472	71.7269	1.27044	82.7804	1.14079	0.75433
42.51968	71.4731	0.98805	82.6393	1.14931	0.58359
42.83465	71.2199	0.69497	82.4981	1.15782	0.40833
43.14961	70.9672	0.3905	82.3568	1.16633	0.22823
43.46457	70.7151	0.07391	82.2155	1.17485	0.04297
43.77953	70.4635	-0.25553	82.0741	1.18336	-0.14778
44.09449	70.2125	-0.59856	81.9327	1.19187	-0.34434
44.40945	69.9621	-0.95694	81.7912	1.20039	-0.54702
44.72441	69.7124	-1.32843	81.6497	1.20890	-0.75614
45.03937	69.4633	-1.71678	81.5081	1.21741	-0.97201
45.35433	69.2148	-2.1218	81.3665	1.22593	-1.19495
45.66929	68.967	-2.54426	81.2249	1.23444	-1.42525
45.98425	68.7198	-2.98497	81.0832	1.24295	-1.66323
46.29921	68.4735	-3.44473	80.9415	1.25146	-1.90919
46.61417	68.2278	-3.92437	80.7998	1.25998	-2.16342
46.92913	67.9828	-4.4247	80.658	1.26849	-2.42622
47.24409	67.7385	-4.94658	80.5162	1.27701	-2.69789
47.55906	67.495	-5.49086	80.3744	1.28552	-2.97872
47.87402	67.2522	-6.05837	80.2326	1.29403	-3.26899
48.18898	67.0103	-6.64999	80.0907	1.30255	-3.56898
48.50394	66.7691	-7.2666	79.9488	1.31106	-3.87899
48.8189	66.5287	-7.90906	79.8069	1.31957	-4.19928
49.13386	66.2891	-8.57833	79.665	1.32809	-4.53015
49.44882	66.0503	-9.27525	79.5231	1.33660	-4.87185
49.76378	65.8124	-10.0008	79.3812	1.34511	-5.22467
50.07874	65.5753	-10.7558	79.2393	1.35363	-5.58886
50.3937	65.339	-11.5413	79.0974	1.36214	-5.96470
50.70866	65.1036	-12.3581	78.9555	1.37066	-6.35244
51.02362	64.8691	-13.2074	78.8136	1.37917	-6.75235
51.33858	64.6355	-14.0899	78.6716	1.38768	-7.16468
51.65355	64.4027	-15.0067	78.5297	1.39620	-7.58970
51.96851	64.1709	-15.9588	78.3878	1.40471	-8.02762
52.28347	63.94	-16.9471	78.246	1.41322	-8.47872

Measured Data

Raw Frequency (cy/inch)	Corrected Frequency (cy/mrad)	Measured Camera MTF	Measured Monocula MTF Data	Actual Measured Monocular MTF (mono/camera)
185	1.57498	78.30526	2.13528	2.72687
186	1.58349	78.09655	2.21416	2.83516
187	1.59200	77.88798	2.31020	2.96050
188	1.60052	77.67961	2.41896	3.11402
189	1.60903	77.47146	2.53614	3.27364
190	1.61754	77.26358	2.65784	3.43996
191	1.62606	77.05599	2.78058	3.60852
192	1.63457	76.84870	2.90336	3.77542
193	1.64308	76.64171	3.01759	3.93727
194	1.65160	76.43502	3.12706	4.09114
195	1.66011	76.22861	3.22791	4.23511
196	1.66862	76.02246	3.31859	4.36528
197	1.67714	75.81652	3.39778	4.48158
198	1.68565	75.61075	3.46445	4.58195
199	1.69416	75.40511	3.51775	4.66513
200	1.70268	75.19952	3.55706	4.73016
201	1.71119	74.99392	3.58196	4.77633
202	1.71970	74.78825	3.59218	4.80313
203	1.72822	74.58243	3.58788	4.81036
204	1.73673	74.37637	3.56856	4.79798
205	1.74524	74.17001	3.53513	4.76225
206	1.75375	73.96325	3.48787	4.71568
207	1.76227	73.75602	3.42744	4.64700
208	1.77078	73.54826	3.35471	4.56124
209	1.77930	73.33984	3.27076	4.46072
210	1.78781	73.13074	3.17666	4.34407
211	1.79632	72.92088	3.07456	4.21628
212	1.80484	72.71019	2.96563	4.07870
213	1.81335	72.49882	2.85219	3.93413
214	1.82186	72.28613	2.73663	3.78583
215	1.83038	72.07287	2.62169	3.63576
216	1.83889	71.85822	2.51049	3.49367
217	1.84740	71.64276	2.40645	3.35966
218	1.85592	71.42628	2.31327	3.23688
219	1.86443	71.20878	2.23478	3.13635
220	1.87294	70.99027	2.17462	3.06326
221	1.88146	70.77076	2.13597	3.01851
222	1.88997	70.55030	2.12110	3.00615
223	1.89849	70.32891	2.13105	3.03012
224	1.90700	70.10666	2.16546	3.08881
225	1.91551	69.88358	2.22265	3.18050
226	1.92403	69.65976	2.29993	3.30166
227	1.93254	69.43526	2.39393	3.44772
228	1.94105	69.21016	2.50103	3.61367
229	1.94957	68.98454	2.61764	3.79453
230	1.95808	68.75849	2.74037	3.98550
231	1.96659	68.53210	2.86818	4.18224
232	1.97511	68.30547	2.99233	4.38081
233	1.98362	68.07868	3.11646	4.57773
234	1.99213	67.85184	3.23652	4.76998
235	2.00065	67.62503	3.35077	4.95493
236	2.00916	67.39834	3.45772	5.13027
237	2.01767	67.17185	3.55610	5.29403
238	2.02619	66.94566	3.64487	5.44452
239	2.03470	66.71983	3.72317	5.58030
240	2.04321	66.49443	3.79033	5.70222
241	2.05173	66.26952	3.84580	5.80327
242	2.06024	66.04516	3.88921	5.88711
243	2.06875	65.82139	3.92032	5.95600
244	2.07727	65.59824	3.93899	6.00472
245	2.08578	65.37574	3.94523	6.03470
246	2.09429	65.15390	3.93913	6.04589
247	2.10281	64.93273	3.92092	6.03843
248	2.11132	64.71222	3.89088	6.01259
249	2.11983	64.49236	3.84943	5.96882
250	2.12835	64.27312	3.79703	5.90785
251	2.13686	64.05448	3.73424	5.82979
252	2.14537	63.83639	3.66169	5.73605
253	2.15389	63.61879	3.58005	5.62735
254	2.16240	63.40165	3.49008	5.50471
255	2.17091	63.18488	3.39258	5.36929
256	2.17943	62.96843	3.28836	5.22228
257	2.18794	62.75222	3.17840	5.06500
258	2.19645	62.53617	3.06354	4.89883
259	2.20497	62.32022	2.94478	4.72624
260	2.21348	62.10428	2.82311	4.54876
261	2.22199	61.88828	2.69860	4.36205
262	2.23051	61.67214	2.57322	4.17582
263	2.23902	61.45579	2.44544	3.98995
264	2.24753	61.23916	2.32915	3.80337
265	2.25605	61.02218	2.20977	3.62126
266	2.26456	60.80480	2.09467	3.44491
267	2.27307	60.58897	1.98536	3.27688
268	2.28159	60.38683	1.88345	3.11992
269	2.29010	60.19476	1.79068	2.97704
270	2.29861	59.99303	1.70884	2.85138
271	2.30713	59.79132	1.63977	2.74621
272	2.31564	59.58972	1.58517	2.66461
273	2.32415	59.38852	1.54650	2.60931
274	2.33267	59.18766	1.52477	2.58231
275	2.34118	58.98244	1.52041	2.58466
276	2.34969	58.78160	1.53314	2.61621
277	2.35821	58.57827	1.56206	2.67576
278	2.36672	58.37541	1.60567	2.76104
279	2.37523	58.17307	1.66215	2.86922
280	2.38375	57.97052	1.72944	2.99959

Calculated Data

Frequency (cy/mm)	Objective Lens MT	Tube MTF	Lens MTF	Eyes Pie	Frequency (cy/mrad)	Calculated Monocular MTF (obj*tube*eye)
58.26772	59.7355	-44.0036	75.5556	1.57498	-19.86041	
58.58268	59.5243	-45.9402	75.4145	1.58349	-20.62254	
58.89764	59.3141	-47.9361	75.2734	1.59200	-21.40239	
59.2126	59.105	-49.9925	75.1324	1.60052	-22.20015	
59.52756	58.8969	-52.1106	74.9914	1.60903	-23.01601	
59.84252	58.6899	-54.2916	74.8505	1.61754	-23.85015	
60.15748	58.4839	-56.5369	74.7097	1.62606	-24.70274	
60.47244	58.279	-58.8476	74.5689	1.63457	-25.57347	
60.7874	58.0751	-61.2249	74.4282	1.64308	-26.46402	
61.10236	57.8723	-63.6702	74.2876	1.65160	-27.37305	
61.41732	57.6706	-66.1847	74.1471	1.66011	-28.30124	
61.73228	57.4699	-68.7696	74.0066	1.66862	-29.24876	
62.04725	57.2702	-71.4265	73.8662	1.67714	-30.21580	
62.36221	57.0717	-74.1563	73.7259	1.68565	-31.20247	
62.67717	56.8742	-76.9605	73.5857	1.69416	-32.20896	
62.99213	56.6777	-79.8404	73.4456	1.70268	-33.23543	
63.30709	56.4824	-82.7974	73.3056	1.71119	-34.28204	
63.62205	56.2881	-85.8327	73.1656	1.71970	-35.34894	
63.93701	56.0948	-88.9478	73.0258	1.72822	-36.43629	
64.25197	55.9026	-92.1439	72.8861	1.73673	-37.54424	
64.56693	55.7115	-95.4225	72.7464	1.74524	-38.67299	
64.88189	55.5214	-98.7849	72.6069	1.75375	-39.82253	
65.19685	55.3324	-102.233	72.4674	1.76227	-40.99317	
65.51181	55.1445	-105.767	72.3281	1.77078	-42.18459	
65.82677	54.9576	-109.389	72.1888	1.77930	-43.39813	
66.14173	54.7717	-113.101	72.0497	1.78781	-44.63374	
66.45669	54.5869	-116.903	71.9107	1.79632	-45.89000	
66.77165	54.4031	-120.798	71.7718	1.80484	-47.16690	
67.08662	54.2204	-124.787	71.633	1.81335	-48.46676	
67.40157	54.0388	-128.87	71.4943	1.82186	-49.78854	
67.71654	53.8581	-133.051	71.3558	1.83038	-51.13263	
68.03149	53.6785	-137.329	71.2173	1.83889	-52.49869	
68.34646	53.4999	-141.707	71.079	1.84740	-53.88731	
68.66142	53.3224	-146.186	70.9406	1.85592	-55.29842	
68.97638	53.1458	-150.768	70.8028	1.86443	-56.73213	
69.29134	52.9703	-155.454	70.6648	1.87294	-58.18859	
69.6063	52.7958	-160.246	70.527	1.88146	-59.66790	
69.92126	52.6222	-165.144	70.3893	1.88997	-61.17020	
70.23622	52.4497	-170.152	70.2518	1.89849	-62.69558	
70.55119	52.2782	-175.27	70.1144	1.90700	-64.24421	
70.86614	52.1076	-180.499	69.9771	1.91551	-65.81604	
71.18111	51.938	-185.842	69.84	1.92403	-67.41138	
71.49606	51.7694	-191.299	69.703	1.93254	-69.03014	
71.81103	51.6018	-196.874	69.5662	1.94105	-70.67262	
72.12598	51.4351	-202.566	69.4295	1.94957	-72.33870	
72.44095	51.2694	-208.379	69.2929	1.95808	-74.02871	
72.75591	51.1046	-214.312	69.1565	1.96659	-75.74257	
73.07087	50.9407	-220.369	69.0203	1.97511	-77.48042	
73.38583	50.7778	-226.55	68.8842	1.98362	-79.24236	
73.70079	50.6157	-232.858	68.7483	1.99213	-81.02848	
74.01575	50.4546	-239.293	68.6125	2.00065	-82.83886	
74.33071	50.2944	-245.858	68.4768	2.00916	-84.67357	
74.64567	50.135	-252.555	68.3414	2.01767	-86.53271	
74.96063	49.9768	-259.384	68.2061	2.02619	-88.41634	
75.27559	49.819	-266.348	68.0709	2.03470	-90.32454	
75.59055	49.6622	-273.448	67.936	2.04321	-92.25759	
75.90551	49.5064	-280.687	67.8012	2.05173	-94.21492	
76.22047	49.3513	-288.065	67.6665	2.06024	-96.19724	
76.53543	49.1971	-295.584	67.5321	2.06875	-98.20439	
76.8504	49.0436	-303.248	67.3978	2.07727	-100.23649	
77.16536	48.891	-311.055	67.2637	2.08578	-102.29341	
77.48032	48.7392	-319.011	67.1297	2.09429	-104.37545	
77.79528	48.5882	-327.114	66.996	2.10281	-106.48248	
78.11024	48.4379	-335.366	66.8624	2.11132	-108.61459	
78.4252	48.2884	-343.774	66.729	2.11983	-110.77182	
78.74016	48.1396	-352.333	66.5958	2.12835	-112.95423	
79.05512	47.9915	-361.049	66.4627	2.13686	-115.16182	
79.37008	47.8442	-369.922	66.3299	2.14537	-117.39465	
79.68504	47.6975	-378.954	66.1972	2.15389	-119.65272	
80	47.5516	-388.148	66.0648	2.16240	-121.93606	
80.31496	47.4063	-397.505	65.9325	2.17091	-124.24468	
80.62992	47.2616	-407.027	65.8004	2.17943	-126.57859	
80.94489	47.1177	-416.715	65.6685	2.18794	-128.93788	
81.25984	46.9743	-426.572	65.5369	2.19645	-131.32232	
81.57481	46.8316	-436.6	65.4054	2.20497	-133.73211	
81.88976	46.6894	-446.8	65.2741	2.21348	-136.16722	
82.20473	46.5478	-457.175	65.143	2.22199	-138.62722	
82.51969	46.4069					

Measured Data

Raw Frequency (cy/inch)	Corrected Frequency (cy/mrad)	Measured Camera MTF	Measured Monocula MTF Data	Actual Measured Monocular MTF (mono/camera)
281	2.39226	57.48123	1.80546	3.14096
282	2.40077	57.25638	1.8882	3.29780
283	2.40829	57.03146	1.97574	3.46430
284	2.41780	56.80655	2.06635	3.63752
285	2.42631	56.58174	2.1584	3.81466
286	2.43483	56.35713	2.25043	3.99316
287	2.44334	56.13281	2.34105	4.17056
288	2.45186	55.90887	2.42903	4.34462
289	2.46037	55.68541	2.5132	4.51321
290	2.46888	55.46245	2.59245	4.67424
291	2.47740	55.24027	2.66577	4.82577
292	2.48591	55.01876	2.73222	4.96558
293	2.49442	54.79805	2.79091	5.09308
294	2.50294	54.57821	2.84102	5.20541
295	2.51145	54.35931	2.88181	5.30141
296	2.51996	54.14140	2.91282	5.37965
297	2.52848	53.92451	2.93283	5.43877
298	2.53699	53.70869	2.94194	5.47759
299	2.54550	53.49305	2.93653	5.49507
300	2.55402	53.28031	2.92526	5.49032
301	2.56253	53.06777	2.89888	5.46260
302	2.57104	52.85632	2.86026	5.41139
303	2.57956	52.64596	2.80934	5.33629
304	2.58807	52.43664	2.74819	5.23716
305	2.59658	52.22834	2.67096	5.11401
306	2.60510	52.02101	2.58392	4.96707
307	2.61361	51.81459	2.48544	4.79680
308	2.62212	51.60903	2.37598	4.60383
309	2.63064	51.40426	2.25612	4.38897
310	2.63915	51.20021	2.1265	4.15330
311	2.64766	50.99680	1.98788	3.89005
312	2.65618	50.79395	1.8411	3.62464
313	2.66469	50.59159	1.68707	3.33468
314	2.67320	50.38962	1.52679	3.02997
315	2.68172	50.18797	1.36132	2.71244
316	2.69023	49.98656	1.19177	2.38418
317	2.69874	49.78531	1.01932	2.04743
318	2.70726	49.58414	0.84519	1.70456
319	2.71577	49.38298	0.67065	1.35806
320	2.72428	49.18178	0.49704	1.01062
321	2.73280	48.98048	0.32594	0.66545
322	2.74131	48.77903	0.16012	0.32626
323	2.74982	48.57738	0.0438	0.09017
324	2.75834	48.37552	0.17382	0.36931
325	2.76685	48.17341	0.32293	0.67035
326	2.77536	47.97104	0.46556	0.97050
327	2.78388	47.76842	0.59943	1.25487
328	2.79239	47.56555	0.72324	1.52051
329	2.80090	47.36246	0.83594	1.76498
330	2.80942	47.15917	0.93662	1.98608
331	2.81793	46.95572	1.02445	2.18174
332	2.82644	46.75216	1.09873	2.35012
333	2.83496	46.54855	1.15888	2.48962
334	2.84347	46.34495	1.2044	2.59877
335	2.85198	46.14145	1.23495	2.67644
336	2.86050	45.93812	1.25027	2.72166
337	2.86901	45.73504	1.25027	2.73372
338	2.87752	45.53231	1.23496	2.71227
339	2.88604	45.33002	1.20449	2.65716
340	2.89455	45.12827	1.15913	2.56852
341	2.90306	44.92715	1.09929	2.44683
342	2.91158	44.72677	1.0255	2.29281
343	2.92009	44.52722	0.93844	2.10756
344	2.92860	44.32859	0.83886	1.89237
345	2.93712	44.13087	0.72787	1.64889
346	2.94563	43.93446	0.60586	1.37801
347	2.95414	43.73912	0.47456	1.08488
348	2.96266	43.54503	0.335	0.76932
349	2.97117	43.35228	0.18874	0.43536
350	2.97969	43.16087	0.04185	0.09696

Calculated Data

Frequency (cy/mm) f1	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mrad) (f1*27.03/1000)	Calculated Monocular MTF (obj*tube*eye)
88.50394	43.8122	-704.305	62.5663	2.39226	-193.06200
88.8189	43.6788	-718.799	62.4399	2.40077	-196.03780
89.13386	43.5455	-733.511	62.3136	2.40829	-199.03676
89.44882	43.4124	-748.444	62.1877	2.41780	-202.05667
89.76378	43.2794	-763.601	62.0619	2.42631	-205.10331
90.07874	43.1465	-778.982	61.9364	2.43483	-208.17048
90.3937	43.0137	-794.591	61.8111	2.44334	-211.25993
90.70866	42.8809	-810.429	61.6861	2.45186	-214.37142
91.02362	42.7482	-826.499	61.5614	2.46037	-217.50469
91.33858	42.6155	-842.803	61.4368	2.46888	-220.65947
91.65354	42.4828	-859.342	61.3126	2.47740	-223.83548
91.96851	42.3501	-876.121	61.1885	2.48591	-227.03251
92.28346	42.2173	-893.139	61.0648	2.49442	-230.24897
92.59843	42.0844	-910.4	60.9412	2.50294	-233.48782
92.91338	41.9514	-927.905	60.818	2.51145	-236.74561
93.22835	41.8182	-945.659	60.695	2.51996	-240.02311
93.54331	41.6849	-963.662	60.5722	2.52848	-243.31973
93.85827	41.5515	-981.916	60.4497	2.53699	-246.63520
94.17323	41.4178	-1000.42	60.3275	2.54550	-249.96910
94.48819	41.2839	-1019.19	60.2055	2.55402	-253.32103
94.80315	41.1497	-1038.21	60.0838	2.56253	-256.69054
95.11811	41.0152	-1057.49	59.9624	2.57104	-260.07718
95.43307	40.8805	-1077.04	59.8412	2.57956	-263.48048
95.74803	40.7453	-1096.85	59.7203	2.58807	-266.89995
96.063	40.6098	-1116.93	59.5997	2.59658	-270.33520
96.37795	40.474	-1137.28	59.4793	2.60510	-273.78536
96.69292	40.3376	-1157.91	59.3592	2.61361	-277.25034
97.00787	40.2009	-1178.8	59.2394	2.62212	-280.72912
97.32284	40.0637	-1199.98	59.1198	2.63064	-284.22156
97.63779	39.9259	-1221.43	59.0006	2.63915	-287.72661
97.95276	39.7876	-1243.17	58.8816	2.64766	-291.24408
98.26772	39.6488	-1265.19	58.7628	2.65618	-294.77298
98.58268	39.5093	-1287.5	58.6444	2.66469	-298.31276
98.89764	39.3693	-1310.09	58.5262	2.67320	-301.86272
99.2126	39.2285	-1332.98	58.4084	2.68172	-305.42213
99.52756	39.0871	-1356.16	58.2908	2.69023	-308.99205
99.84252	38.945	-1379.64	58.1735	2.69874	-312.57263
100.1575	38.8021	-1403.42	58.0564	2.70726	-316.16491
100.4724	38.6585	-1427.49	57.9397	2.71577	-319.76904
100.7874	38.514	-1451.88	57.8232	2.72428	-323.38405
101.1024	38.3688	-1476.57	57.7071	2.73280	-326.99936
101.4173	38.2226	-1501.56	57.5912	2.74131	-330.63579
101.7323	38.0755	-1526.87	57.4756	2.74982	-334.29366
102.0473	37.9275	-1552.5	57.3603	2.75834	-337.97310
102.3622	37.7786	-1578.44	57.2454	2.76685	-341.67460
102.6772	37.6286	-1604.69	57.1307	2.77536	-345.39834
102.9921	37.4776	-1631.27	57.0163	2.78388	-349.14463
103.3071	37.3256	-1658.18	56.9022	2.79239	-352.91261
103.6221	37.1724	-1685.41	56.7884	2.80090	-356.70216
103.937	37.0181	-1712.97	56.6749	2.80942	-360.51371
104.252	36.8626	-1740.86	56.5616	2.81793	-364.34705
104.5669	36.706	-1769.06	56.4488	2.82644	-368.20260
104.8819	36.5481	-1797.64	56.3362	2.83496	-372.08066
105.1969	36.3889	-1826.55	56.2239	2.84347	-375.98171
105.5118	36.2284	-1855.79	56.1119	2.85198	-379.90529
105.8268	36.0666	-1885.38	56.0002	2.86050	-383.85197
106.1417	35.9034	-1915.31	55.8888	2.86901	-387.82121
106.4567	35.7388	-1945.6	55.7778	2.87752	-391.81279
106.7717	35.5727	-1976.24	55.667	2.88604	-395.82619
107.0866	35.4052	-2007.23	55.5566	2.89455	-399.86108
107.4016	35.2361	-2038.58	55.4465	2.90306	-403.91694
107.7165	35.0655	-2070.3	55.3367	2.91158	-407.99323
108.0315	34.8933	-2102.37	55.2272	2.92009	-412.08943
108.3465	34.7195	-2134.82	55.118	2.92860	-416.20593
108.6614	34.544	-2167.63	55.0091	2.93712	-420.34303
108.9764	34.3687	-2200.81	54.9006	2.94563	-424.49993
109.2913	34.1878	-2234.37	54.7924	2.95414	-428.67673
109.6063	34.007	-2268.3	54.6845	2.96266	-432.87264
109.9213	33.8244	-2302.61	54.5769	2.97117	-437.08799
110.2362	33.64	-2337.31	54.4696	2.97969	-441.32201

### A.2.3 SYSTEM MTF DATA

Monocular 3\_1

Objective Lens S/N: 2529

Eyepiece Lens S/N: 18159A

Image Intensifier Tube S/N: 2400112

# System MTF Measurement for a Complete ANVIS System

**Data Identification:** Mono3\_1  
**Date:** 22 Feb 95  
**Excel Filename:** mono3\_1.xls  
mono3\_1a.xls

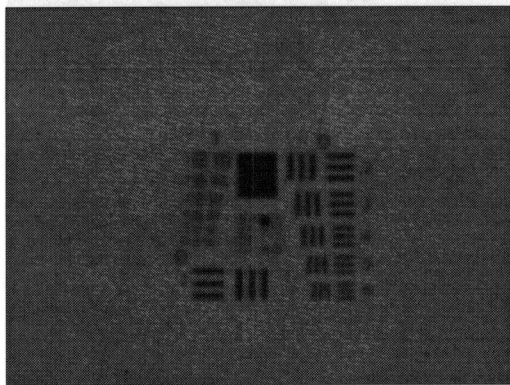
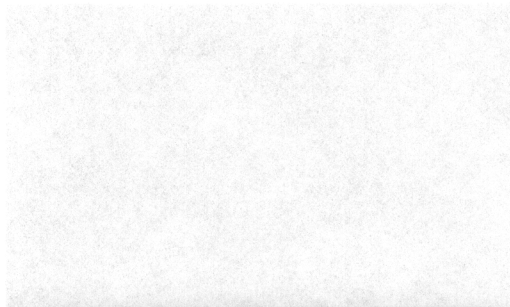
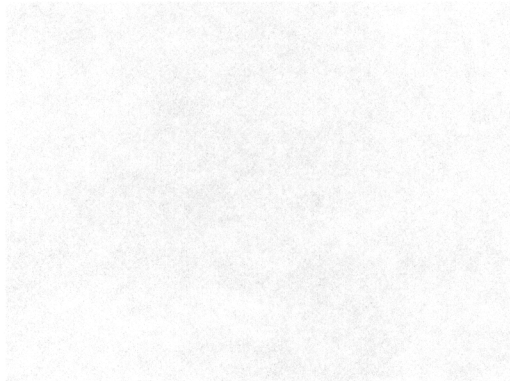
**Slit Used:** 2.5 micron

**Monocular Components:**  
**Eyepiece S/N:** 18159A  
**Objective S/N:** 2529  
**Tube S/N:** 2400112

**Camera Focus Data**  
**Filename:** None  
**Integration Time:**  
**Light Level:**

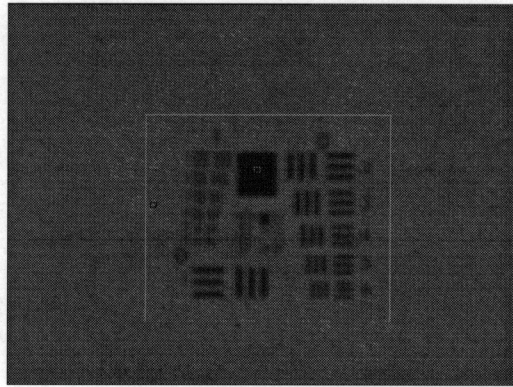
**Monocular Focus Data**  
**Filename:** mon3foc1.tif  
**Integration Time:** 1000  
**Light Level:** 9.5E-5 ft-L

**Monocular Focus Data**  
**Filename:** mon3foc1.tif  
**Integration Time:** 1000  
**Light Level:** 9.5E-5 ft-L



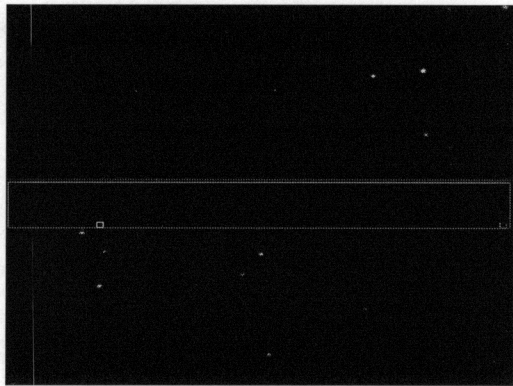
**Monocular Luminance Measurement**

Filename: mon3lm1.tif  
Integration Time: 1000  
Light Level: 9.5E-5 ft-L  
Max. Luminance (ft-L): 0.4  
Min. Luminance (ft-L): 0.093  
Ave. Luminance (ft-L): 0.313



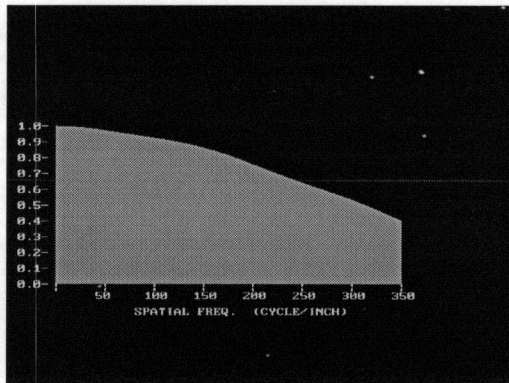
**Horizontal Line Setting**

Filename: cam3hslt.tif  
Integration Time: 1000  
Light Level: 14.39 ft-L  
Slit Size: 2.5 micron



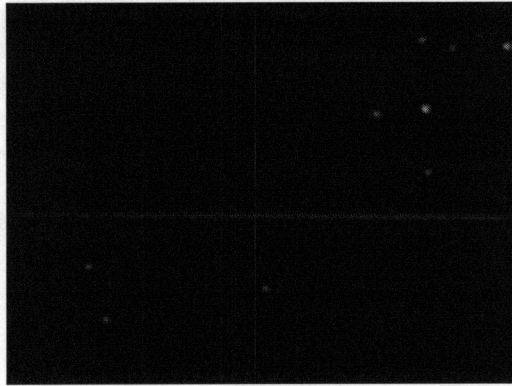
**Camera MTF Measurement**

Image Filename: cam3h.tif  
Data Filename: cam3h.dat  
Integration Time: 1000  
Light Level: 14.39 ft-L



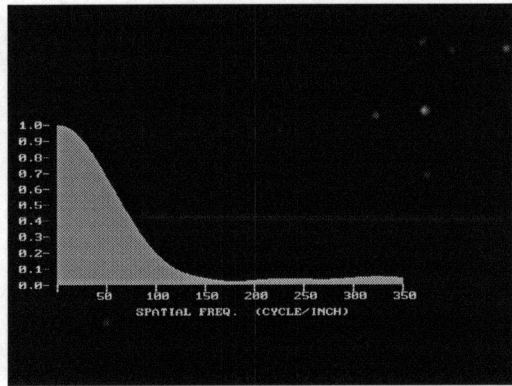
Monocular Image of Horizontal Slit

Filename: mon3slt1.tif  
Integration Time: 1000  
Light Level: 1.504 ft-L

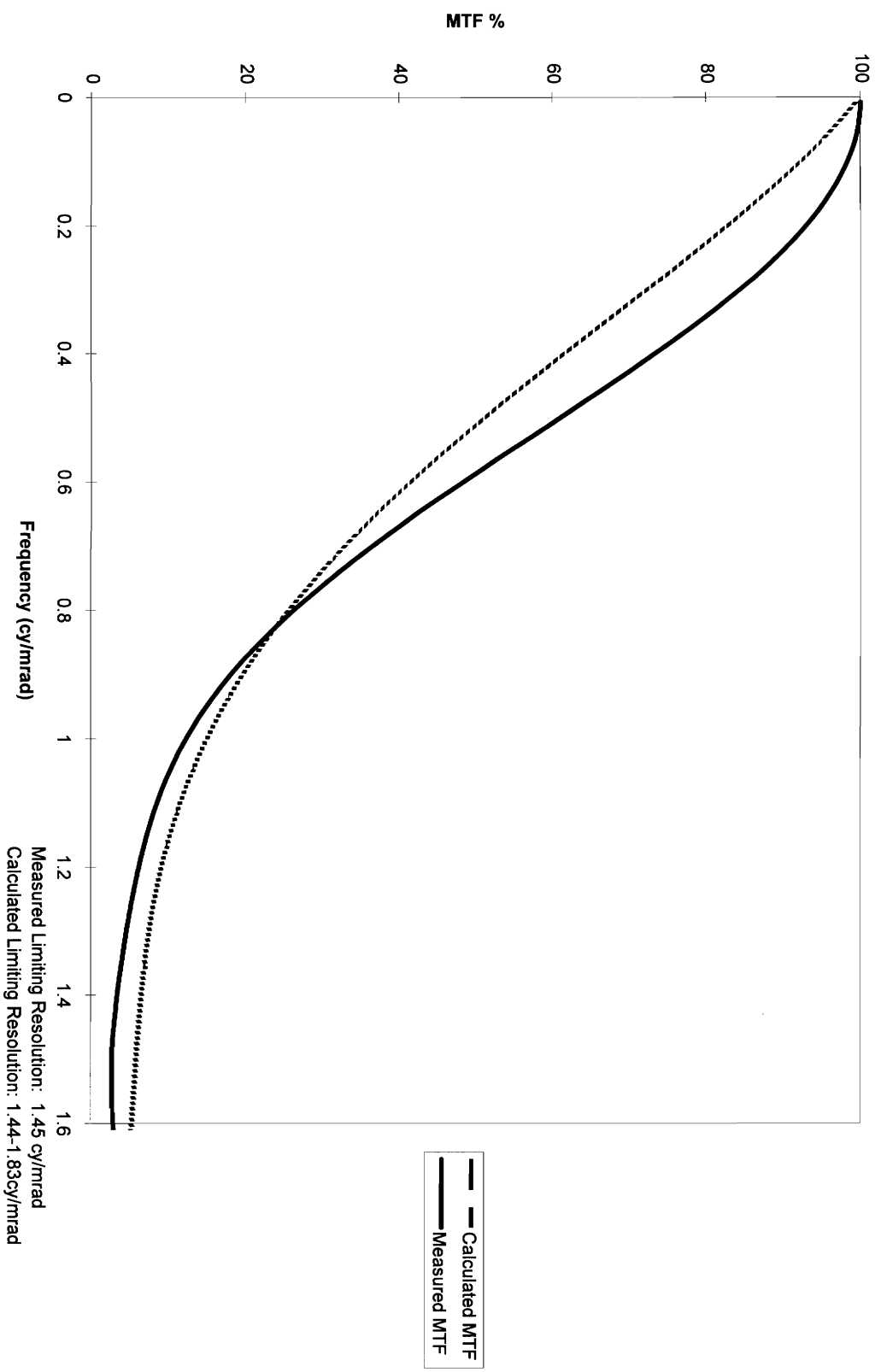


Monocular MTF Measurement Using Horizontal Slit

Image Filename: mon3h2.tif  
Data Filename: mon3h2.dat  
Integration Time: 1000  
Light Level: 1.504 ft-L



# SYSTEM MTF of MONOCULAR 3\_1





**MTF Data**

Monocular: Mono3\_1  
 Date: 22 Feb 95

Monocular Components:  
 Eye Piece S/N: 18159A  
 Objective S/N: 2529  
 Tube S/N: 2400112

**Measured Data**

Raw Frequency (cy/inch)	Corrected Frequency (cy/mrad)	Measured Camera MTF	Measured Monocular MTF Data	Actual Measured Monocular MTF (mono/camera)
1	0.00951	100.00000	100.00000	100.00000
2	0.01703	99.99870	99.98445	99.98575
3	0.02554	99.99481	99.93781	99.94300
4	0.03406	99.98833	99.86012	99.87178
5	0.04257	99.97927	99.75145	99.77213
6	0.05108	99.96763	99.61189	99.64414
7	0.05959	99.95342	99.44157	99.48791
8	0.06811	99.93665	99.24063	99.30354
9	0.07662	99.91735	99.00925	99.09115
10	0.08513	99.89551	98.74763	98.85092
11	0.09365	99.87117	98.45599	98.58299
12	0.10216	99.84434	98.13458	98.28757
13	0.11067	99.81504	97.78369	97.96489
14	0.11919	99.78330	97.40361	97.61514
15	0.12770	99.74915	96.99467	97.23859
16	0.13621	99.71260	96.55723	96.83554
17	0.14473	99.67369	96.09165	96.40623
18	0.15324	99.63245	95.59833	95.95100
19	0.16175	99.58892	95.07769	95.47015
20	0.17027	99.54312	94.53018	94.96405
21	0.17878	99.49510	93.95625	94.43304
22	0.18729	99.44489	93.35639	93.87751
23	0.19581	99.39254	92.73109	93.29784
24	0.20432	99.33807	92.08089	92.69446
25	0.21283	99.28154	91.40633	92.06780
26	0.22135	99.22299	90.70796	91.41829
27	0.22986	99.16246	90.98635	90.74639
28	0.23837	99.10001	89.24211	90.05257
29	0.24689	99.03566	88.47584	89.33736
30	0.25540	98.96949	87.68816	88.60120
31	0.26391	98.90152	86.87972	87.84468
32	0.27243	98.83183	86.05115	87.06826
33	0.28094	98.76044	85.20314	86.27554
34	0.28946	98.68743	84.33634	85.46820
35	0.29797	98.61283	83.45145	84.62535
36	0.30648	98.53671	82.54916	83.77503
37	0.31500	98.45911	81.63018	82.90770
38	0.32351	98.38009	80.69523	82.02394
39	0.33202	98.29971	79.74501	81.12436
40	0.34054	98.21802	78.78027	80.20959
41	0.34905	98.13507	77.80173	79.28025
42	0.35756	98.05092	76.81014	78.33699
43	0.36608	97.96562	75.80624	77.38045
44	0.37459	97.87924	74.79076	76.41126
45	0.38310	97.79181	73.76448	75.43012
46	0.39162	97.70341	72.72812	74.43765
47	0.40013	97.61407	71.68245	73.43455
48	0.40864	97.52386	70.62822	72.42148
49	0.41716	97.43283	69.56616	71.39912
50	0.42567	97.34103	68.49707	70.35814
51	0.43418	97.24851	67.42168	69.30925
52	0.44270	97.15532	66.34067	68.26311
53	0.45121	97.06152	65.25485	67.23040
54	0.45972	96.96715	64.16495	66.21184
55	0.46824	96.87228	63.07168	65.20809
56	0.47675	96.77690	61.97578	64.20985
57	0.48526	96.68111	60.87797	63.21670
58	0.49378	96.58494	59.77895	62.22822
59	0.50229	96.48843	58.67944	61.24405
60	0.51080	96.39162	57.58013	60.26352
61	0.51932	96.29455	56.48171	59.28515
62	0.52783	96.19727	55.38485	58.30924
63	0.53634	96.09980	54.29023	57.33539
64	0.54486	96.00219	53.19850	56.36314
65	0.55337	95.90446	52.11031	55.39265
66	0.56188	95.80666	51.02629	54.42330
67	0.57040	95.70880	49.94707	53.45450
68	0.57891	95.61092	48.87325	52.48614
69	0.58742	95.51305	47.80544	51.51814
70	0.59594	95.41521	46.74422	50.55039
71	0.60445	95.31741	45.68916	49.58265
72	0.61296	95.21969	44.64382	48.61489
73	0.62148	95.12205	43.60574	47.64714
74	0.62999	95.02452	42.57645	46.67939
75	0.63850	94.92711	41.55646	45.71164
76	0.64702	94.82984	40.54626	44.74389
77	0.65553	94.73270	39.54635	43.77614
78	0.66404	94.63570	38.55718	42.80839
79	0.67256	94.53887	37.57920	41.84064
80	0.68107	94.44218	36.61286	40.87289
81	0.68958	94.34565	35.65856	39.90514
82	0.69810	94.24929	34.71671	38.93739
83	0.70661	94.15307	33.78768	37.96964
84	0.71512	94.05700	32.87186	36.99989
85	0.72364	93.96106	31.96958	36.02914
86	0.73215	93.86526	31.08117	35.05839
87	0.74066	93.76957	30.20696	34.08764
88	0.74918	93.67398	29.34724	33.11689

**Calculated Data**

Frequency (cy/mm)	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mrad) ((1*27.03/1000))	Calculated Monocular MTF (obj*tube*eye)
0.31496	99.9817	99.5472	99.8055	0.00951	99.43502
0.62992	99.9648	99.0774	99.8105	0.01703	98.85487
0.94488	99.945	98.581	99.715	0.02554	98.25605
1.25984	99.9226	98.085	99.619	0.03406	97.63915
1.5748	99.8974	97.5704	99.5224	0.04257	97.00476
1.88976	99.8695	97.037	99.4254	0.05108	96.35347
2.20472	99.839	96.4888	99.3278	0.05959	95.68586
2.51968	99.8058	95.9263	99.2287	0.06811	95.00249
2.83465	99.77	95.3499	99.1311	0.07662	94.30398
3.14961	99.7317	94.76	99.0319	0.08513	93.59087
3.46457	99.6908	94.1571	98.9323	0.09365	92.86374
3.77953	99.6474	93.5415	98.8322	0.10216	92.12312
4.09449	99.6015	92.9138	98.7315	0.11067	91.36959
4.40945	99.5531	92.2742	98.6303	0.11919	90.60369
4.72441	99.5023	91.6233	98.5287	0.12770	89.82595
5.03937	99.4491	90.9614	98.4285	0.13621	89.03693
5.35433	99.3935	90.289	98.3238	0.14473	88.23714
5.66929	99.3355	89.6063	98.2207	0.15324	87.42712
5.98425	99.2752	88.9139	98.117	0.16175	86.60739
6.29921	99.2126	88.2121	98.0128	0.17027	85.77845
6.61417	99.1478	87.5013	97.9081	0.17878	84.94082
6.92913	99.0806	86.7819	97.803	0.18729	84.09499
7.24409	99.0113	86.0543	97.6973	0.19581	83.24146
7.55906	98.9397	85.3187	97.5911	0.20432	82.38070
7.87402	98.866	84.5757	97.4845	0.21283	81.51323
8.18898	98.7902	83.8255	97.3773	0.22135	80.63951
8.50394	98.7122	83.0686	97.2697	0.22986	79.76000
8.8189	98.6321	82.3053	97.1616	0.23837	78.87517
9.13386	98.5499	81.5359	97.053	0.24689	77.98547
9.44882	98.4657	80.7607	96.9439	0.25540	77.09134
9.76378	98.3795	79.9803	96.8343	0.26391	76.19324
10.07874	98.2912	79.1947	96.7242	0.27243	75.29158
10.3937	98.201	78.4045	96.6137	0.28094	74.38681
10.70866	98.1089	77.61	96.5027	0.28946	73.47933
11.02362	98.0148	76.8114	96.3912	0.29797	72.56957
11.33858	97.9188	76.0091	96.2792	0.30648	71.65793
11.65354	97.821	75.2034	96.1668	0.31500	70.74480
11.9685	97.7213	74.3946	96.0539	0.32351	69.83058
12.28346	97.6198	73.5831	95.9405	0.33202	68.91566
12.59842	97.5164	72.7692	95.8266	0.34054	68.00049
12.91339	97.4113	71.953	95.7123	0.34905	67.08515
13.22835	97.3045	71.1351	95.5975	0.35756	66.17032
13.54331	97.1959	70.3156	95.4823	0.36608	65.25526
13.85827	97.0856	69.4948	95.3666	0.37459	64.34329
14.17323	96.9736	68.6731	95.2504	0.38310	63.43122
14.48819	96.86	67.8507	95.1337	0.39162	62.52202
14.80315	96.7447	67.0278	95.0167	0.40013	61.61437
15.11811	96.6276	66.2049	94.8991	0.40864	60.70914
15.43307	96.5093	65.382	94.7811	0.41716	59.80684
15.74803	96.3893	64.5596	94.6627	0.42567	58.90717
16.06299	96.2677	63.7378	94.5438	0.43418	58.01103
16.37795	96.1445	62.917	94.4244	0.44270	57.11851
16.69291	96.0199	62.0973	94.3046	0.45121	56.22989
17.00787	95.8938	61.2781	94.1844	0.45972	55.34544
17.32283	95.7662	60.4626	94.0637	0.46824	54.46543
17.63778	95.6372	59.6479	93.9426	0.47675	53.59009
17.95274	95.5068	58.8354	93.821	0.48526	52.71973
18.2677	95.375	58.0253	93.699	0.49378	51.85457
18.58268	95.2418	57.2178	93.5768	0.50229	50.99485
18.89764	95.1073	56.4132	93.4537	0.51080	50.14080
19.2126	94.9714	55.6117	93.3304	0.51932	49.29263
19.52756	94.8343	54.8134	93.2067	0.52783	48.45058
19.84252	94.6958	54.0186	93.0825	0.53634	47.61484
20.15748	94.5561	53.2275	92.958	0.54486	46.78563
20.47244	94.4151	52.4404	92.833	0.55337	45.96313
20.7874	94.273	51.6573	92.7076	0.56188	45.14754
21.10236	94.1296	50.8786	92.5817	0.57040	44.33903
21.41732	93.985	50.1043	92.4555	0.57891	43.53780
21.73228	93.8393	49.3348	92.3288	0.58742	42.74399
22.04725	93.6924	48.5701	92.2017	0.59594	41.95776
22.36221	93.5444	47.8105	92.0742	0.60445	41.17930
22.67717	93.3953	47.0561	91.9463	0.61296	40.40874
22.99213	93.2451	46.3071	91.818	0.62148	39.64623
23.30709	93.0938	45.5637	91.6893	0.62999	38.89189
23.62205	92.9416	44.8261	91.5602	0.63850	38.14587
23.93701	92.7883	44.0943	91.4306	0.64702	37.40827
24.25197	92.634	43.3686	91.3007	0.65553	36.67922
24.56693	92.4787	42.6491	91.1704	0.66404	35.95883
24.88189	92.3224	41.9359	91.0397	0.67256	35.24720
25.19685	92.1652	41.2293	90.9086	0.68107	34.54443
25.51181	92.0071	40.5293	90.7772	0.6895	

Measured Data

Raw Frequency (cy/inch)	Corrected Frequency (cy/mrad)	Measured Camera MTF	Measured Monocula MTF Data	Actual Measured Monocular MTF (mono/camera)
89	0.75769	93.57848	28.50229	30.45817
90	0.76620	93.48304	27.67236	29.60148
91	0.77472	93.38765	26.85771	28.75938
92	0.78323	93.29229	26.05856	27.93217
93	0.79174	93.19692	25.27511	27.12011
94	0.80026	93.10154	24.50756	26.32347
95	0.80877	93.00616	23.75607	25.54249
96	0.81729	92.91057	23.02080	24.77737
97	0.82580	92.81493	22.30189	24.02834
98	0.83431	92.71915	21.58944	23.29555
99	0.84283	92.62318	20.91356	22.57919
100	0.85134	92.52700	20.24432	21.87936
101	0.85985	92.43057	19.59179	21.19622
102	0.86837	92.33384	18.95599	20.52984
103	0.87688	92.23678	18.33696	19.88031
104	0.88539	92.13934	17.73470	19.24770
105	0.89391	92.04149	17.14917	18.63200
106	0.90242	91.94319	16.58036	18.03327
107	0.91093	91.84438	16.02820	17.45148
108	0.91945	91.74520	15.49260	16.88658
109	0.92796	91.64596	14.97349	16.33857
110	0.93647	91.54647	14.47072	15.80731
111	0.94499	91.44679	13.98417	15.29274
112	0.95350	91.34679	13.51368	14.79473
113	0.96201	91.24637	13.05907	14.31313
114	0.97053	91.14574	12.62012	13.84776
115	0.97904	91.04499	12.19663	13.39844
116	0.98755	90.94419	11.78834	12.96494
117	0.99607	90.84337	11.39500	12.54702
118	1.00458	90.74254	11.01632	12.14443
119	1.01309	90.64169	10.65199	11.75685
120	1.02161	90.54079	10.30170	11.38401
121	1.03012	90.43989	9.96509	11.02554
122	1.03863	90.33899	9.64181	10.68110
123	1.04715	90.23809	9.33147	10.35030
124	1.05566	90.13719	9.03370	10.03277
125	1.06417	90.03629	8.74806	9.72808
126	1.07269	89.93539	8.47415	9.43580
127	1.08120	89.83449	8.21154	9.15551
128	1.08971	89.73359	7.95976	8.88671
129	1.09823	89.63269	7.71839	8.62989
130	1.10674	89.53179	7.48695	8.38181
131	1.11525	89.43089	7.26499	8.14173
132	1.12377	89.32999	7.05204	7.91275
133	1.13228	89.22909	6.84765	7.69489
134	1.14079	89.12819	6.65137	7.48819
135	1.14931	89.02729	6.46273	7.29261
136	1.15782	88.92639	6.28129	7.09722
137	1.16633	88.82549	6.10664	6.90706
138	1.17485	88.72459	5.93834	6.72177
139	1.18336	88.62369	5.77599	6.53632
140	1.19187	88.52279	5.61920	6.35957
141	1.20039	88.42189	5.46781	6.22384
142	1.20890	88.32099	5.32087	6.06684
143	1.21741	88.22009	5.17864	5.91462
144	1.22593	88.11919	5.04062	5.76683
145	1.23444	88.01829	4.90653	5.62317
146	1.24295	87.91739	4.77610	5.48334
147	1.25147	87.81649	4.64909	5.34709
148	1.25998	87.71559	4.52531	5.21419
149	1.26849	87.61469	4.40455	5.08442
150	1.27701	87.51379	4.28665	4.95760
151	1.28552	87.41289	4.17148	4.83358
152	1.29403	87.31199	4.05893	4.71225
153	1.30255	87.21109	3.94890	4.59350
154	1.31106	87.11019	3.84133	4.47727
155	1.31957	87.00929	3.73618	4.36350
156	1.32809	86.90839	3.63343	4.25219
157	1.33660	86.80749	3.53310	4.14337
158	1.34511	86.70659	3.43519	4.03704
159	1.35363	86.60569	3.33978	3.93331
160	1.36214	86.50479	3.24684	3.83226
161	1.37065	86.40389	3.15673	3.73389
162	1.37917	86.30299	3.06934	3.63809
163	1.38768	86.20209	2.98485	3.54451
164	1.39620	86.10119	2.90342	3.45765
165	1.40471	86.00029	2.82525	3.37325
166	1.41323	85.89939	2.75051	3.29084
167	1.42174	85.79849	2.67941	3.21339
168	1.43025	85.69759	2.61218	3.14030
169	1.43877	85.59669	2.54903	3.07184
170	1.44728	85.49579	2.49019	3.00833
171	1.45579	85.39489	2.43500	2.95008
172	1.46430	85.29399	2.38338	2.89740
173	1.47282	85.19309	2.34184	2.85058
174	1.48133	85.09219	2.30246	2.80987
175	1.48984	85.00129	2.26425	2.77555
176	1.49836	84.91039	2.22985	2.74781
177	1.50687	84.81949	2.21684	2.72693
178	1.51538	84.72859	2.19945	2.71272
179	1.52390	84.63769	2.18766	2.70551
180	1.53241	84.54679	2.18144	2.70522
181	1.54092	84.45589	2.18068	2.71177
182	1.54944	84.36499	2.18523	2.72502
183	1.55795	84.27409	2.19490	2.74480
184	1.56646	84.18319	2.20945	2.77086

Calculated Data

Frequency (cy/mm) f1	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mrad) (f1*27.03/1000)	Calculated Monocular MTF (obj*tube*eye)
28.0315	90.7108	35.1833	89.7116	0.75769	28.63154
28.34646	90.5451	34.5487	89.5767	0.76620	28.02150
28.66142	90.3787	33.9218	89.4415	0.77472	27.42101
28.97638	90.2116	33.3026	89.3058	0.78323	26.83011
29.29134	90.0437	32.6918	89.1699	0.79174	26.24881
29.6063	89.8752	32.0888	89.0336	0.80026	25.67718
29.92126	89.706	31.494	88.8969	0.80877	25.11518
30.23622	89.5361	30.9075	88.7598	0.81729	24.56284
30.55118	89.3656	30.3293	88.6225	0.82580	24.02016
30.86614	89.1944	29.7594	88.4847	0.83431	23.48715
31.1811	89.0226	29.198	88.3466	0.84283	22.96380
31.49606	88.8503	28.6451	88.2082	0.85134	22.45010
31.81102	88.6773	28.1008	88.0695	0.85985	21.94603
32.12598	88.5038	27.565	87.9304	0.86837	21.45158
32.44094	88.3298	27.038	87.7909	0.87688	20.96673
32.75591	88.1552	26.5196	87.6512	0.88539	20.49144
33.07087	87.9801	26.01	87.511	0.89391	20.02569
33.38583	87.8045	25.5092	87.3706	0.90242	19.56945
33.70079	87.6285	25.0172	87.2299	0.91093	19.12287
34.01575	87.4519	24.534	87.0889	0.91945	18.68631
34.33071	87.2748	24.0598	86.9474	0.92796	18.25372
34.64567	87.0975	23.5944	86.8057	0.93647	17.82986
34.96063	86.9196	23.1379	86.6637	0.94499	17.41925
35.27559	86.7414	22.6903	86.5213	0.95350	17.02905
35.59055	86.5627	22.2517	86.3787	0.96201	16.65380
35.90551	86.3837	21.822	86.2357	0.97053	16.29302
36.22047	86.2043	21.4013	86.0924	0.97904	15.94634
36.53543	86.0248	20.9894	85.9489	0.98755	15.61490
36.85039	85.8455	20.5865	85.805	0.99607	15.29811
37.16535	85.6661	20.1925	85.6609	1.00458	14.99547
37.48032	85.4864	19.8074	85.5164	1.01309	14.70769
37.79528	85.3064	19.4312	85.3717	1.02161	14.43509
38.11024	85.1261	19.0638	85.2267	1.03012	14.17800
38.4252	84.9456	18.7052	85.0813	1.03863	13.93674
38.74016	84.7648	18.3554	84.9358	1.04715	13.71102
39.05512	84.5837	18.0144	84.7899	1.05566	12.91842
39.37008	84.3936	17.682	84.6437	1.06417	12.63097
39.68504	84.2111	17.3584	84.4973	1.07269	12.35154
40	84.0285	17.0433	84.3506	1.08120	12.08003
40.31496	83.8456	16.7368	84.2037	1.08971	11.81635
40.62992	83.6626	16.4388	84.0565	1.09823	11.56037
40.94488	83.4794	16.1492	83.909	1.10674	11.31198
41.25984	83.2961	15.868	83.7612	1.11525	11.07107
41.5748	83.1127	15.5951	83.6132	1.12377	10.83752
41.88976	82.9291	15.3304	83.465	1.13228	10.61230
42.20472	82.7454	15.0739	83.3165	1.14079	10.39201
42.51968	82.5616	14.8254	83.1678	1.14931	10.17981
42.83465	82.3778	14.5849	83.0188	1.15782	9.97447
43.14961	82.1938	14.3523	82.8696	1.16633	9.77589
43.46457	82.0098	14.1275	82.7201	1.17485	9.58391
43.77953	81.8258	13.9104	82.5704	1.18336	9.39841
44.09449	81.6417	13.7009	82.4205	1.19187	9.21926
44.40945	81.4576	13.4989	82.2703	1.20039	9.04632
44.72441	81.2734	13.3042	82.1199	1.20890	8.87946
45.03937	81.0893	13.1168	81.9694	1.21741	8.71854
45.35433	80.9051	12.9366	81.8185	1.22593	8.56342
45.66929	80.721	12.7633	81.6675	1.23444	8.41396
45.98425	80.5369	12.597	81.5163	1.24295	8.27002
46.29921	80.3529	12.4374	81.3648	1.25147	8.13145
46.61417	80.1688	12.2845	81.2132	1.25998	7.99812
46.92913	79.9849	12.138	81.0613	1.26849	7.86987
47.24409	79.8011	11.9978	80.9092	1.27701	7.74656
47.55906	79.6172	11.8639	80.757	1.28552	7.62804
47.87402	79.4335	11.7359	80.6045	1.29403	7.51417
48.18898	79.2498	11.6139	80.4519	1.30255	7.40480
48.50394	79.0663	11.4976	80.2991	1.31106	7.29977
48.8189	78.8829	11.3868	80.1461	1.31957	7.19894
49.13386	78.6997	11.2815	79.9929	1.32809	7.10215
49.44882	78.5165	11.1813	79.8395	1.33660	7.00925
49.76378	78.3335	11.0862	79.686	1.34511	6.92010
50.07874	78.1507	10.9959	79.5323	1.35363	6.83453
50.3937	77.968	10.9103	79.3784	1.36214	6.75239
50.70866	77.7855	10.8292	79.2244	1.37065	6.67354
51.02362	77.6032	10.7524	79.0702	1.37917	6.59780
51.33858	77.4211	10.6797	78.9159	1.38768	6.52504
51.65355	77.2392	10.6109	78.7614	1.39620	6.45508
51.96851	77.0574	10.5457	78.6067	1.40471	6.38779
52.					

Measured Data

Raw Frequency (cy/inch)	Corrected Frequency (cy/mrad)	Measured Camera MTF	Measured Monocular MTF Data	Actual Measured Monocular MTF (mono/camera)
185	1.57498	79.51056	2.22862	2.80292
186	1.58349	79.28108	2.23212	2.84086
187	1.59200	79.05043	2.23561	2.88374
188	1.60052	78.81863	2.23910	2.93177
189	1.60903	78.58576	2.24259	2.98437
190	1.61754	78.35180	2.24608	3.04115
191	1.62606	78.11700	2.24958	3.10173
192	1.63457	77.88122	2.25307	3.16573
193	1.64308	77.64459	2.25656	3.23277
194	1.65160	77.40716	2.26005	3.30247
195	1.66011	77.16899	2.26354	3.37452
196	1.66862	76.93014	2.26703	3.44854
197	1.67714	76.69066	2.27052	3.52424
198	1.68565	76.45061	2.27401	3.60132
199	1.69416	76.21006	2.27750	3.67947
200	1.70268	75.96905	2.28099	3.75846
201	1.71119	75.72754	2.28448	3.83800
202	1.71970	75.48559	2.28797	3.91766
203	1.72822	75.24313	2.29146	3.99780
204	1.73673	75.00016	2.29495	4.07763
205	1.74524	74.75672	2.29844	4.15712
206	1.75376	74.51281	2.30193	4.23626
207	1.76227	74.26841	2.30542	4.31503
208	1.77078	74.02354	2.30891	4.39343
209	1.77929	73.77819	2.31240	4.47146
210	1.78780	73.53238	2.31589	4.54912
211	1.79631	73.28610	2.31938	4.62641
212	1.80482	73.03937	2.32287	4.70332
213	1.81333	72.79219	2.32636	4.78003
214	1.82184	72.54459	2.32985	4.85643
215	1.83035	72.29659	2.33334	4.93253
216	1.83886	72.04819	2.33683	5.00833
217	1.84737	71.80019	2.34032	5.08383
218	1.85588	71.55179	2.34381	5.15903
219	1.86439	71.30289	2.34730	5.23393
220	1.87290	71.05349	2.35079	5.30863
221	1.88141	70.80359	2.35428	5.38313
222	1.88992	70.55319	2.35777	5.45743
223	1.89843	70.30229	2.36126	5.53153
224	1.90694	70.05089	2.36475	5.60543
225	1.91545	69.79909	2.36824	5.67913
226	1.92396	69.54669	2.37173	5.75263
227	1.93247	69.29379	2.37522	5.82593
228	1.94098	69.04039	2.37871	5.89903
229	1.94949	68.78649	2.38220	5.97193
230	1.95800	68.53209	2.38569	6.04463
231	1.96651	68.27719	2.38918	6.11713
232	1.97502	68.02179	2.39267	6.18943
233	1.98353	67.76589	2.39616	6.26153
234	1.99204	67.50949	2.39965	6.33343
235	2.00055	67.25259	2.40314	6.40513
236	2.00906	67.00019	2.40663	6.47663
237	2.01757	66.74229	2.41012	6.54793
238	2.02608	66.48389	2.41361	6.61903
239	2.03459	66.22499	2.41710	6.69003
240	2.04310	65.96559	2.42059	6.76093
241	2.05161	65.70569	2.42408	6.83173
242	2.06012	65.44529	2.42757	6.90243
243	2.06863	65.18439	2.43106	6.97303
244	2.07714	64.92299	2.43455	7.04353
245	2.08565	64.66109	2.43804	7.11403
246	2.09416	64.39869	2.44153	7.18443
247	2.10267	64.13579	2.44502	7.25473
248	2.11118	63.87239	2.44851	7.32503
249	2.11969	63.60849	2.45200	7.39523
250	2.12820	63.34409	2.45549	7.46543
251	2.13671	63.07919	2.45898	7.53563
252	2.14522	62.81379	2.46247	7.60573
253	2.15373	62.54789	2.46596	7.67583
254	2.16224	62.28149	2.46945	7.74593
255	2.17075	62.01509	2.47294	7.81603
256	2.17926	61.74819	2.47643	7.88613
257	2.18777	61.48079	2.47992	7.95623
258	2.19628	61.21289	2.48341	8.02633
259	2.20479	60.94449	2.48690	8.09643
260	2.21330	60.67609	2.49039	8.16653
261	2.22181	60.40719	2.49388	8.23663
262	2.23032	60.13779	2.49737	8.30673
263	2.23883	59.86789	2.50086	8.37683
264	2.24734	59.59749	2.50435	8.44693
265	2.25585	59.32659	2.50784	8.51703
266	2.26436	59.05519	2.51133	8.58713
267	2.27287	58.78329	2.51482	8.65723
268	2.28138	58.51139	2.51831	8.72733
269	2.28989	58.23899	2.52180	8.79743
270	2.29840	57.96609	2.52529	8.86753
271	2.30691	57.69319	2.52878	8.93763
272	2.31542	57.42029	2.53227	9.00773
273	2.32393	57.14739	2.53576	9.07783
274	2.33244	56.87449	2.53925	9.14793
275	2.34095	56.60159	2.54274	9.21803
276	2.34946	56.32869	2.54623	9.28813
277	2.35797	56.05579	2.54972	9.35823
278	2.36648	55.78289	2.55321	9.42833
279	2.37499	55.50999	2.55670	9.49843
280	2.38350	55.23709	2.56019	9.56853

Calculated Data

Frequency (cy/mm)	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mrad) (11*27.03/1000)	Calculated Monocular MTF (obj*tube*eye)
58.26772	73.4778	9.6638	75.4881	1.57498	5.36022
58.58268	73.3021	9.62128	75.3312	1.58349	5.31281
58.89764	73.1268	9.57889	75.1742	1.59200	5.26485
59.21260	72.9518	9.53632	75.0171	1.60052	5.21580
59.52756	72.7772	9.49378	74.8601	1.60903	5.16540
59.84252	72.6029	9.45124	74.7028	1.61754	5.11419
60.15748	72.4291	9.40874	74.5455	1.62606	5.06154
60.47244	72.2556	9.36624	74.3882	1.63457	5.00739
60.78740	72.0825	9.32374	74.2309	1.64308	4.95180
61.10236	71.9098	9.28124	74.0735	1.65160	4.89403
61.41732	71.7375	9.23874	73.9161	1.66011	4.83451
61.73228	71.5656	9.19624	73.7586	1.66862	4.77329
62.04724	71.3941	9.15374	73.6011	1.67714	4.70910
62.36220	71.2233	9.11124	73.4436	1.68565	4.64291
62.67716	71.0532	9.06874	73.2861	1.69416	4.57421
62.99212	70.8831	9.02624	73.1285	1.70268	4.50285
63.30708	70.7132	8.98374	72.9711	1.71119	4.42870
63.62204	70.5438	8.94124	72.8134	1.71970	4.35161
63.93700	70.3739	8.89874	72.6558	1.72822	4.27145
64.25196	70.2053	8.85624	72.4982	1.73673	4.18807
64.56692	70.0372	8.81374	72.3407	1.74524	4.10134
64.88188	69.8695	8.77124	72.1831	1.75376	4.01112
65.19684	69.7023	8.72874	72.0255	1.76227	3.91728
65.51180	69.5355	8.68624	71.8678	1.77078	3.81968
65.82676	69.3692	8.64374	71.7104	1.77929	3.71819
66.14172	69.2033	8.60124	71.5529	1.78780	3.61287
66.45668	69.0379	8.55874	71.3954	1.79631	3.50299
66.77164	68.8729	8.51624	71.2378	1.80482	3.38903
67.08660	68.7084	8.47374	71.0805	1.81333	3.27085
67.40156	68.5443	8.43124	70.9231	1.82184	3.14772
67.71652	68.3807	8.38874	70.7658	1.83035	3.02012
68.03148	68.2176	8.34624	70.6085	1.83886	2.88772
68.34644	68.0549	8.30374	70.4513	1.84737	2.75038
68.66140	67.8927	8.26124	70.2941	1.85588	2.60801
68.97636	67.7311	8.21874	70.1369	1.86439	2.46045
69.29132	67.5697	8.17624	69.9799	1.87290	2.30760
69.60628	67.4088	8.13374	69.8229	1.88141	2.14934
69.92124	67.2486	8.09124	69.6656	1.88992	1.98553
70.23620	67.0888	8.04874	69.5081	1.89843	1.81607
70.55116	66.9294	8.00624	69.3503	1.90694	1.64084
70.86612	66.7705	7.96374	69.1927	1.91545	1.45972
71.18108	66.6121	7.92124	69.0351	1.92396	1.27258
71.49604	66.4542	7.87874	68.8776	1.93247	1.07934
71.81100	66.2967	7.83624	68.7202	1.94098	0.87984
72.12596	66.1397	7.79374	68.5628	1.94949	0.67402
72.44092	65.9832	7.75124	68.4053	1.95800	0.46173
72.75588	65.8272	7.70874	68.2478	1.96651	0.24287
73.07084	65.6717	7.66624	68.0901	1.97502	0.01734
73.38580	65.5166	7.62374	67.9326	1.98353	-0.21498
73.70076	65.3622	7.58124	67.7751	1.99204	-0.45411
74.01572	65.2079	7.53874	67.6176	2.00055	-0.70038
74.33068	65.0543	7.49624	67.4601	2.00906	-0.95367
74.64564	64.9011	7.45374	67.3026	2.01757	-1.21417
74.96060	64.7484	7.41124	67.1451	2.02608	-1.48198
75.27556	64.5962	7.36874	67.0138	2.03459	-1.75718
75.59052	64.4445	7.32624	66.8667	2.04310	-2.03989
75.90548	64.2932	7.28374	66.7192	2.05161	-2.33021
76.22044	64.1424	7.24124	66.5717	2.06012	-2.62822
76.53540	63.9921	7.19874	66.4242	2.06863	-2.93402
76.85036	63.8422	7.15624	66.2767	2.07714	-3.24773
77.16532	63.6928	7.11374	66.1292	2.08565	-3.56904
77.48028	63.5439	7.07124	65.9817	2.09416	-3.89816
77.79524	63.3954	7.02874	65.8342	2.10267	-4.23508
78.11020	63.2474	7.01224	65.6867	2.11119	-4.58326
78.42516	63.0998	7.01974	65.5392	2.11970	-4.93779
78.74012	62.9527	7.03224	65.3917	2.12822	-5.30075
79.05508	62.8061	7.04474	65.2442	2.13673	-5.67222
79.37004	62.6599	7.05724	65.0967	2.14524	-6.05231
79.68500	62.5142	7.06974	64.9492	2.15375	-6.44109
80	62.3689	7.08224	64.7917	2.16226	-6.83863
80.31496	62.2244	7.09474	64.6342	2.17077	-7.24504
80.62992	62.0799	7.10724	64.4767	2.17928	-7.66038
80.94488	61.9356	7.11974	64.3192	2.18779	-8.08475
81.25984	61.7922	7.13224	64.1617	2.19630	-8.51819
81.57480	61.6489	7.14474	64.0042	2.20481	-8.96082
81.88976	61.5062	7.15724	63.8467	2.21332	-9.41288
82.20472	61.3639	7.16974	63.6892	2.22183	-9.87389
82.51968	61.2221	7.18224	63.5317	2.23034	-10.34447
82.83					

Measured Data

Raw Frequency (cy/inch)	Corrected Freq (cy/mrad)	Measured Camera MTF	Measured Monocula MTF Data	Actual Measured Monocular MTF (mono/camera)
281	2.39226	57.78125	3.59832	6.22749
282	2.40077	57.56736	3.62916	6.30420
283	2.40929	57.35278	3.66204	6.38511
284	2.41780	57.13747	3.69683	6.47006
285	2.42631	56.92138	3.73341	6.55889
286	2.43483	56.70447	3.77164	6.65140
287	2.44334	56.48670	3.81139	6.74741
288	2.45186	56.26804	3.85251	6.84671
289	2.46037	56.04845	3.89486	6.94909
290	2.46888	55.82878	3.93827	7.05431
291	2.47740	55.60631	3.98259	7.16212
292	2.48591	55.38369	4.02767	7.27230
293	2.49442	55.16000	4.07335	7.38461
294	2.50294	54.93521	4.11947	7.49878
295	2.51145	54.70928	4.16587	7.61456
296	2.51996	54.48219	4.21241	7.73172
297	2.52848	54.25391	4.25893	7.85000
298	2.53699	54.02441	4.30528	7.96914
299	2.54550	53.79367	4.35131	8.08889
300	2.55402	53.56168	4.39687	8.20898
301	2.56253	53.32840	4.44183	8.32920
302	2.57104	53.09382	4.48605	8.44929
303	2.57956	52.85793	4.52939	8.56896
304	2.58807	52.62071	4.57172	8.68836
305	2.59658	52.38215	4.61292	8.80628
306	2.60510	52.14223	4.65286	8.92340
307	2.61361	51.90095	4.69143	9.03920
308	2.62212	51.65829	4.72852	9.15346
309	2.63064	51.41427	4.76402	9.26595
310	2.63915	51.16886	4.79781	9.37643
311	2.64767	50.92208	4.82982	9.48473
312	2.65618	50.67391	4.85994	9.59062
313	2.66469	50.42337	4.88808	9.69398
314	2.67320	50.17145	4.91417	9.79336
315	2.68172	49.91711	4.93811	9.89182
316	2.69023	49.66753	4.95985	9.98910
317	2.69874	49.41254	4.97931	10.07702
318	2.70726	49.15622	4.99643	10.16439
319	2.71577	48.89857	5.01115	10.24806
320	2.72428	48.63962	5.02342	10.32784
321	2.73280	48.37937	5.03322	10.40361
322	2.74131	48.11786	5.04044	10.47529
323	2.74982	47.85510	5.04511	10.54247
324	2.75834	47.59111	5.04718	10.60530
325	2.76685	47.32593	5.04663	10.66356
326	2.77536	47.05957	5.04343	10.71712
327	2.78388	46.79206	5.03758	10.76599
328	2.79239	46.52344	5.02907	10.80976
329	2.80090	46.25373	5.01789	10.84862
330	2.80942	45.98298	5.00406	10.88242
331	2.81793	45.71120	4.98758	10.91107
332	2.82644	45.43844	4.96847	10.93451
333	2.83496	45.16475	4.94675	10.95268
334	2.84347	44.89014	4.92245	10.96555
335	2.85198	44.61467	4.89561	10.97309
336	2.86050	44.33838	4.86625	10.97525
337	2.86901	44.06131	4.83443	10.97205
338	2.87752	43.78350	4.80019	10.96347
339	2.88604	43.50500	4.76359	10.94952
340	2.89455	43.22586	4.72477	10.93026
341	2.90306	42.94612	4.68357	10.90569
342	2.91158	42.66583	4.64028	10.87587
343	2.92009	42.38504	4.5948	10.84085
344	2.92860	42.10379	4.54751	10.80071
345	2.93712	41.82215	4.49822	10.75554
346	2.94563	41.54016	4.44705	10.70542
347	2.95414	41.25787	4.39417	10.65050
348	2.96266	40.97533	4.33964	10.59086
349	2.97117	40.69260	4.28357	10.52666
350	2.97969	40.40974	4.22606	10.45802

Calculated Data

Frequency (cy/mm) f1	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mrad) (f1*27.03/1000)	Calculated Monocular MTF (obj*tube*eye)
88.50394	58.6002	-59.4932	60.698	2.39226	-21.16121
88.8189	58.4657	-61.671	60.5538	2.40077	-21.83352
89.13386	58.3315	-63.8983	60.41	2.40929	-22.51651
89.44882	58.1977	-66.1756	60.2665	2.41780	-23.21023
89.76378	58.0641	-68.5038	60.1234	2.42631	-23.91474
90.07874	57.9308	-70.8835	59.9807	2.43483	-24.63008
90.3937	57.7978	-73.3153	59.8384	2.44334	-25.35628
90.70866	57.665	-75.8002	59.6964	2.45186	-26.09341
91.02362	57.5325	-78.3386	59.5549	2.46037	-26.84150
91.33858	57.4003	-80.9314	59.4137	2.46888	-27.60059
91.65354	57.2684	-83.5793	59.273	2.47740	-28.37072
91.96851	57.1366	-86.2831	59.1326	2.48591	-29.15196
92.28346	57.0052	-89.0433	58.9927	2.49442	-29.94427
92.59843	56.8739	-91.8609	58.8532	2.50294	-30.74778
92.91338	56.7428	-94.7363	58.7141	2.51145	-31.56244
93.22835	56.6121	-97.6707	58.5754	2.51996	-32.38858
93.54331	56.4815	-100.665	58.4372	2.52848	-33.22555
93.85827	56.3511	-103.719	58.2994	2.53699	-34.07401
94.17323	56.2209	-106.834	58.1621	2.54550	-34.93480
94.48819	56.0908	-110.011	58.0252	2.55402	-35.80494
94.80315	55.9609	-113.25	57.8888	2.56253	-36.68466
95.11811	55.8312	-116.553	57.7528	2.57104	-37.58139
95.43307	55.7017	-119.919	57.6173	2.57956	-38.49675
95.74803	55.5723	-123.351	57.4823	2.58807	-39.43056
96.063	55.443	-126.849	57.3477	2.59658	-40.38189
96.37795	55.3139	-130.412	57.2137	2.60510	-41.35166
96.69292	55.1848	-134.043	57.0801	2.61361	-42.32001
97.00787	55.0559	-137.742	56.947	2.62212	-43.28585
97.32284	54.9271	-141.51	56.8145	2.63064	-44.26030
97.63779	54.7984	-145.347	56.6824	2.63915	-45.24427
97.95276	54.6697	-149.255	56.5508	2.64767	-46.23889
98.26772	54.5411	-153.234	56.4198	2.65618	-47.24308
98.58268	54.4126	-157.285	56.2893	2.66469	-48.25689
98.89764	54.2841	-161.409	56.1593	2.67320	-49.28031
99.2126	54.1556	-165.606	56.0298	2.68172	-50.31369
99.52756	54.0272	-169.878	55.9009	2.69023	-51.35699
99.84252	53.8988	-174.226	55.7725	2.69874	-52.41045
100.1575	53.7704	-178.649	55.6447	2.70726	-53.47466
100.4724	53.642	-183.15	55.5174	2.71577	-54.54912
100.7874	53.5136	-187.728	55.3907	2.72428	-55.63446
101.1024	53.3851	-192.385	55.2646	2.73280	-56.73043
101.4173	53.2566	-197.122	55.139	2.74131	-57.83761
101.7323	53.1281	-201.938	55.014	2.74982	-58.95643
102.0473	52.9995	-206.837	54.8896	2.75834	-60.08711
102.3622	52.8708	-211.817	54.7658	2.76685	-61.23018
102.6772	52.742	-216.88	54.6426	2.77536	-62.38616
102.9921	52.6131	-222.028	54.52	2.78388	-63.55469
103.3071	52.4842	-227.259	54.398	2.79239	-64.73633
103.6221	52.3551	-232.577	54.2766	2.80090	-65.93159
103.937	52.2258	-237.981	54.1559	2.80942	-67.14084
104.252	52.0964	-243.472	54.0357	2.81793	-68.36469
104.5669	51.9669	-249.052	53.9162	2.82644	-69.60308
104.8819	51.8372	-254.721	53.7974	2.83496	-70.85641
105.1969	51.7073	-260.479	53.6791	2.84347	-72.12581
105.5118	51.5772	-266.329	53.5616	2.85198	-73.41169
105.8268	51.4469	-272.271	53.4446	2.86050	-74.71465
106.1417	51.3163	-278.305	53.3284	2.86901	-76.03529
106.4567	51.1856	-284.434	53.2128	2.87752	-77.37416
106.7717	51.0545	-290.656	53.0979	2.88604	-78.73186
107.0866	50.9232	-296.975	52.9836	2.89455	-80.10974
107.4016	50.7917	-303.39	52.8701	2.90306	-81.50831
107.7165	50.6598	-309.902	52.7572	2.91158	-82.92829
108.0315	50.5278	-316.512	52.6451	2.92009	-84.36926
108.3465	50.3952	-323.222	52.5336	2.92860	-85.83176
108.6614	50.2623	-330.033	52.4228	2.93712	-87.31609
108.9764	50.1292	-336.944	52.3128	2.94563	-88.82265
109.2913	49.9956	-343.957	52.2035	2.95414	-90.35189
109.6063	49.8617	-351.074	52.0949	2.96266	-91.90426
109.9213	49.7274	-358.294	51.9871	2.97117	-93.48029
110.2362	49.5927	-365.62	51.8799	2.97969	-95.08042

## A.2.4 SYSTEM MTF DATA

Monocular 4\_1

Objective Lens S/N: 2360

Eyepiece Lens S/N: 18229A

Image Intensifier Tube S/N: 2400120

## System MTF Measurement for a Complete ANVIS System

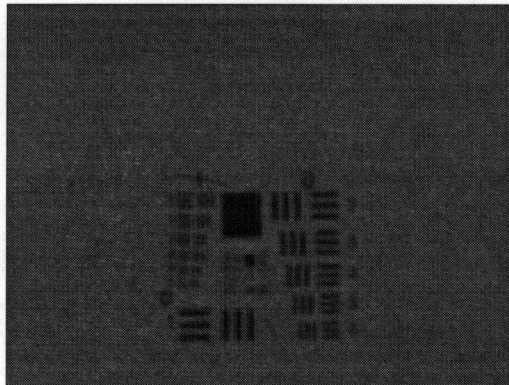
Data Identification: Mono4\_1  
Date: 21 Feb 95  
Excel Filename: mono4\_1.xls  
mono4\_1a.xls

Slit Used: 2.5 micron

Monocular Components:  
Eyepiece S/N: 18229A  
Objective S/N: 2360  
Tube S/N: 2400120

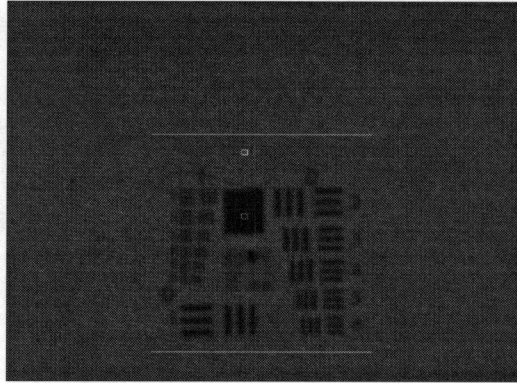
Camera Focus Data  
Filename: None  
Integration Time:  
Light Level:

Monocular Focus Data  
Filename: mon4foc1.tif  
Integration Time: 1000  
Light Level: 9.5E-4 ft-L



Monocular Luminance Measurement

Filename: mon4lm2.tif  
Integration Time: 1000  
Light Level: 9.5E-5 ft-L  
Max. Luminance (ft-L): 0.344  
Min. Luminance (ft-L): 0.076  
Ave. Luminance (ft-L): 0.269

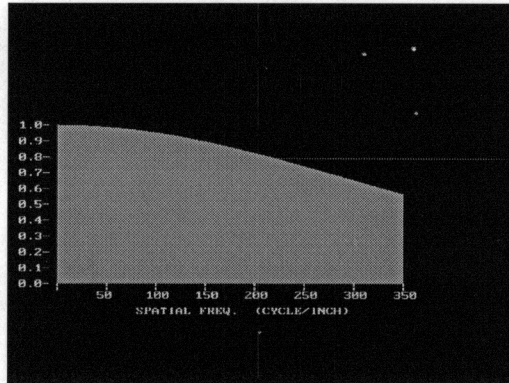


Horizontal Line Setting

Filename: None  
Integration Time:  
Light Level:  
Slit Size:

Camera MTF Measurement

Image Filename: cam4h.tif  
Data Filename: cam4h.dat  
Integration Time: 1000  
Light Level: 14.39 ft-L

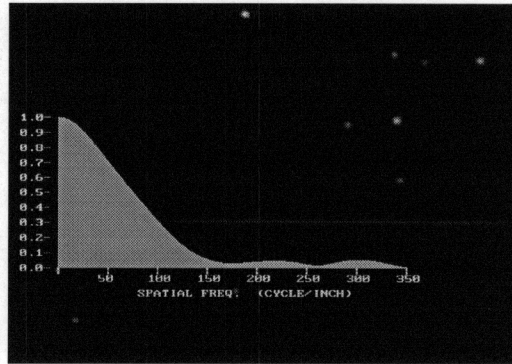


Monocular Image of Horizontal Slit

Filename: None  
Integration Time:  
Light Level:

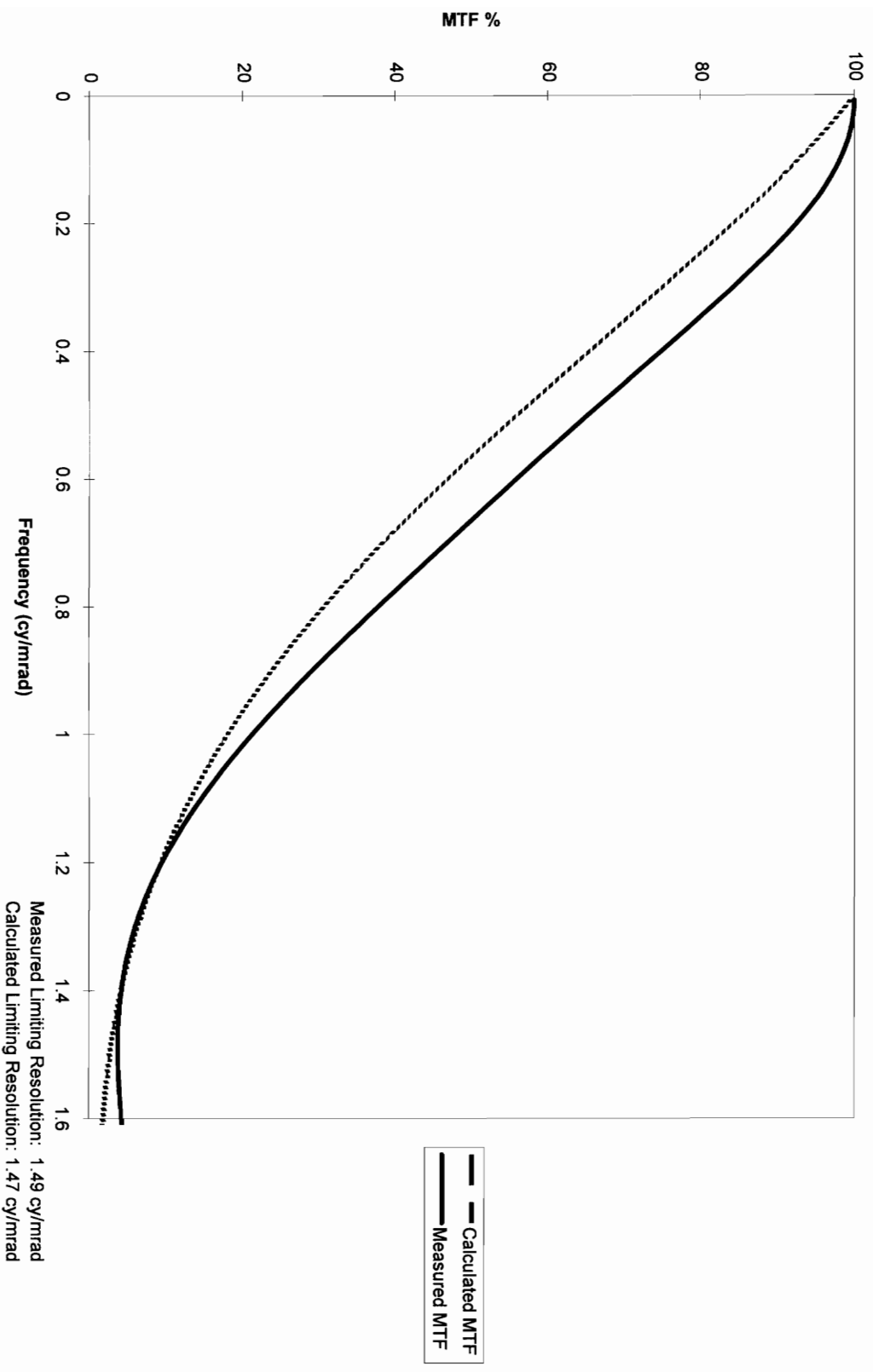
Monocular MTF Measurement Using Horizontal Slit

Image Filename: mon4h1.tif  
Data Filename: mon4h1.dat  
Integration Time: 1000  
Light Level: 1.504 ft-L





# SYSTEM MTF of MONOCULAR 4\_1



**MTF Data**

Monocular: Monod\_1  
Date: 21 Feb 95

Monocular Components:  
Eye Piece S/N: 18229A  
Objective S/N: 2360  
Tube S/N: 2400120

**Measured Data**

Raw Frequency (cy/inch)	Corrected Frequency (cy/mrad)	Measured Camera MTF	Measured Monocular MTF Data	Actual Measured Monocular MTF (mono/camera)
1	0.00851	100.00000	100.00000	100.00000
2	0.01703	99.99943	99.98384	99.98441
3	0.02554	99.99772	99.93538	99.93766
4	0.03405	99.99487	99.85472	99.85984
5	0.04257	99.99098	99.74199	99.75109
6	0.05108	99.98575	99.58730	99.61158
7	0.05959	99.97950	99.42117	99.44156
8	0.06811	99.97211	99.21966	99.24134
9	0.07662	99.96360	98.97520	99.01124
10	0.08513	99.95396	98.70622	98.75169
11	0.09365	99.94321	98.40718	98.46310
12	0.10216	99.93135	98.07859	98.14597
13	0.11067	99.91839	97.72101	97.80083
14	0.11919	99.90433	97.33506	97.42827
15	0.12770	99.88918	96.92138	97.02891
16	0.13621	99.87295	96.48066	96.60339
17	0.14473	99.85564	96.01363	96.15244
18	0.15324	99.83727	95.52106	95.67675
19	0.16175	99.81784	95.00374	95.17711
20	0.17027	99.79737	94.46249	94.65429
21	0.17878	99.77585	93.89817	94.10912
22	0.18729	99.75331	93.31166	93.54242
23	0.19581	99.72976	92.70385	92.95505
24	0.20432	99.70519	92.07567	92.34792
25	0.21283	99.67963	91.42803	91.72188
26	0.22135	99.65308	90.76190	91.07787
27	0.22986	99.62556	90.07820	90.41676
28	0.23837	99.59708	89.37792	89.73950
29	0.24689	99.56764	88.66199	89.04699
30	0.25540	99.53725	87.93137	88.34016
31	0.26391	99.50594	87.18703	87.61993
32	0.27243	99.47371	86.42980	86.88718
33	0.28094	99.44056	85.66093	86.14285
34	0.28946	99.40652	84.88102	85.38774
35	0.29797	99.37159	84.09110	84.62288
36	0.30648	99.33578	83.29204	83.84998
37	0.31500	99.29910	82.48472	83.06694
38	0.32351	99.26156	81.66997	82.27574
39	0.33202	99.22317	80.84861	81.48158
40	0.34054	99.18394	80.02144	80.67984
41	0.34905	99.14388	79.18920	79.87301
42	0.35756	99.10300	78.35264	79.06212
43	0.36608	99.06130	77.51243	78.24693
44	0.37459	99.01879	76.66925	77.42899
45	0.38310	98.97548	75.82371	76.60858
46	0.39162	98.93138	74.97640	75.78350
47	0.40013	98.88649	74.12786	74.96258
48	0.40864	98.84081	73.27862	74.13802
49	0.41716	98.79436	72.42913	73.31302
50	0.42567	98.74713	71.57983	72.48801
51	0.43418	98.69913	70.73112	71.66337
52	0.44270	98.65037	69.88334	70.83941
53	0.45121	98.60084	69.03863	70.01647
54	0.45972	98.55055	68.19185	69.19479
55	0.46824	98.49950	67.34865	68.37461
56	0.47675	98.44768	66.50745	67.55613
57	0.48526	98.39512	65.66842	66.73951
58	0.49378	98.34179	64.83170	65.92487
59	0.50229	98.28770	63.99741	65.11233
60	0.51080	98.23285	63.16563	64.30184
61	0.51932	98.17724	62.33642	63.49376
62	0.52783	98.12086	61.50983	62.68782
63	0.53634	98.06371	60.68585	61.88411
64	0.54486	98.00579	59.86450	61.08262
65	0.55337	97.94710	59.04574	60.28330
66	0.56188	97.88762	58.22953	59.48610
67	0.57040	97.82736	57.41582	58.69096
68	0.57891	97.76631	56.60456	57.89782
69	0.58742	97.70447	55.79567	57.10657
70	0.59594	97.64182	54.98908	56.31714
71	0.60445	97.57836	54.18472	55.52944
72	0.61296	97.51410	53.38250	54.74337
73	0.62148	97.44900	52.58235	53.95884
74	0.62999	97.38308	51.78419	53.17576
75	0.63850	97.31633	50.98796	52.39404
76	0.64702	97.24873	50.19360	51.61363
77	0.65553	97.18027	49.40106	50.83445
78	0.66404	97.11096	48.61029	50.05644
79	0.67256	97.04079	47.82126	49.27955
80	0.68107	96.96973	47.03396	48.50375
81	0.68958	96.89780	46.24838	47.72903
82	0.69810	96.82497	45.46454	46.95539
83	0.70661	96.75125	44.68246	46.18282
84	0.71512	96.67661	43.90218	45.41138
85	0.72364	96.60107	43.12376	44.64108
86	0.73215	96.52460	42.34727	43.87200
87	0.74066	96.44721	41.57281	43.10421
88	0.74918	96.36888	40.80045	42.33783

**Calculated Data**

Frequency (cy/mm)	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mrad) (f1*27.03/1000)	Calculated Monocular MTF (obj*tube*eye)
0.31496	99.9416	99.6104	99.9846	0.00851	99.53718
0.62992	99.8807	99.2097	99.8848	0.01703	98.97715
0.94488	99.8172	98.798	99.7839	0.02554	98.40427
1.25984	99.7512	98.3757	99.6821	0.03405	97.81890
1.5748	99.6827	97.9428	99.5794	0.04257	97.22140
1.88976	99.6117	97.4997	99.4759	0.05108	96.61213
2.20472	99.5383	97.0466	99.3716	0.05959	95.99143
2.51968	99.4624	96.5836	99.2684	0.06811	95.35965
2.83465	99.3842	96.111	99.1604	0.07662	94.71716
3.14961	99.3037	95.629	99.0536	0.08513	94.06431
3.46457	99.2208	95.1378	98.946	0.09365	93.40143
3.77953	99.1356	94.6375	98.8376	0.10216	92.72896
4.09449	99.0481	94.1285	98.7284	0.11067	92.04696
4.40945	98.9584	93.611	98.6184	0.11919	91.35505
4.72441	98.8664	93.085	98.5077	0.12770	90.65548
5.03937	98.7723	92.5509	98.3963	0.13621	89.94857
5.35433	98.676	92.0088	98.2841	0.14473	89.23285
5.66929	98.5775	91.4589	98.1711	0.15324	88.50906
5.98425	98.477	90.9015	98.0575	0.16175	87.77812
6.29921	98.3743	90.3367	97.9431	0.17027	87.04014
6.61417	98.2696	89.7647	97.828	0.17878	86.29545
6.92913	98.1628	89.1857	97.7123	0.18729	85.54436
7.24409	98.054	88.6	97.5958	0.19581	84.78718
7.55906	97.9433	88.0076	97.4787	0.20432	84.02420
7.87402	97.8305	87.4088	97.3609	0.21283	83.25577
8.18898	97.7159	86.8038	97.2425	0.22135	82.48217
8.50394	97.5993	86.1928	97.1234	0.22986	81.70370
8.8189	97.4808	85.576	97.0037	0.23837	80.92065
9.13386	97.3605	84.9535	96.8833	0.24689	80.13331
9.44882	97.2383	84.3255	96.7624	0.25540	79.34197
9.76378	97.1143	83.6923	96.6408	0.26391	78.54693
10.07874	96.9886	83.0539	96.5186	0.27243	77.74845
10.3937	96.861	82.4106	96.3959	0.28094	76.94681
10.70866	96.7317	81.7626	96.2725	0.28946	76.14229
11.02362	96.6007	81.11	96.1486	0.29797	75.33516
11.33858	96.4681	80.453	96.0241	0.30648	74.52569
11.65354	96.3337	79.7918	95.8991	0.31500	73.71413
11.9685	96.1977	79.1265	95.7735	0.32351	72.90074
12.28346	96.0601	78.4574	95.6474	0.33202	72.08579
12.59842	95.9209	77.7845	95.5207	0.34054	71.26951
12.91339	95.7801	77.1081	95.3935	0.34905	70.45214
13.22835	95.6377	76.4284	95.2658	0.35756	69.63396
13.54331	95.4938	75.7455	95.1376	0.36608	68.81560
13.85827	95.3484	75.0595	95.0089	0.37459	67.99627
14.17323	95.2016	74.3707	94.8798	0.38310	67.17683
14.48819	95.0533	73.6791	94.7501	0.39162	66.35768
14.80315	94.9035	72.9851	94.62	0.40013	65.53887
15.11811	94.7523	72.2886	94.4894	0.40864	64.72060
15.43307	94.5997	71.5899	94.3583	0.41716	63.90309
15.74803	94.4458	70.8891	94.2268	0.42567	63.08656
16.06299	94.2905	70.1864	94.0949	0.43418	62.27121
16.37795	94.1339	69.482	93.9625	0.44270	61.45525
16.69291	93.9759	68.776	93.8298	0.45121	60.64487
17.00787	93.8167	68.0685	93.6966	0.45972	59.83427
17.32283	93.6563	67.3597	93.563	0.46824	59.02565
17.63778	93.4945	66.6497	93.4289	0.47675	58.21916
17.95274	93.3316	65.9387	93.2945	0.48526	57.41565
18.26772	93.1675	65.2269	93.1598	0.49378	56.61346
18.58268	93.0022	64.5144	93.0246	0.50229	55.81457
18.89764	92.8357	63.8013	92.8891	0.51080	55.01850
19.2126	92.6681	63.0878	92.7532	0.51932	54.22626
19.52756	92.4994	62.3739	92.617	0.52783	53.43584
19.84252	92.3296	61.66	92.4804	0.53634	52.64845
20.15748	92.1587	60.946	92.3434	0.54486	51.86599
20.47244	91.9868	60.2321	92.2062	0.55337	51.08741
20.7874	91.8138	59.5186	92.0686	0.56188	50.31205
21.10236	91.6398	58.8054	91.9307	0.57040	49.54068
21.41732	91.4649	58.0927	91.7925	0.57891	48.77342
21.73228	91.2889	57.3807	91.654	0.58742	48.01041
22.04725	91.112	56.6695	91.5152	0.59594	47.25178
22.36221	90.9342	55.9592	91.3761	0.60445	46.49768
22.67717	90.7564	55.25	91.2367	0.61296	45.74824
22.99213	90.5786	54.5419	91.0971	0.62148	45.00356
23.30709	90.3953	53.8352	90.9571	0.62999	44.26376
23.62205	90.2139	53.1298	90.817	0.63850	43.52901
23.93701	90.0317	52.426	90.6785	0.64702	42.79936
24.25197	89.8486	51.7239	90.5358	0.65553	42.07493
24.56693	89.6648	51.0236	90.3949	0.66404	41.35585
24.88189	89.4802	50.3252	90.2538	0.67256	40.64220
25.19685	89.2948	49.6287	90.1124	0.68107	39.93409
25.51181	89.1086	48.9345	89.9708	0.68958	

Measured Data

Raw Frequency (cy/inch)	Corrected Frequency (cy/mrad)	Measured Camera MTF	Measured Monocula MTF Data	Actual Measured Monocular MTF (mono/camera)
89	0.75769	96.28961	40.03042	41.57294
90	0.76620	96.20939	39.26275	40.80969
91	0.77472	96.12821	38.49762	40.04820
92	0.78323	96.04608	37.73522	39.28866
93	0.79174	95.96298	36.97571	38.53122
94	0.80026	95.87891	36.21930	37.77609
95	0.80877	95.79386	35.46618	37.02345
96	0.81729	95.70784	34.71660	36.27352
97	0.82580	95.62084	33.97077	35.52653
98	0.83431	95.53285	33.22892	34.78272
99	0.84283	95.44388	32.49131	34.04232
100	0.85134	95.35392	31.75818	33.30558
101	0.85985	95.26296	31.02981	32.57280
102	0.86837	95.17102	30.30645	31.84420
103	0.87688	95.07809	29.58838	31.12008
104	0.88539	94.98417	28.87587	30.40072
105	0.89391	94.88927	28.16919	29.68638
106	0.90242	94.79337	27.46861	28.97735
107	0.91093	94.69650	26.77442	28.27393
108	0.91945	94.59964	26.08689	27.57639
109	0.92796	94.49981	25.40629	26.88502
110	0.93647	94.40001	24.73290	26.20010
111	0.94498	94.29924	24.06698	25.52182
112	0.95350	94.19751	23.40880	24.85076
113	0.96201	94.09482	22.75861	24.18689
114	0.97053	93.99119	22.11668	23.53059
115	0.97904	93.88662	21.48325	22.88212
116	0.98756	93.78111	20.85857	22.24176
117	0.99607	93.67469	20.24287	21.60975
118	1.00458	93.56734	19.63639	20.98637
119	1.01309	93.45910	19.03394	20.37184
120	1.02161	93.34995	18.45194	19.76642
121	1.03012	93.23993	17.87441	19.17034
122	1.03863	93.12903	17.30693	18.58382
123	1.04715	93.01727	16.74870	18.00709
124	1.05566	92.90466	16.20290	17.44035
125	1.06417	92.79121	15.66670	16.88382
126	1.07269	92.67694	15.14126	16.33768
127	1.08120	92.56185	14.62675	15.80214
128	1.08971	92.44597	14.12330	15.27736
129	1.09823	92.32930	13.63106	14.76363
130	1.10674	92.21185	13.15013	14.26078
131	1.11526	92.09365	12.68065	13.76930
132	1.12377	91.97469	12.22271	13.28921
133	1.13228	91.85501	11.77641	12.82065
134	1.14079	91.73461	11.34182	12.36373
135	1.14931	91.61350	10.91904	11.91859
136	1.15782	91.49170	10.50811	11.48532
137	1.16633	91.36923	10.10909	11.06400
138	1.17485	91.24608	9.72202	10.65473
139	1.18336	91.12229	9.34693	10.25757
140	1.19187	90.99786	8.98384	9.87258
141	1.20039	90.87280	8.63275	9.49982
142	1.20890	90.74713	8.29366	9.13931
143	1.21741	90.62087	7.96655	8.79108
144	1.22593	90.49401	7.65141	8.45516
145	1.23444	90.36657	7.34818	8.13152
146	1.24295	90.23857	7.05682	7.82018
147	1.25147	90.11002	6.77728	7.52112
148	1.25998	89.98092	6.50949	7.23430
149	1.26849	89.85129	6.25336	6.95968
150	1.27701	89.72113	6.00880	6.69720
151	1.28552	89.59046	5.77573	6.44681
152	1.29403	89.45928	5.55402	6.20843
153	1.30255	89.32760	5.34357	5.98199
154	1.31106	89.19542	5.14425	5.76739
155	1.31957	89.06277	4.95594	5.56455
156	1.32809	88.92963	4.77948	5.37333
157	1.33660	88.79602	4.61175	5.19364
158	1.34511	88.66195	4.45558	5.02536
159	1.35363	88.52741	4.30992	4.86835
160	1.36214	88.39241	4.17431	4.72248
161	1.37066	88.25695	4.04888	4.58780
162	1.37917	88.12104	3.93335	4.46368
163	1.38768	87.98468	3.82753	4.35022
164	1.39620	87.84788	3.73124	4.24739
165	1.40471	87.71060	3.64428	4.15489
166	1.41322	87.57289	3.56643	4.07253
167	1.42174	87.43473	3.49747	4.00009
168	1.43025	87.29612	3.43718	3.93738
169	1.43876	87.15706	3.38531	3.88415
170	1.44728	87.01754	3.34160	3.84015
171	1.45579	86.87757	3.30578	3.80510
172	1.46430	86.73715	3.27758	3.77873
173	1.47282	86.59626	3.25665	3.76073
174	1.48133	86.45490	3.24274	3.75079
175	1.48984	86.31308	3.23550	3.74856
176	1.49836	86.17079	3.23460	3.75371
177	1.50687	86.02801	3.23970	3.76587
178	1.51538	85.88476	3.25044	3.78465
179	1.52390	85.74101	3.26646	3.80968
180	1.53241	85.59678	3.28742	3.84059
181	1.54092	85.45204	3.31294	3.87696
182	1.54944	85.30680	3.34267	3.91841
183	1.55795	85.16105	3.37624	3.96454
184	1.56646	85.01479	3.41331	4.01496

Calculated Data

Frequency (cy/mm) f1	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mrad) (f1*27.03/1000)	Calculated Monocular MTF (obj*tube*eye)
28.0315	87.5949	43.4705	88.8307	0.75769	33.82494
28.34646	87.4028	42.8005	88.6874	0.76620	33.17691
28.66142	87.2102	42.1336	88.544	0.77472	32.53530
28.97638	87.0177	41.4701	88.4003	0.78323	31.90015
29.29134	86.8233	40.8099	88.2566	0.79174	31.27153
29.6063	86.6291	40.1533	88.1127	0.80026	30.64950
29.92126	86.4344	39.5003	87.9686	0.80877	30.03409
30.23622	86.2391	38.851	87.8244	0.81729	29.42537
30.55118	86.0434	38.2056	87.6802	0.82580	28.82337
30.86614	85.8473	37.5639	87.5357	0.83431	28.22175
31.1811	85.6507	36.9282	87.3912	0.84283	27.63073
31.49606	85.4537	36.2927	87.2466	0.85134	27.05817
31.81102	85.2563	35.6633	87.1018	0.85985	26.48348
32.12598	85.0585	35.0381	86.957	0.86837	25.91672
32.44094	84.8603	34.4173	86.8121	0.87688	25.35489
32.75591	84.6618	33.8009	86.6671	0.88539	24.80103
33.07087	84.4629	33.189	86.522	0.89391	24.25417
33.38583	84.2637	32.5817	86.3768	0.90242	23.71434
33.70079	84.0641	31.979	86.2318	0.91093	23.18154
34.01575	83.8643	31.3811	86.0863	0.91945	22.65580
34.33071	83.6642	30.788	85.9409	0.92796	22.13714
34.64567	83.4638	30.1998	85.7955	0.93647	21.62555
34.96063	83.2631	29.6166	85.65	0.94498	21.12106
35.27559	83.0623	29.0384	85.5045	0.95350	20.62387
35.59055	82.8611	28.4654	85.359	0.96201	20.13339
35.90551	82.6598	27.8975	85.2134	0.97053	19.65021
36.22047	82.4583	27.3349	85.0678	0.97904	19.17416
36.53543	82.2566	26.7776	84.9221	0.98756	18.70521
36.85039	82.0547	26.2256	84.7765	0.99607	18.24336
37.16535	81.8526	25.6792	84.6308	1.00458	17.78863
37.48032	81.6504	25.1383	84.4851	1.01309	17.34100
37.79528	81.4481	24.6029	84.3394	1.02161	16.90045
38.11024	81.2457	24.0732	84.1937	1.03012	16.46699
38.4252	81.0431	23.5492	84.048	1.03863	16.04060
38.74016	80.8405	23.031	83.9023	1.04715	15.62126
39.05512	80.6377	22.5186	83.7567	1.05566	15.20895
39.37008	80.435	22.0121	83.611	1.06417	14.80367
39.68504	80.2321	21.5115	83.4654	1.07269	14.40538
40	80.0292	21.0169	83.3197	1.08120	14.01408
40.31496	79.8263	20.5283	83.1741	1.08971	13.62973
40.62992	79.6234	20.0458	83.0286	1.09823	13.25232
40.94488	79.4204	19.5695	82.8831	1.10674	12.88181
41.25984	79.2175	19.0993	82.7376	1.11526	12.51819
41.57479	79.0146	18.6354	82.5921	1.12377	12.16141
41.88976	78.8117	18.1777	82.4467	1.13228	11.81146
42.20472	78.6089	17.7264	82.3014	1.14079	11.46830
42.51968	78.4061	17.2814	82.1561	1.14931	11.13189
42.83465	78.2034	16.8428	82.0109	1.15782	10.80220
43.14961	78.0007	16.4107	81.8657	1.16633	10.47920
43.46457	77.7982	15.9851	81.7206	1.17485	10.16285
43.77953	77.5957	15.566	81.5755	1.18336	9.85312
44.09449	77.3933	15.1534	81.4306	1.19187	9.54995
44.40945	77.1911	14.7474	81.2857	1.20039	9.25332
44.72441	76.9889	14.3481	81.1409	1.20890	8.96318
45.03937	76.787	13.9554	80.9962	1.21741	8.67949
45.35433	76.5852	13.5684	80.8515	1.22593	8.40221
45.66929	76.3836	13.1901	80.707	1.23444	8.13128
45.98425	76.1821	12.8175	80.5625	1.24295	7.86666
46.29921	75.9808	12.4518	80.4182	1.25147	7.60832
46.61417	75.7797	12.0928	80.2739	1.25998	7.35619
46.92913	75.5788	11.7406	80.1297	1.26849	7.11023
47.24409	75.3781	11.3953	79.9857	1.27701	6.87039
47.55905	75.1776	11.0568	79.8417	1.28552	6.63662
47.87402	74.9773	10.7252	79.6979	1.29403	6.40887
48.18898	74.7773	10.4005	79.5542	1.30255	6.18709
48.50394	74.5776	10.0827	79.4106	1.31106	5.97123
48.8189	74.3781	9.77186	79.2671	1.31957	5.76122
49.13386	74.1788	9.46795	79.1237	1.32809	5.55703
49.44882	73.9798	9.171	78.9805	1.33660	5.35858
49.76378	73.7812	8.88102	78.8373	1.34511	5.16583
50.07874	73.5828	8.59802	78.6944	1.35363	4.97873
50.3937	73.3847	8.32201	78.5515	1.36214	4.79720
50.70866	73.1869	8.05299	78.4088	1.37066	4.62120
51.02362	72.9894	7.79098	78.2662	1.37917	4.45067
51.33858	72.7922	7.53596	78.1238	1.38768	4.28565
51.65355	72.5954	7.28795	77.9814	1.39620	4.12678
51.96851					

Measured Data

Raw Frequency (cy/inch)	Corrected Frequnc (cy/mrad)	Measured Camera MTF	Measured Monocula MTF Data	Actual Measured Monocular MTF (mono/camera)
185	1.57498	84.86800	3.45351	4.06927
186	1.58349	84.72068	3.49651	4.12710
187	1.59200	84.57283	3.54197	4.18807
188	1.60052	84.42444	3.58956	4.25180
189	1.60903	84.27551	3.63895	4.31792
190	1.61754	84.12602	3.68985	4.38610
191	1.62606	83.97598	3.74194	4.45656
192	1.63457	83.82537	3.79495	4.52721
193	1.64308	83.67420	3.84858	4.59948
194	1.65160	83.52246	3.90258	4.67249
195	1.66011	83.37013	3.95668	4.74592
196	1.66862	83.21723	4.01064	4.81948
197	1.67714	83.06375	4.06422	4.89289
198	1.68565	82.90968	4.11719	4.96587
199	1.69416	82.75502	4.16934	5.03817
200	1.70268	82.59976	4.22045	5.10952
201	1.71119	82.44391	4.27033	5.17998
202	1.71970	82.28747	4.31879	5.24842
203	1.72822	82.13043	4.36564	5.31550
204	1.73673	81.97279	4.41072	5.38071
205	1.74524	81.81456	4.45385	5.44384
206	1.75376	81.65573	4.49487	5.50466
207	1.76227	81.49631	4.53363	5.56299
208	1.77078	81.33629	4.56997	5.61861
209	1.77930	81.17569	4.60376	5.67135
210	1.78781	81.01450	4.63485	5.72101
211	1.79632	80.85273	4.66311	5.76741
212	1.80484	80.69038	4.68839	5.81035
213	1.81335	80.52746	4.71058	5.84966
214	1.82186	80.36397	4.72954	5.88515
215	1.83038	80.19992	4.74514	5.91664
216	1.83889	80.03532	4.75727	5.94396
217	1.84740	79.87017	4.76581	5.96695
218	1.85592	79.70449	4.77062	5.98538
219	1.86443	79.53828	4.77161	5.99914
220	1.87294	79.37155	4.76894	6.00800
221	1.88146	79.20431	4.76162	6.01182
222	1.88997	79.03658	4.75043	6.01042
223	1.89848	78.86836	4.73496	6.00382
224	1.90700	78.69968	4.71512	5.99138
225	1.91551	78.53050	4.69082	5.97325
226	1.92403	78.36089	4.66195	5.94933
227	1.93254	78.19084	4.62844	5.91941
228	1.94106	78.02037	4.59022	5.88336
229	1.94957	77.84949	4.54721	5.84103
230	1.95808	77.67822	4.49938	5.79231
231	1.96659	77.50656	4.44663	5.73710
232	1.97511	77.33453	4.38899	5.67533
233	1.98362	77.16215	4.32641	5.60691
234	1.99213	76.98944	4.25891	5.53181
235	2.00065	76.81640	4.18650	5.45001
236	2.00916	76.64305	4.10921	5.36149
237	2.01767	76.46942	4.02712	5.26631
238	2.02619	76.29551	3.94029	5.16451
239	2.03470	76.12133	3.84886	5.05622
240	2.04321	75.94691	3.75295	4.94154
241	2.05173	75.77227	3.65275	4.82069
242	2.06024	75.59740	3.54847	4.69390
243	2.06875	75.42234	3.44037	4.56147
244	2.07727	75.24709	3.32876	4.42377
245	2.08578	75.07168	3.21398	4.28121
246	2.09429	74.89610	3.09647	4.13435
247	2.10281	74.72039	2.97672	3.98381
248	2.11132	74.54454	2.85532	3.83035
249	2.11983	74.36859	2.73294	3.67486
250	2.12835	74.19253	2.61039	3.51840
251	2.13686	74.01638	2.48862	3.36226
252	2.14537	73.84015	2.36874	3.20793
253	2.15388	73.66387	2.25027	3.05220
254	2.16240	73.48752	2.14013	2.91224
255	2.17091	73.31114	2.03473	2.77547
256	2.17943	73.13472	1.93790	2.64377
257	2.18794	72.95828	1.85193	2.53834
258	2.19645	72.78182	1.77928	2.44668
259	2.20497	72.60536	1.72241	2.37229
260	2.21348	72.42890	1.68361	2.32450
261	2.22199	72.25244	1.66470	2.30401
262	2.23051	72.07601	1.66677	2.31252
263	2.23902	71.89960	1.69002	2.35053
264	2.24753	71.72321	1.73371	2.41722
265	2.25605	71.54685	1.79633	2.51070
266	2.26456	71.37054	1.87584	2.62831
267	2.27307	71.19426	1.96993	2.76698
268	2.28159	71.01802	2.07624	2.92354
269	2.29010	70.84183	2.19255	3.09499
270	2.29861	70.66568	2.31681	3.27855
271	2.30713	70.48958	2.44723	3.47176
272	2.31564	70.31353	2.58224	3.67247
273	2.32415	70.13752	2.72049	3.87879
274	2.33267	69.96157	2.86080	4.08910
275	2.34118	69.78566	3.00217	4.30199
276	2.34969	69.60979	3.14372	4.51620
277	2.35821	69.43396	3.28468	4.73065
278	2.36672	69.25818	3.42439	4.94338
279	2.37523	69.08243	3.56226	5.15664
280	2.38375	68.90671	3.69777	5.36634

Calculated Data

Frequency (cy/mm)	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mrad)	Calculated Monocular MTF (obj*tube*eye)
58.26772	68.551	3.69069	75.0292	1.57498	1.89825
58.58268	68.3632	3.59502	74.8905	1.58349	1.84056
58.89764	68.1759	3.50606	74.7519	1.59200	1.78678
59.2126	67.9889	3.42378	74.6136	1.60052	1.73685
59.52756	67.8026	3.34816	74.4754	1.60903	1.69070
59.84252	67.6167	3.27916	74.3374	1.61754	1.64825
60.15748	67.4313	3.21675	74.1996	1.62606	1.60946
60.47244	67.2464	3.1609	74.062	1.63457	1.57426
60.7874	67.062	3.11157	73.9245	1.64308	1.54257
61.10236	66.8781	3.06872	73.7873	1.65160	1.51434
61.41732	66.6947	3.03232	73.6502	1.66011	1.48950
61.73228	66.5119	3.00231	73.5133	1.66862	1.46798
62.04725	66.3295	2.97868	73.3766	1.67714	1.44973
62.36221	66.1477	2.96136	73.2401	1.68565	1.43468
62.67717	65.9664	2.95032	73.1038	1.69416	1.42276
62.99213	65.7856	2.94552	72.9676	1.70268	1.41391
63.30709	65.6054	2.94689	72.8317	1.71119	1.40807
63.62205	65.4257	2.95441	72.6959	1.71970	1.40517
63.93701	65.2465	2.96801	72.5604	1.72822	1.40515
64.25197	65.0679	2.98765	72.425	1.73673	1.40794
64.56693	64.8898	3.01328	72.2898	1.74524	1.41349
64.88189	64.7122	3.04484	72.1548	1.75376	1.42173
65.19685	64.5352	3.08227	72.02	1.76227	1.43259
65.51181	64.3588	3.12553	71.8854	1.77078	1.44601
65.82677	64.1829	3.17455	71.751	1.77930	1.46194
66.14173	64.0075	3.22928	71.6168	1.78781	1.48031
66.45669	63.8328	3.28965	71.4827	1.79632	1.50105
66.77165	63.6585	3.35561	71.3489	1.80484	1.52411
67.08662	63.4849	3.42709	71.2152	1.81335	1.54942
67.40158	63.3118	3.50402	71.0818	1.82186	1.57692
67.71654	63.1392	3.58635	70.9485	1.83038	1.60655
68.03149	62.9672	3.674	70.8154	1.83889	1.63825
68.34646	62.7958	3.76691	70.6825	1.84740	1.67197
68.66142	62.6248	3.865	70.5498	1.85592	1.70763
68.97638	62.4547	3.96821	70.4173	1.86443	1.74517
69.29134	62.2848	4.07647	70.2849	1.87294	1.78455
69.6063	62.1158	4.18969	70.1528	1.88146	1.82570
69.92126	61.9472	4.30781	70.0208	1.88997	1.86855
70.23622	61.7792	4.43075	69.889	1.89848	1.91306
70.55119	61.6117	4.55844	69.7574	1.90700	1.95916
70.86614	61.4449	4.69078	69.626	1.91551	2.00679
71.18111	61.2785	4.82771	69.4948	1.92403	2.05580
71.49606	61.1128	4.96913	69.3638	1.93254	2.10642
71.81103	60.9476	5.11498	69.2329	1.94106	2.15831
72.12598	60.783	5.26515	69.1022	1.94957	2.21149
72.44095	60.619	5.41958	68.9717	1.95808	2.26593
72.75591	60.4555	5.57817	68.8414	1.96659	2.32155
73.07087	60.2926	5.74083	68.7112	1.97511	2.37830
73.38583	60.1303	5.90747	68.5812	1.98362	2.43613
73.70079	59.9685	6.078	68.4514	1.99213	2.49498
74.01575	59.8073	6.25233	68.3218	2.00065	2.55479
74.33071	59.6466	6.43037	68.1923	2.00916	2.61552
74.64567	59.4866	6.61202	68.063	2.01767	2.67710
74.96063	59.327	6.79718	67.9339	2.02619	2.73948
75.27559	59.1681	6.98575	67.8049	2.03470	2.80260
75.59055	59.0096	7.17764	67.6762	2.04321	2.86642
75.90551	58.8518	7.37275	67.5475	2.05173	2.93088
76.22047	58.6945	7.57097	67.4191	2.06024	2.99593
76.53543	58.5377	7.7722	67.2907	2.06875	3.06151
76.8504	58.3815	7.97635	67.1626	2.07727	3.12757
77.16535	58.2258	8.18328	67.0346	2.08578	3.19405
77.48032	58.0707	8.39292	66.9068	2.09429	3.26092
77.79528	57.9161	8.60513	66.7791	2.10281	3.32811
78.11024	57.7621	8.81982	66.6515	2.11132	3.39557
78.4252	57.6086	9.03687	66.5241	2.11983	3.46325
78.74016	57.4556	9.25617	66.3969	2.12835	3.53111
79.05512	57.3031	9.47761	66.2698	2.13686	3.59909
79.37008	57.1512	9.70107	66.1428	2.14537	3.66714
79.68504	56.9998	9.92643	66.016	2.15388	3.73521
80	56.8489	10.1536	65.8893	2.16240	3.80326
80.31496	56.6985	10.3824	65.7628	2.17091	3.87123
80.62992	56.5488	10.6127	65.6363	2.17943	3.93907
80.94489	56.3993	10.8445	65.5101	2.18794	4.00675
81.25984	56.2504	11.0776	65.3839	2.19645	4.07420
81.57481	56.102	11.3119	65.2579	2.20497	4.14139
81.88976	55.9542	11.5472	65.1319	2.21348	4.20826
82.20473	55.8068	11.7834	65.0061	2.22199	4.27477
82.51968	55.6599	12.0204	64.8805	2.23051	4.34086
82.83465	55.5135	12.2581	64.7549</		

Measured Data

Raw Frequency (cy/inch)	Corrected Frequnc (cy/mrad)	Measured Camera MTF	Measured Monocula MTF Data	Actual Measured Monocular MTF (mono/camera)
281	2.39226	68.73103	3.83044	5.57309
282	2.40077	68.55537	3.95985	5.77613
283	2.40929	68.37973	4.08563	5.97491
284	2.41780	68.20411	4.20743	6.16888
285	2.42631	68.02850	4.32494	6.35754
286	2.43483	67.85290	4.43766	6.54041
287	2.44334	67.67731	4.54594	6.71708
288	2.45186	67.50171	4.64893	6.88713
289	2.46037	67.32610	4.7466	7.05016
290	2.46888	67.15048	4.83876	7.20585
291	2.47740	66.97485	4.9252	7.35381
292	2.48591	66.79919	5.00575	7.49373
293	2.49442	66.62350	5.08024	7.62530
294	2.50294	66.44779	5.14852	7.74822
295	2.51145	66.27203	5.21046	7.86223
296	2.51996	66.09624	5.26591	7.96703
297	2.52848	65.92040	5.31475	8.06238
298	2.53699	65.74451	5.35689	8.14804
299	2.54550	65.56857	5.39222	8.22379
300	2.55402	65.39258	5.42064	8.28938
301	2.56253	65.21653	5.44209	8.34465
302	2.57104	65.04042	5.4565	8.38940
303	2.57956	64.86425	5.4638	8.42344
304	2.58807	64.68801	5.46397	8.44665
305	2.59658	64.51172	5.45695	8.45885
306	2.60510	64.33536	5.44274	8.45959
307	2.61361	64.15893	5.42134	8.44986
308	2.62212	63.98245	5.39274	8.42847
309	2.63064	63.80590	5.35698	8.39574
310	2.63915	63.62930	5.31408	8.35164
311	2.64766	63.45264	5.26413	8.29616
312	2.65618	63.27593	5.20718	8.22932
313	2.66469	63.09918	5.14332	8.15117
314	2.67320	62.92238	5.07266	8.06177
315	2.68172	62.74554	4.99533	7.96125
316	2.69023	62.56868	4.91148	7.84974
317	2.69874	62.39179	4.82127	7.72741
318	2.70726	62.21488	4.7248	7.59448
319	2.71577	62.03787	4.62256	7.45118
320	2.72428	61.86106	4.51448	7.29777
321	2.73280	61.68417	4.40091	7.13459
322	2.74131	61.50729	4.28212	6.96197
323	2.74982	61.33044	4.15839	6.78030
324	2.75834	61.15364	4.03004	6.59002
325	2.76685	60.97690	3.89738	6.39157
326	2.77536	60.80023	3.76071	6.19545
327	2.78388	60.62364	3.62058	5.97222
328	2.79239	60.44714	3.4772	5.72446
329	2.80090	60.27075	3.33102	5.52678
330	2.80942	60.09450	3.18249	5.29581
331	2.81793	59.91838	3.03206	5.06032
332	2.82644	59.74242	2.88019	4.82101
333	2.83496	59.56663	2.72739	4.57872
334	2.84347	59.39103	2.5742	4.33432
335	2.85198	59.21563	2.42116	4.08872
336	2.86050	59.04046	2.2689	3.84236
337	2.86901	58.86553	2.11806	3.59813
338	2.87752	58.69086	1.96937	3.35550
339	2.88604	58.51646	1.82364	3.11646
340	2.89455	58.34235	1.68179	2.88262
341	2.90306	58.16856	1.54487	2.65585
342	2.91158	57.99509	1.41416	2.43841
343	2.92009	57.82197	1.29115	2.23297
344	2.92860	57.64921	1.17768	2.04280
345	2.93712	57.47684	1.07585	1.87180
346	2.94563	57.30486	0.98622	1.72450
347	2.95414	57.13331	0.91746	1.60582
348	2.96266	56.96218	0.86607	1.52043
349	2.97117	56.79151	0.83578	1.47166
350	2.97969	56.62130	0.82691	1.46042

Calculated Data

Frequency (cy/mm)	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mrad) (1/*27.03/1000)	Calculated Monocular MTF (obj*tube*eye)
88.50394	52.9541	16.493	62.5107	2.39226	5.49551
88.8189	52.8157	16.7167	62.3967	2.40077	5.50816
89.13396	52.6777	16.9382	62.2827	2.40929	5.55550
89.44892	52.5401	17.1573	62.1388	2.41780	5.60149
89.76378	52.4028	17.3739	62.015	2.42631	5.64609
90.07874	52.2659	17.5877	61.8911	2.43483	5.68927
90.3937	52.1293	17.7987	61.7673	2.44334	5.73098
90.70866	51.993	18.0067	61.6435	2.45186	5.77120
91.02362	51.857	18.2114	61.5198	2.46037	5.80987
91.33858	51.7213	18.4128	61.3961	2.46888	5.84696
91.65354	51.586	18.6107	61.2723	2.47740	5.88245
91.96851	51.4509	18.8048	61.1486	2.48591	5.91628
92.28346	51.3161	18.9951	61.0249	2.49442	5.94843
92.59843	51.1815	19.1813	60.9012	2.50294	5.97886
92.91338	51.0473	19.3634	60.7775	2.51145	6.00753
93.22835	50.9133	19.541	60.6538	2.51996	6.03442
93.54331	50.7795	19.714	60.5301	2.52848	6.06948
93.85827	50.646	19.8823	60.4064	2.53699	6.08268
94.17323	50.5127	20.0457	60.2826	2.54550	6.10400
94.48819	50.3796	20.204	60.1589	2.55402	6.12338
94.80315	50.2467	20.357	60.035	2.56253	6.14081
95.11811	50.1141	20.5045	59.9112	2.57104	6.15626
95.43307	49.9816	20.6464	59.7873	2.57956	6.16968
95.74803	49.8493	20.7824	59.6634	2.58807	6.18105
96.063	49.7172	20.9124	59.5394	2.59658	6.19033
96.37795	49.5852	21.0361	59.4154	2.60510	6.19751
96.69292	49.4534	21.1535	59.2913	2.61361	6.20254
97.00787	49.3217	21.2643	59.1672	2.62212	6.20540
97.32284	49.1901	21.3683	59.0429	2.63064	6.20605
97.63779	49.0587	21.4653	58.9186	2.63915	6.20448
97.95276	48.9274	21.5551	58.7943	2.64766	6.20065
98.26772	48.7962	21.6376	58.6698	2.65618	6.19453
98.58268	48.665	21.7124	58.5452	2.66469	6.18611
98.89764	48.534	21.7796	58.4206	2.67320	6.17534
99.2126	48.403	21.8387	58.2958	2.68172	6.16221
99.52756	48.272	21.8897	58.171	2.69023	6.14689
99.84252	48.1411	21.9323	58.046	2.69874	6.12875
100.1575	48.0102	21.9663	57.9209	2.70726	6.10838
100.4724	47.8794	21.9915	57.7957	2.71577	6.08554
100.7874	47.7485	22.0077	57.6704	2.72428	6.06022
101.1024	47.6177	22.0148	57.5449	2.73280	6.03239
101.4173	47.4868	22.0124	57.4193	2.74131	6.00292
101.7323	47.3559	22.0004	57.2936	2.74982	5.96911
102.0473	47.2249	21.9785	57.1678	2.75834	5.93363
102.3622	47.0939	21.9496	57.0416	2.76685	5.89555
102.6772	46.9629	21.9045	56.9153	2.77536	5.85486
102.9921	46.8317	21.8518	56.7889	2.78388	5.81155
103.3071	46.7005	21.7885	56.6623	2.79239	5.76558
103.6221	46.5691	21.7142	56.5356	2.80090	5.71695
103.937	46.4377	21.6288	56.4086	2.80942	5.66564
104.252	46.3061	21.5321	56.2815	2.81793	5.61164
104.5669	46.1743	21.4238	56.1541	2.82644	5.55492
104.8819	46.0424	21.3036	56.0266	2.83496	5.49547
105.1969	45.9103	21.1714	55.8988	2.84347	5.43329
105.5118	45.7778	21.027	55.7708	2.85198	5.36835
105.8268	45.6456	20.87	55.6426	2.86050	5.30065
106.1417	45.5129	20.7004	55.5141	2.86901	5.23017
106.4567	45.38	20.5177	55.3855	2.87752	5.15691
106.7717	45.2468	20.3219	55.2565	2.88604	5.08085
107.0866	45.1134	20.1127	55.1273	2.89455	5.00199
107.4016	44.9797	19.8898	54.9979	2.90306	4.92032
107.7165	44.8457	19.653	54.8681	2.91158	4.83583
108.0315	44.7115	19.4021	54.7382	2.92009	4.74853
108.3465	44.5769	19.1369	54.6079	2.92860	4.65839
108.6614	44.442	18.857	54.4773	2.93712	4.56542
108.9764	44.3067	18.5622	54.3465	2.94563	4.46962
109.2913	44.1711	18.2524	54.2153	2.95414	4.37099
109.6063	44.0351	17.9272	54.0838	2.96266	4.26951
109.9213	43.8987	17.5864	53.952	2.97117	4.16521
110.2362	43.7619	17.2298	53.8199	2.97969	4.05807

### A.3 SYSTEM MTF DATA MEASURED USING THE SETUP WITH THE 0.5 $\mu\text{m}$ SLIT

### A.3.1 SYSTEM MTF DATA

Monocular 1\_2

Objective Lens S/N: 2360

Eyepiece Lens S/N: 18258A

Image Intensifier Tube S/N: 42115CC

## System MTF Measurement for a Complete ANVIS System

Data Identification: Mono1\_2  
Date: 27 June 95  
Excel Filename: mono1\_2.xls  
mono1\_2a.xls

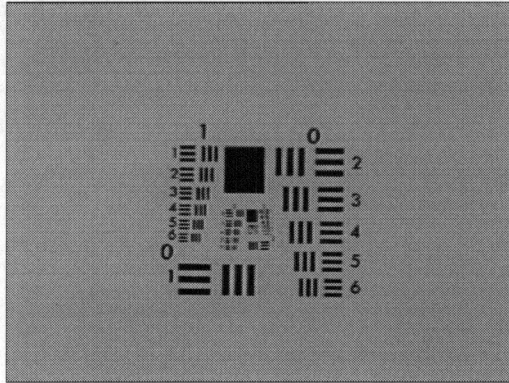
PR-900 Location:  
(0.5782, -3.0768, 0.0)

Slit Used: 0.5 micron

Monocular Components:  
Eyepiece S/N: 18258A  
Objective S/N: 2360  
Tube S/N: 42115CC

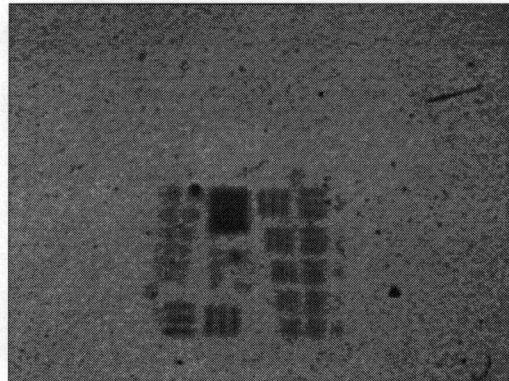
### Camera Focus Data

Filename: cam1.tif  
Integration Time: 24  
Light Level: 35.2 ft-L



### Monocular Focus Data

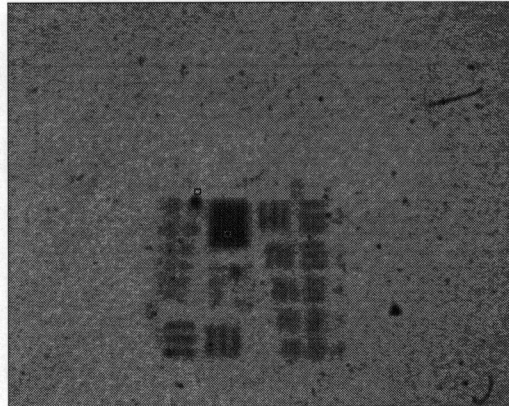
Filename: mon1foc1.tif  
Integration Time: 1000  
Light Level: 6.35E-4 ft-L





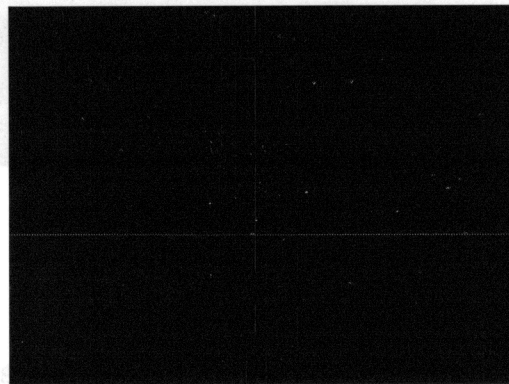
Monocular Luminance Measurement

Filename: mon1lum1.tif  
Integration Time: 1000  
Light Level: 6.35E-4 ft-L  
Max. Luminance (ft-L): 0.687  
Min. Luminance (ft-L): 0.183  
Ave. Luminance (ft-L): 0.541



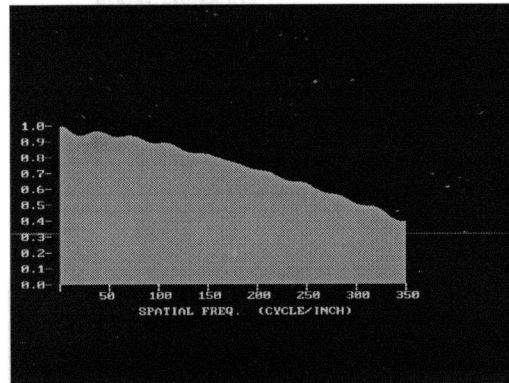
Horizontal Line Setting

Filename: cam1slt1.tif  
Integration Time: 681  
Light Level: 35.2 ft-L  
Slit Size: 0.5 micron



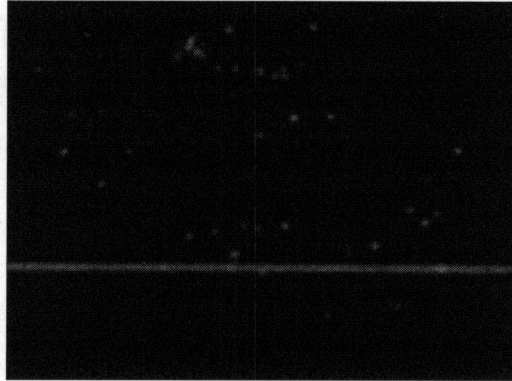
Camera MTF Measurement

Image Filename: cam1slt3.tif  
Data Filename: cam1slt3.dat  
Integration Time: 1000  
Light Level: 35.2 ft-L



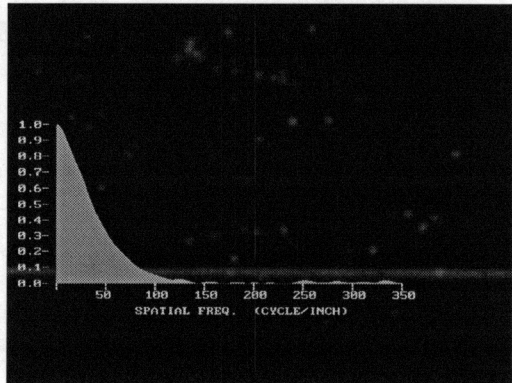
Monocular Image of Horizontal Slit

Filename: mon1slt1.tif  
Integration Time: 1000  
Light Level: 6.52E-2 ft-L

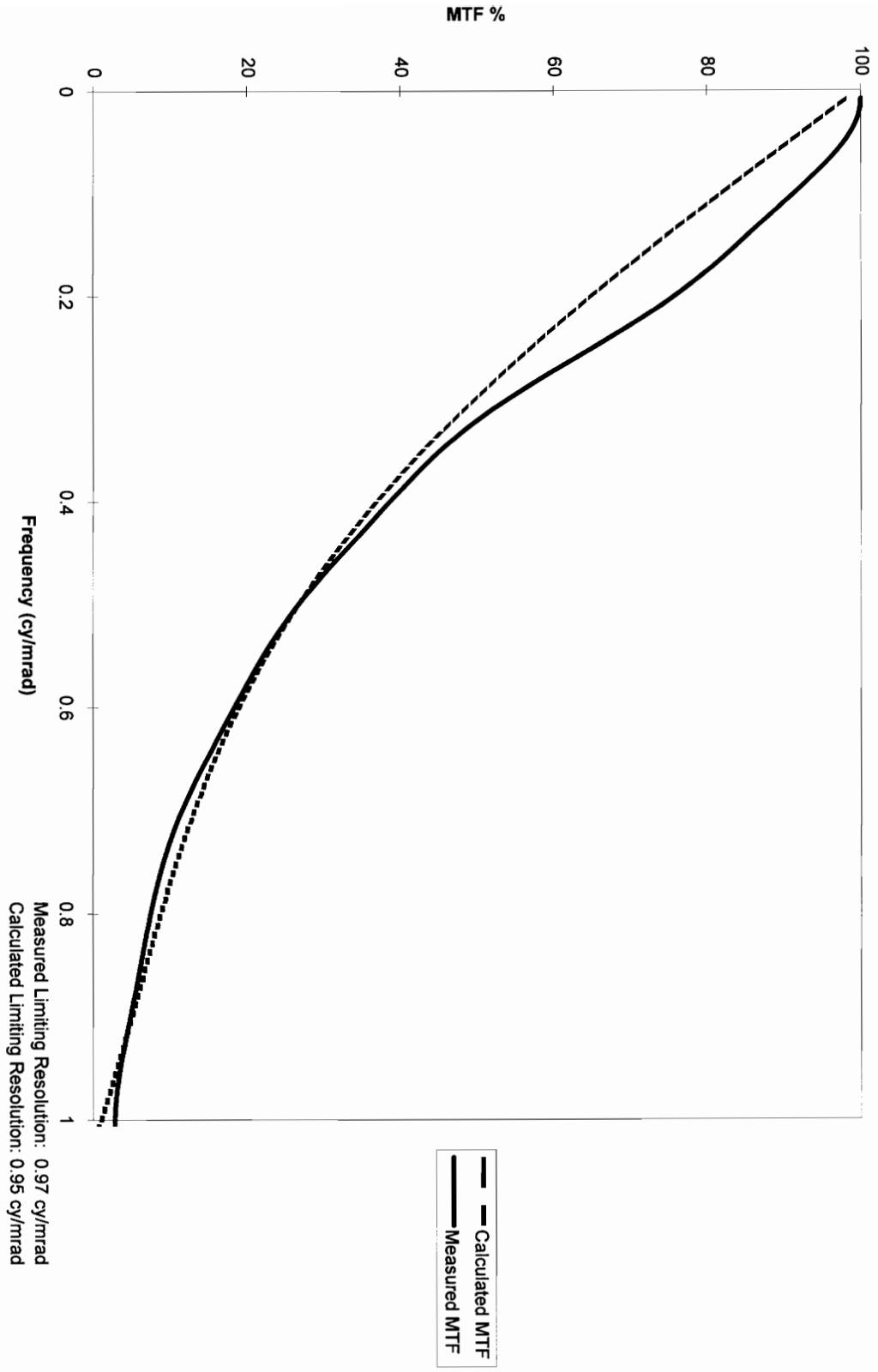


Monocular MTF Measurement Using Horizontal Slit

Image Filename: mon1slt2.tif  
Data Filename: mon1slt2.dat  
Integration Time: 1000  
Light Level: 6.52E-2 ft-L



# SYSTEM MTF of MONOCULAR 1\_2



**MTF Data**

Monocular: Mono1\_2  
 Date: 27 June 95

Monocular Components:  
 Eye Piece S/N: 18258A  
 Objective S/N: 2360  
 Tube S/N: 42115CC

**Measured Data**

Raw Frequency (cy/inch)	Corrected Frequency (cy/mrad)	Measured Camera MTF	Measured Monocular MTF Data	Actual Measured Monocular MTF (mono/camera)
1	0.00851	100.00000	100.00000	100.00000
2	0.01703	99.96070	99.96577	99.90503
3	0.02554	99.84383	99.46715	99.62273
4	0.03405	99.65253	98.81607	99.18062
5	0.04257	99.39185	97.93177	98.53099
6	0.05108	98.96873	96.83978	97.75010
7	0.05959	98.69186	95.57062	96.83758
8	0.06811	98.27054	94.15821	95.81530
9	0.07662	97.81630	92.63815	94.70825
10	0.08513	97.34063	91.04580	93.53319
11	0.09365	96.85562	89.41457	92.31738
12	0.10216	96.37341	87.77418	91.07718
13	0.11067	95.90581	86.14833	89.82702
14	0.11919	95.46400	84.55889	88.57686
15	0.12770	95.05222	83.01429	87.32994
16	0.13621	94.68744	81.52150	86.08628
17	0.14473	94.38916	80.07942	84.83964
18	0.15324	94.13822	78.68170	83.59151
19	0.16175	93.95166	77.31769	82.34288
20	0.17027	93.82863	75.97383	81.10704
21	0.17878	93.77038	74.63504	79.88441
22	0.18729	93.77531	73.28621	78.65886
23	0.19581	93.84005	71.91338	77.44000
24	0.20432	93.95961	70.50489	76.22844
25	0.21283	94.12758	69.05214	75.02366
26	0.22135	94.33632	67.55012	73.82516
27	0.22986	94.57726	65.99770	72.63218
28	0.23837	94.84116	64.39757	71.44454
29	0.24688	95.11838	62.75595	70.26186
30	0.25540	95.39919	61.08215	69.08458
31	0.26391	95.67407	59.38780	67.91220
32	0.27243	95.93394	57.68610	66.74430
33	0.28094	96.17046	55.99092	65.58040
34	0.28946	96.37623	54.31585	64.42090
35	0.29797	96.54494	52.67338	63.26640
36	0.30648	96.67161	51.07411	62.11650
37	0.31500	96.75259	49.52620	60.97160
38	0.32351	96.78571	48.03496	59.83220
39	0.33202	96.77024	46.60275	58.69780
40	0.34054	96.70689	45.22905	57.56880
41	0.34905	96.59773	43.91079	56.44480
42	0.35756	96.44808	42.64282	55.32640
43	0.36608	96.25636	41.41856	54.21320
44	0.37459	96.03395	40.23067	53.10480
45	0.38310	95.78494	39.07170	52.00160
46	0.39162	95.51597	37.93472	50.90320
47	0.40013	95.23402	36.81387	49.80940
48	0.40864	94.94613	35.70479	48.72080
49	0.41716	94.65262	34.60481	47.63680
50	0.42567	94.38005	33.51317	46.55720
51	0.43418	94.11466	32.43092	45.48260
52	0.44270	93.86860	31.36081	44.41360
53	0.45121	93.64659	30.30691	43.35000
54	0.45972	93.45246	29.27428	42.29160
55	0.46824	93.28907	28.26486	41.23840
56	0.47675	93.15828	27.29490	40.19000
57	0.48526	93.06060	26.35853	39.14640
58	0.49378	92.99668	25.46321	38.10760
59	0.50229	92.96443	24.61142	37.07340
60	0.51080	92.96196	23.80404	36.04460
61	0.51932	92.98625	23.04625	35.02080
62	0.52783	93.03350	22.31788	34.00260
63	0.53634	93.09929	21.63256	33.00000
64	0.54486	93.17865	20.98012	32.01360
65	0.55337	93.26627	20.35491	31.04340
66	0.56188	93.35661	19.76120	30.08840
67	0.57040	93.44405	19.19335	29.14860
68	0.57891	93.52310	18.66060	28.22380
69	0.58742	93.58849	18.14467	27.31400
70	0.59594	93.63535	17.64528	26.41920
71	0.60445	93.65934	17.16243	25.53940
72	0.61296	93.65677	16.70169	24.67460
73	0.62148	93.62472	16.26246	23.82480
74	0.62999	93.56109	15.84407	23.00000
75	0.63850	93.46468	14.56117	22.20000
76	0.64702	93.33521	13.97823	21.42600
77	0.65553	93.17334	13.39838	20.67800
78	0.66404	92.98064	12.82539	19.95600
79	0.67256	92.75955	12.26349	19.25900
80	0.68107	92.51329	11.71700	18.58600
81	0.68958	92.24577	11.19010	17.93700
82	0.69810	91.96149	10.68644	17.31200
83	0.70661	91.66538	10.20896	16.71100
84	0.71512	91.36270	9.75962	16.13400
85	0.72364	91.05881	9.33935	15.57900
86	0.73215	90.75909	8.94804	15.04500
87	0.74066	90.46872	8.58469	14.53100
88	0.74918	90.19259	8.24756	14.03700

**Calculated Data**

Frequency (cy/mm)	Objective Lens MT	Tube MTF	Eyeiece Lens MT	Frequency (cy/mrad) (f1*27.03/1000)	Calculated Monocular MTF (obj*tube*eye)
0.31496	99.9416	98.3265	99.8929	0.00851	98.16394
0.62992	99.8807	96.9794	99.7854	0.01703	96.66582
0.94488	99.8172	95.6277	99.6774	0.02554	95.14494
1.25984	99.7512	94.2722	99.5699	0.03405	93.63226
1.57480	99.6827	92.9137	99.4601	0.04257	92.11873
1.88976	99.6117	91.5533	99.3507	0.05108	90.60529
2.20472	99.5383	90.1908	99.2409	0.05959	89.09283
2.51968	99.4624	88.8278	99.1306	0.06811	87.58219
2.83465	99.3842	87.4648	99.0199	0.07662	86.07432
3.14961	99.3037	86.1026	98.9088	0.08513	84.57001
3.46457	99.2208	84.7417	98.7972	0.09365	83.07006
3.77953	99.1356	83.3829	98.6852	0.10216	81.57527
4.09449	99.0481	82.0268	98.5728	0.11067	80.08640
4.40945	98.9584	80.674	98.46	0.11919	78.60419
4.72441	98.8664	79.3252	98.3467	0.12770	77.12936
5.03937	98.7723	77.981	98.233	0.13621	75.66281
5.35433	98.676	76.642	98.1189	0.14473	74.20460
5.66929	98.5775	75.3007	98.0044	0.15324	72.75599
5.98425	98.477	73.9818	97.8895	0.16175	71.31740
6.29921	98.3743	72.6618	97.7741	0.17027	69.88944
6.61417	98.2696	71.3491	97.6584	0.17878	68.47269
6.92913	98.1628	70.0444	97.5423	0.18729	67.06770
7.24409	98.054	68.7481	97.4258	0.19581	65.67502
7.55906	97.9433	67.4607	97.3089	0.20432	64.29337
7.87402	97.8305	66.1827	97.1916	0.21283	62.92853
8.18898	97.7156	64.9146	97.0739	0.22135	61.57574
8.50394	97.5993	63.6567	96.9558	0.22986	60.23716
8.8189	97.4808	62.4095	96.8374	0.23837	58.91323
9.13386	97.3605	61.1734	96.7186	0.24688	57.60434
9.44882	97.2383	59.9488	96.5994	0.25540	56.31088
9.76378	97.1143	58.7361	96.4798	0.26391	55.03320
10.07874	96.9886	57.5356	96.3599	0.27243	53.77165
10.3937	96.861	56.3476	96.2397	0.28094	52.52654
10.70866	96.7317	55.1726	96.119	0.28946	51.29846
11.02362	96.6007	54.0108	95.998	0.29797	50.08681
11.33858	96.4681	52.8625	95.8767	0.30648	48.89271
11.65354	96.3337	51.728	95.755	0.31500	47.71612
11.9685	96.1977	50.6075	95.633	0.32351	46.55727
12.28346	96.0601	49.5013	95.5106	0.33202	45.41626
12.59842	95.9208	48.4097	95.3879	0.34054	44.29337
12.91339	95.7801	47.3326	95.2648	0.34905	43.18668
13.22835	95.6377	46.2709	95.1415	0.35756	42.10240
13.54331	95.4938	45.2241	95.0178	0.36608	41.03461
13.85827	95.3484	44.1927	94.8937	0.37459	39.98541
14.17323	95.2016	43.1767	94.7694	0.38310	38.95487
14.48819	95.0533	42.1763	94.6447	0.39162	37.94305
14.80315	94.9035	41.1917	94.5197	0.40013	36.95001
15.11811	94.7523	40.2229	94.3944	0.40864	35.97575
15.43307	94.5997	39.2701	94.2688	0.41716	35.02029
15.74803	94.4458	38.3333	94.1429	0.42567	34.08367
16.06299	94.2905	37.4125	94.0167	0.43418	33.16572
16.37795	94.1339	36.5079	93.8902	0.44270	32.26653
16.69291	93.9759	35.6194	93.7633	0.45121	31.38599
17.00787	93.8167	34.747	93.6362	0.45972	30.52403
17.32283	93.6563	33.8909	93.5088	0.46824	29.68055
17.63778	93.4945	33.0508	93.3811	0.47675	28.85443
17.95274	93.3316	32.2269	93.2532	0.48526	28.04857
18.26772	93.1675	31.419	93.1249	0.49378	27.25983
18.58268	93.0022	30.6272	92.9964	0.50229	26.48904
18.89764	92.8357	29.8512	92.8678	0.51080	25.73803
19.2126	92.6681	29.0911	92.7385	0.51932	25.00662
19.52756	92.4994	28.3467	92.6091	0.52783	24.28622
19.84252	92.3296	27.6179	92.4795	0.53634	23.58180
20.15748	92.1587	26.9045	92.3497	0.54486	22.89794
20.47244	91.9868	26.2064	92.2195	0.55337	22.23081
20.7874	91.8138	25.5234	92.0891	0.56188	21.58015
21.10236	91.6398	24.8553	91.9585	0.57040	20.94569
21.41732	91.4649	24.2019	91.8276	0.57891	20.32716
21.73228	91.2889	23.563	91.6965	0.58742	19.72427
22.04725	91.112	22.9383	91.5651	0.59594	19.13669
22.36221	90.9342	22.3277	91.4334	0.60445	18.56416
22.67717	90.7554	21.7307	91.3016	0.61296	18.00633
22.99213	90.5758	21.1472	91.1695	0.62148	17.46286
23.30709	90.3953	20.5769	91.0371	0.62999	16.93441
23.62205	90.2139	20.0194	90.9046	0.63850	16.41761
23.93701	90.0317	19.4744	90.7718	0.64702	15.91151
24.25197	89.8486	18.9415	90.6388	0.65553	15.42552
24.56693	89.6648	18.4204	90.5055	0.66404	14.94845
24.88189	89.4802	17.9107	90.3721	0.67256	14.48352
25.19685	89.2948	17.4121	90.2384	0.68107	14.03032
25.51181	89.1086	16.924	90.104		

Measured Data

Raw Frequency (cy/inch)	Corrected Frequency (cy/rad)	Measured Camera MTF	Measured Monocular MTF Data	Actual Measured Monocular MTF (mono/camera)
89	0.75769	89.93511	7.93445	8.82242
90	0.76620	89.70011	7.64291	8.52051
91	0.77472	89.49073	7.37044	8.23598
92	0.78323	89.30935	7.11466	7.96631
93	0.79174	89.15750	6.87333	7.70920
94	0.80026	89.03584	6.64444	7.46286
95	0.80877	88.94416	6.42612	7.22489
96	0.81729	88.88135	6.21861	6.99428
97	0.82580	88.84549	6.01422	6.76930
98	0.83431	88.83386	5.81727	6.54848
99	0.84283	88.84304	5.62407	6.33034
100	0.85134	88.86961	5.43296	6.11347
101	0.85985	88.90724	5.24241	5.89649
102	0.86837	88.95282	5.05093	5.67821
103	0.87688	89.00060	4.85734	5.45785
104	0.88539	89.04533	4.66078	5.23417
105	0.89391	89.08181	4.46807	5.00761
106	0.90242	89.10499	4.25774	4.77834
107	0.91093	89.11019	4.05219	4.54739
108	0.91945	89.09317	3.84572	4.31651
109	0.92796	89.05026	3.64052	4.08616
110	0.93647	88.97853	3.43955	3.85650
111	0.94499	88.87576	3.24641	3.62755
112	0.95350	88.74069	3.06529	3.45241
113	0.96201	88.57285	2.90073	3.27497
114	0.97053	88.37273	2.75738	3.12017
115	0.97904	88.14174	2.63953	2.99464
116	0.98755	87.88211	2.55056	2.90226
117	0.99607	87.59688	2.49234	2.84524
118	1.00458	87.28981	2.46468	2.82356
119	1.01309	86.96520	2.46508	2.83456
120	1.02161	86.62783	2.48896	2.87305
121	1.03012	86.28272	2.52959	2.93175
122	1.03863	85.93507	2.57971	3.00193
123	1.04715	85.59002	2.63118	3.07417
124	1.05566	85.25250	2.67599	3.13980
125	1.06417	84.92713	2.70664	3.18701
126	1.07269	84.61804	2.71649	3.21300
127	1.08120	84.32878	2.70005	3.20187
128	1.08971	84.06223	2.65323	3.15621
129	1.09823	83.82054	2.57360	3.07307
130	1.10674	83.60512	2.46049	2.94299
131	1.11525	83.41681	2.31518	2.77544
132	1.12377	83.25490	2.14085	2.57144
133	1.13228	83.11921	1.94254	2.33705
134	1.14079	83.00810	1.72704	2.08057
135	1.14931	82.91958	1.50264	1.81217
136	1.15782	82.85118	1.27887	1.54357
137	1.16633	82.80002	1.06621	1.28769
138	1.17485	82.76293	0.87558	1.05794
139	1.18336	82.73652	0.71733	0.86701
140	1.19187	82.71726	0.59898	0.72413
141	1.20039	82.70158	0.52122	0.63024
142	1.20890	82.68897	0.47553	0.57510
143	1.21741	82.68701	0.44836	0.54237
144	1.22593	82.64147	0.43009	0.52043
145	1.23444	82.60641	0.42129	0.51000
146	1.24295	82.55920	0.43295	0.52441
147	1.25147	82.49759	0.47884	0.58043
148	1.25998	82.41978	0.56372	0.68396
149	1.26849	82.32445	0.68027	0.82633
150	1.27701	82.21080	0.81540	0.98184
151	1.28552	82.07853	0.95575	1.16443
152	1.29403	81.92789	1.08952	1.32985
153	1.30255	81.75963	1.20678	1.47601
154	1.31106	81.57498	1.29957	1.59310
155	1.31957	81.37559	1.36202	1.67375
156	1.32809	81.16348	1.39040	1.71309
157	1.33660	80.94092	1.38319	1.70889
158	1.34511	80.71038	1.34105	1.66156
159	1.35363	80.47440	1.26968	1.57402
160	1.36214	80.23551	1.16459	1.45146
161	1.37066	79.99610	1.04074	1.30059
162	1.37917	79.75837	0.90221	1.13118
163	1.38768	79.52419	0.75665	0.95147
164	1.39620	79.29512	0.61187	0.77164
165	1.40471	79.07227	0.47525	0.60103
166	1.41323	78.85636	0.35315	0.44784
167	1.42174	78.64768	0.25019	0.31811
168	1.43025	78.44610	0.16812	0.21331
169	1.43876	78.25111	0.10438	0.13339
170	1.44728	78.06190	0.05167	0.06619
171	1.45579	77.87739	0.01361	0.01748
172	1.46430	77.69630	0.06673	0.08589
173	1.47282	77.51721	0.14031	0.18100
174	1.48133	77.33867	0.22649	0.29285
175	1.48984	77.15920	0.32201	0.41733
176	1.49836	76.97741	0.42240	0.54873
177	1.50687	76.79199	0.52265	0.68600
178	1.51538	76.60180	0.61775	0.82064
179	1.52390	76.40589	0.70318	0.95232
180	1.53241	76.20352	0.77515	1.07121
181	1.54092	75.99421	0.83083	1.19228
182	1.54944	75.77775	0.86845	1.14605
183	1.55795	75.55422	0.88728	1.17436
184	1.56646	75.32403	0.88760	1.17838

Calculated Data

Frequency (cy/mm)	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/rad) (f1*27.03/1000)	Calculated Monocular MTF (obj*tube*eye)
28.0315	87.5948	13.3466	89.0262	0.75769	10.40800
28.34646	87.4028	12.9329	88.8905	0.76620	10.04793
28.66142	87.2102	12.5248	88.7547	0.77472	9.69460
28.97638	87.0177	12.1218	88.6187	0.78323	9.34751
29.29134	86.8233	11.7232	88.4825	0.79174	9.00617
29.6063	86.6291	11.3285	88.3461	0.80026	8.67006
29.92126	86.4344	10.9369	88.2096	0.80877	8.33888
30.23622	86.2391	10.548	88.0729	0.81729	8.01152
30.55118	86.0434	10.1609	87.936	0.82580	7.68805
30.86614	85.8473	9.77504	87.799	0.83431	7.36775
31.1811	85.6507	9.38972	87.6618	0.84283	7.05008
31.49606	85.4537	9.00423	87.5244	0.85134	6.73453
31.81102	85.2563	8.61783	87.3869	0.85985	6.42053
32.12598	85.0585	8.22879	87.2493	0.86837	6.10757
32.44094	84.8603	7.83955	87.1114	0.87688	5.79509
32.75591	84.6618	7.44573	86.9735	0.88539	5.48254
33.07087	84.4629	7.04817	86.8354	0.89391	5.16938
33.38583	84.2637	6.64584	86.6972	0.90242	4.85566
33.70079	84.0641	6.23793	86.5588	0.91093	4.53902
34.01575	83.8643	5.82381	86.4203	0.91945	4.22071
34.33071	83.6642	5.40203	86.2816	0.92796	3.89955
34.64567	83.4638	4.97322	86.1428	0.93647	3.57500
34.96063	83.2631	4.53559	86.0039	0.94499	3.24649
35.27559	83.0623	4.08496	85.8649	0.95350	2.91345
35.59055	82.8611	3.62551	85.7258	0.96201	2.57532
35.90551	82.6598	3.1543	85.5865	0.97053	2.23153
36.22047	82.4583	2.67041	85.4471	0.97904	1.88152
36.53543	82.2566	2.17286	85.3076	0.98755	1.52472
36.8504	82.0547	1.66066	85.168	0.99607	1.16054
37.16536	81.8526	1.13286	85.0283	1.00458	0.78844
37.48032	81.6504	0.58424	84.8885	1.01309	0.40785
37.79528	81.4481	0.02634	84.7486	1.02161	0.01816
38.11024	81.2457	-0.55443	84.6086	1.03012	-0.38112
38.4252	81.0431	-1.15495	84.4684	1.03863	-0.79063
38.74016	80.8405	-1.77628	84.3282	1.04715	-1.21091
39.05512	80.6377	-2.41951	84.1879	1.05566	-1.64254
39.37008	80.435	-3.08574	84.0475	1.06417	-2.08607
39.68504	80.2321	-3.7761	83.9071	1.07269	-2.54208
40	80.0292	-4.4917	83.7665	1.08120	-3.01113
40.31496	79.8263	-5.2337	83.6258	1.08971	-3.49378
40.62992	79.6234	-6.00327	83.4851	1.09823	-3.99060
40.94488	79.4204	-6.80158	83.3443	1.10674	-4.50213
41.25984	79.2175	-7.62984	83.2034	1.11525	-5.02896
41.5748	79.0146	-8.48924	83.0625	1.12377	-5.57162
41.88976	78.8117	-9.38102	82.9215	1.13228	-6.13067
42.20472	78.6088	-10.3064	82.7804	1.14079	-6.70668
42.51968	78.4061	-11.2667	82.6393	1.14931	-7.30018
42.83464	78.2034	-12.2632	82.4981	1.15782	-7.91175
43.14961	78.0007	-13.2971	82.3568	1.16633	-8.54189
43.46457	77.7982	-14.3697	82.2155	1.17485	-9.19116
43.77953	77.5957	-15.4824	82.0741	1.18336	-9.86012
44.09449	77.3933	-16.6365	81.9327	1.19187	-10.54929
44.40945	77.1911	-17.8334	81.7912	1.20039	-11.25921
44.72441	76.989	-19.0744	81.6497	1.20890	-11.99044
45.03937	76.787	-20.3609	81.5081	1.21741	-12.74342
45.35433	76.5852	-21.6943	81.3665	1.22593	-13.51787
45.66929	76.3836	-23.0761	81.2249	1.23444	-14.31699
45.98425	76.1821	-24.5076	81.0832	1.24295	-15.13858
46.29921	75.9808	-25.9904	80.9415	1.25147	-15.98407
46.61417	75.7797	-27.5258	80.7998	1.25998	-16.85397
46.92913	75.5788	-29.1153	80.658	1.26849	-17.74873
47.24409	75.3781	-30.7605	80.5162	1.27701	-18.66908
47.55905	75.1776	-32.4629	80.3744	1.28552	-19.61522
47.87402	74.9773	-34.2239	80.2326	1.29403	-20.58782
48.18898	74.7773	-36.0452	80.0907	1.30255	-21.58733
48.50394	74.5778	-37.9282	79.9488	1.31106	-22.61426
48.8189	74.3781	-39.8746	79.8069	1.31957	-23.66907
49.13386	74.1788	-41.8859	79.665	1.32809	-24.75227
49.44882	73.9798	-43.9637	79.5231	1.33660	-25.86433
49.76378	73.7812	-46.1097	79.3812	1.34511	-27.00572
50.07874	73.5828	-48.3255	79.2393	1.35363	-28.17691
50.3937	73.3847	-50.6128	79.0974	1.36214	-29.37837
50.70866	73.1869	-52.9732	78.9555	1.37066	-30.61006
51.02362	72.9894	-55.4083	78.8136	1.37917	-31.87394
51.33858	72.7922	-57.92	78.6716	1.38768	-33.16987
51.65355	72.5954	-60.51	78.5297	1.39620	-34.49612
51.96851	72.3989	-63.1798	78.3878	1.40471	-35.85577
52.28347	72.2028	-65.9313	78.246	1.41323	-37.24840
52.59843	72.0				

Measured Data

Calculated Data

Raw Frequency (cy/inch)	Corrected Frequnc (cy/mrad)	Measured Camera MTF	Measured Monocula MTF Data	Actual Measured Monocular MTF (mono/camera)
185	1.57498	75.08789	0.87054	1.15936
186	1.58349	74.84686	0.83793	1.11953
187	1.59200	74.60232	0.79215	1.06193
188	1.60052	74.35597	0.73601	0.98985
189	1.60903	74.10977	0.67274	0.90776
190	1.61754	73.86593	0.60613	0.82058
191	1.62606	73.62678	0.54081	0.73453
192	1.63457	73.39478	0.48268	0.65765
193	1.64308	73.17229	0.43893	0.59986
194	1.65160	72.96157	0.41673	0.57116
195	1.66011	72.76456	0.41984	0.57698
196	1.66862	72.58282	0.44559	0.61391
197	1.67714	72.41739	0.48614	0.67130
198	1.68565	72.26887	0.53226	0.73650
199	1.69416	72.13638	0.57576	0.79815
200	1.70268	72.01951	0.61019	0.84726
201	1.71119	71.91631	0.63072	0.87702
202	1.71970	71.82433	0.63399	0.88270
203	1.72822	71.74051	0.61807	0.86154
204	1.73673	71.66128	0.58255	0.81292
205	1.74524	71.58271	0.52878	0.73870
206	1.75376	71.50066	0.46027	0.64373
207	1.76227	71.41982	0.38394	0.53765
208	1.77078	71.33962	0.31275	0.43858
209	1.77930	71.26289	0.26965	0.37876
210	1.78781	71.18973	0.23923	0.33296
211	1.79632	71.12008	0.21825	0.29707
212	1.80484	71.05484	0.20212	0.26890
213	1.81335	70.99302	0.18949	0.24580
214	1.82186	70.93462	0.18081	0.22752
215	1.83038	70.87962	0.17552	0.21340
216	1.83889	70.82792	0.17312	0.20290
217	1.84740	70.77942	0.17307	0.20228
218	1.85592	70.73412	0.17544	0.20591
219	1.86443	70.69202	0.18026	0.21340
220	1.87294	70.65322	0.18704	0.22420
221	1.88146	70.61782	0.19572	0.23790
222	1.88997	70.58582	0.20624	0.25480
223	1.89848	70.55722	0.21852	0.27450
224	1.90700	70.53202	0.23268	0.29740
225	1.91551	70.50922	0.24872	0.32390
226	1.92403	70.48882	0.26672	0.35440
227	1.93254	70.47082	0.28672	0.38940
228	1.94106	70.45522	0.30872	0.42940
229	1.94957	70.44182	0.33272	0.47490
230	1.95808	70.43042	0.35872	0.52640
231	1.96660	70.42102	0.38672	0.58440
232	1.97511	70.41362	0.41672	0.64940
233	1.98362	70.40822	0.44872	0.72190
234	1.99214	70.40482	0.48272	0.80240
235	2.00065	70.40342	0.51872	0.89190
236	2.00916	70.40402	0.55672	0.99140
237	2.01768	70.40662	0.59672	1.10290
238	2.02619	70.41122	0.63872	1.22740
239	2.03470	70.41782	0.68272	1.36690
240	2.04322	70.42642	0.72872	1.52240
241	2.05173	70.43702	0.77672	1.69590
242	2.06024	70.44962	0.82672	1.88940
243	2.06876	70.46422	0.87872	2.10590
244	2.07727	70.48082	0.93272	2.34740
245	2.08578	70.50942	0.98872	2.61690
246	2.09429	70.54002	1.04672	2.91640
247	2.10281	70.57262	1.10672	3.24790
248	2.11132	70.60722	1.16872	3.61440
249	2.11983	70.64382	1.23272	4.01890
250	2.12835	70.68242	1.29872	4.46540
251	2.13686	70.72302	1.36672	4.95690
252	2.14537	70.76562	1.43672	5.49740
253	2.15389	70.81022	1.50872	6.09190
254	2.16240	70.85682	1.58272	6.74440
255	2.17091	70.90542	1.65872	7.45990
256	2.17943	70.95602	1.73672	8.24240
257	2.18794	71.00862	1.81672	9.09590
258	2.19645	71.06322	1.89872	10.02440
259	2.20497	71.11982	1.98272	11.03190
260	2.21348	71.17842	2.06872	12.12240
261	2.22199	71.23902	2.15672	13.29990
262	2.23051	71.30162	2.24672	14.56740
263	2.23902	71.36622	2.33872	15.92790
264	2.24753	71.43282	2.43272	17.38540
265	2.25604	71.50142	2.52872	18.94290
266	2.26456	71.57202	2.62672	20.60440
267	2.27307	71.64462	2.72672	22.37490
268	2.28158	71.71922	2.82872	24.25940
269	2.29010	71.79582	2.93272	26.25290
270	2.29861	71.87442	3.03872	28.36140
271	2.30712	71.95502	3.14672	30.58990
272	2.31564	72.03762	3.25672	32.94240
273	2.32415	72.12222	3.36872	35.41490
274	2.33267	72.20882	3.48272	38.01240
275	2.34118	72.29742	3.59872	40.73990
276	2.34969	72.38802	3.71672	43.60240
277	2.35821	72.48062	3.83672	46.60490
278	2.36672	72.57522	3.95872	49.75240
279	2.37523	72.67182	4.08272	53.04990
280	2.38375	72.77042	4.20872	56.50240

Frequency (cy/mm)	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mrad)	Calculated Monocular MTF (obj*tube*eye)
58.26772	68.551	-136.167	75.556	1.57498	-70.52662
58.58268	68.3632	-140.943	75.4145	1.58349	-72.66429
58.89764	68.1759	-145.841	75.2734	1.59200	-74.84313
59.2126	67.989	-150.863	75.1324	1.60052	-77.06349
59.52756	67.8026	-156.011	74.9914	1.60903	-79.32570
59.84252	67.6167	-161.288	74.8505	1.61754	-81.63009
60.15748	67.4313	-166.695	74.7097	1.62606	-83.97698
60.47244	67.2464	-172.234	74.5689	1.63457	-86.36711
60.7874	67.062	-177.908	74.4282	1.64308	-88.79958
61.10236	66.8781	-183.72	74.2876	1.65160	-91.27590
61.41732	66.6947	-189.67	74.1471	1.66011	-93.79600
61.73228	66.5119	-195.762	74.0066	1.66862	-96.36016
62.04725	66.3295	-201.997	73.8662	1.67714	-98.96878
62.36221	66.1477	-208.378	73.7259	1.68565	-101.62197
62.67717	65.9664	-214.908	73.5857	1.69416	-104.32012
62.99213	65.7856	-221.587	73.4456	1.70268	-107.06351
63.30709	65.6054	-228.419	73.3056	1.71119	-109.85242
63.62205	65.4257	-235.407	73.1656	1.71970	-112.68713
63.93701	65.2465	-242.551	73.0258	1.72822	-115.56790
64.25197	65.0679	-249.856	72.8861	1.73673	-118.49502
64.56693	64.8898	-257.322	72.7464	1.74524	-121.46873
64.88189	64.7122	-264.953	72.6069	1.75376	-124.48931
65.19685	64.5352	-272.75	72.4674	1.76227	-127.55701
65.51181	64.3588	-280.717	72.3281	1.77078	-130.67207
65.82677	64.1829	-288.855	72.1888	1.77930	-133.83474
66.14173	64.0075	-297.167	72.0497	1.78781	-137.04527
66.45669	63.8328	-305.656	71.9107	1.79632	-140.30400
66.77165	63.6585	-314.324	71.7718	1.80484	-143.61095
67.08662	63.4849	-323.173	71.633	1.81335	-146.96647
67.40158	63.3118	-332.206	71.4943	1.82186	-150.37066
67.71654	63.1392	-341.426	71.3558	1.83038	-153.82407
68.03149	62.9672	-350.834	71.2173	1.83889	-157.32648
68.34646	62.7958	-360.434	71.0789	1.84740	-160.87855
68.66142	62.6249	-370.229	70.9408	1.85592	-164.48015
68.97638	62.4547	-380.22	70.8028	1.86443	-168.13160
69.29134	62.2849	-390.41	70.6648	1.87294	-171.83310
69.6063	62.1158	-400.802	70.527	1.88146	-175.58484
69.92126	61.9472	-411.398	70.3893	1.88997	-179.38703
70.23622	61.7792	-422.202	70.2518	1.89848	-183.23983
70.55119	61.6117	-433.216	70.1144	1.90700	-187.14357
70.86614	61.4449	-444.442	69.9771	1.91551	-191.09806
71.18111	61.2785	-455.883	69.84	1.92403	-195.10396
71.49606	61.1128	-467.542	69.703	1.93254	-199.16094
71.81103	60.9476	-479.422	69.5662	1.94106	-203.26969
72.12598	60.783	-491.524	69.4295	1.94957	-207.42985
72.44095	60.619	-503.854	69.2929	1.95808	-211.64210
72.75591	60.4555	-516.412	69.1565	1.96660	-215.90626
73.07087	60.2926	-529.201	69.0203	1.97511	-220.22245
73.38583	60.1303	-542.225	68.8842	1.98362	-224.59097
73.70079	59.9685	-555.486	68.7483	1.99214	-229.01193
74.01575	59.8073	-568.987	68.6125	2.00065	-233.48545
74.33071	59.6466	-582.731	68.4768	2.00916	-238.01167
74.64567	59.4866	-596.721	68.3414	2.01768	-242.59073
74.96063	59.327	-610.96	68.2061	2.02619	-247.22275
75.27559	59.1681	-625.45	68.0709	2.03470	-251.90785
75.59055	59.0096	-640.195	67.936	2.04322	-256.64616
75.90551	58.8518	-655.196	67.8012	2.05173	-261.43778
76.22047	58.6945	-670.459	67.6665	2.06024	-266.28283
76.53543	58.5377	-685.984	67.5321	2.06876	-271.18141
76.8504	58.3815	-701.776	67.3978	2.07727	-276.13378
77.16535	58.2258	-717.837	67.2637	2.08578	-281.13957
77.48032	58.0707	-734.171	67.1297	2.09429	-286.19950
77.79528	57.9161	-750.779	66.996	2.10281	-291.31319
78.11024	57.7621	-767.666	66.8624	2.11132	-296.48088
78.4252	57.6086	-784.834	66.729	2.11983	-301.70264
78.74016	57.4556	-802.286	66.5958	2.12835	-306.97856
79.05512	57.3031	-820.026	66.4627	2.13686	-312.30870
79.37008	57.1512	-838.057	66.3299	2.14537	-317.69314
79.68504	56.9998	-856.381	66.1972	2.15389	-323.13192
80	56.8489	-875.002	66.0646	2.16240	-328.62511
80.31496	56.6985	-893.923	65.9325	2.17091	-334.17277
80.62992	56.5486	-913.147	65.8004	2.17943	-339.77493
80.94488	56.3993	-932.678	65.6685	2.18794	-345.43183
81.25984	56.2504	-952.517	65.5369	2.19645	-351.14236
81.57481	56.102	-972.67	65.4054	2.20497	-356.90606
81.88976	55.9542	-993.138	65.2741	2.21348	-362.72445
82.20473	55.8068	-1013.93	65.		

Measured Data

Raw Frequency (cy/inch)	Corrected Frequenc (cy/mrad)	Measured Camera MTF	Measured Monocula MTF Data	Actual Measured Monocular MTF (mono/camera)
281	2.39226	56.09403	1.44309	2.57263
282	2.40077	55.92362	1.53425	2.74347
283	2.40929	55.73046	1.60357	2.97737
284	2.41780	55.51370	1.64805	2.96873
285	2.42631	55.27322	1.66616	3.01441
286	2.43483	55.00958	1.65787	3.01378
287	2.44334	54.72402	1.62451	2.96855
288	2.45186	54.41843	1.56857	2.88242
289	2.46037	54.09522	1.49349	2.76005
290	2.46888	53.75734	1.40333	2.61049
291	2.47740	53.40812	1.30246	2.43869
292	2.48591	53.05120	1.19528	2.25307
293	2.49442	52.69048	1.08599	2.06107
294	2.50294	52.32995	0.97854	1.86984
295	2.51145	51.97365	0.87677	1.68695
296	2.51996	51.62553	0.7848	1.52018
297	2.52848	51.28939	0.70768	1.37978
298	2.53699	50.96877	0.65177	1.27863
299	2.54550	50.66686	0.6238	1.23118
300	2.55402	50.38643	0.62896	1.24827
301	2.56253	50.12977	0.66724	1.33103
302	2.57104	49.89859	0.73327	1.46952
303	2.57956	49.69400	0.81870	1.64766
304	2.58807	49.51643	0.91532	1.84852
305	2.59658	49.36565	1.01537	2.05684
306	2.60510	49.24071	1.1265	2.28961
307	2.61361	49.13996	1.202	2.44607
308	2.62212	49.06107	1.27919	2.60734
309	2.63064	49.01013	1.34087	2.73641
310	2.63915	48.98525	1.38445	2.82793
311	2.64766	48.92282	1.40804	2.87810
312	2.65618	48.89557	1.4104	2.88451
313	2.66469	48.87020	1.39086	2.84603
314	2.67320	48.84137	1.34928	2.76258
315	2.68172	48.80388	1.28604	2.63512
316	2.69023	48.75255	1.20218	2.46588
317	2.69874	48.68236	1.09966	2.25885
318	2.70726	48.58864	0.98197	2.02099
319	2.71577	48.46714	0.85543	1.76497
320	2.72428	48.31421	0.73173	1.51452
321	2.73280	48.12687	0.63242	1.31407
322	2.74131	47.90293	0.5908	1.23333
323	2.74982	47.64109	0.63498	1.32884
324	2.75834	47.34396	0.75967	1.60466
325	2.76685	47.00315	0.9365	1.99242
326	2.77536	46.62923	1.13965	2.44407
327	2.78388	46.22178	1.35145	2.92384
328	2.79239	45.78431	1.55952	3.40623
329	2.80090	45.32120	1.75437	3.87097
330	2.80942	44.83765	1.92819	4.30038
331	2.81793	44.33952	2.07451	4.67869
332	2.82644	43.83323	2.18805	4.99176
333	2.83496	43.32558	2.2648	5.22740
334	2.84347	42.82359	2.30213	5.37585
335	2.85198	42.33429	2.29886	5.43026
336	2.86050	41.86454	2.25537	5.38730
337	2.86901	41.42083	2.17361	5.24763
338	2.87752	41.00905	2.05713	5.01628
339	2.88604	40.63433	1.91107	4.70309
340	2.89455	40.30085	1.74213	4.32281
341	2.90306	40.01172	1.55866	3.89551
342	2.91158	39.76883	1.37077	3.44685
343	2.92009	39.57280	1.19057	3.00856
344	2.92860	39.42294	1.03225	2.61840
345	2.93712	39.31729	0.91098	2.31700
346	2.94563	39.25285	0.8389	2.13710
347	2.95414	39.22468	0.81808	2.08563
348	2.96266	39.22799	0.83715	2.13406
349	2.97117	39.25644	0.87714	2.23438
350	2.97969	39.30318	0.92006	2.34083

Calculated Data

Frequency (cy/mm) f1	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mrad)	Calculated Monocular MTF (obj*tube*eye)
88.50394	52.9541	-1501.82	62.5663	2.39226	-497.57584
88.8189	52.8157	-1530.09	62.4399	2.40077	-504.59422
89.13386	52.6777	-1558.75	62.3136	2.40929	-511.66625
89.44882	52.5401	-1587.81	62.1877	2.41780	-518.79182
89.76378	52.4028	-1617.27	62.0619	2.42631	-525.97079
90.07874	52.2659	-1647.13	61.9364	2.43483	-533.20301
90.3937	52.1293	-1677.4	61.8111	2.44334	-540.48835
90.70866	51.993	-1708.09	61.6861	2.45186	-547.82663
91.02362	51.857	-1739.19	61.5614	2.46037	-555.21770
91.33858	51.7213	-1770.71	61.4368	2.46888	-562.66137
91.65354	51.586	-1802.66	61.3126	2.47740	-570.15746
91.96851	51.4509	-1835.03	61.1885	2.48591	-577.70602
92.28346	51.3161	-1867.93	61.0648	2.49442	-585.30611
92.59843	51.1815	-1901.08	60.9412	2.50294	-592.95849
92.91338	51.0473	-1934.75	60.818	2.51145	-600.66196
93.22835	50.9133	-1968.87	60.695	2.51996	-608.41727
93.54331	50.7795	-2003.44	60.5722	2.52848	-616.2343
93.85827	50.646	-2038.46	60.4497	2.53699	-624.08044
94.17323	50.5127	-2073.93	60.3275	2.54550	-631.98802
94.48819	50.3796	-2109.85	60.2055	2.55402	-639.94589
94.80315	50.2467	-2146.24	60.0838	2.56253	-647.95377
95.11811	50.1141	-2183.11	59.9624	2.57104	-656.01136
95.43307	49.9816	-2220.42	59.8412	2.57956	-664.11834
95.74803	49.8493	-2258.22	59.7203	2.58807	-672.27438
96.063	49.7172	-2296.49	59.5997	2.59658	-680.47942
96.37795	49.5852	-2335.25	59.4793	2.60510	-688.73230
96.69292	49.4534	-2374.49	59.3592	2.61361	-697.03373
97.00787	49.3217	-2414.22	59.2394	2.62212	-705.38226
97.32284	49.1901	-2454.44	59.1198	2.63064	-713.77857
97.63779	49.0587	-2495.16	59.0006	2.63915	-722.22118
97.95276	48.9274	-2536.38	58.8816	2.64766	-730.71074
98.26772	48.7962	-2578.1	58.7628	2.65618	-739.24603
98.58268	48.665	-2620.34	58.6444	2.66469	-747.82685
98.89764	48.534	-2663.09	58.5262	2.67320	-756.45274
99.2126	48.403	-2706.35	58.4084	2.68172	-765.12323
99.52756	48.272	-2750.14	58.2908	2.69023	-773.83782
99.84252	48.1411	-2794.45	58.1735	2.69874	-782.59599
100.1575	48.0102	-2839.29	58.0564	2.70726	-791.39723
100.4724	47.8794	-2884.67	57.9397	2.71577	-800.24097
100.7874	47.7485	-2930.58	57.8232	2.72428	-809.12687
101.1024	47.6177	-2977.04	57.7071	2.73280	-818.05375
101.4173	47.4868	-3024.04	57.5912	2.74131	-827.02188
101.7323	47.3559	-3071.59	57.4756	2.74982	-836.02960
102.0473	47.2249	-3119.7	57.3603	2.75834	-845.07742
102.3622	47.0939	-3168.37	57.2454	2.76685	-854.16383
102.6772	46.9629	-3217.6	57.1307	2.77536	-863.28843
102.9921	46.8317	-3267.4	57.0163	2.78388	-872.45054
103.3071	46.7005	-3317.77	56.9022	2.79239	-881.64944
103.6221	46.5691	-3368.71	56.7884	2.80090	-890.88439
103.937	46.4377	-3420.24	56.6749	2.80942	-900.15464
104.252	46.3061	-3472.35	56.5616	2.81793	-909.45942
104.5669	46.1743	-3525.05	56.4488	2.82644	-918.79793
104.8819	46.0424	-3578.34	56.3362	2.83496	-928.16933
105.1969	45.9103	-3632.24	56.2239	2.84347	-937.57280
105.5118	45.778	-3686.73	56.1119	2.85198	-947.00745
105.8268	45.6456	-3741.83	56.0002	2.86050	-956.47240
106.1417	45.5129	-3797.54	55.8888	2.86901	-965.96674
106.4567	45.38	-3853.87	55.7778	2.87752	-975.48982
106.7717	45.2468	-3910.82	55.667	2.88604	-985.03977
107.0866	45.1134	-3968.39	55.5566	2.89455	-994.61681
107.4016	44.9797	-4026.59	55.4465	2.90306	-1004.21870
107.7165	44.8457	-4085.43	55.3367	2.91158	-1013.84563
108.0315	44.7115	-4144.9	55.2272	2.92009	-1023.49528
108.3465	44.5769	-4205.02	55.118	2.92860	-1033.16780
108.6614	44.442	-4265.78	55.0091	2.93712	-1042.86112
108.9764	44.3067	-4327.2	54.9006	2.94563	-1052.57441
109.2913	44.1711	-4389.27	54.7924	2.95414	-1062.30646
109.6063	44.0351	-4452	54.6845	2.96266	-1072.05607
109.9213	43.8987	-4515.4	54.5769	2.97117	-1081.82198
110.2362	43.7619	-4579.47	54.4696	2.97969	-1091.60292

### A.3.2 SYSTEM MTF DATA

Monocular 2\_2

Objective Lens S/N: 26340A

Eyepiece Lens S/N: 18159A

Image Intensifier Tube S/N: 63585CC



## System MTF Measurement for a Complete ANVIS System

Data Identification: Mono2\_2  
Date: 17 May 95  
Excel Filename: mono2\_2.xls  
mono2\_2a.xls

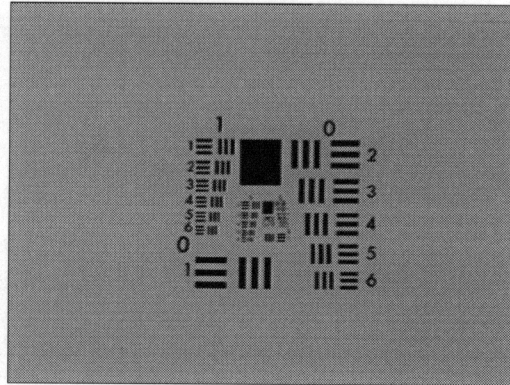
PR-900 Location:  
(0.5782, -3.0768, 0.0)

Slit Used: 0.5 micron

Monocular Components:  
Eyepiece S/N: 18159A  
Objective S/N: 26340A  
Tube S/N: 63585CC

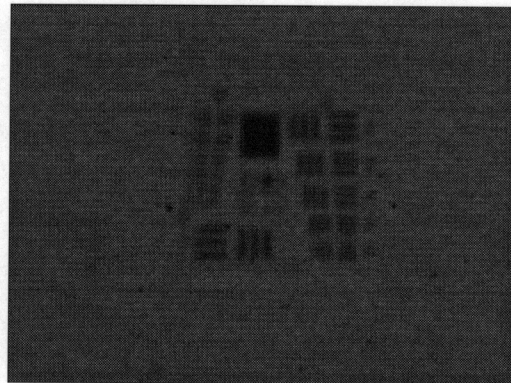
### Camera Focus Data

Filename: cam2.tif  
Integration Time: 24  
Light Level: 35.2 ft-L



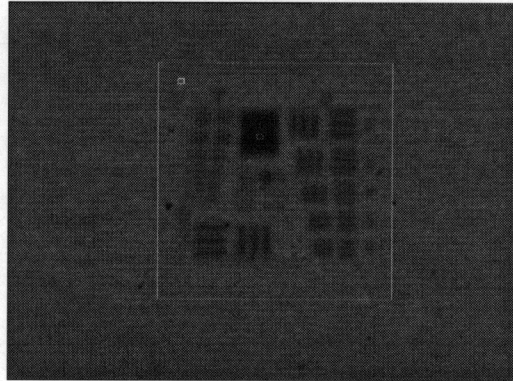
### Monocular Focus Data

Filename: mon2foc1.tif  
Integration Time: 1000  
Light Level: 6.35E-4 ft-L



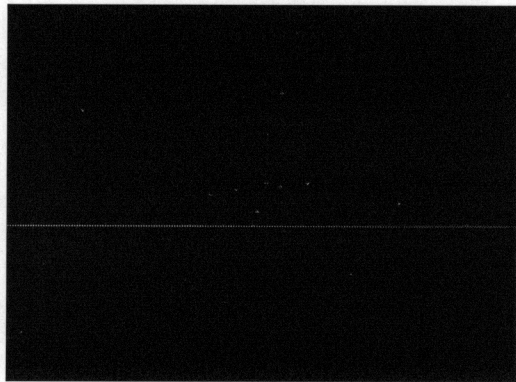
Monocular Luminance Measurement

Filename: mon2lum1.tif  
Integration Time: 1000  
Light Level: 6.35E-4 ft-L  
Max. Luminance (ft-L): 0.675  
Min. Luminance (ft-L): 0.162  
Ave. Luminance (ft-L): 0.543



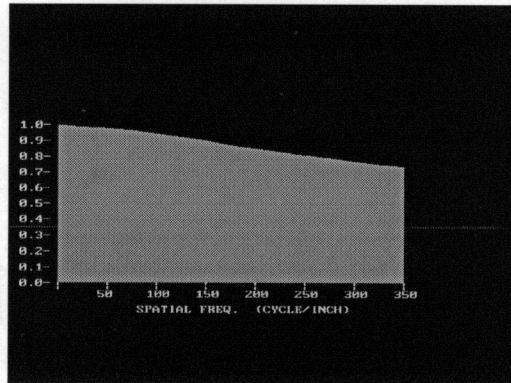
Horizontal Line Setting

Filename: cam2slt1.tif  
Integration Time: 1000  
Light Level: 35.2 ft-L  
Slit Size: 0.5 micron



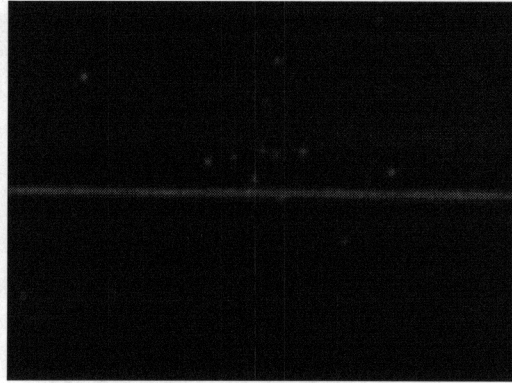
Camera MTF Measurement

Image Filename: cam2slt2.tif  
Data Filename: cam2slt2.dat  
Integration Time: 1000  
Light Level: 35.2 ft-L



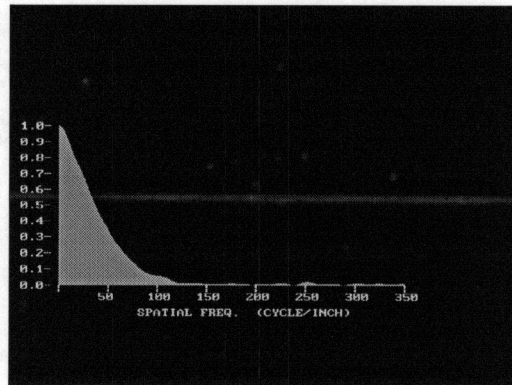
Monocular Image of Horizontal Slit

Filename: mon2slt1.tif  
Integration Time: 1000  
Light Level: 6.52E-2 ft-L

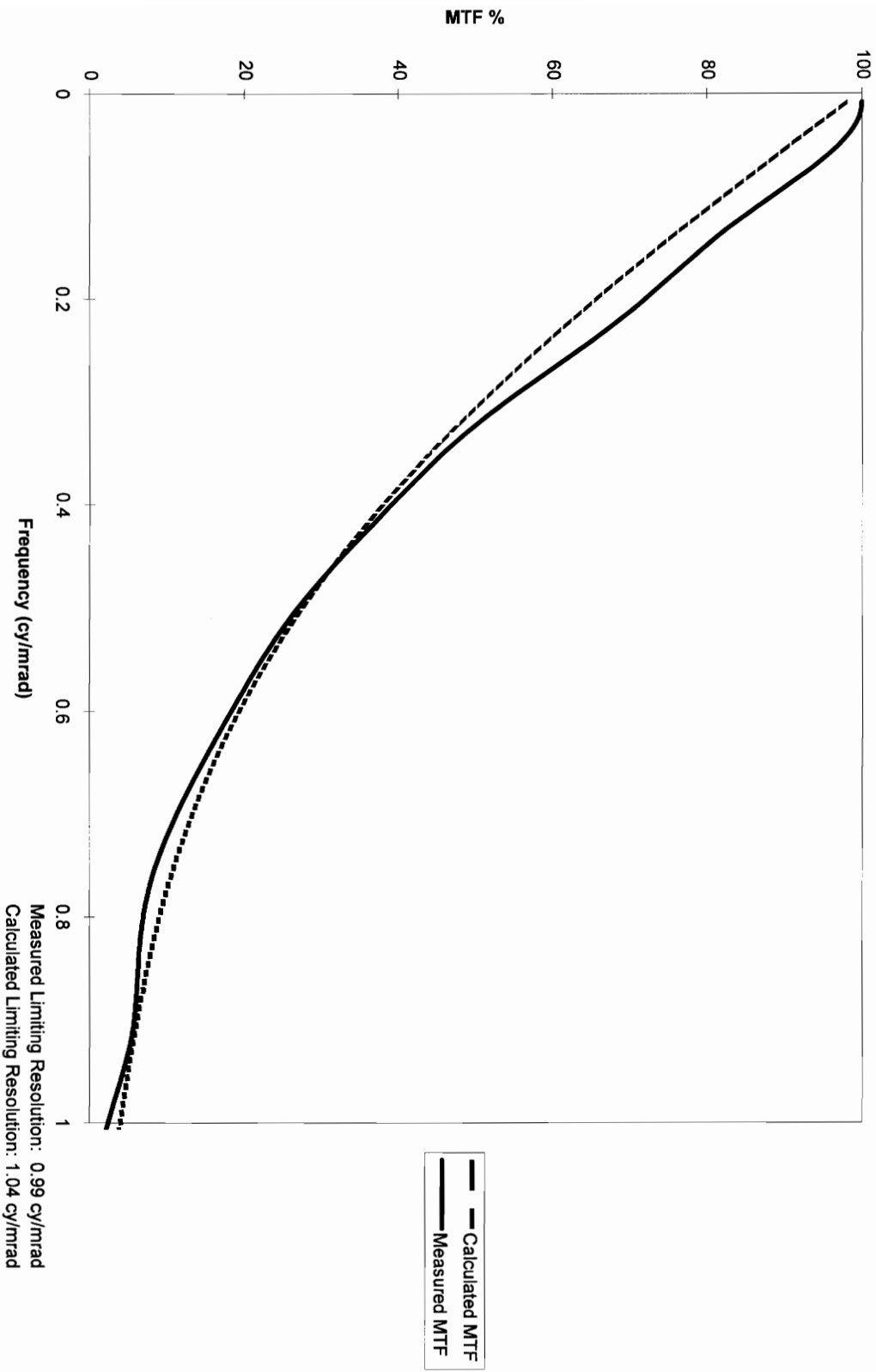


Monocular MTF Measurement Using Horizontal Slit

Image Filename: mon2slt3.tif  
Data Filename: mon2slt3.dat  
Integration Time: 1000  
Light Level: 6.52E-2 ft-L



# SYSTEM MTF of MONOCULAR 2\_2



**MTF Data**

Monocular: Mono2\_2  
Date: 17 May 95

Monocular Components:  
Eye Piece S/N: 18159A  
Objective S/N: 26340A  
Tube S/N: 63585CC

**Measured Data**

Raw Frequency (cy/inch)	Corrected Freq (cy/mrad)	Measured Camera MTF	Measured Monocular MTF Data	Actual Measured Monocular MTF (mono/camera)
1	0.00851	100.00000	100.00000	100.00000
2	0.01703	99.98119	99.88128	99.87008
3	0.02554	99.96519	99.44953	99.48416
4	0.03405	99.92318	98.77769	98.85363
5	0.04257	99.86708	97.86653	97.99679
6	0.05108	99.79939	96.74349	96.93796
7	0.05959	99.72302	95.44115	95.70624
8	0.06811	99.64109	93.99547	94.33404
9	0.07662	99.55677	92.44387	92.85543
10	0.08513	99.47303	90.82330	91.30445
11	0.09365	99.39250	89.16839	89.71340
12	0.10216	99.31728	87.50982	88.11137
13	0.11067	99.24890	85.87304	86.52291
14	0.11919	99.18620	84.27728	84.96704
15	0.12770	99.13537	82.73507	83.45696
16	0.13621	99.08995	81.25218	81.99842
17	0.14473	99.05069	79.82800	80.58283
18	0.15324	99.01708	78.45625	79.23507
19	0.16175	98.98859	77.12608	77.91569
20	0.17027	98.96576	75.82342	76.62207
21	0.17878	98.94891	74.53234	75.33929
22	0.18729	98.93853	73.23661	74.05227
23	0.19581	98.93454	71.92102	72.74836
24	0.20432	98.93886	70.57264	71.40894
25	0.21283	98.95842	69.18175	70.03022
26	0.22135	98.99421	67.74255	68.60407
27	0.22986	99.03675	66.25348	67.12833
28	0.23837	99.08687	64.71716	65.60488
29	0.24689	99.14456	63.14013	64.03946
30	0.25540	99.20981	61.53218	62.44110
31	0.26391	99.28248	59.89555	60.82141
32	0.27243	99.36229	58.24294	59.18364
33	0.28094	99.44984	56.56150	57.57170
34	0.28946	99.54569	54.85017	55.96915
35	0.29797	99.64944	53.12083	54.38311
36	0.30648	99.76169	51.37549	52.82863
37	0.31500	99.88294	49.61816	51.30007
38	0.32351	99.01269	47.85383	49.80549
39	0.33202	99.15044	46.07750	48.34557
40	0.34054	99.29669	44.29417	46.92363
41	0.34905	99.45094	42.50884	45.54311
42	0.35757	99.61269	40.71751	44.20863
43	0.36608	99.78144	38.92618	42.91511
44	0.37459	99.95769	37.13085	41.65863
45	0.38311	100.14094	35.33552	40.43411
46	0.39162	100.33169	33.54019	39.24563
47	0.40013	100.52944	31.74486	38.08811
48	0.40865	100.73419	29.94953	36.96563
49	0.41716	100.94564	28.15420	35.87411
50	0.42567	101.16389	26.35887	34.81863
51	0.43419	101.38914	24.56354	33.79511
52	0.44270	101.62139	22.76821	32.80863
53	0.45121	101.86064	20.97288	31.85511
54	0.45973	102.10689	19.17755	30.93063
55	0.46824	102.35914	17.38222	30.03911
56	0.47675	102.61739	15.58689	29.17563
57	0.48527	102.88164	13.79156	28.33511
58	0.49378	103.15189	11.99623	27.51263
59	0.50229	103.42814	10.20090	26.71211
60	0.51081	103.71039	8.40557	25.92963
61	0.51932	104.00064	6.61024	25.16011
62	0.52783	104.29889	4.81491	24.40963
63	0.53635	104.60514	3.01958	23.67411
64	0.54486	104.91939	1.22425	22.94863
65	0.55337	105.24164	-0.57108	22.23811
66	0.56188	105.57189	-2.37575	21.53763
67	0.57040	105.91014	-4.18042	20.84211
68	0.57891	106.25639	-6.08509	20.15663
69	0.58742	106.61064	-8.08976	19.47611
70	0.59594	106.97289	-10.19443	18.80563
71	0.60445	107.34314	-12.39910	18.14011
72	0.61296	107.72139	-14.60377	17.48463
73	0.62148	108.10764	-16.80844	16.83411
74	0.62999	108.50189	-19.01311	16.18863
75	0.63851	108.90414	-21.21778	15.54811
76	0.64702	109.31439	-23.42245	14.91263
77	0.65554	109.73264	-25.62712	14.28211
78	0.66405	110.15889	-27.83179	13.65663
79	0.67257	110.59314	-30.03646	13.03611
80	0.68108	111.03539	-32.24113	12.42063
81	0.68959	111.48564	-34.44580	11.81011
82	0.69811	111.94389	-36.65047	11.20463
83	0.70662	112.41014	-38.85514	10.60411
84	0.71514	112.88439	-41.05981	10.00863
85	0.72365	113.36664	-43.26448	9.41811
86	0.73216	113.85689	-45.46915	8.83263
87	0.74068	114.35514	-47.67382	8.25211
88	0.74919	114.86139	-49.87849	7.67663

**Calculated Data**

Frequency (cy/mm)	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mrad) (f1*27.03/1000)	Calculated Monocular MTF (obj*tube*eye)
0.31496	99.9501	98.286	99.9055	0.00851	98.14417
0.62992	99.8995	96.9308	99.8105	0.01703	96.64996
0.94488	99.8481	95.5741	99.715	0.02554	95.15693
1.25984	99.7958	94.2163	99.619	0.03405	93.66570
1.5748	99.7429	92.858	99.5224	0.04257	92.17689
1.88976	99.6891	91.4997	99.4254	0.05108	90.69111
2.20472	99.6346	90.1421	99.3278	0.05959	89.20893
2.51969	99.5793	88.7855	99.2297	0.06811	87.73090
2.83465	99.5232	87.4306	99.1311	0.07662	86.25777
3.14961	99.4665	86.0778	99.0319	0.08513	84.78974
3.46457	99.4099	84.7277	98.9323	0.09365	83.32765
3.77953	99.3507	83.3807	98.8322	0.10216	81.87192
4.09449	99.2917	82.0374	98.7315	0.11067	80.42307
4.40945	99.232	80.6981	98.6303	0.11919	78.98158
4.72441	99.1716	79.3634	98.5287	0.12770	77.54794
5.03937	99.1105	78.0337	98.4265	0.13621	76.12262
5.35433	99.0487	76.7094	98.3238	0.14473	74.70680
5.66929	98.9862	75.391	98.2207	0.15324	73.29876
5.98425	98.923	74.0788	98.117	0.16175	71.90110
6.29921	98.8581	72.7734	98.0128	0.17027	70.51350
6.61417	98.7945	71.4751	97.9081	0.17878	69.13638
6.92913	98.7283	70.1843	97.803	0.18729	67.77012
7.24409	98.6634	68.9014	97.6973	0.19581	66.41512
7.55906	98.5968	67.6268	97.5911	0.20432	65.07168
7.87402	98.5296	66.3608	97.4845	0.21283	63.74024
8.18898	98.4618	65.1037	97.3773	0.22135	62.42111
8.50394	98.3933	63.8561	97.2697	0.22986	61.11462
8.8189	98.3242	62.618	97.1616	0.23837	59.82107
9.13386	98.2544	61.39	97.053	0.24689	58.54077
9.44882	98.184	60.1723	96.9439	0.25540	57.27401
9.76378	98.113	58.9652	96.8343	0.26391	56.02106
10.07874	98.0414	57.769	96.7242	0.27243	54.78220
10.3937	97.9692	56.584	96.6137	0.28094	53.55767
10.70866	97.8963	55.4105	96.5027	0.28946	52.34772
11.02362	97.8229	54.2487	96.3912	0.29797	51.15258
11.33858	97.7489	53.099	96.2792	0.30648	49.97245
11.65354	97.6743	51.9615	96.1668	0.31500	48.80755
11.9685	97.5991	50.8365	96.0539	0.32351	47.65807
12.28346	97.5234	49.7242	95.9405	0.33202	46.52418
12.59842	97.4471	48.6249	95.8266	0.34054	45.40606
12.91339	97.3702	47.5387	95.7123	0.34905	44.30383
13.22835	97.2928	46.4659	95.5975	0.35757	43.21770
13.54331	97.2148	45.4066	95.4823	0.36608	42.14777
13.85827	97.1363	44.3611	95.3666	0.37459	41.09411
14.17323	97.0572	43.3295	95.2504	0.38311	40.05701
14.48819	96.9776	42.312	95.1337	0.39162	39.03638
14.80315	96.8975	41.3087	95.0167	0.40013	38.03238
15.11811	96.8169	40.3197	94.8991	0.40865	37.04500
15.43307	96.7357	39.3453	94.7811	0.41716	36.07456
15.74803	96.654	38.3854	94.6627	0.42567	35.12085
16.06299	96.5718	37.4403	94.5438	0.43419	34.18402
16.37795	96.4882	36.5101	94.4244	0.44270	33.26110
16.69291	96.406	35.5948	94.3046	0.45121	32.36110
17.00787	96.3223	34.6945	94.1844	0.45973	31.47505
17.32283	96.2381	33.8093	94.0637	0.46824	30.60594
17.63778	96.1535	32.9393	93.9426	0.47675	29.75375
17.95274	96.0684	32.0845	93.821	0.48527	28.91851
18.26772	95.9828	31.245	93.699	0.49378	28.10016
18.58268	95.8968	30.4208	93.5766	0.50229	27.29686
18.89764	95.8102	29.6119	93.4537	0.51081	26.51399
19.2126	95.7233	28.8184	93.3304	0.51932	25.74605
19.52756	95.6359	28.0402	93.2067	0.52783	24.99481
19.84252	95.548	27.2775	93.0825	0.53635	24.26017
20.15748	95.4597	26.53	92.958	0.54486	23.54207
20.47244	95.371	25.7979	92.833	0.55337	22.84039
20.7874	95.2818	25.0812	92.7078	0.56188	22.15505
21.10236	95.1922	24.3796	92.5817	0.57040	21.48591
21.41732	95.1022	23.6933	92.4555	0.57891	20.83287
21.73228	95.0118	23.0222	92.3288	0.58742	20.19579
22.04725	94.9209	22.3661	92.2017	0.59594	19.57452
22.36221	94.8297	21.725	92.0742	0.60445	18.96894
22.67717	94.7381	21.0989	91.9463	0.61296	18.37888
22.99213	94.646	20.4876	91.818	0.62148	17.80417
23.30709	94.5536	19.891	91.6893	0.62999	17.24464
23.62205	94.4608	19.3091	91.5602	0.63851	16.70012
23.93701	94.3676	18.7416	91.4306	0.64702	16.17040
24.25197	94.274	18.1864	91.3007	0.65554	15.65300
24.56693	94.1801	17.6495	91.1704	0.66405	15.15461
24.88189	94.0858	17.1246	91.0397	0.67257	14.66812
25.19685	93.9911	16.6135	90.9096	0.68108	14.19661
25.51181	93.8961	16.116			

Measured Data

Raw Frequency (cy/inch)	Corrected Freq (cy/rad)	Measured Camera MTF	Measured Monocula MTF Data	Actual Measured Monocular MTF (mono/camera)
89	0.75769	95.19777	7.83282	8.22794
90	0.76620	95.10219	7.51164	7.89849
91	0.77472	95.01076	7.22428	7.60365
92	0.78323	94.92372	6.97055	7.34332
93	0.79174	94.84106	6.74934	7.11647
94	0.80026	94.76243	6.55877	6.92128
95	0.80877	94.68725	6.39627	6.75515
96	0.81729	94.61470	6.25879	6.61503
97	0.82580	94.54380	6.14288	6.49739
98	0.83431	94.47348	6.04483	6.39844
99	0.84283	94.40267	5.96060	6.31402
100	0.85134	94.33035	5.88582	6.23958
101	0.85985	94.25567	5.81567	6.17010
102	0.86837	94.17797	5.74487	6.10061
103	0.87688	94.09687	5.66779	6.02336
104	0.88539	94.01223	5.57883	5.93334
105	0.89391	93.92423	5.47189	5.82584
106	0.90242	93.83330	5.34186	5.69293
107	0.91093	93.74011	5.18494	5.53119
108	0.91945	93.64549	4.99806	5.33721
109	0.92796	93.55038	4.77899	5.10954
110	0.93647	93.45576	4.53137	4.84968
111	0.94499	93.36256	4.25471	4.55719
112	0.95350	93.27157	3.95442	4.23968
113	0.96201	93.18344	3.63860	3.90262
114	0.97053	93.09857	3.30878	3.55406
115	0.97904	93.01711	2.97962	3.20330
116	0.98755	92.93885	2.65845	2.86043
117	0.99607	92.86373	2.35485	2.53581
118	1.00458	92.79089	2.07808	2.23953
119	1.01309	92.71968	1.83628	1.98046
120	1.02161	92.64923	1.63545	1.76521
121	1.03012	92.57865	1.47818	1.59667
122	1.03863	92.50706	1.36260	1.47297
123	1.04715	92.43367	1.28240	1.38737
124	1.05566	92.35784	1.22839	1.33003
125	1.06417	92.27912	1.19087	1.29051
126	1.07269	92.19728	1.16172	1.26004
127	1.08120	92.11233	1.13549	1.23272
128	1.08971	92.02451	1.10948	1.20654
129	1.09823	91.93425	1.08326	1.17830
130	1.10674	91.84219	1.05808	1.15206
131	1.11525	91.74905	1.03611	1.12929
132	1.12377	91.65564	1.01983	1.11268
133	1.13228	91.56278	1.01134	1.10453
134	1.14079	91.47124	1.01190	1.10265
135	1.14931	91.38164	1.02156	1.11791
136	1.15782	91.29450	1.03909	1.13817
137	1.16633	91.21008	1.06220	1.16456
138	1.17485	91.12847	1.08783	1.19373
139	1.18336	91.04950	1.11259	1.22196
140	1.19187	90.97279	1.13302	1.24545
141	1.20039	90.89774	1.14591	1.26066
142	1.20890	90.82357	1.14845	1.26848
143	1.21741	90.74940	1.13845	1.25450
144	1.22593	90.67424	1.11439	1.22900
145	1.23444	90.59709	1.07561	1.18725
146	1.24295	90.51696	1.02236	1.12950
147	1.25147	90.43297	0.95612	1.05727
148	1.25998	90.34435	0.87941	0.97340
149	1.26849	90.25054	0.79634	0.88237
150	1.27701	90.15115	0.71268	0.79054
151	1.28552	90.04605	0.63613	0.70645
152	1.29403	89.93532	0.57599	0.64045
153	1.30255	89.81931	0.54125	0.60260
154	1.31106	89.69854	0.53661	0.58824
155	1.31957	89.57376	0.55917	0.62428
156	1.32808	89.44583	0.59992	0.67071
157	1.33660	89.31574	0.64853	0.72811
158	1.34511	89.18451	0.69655	0.78102
159	1.35363	89.05314	0.73823	0.82968
160	1.36214	88.92262	0.77030	0.86626
161	1.37066	88.79378	0.79147	0.88136
162	1.37917	88.66735	0.80209	0.90461
163	1.38768	88.54384	0.80387	0.90788
164	1.39620	88.42360	0.79971	0.90441
165	1.40471	88.30676	0.79347	0.89854
166	1.41322	88.19327	0.78596	0.89526
167	1.42174	88.08289	0.78240	0.89661
168	1.43025	87.97525	0.80564	0.91564
169	1.43876	87.86988	0.83076	0.94544
170	1.44728	87.76624	0.86756	0.98849
171	1.45579	87.66378	0.91319	1.04170
172	1.46430	87.56199	0.96329	1.10012
173	1.47282	87.46045	1.01263	1.15781
174	1.48133	87.35884	1.05585	1.20684
175	1.48984	87.25697	1.08804	1.24694
176	1.49836	87.15482	1.10517	1.26805
177	1.50687	87.05252	1.10445	1.26972
178	1.51538	86.95033	1.08481	1.24739
179	1.52390	86.84862	1.04624	1.20487
180	1.53241	86.74786	0.99198	1.14352
181	1.54092	86.64854	0.92673	1.06953
182	1.54944	86.55117	0.85763	0.99089
183	1.55795	86.45619	0.79364	0.91797
184	1.56646	86.36396	0.74408	0.86156

Calculated Data

Frequency (cy/mm) f1	Objective Lens MT	Tube MTF	Eye/lens Lens MT	Frequency (cy/rad) (f1*27.03/1000)	Calculated Monocular MTF (obj*tube*eye)
28.0315	93.1235	12.6069	89.7116	0.75769	10.53214
28.34646	93.0255	12.2235	89.5767	0.76620	10.18575
28.66142	92.9271	11.8515	89.4415	0.77472	9.85046
28.97638	92.8284	11.4907	89.3058	0.78323	9.52596
29.29134	92.7295	11.1408	89.1699	0.79174	9.21196
29.60630	92.6302	10.8014	89.0336	0.80026	8.90814
29.92126	92.5306	10.4723	88.8969	0.80877	8.61419
30.23622	92.4308	10.1531	88.7598	0.81729	8.32977
30.55118	92.3307	9.84356	88.6225	0.82580	8.05457
30.86614	92.2302	9.54327	88.4847	0.83431	7.78823
31.18110	92.1295	9.25191	88.3466	0.84283	7.53044
31.49606	92.0286	8.96912	88.2082	0.85134	7.28084
31.81102	91.9273	8.69453	88.0695	0.85985	7.03950
32.12598	91.8258	8.42777	87.9304	0.86837	6.80482
32.44094	91.724	8.16846	87.7909	0.87688	6.57768
32.75591	91.622	7.91618	87.6512	0.88539	6.35731
33.07087	91.5197	7.67055	87.511	0.89391	6.14334
33.38583	91.4172	7.43115	87.3706	0.90242	5.93539
33.70079	91.3144	7.19756	87.2299	0.91093	5.73310
34.01575	91.2114	6.96933	87.0888	0.91945	5.53608
34.33071	91.1082	6.74603	86.9474	0.92796	5.34395
34.64567	91.0047	6.5272	86.8057	0.93647	5.15631
34.96063	90.901	6.31238	86.6637	0.94499	4.97277
35.27559	90.797	6.1011	86.5213	0.95350	4.79295
35.59055	90.6928	5.89288	86.3787	0.96201	4.61644
35.90551	90.5885	5.68722	86.2357	0.97053	4.44284
36.22047	90.4839	5.48363	86.0924	0.97904	4.27173
36.53543	90.3791	5.28159	85.9489	0.98755	4.10273
36.85039	90.2741	5.08057	85.8057	0.99607	3.93539
37.16535	90.1689	4.88006	85.6609	1.00458	3.76933
37.48032	90.0634	4.67952	85.5164	1.01309	3.60412
37.79528	89.9578	4.47839	85.3717	1.02161	3.43933
38.11024	89.8521	4.27611	85.2267	1.03012	3.27455
38.42520	89.7461	4.07212	85.0813	1.03863	3.10935
38.74016	89.6399	3.86583	84.9358	1.04715	2.94330
39.05512	89.5336	3.65667	84.7899	1.05566	2.77598
39.37008	89.427	3.44403	84.6437	1.06417	2.60694
39.68504	89.3204	3.2273	84.4973	1.07269	2.43575
40	89.2135	3.00588	84.3506	1.08120	2.26199
40.31496	89.1065	2.77912	84.2037	1.08971	2.08520
40.62992	88.9993	2.5464	84.0565	1.09823	1.90496
40.94488	88.8919	2.30708	83.909	1.10674	1.72081
41.25984	88.7844	2.06049	83.7612	1.11525	1.53232
41.57480	88.6768	1.80597	83.6132	1.12377	1.33905
41.88976	88.569	1.54285	83.465	1.13228	1.14054
42.20472	88.461	1.27044	83.3165	1.14079	0.93635
42.51968	88.3529	1.08805	83.1678	1.14931	0.72603
42.83464	88.2447	0.89497	83.0188	1.15782	0.50913
43.14961	88.1364	0.7005	82.8696	1.16633	0.28521
43.46457	88.0279	0.50391	82.7201	1.17485	0.05382
43.77953	87.9193	0.25553	82.5704	1.18336	-0.18550
44.09449	87.8105	-0.59856	82.4205	1.19187	-0.43320
44.40945	87.7017	-1.09594	82.2703	1.20039	-0.68974
44.72441	87.5927	-1.32843	82.1199	1.20890	-0.95555
45.03937	87.4836	-1.71676	81.9694	1.21741	-1.23110
45.35433	87.3744	-2.1218	81.8185	1.22593	-1.51684
45.66929	87.2651	-2.54426	81.6675	1.23444	-1.81322
45.98425	87.1557	-2.98497	81.5163	1.24295	-2.12070
46.29921	87.0461	-3.44473	81.3648	1.25147	-2.43973
46.61417	86.9365	-3.92437	81.2132	1.25998	-2.77075
46.92913	86.8268	-4.4247	81.0613	1.26849	-3.11424
47.24409	86.717	-4.94558	80.9092	1.27701	-3.47062
47.55905	86.6071	-5.49086	80.757	1.28552	-3.84038
47.87402	86.497	-6.05837	80.6045	1.29403	-4.22393
48.18898	86.387	-6.64999	80.4519	1.30255	-4.62174
48.50394	86.2769	-7.2666	80.2991	1.31106	-5.03427
48.81890	86.1667	-7.90908	80.1461	1.31957	-5.46195
49.13386	86.0564	-8.57833	79.9929	1.32808	-5.90523
49.44882	85.946	-9.27526	79.8395	1.33660	-6.36468
49.76378	85.8356	-10.0008	79.686	1.34511	-6.84042
50.07874	85.7251	-10.7558	79.5323	1.35363	-7.33221
50.39370	85.6145	-11.5413	79.3784	1.36214	-7.84339
50.70866	85.5039	-12.3581	79.2244	1.37066	-8.37140
51.02362	85.3932	-13.2074	79.0702	1.37917	-8.91799
51.33858	85.2824	-14.0899	78.9159	1.38768	-9.48269
51.65355	85.1718	-15.0067	78.7614	1.39620	-10.06696
51.96851	85.0608	-15.9568	78.6067	1.40471	-10.67061
52.28347	84.9499	-16.9471	78.4519	1.41322	-11.29438
52.59843	84.8389	-17.972			

Measured Data

Calculated Data

Raw Frequency (cy/inch)	Corrected Frequency (cy/rad)	Measured Camera MTF	Measured Monocula MTF Data	Actual Measured Monocular MTF (mono/camera)
185	1.57498	86.27475	0.71580	0.82967
186	1.58349	86.18866	0.70994	0.82370
187	1.59200	86.10566	0.72078	0.83706
188	1.60052	86.02560	0.73814	0.85805
189	1.60903	85.94818	0.75125	0.87407
190	1.61754	85.87299	0.75126	0.87485
191	1.62606	85.79959	0.73249	0.85372
192	1.63457	85.72749	0.69274	0.80807
193	1.64308	85.65620	0.63341	0.73948
194	1.65160	85.58530	0.55998	0.65429
195	1.66011	85.51443	0.48303	0.56485
196	1.66862	85.44330	0.41984	0.49137
197	1.67714	85.37177	0.39257	0.45984
198	1.68565	85.29975	0.41446	0.48589
199	1.69416	85.22728	0.47572	0.55818
200	1.70268	85.15442	0.55473	0.65144
201	1.71119	85.08130	0.63345	0.74452
202	1.71970	85.00803	0.70050	0.82404
203	1.72822	84.93470	0.74949	0.88243
204	1.73673	84.86132	0.77756	0.91627
205	1.74524	84.78785	0.78457	0.92533
206	1.75376	84.71414	0.77243	0.91181
207	1.76227	84.63993	0.74465	0.87979
208	1.77078	84.56493	0.70569	0.83449
209	1.77930	84.48875	0.66041	0.78195
210	1.78781	84.41100	0.61350	0.72680
211	1.79632	84.33132	0.56917	0.67492
212	1.80484	84.24938	0.53141	0.63076
213	1.81335	84.16498	0.50463	0.59597
214	1.82186	84.07803	0.49454	0.58819
215	1.83038	83.98859	0.50784	0.60465
216	1.83889	83.89687	0.54983	0.65536
217	1.84740	83.80325	0.62152	0.74164
218	1.85592	83.70821	0.71894	0.85868
219	1.86443	83.61232	0.83481	0.99843
220	1.87294	83.51619	0.96048	1.15005
221	1.88146	83.42042	1.08701	1.30305
222	1.88997	83.32553	1.20573	1.44701
223	1.89848	83.23193	1.30872	1.57238
224	1.90700	83.13983	1.38910	1.67080
225	1.91551	83.04929	1.44144	1.73564
226	1.92403	82.96011	1.46204	1.76234
227	1.93254	82.87192	1.44917	1.74869
228	1.94105	82.78419	1.40318	1.69499
229	1.94957	82.69623	1.32647	1.60403
230	1.95808	82.60733	1.22334	1.48091
231	1.96659	82.51678	1.09965	1.33264
232	1.97511	82.42394	0.96237	1.16759
233	1.98362	82.32837	0.81898	0.99477
234	1.99213	82.22984	0.67877	0.82302
235	2.00065	82.12840	0.54212	0.66009
236	2.00916	82.02442	0.42032	0.51243
237	2.01767	81.91854	0.31688	0.38684
238	2.02619	81.81170	0.24371	0.29789
239	2.03470	81.70506	0.22805	0.27911
240	2.04321	81.59991	0.28878	0.35387
241	2.05173	81.49780	0.40693	0.49932
242	2.06024	81.39945	0.56154	0.69896
243	2.06875	81.30660	0.74124	0.91166
244	2.07727	81.21998	0.93776	1.15459
245	2.08578	81.14017	1.14278	1.40840
246	2.09429	81.06737	1.34736	1.68203
247	2.10281	81.00137	1.54224	1.90397
248	2.11132	80.94156	1.71840	2.12301
249	2.11983	80.88693	1.86760	2.30890
250	2.12835	80.83618	1.98296	2.45306
251	2.13686	80.78777	2.05940	2.56106
252	2.14537	80.74005	2.09391	2.59340
253	2.15389	80.69137	2.08578	2.58489
254	2.16240	80.64020	2.03657	2.52550
255	2.17091	80.58522	1.95006	2.41987
256	2.17943	80.52545	1.83190	2.27493
257	2.18794	80.46029	1.68930	2.09955
258	2.19645	80.39556	1.53056	1.90393
259	2.20497	80.33149	1.36453	1.69900
260	2.21348	80.23271	1.20009	1.49576
261	2.22199	80.14819	1.04562	1.30661
262	2.23051	80.06113	0.90848	1.13473
263	2.23902	79.97287	0.79446	0.99341
264	2.24753	79.88477	0.70726	0.88535
265	2.25605	79.79810	0.64807	0.81254
266	2.26456	79.71394	0.61547	0.77210
267	2.27307	79.63309	0.60608	0.76109
268	2.28159	79.55600	0.61542	0.77357
269	2.29010	79.48275	0.63869	0.80356
270	2.29861	79.41304	0.67104	0.84500
271	2.30713	79.34626	0.70765	0.89185
272	2.31564	79.28148	0.74381	0.93819
273	2.32415	79.21759	0.77519	0.97586
274	2.33267	79.15337	0.79817	1.00838
275	2.34118	79.08760	0.81016	1.02438
276	2.34969	79.01914	0.80978	1.02479
277	2.35821	78.94708	0.79698	1.00951
278	2.36672	78.87066	0.77291	0.97987
279	2.37523	78.78953	0.73679	0.93884
280	2.38375	78.70361	0.70051	0.89006

Frequency (cy/mm)	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/rad)	Calculated Monocular MTF (obj/Tube/Eye)
58.26772	82.8375	-44.0036	75.4881	1.57498	-27.51655
58.58268	82.7262	-45.9402	75.3312	1.58349	-28.62829
58.89784	82.6149	-47.8361	75.1742	1.59200	-29.77073
59.2128	82.5036	-49.9625	75.0171	1.60052	-30.94124
59.52756	82.3923	-52.1106	74.86	1.60903	-32.14121
59.84252	82.2811	-54.2919	74.7028	1.61754	-33.37103
60.15748	82.1698	-56.5369	74.5455	1.62606	-34.63106
60.47244	82.0586	-58.8476	74.3882	1.63457	-35.92168
60.7874	81.9474	-61.2249	74.2309	1.64308	-37.24326
61.10236	81.8362	-63.6702	74.0735	1.65160	-38.59617
61.41732	81.725	-66.1847	73.9161	1.66011	-39.98077
61.73228	81.6138	-68.7696	73.7586	1.66862	-41.39742
62.04725	81.5027	-71.4265	73.6011	1.67714	-42.84653
62.36221	81.3916	-74.1563	73.4436	1.68565	-44.32837
62.67717	81.2805	-76.9605	73.2861	1.69416	-45.84332
62.99213	81.1695	-79.8404	73.1285	1.70268	-47.39174
63.30709	81.0585	-82.7974	72.971	1.71119	-48.97397
63.62205	80.9475	-85.8327	72.8134	1.71970	-50.59036
63.93701	80.8366	-88.9478	72.6558	1.72822	-52.24124
64.25197	80.7257	-92.1439	72.4982	1.73673	-53.92695
64.56693	80.6148	-95.4225	72.3407	1.74524	-55.64782
64.88189	80.504	-98.7849	72.1831	1.75376	-57.40418
65.19685	80.3932	-102.233	72.0255	1.76227	-59.19635
65.51181	80.2825	-105.767	71.868	1.77078	-61.02466
65.82677	80.1718	-109.389	71.7104	1.77930	-62.88943
66.14173	80.0612	-113.101	71.5529	1.78781	-64.79096
66.45669	79.9506	-116.903	71.3954	1.79632	-66.72965
66.77165	79.8401	-120.798	71.238	1.80484	-68.70559
67.08662	79.7296	-124.787	71.0805	1.81335	-70.71937
67.40157	79.6192	-128.87	70.9231	1.82186	-72.77101
67.71654	79.5088	-133.051	70.7658	1.83038	-74.86107
68.03149	79.3986	-137.329	70.6085	1.83889	-76.98960
68.34646	79.2883	-141.707	70.4513	1.84740	-79.15714
68.66142	79.1781	-146.186	70.2941	1.85592	-81.36378
68.97638	79.068	-150.768	70.1369	1.86443	-83.60988
69.29134	78.958	-155.454	69.9799	1.87294	-85.89571
69.6063	78.848	-160.246	69.8229	1.88146	-88.22155
69.92126	78.7381	-165.144	69.666	1.88997	-90.58767
70.23622	78.6282	-170.152	69.5091	1.89848	-92.99436
70.55119	78.5185	-175.27	69.3523	1.90700	-95.44194
70.86614	78.4088	-180.499	69.1957	1.91551	-97.93045
71.18111	78.2991	-185.842	69.0391	1.92403	-100.46048
71.49606	78.1896	-191.299	68.8825	1.93254	-103.03194
71.81103	78.0801	-196.874	68.7262	1.94105	-105.64542
72.12598	77.9707	-202.566	68.5699	1.94957	-108.30084
72.44095	77.8614	-208.379	68.4137	1.95808	-111.00899
72.75591	77.7521	-214.312	68.2576	1.96659	-113.77024
73.07087	77.6429	-220.369	68.1017	1.97511	-116.58254
73.38583	77.5339	-226.55	67.9458	1.98362	-119.44891
73.70079	77.4249	-232.858	67.7901	1.99213	-122.37188
74.01575	77.3159	-239.293	67.6345	2.00065	-125.35179
74.33071	77.2071	-245.858	67.4791	2.00916	-128.38976
74.64567	77.0984	-252.554	67.3238	2.01767	-131.49592
74.96063	76.9897	-259.384	67.1686	2.02619	-134.66148
75.27559	76.8811	-266.348	67.0136	2.03470	-137.88248
75.59055	76.7726	-273.448	66.8587	2.04321	-141.15871
75.90551	76.6643	-280.687	66.704	2.05173	-144.49137
76.22047	76.556	-288.065	66.5494	2.06024	-147.88193
76.53543	76.4477	-295.584	66.395	2.06875	-151.33133
76.8504	76.3396	-303.248	66.2408	2.07727	-154.84629
77.16536	76.2316	-311.055	66.0868	2.08578	-158.42761
77.48032	76.1237	-319.011	65.9329	2.09429	-162.07520
77.79528	76.0158	-327.114	65.7792	2.10281	-165.78936
78.11024	75.9081	-335.368	65.6258	2.11132	-169.56941
78.4252	75.8005	-343.774	65.4725	2.11983	-173.41694
78.74016	75.6929	-352.333	65.3194	2.12835	-177.33213
79.05512	75.5855	-361.049	65.1665	2.13686	-181.31593
79.37008	75.4781	-369.922	65.0138	2.14537	-185.36934
79.68504	75.3709	-378.954	64.8613	2.15389	-189.49369
80	75.2638	-388.148	64.7091	2.16240	-193.68979
80.31496	75.1567	-397.505	64.557	2.17091	-197.95814
80.62992	75.0498	-407.027	64.4052	2.17943	-202.29930
80.94489	74.9429	-416.715	64.2536	2.18794	-206.71384
81.25984	74.8362	-426.572	64.1023	2.19645	-211.20241
81.57481	74.7296	-436.6	63.9512	2.20497	-215.76531
81.88976	74.6231	-446.8	63.8004	2.21348	-220.40311
82.20473	74.5166	-457.175	63.6497	2.22199	-225.11631
82.51968					

Measured Data

Raw Frequency (cy/inch)	Corrected Frequency (cy/mrad)	Measured Camera MTF	Measured Monocular MTF Data	Actual Measured Monocular MTF (mono/camera)
281	2.39226	78.61313	0.65824	0.83732
282	2.40077	78.51863	0.61581	0.78441
283	2.40929	78.42086	0.57576	0.73419
284	2.41780	78.32075	0.53912	0.68835
285	2.42631	78.21932	0.50638	0.64738
286	2.43483	78.11760	0.47748	0.61123
287	2.44334	78.01655	0.45251	0.58002
288	2.45186	77.91702	0.43247	0.55504
289	2.46037	77.81966	0.41711	0.53934
290	2.46888	77.72495	0.41788	0.53764
291	2.47740	77.63313	0.43105	0.55524
292	2.48591	77.54425	0.46219	0.59603
293	2.49442	77.45819	0.51202	0.66103
294	2.50294	77.37468	0.57908	0.74841
295	2.51145	77.29335	0.66054	0.85459
296	2.51996	77.21382	0.75295	0.97515
297	2.52848	77.13567	0.85257	1.10529
298	2.53699	77.05854	0.95534	1.23976
299	2.54550	76.98212	1.05689	1.37290
300	2.55402	76.90618	1.15252	1.49861
301	2.56253	76.83058	1.23729	1.61041
302	2.57104	76.75523	1.30633	1.70190
303	2.57956	76.68010	1.355	1.76708
304	2.58807	76.60518	1.37954	1.80084
305	2.59658	76.53045	1.37718	1.79952
306	2.60510	76.45588	1.34664	1.76133
307	2.61361	76.38138	1.28847	1.68689
308	2.62212	76.30680	1.2053	1.57954
309	2.63064	76.23197	1.10221	1.44586
310	2.63915	76.15666	0.98706	1.29609
311	2.64766	76.08062	0.87097	1.14480
312	2.65618	76.00365	0.7686	1.01127
313	2.66469	75.92566	0.69677	0.91170
314	2.67320	75.84629	0.66886	0.88186
315	2.68172	75.76587	0.66621	0.90570
316	2.69023	75.68448	0.73643	0.97303
317	2.69874	75.60246	0.80205	1.06088
318	2.70726	75.52026	0.86866	1.15023
319	2.71577	75.43847	0.92728	1.22916
320	2.72428	75.35777	0.9736	1.29197
321	2.73280	75.27887	1.00689	1.33755
322	2.74131	75.20247	1.02854	1.36769
323	2.74982	75.12817	1.041	1.38561
324	2.75834	75.05640	1.04668	1.39447
325	2.76685	74.98373	1.04708	1.39622
326	2.77536	74.91200	1.04231	1.39101
327	2.78388	74.84149	1.03105	1.37704
328	2.79239	74.771994	1.01108	1.35135
329	2.80090	74.70370	0.98005	1.31078
330	2.80942	74.63645	0.93636	1.25316
331	2.81793	74.57027	0.87994	1.17940
332	2.82644	74.50518	0.81292	1.08933
333	2.83496	74.44119	0.74024	0.99257
334	2.84347	74.37816	0.66999	0.89895
335	2.85198	74.31616	0.6132	0.82330
336	2.86050	74.25517	0.58156	0.78136
337	2.86901	74.19514	0.56226	0.76287
338	2.87752	74.13608	0.61327	0.82517
339	2.88604	74.07807	0.66474	0.89511
340	2.89455	74.02101	0.72501	0.97703
341	2.90306	73.96491	0.78494	1.05661
342	2.91158	73.90976	0.83918	1.13263
343	2.92009	73.85556	0.88602	1.19675
344	2.92860	73.80233	0.9267	1.25259
345	2.93712	73.74904	0.9646	1.30470
346	2.94563	73.69570	1.00412	1.35902
347	2.95414	73.64191	1.04943	1.42118
348	2.96266	73.58730	1.10323	1.49487
349	2.97117	73.53136	1.166	1.58073
350	2.97969	73.47611	1.23594	1.67638

Calculated Data

Frequency (cy/mm)	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mrad)	Calculated Monocular MTF (obj*tube*eye)
86.50394	72.4108	-704.305	60.698	2.39226	-309.55566
88.8189	72.3067	-718.799	60.538	2.40077	-314.72214
89.13386	72.2027	-733.511	60.41	2.40929	-319.94009
89.44882	72.0988	-748.444	60.2665	2.41780	-325.20963
89.76378	71.995	-763.601	60.1234	2.42631	-330.53088
90.07874	71.8913	-778.982	59.9807	2.43483	-335.90396
90.3937	71.7877	-794.591	59.8384	2.44334	-341.32900
90.70866	71.6842	-810.429	59.6964	2.45186	-346.80611
91.02362	71.5808	-826.499	59.5549	2.46037	-352.33541
91.33858	71.4776	-842.803	59.4137	2.46888	-357.91703
91.65354	71.3744	-859.342	59.273	2.47740	-363.55109
91.96851	71.2714	-876.121	59.1326	2.48591	-369.23788
92.28346	71.1685	-893.139	58.9927	2.49442	-374.97698
92.59843	71.0656	-910.4	58.8532	2.50294	-380.76625
92.91338	70.9629	-927.905	58.7141	2.51145	-386.61407
93.22835	70.8603	-945.659	58.5754	2.51996	-392.51230
93.54331	70.7578	-963.662	58.4372	2.52848	-398.46351
93.85827	70.6554	-981.916	58.2994	2.53699	-404.46800
94.17323	70.5532	-1000.42	58.1621	2.54550	-410.52590
94.48819	70.4511	-1019.19	58.0252	2.55402	-416.63734
94.80315	70.3489	-1038.21	57.8888	2.56253	-422.80243
95.11811	70.247	-1057.49	57.7528	2.57104	-429.02131
95.43307	70.1451	-1077.04	57.6173	2.57956	-435.29410
95.74803	70.0434	-1096.85	57.4823	2.58807	-441.62093
96.063	69.9417	-1116.93	57.3477	2.59658	-448.00214
96.37795	69.8402	-1137.28	57.2137	2.60510	-454.43724
96.69292	69.7387	-1157.91	57.0801	2.61361	-460.92719
97.00787	69.6374	-1178.8	56.947	2.62212	-467.47130
97.32284	69.5362	-1199.96	56.8145	2.63064	-474.07053
97.63779	69.4351	-1221.43	56.6824	2.63915	-480.72419
97.95276	69.334	-1243.17	56.5508	2.64766	-487.43326
98.26772	69.2331	-1265.19	56.4198	2.65618	-494.19725
98.58268	69.1323	-1287.5	56.2893	2.66469	-501.01651
98.89764	69.0316	-1310.09	56.1593	2.67320	-507.89120
99.2126	68.9309	-1332.98	56.0298	2.68172	-514.82146
99.52756	68.8304	-1356.16	55.9009	2.69023	-521.80744
99.84252	68.73	-1379.64	55.7725	2.69874	-528.84931
100.1575	68.6297	-1403.42	55.6447	2.70726	-535.94721
100.4724	68.5294	-1427.49	55.5174	2.71577	-543.10131
100.7874	68.4293	-1451.88	55.3907	2.72428	-550.31178
101.1024	68.3292	-1476.57	55.2646	2.73280	-557.57879
101.4173	68.2293	-1501.56	55.139	2.74131	-564.90272
101.7323	68.1294	-1526.87	55.014	2.74982	-572.28307
102.0473	68.0296	-1552.5	54.8896	2.75834	-579.72095
102.3622	67.93	-1578.44	54.7658	2.76685	-587.21582
102.6772	67.8304	-1604.69	54.6426	2.77536	-594.76812
102.9921	67.7309	-1631.27	54.52	2.78388	-602.37804
103.3071	67.6314	-1658.18	54.398	2.79239	-610.04575
103.6221	67.5321	-1685.41	54.2766	2.80090	-617.77148
103.937	67.4329	-1712.97	54.1559	2.80942	-625.55641
104.252	67.3337	-1740.86	54.0357	2.81793	-633.39775
104.5669	67.2348	-1769.08	53.9162	2.82644	-641.29672
104.8819	67.1356	-1797.64	53.7974	2.83496	-649.25552
105.1969	67.0367	-1826.55	53.6791	2.84347	-657.2739
105.5118	66.9379	-1855.79	53.5616	2.85198	-665.35555
105.8268	66.8391	-1885.38	53.4446	2.86050	-673.49323
106.1417	66.7405	-1915.31	53.3284	2.86901	-681.68667
106.4567	66.6418	-1945.6	53.2128	2.87752	-689.94837
106.7717	66.5433	-1976.24	53.0979	2.88604	-698.2679
107.0866	66.4449	-2007.23	52.9836	2.89455	-706.64424
107.4016	66.3465	-2038.58	52.8701	2.90306	-715.08292
107.7165	66.2482	-2070.3	52.7572	2.91158	-723.58316
108.0315	66.1499	-2102.37	52.6451	2.92009	-732.14416
108.3465	66.0518	-2134.82	52.5336	2.92860	-740.76728
108.6614	65.9536	-2167.63	52.4228	2.93712	-749.45199
108.9764	65.8556	-2200.81	52.3128	2.94563	-758.19884
109.2913	65.7576	-2234.37	52.2035	2.95414	-767.00815
109.6063	65.6597	-2268.3	52.0949	2.96266	-775.88021
109.9213	65.5618	-2302.61	51.9871	2.97117	-784.81534
110.2362	65.464	-2337.31	51.8799	2.97969	-793.81385



### A.3.3 SYSTEM MTF DATA

Monocular 3\_2

Objective Lens S/N: 2529

Eyepiece Lens S/N: 18159A

Image Intensifier Tube S/N: 2400112

### System MTF Measurement for a Complete ANVIS System

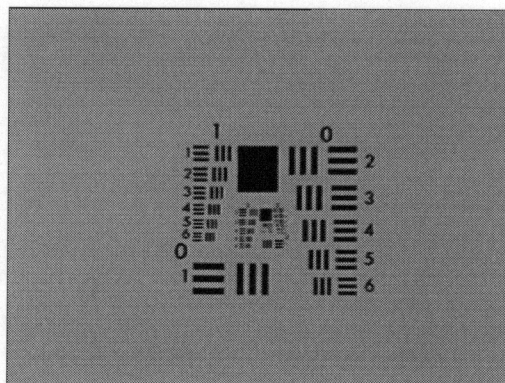
Data Identification: Mono3\_2  
Date: 26 June 95  
Excel Filename: mono3\_2.xls  
mono3\_2a.xls

PR-900 Location:  
(0.5782, -3.0768, 0.0)

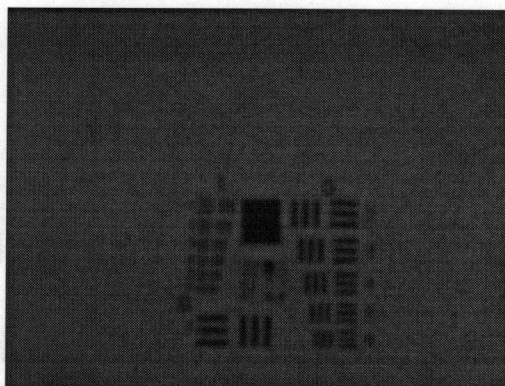
Slit Used: 0.5 micron

Monocular Components:  
Eyepiece S/N: 18159  
Objective S/N: 2529  
Tube S/N: 2400112

Camera Focus Data  
Filename: cam3.tif  
Integration Time: 23  
Light Level: 35.2 ft-L

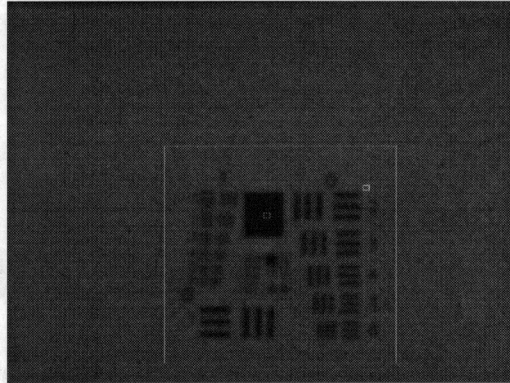


Monocular Focus Data  
Filename: mon3foc3.tif  
Integration Time: 1000  
Light Level: 6.35E-4 ft-L



Monocular Luminance Measurement

Filename: mon3lum3.tif  
Integration Time: 1000  
Light Level: 6.35E-4 ft-L  
Max. Luminance (ft-L): 0.479  
Min. Luminance (ft-L): 0.102  
Ave. Luminance (ft-L): 0.371



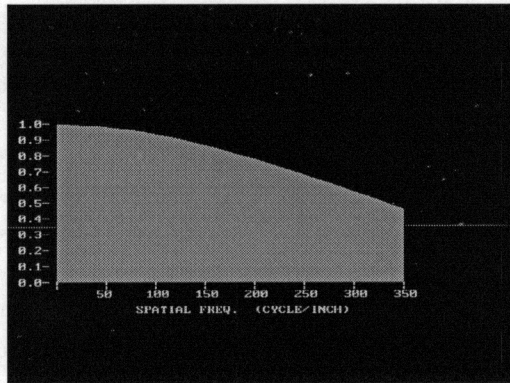
Horizontal Line Setting

Filename: cam3slt1.tif  
Integration Time: 1000  
Light Level: 35.2 ft-L  
Slit Size: 0.5 micron



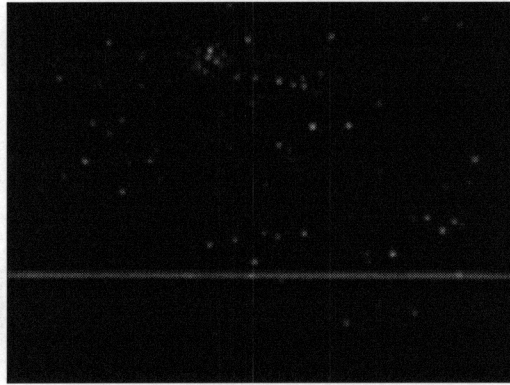
Camera MTF Measurement

Image Filename: cam3slt2.tif  
Data Filename: cam3slt2.dat  
Integration Time: 1000  
Light Level: 35.2 ft-L



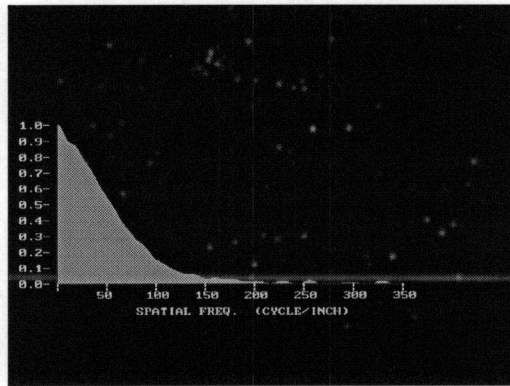
Monocular Image of Horizontal Slit

Filename: mon3slt1.tif  
Integration Time: 1000  
Light Level: 6.52E-2 ft-L

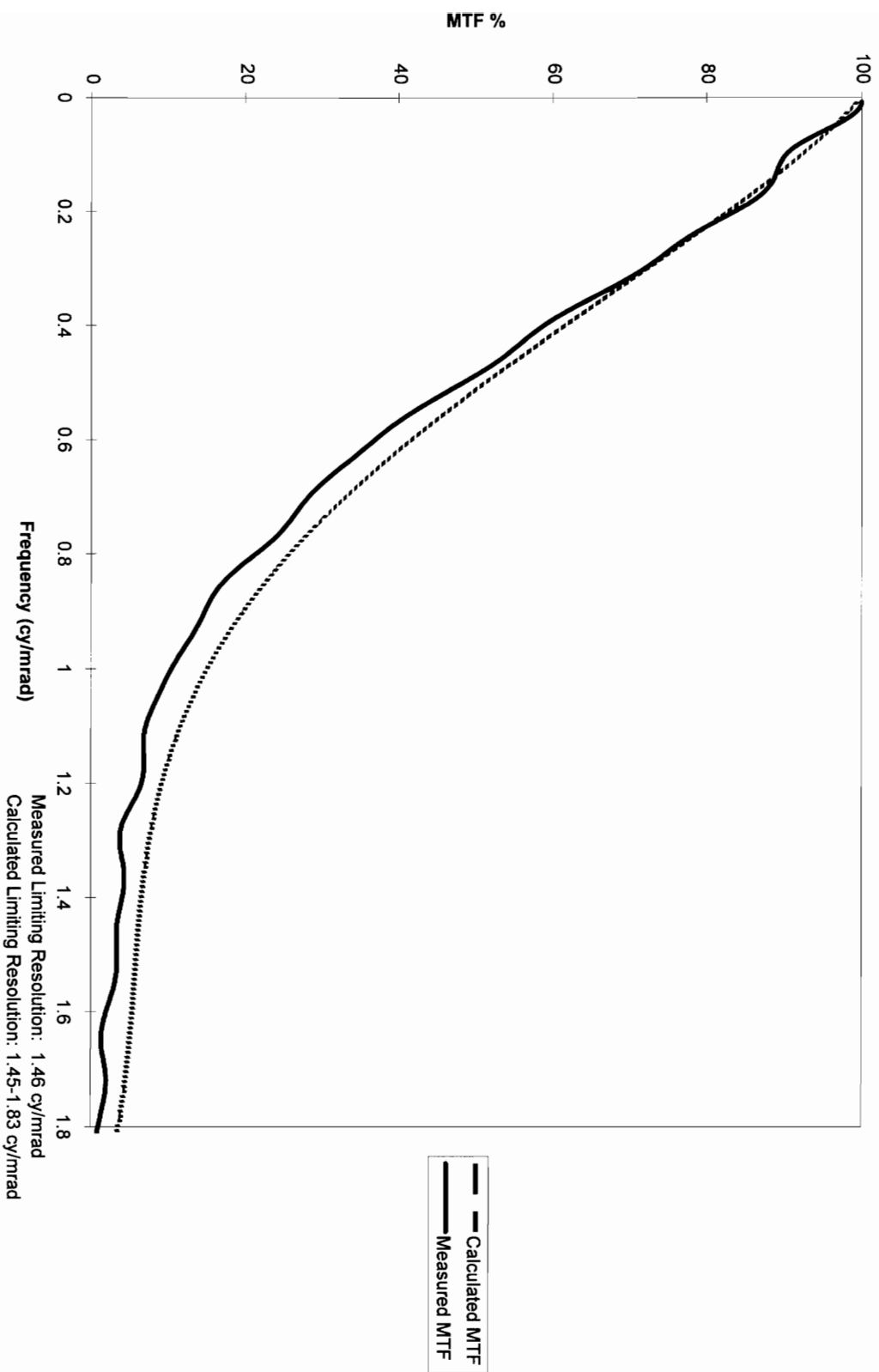


Monocular MTF Measurement Using Horizontal Slit

Image Filename: mon3slt3.tif  
Data Filename: mon3slt3.dat  
Integration Time: 1000  
Light Level: 6.52E-2 ft-L



# SYSTEM MTF of MONOCULAR 3\_2



**MTF Data**

Monocular: Mono3\_2  
Date: 26 June 95

Monocular Components:  
Eye Piece S/N: 18159A  
Objective S/N: 2529  
Tube S/N: 2400112

**Measured Data**

Raw Frequency (cy/inch)	Corrected Frequency (cy/mrad)	Measured Camera MTF	Measured Monocular MTF Data	Actual Measured Monocular MTF (mono/camera)
1	0.00851	100.00000	100.00000	100.00000
2	0.01703	99.99576	99.82279	99.82703
3	0.02554	99.98312	99.30580	99.32257
4	0.03405	99.96233	98.49124	98.52636
5	0.04257	99.93380	97.44426	97.50881
6	0.05108	99.89607	96.24572	96.34383
7	0.05959	99.85584	94.98338	95.12050
8	0.06811	99.80789	93.74248	93.82291
9	0.07662	99.75511	92.59687	92.82419
10	0.08513	99.69844	91.60174	91.87881
11	0.09365	99.63890	90.78968	91.11770
12	0.10216	99.57747	90.16375	90.54633
13	0.11067	99.51516	89.70852	90.14558
14	0.11919	99.45294	89.38309	89.87567
15	0.12770	99.39171	89.13668	89.68221
16	0.13621	99.33230	88.90060	89.50367
17	0.14473	99.27544	88.63232	89.27921
18	0.15324	99.22176	88.26358	88.95587
19	0.16175	99.17176	87.76151	88.49445
20	0.17027	99.12580	87.187314	87.9314
21	0.17878	99.08415	86.29115	87.08875
22	0.18729	99.04690	85.33457	86.15572
23	0.19581	99.01404	84.26372	85.10280
24	0.20432	98.98542	83.11638	83.96831
25	0.21283	98.96078	81.93414	82.79455
26	0.22135	98.93977	80.75676	81.62214
27	0.22986	98.92194	79.61734	80.48502
28	0.23837	98.90674	78.53865	79.40677
29	0.24689	98.89359	77.53109	78.38650
30	0.25540	98.88184	76.59246	77.45857
31	0.26391	98.87081	75.70943	76.57470
32	0.27243	98.85980	74.86037	75.73211
33	0.28094	98.84811	74.01893	74.88148
34	0.28945	98.83505	73.15817	74.02047
35	0.29797	98.81995	72.25431	73.11713
36	0.30648	98.80218	71.28982	72.15410
37	0.31500	98.78116	70.25552	71.12239
38	0.32351	98.75635	69.15139	70.02222
39	0.33202	98.72731	67.98822	68.86263
40	0.34054	98.69365	66.77627	67.66015
41	0.34905	98.65510	65.54296	66.43646
42	0.35756	98.61146	64.31024	65.21579
43	0.36608	98.56261	63.10182	64.02207
44	0.37459	98.50858	61.93839	62.87614
45	0.38310	98.44947	60.83567	61.79380
46	0.39162	98.38547	59.80279	60.78417
47	0.40013	98.31691	58.84164	59.84895
48	0.40864	98.24417	57.94693	58.98256
49	0.41716	98.16774	57.10701	58.17299
50	0.42567	98.08818	56.30528	57.40271
51	0.43418	98.00611	55.52204	56.65161
52	0.44270	97.92219	54.73860	55.99806
53	0.45121	97.83713	53.92934	55.12155
54	0.45972	97.75162	53.08368	54.30466
55	0.46824	97.66638	52.18765	53.43461
56	0.47675	97.58206	51.23493	52.50446
57	0.48526	97.49928	50.22536	51.51357
58	0.49378	97.41881	49.16472	50.46749
59	0.50229	97.34051	48.06409	49.37277
60	0.51080	97.26533	46.93844	48.25814
61	0.51932	97.19332	45.80506	47.12779
62	0.52783	97.12461	44.68175	46.00457
63	0.53634	97.05918	43.58501	44.90560
64	0.54486	96.99689	42.52843	43.84514
65	0.55337	96.93746	41.52151	42.83330
66	0.56188	96.88050	40.56894	41.87524
67	0.57040	96.82547	39.67035	40.97098
68	0.57891	96.77177	38.82063	40.11665
69	0.58742	96.71870	38.01078	39.30304
70	0.59594	96.66550	37.22918	38.51341
71	0.60445	96.61137	36.48319	37.74213
72	0.61296	96.55550	35.70102	36.97461
73	0.62148	96.49707	34.93444	36.20156
74	0.62999	96.43533	34.15528	35.41781
75	0.63850	96.36954	33.36641	34.62340
76	0.64702	96.29908	32.57189	33.82368
77	0.65553	96.22340	31.78130	33.02686
78	0.66404	96.14206	31.00736	32.25160
79	0.67256	96.05476	30.26369	31.50670
80	0.68107	95.96129	29.56262	30.80682
81	0.68958	95.86162	28.91289	30.16106
82	0.69810	95.75581	28.31798	29.57312
83	0.70661	95.64409	27.77516	29.04012
84	0.71512	95.52676	27.27560	28.55284
85	0.72364	95.40427	26.80516	28.09940
86	0.73215	95.27715	26.34800	27.65196
87	0.74066	95.14600	25.87863	27.19886
88	0.74918	95.01151	25.38402	26.71678

**Calculated Data**

Frequency (cy/mm)	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mrad) (1/27.031000)	Calculated Monocular MTF (obj/tube*eye)
0.31496	99.9817	99.5472	99.9055	0.00851	99.43502
0.52982	99.9648	99.0774	99.8105	0.01703	98.85487
0.94488	99.945	98.591	99.715	0.02554	98.25605
1.25984	99.9226	98.0885	99.619	0.03405	97.63915
1.5748	99.8974	97.5704	99.5224	0.04257	97.00476
1.88976	99.8695	97.037	99.4254	0.05108	96.35347
2.20472	99.839	96.4888	99.3278	0.05959	95.68566
2.51968	99.8058	95.9263	99.2297	0.06811	95.00249
2.83465	99.77	95.3499	99.1311	0.07662	94.30398
3.14961	99.7317	94.76	99.0319	0.08513	93.59087
3.46457	99.6908	94.1571	98.9323	0.09365	92.86374
3.77953	99.6474	93.5415	98.8322	0.10216	92.12312
4.09449	99.6015	92.9138	98.7315	0.11067	91.36959
4.40945	99.5531	92.2742	98.6303	0.11919	90.60369
4.72441	99.5023	91.6233	98.5287	0.12770	89.82595
5.03937	99.4491	90.9614	98.4265	0.13621	89.03693
5.35433	99.3935	90.289	98.3238	0.14473	88.23714
5.66929	99.3355	89.6063	98.2207	0.15324	87.42712
5.98425	99.2752	88.9139	98.117	0.16175	86.60739
6.29921	99.2126	88.2121	98.0128	0.17027	85.77845
6.61417	99.1478	87.5013	97.9081	0.17878	84.94082
6.92913	99.0806	86.7819	97.803	0.18729	84.09499
7.24409	99.0113	86.0543	97.6973	0.19581	83.24146
7.55905	98.9397	85.3187	97.5911	0.20432	82.38070
7.87402	98.866	84.5757	97.4845	0.21283	81.51323
8.18898	98.7902	83.8255	97.3773	0.22135	80.63951
8.50394	98.7122	83.0686	97.2697	0.22986	79.76000
8.8189	98.6321	82.3053	97.1616	0.23837	78.87517
9.13386	98.5499	81.5359	97.053	0.24689	77.98547
9.44882	98.4657	80.7607	96.9439	0.25540	77.09134
9.76378	98.3795	79.9803	96.8343	0.26391	76.19324
10.07874	98.2912	79.1947	96.7242	0.27243	75.29158
10.3937	98.201	78.4045	96.6137	0.28094	74.38681
10.70866	98.1089	77.61	96.5027	0.28945	73.47933
11.02362	98.0148	76.8114	96.3912	0.29797	72.56957
11.33858	97.9188	76.0081	96.2792	0.30648	71.65793
11.65354	97.821	75.2034	96.1666	0.31500	70.74480
11.9685	97.7213	74.3946	96.0539	0.32351	69.83058
12.28346	97.6198	73.5831	95.9405	0.33202	68.91566
12.59842	97.5164	72.7692	95.8266	0.34054	68.00040
12.91339	97.4113	71.953	95.7123	0.34905	67.08515
13.22835	97.3045	71.1351	95.5975	0.35756	66.17032
13.54331	97.1959	70.3166	95.4823	0.36608	65.25626
13.85827	97.0856	69.4948	95.3666	0.37459	64.34329
14.17323	96.9736	68.6731	95.2504	0.38310	63.43177
14.48819	96.86	67.8507	95.1337	0.39162	62.52202
14.80315	96.7447	67.0278	95.0167	0.40013	61.61437
15.11811	96.6278	66.2049	94.8991	0.40864	60.70914
15.43307	96.5093	65.382	94.7811	0.41716	59.80664
15.74803	96.3893	64.5596	94.6627	0.42567	58.90717
16.06299	96.2677	63.7378	94.5438	0.43418	58.01103
16.37795	96.1445	62.917	94.4244	0.44270	57.11851
16.69291	96.0199	62.0973	94.3046	0.45121	56.22989
17.00787	95.8938	61.2791	94.1844	0.45972	55.34544
17.32283	95.7662	60.4626	94.0637	0.46824	54.46224
17.63778	95.6372	59.6479	93.9426	0.47675	53.59009
17.95274	95.5068	58.8354	93.821	0.48526	52.71973
18.26770	95.375	58.0253	93.699	0.49378	51.85457
18.58266	95.2418	57.2178	93.5766	0.50229	50.99485
18.89764	95.1073	56.4132	93.4537	0.51080	50.14080
19.2126	94.9714	55.6117	93.3304	0.51932	49.29263
19.52756	94.8343	54.8134	93.2067	0.52783	48.45058
19.84252	94.6958	54.0186	93.0825	0.53634	47.61484
20.15748	94.5561	53.2275	92.958	0.54486	46.78563
20.47244	94.4151	52.4404	92.833	0.55337	45.96313
20.7874	94.273	51.6573	92.7076	0.56188	45.14754
21.10236	94.1296	50.8786	92.5817	0.57040	44.33903
21.41732	93.985	50.1043	92.4555	0.57891	43.53780
21.73228	93.8393	49.3348	92.3288	0.58742	42.74399
22.04724	93.6924	48.5701	92.2017	0.59594	41.95776
22.36221	93.5444	47.8105	92.0742	0.60445	41.17930
22.67717	93.3953	47.0561	91.9463	0.61296	40.40874
22.99213	93.2451	46.3071	91.818	0.62148	39.64623
23.30709	93.0939	45.5637	91.6893	0.62999	38.89189
23.62205	92.9416	44.8261	91.5602	0.63850	38.14587
23.93701	92.7883	44.0943	91.4306	0.64702	37.40827
24.25197	92.634	43.3686	91.3007	0.65553	36.67922
24.56693	92.4787	42.6491	91.1704	0.66404	35.95883
24.88189	92.3224	41.9359	91.0397	0.67256	35.24720
25.19685	92.1652	41.2293	90.9086	0.68107	34.54443
25.51181	92.0071	40.5293	90.7772	0.68958	

Measured Data

Raw Frequency (cy/inch)	Corrected Frequnc (cy/mrad)	Measured Camera MTF	Measured Monocular MTF Data	Actual Measured Monocular MTF (mono/camera)
89	0.75769	94.87438	24.84594	26.16825
90	0.76620	94.73536	24.25276	25.60054
91	0.77472	94.59520	23.59904	24.94740
92	0.78323	94.45463	22.88635	24.23000
93	0.79174	94.31438	22.12336	23.45704
94	0.80026	94.17510	21.32512	22.64411
95	0.80877	94.03741	20.51145	21.81201
96	0.81729	93.90184	19.70485	20.98452
97	0.82580	93.76888	18.92787	20.18566
98	0.83431	93.63890	18.20057	19.43687
99	0.84283	93.51218	17.53822	18.75501
100	0.85134	93.38894	16.94672	18.14960
101	0.85985	93.26926	16.43684	17.62300
102	0.86837	93.15316	15.99450	17.17011
103	0.87688	93.04055	15.61181	16.77957
104	0.88539	92.93126	15.27381	16.45660
105	0.89391	92.82502	14.96358	16.12021
106	0.90242	92.72150	14.66436	15.81549
107	0.91093	92.62028	14.36136	15.50563
108	0.91945	92.52098	14.04338	15.17861
109	0.92796	92.42277	13.70358	14.82706
110	0.93647	92.32539	13.33964	14.44872
111	0.94499	92.22811	12.95438	14.04602
112	0.95350	92.13031	12.55294	13.62520
113	0.96201	92.03314	12.14352	13.19498
114	0.97053	91.93058	11.73493	12.76499
115	0.97904	91.82740	11.33544	12.34429
116	0.98755	91.72123	10.95148	11.93996
117	0.99607	91.61152	10.58683	11.55623
118	1.00458	91.49781	10.24231	11.19405
119	1.01309	91.37970	9.91596	10.85138
120	1.02161	91.25687	9.60378	10.52390
121	1.03012	91.12910	9.30093	10.20632
122	1.03863	90.99628	9.00294	9.89374
123	1.04715	90.85840	8.70702	9.58307
124	1.05566	90.71558	8.41291	9.27394
125	1.06417	90.56803	8.12333	8.96931
126	1.07269	90.41609	7.84381	8.67524
127	1.08120	90.26020	7.58207	8.40023
128	1.08971	90.10088	7.34682	8.15399
129	1.09823	89.93875	7.14649	7.94595
130	1.10674	89.77448	6.98778	7.78370
131	1.11525	89.60878	6.87444	7.67161
132	1.12377	89.44240	6.80638	7.60979
133	1.13228	89.27608	6.77923	7.59356
134	1.14079	89.11057	6.78432	7.61338
135	1.14931	88.94653	6.80934	7.65554
136	1.15782	88.78460	6.83922	7.70316
137	1.16633	88.62531	6.85766	7.73781
138	1.17485	88.46910	6.84865	7.74129
139	1.18336	88.31629	6.79827	7.69764
140	1.19187	88.16709	6.69606	7.59474
141	1.20039	88.02155	6.53634	7.42584
142	1.20890	87.87961	6.31886	7.19036
143	1.21741	87.74106	6.04996	6.89410
144	1.22593	87.60559	5.73723	6.54893
145	1.23444	87.47275	5.39854	6.17168
146	1.24295	87.34199	5.05079	5.78277
147	1.25147	87.21270	4.71327	5.40434
148	1.25998	87.08417	4.40498	5.05830
149	1.26849	86.95569	4.12290	4.74948
150	1.27701	86.82649	3.94034	4.53618
151	1.28552	86.69682	3.80550	4.38949
152	1.29403	86.56629	3.74037	4.32098
153	1.30255	86.42717	3.74027	4.32766
154	1.31106	86.28788	3.79454	4.39754
155	1.31957	86.14451	3.85784	4.51316
156	1.32809	85.99659	4.00231	4.65403
157	1.33660	85.84376	4.11975	4.79913
158	1.34511	85.68576	4.22363	4.92921
159	1.35363	85.52243	4.30067	5.02871
160	1.36214	85.35374	4.34195	5.08701
161	1.37066	85.17975	4.34325	5.09892
162	1.37917	85.00063	4.30490	5.06455
163	1.38768	84.81665	4.23100	4.98840
164	1.39620	84.62818	4.12836	4.87824
165	1.40471	84.43565	4.00545	4.74379
166	1.41322	84.23966	3.87148	4.59580
167	1.42174	84.04050	3.74027	4.44546
168	1.43025	83.83906	3.60851	4.30409
169	1.43876	83.63589	3.49816	4.18261
170	1.44728	83.43165	3.41281	4.09054
171	1.45579	83.22701	3.35744	4.03408
172	1.46430	83.02264	3.33279	4.01431
173	1.47282	82.81918	3.33455	4.02631
174	1.48133	82.61725	3.35412	4.05983
175	1.48984	82.41744	3.38057	4.10177
176	1.49836	82.22026	3.40296	4.13883
177	1.50687	82.02620	3.42106	4.15972
178	1.51538	81.83568	3.40110	4.15601
179	1.52390	81.64895	3.36560	4.12204
180	1.53241	81.46632	3.30279	4.05418
181	1.54092	81.28792	3.21094	3.95009
182	1.54944	81.11380	3.08940	3.80874
183	1.55795	80.94393	2.93895	3.63072
184	1.56646	80.77815	2.76260	3.41999

Calculated Data

Frequency (cy/mm)	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mrad) (f*27.031000)	Calculated Monocular MTF (obj*tube*eye)
28.0315	90.7108	35.1833	86.7116	0.75769	28.63164
28.34646	90.5451	34.5487	89.5767	0.76620	28.02160
28.66142	90.3787	33.9218	89.4415	0.77472	27.42101
28.97638	90.2116	33.3028	89.3058	0.78323	26.83011
29.29134	90.0437	32.6918	89.1699	0.79174	26.24883
29.6063	89.8752	32.0888	89.0336	0.80026	25.67718
29.92126	89.706	31.494	88.8969	0.80877	25.1158
30.23622	89.5361	30.9075	88.7598	0.81729	24.56284
30.55118	89.3656	30.3293	88.6225	0.82580	24.02016
30.86614	89.1944	29.7594	88.4847	0.83431	23.48715
31.1811	89.0226	29.198	88.3466	0.84283	22.96380
31.49606	88.8503	28.6451	88.2082	0.85134	22.45010
31.81102	88.6773	28.1008	88.0695	0.85985	21.94603
32.12598	88.5038	27.5657	87.9304	0.86837	21.45158
32.44094	88.3298	27.038	87.7909	0.87688	20.96673
32.75591	88.1552	26.5196	87.6512	0.88539	20.49144
33.07087	87.9801	26.01	87.511	0.89391	20.02569
33.38583	87.8045	25.5092	87.3706	0.90242	19.56945
33.70079	87.6285	25.0172	87.2299	0.91093	19.12267
34.01575	87.4519	24.534	87.0888	0.91945	18.68531
34.33071	87.2749	24.0598	86.9474	0.92796	18.25732
34.64567	87.0975	23.5944	86.8057	0.93647	17.83866
34.96063	86.9196	23.1379	86.6637	0.94499	17.42925
35.27559	86.7414	22.6903	86.5213	0.95350	17.02905
35.59055	86.5627	22.2517	86.3787	0.96201	16.63800
35.90551	86.3837	21.822	86.2357	0.97053	16.25602
36.22047	86.2043	21.4013	86.0924	0.97904	15.88304
36.53543	86.0246	20.9894	85.9489	0.98755	15.51900
36.8504	85.8445	20.5865	85.805	0.99607	15.16381
37.16536	85.6641	20.1925	85.6609	1.00458	14.81740
37.48032	85.4834	19.8074	85.5164	1.01309	14.47969
37.79528	85.3024	19.4312	85.3717	1.02161	14.15059
38.11024	85.1211	19.0638	85.2267	1.03012	13.83000
38.4252	84.9396	18.7052	85.0813	1.03863	13.51784
38.74016	84.7578	18.3554	84.9358	1.04715	13.21402
39.05512	84.5758	18.0144	84.7899	1.05566	12.91842
39.37008	84.3936	17.682	84.6437	1.06417	12.63097
39.68504	84.2111	17.3584	84.4973	1.07269	12.35154
40	84.0285	17.0433	84.3506	1.08120	12.08003
40.31496	83.8456	16.7368	84.2037	1.08971	11.81635
40.62992	83.6626	16.4388	84.0565	1.09823	11.56037
40.94488	83.4794	16.1492	83.909	1.10674	11.31198
41.25984	83.2961	15.868	83.7612	1.11525	11.07107
41.5748	83.1127	15.5951	83.6132	1.12377	10.83752
41.88976	82.9291	15.3304	83.465	1.13228	10.61120
42.20472	82.7454	15.0739	83.3165	1.14079	10.39201
42.51968	82.5616	14.8254	83.1678	1.14931	10.17981
42.83465	82.3778	14.5849	83.0188	1.15782	9.97447
43.14961	82.1938	14.3523	82.8696	1.16633	9.77589
43.46457	82.0098	14.1275	82.7201	1.17485	9.58391
43.77953	81.8258	13.9104	82.5704	1.18336	9.39841
44.09449	81.6417	13.7008	82.4205	1.19187	9.21926
44.40945	81.4576	13.4989	82.2703	1.20039	9.04632
44.72441	81.2734	13.3042	82.1199	1.20890	8.87946
45.03937	81.0893	13.1166	81.9694	1.21741	8.71854
45.35433	80.9051	12.9366	81.8185	1.22593	8.56342
45.66929	80.721	12.7633	81.6675	1.23444	8.41396
45.98425	80.5369	12.597	81.5163	1.24295	8.27002
46.29921	80.3529	12.4374	81.3648	1.25147	8.13145
46.61417	80.1688	12.2845	81.2132	1.25998	7.99812
46.92913	79.9849	12.138	81.0613	1.26849	7.86987
47.24409	79.801	11.9978	80.9092	1.27701	7.74656
47.55905	79.6172	11.8639	80.757	1.28552	7.62804
47.87402	79.4335	11.7359	80.6045	1.29403	7.51417
48.18898	79.2498	11.6139	80.4519	1.30255	7.40480
48.50394	79.0663	11.4976	80.2991	1.31106	7.29977
48.8189	78.8829	11.3868	80.1461	1.31957	7.19894
49.13386	78.6997	11.2815	79.9929	1.32809	7.10215
49.44882	78.5165	11.1813	79.8395	1.33660	7.00925
49.76378	78.3335	11.0862	79.686	1.34511	6.92010
50.07874	78.1507	10.9959	79.5323	1.35363	6.83453
50.3937	77.968	10.9103	79.3784	1.36214	6.75239
50.70866	77.7855	10.8292	79.2244	1.37066	6.67354
51.02362	77.6032	10.7524	79.0702	1.37917	6.59780
51.33858	77.4211	10.6797	78.9159	1.38768	6.52504
51.65355	77.2392	10.6109	78.7614	1.39620	6.45508
51.96851	77.0574	10.5457	78.6067	1.40471	6.38779
52.28347	7				

Measured Data

Calculated Data

Raw Frequency (cy/inch)	Corrected Frequency (cy/mmrad)	Measured Camera MTF	Measured Monocular MTF Data	Actual Measured Monocular MTF (mono/camera)
185	1.57498	80.61623	2.56636	3.18342
186	1.58349	80.45783	2.93217	2.93217
187	1.59200	80.30253	2.15204	2.67891
188	1.60052	80.14982	1.95626	2.44076
189	1.60903	79.99911	1.78099	2.22627
190	1.61754	79.84976	1.63169	2.04345
191	1.62606	79.70108	1.51041	1.89509
192	1.63457	79.55236	1.41856	1.78318
193	1.64308	79.40285	1.36025	1.71310
194	1.65160	79.25185	1.34301	1.69461
195	1.66011	79.09863	1.37355	1.73650
196	1.66862	78.94255	1.45095	1.83799
197	1.67714	78.78300	1.56341	1.98445
198	1.68565	78.61946	1.69139	2.15136
199	1.69416	78.45152	1.81378	2.31198
200	1.70268	78.27883	1.91260	2.44332
201	1.71119	78.10120	1.97541	2.52930
202	1.71970	77.91853	1.99605	2.56171
203	1.72822	77.73086	1.97416	2.53974
204	1.73673	77.53835	1.91407	2.46855
205	1.74524	77.34127	1.82305	2.35715
206	1.75376	77.14000	1.58167	2.21620
207	1.76227	76.93501	1.58167	2.05586
208	1.77078	76.72687	1.44591	1.88449
209	1.77930	76.51620	1.30712	1.70829
210	1.78781	76.30367	1.16893	1.53195
211	1.79632	76.08997	1.03677	1.35980
212	1.80484	75.87579	0.90827	1.19705
213	1.81335	75.66181	0.79493	1.05064
214	1.82186	75.44866	0.70099	0.92910
215	1.83038	75.23693	0.63311	0.81448
216	1.83889	75.02710	0.59704	0.71976
217	1.84740	74.81961	0.59885	0.71976
218	1.85592	74.61477	0.63590	0.85144
219	1.86443	74.41280	0.71477	0.96055
220	1.87294	74.21380	0.83660	1.12728
221	1.88146	74.01777	0.96945	1.35028
222	1.88997	73.82463	1.19797	1.62773
223	1.89849	73.63416	1.42264	1.93204
224	1.90700	73.44608	1.66048	2.26082
225	1.91551	73.26005	1.89618	2.58828
226	1.92403	73.07564	2.11330	2.89194
227	1.93254	72.89240	2.29579	3.14957
228	1.94105	72.70982	2.42945	3.34130
229	1.94957	72.52741	2.50318	3.45135
230	1.95808	72.34467	2.51016	3.46973
231	1.96659	72.16108	2.44847	3.39306
232	1.97511	71.97820	2.32116	3.22489
233	1.98362	71.79558	2.15922	2.97525
234	1.99213	71.60885	1.90415	2.65940
235	2.00065	71.40967	1.63955	2.29598
236	2.00916	71.21577	1.35683	1.90524
237	2.01767	71.01893	1.07048	1.50731
238	2.02619	70.81902	0.79443	1.12178
239	2.03470	70.61594	0.54380	0.77008
240	2.04321	70.40970	0.34232	0.48619
241	2.05173	70.20033	0.24245	0.34537
242	2.06024	69.98797	0.27389	0.39134
243	2.06875	69.77278	0.34207	0.49026
244	2.07727	69.55500	0.37483	0.53899
245	2.08578	69.33492	0.34439	0.49670
246	2.09429	69.11288	0.24061	0.34814
247	2.10281	68.88924	0.10726	0.15570
248	2.11132	68.66444	0.28451	0.41435
249	2.11983	68.43891	0.63191	0.92331
250	2.12835	68.21313	1.04631	1.53388
251	2.13686	67.98757	1.49746	2.20256
252	2.14537	67.76273	1.95441	2.88419
253	2.15389	67.53907	2.38419	3.53009
254	2.16240	67.31707	2.75440	4.09168
255	2.17091	67.09714	3.03645	4.52545
256	2.17943	66.87868	3.20846	4.79737
257	2.18794	66.66053	3.25767	4.88663
258	2.19645	66.44345	3.18166	4.78780
259	2.20497	66.24515	2.98851	4.51128
260	2.21348	66.04024	2.69569	4.08189
261	2.22199	65.83873	2.32789	3.53574
262	2.23051	65.64056	1.91420	2.91618
263	2.23902	65.44557	1.48487	2.28986
264	2.24753	65.25347	1.06865	1.63769
265	2.25604	65.06392	0.69154	1.02966
266	2.26456	64.87647	0.38196	0.58874
267	2.27307	64.69060	0.21193	0.32761
268	2.28159	64.50572	0.27560	0.43725
269	2.29010	64.32119	0.40102	0.62346
270	2.29861	64.13635	0.49931	0.77852
271	2.30713	63.95053	0.56243	0.87948
272	2.31564	63.76305	0.59575	0.93432
273	2.32415	63.57327	0.60741	0.95545
274	2.33267	63.38059	0.60602	0.95616
275	2.34118	63.18448	0.59929	0.94848
276	2.34969	62.98448	0.59250	0.94070
277	2.35821	62.78023	0.58729	0.93546
278	2.36672	62.57149	0.58185	0.92989
279	2.37523	62.35812	0.57782	0.91960
280	2.38375	62.14008	0.55788	0.89779

Frequency (cy/mm)	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mmrad)	Calculated Monocular MTF (obj*tube*eye)
58.26772	73.4778	9.6638	75.4881	1.57498	5.36022
58.58268	73.3021	9.62128	75.3312	1.58349	5.31281
58.89764	73.1268	9.57689	75.1742	1.59200	5.26465
59.2126	72.9518	9.53032	75.0171	1.60052	5.21560
59.52756	72.7772	9.48128	74.86	1.60903	5.16549
59.84252	72.6029	9.42944	74.7028	1.61754	5.11419
60.15748	72.4281	9.3745	74.5455	1.62606	5.06154
60.47244	72.2556	9.31614	74.3882	1.63457	5.00739
60.7874	72.0825	9.25404	74.2309	1.64308	4.95160
61.10236	71.9098	9.18788	74.0735	1.65160	4.89403
61.41732	71.7375	9.11733	73.9161	1.66011	4.83451
61.73228	71.5656	9.04205	73.7586	1.66862	4.77292
62.04725	71.3941	8.96171	73.6011	1.67714	4.70910
62.36221	71.223	8.87597	73.4436	1.68565	4.64291
62.67717	71.0523	8.78448	73.2861	1.69416	4.57421
62.99213	70.8821	8.68889	73.1285	1.70268	4.50285
63.30709	70.7122	8.58285	72.9711	1.71119	4.42870
63.62205	70.5428	8.472	72.8134	1.71970	4.35181
63.93701	70.3739	8.35398	72.6558	1.72822	4.27145
64.25197	70.2053	8.22842	72.4982	1.73673	4.18807
64.56693	70.0372	8.09496	72.3407	1.74524	4.10134
64.88189	69.8695	7.95322	72.1831	1.75376	4.01112
65.19685	69.7023	7.80282	72.0255	1.76227	3.91728
65.51181	69.5355	7.64337	71.868	1.77078	3.81968
65.82677	69.3692	7.47451	71.7104	1.77930	3.71819
66.14173	69.2033	7.29582	71.5529	1.78781	3.61267
66.4567	69.0379	7.10892	71.3954	1.79632	3.50299
66.77165	68.8729	6.90742	71.238	1.80484	3.38903
67.08662	68.7084	6.69689	71.0805	1.81335	3.27065
67.40157	68.5443	6.47496	70.9231	1.82186	3.14772
67.71654	68.3807	6.24119	70.7658	1.83038	3.02012
68.03149	68.2176	5.99517	70.6085	1.83889	2.88772
68.34646	68.0549	5.73848	70.4513	1.84740	2.75038
68.66142	67.8927	5.4647	70.2941	1.85592	2.60801
68.97638	67.731	5.17942	70.1369	1.86443	2.46045
69.29134	67.5697	4.88018	69.9799	1.87294	2.30780
69.6063	67.4089	4.56866	69.8229	1.88146	2.14934
69.92126	67.2486	4.23812	69.666	1.88997	1.98553
70.23622	67.0888	3.89441	69.5091	1.89849	1.81607
70.55119	66.9294	3.53498	69.3523	1.90700	1.64084
70.86614	66.7705	3.1594	69.1957	1.91551	1.45972
71.18111	66.6121	2.76718	69.0391	1.92403	1.27258
71.49606	66.4542	2.3579	68.8826	1.93254	1.07934
71.81103	66.2967	1.93104	68.7262	1.94105	0.87984
72.12598	66.1397	1.4862	68.5699	1.94957	0.67402
72.44095	65.9832	1.02284	68.4137	1.95808	0.46173
72.75591	65.8272	0.54053	68.2576	1.96659	0.24287
73.07087	65.6717	0.03877	68.1017	1.97511	0.01734
73.38583	65.5166	-0.48292	67.9458	1.98362	-0.21498
73.70079	65.362	-1.02503	67.7901	1.99213	-0.45418
74.01575	65.2079	-1.58805	67.6345	2.00065	-0.70038
74.33071	65.0543	-2.17248	67.4791	2.00916	-0.95367
74.64567	64.9011	-2.77882	67.3238	2.01767	-1.21417
74.96063	64.7484	-3.40758	67.1686	2.02619	-1.48198
75.27559	64.5962	-4.05926	67.0136	2.03470	-1.75718
75.59055	64.4445	-4.73439	66.8587	2.04321	-2.03989
75.90551	64.2932	-5.43347	66.704	2.05173	-2.33021
76.22047	64.1424	-6.15703	66.5494	2.06024	-2.62822
76.53543	63.9921	-6.9056	66.395	2.06875	-2.93402
76.8504	63.8422	-7.67973	66.2408	2.07727	-3.24773
77.16535	63.6928	-8.47988	66.0868	2.08578	-3.56940
77.48032	63.5439	-9.30669	65.9329	2.09429	-3.89916
77.79528	63.3954	-10.1606	65.7792	2.10281	-4.23708
78.11024	63.2474	-11.0423	65.6258	2.11132	-4.58326
78.4252	63.0998	-11.9521	65.4725	2.11983	-4.93779
78.74016	62.9527	-12.8908	65.3194	2.12835	-5.30075
79.05512	62.8061	-13.8589	65.1665	2.13686	-5.67222
79.37008	62.6599	-14.8568	65.0138	2.14537	-6.05231
79.68504	62.5142	-15.8853	64.8613	2.15389	-6.44109
80	62.3689	-16.9448	64.7091	2.16240	-6.83863
80.31496	62.224	-18.036	64.557	2.17091	-7.24504
80.62992	62.0796	-19.1593	64.4052	2.17943	-7.66038
80.94488	61.9356	-20.3155	64.2536	2.18794	-8.08475
81.25984	61.792	-21.5051	64.1023	2.19645	-8.51819
81.57481	61.6489	-22.7287	63.9512	2.20497	-8.96082
81.88977	61.5062	-23.9867	63.8004	2.21348	-9.41268
82.20473	61.3639	-25.2801	63.6497	2.22199	-9.87399
82.51968	61.2221	-26.6091	63.4994	2.23051	-10.34447
82.83465	61.0806	-27.9745	63.3493	2.	



Measured Data

Raw Frequency (cy/inch)	Corrected Frequnc (cy/mrad)	Measured Camera MTF	Measured Monocula MTF Data	Actual Measured Monocular MTF (mono/camera)
281	2.39226	61.91748	0.537505725	0.86810
282	2.40077	61.69053	0.515411361	0.83548
283	2.40929	61.45955	0.497807094	0.80598
284	2.41780	61.22494	0.492201381	0.80392
285	2.42631	60.98721	0.50666361	0.83077
286	2.43483	60.74692	0.549048413	0.90383
287	2.44334	60.50471	0.624695168	1.03247
288	2.45186	60.26121	0.73275993	1.21597
289	2.46037	60.01710	0.864570264	1.44054
290	2.46888	59.77304	1.004867746	1.68114
291	2.47740	59.52967	1.134845868	1.90635
292	2.48591	59.28760	1.235806476	2.08443
293	2.49442	59.04736	1.293233093	2.19016
294	2.50294	58.80943	1.300964828	2.21217
295	2.51145	58.57421	1.265539902	2.16058
296	2.51996	58.34201	1.209214424	2.07261
297	2.52848	58.11306	1.168566928	2.01085
298	2.53699	57.88747	1.180082667	2.03858
299	2.54550	57.66528	1.254498374	2.17548
300	2.55402	57.44645	1.365915561	2.37772
301	2.56253	57.23081	1.46982019	2.56823
302	2.57104	57.01817	1.52489987	2.67441
303	2.57956	56.80823	1.503162482	2.64603
304	2.58807	56.60064	1.392581427	2.46036
305	2.59658	56.39502	1.196825535	2.12222
306	2.60510	56.19091	0.934314821	1.66275
307	2.61361	55.98787	0.638298974	1.14007
308	2.62212	55.78540	0.370043058	0.68333
309	2.63064	55.58302	0.28566278	0.51394
310	2.63915	55.38025	0.42715589	0.77131
311	2.64766	55.17960	0.580372839	1.05185
312	2.65618	54.97162	0.669581868	1.21805
313	2.66469	54.76487	0.682663905	1.24654
314	2.67320	54.55958	0.629206817	1.15332
315	2.68172	54.34459	0.531881258	0.97835
316	2.69023	54.13041	0.421075695	0.77789
317	2.69874	53.91818	0.333628994	0.61883
318	2.70726	53.69273	0.307546292	0.57279
319	2.71577	53.46895	0.371729761	0.69523
320	2.72428	53.24179	0.535988741	1.00671
321	2.73280	53.01129	0.800942592	1.51089
322	2.74131	52.77756	1.159072151	2.19615
323	2.74982	52.54079	1.591144709	3.02840
324	2.75834	52.30124	2.067140282	3.95237
325	2.76685	52.05925	2.549998319	4.89826
326	2.77536	51.81523	2.999967384	5.78974
327	2.78388	51.56965	3.37915809	6.55281
328	2.79239	51.32303	3.655824685	7.12317
329	2.80090	51.07596	3.807796207	7.45517
330	2.80942	50.82901	3.824607247	7.52446
331	2.81793	50.58282	3.708413252	7.33137
332	2.82644	50.33799	3.473360776	6.90008
333	2.83496	50.09513	3.143658875	6.27538
334	2.84347	49.85478	2.750728218	5.51748
335	2.85198	49.61747	2.329441626	4.69480
336	2.86050	49.38364	1.914399182	3.87659
337	2.86901	49.15363	1.536203939	3.12531
338	2.87752	48.92771	1.218573279	2.49056
339	2.88603	48.70603	0.976326751	2.00463
340	2.89455	48.48861	0.814727417	1.68024
341	2.90306	48.27537	0.730123871	1.51241
342	2.91158	48.06611	0.710916694	1.47904
343	2.92009	47.86049	0.739022939	1.54412
344	2.92860	47.65808	0.792331542	1.62623
345	2.93712	47.45835	0.848154224	1.78715
346	2.94563	47.26069	0.886423791	1.87560
347	2.95414	47.06441	0.892096597	1.89548
348	2.96266	46.86879	0.856625486	1.82771
349	2.97117	46.67308	0.778628708	1.66826
350	2.97969	46.47652	0.664292421	1.42931

Calculated Data

Frequency (cy/mm) f1	Objective Lens MT	Tube MTF	Eyeiece Lens MT	Frequency (cy/mrad) (f1*27.03/1000)	Calculated Monocular MTF (obj*tube*eye)
88.50394	58.6002	-59.4932	60.698	2.39226	-21.16121
88.8189	58.4657	-61.671	60.5538	2.40077	-21.83352
89.13386	58.3315	-63.8983	60.41	2.40929	-22.51651
89.44882	58.1977	-66.1756	60.2665	2.41780	-23.21023
89.76378	58.0641	-68.5038	60.1234	2.42631	-23.91474
90.07874	57.9308	-70.8835	59.9807	2.43483	-24.63008
90.3937	57.7978	-73.3153	59.8384	2.44334	-25.35628
90.70866	57.665	-75.8002	59.6964	2.45186	-26.09341
91.02362	57.5325	-78.3396	59.5549	2.46037	-26.84150
91.33858	57.4003	-80.9314	59.4137	2.46888	-27.60059
91.65354	57.2684	-83.5793	59.273	2.47740	-28.37072
91.96851	57.1366	-86.2831	59.1326	2.48591	-29.15196
92.28346	57.0052	-89.0433	58.9927	2.49442	-29.94427
92.59843	56.8739	-91.8609	58.8532	2.50294	-30.74778
92.91338	56.7429	-94.7363	58.7141	2.51145	-31.56244
93.22835	56.6121	-97.6707	58.5754	2.51996	-32.38838
93.54331	56.4815	-100.665	58.4372	2.52848	-33.22555
93.85827	56.3511	-103.719	58.2994	2.53699	-34.07401
94.17323	56.2209	-106.834	58.1621	2.54550	-34.93380
94.48819	56.0908	-110.011	58.0252	2.55402	-35.80494
94.80315	55.9609	-113.25	57.8888	2.56253	-36.68748
95.11811	55.8312	-116.553	57.7528	2.57104	-37.58139
95.43307	55.7017	-119.919	57.6173	2.57956	-38.48675
95.74803	55.5723	-123.351	57.4823	2.58807	-39.40356
96.063	55.443	-126.849	57.3477	2.59658	-40.33189
96.37795	55.3139	-130.412	57.2137	2.60510	-41.27166
96.69292	55.1848	-134.043	57.0801	2.61361	-42.22301
97.00787	55.0559	-137.742	56.947	2.62212	-43.18585
97.32284	54.9271	-141.511	56.8145	2.63064	-44.16030
97.63779	54.7984	-145.347	56.6824	2.63915	-45.14627
97.95276	54.6697	-149.255	56.5508	2.64766	-46.14389
98.26772	54.5411	-153.234	56.4198	2.65618	-47.15308
98.58268	54.4126	-157.285	56.2893	2.66469	-48.17388
98.89764	54.2841	-161.409	56.1593	2.67320	-49.20631
99.2126	54.1556	-165.606	56.0298	2.68172	-50.25038
99.52756	54.0272	-169.878	55.9009	2.69023	-51.30609
99.84252	53.8988	-174.226	55.7725	2.69874	-52.37345
100.1575	53.7704	-178.649	55.6447	2.70726	-53.45246
100.4724	53.642	-183.15	55.5174	2.71577	-54.54312
100.7874	53.5136	-187.728	55.3907	2.72428	-55.64545
101.1024	53.3851	-192.385	55.2646	2.73280	-56.75943
101.4173	53.2566	-197.122	55.139	2.74131	-57.88510
101.7323	53.1281	-201.938	55.014	2.74982	-59.02234
102.0473	52.9995	-206.837	54.8896	2.75834	-60.17131
102.3622	52.8708	-211.817	54.7658	2.76685	-61.33188
102.6772	52.742	-216.88	54.6426	2.77536	-62.50408
102.9921	52.6131	-222.028	54.52	2.78388	-63.68790
103.3071	52.4842	-227.259	54.398	2.79239	-64.88333
103.6221	52.3551	-232.577	54.2766	2.80090	-66.09035
103.937	52.2258	-237.981	54.1559	2.80942	-67.30894
104.252	52.0964	-243.472	54.0357	2.81793	-68.53910
104.5669	51.9669	-249.052	53.9162	2.82644	-69.78080
104.8819	51.8372	-254.721	53.7974	2.83496	-71.03401
105.1969	51.7073	-260.479	53.6791	2.84347	-72.29871
105.5118	51.5772	-266.329	53.5616	2.85198	-73.57489
105.8268	51.4469	-272.271	53.4446	2.86050	-74.86250
106.1417	51.3163	-278.305	53.3284	2.86901	-76.16152
106.4567	51.1856	-284.434	53.2128	2.87752	-77.47196
106.7717	51.0545	-290.656	53.0979	2.88603	-78.79366
107.0866	50.9232	-296.975	52.9836	2.89455	-80.12674
107.4016	50.7917	-303.39	52.8701	2.90306	-81.47101
107.7165	50.6598	-309.902	52.7572	2.91158	-82.82659
108.0315	50.5276	-316.512	52.6451	2.92009	-84.19326
108.3465	50.3952	-323.222	52.5336	2.92860	-85.57116
108.6614	50.2623	-330.033	52.4228	2.93712	-86.96009
108.9764	50.1292	-336.944	52.3128	2.94563	-88.36005
109.2913	49.9956	-343.957	52.2035	2.95414	-89.77100
109.6063	49.8617	-351.074	52.0949	2.96266	-91.19286
109.9213	49.7274	-358.294	51.9871	2.97117	-92.62559
110.2362	49.5927	-365.62	51.8799	2.97969	-94.06912

#### A.3.4 SYSTEM MTF DATA

Monocular 4\_2

Objective Lens S/N: 2397

Eyepiece Lens S/N: 18229A

Image Intensifier Tube S/N: 2400120

## System MTF Measurement for a Complete ANVIS System

Data Identification: Mono4\_2  
Date: 25 May 95  
Excel Filename: mono4\_2.xls  
mono4\_2a.xls

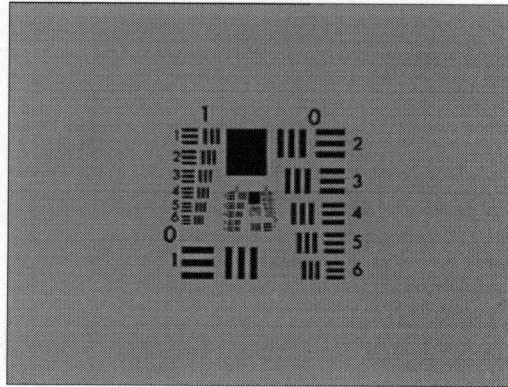
PR-900 Location:  
(0.5782, -3.0768, 0.0)

Slit Used: 0.5 micron

Monocular Components:  
Eyepiece S/N: 18229A  
Objective S/N: 2397  
Tube S/N: 2400120

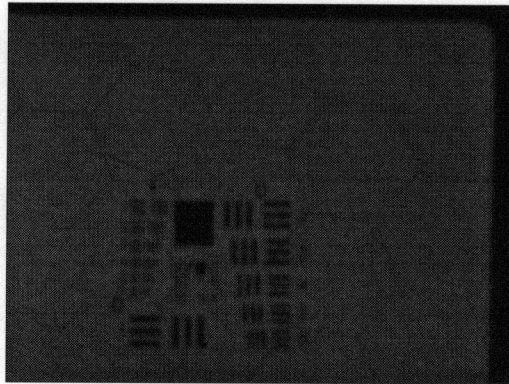
### Camera Focus Data

Filename: cam4.tif  
Integration Time: 27  
Light Level: 35.2 ft-L



### Monocular Focus Data

Filename: mon4foc1.tif  
Integration Time: 1000  
Light Level: 6.35E-4 ft-L

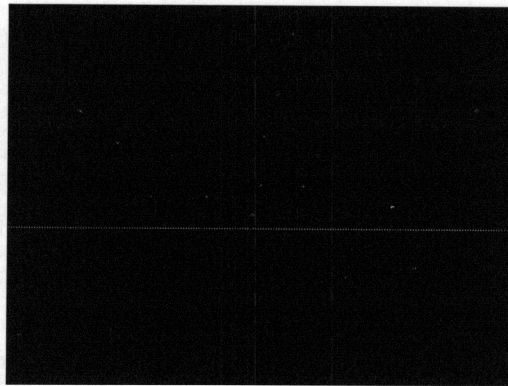


Monocular Luminance Measurement

Filename: None  
Integration Time: 1000  
Light Level: 6.35E-4 ft-L  
Max. Luminance (ft-L): 0.574  
Min. Luminance (ft-L): 0.126  
Ave. Luminance (ft-L): 0.441

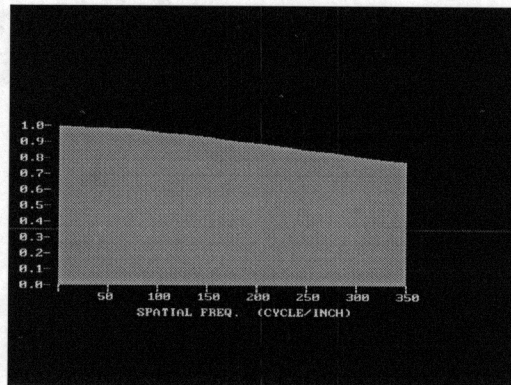
Horizontal Line Setting

Filename: cam4slit1.tif  
Integration Time: 1000  
Light Level: 35.2 ft-L  
Slit Size: 0.5 micron



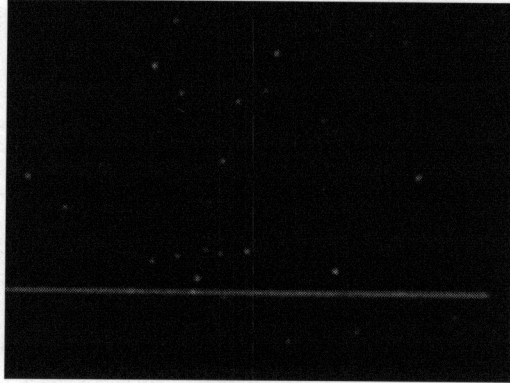
Camera MTF Measurement

Image Filename: cam4slit2.tif  
Data Filename: cam4slit2.tif  
Integration Time: 1000  
Light Level: 35.2 ft-L



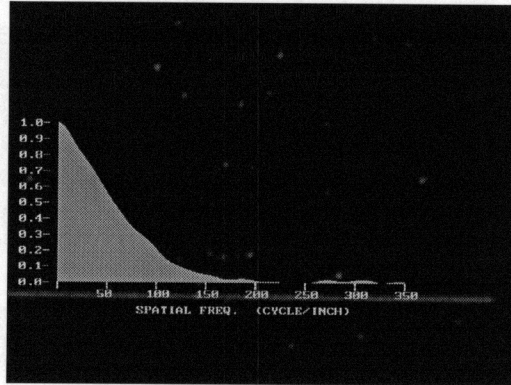
Monocular Image of Horizontal Slit

Filename: mon4slit1.tif  
Integration Time: 1000  
Light Level: 6.52E-2 ft-L

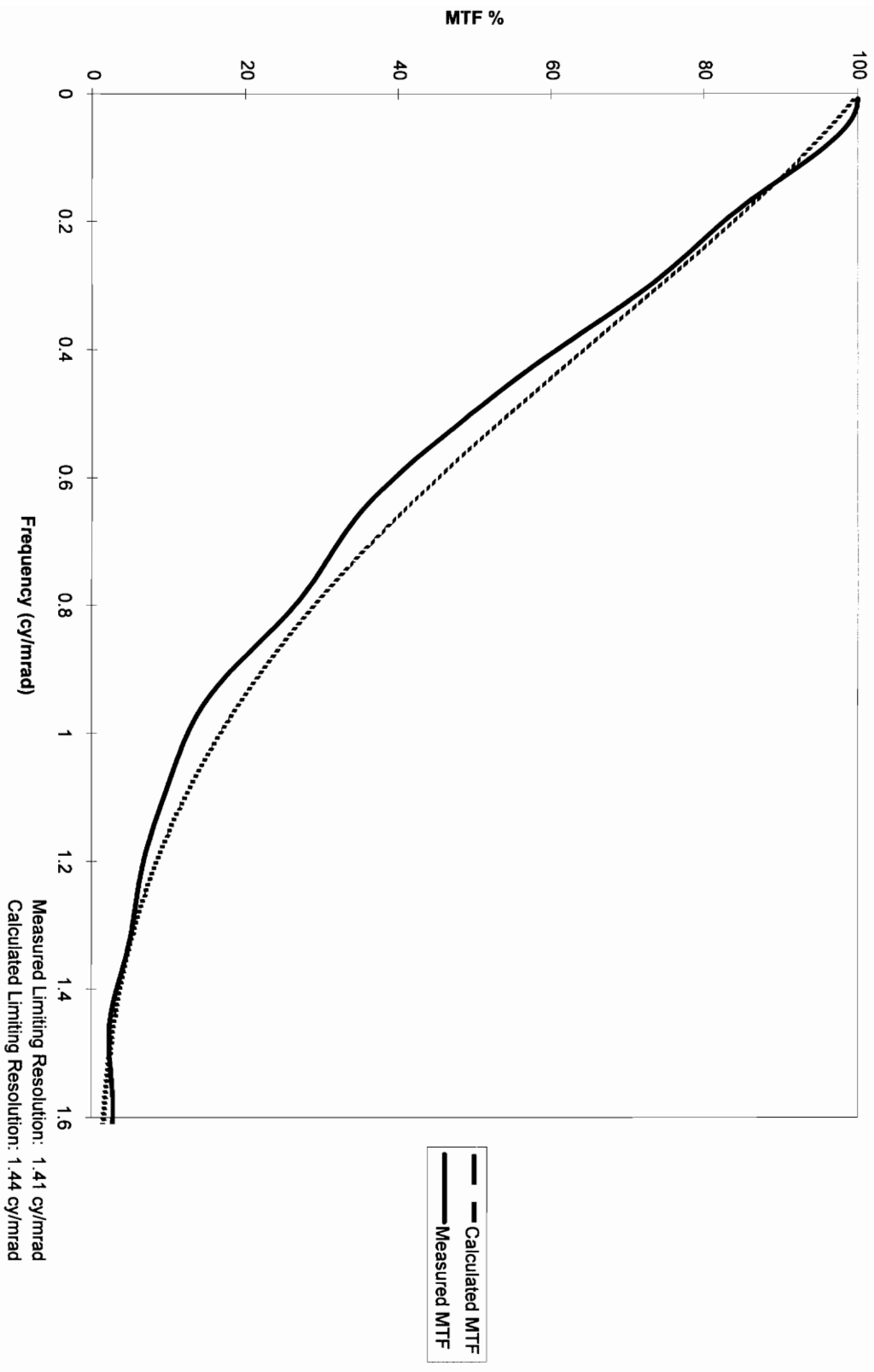


Monocular MTF Measurement Using Horizontal Slit

Image Filename: mon4slit2.tif  
Data Filename: mon4slit2.dat  
Integration Time: 1000  
Light Level: 6.52E-2 ft-L



# SYSTEM MTF of MONOCULAR 4\_2



**MTF Data**

Monocular: Eye Piece S/N: 18229A  
 Date: 2387  
 Mono4\_2  
 25 May 95

Monocular Components:  
 Eye Piece S/N: 18229A  
 Objective S/N: 2387  
 Tube S/N: 2400120

**Measured Data**

**Calculated Data**

Raw Frequency (cy/inch)	Corrected Freq (cy/mrad)	Measured Camera MTF	Measured Monocula MTF Data	Actual Measured Monocular MTF (mono/camera)
1	0.00851	100.00000	100.00000	100.00000
2	0.01703	99.98390	99.93474	99.94084
3	0.02554	99.87585	99.74008	99.76417
4	0.03405	99.64859	99.41942	99.47255
5	0.04257	99.90729	99.97825	99.07010
6	0.05108	99.85948	99.42405	99.56255
7	0.05959	99.80500	97.76603	97.95705
8	0.06811	99.74583	97.01489	97.26210
9	0.07662	99.68401	96.18242	96.48731
10	0.08513	99.62152	95.28124	95.64323
11	0.09365	99.56017	94.32438	94.74108
12	0.10216	99.50151	93.32494	93.79249
13	0.11067	99.44675	92.29570	92.80917
14	0.11919	99.39670	91.24879	91.80264
15	0.12770	99.35177	90.19538	90.78387
16	0.13621	99.31197	89.14541	89.76311
17	0.14473	99.27694	88.10736	88.74907
18	0.15324	99.24600	87.08609	87.74972
19	0.16175	99.21825	86.09275	86.77108
20	0.17027	99.19261	85.12472	85.81760
21	0.17878	99.16798	84.18564	84.89196
22	0.18729	99.14328	83.27548	83.99508
23	0.19581	99.11757	82.39269	83.12622
24	0.20432	99.09100	81.53403	82.28306
25	0.21283	99.06380	80.69650	81.46193
26	0.22135	99.02821	79.87419	80.65602
27	0.22986	98.99367	79.06195	79.86566
28	0.23837	98.95715	78.25396	79.07683
29	0.24689	98.91927	77.44438	78.29049
30	0.25540	98.88083	76.62758	77.49488
31	0.26391	98.84276	75.79840	76.68584
32	0.27243	98.80605	74.95234	75.85805
33	0.28094	98.77163	74.08575	75.00711
34	0.28946	98.74034	73.19594	74.12972
35	0.29797	98.71283	72.28124	73.23756
36	0.30648	98.68854	71.34106	72.28937
37	0.31500	98.67062	70.37584	71.32401
38	0.32351	98.65597	69.38701	70.33230
39	0.33202	98.64521	68.37686	69.31595
40	0.34054	98.63772	67.34840	68.27854
41	0.34905	98.63267	66.30524	67.22442
42	0.35756	98.62910	65.25137	66.15543
43	0.36608	98.62596	64.19098	65.08528
44	0.37459	98.62221	63.12831	64.01024
45	0.38310	98.61686	62.06743	62.93795
46	0.39162	98.60906	61.01213	61.87274
47	0.40013	98.59814	59.96576	60.81835
48	0.40864	98.58365	58.93115	59.77781
49	0.41716	98.56539	57.91051	58.75339
50	0.42567	98.54341	56.90542	57.74655
51	0.43418	98.51801	55.91670	56.75794
52	0.44270	98.48968	54.94491	55.78748
53	0.45121	98.45860	53.98960	54.83445
54	0.45972	98.42475	53.04974	53.89752
55	0.46824	98.38840	52.12442	52.97499
56	0.47675	98.36200	51.21204	52.06486
57	0.48526	98.33062	50.31089	51.16503
58	0.49378	98.30094	49.41923	50.27341
59	0.50229	98.27348	48.53538	49.38807
60	0.51080	98.24855	47.65768	48.50746
61	0.51932	98.22628	46.78554	47.63037
62	0.52783	98.20655	45.91761	46.75616
63	0.53634	98.18906	45.05381	45.88476
64	0.54486	98.17332	44.19438	45.01669
65	0.55337	98.15866	43.34012	44.15312
66	0.56188	98.14436	42.49237	43.29578
67	0.57040	98.12953	41.65297	42.44693
68	0.57891	98.11332	40.82148	41.60921
69	0.58742	98.09488	40.00862	40.78564
70	0.59594	98.07341	39.20912	39.97936
71	0.60445	98.04820	38.42856	39.19354
72	0.61296	98.01867	37.66878	38.43123
73	0.62148	97.98434	36.93538	37.69519
74	0.62999	97.94491	36.22759	36.98772
75	0.63850	97.90021	35.54810	36.31055
76	0.64702	97.85019	34.89799	35.66471
77	0.65553	97.79496	34.27760	35.05048
78	0.66404	97.73472	33.68648	34.46726
79	0.67256	97.66977	33.12336	33.91363
80	0.68107	97.60050	32.58616	33.38726
81	0.68958	97.52733	32.07202	32.88516
82	0.69810	97.45074	31.57742	32.40347
83	0.70661	97.37123	31.09824	31.93781
84	0.71512	97.28930	30.62989	31.48331
85	0.72364	97.20548	30.16754	31.03481
86	0.73215	97.12025	29.70618	30.58701
87	0.74066	97.03412	29.24086	30.14462
88	0.74918	96.94755	28.76685	29.67259

Frequency (cy/mm)	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mrad) (f1*27.03/1000)	Calculated Monocular MTF (obj*tube*eye)
0.31496	99.9332	99.6104	99.9849	0.00851	99.82881
0.62992	99.8624	99.2007	99.8848	0.01703	98.95002
0.94488	99.7875	98.798	99.7839	0.02554	98.37503
1.25984	99.7087	98.3757	99.6821	0.03405	97.77726
1.5748	99.626	97.9428	99.5794	0.04257	97.16611
1.88976	99.5393	97.4997	99.4759	0.05108	96.54198
2.20472	99.4488	97.0468	99.3716	0.05959	95.90528
2.51969	99.3547	96.5836	99.2664	0.06811	95.25640
2.83465	99.2568	96.111	99.1604	0.07662	94.59576
3.14961	99.1553	95.629	99.0536	0.08513	93.92376
3.46457	99.0501	95.1378	98.946	0.09365	93.24077
3.77953	98.9413	94.6375	98.8376	0.10216	92.54721
4.09449	98.8291	94.1285	98.7284	0.11067	91.84344
4.40945	98.7134	93.6111	98.6184	0.11919	91.12987
4.72441	98.5942	93.085	98.5077	0.12770	90.40687
5.03937	98.4717	92.5509	98.3963	0.13621	89.67483
5.35433	98.3459	92.0088	98.2841	0.14473	88.93412
5.66929	98.2167	91.4589	98.1711	0.15324	88.18512
5.98425	98.0844	90.9015	98.0575	0.16175	87.42820
6.29921	97.9489	90.3367	97.9431	0.17027	86.66372
6.61417	97.8102	89.7647	97.828	0.17878	85.89205
6.92913	97.6685	89.1857	97.7123	0.18729	85.11355
7.24409	97.5237	88.6	97.5958	0.19581	84.32657
7.55906	97.3759	88.0076	97.4787	0.20432	83.53745
7.87402	97.2251	87.4088	97.3609	0.21283	82.74057
8.18898	97.0715	86.8038	97.2425	0.22135	81.93827
8.50394	96.915	86.1928	97.1234	0.22986	81.13087
8.8189	96.7557	85.576	97.0037	0.23837	80.31872
9.13386	96.5936	84.9535	96.8833	0.24689	79.50214
9.44882	96.4288	84.3255	96.7624	0.25540	78.68147
9.76378	96.2613	83.6923	96.6408	0.26391	77.85703
10.07874	96.0912	83.0539	96.5186	0.27243	77.02913
10.3937	95.9185	82.4106	96.3959	0.28094	76.19809
10.70866	95.7433	81.7626	96.2725	0.28946	75.36422
11.02362	95.5655	81.11	96.1486	0.29797	74.52782
11.33858	95.3853	80.453	96.0241	0.30648	73.68920
11.65354	95.2027	79.7918	95.8991	0.31500	72.84865
11.9685	95.0176	79.1265	95.7735	0.32351	72.00646
12.28346	94.8303	78.4574	95.6474	0.33202	71.16292
12.59842	94.6406	77.7845	95.5207	0.34054	70.31831
12.91339	94.4487	77.1081	95.3935	0.34905	69.47287
13.22835	94.2546	76.4284	95.2658	0.35756	68.62694
13.54331	94.0584	75.7455	95.1376	0.36608	67.78076
13.85827	93.86	75.0595	95.0089	0.37459	66.93458
14.17323	93.6695	74.3707	94.8798	0.38310	66.08867
14.48819	93.4769	73.6791	94.7501	0.39162	65.24327
14.80315	93.2824	72.9851	94.62	0.40013	64.39884
15.11811	93.0859	72.2886	94.4884	0.40864	63.55502
15.43307	92.8874	71.5899	94.3583	0.41716	62.71295
15.74803	92.6871	70.8891	94.2288	0.42567	61.87175
16.06299	92.4849	70.1864	94.0940	0.43418	61.03256
16.37795	92.2801	69.482	93.9625	0.44270	60.19531
16.69291	92.0725	68.776	93.8298	0.45121	59.36020
17.00787	91.8627	68.0685	93.6966	0.45972	58.52746
17.32283	91.6505	67.3597	93.563	0.46824	57.69728
17.63778	91.4357	66.6497	93.4289	0.47675	56.86896
17.95274	91.2182	65.9387	93.2945	0.48526	56.04544
18.26770	90.9981	65.2269	93.1598	0.49378	55.22419
18.58266	90.7756	64.5144	93.0246	0.50229	54.40630
18.89762	90.5505	63.8013	92.8891	0.51080	53.59195
19.21258	90.3228	63.0878	92.7532	0.51932	52.78132
19.52754	89.997	62.3739	92.617	0.52783	51.97460
19.84250	89.7385	61.66	92.4804	0.53634	51.17194
20.15746	89.5058	60.946	92.3434	0.54486	50.37352
20.47242	89.2717	60.2321	92.2062	0.55337	49.57950
20.78738	89.0363	59.5186	92.0686	0.56188	48.79002
21.10234	88.7996	58.8054	91.9307	0.57040	48.00526
21.41730	88.5618	58.0927	91.7925	0.57891	47.22534
21.73226	88.3227	57.3807	91.654	0.58742	46.45043
22.04722	88.0825	56.6695	91.5152	0.59594	45.68062
22.36218	87.8411	55.9592	91.3761	0.60445	44.91610
22.67714	87.5987	55.25	91.2367	0.61296	44.15698
22.99210	87.3552	54.5419	91.0971	0.62148	43.40339
23.30706	87.1107	53.8352	90.9571	0.62999	42.65543
23.62202	86.8652	53.1298	90.817	0.63850	41.91324
23.93701	86.6187	52.426	90.6785	0.64702	41.17692
24.25197	86.3714	51.7239	90.5358	0.65553	40.44658
24.56693	86.1231	51.0236	90.3949	0.66404	39.72233
24.88189	85.874	50.3252	90.2538	0.67256	39.00425
25.19685	85.624	49.6287	90.1124	0.68107	38.29246
25.51181	85.3732				

Measured Data

Calculated Data

Raw Frequency (cy/inch)	Corrected Frequency (cy/mm)	Measured Camera MTF	Measured Monocula MTF Data	Actual Measured Monocular MTF (mono/camera)
89	0.75789	96.86101	28.27980	29.19627
90	0.76620	96.77492	27.77586	28.70151
91	0.77472	96.68968	27.25188	28.18489
92	0.78323	96.60563	26.70547	27.64380
93	0.79174	96.52311	26.13508	27.07650
94	0.80026	96.44239	25.54010	26.48223
95	0.80877	96.36366	24.92085	25.86125
96	0.81729	96.28714	24.27858	25.21477
97	0.82580	96.21290	23.61542	24.54496
98	0.83431	96.14099	22.93433	23.85489
99	0.84283	96.07142	22.23897	23.14837
100	0.85134	96.00413	21.53361	22.42988
101	0.85985	95.93903	20.82297	21.70438
102	0.86837	95.87600	20.11205	20.97715
103	0.87688	95.81490	19.40060	20.25363
104	0.88539	95.75559	18.70991	19.53924
105	0.89391	95.69794	18.02868	18.83915
106	0.90242	95.64184	17.36686	18.15222
107	0.91093	95.58719	16.72850	17.50078
108	0.91945	95.53395	16.11704	16.87404
109	0.92796	95.48210	15.53526	16.27034
110	0.93647	95.43166	14.98513	15.70247
111	0.94499	95.38267	14.46786	15.16823
112	0.95350	95.33517	13.98386	14.66810
113	0.96201	95.28921	13.53276	14.20178
114	0.97053	95.24479	13.11348	13.76819
115	0.97904	95.20190	12.72429	13.36556
116	0.98755	95.16045	12.36291	12.99165
117	0.99607	95.12027	12.02864	12.64361
118	1.00458	95.08112	11.71247	12.31840
119	1.01309	95.04267	11.41722	12.01273
120	1.02161	95.00452	11.13765	11.73228
121	1.03012	94.96618	10.87064	11.46865
122	1.03863	94.92712	10.61323	11.21800
123	1.04715	94.88877	10.36279	10.97222
124	1.05566	94.84460	10.11704	10.73166
125	1.06417	94.80006	9.87415	10.49576
126	1.07269	94.75273	9.63277	10.26422
127	1.08120	94.70225	9.39189	9.93739
128	1.08971	94.64841	9.15139	9.61683
129	1.09823	94.59115	8.91096	9.30205
130	1.10674	94.53056	8.67107	9.00277
131	1.11525	94.46690	8.43240	8.72830
132	1.12377	94.40060	8.19587	8.46820
133	1.13228	94.33219	7.96254	8.22300
134	1.14079	94.26233	7.73381	8.00350
135	1.14931	94.19171	7.51028	7.80340
136	1.15782	94.12107	7.29375	7.62330
137	1.16633	94.05109	7.08516	7.45331
138	1.17485	93.98236	6.88554	7.29442
139	1.18336	93.91336	6.69578	7.14663
140	1.19187	93.84539	6.51862	7.01004
141	1.20039	93.77855	6.34857	6.88460
142	1.20890	93.72674	6.19189	6.76933
143	1.21741	93.68764	6.04655	6.66433
144	1.22593	93.65092	5.91214	6.56933
145	1.23444	93.61529	5.78791	6.48433
146	1.24296	93.58443	5.67266	6.40933
147	1.25147	93.55511	5.56481	6.34433
148	1.25998	93.52742	5.46240	6.28933
149	1.26849	93.50096	5.36318	6.24433
150	1.27701	93.47510	5.26740	6.20933
151	1.28552	93.44981	5.17443	6.18433
152	1.29403	93.42500	5.08999	6.16933
153	1.30255	93.40074	4.94889	6.16433
154	1.31106	92.91857	4.82943	6.15933
155	1.31957	92.82454	4.70005	6.15433
156	1.32808	92.72577	4.55890	6.14933
157	1.33660	92.62293	4.40833	6.14433
158	1.34511	92.51687	4.24590	6.13933
159	1.35363	92.40858	4.07342	6.13433
160	1.36214	92.29912	3.89239	6.12933
161	1.37066	92.18956	3.70488	6.12433
162	1.37917	92.08091	3.51347	6.11933
163	1.38768	91.97411	3.32115	6.11433
164	1.39620	91.86993	3.13127	6.10933
165	1.40471	91.76895	2.94741	6.10433
166	1.41322	91.67155	2.77326	6.09933
167	1.42174	91.57789	2.61251	6.09433
168	1.43025	91.48791	2.46866	6.08933
169	1.43876	91.40136	2.34483	6.08433
170	1.44728	91.31783	2.24350	6.07933
171	1.45579	91.23678	2.16626	6.07433
172	1.46430	91.15760	2.11362	6.06933
173	1.47281	91.07966	2.08494	6.06433
174	1.48133	91.00236	2.07842	6.05933
175	1.48984	90.92519	2.09137	6.05433
176	1.49836	90.84774	2.12047	6.04933
177	1.50687	90.76976	2.16209	6.04433
178	1.51538	90.69115	2.21252	6.03933
179	1.52390	90.61201	2.26817	6.03433
180	1.53241	90.53259	2.32563	6.02933
181	1.54092	90.45328	2.38176	6.02433
182	1.54944	90.37460	2.43370	6.01933
183	1.55795	90.29714	2.47896	6.01433
184	1.56646	90.22153	2.51503	6.00933

Frequency (1/mm)	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mm)	Calculated Monocular MTF (obj/tube*eye)
28.0315	83.3421	43.4705	88.8307	0.75789	32.18272
28.34646	83.0855	42.8005	88.6874	0.76620	31.53812
28.66142	82.8284	42.1338	88.544	0.77472	30.80060
28.97638	82.5709	41.4701	88.4003	0.78323	30.27021
29.29134	82.3129	40.8099	88.2566	0.79174	29.84699
29.6063	82.0545	40.1533	88.1127	0.80026	29.43099
29.92126	81.7957	39.5003	87.9696	0.80877	29.02224
30.23622	81.5365	38.8517	87.8244	0.81729	28.62080
30.55118	81.2777	38.2055	87.6802	0.82580	28.22668
30.86614	81.0172	37.5639	87.5357	0.83431	27.83992
31.1811	80.7571	36.9262	87.3912	0.84283	27.46055
31.49606	80.4968	36.2927	87.2466	0.85134	27.08860
31.81102	80.2362	35.6633	87.1018	0.85985	26.72408
32.12598	79.9755	35.0381	86.9571	0.86837	26.36701
32.44094	79.7145	34.4173	86.8121	0.87688	26.01741
32.75591	79.4534	33.8009	86.6671	0.88539	25.67528
33.07087	79.1922	33.189	86.5221	0.89391	25.34065
33.38583	78.9309	32.5817	86.3766	0.90242	25.01353
33.70079	78.6695	31.979	86.2316	0.91093	24.69391
34.01575	78.408	31.3811	86.0863	0.91945	24.38180
34.33071	78.1465	30.788	85.9409	0.92796	24.07719
34.64567	77.885	30.1998	85.7955	0.93647	23.77909
34.96063	77.6236	29.6166	85.65	0.94499	23.48749
35.27559	77.3621	29.0384	85.5045	0.95350	23.20238
35.59055	77.1008	28.4654	85.359	0.96201	22.92375
35.90551	76.8395	27.8975	85.2134	0.97053	22.65160
36.22047	76.5783	27.3349	85.0678	0.97904	22.38608
36.53543	76.3173	26.7776	84.9221	0.98755	22.12719
36.8504	76.0564	26.2258	84.7765	0.99607	21.87497
37.16536	75.7957	25.6792	84.6308	1.00458	21.62930
37.48032	75.5352	25.1363	84.4851	1.01309	21.39023
37.79528	75.2749	24.6029	84.3394	1.02161	21.15765
38.11024	75.0148	24.0732	84.1937	1.03012	20.93151
38.4252	74.755	23.5492	84.048	1.03863	20.71180
38.74016	74.4955	23.031	83.9023	1.04715	20.49851
39.05512	74.2362	22.5186	83.7567	1.05566	20.29166
39.37008	73.9773	22.0121	83.611	1.06417	20.09117
39.68504	73.7188	21.5115	83.4654	1.07269	19.89703
40	73.4605	21.0169	83.3197	1.08120	19.70933
40.31496	73.2027	20.5283	83.1741	1.08971	19.52808
40.62992	72.9453	20.0458	83.0286	1.09823	19.35333
40.94488	72.6882	19.5695	82.8831	1.10674	19.18508
41.25984	72.4316	19.0993	82.7376	1.11525	19.02333
41.5748	72.1755	18.6354	82.5921	1.12377	18.86808
41.88976	71.9198	18.1777	82.4467	1.13228	18.71933
42.20472	71.6646	17.7264	82.3014	1.14079	18.57708
42.51968	71.4099	17.2814	82.1561	1.14931	18.44133
42.83465	71.1557	16.8428	82.0109	1.15782	18.31208
43.14961	70.9021	16.4107	81.8657	1.16633	18.18933
43.46457	70.649	15.9851	81.7206	1.17485	18.07308
43.77953	70.3964	15.566	81.5755	1.18336	17.96333
44.09449	70.1445	15.1534	81.4306	1.19187	17.86008
44.40945	69.8931	14.7474	81.2857	1.20039	17.76333
44.72441	69.6424	14.3481	81.1409	1.20890	17.67308
45.03937	69.3923	13.9554	80.9962	1.21741	17.58833
45.35433	69.1428	13.5694	80.8515	1.22593	17.50908
45.66929	68.894	13.1901	80.707	1.23444	17.43533
45.98425	68.6459	12.8175	80.5625	1.24296	17.36708
46.29921	68.3985	12.4518	80.4182	1.25147	17.30433
46.61417	68.1517	12.0928	80.2739	1.25998	17.24708
46.92913	67.9057	11.7406	80.1297	1.26849	17.19533
47.24409	67.6604	11.3953	79.9857	1.27701	17.14908
47.55905	67.4159	11.0569	79.8417	1.28552	17.10833
47.87402	67.172	10.7252	79.6979	1.29403	17.07308
48.18898	66.929	10.4005	79.5542	1.30255	17.04333
48.50394	66.6867	10.0827	79.4106	1.31106	17.01908
48.8189	66.4453	9.77186	79.2671	1.31957	17.00033
49.13386	66.2046	9.46795	79.1237	1.32808	16.98708
49.44882	65.9647	9.171	78.9805	1.33660	16.97933
49.76378	65.7257	8.88102	78.8373	1.34511	16.97608
50.07874	65.4875	8.59802	78.6944	1.35363	16.97833
50.3937	65.2502	8.32201	78.5515	1.36214	16.98608
50.70866	65.0137	8.05299	78.4088	1.37066	16.99933
51.02362	64.778	7.79098	78.2662	1.37917	17.01808
51.33858	64.5433	7.53596	78.1238	1.38768	17.04233
51.65355	64.3094	7.28795	77.9814	1.39620	17.07208
51.96851	64.0764	7.04696	77.8393	1.40471	17.1073



Measured Data

Raw Frequency (cy/inch)	Corrected Frequency (cy/mrad)	Measured Camera MTF	Measured Monocular MTF Data	Actual Measured Monocular MTF (mono/camera)
185	1.57498	90.14837	2.54022	2.81782
186	1.58349	90.07820	2.55286	2.83405
187	1.59200	90.01146	2.55171	2.83487
188	1.60052	89.94846	2.53592	2.81930
189	1.60903	89.88931	2.50504	2.78681
190	1.61754	89.83396	2.45900	2.73727
191	1.62606	89.78216	2.39815	2.67106
192	1.63457	89.73347	2.32319	2.58999
193	1.64308	89.68730	2.23521	2.49223
194	1.65160	89.64291	2.13568	2.38243
195	1.66011	89.59946	2.02635	2.26156
196	1.66862	89.55604	1.90933	2.13199
197	1.67714	89.51175	1.78702	1.99641
198	1.68565	89.46570	1.66211	1.85782
199	1.69416	89.41707	1.53760	1.71958
200	1.70268	89.36516	1.41672	1.58532
201	1.71119	89.30941	1.30297	1.45894
202	1.71970	89.24942	1.19994	1.34448
203	1.72822	89.18498	1.11113	1.24587
204	1.73673	89.11607	1.03949	1.16645
205	1.74524	89.04284	0.98690	1.10834
206	1.75376	88.96562	0.95357	1.07184
207	1.76227	88.88490	0.93778	1.05005
208	1.77078	88.80124	0.93612	1.05417
209	1.77930	88.71535	0.94419	1.06429
210	1.78781	88.62782	0.95735	1.08019
211	1.79632	88.53970	0.97137	1.09710
212	1.80484	88.45138	0.98274	1.11505
213	1.81335	88.36380	0.98878	1.11899
214	1.82186	88.27690	0.98761	1.11876
215	1.83038	88.19171	0.97807	1.10903
216	1.83889	88.10830	0.95963	1.08915
217	1.84740	88.02684	0.93227	1.05907
218	1.85592	87.94732	0.89645	1.01930
219	1.86443	87.86958	0.85299	0.97075
220	1.87294	87.79335	0.80301	0.91466
221	1.88146	87.71824	0.74785	0.85236
222	1.88997	87.64377	0.68800	0.78614
223	1.89849	87.56938	0.62604	0.71719
224	1.90700	87.49450	0.56284	0.64751
225	1.91551	87.41853	0.50599	0.57881
226	1.92403	87.34092	0.44769	0.51258
227	1.93254	87.26117	0.39271	0.45004
228	1.94106	87.17887	0.34176	0.39202
229	1.94957	87.09371	0.29522	0.33887
230	1.95808	87.00550	0.25313	0.29094
231	1.96659	86.91422	0.21635	0.24777
232	1.97511	86.81996	0.18189	0.20950
233	1.98362	86.72295	0.15347	0.17697
234	1.99213	86.62357	0.13233	0.15276
235	2.00065	86.52231	0.11670	0.13107
236	2.00916	86.41973	0.10620	0.11820
237	2.01768	86.31647	0.10042	0.11195
238	2.02619	86.21320	0.10042	0.10810
239	2.03470	86.11058	0.10555	0.10544
240	2.04322	86.00926	0.10635	0.10385
241	2.05173	85.90980	0.10292	0.10339
242	2.06024	85.81269	0.10362	0.10387
243	2.06875	85.71629	0.10429	0.10429
244	2.07727	85.62684	0.10487	0.10457
245	2.08578	85.53847	0.10528	0.10489
246	2.09429	85.45315	0.10561	0.10514
247	2.10281	85.37075	0.10585	0.10531
248	2.11132	85.29102	0.10602	0.10541
249	2.11983	85.21365	0.10612	0.10546
250	2.12835	85.13827	0.10615	0.10546
251	2.13686	85.06451	0.10612	0.10546
252	2.14537	84.99204	0.10602	0.10541
253	2.15389	84.92044	0.10585	0.10531
254	2.16240	84.84957	0.10561	0.10514
255	2.17091	84.77925	0.10528	0.10489
256	2.17943	84.70945	0.10487	0.10457
257	2.18794	84.64022	0.10429	0.10429
258	2.19645	84.57175	0.10362	0.10387
259	2.20497	84.50429	0.10292	0.10339
260	2.21348	84.43818	0.10209	0.10281
261	2.22199	84.37375	0.10114	0.10219
262	2.23051	84.31137	0.10008	0.10157
263	2.23902	84.25135	0.09892	0.10092
264	2.24753	84.19390	0.09767	0.10027
265	2.25605	84.13915	0.09633	0.09959
266	2.26456	84.08704	0.09490	0.09885
267	2.27307	84.03740	0.09338	0.09807
268	2.28159	83.98984	0.09178	0.09725
269	2.29010	83.94381	0.09011	0.09639
270	2.29861	83.89962	0.08837	0.09549
271	2.30713	83.85342	0.08657	0.09455
272	2.31564	83.80739	0.08471	0.09357
273	2.32415	83.75925	0.08280	0.09255
274	2.33267	83.70833	0.08084	0.09149
275	2.34118	83.65580	0.07884	0.09039
276	2.34969	83.60225	0.07679	0.08925
277	2.35821	83.54694	0.07470	0.08807
278	2.36672	83.48934	0.07257	0.08685
279	2.37523	83.43300	0.07041	0.08559
280	2.38375	83.30076	0.06822	0.08430

Calculated Data

Frequency (cy/mm) f1	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mrad) (f1*27.03/1000)	Calculated Monocular MTF (obj*tube*eye)
58.26772	59.6167	3.69069	75.0292	1.57498	1.65085
58.58268	59.4042	3.69502	74.8905	1.58349	1.58936
58.89764	59.1928	3.60606	74.7519	1.59200	1.55135
59.21260	58.9823	3.42378	74.6136	1.60052	1.50677
59.52756	58.7729	3.34816	74.4754	1.60903	1.46554
59.84252	58.5646	3.27916	74.3374	1.61754	1.42760
60.15748	58.3573	3.21675	74.1996	1.62606	1.39288
60.47244	58.1511	3.1609	74.062	1.63457	1.36133
60.7874	57.9458	3.11157	73.9245	1.64308	1.33288
61.10236	57.7417	3.06872	73.7873	1.65160	1.30746
61.41732	57.5386	3.03232	73.6502	1.66011	1.28501
61.73228	57.3365	3.00231	73.5133	1.66862	1.26548
62.04725	57.1355	2.97868	73.3766	1.67714	1.24878
62.36221	56.9356	2.96136	73.2401	1.68565	1.23488
62.67717	56.7367	2.95032	73.1038	1.69416	1.22370
62.99213	56.5389	2.94552	72.9676	1.70268	1.21518
63.30709	56.3421	2.94689	72.8317	1.71119	1.20926
63.62205	56.1464	2.95441	72.6959	1.71970	1.20588
63.93701	55.9518	2.96801	72.5604	1.72822	1.20498
64.25197	55.7582	2.98765	72.425	1.73673	1.20650
64.56693	55.5656	3.01328	72.2898	1.74524	1.21038
64.88189	55.3741	3.04484	72.1548	1.75376	1.21657
65.19685	55.1837	3.08227	72.02	1.76227	1.22500
65.51181	54.9943	3.12553	71.8854	1.77078	1.23561
65.82677	54.8059	3.17455	71.751	1.77930	1.24836
66.14173	54.6186	3.22928	71.6168	1.78781	1.26317
66.45669	54.4324	3.28965	71.4827	1.79632	1.28000
66.77165	54.2472	3.35561	71.3489	1.80484	1.29878
67.08662	54.063	3.42709	71.2152	1.81335	1.31946
67.40157	53.8798	3.50402	71.0818	1.82186	1.34199
67.71654	53.6977	3.58635	70.9485	1.83038	1.36632
68.03149	53.5166	3.674	70.8154	1.83889	1.39237
68.34646	53.3365	3.76691	70.6825	1.84740	1.42011
68.66142	53.1574	3.865	70.5498	1.85592	1.44947
68.97638	52.9793	3.96821	70.4173	1.86443	1.48040
69.29134	52.8023	4.07647	70.2849	1.87294	1.51296
69.6063	52.6262	4.18999	70.1528	1.88146	1.54678
69.92126	52.4512	4.30781	70.0208	1.88997	1.58212
70.23622	52.2771	4.43075	69.889	1.89849	1.61882
70.55119	52.104	4.55844	69.7574	1.90700	1.65683
70.86614	51.9319	4.69078	69.626	1.91551	1.69610
71.18111	51.7608	4.82771	69.4948	1.92403	1.73658
71.49606	51.5906	4.96913	69.3638	1.93254	1.77821
71.81103	51.4214	5.11498	69.2329	1.94106	1.82096
72.12598	51.2531	5.26515	69.1022	1.94957	1.86476
72.44095	51.0858	5.41958	68.9717	1.95808	1.90957
72.75591	50.9194	5.57817	68.8414	1.96659	1.95535
73.07087	50.7539	5.74083	68.7112	1.97511	2.00203
73.38583	50.5893	5.90747	68.5812	1.98362	2.04958
73.70079	50.4257	6.078	68.4514	1.99213	2.09795
74.01575	50.2629	6.25233	68.3218	2.00065	2.14708
74.33071	50.1011	6.43037	68.1923	2.00916	2.19694
74.64567	49.9401	6.61202	68.063	2.01768	2.24747
74.96063	49.78	6.79718	67.9339	2.02619	2.29863
75.27559	49.6207	6.98575	67.8049	2.03470	2.35038
75.59055	49.4623	7.17764	67.6762	2.04322	2.40266
75.90551	49.3048	7.37275	67.5475	2.05173	2.45543
76.22047	49.148	7.57097	67.4191	2.06024	2.50865
76.53543	48.9921	7.7722	67.2907	2.06875	2.56227
76.8504	48.837	7.97635	67.1626	2.07727	2.61626
77.16535	48.6827	8.18328	67.0346	2.08578	2.67055
77.48032	48.5292	8.39292	66.9068	2.09429	2.72512
77.79528	48.3764	8.60513	66.7791	2.10281	2.77991
78.11024	48.2244	8.81982	66.6515	2.11132	2.83489
78.4252	48.0732	9.03697	66.5241	2.11983	2.89001
78.74016	47.9228	9.25617	66.3969	2.12835	2.94523
79.05512	47.7728	9.47761	66.2698	2.13686	3.00051
79.37008	47.6237	9.70107	66.1428	2.14537	3.05581
79.68504	47.4754	9.92643	66.016	2.15389	3.11107
80	47.3276	10.1536	65.8893	2.16240	3.16628
80.31496	47.1806	10.3824	65.7628	2.17091	3.22137
80.62992	47.0342	10.6127	65.6363	2.17943	3.27632
80.94489	46.8884	10.8445	65.5101	2.18794	3.33108
81.25984	46.7433	11.0776	65.3839	2.19645	3.38560
81.57481	46.5987	11.3119	65.2579	2.20497	3.43987
81.88976	46.4548	11.5472	65.1319	2.21348	3.49382
82.20473	46.3114	11.7834	65.0061	2.22199	3.54743
82.51968	46.1686	12.0204	64.8805	2.23051	3.60064
82.83465	46.0263	12.2			

Measured Data

Raw Frequency (cy/inch)	Corrected Frequency (cy/mrad)	Measured Camera MTF	Measured Monocular MTF Data	Actual Measured Monocular MTF (mono/camera)
281	2.39226	83.21283	1.63643	1.96656
282	2.40077	83.11670	1.54834	1.86278
283	2.40929	83.02206	1.46287	1.76215
284	2.41780	82.92077	1.38306	1.66783
285	2.42631	82.81681	1.31111	1.58313
286	2.43483	82.71121	1.2494	1.51056
287	2.44334	82.60501	1.19994	1.45282
288	2.45186	82.49919	1.16446	1.41148
289	2.46037	82.39464	1.14436	1.38888
290	2.46888	82.29206	1.14073	1.38520
291	2.47740	82.19198	1.15421	1.40429
292	2.48591	82.09475	1.18494	1.44338
293	2.49442	82.00043	1.23246	1.50302
294	2.50294	81.90895	1.29577	1.58196
295	2.51145	81.82001	1.37315	1.67826
296	2.51996	81.73317	1.46247	1.78320
297	2.52848	81.64789	1.56112	1.91202
298	2.53699	81.56357	1.66624	2.04287
299	2.54550	81.47961	1.77475	2.17815
300	2.55402	81.39545	1.88348	2.31399
301	2.56253	81.31064	1.98927	2.4651
302	2.57104	81.22484	2.08907	2.57196
303	2.57956	81.13789	2.17997	2.66675
304	2.58807	81.04977	2.25933	2.76758
305	2.59658	80.96064	2.32479	2.87151
306	2.60510	80.87083	2.37436	2.93599
307	2.61361	80.78077	2.40641	2.97894
308	2.62212	80.69100	2.41977	2.99881
309	2.63064	80.60209	2.41368	2.99456
310	2.63915	80.51461	2.38784	2.96572
311	2.64766	80.42910	2.34235	2.91232
312	2.65618	80.34587	2.27775	2.83493
313	2.66469	80.26554	2.19497	2.73464
314	2.67320	80.18794	2.09525	2.61292
315	2.68172	80.11315	1.98016	2.47170
316	2.69023	80.04097	1.85151	2.31320
317	2.69874	79.97105	1.71129	2.13989
318	2.70726	79.90289	1.56165	1.95443
319	2.71577	79.83590	1.4048	1.75981
320	2.72428	79.76944	1.24298	1.55822
321	2.73280	79.70285	1.07844	1.35308
322	2.74131	79.63552	0.91337	1.14694
323	2.74982	79.56862	0.74993	0.94251
324	2.75834	79.49667	0.59031	0.74256
325	2.76685	79.42453	0.43706	0.56028
326	2.77536	79.35045	0.29429	0.37087
327	2.78388	79.27457	0.17388	0.21934
328	2.79239	79.19721	0.12608	0.15920
329	2.80090	79.11887	0.19241	0.24319
330	2.80942	79.04016	0.29483	0.37301
331	2.81793	78.96180	0.39894	0.50523
332	2.82644	78.88455	0.49775	0.63089
333	2.83496	78.80917	0.58947	0.74797
334	2.84347	78.73635	0.67385	0.85558
335	2.85198	78.66669	0.75037	0.95386
336	2.86050	78.60061	0.81981	1.04313
337	2.86901	78.53839	0.88265	1.12385
338	2.87752	78.48007	0.939	1.19648
339	2.88604	78.42550	0.98935	1.26152
340	2.89455	78.37431	1.034	1.31931
341	2.90306	78.32595	1.07322	1.37020
342	2.91158	78.27970	1.10717	1.41438
343	2.92009	78.23472	1.13593	1.45195
344	2.92860	78.19008	1.15953	1.48296
345	2.93712	78.14485	1.17795	1.50739
346	2.94563	78.09810	1.19115	1.52520
347	2.95414	78.04896	1.19911	1.53636
348	2.96266	77.99669	1.20184	1.54089
349	2.97117	77.94068	1.19845	1.53893
350	2.97969	77.88048	1.1921	1.53068

Calculated Data

Frequency (cy/mm)	Objective Lens MT	Tube MTF	Eyepiece Lens MT	Frequency (cy/mrad) ((1/27.03/1000))	Calculated Monocular MTF (obj*tube*eye)
88.50384	43.5382	16.493	62.5107	2.39226	4.48874
88.8189	43.4028	16.7167	62.3967	2.40077	4.52648
89.13386	43.2675	16.9382	62.2827	2.40929	4.56308
89.44882	43.1324	17.1573	62.1398	2.41780	4.59850
89.76378	42.9975	17.3739	62.015	2.42631	4.63272
90.07874	42.8628	17.5877	61.8911	2.43483	4.66570
90.3937	42.7278	17.7987	61.7673	2.44334	4.69741
90.70866	42.5931	18.0067	61.6435	2.45186	4.72781
91.02362	42.4583	18.2114	61.5198	2.46037	4.75688
91.33858	42.3236	18.4128	61.3961	2.46888	4.78458
91.65354	42.1889	18.6107	61.2723	2.47740	4.81088
91.96851	42.0541	18.8048	61.1486	2.48591	4.83576
92.28346	41.9193	18.9951	61.0249	2.49442	4.85918
92.59843	41.7843	19.1813	60.9012	2.50294	4.88111
92.91338	41.6493	19.3634	60.7775	2.51145	4.90153
93.22835	41.5141	19.541	60.6538	2.51996	4.92040
93.54331	41.3788	19.714	60.5301	2.52848	4.93770
93.85827	41.2432	19.8823	60.4064	2.53699	4.95340
94.17323	41.1075	20.0457	60.2826	2.54550	4.96746
94.48819	40.9715	20.204	60.1589	2.55402	4.97988
94.80315	40.8352	20.357	60.035	2.56253	4.99060
95.11811	40.6987	20.5045	59.9112	2.57104	4.99962
95.43307	40.5618	20.6464	59.7873	2.57956	5.00691
95.74803	40.4246	20.7824	59.6634	2.58807	5.01243
96.063	40.287	20.9124	59.5394	2.59658	5.01617
96.37795	40.149	21.0361	59.4154	2.60510	5.01810
96.69292	40.0105	21.1535	59.2913	2.61361	5.01820
97.00787	39.8716	21.2643	59.1672	2.62212	5.01644
97.32284	39.7322	21.3683	59.0429	2.63064	5.01280
97.63779	39.5924	21.4653	58.9186	2.63915	5.00727
97.95276	39.4519	21.5551	58.7943	2.64766	4.99981
98.26772	39.3109	21.6376	58.6698	2.65618	4.99041
98.58268	39.1693	21.7124	58.5452	2.66469	4.97904
98.89764	39.027	21.7796	58.4206	2.67320	4.96570
99.2126	38.8841	21.8387	58.2958	2.68172	4.95036
99.52756	38.7405	21.8897	58.171	2.69023	4.93300
99.84252	38.5962	21.9323	58.046	2.69874	4.91361
100.1575	38.4511	21.9663	57.9209	2.70726	4.89217
100.4724	38.3053	21.9915	57.7957	2.71577	4.86866
100.7874	38.1586	22.0077	57.6704	2.72428	4.84307
101.1024	38.0111	22.0148	57.5449	2.73280	4.81539
101.4173	37.8627	22.0124	57.4193	2.74131	4.78560
101.7323	37.7134	22.0004	57.2936	2.74982	4.75370
102.0473	37.5632	21.9785	57.1676	2.75834	4.71986
102.3622	37.4119	21.9486	57.0416	2.76685	4.68349
102.6772	37.2597	21.9045	56.9153	2.77536	4.64517
102.9921	37.1065	21.8518	56.7889	2.78388	4.60470
103.3071	36.9521	21.7885	56.6623	2.79239	4.56206
103.6221	36.7967	21.7142	56.5356	2.80090	4.51728
103.937	36.6401	21.6288	56.4086	2.80942	4.47029
104.252	36.4823	21.5321	56.2815	2.81793	4.42114
104.5669	36.3234	21.4238	56.1541	2.82644	4.36982
104.8819	36.1632	21.3036	56.0266	2.83496	4.31632
105.1969	36.0017	21.1714	55.8988	2.84347	4.26064
105.5118	35.8389	21.027	55.7708	2.85198	4.20279
105.8268	35.6747	20.87	55.6426	2.86050	4.14227
106.1417	35.5092	20.7004	55.5141	2.86901	4.08059
106.4567	35.3423	20.5177	55.3855	2.87752	4.01624
106.7717	35.1739	20.3219	55.2565	2.88604	3.94974
107.0866	35.004	20.1127	55.1273	2.89455	3.88110
107.4016	34.8325	19.8898	54.9979	2.90306	3.81032
107.7165	34.6596	19.653	54.8681	2.91158	3.73743
108.0315	34.485	19.4021	54.7382	2.92009	3.66243
108.3465	34.3087	19.1369	54.6079	2.92860	3.58534
108.6614	34.1308	18.857	54.4773	2.93712	3.50618
108.9764	33.9512	18.5622	54.3465	2.94563	3.42497
109.2913	33.7698	18.2524	54.2153	2.95414	3.34172
109.6063	33.5867	17.9272	54.0838	2.96266	3.25647
109.9213	33.4017	17.5864	53.952	2.97117	3.16923
110.2362	33.2148	17.2298	53.8199	2.97969	3.08004

## VITA

Colin E. Reese was born on May 9, 1971. He is presently an Electronics Engineer with the U.S. Army Night Vision and Electronic Sensors Directorate (NVESD) at Fort Belvoir, VA. He received a Bachelors of Science in Electrical Engineering from Virginia Polytechnic Institute and State University (Virginia Tech) on May 8, 1993. He continued at Virginia Tech working on a Masters of Science in Electrical Engineering. He spent one year at Virginia Tech completing the required courses and one year at NVESD completing the research for his thesis. His Masters of Science program was completed December 15, 1995.

This research abides by the Virginia Tech Honor Code.

A handwritten signature in black ink that reads "Colin E. Reese". The signature is written in a cursive style with a long horizontal stroke at the end.

Colin E. Reese